REQUEST FOR PROPOSAL

RFP # 22-12

Biodigester Feasibility Study

City of Ann Arbor
Wastewater Treatment Services Unit

Due Date: March 2, 2022 by 2:00 p.m. (local time)

Issued By:

City of Ann Arbor
Procurement Unit
301 E. Huron Street
Ann Arbor, MI 48104

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SECTION I - GENERAL INFORMATION

A. OBJECTIVE

The City of Ann Arbor is seeking a detailed feasibility study for the installation of an anaerobic biodigester at its Wastewater Treatment Plant (WWTP) to treat biosolids from the plant, with the potential to add organics from university and commercial sources, as well as fats, oils and greases (FOG). The study shall include an analysis that identifies a series of plausible organic inputs for the biodigester from within the City of Ann Arbor and possibly from surrounding areas. Proposals shall include the timeline for completing the study.

The internal project team will include staff from various City Service Units and Washtenaw County staff may participate. This is a City-funded project.

Earlier studies developed a significant amount of data and explored several of these issues and is included herein as Appendix A.

The successful proposer will have:

- Designed or built a biodigester that has been operating for a period of two years or more
- Experience sourcing material for biodigesters
- Experience with digestate management and managing all process flows from biodigesters
- Direct experience designing, building, and operating biodigesters that take municipal biosolids as a significant portion of the organics input
- Direct experience designing, building, and operating biodigesters that treat both liquid and solid organics (FOG, commercial and other organic wastes) in addition to biosolids
- Direct experience designing, building, and operating biodigesters that generate electricity from the biogas
- Direct experience designing, building, and operating biodigesters that generate transportation fuel from the biogas
- Direct experience developing economic feasibility studies for municipalities for biodigesters that treat municipal biosolids
- Broad understanding of the regulatory requirements of composting end products
- Broad understanding of managing all process flows from the biodigester (digested solids and any recycle streams)
- Broad experience selling excess electricity through the renewable gas market

- Broad understanding of private and public capital financing options.

  The City of Ann Arbor currently operates a landfill gas to energy facility and compost facility and all opportunities to explore synergies with these and other municipal lines of business should be explored.

B. QUESTIONS AND CLARIFICATIONS / DESIGNATED CITY CONTACTS

All questions regarding this Request for Proposal (RFP) shall be submitted via e-mail. Questions will be accepted and answered in accordance with the terms and conditions of this RFP.

All questions shall be submitted on or before February 15, 2022 at 10:00 a.m., and should be addressed as follows:

Scope of Work/Proposal Content questions shall be e-mailed to Keith Sanders, Assistant Manager WWTSU, KSanders@a2gov.org

RFP Process and Compliance questions shall be e-mailed to Colin Spencer, Buyer - CSpencer@a2gov.org

Should any prospective offeror be in doubt as to the true meaning of any portion of this RFP, or should the prospective offeror find any ambiguity, inconsistency, or omission therein, the prospective offeror shall make a written request for an official interpretation or correction by the due date for questions above.

All interpretations, corrections, or additions to this RFP will be made only as an official addendum that will be posted to a2gov.org and MITN.info and it shall be the prospective offeror's responsibility to ensure they have received all addenda before submitting a proposal. Any addendum issued by the City shall become part of the RFP, and must be incorporated in the proposal where applicable.

C. PRE-PROPOSAL MEETING

No pre-proposal meeting will be held for this RFP. Please contact staff indicated above with general questions or for a site visit regarding the RFP.

D. PROPOSAL FORMAT

To be considered, each firm must submit a response to this RFP using the format provided in Section III. No other distribution of proposals is to be made by the prospective offeror. An official authorized to bind the offeror to its provisions must sign the proposal in ink. Each proposal must remain valid for at least ninety days from the due date of this RFP.

Proposals should be prepared simply and economically providing a straightforward, concise description of the offeror's ability to meet the requirements of the RFP. No erasures are permitted. Mistakes may be crossed out and corrected and must be initialed in ink by the person signing the proposal.

E. SELECTION CRITERIA

Responses to this RFP will be evaluated using a point system as shown in Section III. A selection committee comprised of staff from the City will complete the evaluation.

The fee proposals will not be reviewed at the initial evaluation. After initial evaluation, the City will determine top proposals, and open only those fee proposals. The City will then determine which, if any, firms will be interviewed. During the interviews, the selected firms will be given the opportunity to discuss their proposal, qualifications, past experience, and their fee proposal in more detail. The City further reserves the right to interview the key personnel assigned by the selected offeror to this project. If the City chooses to interview any respondents, the interviews will be tentatively held the **week of March 14, 2022**. Offeror must be available on these dates.

All proposals submitted may be subject to clarifications and further negotiation. All agreements resulting from negotiations that differ from what is represented within the RFP or in the proposal response shall be documented and included as part of the final contract.

F. SEALED PROPOSAL SUBMISSION

All proposals are due and must be delivered to the City on or before, March 2, 2022 at 2:00 p.m. (local time). Proposals submitted late or via oral, telephonic, telegraphic, electronic mail or facsimile **will not** be considered or accepted.

Each respondent must submit in a sealed envelope

- **one (1) original proposal**
- **three (3) additional proposal copies**
- **one (1) digital copy of the proposal preferably on a USB/flash drive as one file in PDF format**

Each respondent must submit in a single separate sealed envelope marked Fee Proposal

- **two (2) copies of the fee proposal**

The fee proposal and all costs must be separate from the rest of the proposal.

Proposals submitted must be clearly marked: **"RFP No.22-12 – Bio-digester Feasibility Study**" and list the offeror's name and address.

Proposals must be addressed and delivered to:
City of Ann Arbor
c/o Customer Service
301 East Huron Street
Ann Arbor, MI 48107

All proposals received on or before the due date will be publicly opened and recorded on the due date. No immediate decisions will be rendered.

Hand delivered bids may be dropped off in the Purchasing drop box located in the Ann Street (north) vestibule/entrance of City Hall. The City will not be liable to any prospective offeror for any unforeseen circumstances, delivery, or postal delays. Postmarking on the due date will not substitute for receipt of the proposal. Offerors are responsible for submission of their proposal. Additional time will not be granted to a single prospective offeror. However, additional time may be granted to all prospective offerors at the discretion of the City.

A proposal may be disqualified if the following required forms are not included with the proposal:

- **Attachment C - City of Ann Arbor Non-Discrimination Declaration of Compliance**
- **Attachment D - City of Ann Arbor Living Wage Declaration of Compliance**
- **Attachment E - Vendor Conflict of Interest Disclosure Form of the RFP Document**

Proposals that fail to provide these forms listed above upon proposal opening may be deemed non-responsive and may not be considered for award.

Please provide the forms outlined above (Attachments C, D and E) within your narrative proposal, not within the separately sealed Fee Proposal envelope.

All proposed fees, cost or compensation for the services requested herein should be provided in the separately sealed Fee Proposal envelope only.

G. DISCLOSURES

Under the Freedom of Information Act (Public Act 442), the City is obligated to permit review of its files, if requested by others. All information in a proposal is subject to disclosure under this provision. This act also provides for a complete disclosure of contracts and attachments thereto.

H. TYPE OF CONTRACT

A sample of the Professional Services Agreement is included as Appendix A. Those who wish to submit a proposal to the City are required to review this sample agreement

carefully. **The City will not entertain changes to its Professional Services Agreement.**

The City reserves the right to award the total proposal, to reject any or all proposals in whole or in part, and to waive any informality or technical defects if, in the City's sole judgment, the best interests of the City will be so served.

This RFP and the selected offeror's response thereto, shall constitute the basis of the scope of services in the contract by reference.

I. NONDISCRIMINATION

All offerors proposing to do business with the City shall satisfy the contract compliance administrative policy adopted by the City Administrator in accordance with the Section 9:158 of the Ann Arbor City Code. Breach of the obligation not to discriminate as outlined in Attachment C shall be a material breach of the contract. Contractors are required to post a copy of Ann Arbor's Non-Discrimination Ordinance attached at all work locations where its employees provide services under a contract with the City.

J. WAGE REQUIREMENTS

The Attachments provided herein outline the requirements for payment of prevailing wages or of a "living wage" to employees providing service to the City under this contract. The successful offeror must comply with all applicable requirements and provide documentary proof of compliance when requested.

K. CONFLICT OF INTEREST DISCLOSURE

The City of Ann Arbor Purchasing Policy requires that the consultant complete a Conflict of Interest Disclosure form. A contract may not be awarded to the selected offeror unless and until the Procurement Unit and the City Administrator have reviewed the Disclosure form and determined that no conflict exists under applicable federal, state, or local law or administrative regulation. Not every relationship or situation disclosed on the Disclosure Form may be a disqualifying conflict. Depending on applicable law and regulations, some contracts may awarded on the recommendation of the City Administrator after full disclosure, where such action is allowed by law, if demonstrated competitive pricing exists and/or it is determined the award is in the best interest of the City. A copy of the Conflict of Interest Disclosure Form is attached.

L. COST LIABILITY

The City of Ann Arbor assumes no responsibility or liability for costs incurred by the offeror prior to the execution of a Professional Services Agreement. The liability of the City is limited to the terms and conditions outlined in the Agreement. By submitting

a proposal, offeror agrees to bear all costs incurred or related to the preparation, submission, and selection process for the proposal.

M. DEBARMENT

Submission of a proposal in response to this RFP is certification that the Respondent is not currently debarred, suspended, proposed for debarment, and declared ineligible or voluntarily excluded from participation in this transaction by any State or Federal departments or agency. Submission is also agreement that the City will be notified of any changes in this status.

N. PROPOSAL PROTEST

All proposal protests must be in writing and filed with the Purchasing Manager within five (5) business days of the award action. The offeror must clearly state the reasons for the protest. If an offeror contacts a City Service Area/Unit and indicates a desire to protest an award, the Service Area/Unit shall refer the offeror to the Purchasing Manager. The Purchasing Manager will provide the offeror with the appropriate instructions for filing the protest. The protest shall be reviewed by the City Administrator or designee, whose decision shall be final.

Any inquiries or requests regarding this procurement should be only submitted in writing to the Designated City Contacts provided herein. Attempts by the offeror to initiate contact with anyone other than the Designated City Contacts provided herein that the offeror believes can influence the procurement decision, e.g., Elected Officials, City Administrator, Selection Committee Members, Appointed Committee Members, etc., may lead to immediate elimination from further consideration.

O. SCHEDULE

The proposals submitted should define an appropriate schedule in accordance with the requirements of the Proposed Work Plan in Section III.

The following is the schedule for this RFP process.

Activity/Event	**Anticipated Date**
Written Question Deadline	February 15, 2022, 10:00 a.m.
Addenda Published (if needed)	Week of February 22, 2022
Proposal Due Date	March 2, 2022 by 2:00 p.m. (Local Time)
Tentative Interviews (if needed)	Week of March 14, 2022
Selection/Negotiations	March/April 2022
Expected City Council Authorizations	May 2022

The above schedule is for information purposes only and is subject to change at the City's discretion.

P. IRS FORM W-9

The selected offeror will be required to provide the City of Ann Arbor an IRS form W-9.

Q. RESERVATION OF RIGHTS

1. The City reserves the right in its sole and absolute discretion to accept or reject any or all proposals, or alternative proposals, in whole or in part, with or without cause.
2. The City reserves the right to waive, or not waive, informalities or irregularities in of any proposal if determined by the City to be in its best interest.
3. The City reserves the right to request additional information from any or all offerors.
4. The City reserves the right to reject any proposal that it determines to be unresponsive and deficient in any of the information requested within RFP.
5. The City reserves the right to determine whether the scope of the project will be entirely as described in the RFP, a portion of the scope, or a revised scope be implemented.
6. The City reserves the right to select one or more consultants to perform services.
7. The City reserves the right to retain all proposals submitted and to use any ideas in a proposal regardless of whether that proposal is selected. Submission of a proposal indicates acceptance by the firm of the conditions contained in this RFP, unless clearly and specifically noted in the proposal submitted.
8. The City reserves the right to disqualify proposals that fail to respond to any requirements outlined in the RFP, or failure to enclose copies of the required documents outlined within RFP.

R. ENVIRONMENTAL COMMITMENT

The City of Ann Arbor recognizes its responsibility to minimize negative impacts on human health and the environment while supporting a vibrant community and economy. The City further recognizes that the products and services the City buys have inherent environmental and economic impacts and that the City should make procurement decisions that embody, promote, and encourage the City's commitment to the environment.

The City encourages potential vendors to bring forward emerging and progressive products and services that are best suited to the City's environmental principles.

SECTION II - SCOPE OF SERVICES

The City of Ann Arbor is seeking a detailed feasibility study for the installation of an anaerobic biodigester at its Wastewater Treatment Plant (WWTP) to treat biosolids from the plant, with the potential to add organics from university and commercial sources, as well as fats, oils and greases (FOG). The study shall include an analysis that identifies a series of plausible organic inputs for the biodigester from within the City of Ann Arbor and possibly from surrounding areas. Proposals shall include the timeline for completing the study.

Task 1 – INFORMATION GATHERING

Meet with staff from various City Service Units, the University of Michigan, and the City's contracted compost partner to review the proposed scope of services and available data. Review previous data collected by Fishbeck (2017 report) and Quantalux (2014).

Task 2 – SITE FEASIBILITY ASSESSMENT

Determine the feasibility of siting an anaerobic digester and all related equipment at the Ann Arbor WWTP.

The Ann Arbor WWTP is very limited on open space but would see the biggest benefit of a biodigester if energy is produced for on-site use. If this location is not feasible then the location for a biodigester would be at the City landfill (this was the location considered in the 2017 Fishbeck study due to ongoing construction at the WWTP and the uncertainty of space availability).

Task 3 – MATERIALS ASSESSMENT

–Perform an expanded analysis of biomass availability for input to the biodigester. Identify the range of suitable organic material available for collection at the local and regional levels.

By range we mean the different types of organic materials (e.g., food waste, biosolids, FOG). Within that range there may be available organic material that may not be suitable for biodigestion. We are looking for the contractor to define the materials that are available for biodigestion within the three scales provided in the RFP. If the material is available but of insufficient quality and should not be included in the available material, the consultant shall note that as part of the analysis. If the material is available but should not be used in a biodigester (e.g., grass clippings, PLA plastic utensils), the contractor shall also note that in the analysis.

Develop a series of biomass estimates (with associated levels of risk or uncertainty) for the following inputs:

- City of Ann Arbor WWTP biosolids
- All of the above and commercial organics from institutions and commercial establishments within the City of Ann Arbor including FOG and compostable packaging materials from restaurants and food service establishments.
- All of the above and available biosolids from regional facilities outside the city of Ann Arbor (within 50 miles) and commercial organics (within 50 miles) from institutions and commercial establishments outside the City of Ann Arbor including FOG and compostable packaging materials from restaurants and food service establishments.

The analysis will include a discussion of the quantity and quality of each source's biomass suitability for co-digestion with biosolids.

We are looking to identify an estimate of how much of the material is available (and how certain you are of the estimate) and whether we should include this material as part of the biodigestion stream for this analysis. If it is included in the analysis, we are interested in the amount of energy that will be produced for the material. In terms of risk, we *are interested in estimates of weight and volume of material. We expect the consultant to provide any additional input as to "risk" associated with any one stream of organic material.*

Develop a list of potential sites (within 100 miles) that could compete for regional biomass materials and any information on current charges.

Task 4 – SYSTEM RECOMMENDATIONS AND DESIGN CONSIDERATIONS

Based on the previous analysis, what system would you recommend to manage organics at the previously discussed levels?

This task includes recommending an anaerobic biodigestion system including equipment for receiving and managing liquid and solid materials, digester tanks, options for heat recovery, options for any post treatment to make the biogas acceptable as transportation fuel and fueling equipment, options for dewatering and possible recovery of nutrients. In addition, the consultant is to provide a preliminary cost estimate for the design of the system, construction costs and operation and maintenance costs.

All design, build, operation, and maintenance expenses will be clearly defined based on the input scenarios developed previously, the recommended system size, and any pre- or post-treatment needs to generate output material of sufficient quality. Clearly state which compostable materials could/should not be accepted and any cost implications of allowing certain materials to be accepted. Make a recommendation on the

quality/marketability of the remaining solid material – and provide a cost benefit as to the cost to generate Class A vs. Class B solids.

Discuss redundancy needs of the City and system design elements and costs to ensure that biosolids can be managed without any interruption due to system malfunction, loss of electric power, or other low probability/high consequence events.

Task 5 – EXPANDED ANALYSIS OF OUTPUTS – Expanded analysis of Biogas and other outputs

Identify the biodigester system outputs that are available for beneficial use including gas for energy, gas for transportation fuel, waste heat, compostable solids and digestate.

Develop an input/output model that is flexible enough to handle the three input scenarios described above (and others as needed) and the associated outputs (e.g., volumes, characteristics, etc.) of biogas (used for electricity generation and/or transportation fuel), heat, compostable solids (managed separately or combined with existing compost), and liquid digestate.

Using the outputs generated above, calculate costs and benefits and discuss opportunities to use the generated electricity to offset energy at existing nearby City facilities based on current costs of electricity.

Using the outputs generated above, calculate costs and benefits and discuss opportunities to use the generated biogas to develop transportation fuel for City CNG vehicles. Model system outputs against current and potential future City CNG fuel demand.

Using the outputs generated above, calculate costs and benefits and discuss opportunities to use the generated heat for building conditioning or other uses such as heating the compost pads or heating hoop houses.

Using the outputs generated above, calculate costs and benefits and discuss opportunities to use the solid material generated after digestion for other beneficial uses including compost. Explore options and make recommendations to manage the material separately or combined with existing compost material based on likely sales prices and regulatory issues associated with each method. This task will be closely coordinated with the City contracted compost operator.

Using the outputs generated above, calculate costs and benefits and discuss opportunities to manage the digestate generated by the biodigester under evaluated scenarios. This discussion must include narrative on the quality and quantity of material and any needs for digestate storage during wet weather events in the case of system capacity issues (if any).

Task 6 – FINANCES

Based on these inputs, outputs, and design costs, develop a financial model under the following scenarios given the expected life of the system:

- Municipal financing and ownership of the land and system – City operation
- Municipal financing and ownership of the land and system – Contracted operation of the system and securing input materials and managing digester outputs. Assume an incentive structure for additional materials brought in from outside Ann Arbor and profit sharing with the City.
- Design build and operated by a contractor under a long-term contract. Assume an incentive structure for additional materials brought in from outside Ann Arbor and profit sharing with the City.
- Other financing scenarios may be explored depending on the scale of the organics collection area.
- Recommendations on federal funding support, if available, including within the infrastructure bill, to help support the installation of a potential biodigester

Task 7 – OTHER ENVIRONMENTAL BENEFITS

Based on the assumptions above, discuss other benefits that support the City's sustainability framework goals including but not limited to the amount of material diverted from landfills, any greenhouse gas emission reductions, other beneficial reuses of material including nutrient recovery, and renewable energy generation.

The A2 zero action plan can be found here:
https://www.a2gov.org/departments/sustainability/Documents/A2Zero%20Climate%20Action%20Plan%20_3.0.pdf

https://www.a2gov.org/departments/sustainability/Pages/default.aspx

SECTION III - MINIMUM INFORMATION REQUIRED

PROPOSAL FORMAT

Offerors should organize Proposals into the following Sections:

A. Professional Qualifications
B. Past Involvement with Similar Projects
C. Proposed Work Plan
D. Fee Proposal (include in a separate sealed envelope clearly marked “Fee Proposal”)
E. Authorized Negotiator
F. Attachments

The following describes the elements that should be included in each of the proposal sections and the weighted point system that will be used for evaluation of the proposals.

A. Professional Qualifications – 20 points

1. State the full name and address of your organization and, if applicable, the branch office or other subsidiary element that will perform, or assist in performing, the work hereunder. Indicate whether it operates as an individual, partnership, or corporation. If as a corporation, include whether it is licensed to operate in the State of Michigan.

2. Include the name of executive and professional personnel by skill and qualification that will be employed in the work. Show where these personnel will be physically located during the time they are engaged in the work. Indicate which of these individuals you consider key to the successful completion of the project. Identify only individuals who will do the work on this project by name and title. Resumes and qualifications are required for all proposed project personnel, including all subcontractors. Qualifications and capabilities of any subcontractors must also be included.

3. State history of the firm, in terms of length of existence, types of services provided, etc. Identify the technical details that make the firm uniquely qualified for this work.

B. Past involvement with Similar Projects – 30 points

The written proposal must include a list of specific experience in the project area and indicate proven ability in implementing similar projects for the firm **and** the individuals to be involved in the project. A complete list of client references must be provided for similar projects recently completed. The list shall include the firm/agency name, address, telephone number, project title, and contact person.

C. Proposed Work Plan – 30 points

Provide a detailed and comprehensive description of how the offeror intends to provide the services requested in this RFP. This description shall include, but not be limited to: how the project(s) will be managed and scheduled, how and when data and materials will be delivered to the City, communication and coordination, the working relationship between the offeror and City staff, and the company's general philosophy in regards to providing the requested services.

Offerors shall be evaluated on the clarity, thoroughness, and content of their responses to the above items.

D. Fee Proposal - 20 points

Fee schedules shall be submitted in a separate, sealed, envelope as part of the proposal. Fee quotations are to include the names, title, hourly rates, overhead factors, and any other relevant details. The proposal should highlight key staff and positions that would likely be involved with projects. Offerors shall be capable of justifying the details of the fee proposal relative to personnel costs, overhead, how the overhead rate is derived, material and time.

E. Authorized Negotiator

Include the name, phone number, and e-mail address of persons(s) in your organization authorized to negotiate the agreement with the City

F. Attachments

Legal Status of Offeror, Conflict of Interest Form, Living Wage Compliance Form, and the Non-Discrimination Form must be returned with the proposal. These elements should be included as attachments to the proposal submission.

PROPOSAL EVALUATION

1. The selection committee will evaluate each proposal by the above-described criteria and point system (A through C) to select a short-list of firms for further consideration. The City reserves the right to reject any proposal that it determines to be unresponsive and deficient in any of the information requested for evaluation. A proposal with all the requested information does not guarantee the proposing firm to be a candidate for an interview. The committee may contact references to verify material submitted by the offerors.

2. The committee then will schedule interviews with the selected firms if necessary. The selected firms will be given the opportunity to discuss in more detail their qualifications, past experience, proposed work plan and fee proposal.

3. The interview must include the project team members expected to complete a majority of work on the project, but no more than six members total. The interview shall consist of a presentation of up to thirty minutes (or the length provided by the committee) by the offeror, including the person who will be the project manager on this contract, followed by approximately thirty minutes of questions and answers. Audiovisual aids may be used during the oral interviews. The committee may record the oral interviews.

4. The firms interviewed will then be re-evaluated by the above criteria (A through D), and adjustments to scoring will be made as appropriate. After evaluation of the proposals, further negotiation with the selected firm may be pursued leading to the award of a contract by City Council, if suitable proposals are received.

The City reserves the right to waive the interview process and evaluate the offerors based on their proposals and fee schedules alone and open fee schedules before or prior to interviews.

The City will determine whether the final scope of the project to be negotiated will be entirely as described in this RFP, a portion of the scope, or a revised scope.

Work to be done under this contract is generally described through the detailed specifications and must be completed fully in accordance with the contract documents.

Any proposal that does not conform fully to these instructions may be rejected.

PREPARATION OF PROPOSALS

Proposals should have no plastic bindings but will not be rejected as non-responsive for being bound. Staples or binder clips are acceptable. Proposals should be printed double sided on recycled paper. Proposals should not be more than 30 sheets (60 sides), not including required attachments and resumes.

Each person signing the proposal certifies that they are a person in the offeror's firm/organization responsible for the decisions regarding the fees being offered in the Proposal and has not and will not participate in any action contrary to the terms of this provision.

ADDENDA

If it becomes necessary to revise any part of the RFP, notice of the addendum will be posted to Michigan Inter-governmental Trade Network (MITN) www.mitn.info and/or the City of Ann Arbor web site www.A2gov.org for all parties to download.

Each offeror must acknowledge in its proposal all addenda it has received. The failure of an offeror to receive or acknowledge receipt of any addenda shall not relieve the offeror

of the responsibility for complying with the terms thereof. The City will not be bound by oral responses to inquiries or written responses other than official written addenda.

SECTION IV - ATTACHMENTS

Attachment A – Data and Past Studies

Attachment B - Legal Status of Offeror

Attachment C – Non-Discrimination Ordinance Declaration of Compliance Form

Attachment D – Living Wage Declaration of Compliance Form

Attachment E – Vendor Conflict of Interest Disclosure Form

Attachment F – Non-Discrimination Ordinance Poster

Attachment G – Living Wage Ordinance Poster

ATTACHMENT A

Ann Arbor Biodigester

A Feasibility Study

30 June 2014

Submitted to the City of Ann Arbor
City of Ann Arbor
301 E. Huron
Ann Arbor, Michigan 48107

In fulfillment of the Scope of Work offered in RFP 889
By Quantalux LLC

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Acknowledgements

The Team of Quantalux/Swedish Biogas would like to acknowledge the assistance from the following people during the preparation of this Study:

Mr. Tom McMurtrie and *Mr. Matt Naud* from the City of Ann Arbor: Both Mr. McMurtrie and Mr. Naud met with Quantalux multiple times during the course of this Study in order to provide technical inputs, and recommend mid-course corrections (where needed). These meetings were very collaborative, and provided valuable opportunities for the Team to focus the tasks in the Feasibility Study to the specific needs of the City of Ann Arbor.

Mr. Keith Sanders and *Mr. Earl Kenzie* from the Ann Arbor Wastewater Treatment Plant (WWTP): Mr. Sanders and Mr. Kenzie provided the Team with technical data and detailed specifications on current WWTP plant operation. Mr. Sanders and Mr. Kenzie were very open to discussions on alternative processing techniques, and were quick to respond to the Team's request for detailed technical information.

Ms. Tracy Artley, Manager, Waste Reduction & Recycling Office, University of Michigan: Ms. Artley has worked for several years to determine the available food waste at the University of Michigan, and as the Study shows, the pre-consumer food waste from the University can be a valuable addition to the proposed Ann Arbor biodigester. Ms. Artley generously provided details on the University's food sort data, and shared technical information on the challenges facing a large institution with food waste collection.

Ms. Jean Henry, Sustainability Coordinator, Zingermans, Ann Arbor: Ms. Henry is responsible for managing the sustainable disposal of large amounts of food waste from Zingermans' restaurants and food production units. She shared data on the food waste generated by Zingermans, and identified the company's current methods for food waste composting. She was also particularly helpful in helping us understand the challenge of separating pre- and post-consumer food waste in the restaurant disposal stream.

Many other managers and owners of restaurants and breweries were interviewed to determine how food waste is disposed of in their establishments, including *Mr. Kevin Gudejko* (Main Street Ventures), *Mr. Dan Peron* (Corner Brewery) and *Mr. Tony Grant* (Northern United Breweries). We are grateful for the opportunity to see their businesses in person, and to discuss the various day-to-day issues they face with food waste disposal.

Ann Arbor Biodigester
A Feasibility Study

Introduction

A Request for Proposal (RFP) 889 was issued in March of 2014 to conduct a Feasibility Study on the use of biodigesters to process food waste from the City. This RFP was motivated by a Call to Action in the 2013 Ann Arbor Solid Waste Resource Plan, which calls for the City to research options to collect and process all food waste produced within the city. While the City already composts small amounts of food waste mixed with yard waste via weekly pickup from City residences, as much as 40% of the current trash load may consist of food waste, which – with good planning – can be diverted to a beneficial use.

Biodigesters are a good option for processing food waste, and are used routinely in Europe where the landfilling of food waste is prohibited. European systems typically find a good revenue stream from generating electricity from the biogas produced by the biodigester, and this is their primary revenue source. However, since electrical production is far less valuable in the US market, the successful adaptation of biodigester technology here requires that a biodigester find diverse revenue streams in order to maintain financial viability. Other revenue sources can include the sale of digested solids (a soil amendment), biogas (for heat or electricity) and the receipt of tipping fees when accepting materials to put into the digester. Another important revenue stream is the avoided cost of disposing of materials such as food waste or biosolids in the local landfill.

This Feasibility Study is an initial look at the resources needed for a successful biodigester near Ann Arbor. Our goals in the Study were to:

- Identify available food waste from commercial and industrial sources in the Ann Arbor region (excluding residential)
- Develop a high-level Biodigester cost description that is scaled to the available feedstocks
- Estimate the financial viability of the Biodigester (both short term and long term) based on revenues and expenses.

Using the results from this Feasibility Study, the City of Ann Arbor can assess options for enhanced solid waste disposal in the future.

1. Executive Summary

This Feasibility Study evaluates the potential for a biodigester for the City of Ann Arbor. Biodigestion is a method for processing organic waste materials (termed "feedstocks") such as food waste, grease, oils and sludges/manures. A biodigester earns revenue from the production of renewable electricity, from the sale of soil amendments, tipping fees for accepting feedstocks and via the avoided cost of landfilling the raw waste.

The Study focused on three main goals:

1. Identify available food waste and other organic waste from commercial and industrial sources in the Ann Arbor region.
2. Create an accurate system description for a biodigester that is scaled to the available feedstocks.
3. Develop software based cost-models to calculate financial viability of the Biodigester based on available feedstocks, including a 20 year pro forma model that includes all anticipated revenues and expenses.

The inclusion of sewage sludge in the list of available feedstocks is an important factor to economic success. Processing sewage sludge in a biodigester offers significant cost savings over the disposal of sludge in landfills or by land application (the current disposal method.)

The Study included the digestion of food waste from restaurants and food processors in the Ann Arbor area, and from the University of Michigan cafeterias. Food waste is a highly desirable feedstock, generating high quality biogas. The renewable electricity created from the biodigestion of food waste will earn significant annual revenue for the proposed biodigester.

Financial modeling of a biodigester showed the following results:

Case #	Type of financing	Fraction of sludge	Cost of Electricity ¢/kWh	Discount Rate, %	Cost of Money %	Term, years	Return on Investment, %	Internal Rate of Return, %	NPV
3	Public	100%	9 ¢/kWh	2.1%	3.5%	10	13.5%	6.06%	$2,705,235
4			5.5 ¢/kWh				15.6%	4.58%	$1,658,744

Key requirements for financial viability (i.e. profitabiliy) include the use of public financing using tax-exempt bonds, and the diversion of the sludge from the Ann Arbor Wastewaster Treatment Plant. Revenue from electrical generation can be earned via sale to the local utility (at 5.5 ¢/kWh) or by self-consumption for the plant and other City facilities (at 9 ¢/kWh).

Assuming these requirements are met, the models developed in this Feasibility Study show that an investment in the development of a biodigester system can be profitable to the City. The Study's financial modeling was fairly conservative, assuming very low inflation over the 20 year lifetime of the project. Should costs for current solid waste disposal increase significantly, then the biodigester's project profitability will improve further.

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2. Background

Organic waste makes up a large component of the total municipal solid waste (MSW) landfilled in the US. It is estimated that over 34 million tons of food waste is generated each year, which is approximately 15% of the total landfill volume.[1] Landfilling of food waste results in increased methane emissions through the natural decomposition of organic matter. While many landfills seek to capture and destroy methane using flaring and/or gas-to-energy systems, significant leakage means that approximately half of the landfill methane is emitted into the atmosphere

Conversely, biodigesters[i] use sealed vessels to process food waste, which captures nearly 100% of the methane produced from decomposing food waste. The methane can be used for a variety of power generation activities including electricity, natural gas replacement, and or vehicle fuel. Using the residual materials from the biodigester (digestate) as a soil amendment such as compost offers the opportunity to recycle valuable nutrients back into the ecosystem.

Biodigestion of food waste is a natural solution for a number of reasons:

- Food waste is high in nutrients, and can readily be broken-down by anaerobic digestion. Furthermore, food waste is inherently diverse, providing the required trace elements and nutrients for optimal digestion.
- Food waste has a very low potential for unwanted chemicals. In many cases, food waste is produced in USDA and FDA-compliant food processing facilities, assuring quality.
- Biodigesters can sustainably process many types of food waste that are not appropriate for composting. For example, sugary or soupy waste is a challenge to compost, but ideal for biodigestion.
- Businesses typically have loading docks and good site access for trucks to pick up food waste before it is transported to the biodigestion facility.

From an economic development-viewpoint, a biodigester can offer the following advantages:

- Businesses that desire a green solution to waste management can use this fact to offer legitimate green branding to attract and retain customers. Diverting food waste from landfills to a community digester makes business sense.
- A biodigester offers a responsible disposal option to a food production company contemplating a move in the Ann Arbor area. This is an economic development incentive.
- "Clean industries" such as food processing (as opposed to heavy industry) benefit from responsible and cost-effective waste disposal options, and are therefore more likely to expand in the Ann Arbor region.

[i] Biodigesters are also referred to as methane digesters or anaerobic digesters). For simplicity, this Study will use the term "biodigester".

Recent Food Waste Studies and State-of-the-Industry Investigation

The following is a set of summaries from recent food waste studies.

- A study by BSR, conducted on behalf of the Food Waste Reduction Alliance[2], investigated the quantities and disposal methods of food manufacturing and retail grocery sectors. The study surveyed 13 food manufactures (equating to 17% of U.S. industry represented by revenue) and 13 retail stores (30% of U.S. industry represented by revenue). The results showed that a majority of the food waste, 93% from manufacturing was diverted either to animal feed, land application, or compost. Retail grocery stores diverted a much smaller percentage of total waste generated, 37% was recycled, and 17% was donated. Composting was observed to be the primary recycling option accounting for 43% of all diverted waste.

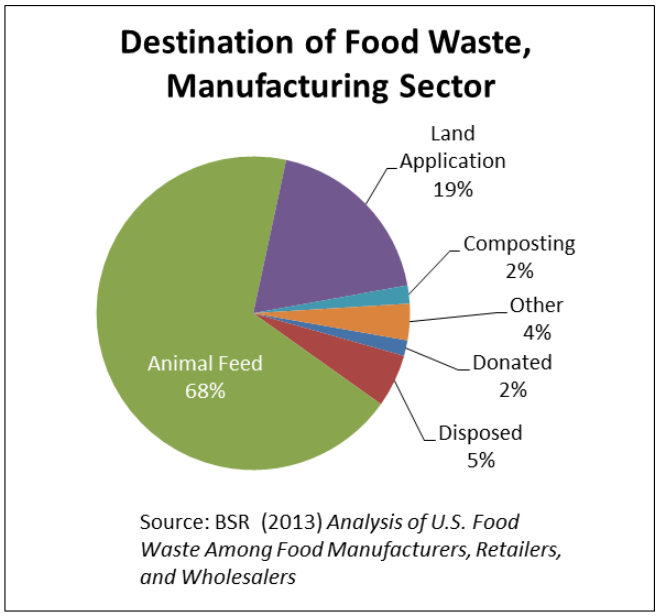


Figure 1: BSR manufacturing food waste study

- A study from 2008 for the City of New York estimated 1,640 tons/day of commercial food waste were produced in New York City alone.[3] A second study by the Coalition for Resource Recovery (CoRR) used this data to calculate the primary sources of this waste and the economic feasibility of diverting it from landfills.[4, 5] The breakdown of the sources showed restaurants and hotels being the largest producer (53%) followed by other food establishments and retail stores (20% and 14%). The report also showed that capacity for diverting food waste to compost or to anaerobic digestion facilities was limited. One of the potential diversion options proposed was transporting food waste to the City's wastewater treatment plant (WWTP), similar to the operation currently in practice at East Bay Municipal Utility District (EBMUD).

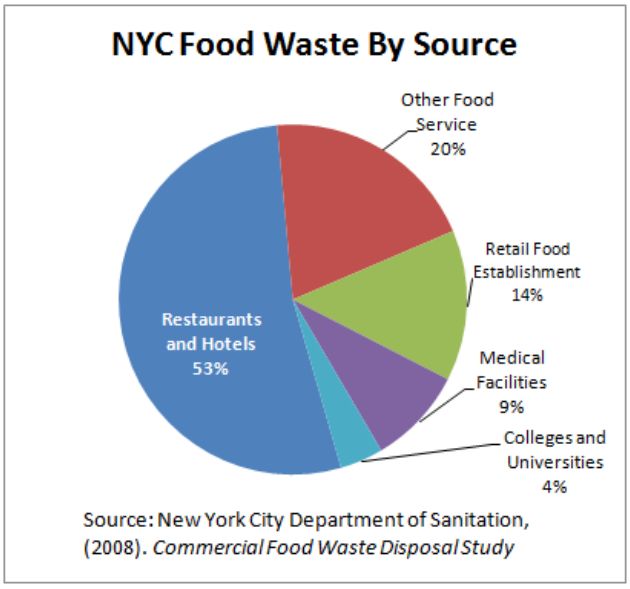


Figure 2: New York City commercial food waste by source

- East Bay Municipal Utility District WWTP in Oakland, California currently accepts 40 tons/day of food waste from restaurants and hotels. The WWTP also processes food processing waste and municipal sludge. The result is that the WWTP is able to produce 90% of its onsite power requirements from its anaerobic digesters to produce biogas. Future design of the system and expansion of organic waste acceptance is expected to turn the WWTP into an energy exporter.[6] In the Bay Area, there is approximately 2,100 tons/day of commercial food waste. *Recology*, the waste management company operating in the area, is building a preprocessing plant next to EBMUD's anaerobic digesters to remove non-digestible items from the organic waste stream that it collects.[7] The facility will be able to process up to 600 tons of material per day and feed directly into EMBUD front-end processing facility.[8]

Both EBMUD and the City of New York operate in a vastly different scale to Ann Arbor in terms of population and infrastructure. However, some of the information and lessons learned from these examples can serve as guidance for evaluating the feasibility of a community digester for the City of Ann Arbor. Food waste generation in the retail and food service establishments are expected to be fairly universal in terms of generation on a revenue or per customer basis. What is highly variable is the quantity of production across different types of food service establishments and retail stores. Also, the availability of alternative disposal options varies greatly as well. The comparison to a similar feasibility study effort by AECOM for Dane County, Wisconsin adds valuable insight into a city of comparable size to Ann Arbor.

- The Dane County Phase I feasibility study[9] showed that the diversion of organics from landfill are primarily driven by cost. The food processor waste survey estimated that on average 86% of waste was diverted from landfill. The primary diversion pathways included animal feed, compost, or rendering with only 14% of organics going to landfill. These findings reflect a similar breakdown to the BSR study mentioned previously. Diverting processor waste streams to animal feed and rendering are cost saving, or even revenue generating, opportunities for the food processors in the Dane County area. Another point of interest outlined in the Dane County survey is that waste quantity and disposal data was difficult to generate. This proved to be a similar challenge in Ann Arbor, Michigan.

All of these studies and active projects provide insight into an investigation into the Ann Arbor area. The technology and logistics for operating a community style digester has been proven both on a national and regional level.

Biodigester Overview

A flowchart for a typical biodigester is shown in Figure 3. The materials on the left (referred to as "feedstocks") are fed into the anaerobic digester at a pre-determined rate. Feedstocks include manure, wastewater treatment plant sludge, food waste, grease and fats from the surrounding community. Unlike a composting operation, biodigesters are anaerobic, which means that the system is sealed in order to eliminate oxygen, which is toxic to the culture of organisms inside the digester that consume the feedstocks to produce biogas and digested solids. As a result, the systems have very little odor, and are highly efficient at extracting biogas.

Feedstocks are held in the digesters for set period of time (typically 20 to 40 days) in order to allow the methanogenic organisms to break down the organic material. The output is then expelled for post-processing (moisture removal). Figure 1 also shows that the digestion process can earn revenues in several ways: direct payment of tipping fees, avoidance of landfill costs, and by the sale of byproducts (compost and bioenergy)

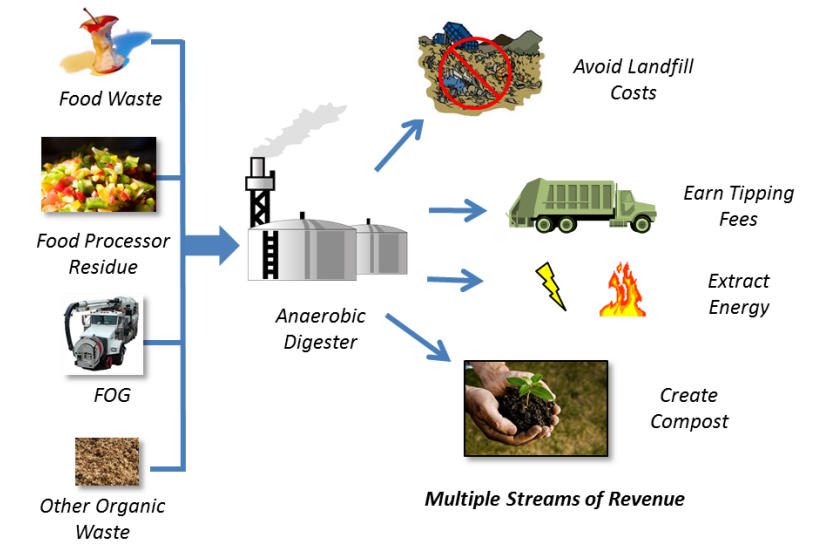


Figure 3: Multiple Feedstocks can be processed in a biodigester, yielding revenue from multiple sources.

Examples of Food Waste Biodigesters

While food-waste biodigesters are common in Germany and Sweden, the specific use of food waste as a feedstock is an emerging technique in the US, motivated by both environmental and fiscal considerations. Several examples of successfully operating food waste digesters are in operation today (see Figure 4.) These include:

Central Florida Energy Garden: The Energy Garden near Orlando is designed to process organic waste from the Central Florida region. The largest supplier of food waste will be Walt Disney World Resort. Other suppliers include restaurants, hotels and food processors in Central Florida. Energy production is 5.4 MW of renewable electrical generation

ecoCitysystem Columbus, OH: The ecoCitysystem processes biosolids from the City of Columbus, regional food waste and FOG (fats, oil and grease) to generate 1 MW of renewable energy.

South Campus Digester at Michigan State University: This facility processes dairy manure, food wastes and food scraps from the MSU dorms and other eating facilities on

campus. The system is also designed as a research asset for MSU, allowing researchers to explore optimum feedstock combinations. Energy production is 400 kW of renewable electricity for the MSU campus.

Forest County Potawatomi Community, Milwaukee, WI: A biodigester at the Potawatomi Bingo Casino accepts food waste from casino food services in addition to soy, whey, and bakery byproducts from local industry. The plant is designed to process 132,000 gallons of material per day and will generate 2 MW of renewable power.

Central Florida Energy Garden
Orlando, FL

South Campus Digester, Michigan State University

ecoCitysystem, Columbus, OH

Potawatomi Casino, Milwaukee WI

Figure 4: Examples of biodigesters that process food waste and food residues

Note that all of the digesters shown in Figure 4 are large-scale, centralized facilities. Experience in Europe and the US has shown that large scale facilities are required to achieve the required economies of scale for financial viability.

Biodigester Feedstocks

While biodigestion is a mature and reliable technology, the key design and operational challenge is to identify a locally available, continuous supply of feedstocks to feed the digester during operation. In addition, the correct mixture of feedstocks must be fed to the biodigester. (This is essentially the "diet" for the biodigester). The following is a list of potential feedstock materials:

- Vegetative: Fruit and vegetable trimmings, spoiled produce
- Non-Vegetative: Meats, dairy, fish
- Industrial/Food Processing: Vegetative or Non-Vegetative (often referred to as food residue).

- Food that has been served but not consumed, e.g., plate scrapings, salad bar contents
- Fats, oils and grease (FOG) from restaurant grease traps and other sources
- Biodiesel by-products (glycerin and oilseed meal)

In addition, biodigesters can readily process animal and human wastes:

- Manure from feedlots, dairies or concentrated animal feeding operations (CAFOs)
- Waste activated sewage sludge from municipal wastewater treatment plants (WWTP).

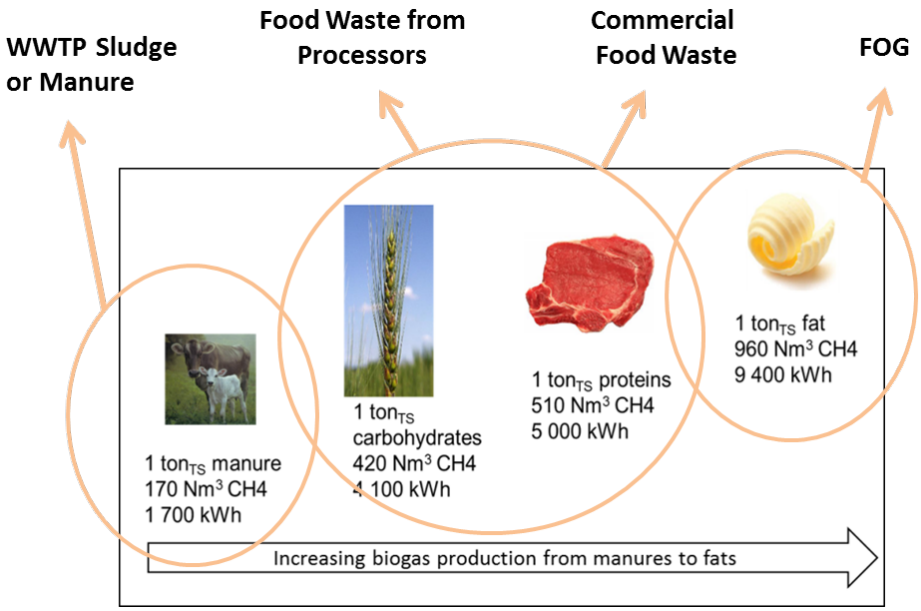


Figure 5: Energy content in different feedstocks, ranging from manure to fats and greases

Figure 5 shows the energy content for different types of food wastes. Sludges or manures have the lowest energy content because they are already partially digested. Carbohydrates and proteins (typically found in food waste) have the next highest energy content, and Fats, Oils and Greases (FOG) from cooking oils and greases has the highest energy density.

Optimizing Digester Performance

In order to generate the maximum amount of biogas and maintain system stability, this Feasibly Study focused on mixing five available feedstocks from the Ann Arbor area (see Figure 6). While the percentage of each feedstock can vary, this blend of feedstocks has been shown in other biodigesters to yield optimum performance and stability. Major feedstocks include:

Manure, or Sludge: The largest fraction of feedstock material in a digester is often manure or sludge because it readily available, and also provides an excellent buffering material for the higher energy organic materials such as food waste and FOG. Use of a manure/sludge buffer results in very stable digester performance, resulting in consistent and uniform

biogas production. This material is sourced from either a local farm, or a wastewater treatment plant (WWTP).

Pre-Consumer Food Waste: Food waste gathered from community sources such as hospitals, universities, restaurants and even consumers provides a higher energy density feedstock. A major advantage is that food waste has a rich, diverse range of nutrients for the organisms inside the digester vessel that produce biogas.

Food waste from Processors: Feedstocks from out-of-spec food, past-date materials and other inedible food materials are excellent digester feedstocks, although they often need to be depackaged to separate the non-digestable wrappers or enclosures from the organic food. A key advantage with a food processor as a feedstock source is that the companies typically have good information on the material characteristics and daily quantity available.

Milk Waste: Dairies routinely need to dispose of spoiled milk, cheese whey, and other non-edible dairy products that are generated during the milk-production process. Because this material is mostly liquid, disposal in a landfill is a particularly poor option. Conversely, disposal in a biodigester is the ideal option. Several dairies near Ann Arbor are candidates to supply milk waste.

Fats, Oils and Greases (FOG): A very desirable feedstock for any biodigester is the grease or oils that comes from cooking food in restaurants, termed FOG. The majority of this material is grease trap waste (GTW), which is accumulated in grease traps and interceptors where nonresidential food preparation activities take place. Due to its high energy content (and low economic value elsewhere), FOG is an excellent material to add to a biodigester in modest quantities.

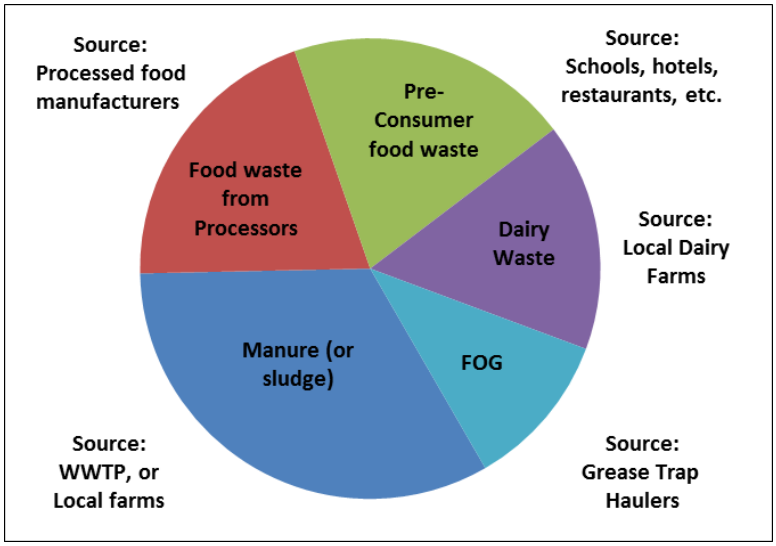


Figure 6: A biodigester performs best with a diverse range of feedstocks Typical Feedstocks and Sources

3. Food Waste Sources in the Ann Arbor Area

This feasibility study focused on the opportunities to divert food waste generated in the processor, retail and food service sector in Ann Arbor, Michigan. The major focus was on non-residential food waste sources within a distance of 25 miles from Ann Arbor. (This distance was chosen because it is the typical range for a logistics pickup system.) A systematic approach was used to identify the types and quantities of food waste, including: on-site interviews, phone

interviews and data gathered from previous food sorts. A full rollup of the available food waste was compiled using the data gathered.

The primary objectives for reaching out to Ann Arbor food processors, retail stores, and food service establishments were to:

1) Determine if Ann Arbor food waste generation follows similar trends to the national and regional studies.

2) Estimate the quantity of waste production at each type of food service establishment.

3) Assess for the acceptance level among business owners for diverting organic waste streams to a community digester.

The following is an overview of how each sector was evaluated.

Restaurants

The outreach to local food service establishments provided valuable insight into business practices in Ann Arbor. Owners were willing to talk about the waste produced at their facilities and were, in general, open to further discussion. While most respondents said "Yes, we have food waste and would like a better solution", few owners knew the exact amount of food waste produced at their restaurants.

Seven restaurant managers were interviewed representing over 20 Ann Arbor food service establishments. Preliminary data collected showed that waste generation is highly variable between restaurant types, location, and practices. In spite of the small sample set, three important observations were clear:

Composting: Several restaurant owners already had a composting system implemented to divert pre-consumer "kitchen" waste. This is a particularly popular solution because both pre- and post-consumer waste can be included in the composting bin (including napkins and other paper products). One owner told us "*Don't take my composting away – I love it.*"

Space constraints: For restaurants in high density areas (downtown, for example) the practical consideration arose as to where to place a bin for segregated food waste. Restaurants already separate trash, recyclables (multiple bins) and (sometimes) cooking oil. For many restaurants, the physical space for a dedicated "food waste bin" is simply unavailable.

Low priority: Several restaurant owners estimated the total weekly production of food waste to be relatively marginal and did not see the cost of disposal as a major concern.

Rough estimates of waste production were collected from restaurant managers and compared with documented values from a variety sources. Food service establishments were categorized into three categories, Casual Dining – larger full service restaurants, Fine Dining – smaller atmosphere focused restaurants, and Fast Casual – restaurants not offering full table service, fast food – limited menu, quick service.

Interviews with several fast-food chains yielded little optimism about being able to divert food waste from these locations. Several responses from these organizations considered their waste handling operations to be "proprietary information," and were not open to discuss alternative opportunities at this time. However, our team did speak to a franchisee with 67 outlets for a national fast-food chain. This owner indicated that fast food is a highly efficient food delivery system, with very little pre-consumer food waste produced. The post-consumer waste is typically co-mingled with paper and plastic.

Grocery Stores

Several local area grocery stores were contacted about their options for surplus food and other organic waste streams. Community food donation is the first priority for these stores. Over 300 food donors in Washtenaw County coordinate with Food Gatherers to take surplus food. The remaining non-edible, food waste/vegetable clippings is generated in the produce department, with a rough estimate of 400 pounds per week from a large grocery store.

Shift managers could not confirm disposal costs but did articulate that the primary pathways for expired food (or near expired) involved donation, composting, or diversion to animal feed. This appears to follow a similar pattern to the BSR study sponsored by the Food Waste Reduction Alliance.[10]

One of the key questions we asked of grocery stores was "*Will your staff be able to segregate food clippings/residues without significant extra work?*" The managers we spoke with said that their staff would be eager to implement more sustainable solutions in their workplace with little additional effort. Another question dealt with the physical space needed for an additional food-waste bin to store food waste before pick-up. Managers said that groceries tend to have ample storage space near loading docks and in the back of stores. However, an important caveat is that the food waste must be stored separately from incoming food stuffs in order to maintain a hygienic environment for incoming food.

Cafeterias

Large cafeterias were also considered to be potential sources for food waste collection. Schools, hospitals, and community colleges were all possibilities. A key difficulty is the separation of pre- and post-consumer waste. As noted previously, post-consumer waste is typically co-mingled with napkins, straws, flatware and other items that would foul a digester. Composting is the preferred solution for post-consumer food waste for this reason.

Figure 7: Composting tubs at WCC

Washtenaw Community College (WCC) was considered to be potential large source of food waste. However, our interview with the Recycling Operations Manager determined that WCC has already made a significant investment in composting equipment, and they plan to divert their pre-and post-consumer food waste into a compost system. WCC has installed two Green Mountain Technology Earth Tubs™ [ii] for composting (see Figure 7). These Earth Tubs™ can process up to 100 lbs per day of food scraps when mixed with a bulking agent such as wood shavings. The composted material will eventually be used as fertilizer for a neighboring greenhouse.

As with most institutions, segregation of pre- and post-consumer food waste remains a challenge for WCC and other cafeteria services. Our team was not successful in determining the available food waste from local public schools; however, other studies show that school food waste is typically both pre- and post-consumer. Given the modest timeframe for this effort, the focus was turned to larger sources of food waste such as food processors, restaurants and the University of Michigan.

Food Processors

The ideal source for food waste for biodigestion is sourced from local food processors. Food waste (or food residue) from the food production process is typically:

- Available in well-defined, consistent quantities (by product of the food production process),
- Well-characterized in terms of nutrient qualities, and
- Likely to be supplied via long term contract.

To identify the food processors near a proposed Ann Arbor Biodigester, a list of 1800+ active food processors was obtained from the Michigan Department of Agriculture and Rural Development (MDARD). Because most food processors must be permitted to dispose of food materials, the MDARD will issue permits based on the material type and quantity.

This long list was then narrowed down by first removing all "Limited Wholesale Food Producer" license type. [iii] Secondly, a 25 mile radius

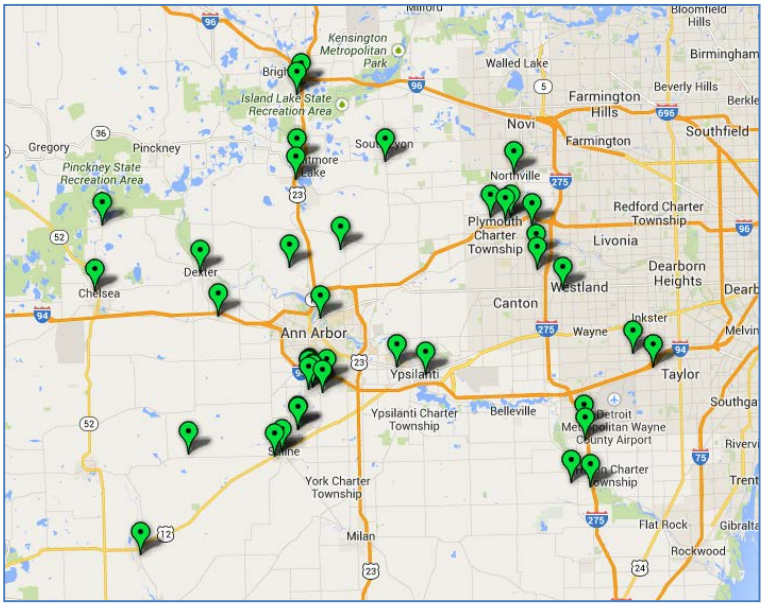


Figure 8: Wholesale food processors within 25 miles of Ann Arbor

[ii] http://compostingtechnology.com/products/compost-systems/earth-tub/

[iii] Limited Wholesale Food Producers are defined as $25,000 or less in annual gross wholesale sales

was used to sort by travel distance to Ann Arbor.[iv] The remaining list of 38 processors was vetted by investigating the company websites or by personal phone calls to determine available material.

Our interviews showed that the food processors shown in Figure 8 are only modest producers of food residue/waste. The largest producer was a bagel manufacturer that disposed of 100 to 500 lbs of dough per week. Nearly all companies co-mingle their food waste with trash in a dumpster, and the material is picked up at regular intervals their trash hauler.

As was the case with grocery stores, food processing companies wanted to be sure that the organic materials were quickly removed from the building (to maintain cleanliness) and periodically removed from the site.

The food processors that were interviewed identified the following important opinions about food-waste diversion to a biodigester:

- Nearly every processor we contacted was supportive of the idea of enhanced food-waste diversion, and indicated a willingness to participate in a City program (if implemented).
- While co-mingling food waste with trash for the landfill was considered a poor approach, processors reluctantly do so because it is easy and cost-effective. Optimizing disposal is simply not a core requirement for any company's success.
- Current cost of disposal was not a particular concern, likely because of the small quantities of food waste.
- Low quantities of food waste from processors is based on the fact that companies need to be efficient, and waste material has been engineered out of their production processes.

In summary, the food processors within a reasonable distance of Ann Arbor (approximately 25 miles) produce only small quantities of material. Ideally, a large food processor would be situated near the biodigester, with all the food waste efficiently diverted to the digester on a continual basis. At the current time, however, this notional "large" food processor does not yet exist in the Ann Arbor region.

4. Estimation of Available Food Waste

Given the low quantities of food waste from local food processors and grocery stores, this Study focused on estimating available food waste from two key sources:

- Restaurants and food services within Ann Arbor proper, and
- University of Michigan.

Each source is capable of providing pre-consumer food waste that does not conflict with their existing composting of post-consumer food waste. This will result in a very conservative

[iv] A filter of 50 miles was originally used but returned over 200 processors, mostly from the Detroit-metro area, a shorter range filter was necessary before conducting a more targeted outreach.

estimate on the food waste, with any additional quantities from other sources a bonus to the overall system.

Restaurant Food Waste – Statistical Estimate

A statistical estimate of restaurant food waste was based on a database of 275 Ann Arbor food service establishments using a series of Monte Carlo simulations. This approach is used routinely in engineering and science for determining quantities or instances for a large dataset with a small number of samples within that dataset. The results of the Monte Carlo simulation were then compared to the results of food sorts from other cities in the US in order to validate the results.

Table 1: Food waste generation by restaurant type

Ann Arbor Food Waste Generation Survey by Restaurant Type				
		Generation [lbs/week]		
	Sample Size	Lower Range	Average	Upper Range
Casual Dining*	8	500	1000	2000
Fine Dining**	3	250	500	1000
Fast Casual***	2	90	180	280
*4 yd dumpster 3x week collection @ 80% food waste and 245 lbs yd				
**4 yd dumpster 2x week collection @ 80% food waste and 245 lbs yd				
***Based on 50 lbs / day estimate @ 80% food waste				

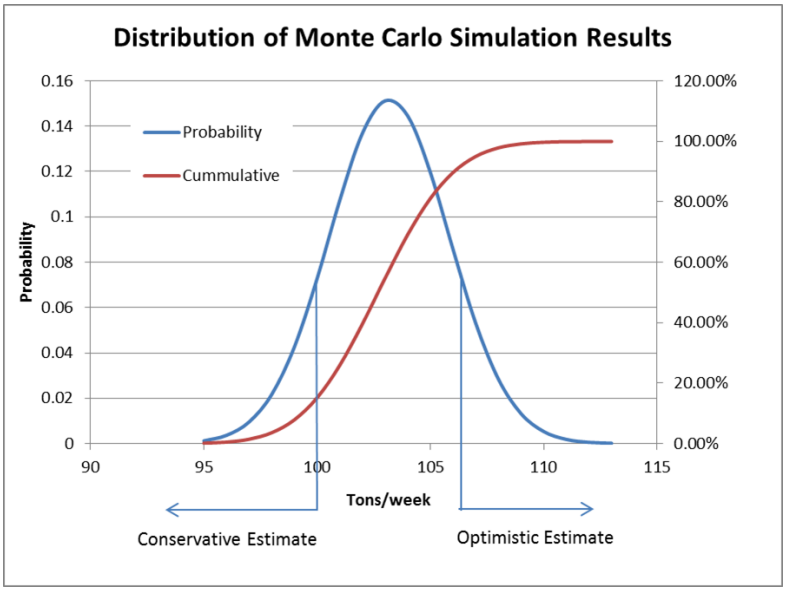


Figure 9: Results of Monte Carlo Simulations on food waste.

To construct the Monte Carlo simulations, each food service establishment was geographically referenced and assigned a category; Casual Dining, Fine Dining, and Fast Casual. The 275 restaurant database is not an exhaustive list of restaurants in Ann Arbor however, for the purpose of the simulation, it was considered to be representative of 90-100% of the total food service population in Ann Arbor.[v] For each simulation, a randomly generated food waste production value (in lbs) between the lower and upper range established in Table 1 was assigned to each restaurant. The randomly generated values for all restaurants were summed together to produce a simulation total. The simulation was then run 1000 times. The results are shown in Figure 9, where the peak of the probability distribution represents the amount of food waste (103 tons/week) that is statistically most likely to be available. The

[v] There are potentially more sources of food waste production; however, the researchers felt that considering the 275 restaurant database as 100% of the population allowed for a conservative estimate.

distribution of food waste availability follows a normal distribution ("bell curve"), which is consistent with a large number of samples generated by the Monte Carlo procedure.

To get a sense for how accurate this statistical approach is, a number of other reports/surveys were compared to the Monte Carlo results[11] [12] [13] [14]. This data is shown in Table 2. Results for these surveys show that for 800 meals/day, the upper range for available food waste will be approximately 2000 lbs/week. This compares favorably to the upper range from the Ann Arbor data for "Casual dining" (see Table 1), yielding confidence that the upper and lower values for the Monte Carlo analysis were selected correctly.

Table 2: Comparable food waste data from other studies and surveys (see text above for references.)

Restaurant Waste Production Comparison Table			
Source	**Metric**	**Upper Range Conversion Factor**	**Comparison**
Recycling Works Massachusetts	0.5 lbs/meal	800 meals/day* x 5 days/week	2000 lbs/week
EPA Food Waste Management Cost Calculator	0.5-1.5 lbs/meal	800 meals/day x 5 days/week	2000 – 6000 lbs/week
The Rosenthal Group (incl all discarded waste)	1.5 lbs/meal	800 meals/day x 5 days/week x 30%**	1800 lbs/week
Cascadia Consulting Group	2,900 lbs/employee/yr	2,900 lbs / 52 weeks/yr	30 employees = 1600 lbs/week 50 employees= 2800 lbs/week

The results of the Monte Carlo simulation are considered to be representative of the food waste in Ann Arbor restaurants, but conservative.

Important Note: The most accurate method for determining available food waste is to conduct a food sort from a series of restaurants, including sufficient restaurants in the effort so that the sample size is statistically valid.

Geographic Location of Food Waste in Ann Arbor

The results from the Monte Carlo simulation were further broken down into geographical areas within Ann Arbor. Per the recommendations of City staff, this study did not include food establishments outside Ann Arbor city limits on the thesis that access to outside food waste could not be guaranteed to the City. Inside the City, however, the possibility of franchising the collection of food waste exists. This would offer a steady supply of food waste to the biodigester, which is a critical requirement for successful operation. In future studies, food waste outside Ann Arbor proper should also be considered, along with an assessment of how to incentivize the delivery of that material to the biodigester.

Figure 10 shows the geographic area and relative waste production estimates for restaurants in Ann Arbor proper. The physical location of restaurants is shown in the map on the left, and a "heat map" of food waste concentrations is shown on the right.

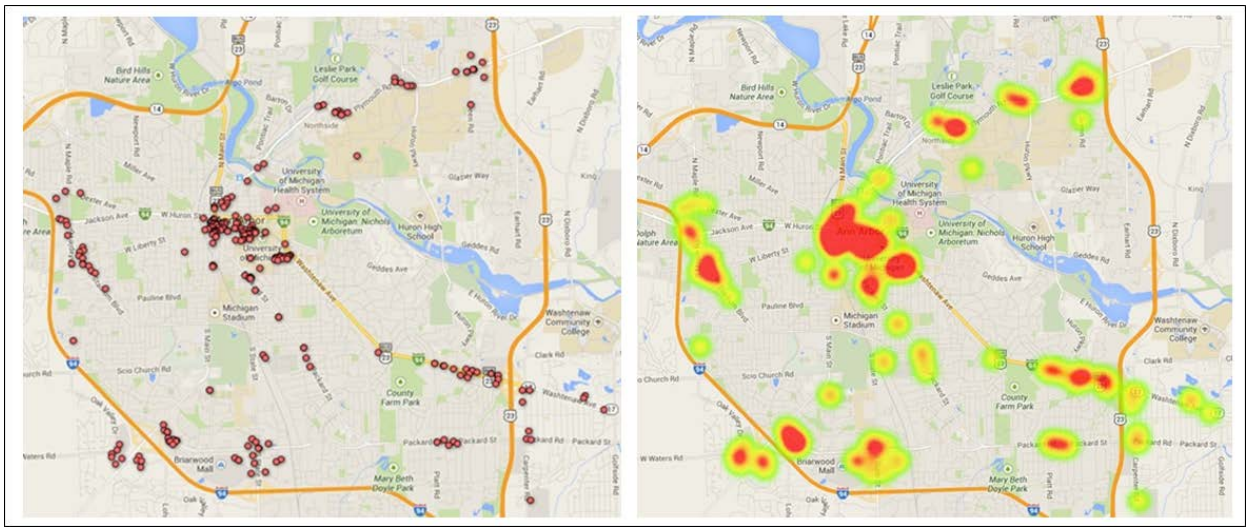


Figure 10: Geographic location of food service establishments in the restaurant database; geo-code (left) and heat map of food concentrations (right).

The data in Figure 10 can be further combined to identify "food waste corridors" in the City of Ann Arbor. Figure 10 shows a breakdown of the restaurant database according to location, with estimations of the food waste available from each "corridor In general, the Downtown area is the largest source of food waste, with the other areas roughly equal in food waste generation.

The estimate of 100 tons per week is the value of food waste production used this Study's computer modeling (described in later sections of this report).

Weekly Food Waste Generation (tons/week)			
Area	Low	Med	High
Downtown	39	45	50
South Ann Arbor	12	16	19
Packard/Washtenaw Corridor	12	15	19
West Ann Arbor	7	9	12
Plymouth Road Corridor	7	9	12
South University	6	8	10
Totals	83	103	122

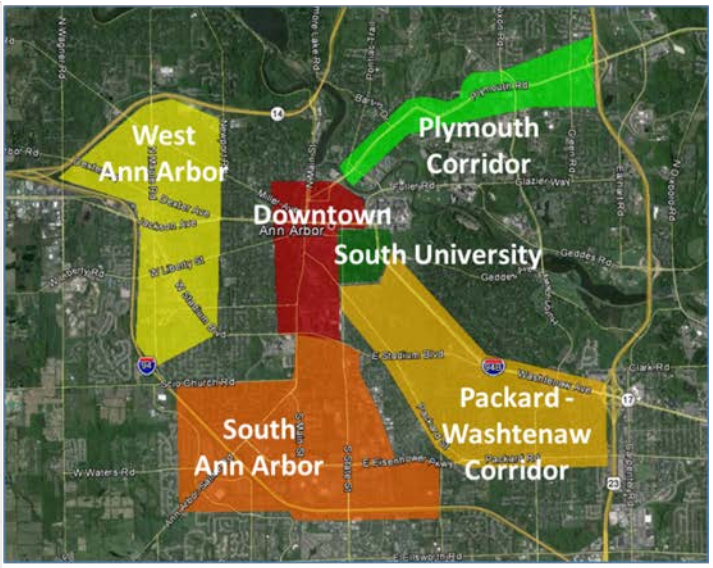


Figure 11: Restaurant Food Waste Generation by Corridor with map of corridors in Ann Arbor

University of Michigan

The University of Michigan conducted a refuse sort in 2013 for the waste generated at several of the University's cafeterias, and also at on-campus food service locations and special events. The data in Figure 12 represents pre-consumer food waste only, which is therefore an accurate representation of the available materials from the University of Michigan for biodigestion[vi].

2013	UM Food Waste [tons/wk]			
	Housing	Other	Events	Totals
Jan	3.3	0.2	0.0	**3.5**
Feb	4.7	0.3	0.5	**5.5**
Mar	3.1	0.2	0.6	**3.9**
Apr	3.5	0.2	1.8	**5.5**
May	0.7	0.3	0.1	**1.2**
Jun	1.3	0.2	0.0	**1.5**
Jul	1.9	0.2	0.0	**2.2**
Aug	1.0	0.2	0.0	**1.3**
Sep	4.7	0.6	1.8	**7.1**
Oct	5.3	0.7	1.3	**7.3**
Nov	5.4	0.8	1.8	**8.1**
Dec	3.2	0.6	0.7	**4.5**

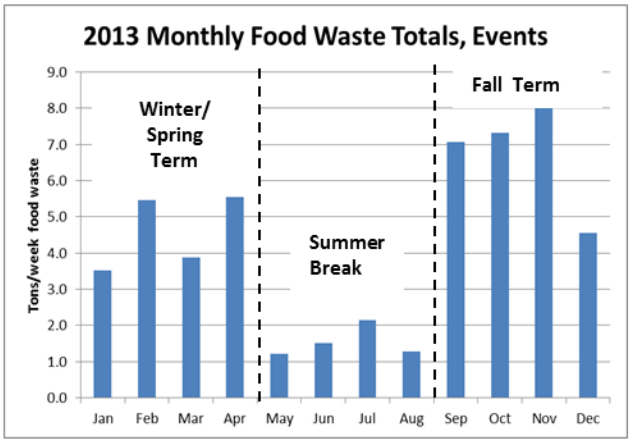


Figure 12: Pre-consumer food waste from the University of Michigan was tallied in 2013.

As with most schools, the available food waste from University of Michigan is synchronized with the school calendar. Summer quantities drop to very low values, and peak values are seen in the Fall and Spring terms. The average pre-consumer food waste from the University of Michigan is calculated to be 4.3 tons/week, with a high value of 8.1 tons/week in November and a low of 1.2 tons/week in May.

Composting vs Biodigestion – Target Pre-consumer waste for Biodigestion

Several of the restaurants interviewed had already established popular composting programs for much of their pre- and post-consumer food waste. From the restaurants interviewed, up to 20% of restaurants in the downtown area may already be diverting food waste to compost.[vii]

A significant challenge is to strip to non-digestable materials out of the total waste stream, and to segregate all materials before transport to either the composting facility or the biodigester. For practical considerations, it is recommended that only pre-consumer food waste be targeted as the feedstock for the biodigester. Pre-consumer waste is typically generated in kitchens where staff can be trained on the correct materials to segregate. Interviews with restaurant owners indicated that this would be a trivial change to the kitchen's workflow, with employees generally willing to support most sustainable disposal options.

[vi] Data courtesy of Ms. Tracy Artley, Sustainability Coordinator for the University of Michigan.

[vii] This percentage could be a result of a biased sample set. It was the experience of the researchers that environmentally focused businesses were more likely to discuss and engage in conversation about their business's waste diversion efforts.

5. Non-Food Waste Biodigester Feedstocks

For maximum stability of the ecosystem inside the biodigester, a diverse offering of feedstocks should be fed to the organisms in the digester vessel. In the same way that humans and animals benefit from a diverse diet with carbohydrates, proteins and fats, the methanogenic organisms in a biodigester are enhanced by the addition of secondary feedstocks other than food waste. (These secondary feedstocks are typically referred to as "co-feedstocks".)

For the Ann Arbor Biodigester, the selected co-feedstocks were:

- Fats Oils and Grease, or FOG (from grease traps in restaurants in the Ann Arbor region)
- Sludge from the Ann Arbor Waste Water Treatment Plant

FOG Co-feedstocks

Fats, oils, and grease (FOG) are generated as part of our daily lives. FOG is produced from residential, commercial, and industrial processes. FOG in the Ann Arbor area is generally broken down into two major categories[viii]:

Brown Grease: flotatable FOG, settled solids (food particles) and associated wastewater retained by grease traps and inceptors. Brown grease is also commonly known as grease trap waste (GTW).

Yellow Grease: inedible or spent FOG removed from Food Service Establishments (FSEs). A major source of yellow grease is deep frying.

Depending on its source, FOG may or may not have a market value. In general, the higher purity of the FOG, the higher value it has for reuse. For example, yellow grease is commonly recycled for reuse at FSEs or collected for biodiesel manufacturing. Of the two major sources of FOG, grease trap waste is most available for the use in an anaerobic digester. Brown Grease is generated through the preparation, serving and cleanup of food. As such, the FOG is discharged through sinks and drains that are connected to the sanitary sewer. Because it is co-mingled with kitchen wastewater, GTW is typically considered to be a waste product with little to no value; however, due to its high energy potential per unit volume and the form that it is collected; GTW is very desirable for use in a biodigester.

Figure 13: Typical Grease Accumulator near the kitchen sink

[viii] Another source of grease is the biodiesel manufacturing process, where the glycerin byproduct is an outstanding co-feedstock in a biodigester. However, the closest biodiesel facility is in Sandusky MI, which is too far to be considered a viable glycerin supplier.

Grease trap waste (GTW): Grease trap waste (GTW) is accumulated in grease traps and interceptors where non-residential food preparation activities are performed. Grease traps and interceptors work on the principle that FOG is less dense than water and therefore will accumulated on top of the water, much the same as an oil slick after an oil spill. Periodically, the grease traps are cleaned. Cleaning of the grease trap is performed by the skimming or vacuuming of the grease that is floating on top of the water into a truck. The collected grease is then taken off site for disposal.

Table 3: Grease trap waste characterization

Parameter	Results on Wet Weight Basis
Total Solids (%)	6.0
Total Volatile Solids (%)	88
Fats, Oils & Grease (%)	1.1
pH (SU)	4.4

Disposal of the GTW is typically performed through landfilling. Due to the high water content of GTW, landfills in Michigan cannot accept GTW without modifying it through a process called "solidification". Typical characteristics of GTW are provided below in Table 3[ix].

Access to Grease Trap Market

Grease trap waste is collected by companies that specialize in grease trap and interceptor cleaning. They have specialized trucks that are able to vacuum the GTW from the establishment's collection point. The companies have specific knowledge of the regulations for cleaning, transportation, and disposal of the GTW. Examples of companies in the Ann Arbor area that perform such services include:

- Dover Grease Trap – Fraser, MI
- Power Vac of Michigan, Inc., Novi, Mi
- Great Lakes Grease, Detroit, Mi
- Rooter-Man, various locations in south east Michigan
- Roto Rooter, various locations in south east Michigan

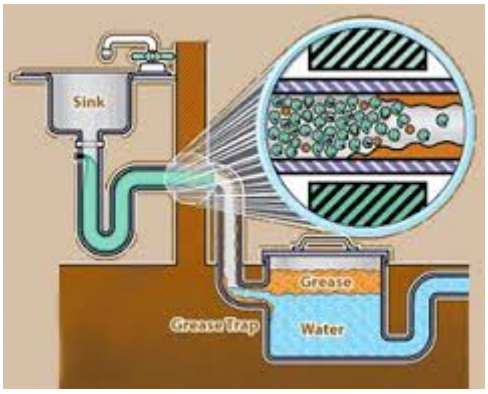


Figure 14: Under sink grease trap

FSEs depend on these types of companies to periodically clean grease from their collection points and dispose of it. Without periodic cleaning of grease traps and interceptors, FSE would likely experience sewer backups and or surcharge fees from the local sewer authority. As GTW material is centralized by various collection and disposal companies, the most efficient way to understand the quantity of GTW that is available is to speak directly with these companies.

Another route that may be taken is to speak with the disposal site that ultimately handles the GTW, however, these sites are less likely to collaborate with inventory studies as they are profiting from the disposal of the waste and would not support any diversion.

[ix] Taken from The Pumper, March 2000.

Current cost for GTW disposal is approximately 20 to 30 cents per gallon. Based on the experience of Swedish Biogas in accepting FOG materials at the Flint WWTP, tipping fees of 10 to 15 cents per gallon should be attainable depending on the overall logistics of transportation.

Important Note: The sustainable disposal of Grease Trap Waste is an additional selling point that collection companies can offer Food Service Establishment for green branding.

Sludge from the Ann Arbor WWTP as a co-feedstock

The additional of waste water treatment plant (WWTP) sludges to a digester can provide many benefits. They include:

- Improved digestion via the addition of necessary trace elements and nutrients.
- The creation of stabilized material that meet the standards to CFR 40 Part 503 for reuse.
- A reduction of lime stabilization costs, and also in the expense to landfill the digested material.

Perhaps the major advantage of digesting sludge is that *biodigestion naturally reduces the total amount of material by nearly 40%*. This means 40% lower disposal charges will decrease by approximately 40%, offering the WWTP a very large savings in disposal costs.

The Ann Arbor Wastewater Treatment Plant (WWTP) receives and treats approximately 19.0 million gallons of wastewater per day from the City of Ann Arbor, Pittsfield, Scio, and Ann Arbor Townships. The facility has a total treatment capacity of 29.5 million gallons per day. Sewage sludge is generated at two major locations within the flow regime of the plant:

1) Primary clarifiers where primary sludge is separated from incoming wastewater,

2) Secondary clarifiers where activated sludge is collected and pumped to holding tanks and then thickened to 6% total solids using a gravity belt thickener.

Based on the preliminary data provided by City staff, the quantity and characteristics of sludge that is available is provided in Table 4.

Table 4: Characteristics of sludge at the Ann Arbor WWTP

Description	Primary Sludge	Thickened Waste Activated Sludge (TWAS)
Quantity, dry tons per year	2,900	3,000
Quantity, avg dry tons per day	8	8.3
Total Solids, %	5.3%	6%
Volatile Solids, %	85%	75%

The City of Ann Arbor currently uses two processes for reuse and disposal of their biosolids:

Land Application: During allowable time periods of the year, sewage sludge is converted to 40 CFR Class B biosolids using alkalinity (lime) stabilization. The biosolids are then

applied to agricultural lands as a soil amendment. A majority of the sewage sludge generated at the facility is handled in this way. Reuse of the biosolids in this fashion is heavily dependent on permissible weather conditions and availability of agricultural lands.

Landfilling: During time periods that land application of biosolids is not permissible, the sewage sludge is dewatered and sent to a landfill for disposal It was assumed that solids to the landfill and land application were at 27% and 7%, respectively

Biodigestion of Sewage Sludge

Biodigestion of sewage sludge can provide several benefits to a waste water treatment facility. Benefits include:

- 30 to 40% reduction in overall sludge volumes that require disposal/reuse
- Energy recovery through biogas production
- Obtainment of CFR 40 Class B biosolids without chemical (lime) addition
- Ability to co-mingle existing compost operations to achieve CFR 40 Class A EQ biosolids (soil amendment for unlimited use)
- Greater de-waterability as compared to waste activated sludge
- Nutrient recovery of phosphorus and ammonia
- Reduce odor control requirements as digestion takes place within closed vessel

Biodigestion is not without its drawbacks. The primary concern for the treatment facility would be any streams from the digester that would be diverted back to the treatment plant. The "recycle" stream would be rich in soluble phosphorous and nitrogen which may increase costs of processing.

Specific Benefits of Adding City of Ann Arbor Sewage Sludge

Discussions with the staff at the Ann Arbor WWTP identified two major benefits of processing some fraction of the incoming sludge into the digester. These include:

- Enhanced Biogas Production, and
- Reduction in disposal costs.

Enhanced Biogas Production: Based on the sewage sludge solids provided by City staff, estimates of biogas production were generated. A common range of biogas production from sewage sludge is between 12 and 17 cubic feet per pound of volatile solids destroyed. Actual biogas production is highly dependent on digester configuration, operation protocols, and actual feed stocks. It is beyond the scope of this study to determine the actual biogas production potential of the sewage sludges generated by the treatment plant. However, estimates from other digester operations can provide typical biogas production (See Table 5).

Table 5: Estimated biogas production as a function of volatile solids destroyed

Volatile Solids Reduction during Biodigestion	50% volatile Solids reduction	55% volatile solids reduction	Methane Concentration, %
	Biogas Production, ft^3/day	Biogas Production, ft^3/day	
12 ft^3/lb VS destroyed	156,403	172,043	65%
15 ft^3/lb VS destroyed	195,504	215,054	65%
17 ft^3/lb VS destroyed	221,571	243,728	65%

It is recommend as part of further study that laboratory testing be performed to determine more precise estimates of biogas production from the materials available from the WWTP.

Reduction in solids volume: As detailed above, a significant advantage of biodigestion is the reduction in the overall amount of material that has to be handled after the digestion process. Based on conservative rates of volatilization of organic solids, it is estimated the solids will be reduced from approximately 5,900 to 3,600 dry tons per year. The economic value of these biogas production and volume reduction will be detailed in the later section on Economic Modeling.

6. Bags and Bins

An underappreciated factor in biodigestion is the need to collect and store food waste before transportation to the biodigester. Typically, trash and waste is collected in plastic bags for transport to final disposal. This is a simple, reliable and robust solution, but unfortunately, bags based on petroleum feedstocks are not a sustainable solution. “Compostable” bags are made from corn starch and can break down in commercial composting operations, but are not “digestable” in a biodigester. The challenge is to find a solution for collection/storage of food waste that offers the convenience and reliability of a plastic trash bag, but fits into the flow of materials into a biodigester.

Other biodigesters have encountered the same problem, with a biodigester in Germany offering a very workable solution. Figure 15 shows the German approach that uses compostable bags to collect and transport food waste, but the bags are stripped away before digestion and routed to a composting operation.

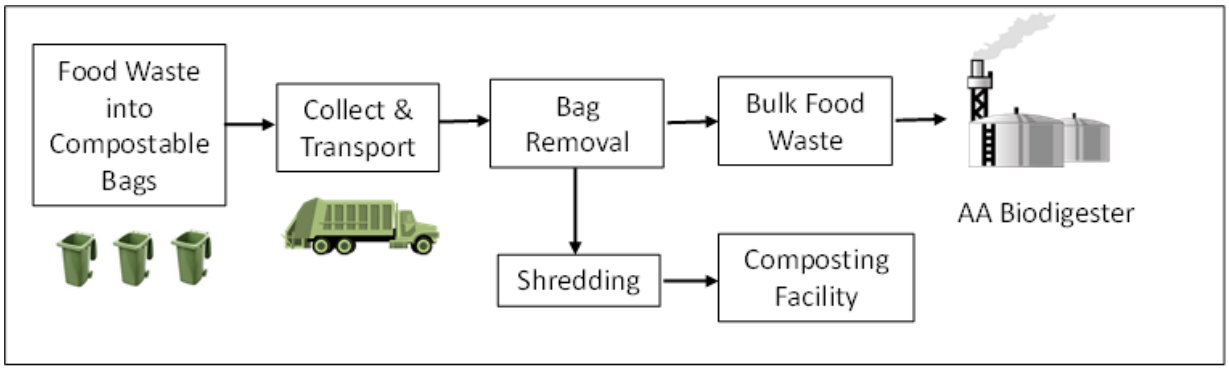


Figure 15: Use of compostable bags with a biodigester

The demands on bags for food waste are considerable. For example, restaurant workers will collect food waste in an internal container (see Figure 16) and then move it to a larger bin outside the facility. This bin will be collected once every 2-3 days, so any bag for food waste must be sturdy.

Figure 16: Rubbermaid Slim Jim is a ubiquitous trash container (23 gallon).

Using compostable bags in plastic containers makes the process of collecting food waste easier for the restaurant employees and cuts down on the smell and mess in the outside receptacles. However, to collect/store food waste, the bags must have the following characteristics:

Table 6: High Level Requirements for Food Waste Bags

Specification	Justification
Bags must be capable of containing liquids.	Food waste will be gooey and sludgy.
Bag must be able to withstand elevated temperatures.	Food waste may be warm or hot when it is disposed of.
Bags must be strong.	Food waste is dense, and may contain items that can pierce the bag and cause leakage.

Given the characteristics above, a listing of available compostable bags is shown in Table 7. All of these bags have BPI's seal for compostablility, which means that they meet ASTM 6400. Some of these are available through retail and some of them must be ordered from the manufacturer. Bags that are available for retail purchase are often more expensive than the bags that are ordered direct from the manufacturer in bulk. In addition, ordering bags from the manufacturer gives more options in regards to thickness, size, and shape.

Table 7: A sampling of compostable bags that meet ASTM 6400

Brand	Material	Thickness	Available Sizes?	How to aquire?	Price
BioBag	Derived from plant starches, compostable polymers	.88 mil	2-96 gallons	Retail or Direct	32G liner is $75.60 per case of 120 bags plus shipping
BioTuf	Ecoflex (polylactic acid, cellulose, lignin, starch, PHAs)	.88-1.2 mil	13-64 gallon	Direct or Distributor	$100 per case of 100 bags
Bag to Nature	Organic Biopolymers	Unknown	3-64 gallon	Retail or Direct	Retail price on (10) 33 gallon bags is $12.99
Xylobag	Lignin (byproduct of paper production)	.9-2.5 mil	33 or 45 gallon	Direct	$30.85 for a 25 bag roll

Food Waste Bin Requirements

The second important part of the consumer-end food waste collection system is the large receptacle sitting presumably out back behind the restaurant. This container will house the food waste after it is collected inside. This container will experience the multi-faceted weather of Michigan and also nuisance animals and insects in Ann Arbor. In addition to the environmental concerns, the containers must be user-friendly. Therefore, the following list of specifications has been developed for the food waste collection bin:

Table 8: High level requirements for food waste bins

Specification	Justification
Bin must be large enough to accommodate several days worth of food waste.	Food waste will be collected/picked up every 2-3 days.
Bin must be compact.	There is limited space in alleys behind restaurants.
Bin must be resistant to critters and insects.	Ann Arbor is host to many hungry creatures including, but not limited to, squirrels and raccoons.
Bin must contain odors.	Odors are especially challenging in summer.
One person must be able to put food waste bag into the bin.	A single restaurant employee will typically carry a bag of food waste outside to the bin.
Bin should be able to be cleaned easily.	Food waste may leak from the bags into the bin.

Few food waste bins on the market meet the specifications in Table 8 because food waste collection is a fairly immature movement. Some food waste collection systems use traditional dumpsters to collect food waste, just like the residential recycling bins of Ann Arbor, but colored green.

Commercial Food Waste Bins

A good example of a collection bin targeted to the food waste market is made by Taylor International, a UK-based company that designs metal rubbish and recycling containers.

The Taylor Food Waste Bin (see image below) is made of welded steel and has a 500-liter (about 130-gallon) capacity. It has a plastic lid with a lock that can be opened with a foot-pedal. It can be coated with acid resistant coating on the inside and painted on the outside. An ID chip can also be included in a Taylor Food Waste Bin. The Taylor Food Waste Bin costs about $780 US dollars plus freight costs. This is the price for up to 150 bins.

Figure 17: Taylor Food waste bin is targeted to the growing food-waste collection market.

The lock on the Taylor Food Waste Bin makes the opening resistant to critters, while the solid steel sides keeps them chewing in from the outside. Not only does the lock keep out critters, it also keeps out passersby who may try to put their trash in the bin behind a restaurant. The lid lock and side materials also help contain the odor. The foot pedal makes it easy for one person to easily put food waste into the bin. In addition, the top of the bin is at about waste height, so bags of food waste are easily lifted up and over the top lip. Because of the shallow depth, the bin is also easily cleaned. Traditional waste bins are deep, which may make them more difficult to clean.

7. Cost Model

To assess the magnitude of the financial benefit of a biodigester over time, our team developed several computer models to describe the financial viability of the biodigester over the short-term and the long term. These models were based on financial modeling tools used by our teammate Swedish Biogas to develop accurate bids for digester construction and operation of biogas plants in the US and Europe. The models were populated with data from several key sources:

- Data on available food waste
- Information from the Ann Arbor Wastewater Treatment Plant
- Existing disposal costs for solid waste (from the City of Ann Arbor) and
- Current financial terms available in the public and the private credit markets.
- Experience from actual digester operations in the US and Europe

For this Feasibility Study, several scenarios were modeled, varying key parameters such as:

- Available feedstocks (type and quantity),
- Financial terms (rates, terms), and
- Capital costs (including maintenance and operations costs.)

The ability to compare multiple scenarios can offer the City valuable insight to the potential pros and cons of digester facility over the life span of the project.

Modeling Assumptions

Location

Based on discussions with City staff, it was decided that for the purposes of modeling digester financial performance that the facility would be installed Near the Materials Recovery Facility on the south side of Ann Arbor (4150 Platt Road, Ann Arbor). While the scope of this Study did not require a Site Assessment, it was logical to select an existing location owned by the City of Ann Arbor. A specific location was also needed in order to calculate the logistics (travel time, mileage, and traffic patterns) of hauling sludge to the site from Ann Arbor WWTP on Old Dixboro Road.

Locating a biodigester near the Material Transfer Station offers a number of advantages:

- Available space for construction and operations,
- Close vicinity to the City's current compost site,
- Existing zoning for industrial use, and
- Adequate ingress and egress for waste hauling vehicles.
- •Supplement existing biogas generator as landfill to maintain full electrical production

Feedstock Loading

As part of the modeling effort, recipes for the biodigestion process were developed based on available feedstocks in the Ann Arbor area identified during the course of this Feasibility Study (See the Background Section for details.) Feedstocks included:

- Food waste from commercial businesses within the City of Ann Arbor. Food waste from the University of Michigan was also included.
- FOG from local grease-trap hauling companies
- Milk waste from local dairies ("Dairy Waste")
- Food waste or residues from food processing facilities ("Sugar Water")
- Primary and Thickened Waste Activated Sludge from the Ann Arbor WWTP

The quantity of each feedstock was based on two criteria:

1) Data from this Feasibility Study, which was then correlated with other feasibility studies/reports from similarly sized cities in the US.
2) Experience of Swedish Biogas in the Midwest region of the US; specifically, the amount of FOG, Dairy Waste and Sugar Waste is typical for the materials delivered on a regular basis a similarly sized biodigester in Southeast Michigan.

Discussions with City staff indicated that the inclusion of WWTP sludge was logical due to Ann Arbor's unique constraints on the existing Ann Arbor WWTP facility. As noted earlier, sludge is easily digestible and is a prime candidate as a buffer feedstock for the digester facility. Moreover, processing of sludge will offer the City cost savings because the digester will convert a significant portion of the sludge to biogas.

Parameters to Vary in the Model

A number of key parameters were varied in during the modeling process. These include:

Fraction of WWTP Sludge, (50% vs 100%)

Two different fractions of WWTP Sludge were considered:

1) The biodigester will accept 50% of the available sludge from the Ann Arbor WWTP.
2) The biodigester will accept 100% of the available sludge.

The non-sludge feedstock quantities remained constant for each scenario, however, the relative fraction of each non-sludge feedstock changed for each scenario.
Details on the two fractions are shown in Figure 18 and Figure 19.

Feedstock	Fraction of total	Vin [gpd]	Comment
Food Waste	11%	4329	Commercial businesses in Ann Arbor and University of Michigan
FOG	3%	1000	Sourced by FOG hauling companies
Dairy Waste	5%	2000	Available from local dairy
Sugar Water	3%	1000	Available from local food processor
WWTP Sludge	79%	30660	Transported to Biodigester from AA WWTP

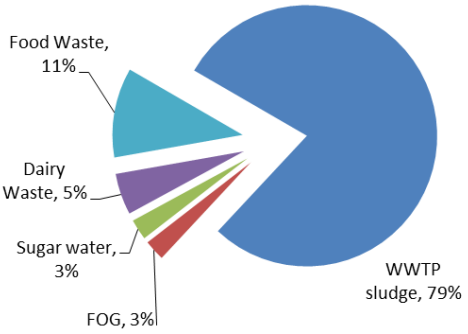


Figure 18: Feedstock menu using 50% of the available WWTP sludge

Feedstock	Fraction of total	Vin [gpd]	Comment
Food Waste	6.2%	4329	Commercial businesses in Ann Arbor and University of Michigan
FOG	1.4%	1000	Sourced by FOG hauling companies
Dairy Waste	2.9%	2000	Available from local dairy
Sugar Water	1.4%	1000	Available from local food processor
WWTP Sludge	88%	61320	Transported to Biodigester from AA WWTP

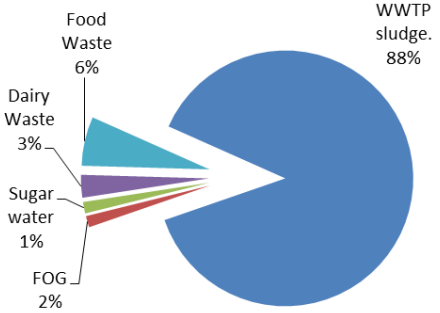


Figure 19: Feedstock menu using 100% of the available WWTP sludge

Facility Ownership - Public vs. Private

A key impact on the feasibility of any waste-to-energy facility is the funding source.

- Funding from private sources demand a shorter time period for the return on the investment, a higher carry cost of the capital, a higher discount rate, and a margin for profit.
- Publicly-financed facilities typically have a longer investment term, lower interest rates, and a lower discount rate.

Modeling was performed for both private and public ownership and funding. A public-private partnership was not included in the modeling but should be further investigated by the City. Table 9 shows the financial terms used in the computer model for public[x] and private[xi] investments.

Table 9: Financial assumptions for public and private financing of the project

	Investment Term	Interest Rate	Discount Rate	Payback
Public Financing	20 years	3.5%	2.1%	<10 years
Private Financing	10 years	12%	10%	< 5 years

Revenue from Electrical Generation, 5.5¢/kWh vs 9¢/kWh

Biogas produced from the digester is generally used as an energy source in three ways:

- Thermal power (i.e. heat generation in boilers), or
- Conditioned to be used as a natural gas replacement, known as biomethane[xii], or
- Electrical generation using a biogas powered electrical gen-set,

[x] The City of Ann Arbor (AA+ rating) is currently issuing tax exempt debt with the same terms as the US Treasury. We have assumed that public financing term and interest rate will match the US T-bill rate. See http://www.bloomberg.com/markets/rates-bonds/government-bonds/us/

[xi] Terms for private financing of biodigesters were determined via discussions with personnel at DTE Energy Trading (a non-regulated part of DTE Energy). Private investors typically seek shorter investment terms, shorter paybacks and a strong interest rate. The discount rate for renewable energy projects is estimated to be between 10% and 15%.

[xii] Biomethane can be injected into the natural gas utility grid or used as a cleaning burning vehicle fuel.

***Thermal Energy*:** Extracting thermal energy from biogas is a viable approach; however, this is typically best done when a thermally intensive industrial process is located near the biodigester. This is not the case near the Materials Transfer Station, so biogas-for-heat was not considered.

Biomethane: Because of the lack of governmental policy for clean fuels in Michigan, the cost of biogas conditioning equipment, and the relatively low cost of natural gas, converting biogas to biomethane currently cannot economically compete against using biogas to generate electricity. Therefore, biomethane was not considered.

Electrical Generation: Electricity generated by biogas can be used in two ways:

1) Consumed on-site to meet existing electrical demand by City facilities.
2) Sold back to the grid via a Net-metering arrangement with Detroit Edison

The economic models for this Study assumed revenue from electrical generation.

Self-Consumption: City staff has indicated that cost of electricity purchased from Detroit Edison (local utility) at the Wheeler site is approximately 9¢/kWh. Additional information from the City shows that the average electrical consumption at that site is in the range of 170 to 190 kW. This level of power production is well within the range of gensets currently available for biodigesters. It is not clear if the City could take full advantage of the 9¢/kWh for the electrical generation at the digester because of the lack of overall power consumption at the Wheeler site (net meeting). It is recommended that further investigation be performed to determine the actual rate that could be gained through the local utility.

Net-metering: It is understood that Landfill Energy Systems (operator of electrical generation system at the Ann Arbor Landfill) is paid approximately for the electricity generated from biogas collected at the City's landfill. While net-metering program revenue can change over time, it is safe to assume that 5.5¢/kWh is a realistic payment for biogas generated electricity.

Important Note: Although electrical generation from the Ann Arbor Biodigester would be eligible for renewable energy credits (RECs), the economic models did not account for them since RECs are not generally not available for sale in the State of Michigan. In addition, the models did not account for the sale of carbon credits. While some estimates put the available value of Carbon Credits at $6-7 per MtCO2e, these markets remain immature. Future economic models can include REC and Carbon Credit revenue if the market improves

Capital Expenses based on WWTP Sludge Fraction (50% vs 100%)

Capital costs for the Biodigester will also vary as a function of the amount of WWTP sludge accepted. For the model, the capital cost estimates were based on Swedish Biogas's past experience of design, building and installing digestion facilities both here in the United States and Sweden. Major differences in the capital expense between the models using 50% and 100% sewage were the size of the digester and electrical generation system. Power production for the 50% sludge-fraction case is assumed to be a 400 kW biogas-powered genset operating with 95% on-time. A 600 kW genset is assumed for the 100% sludge fraction case. Capital cost estimates for the two cases are shown in Table 10.

Table 10: Capital cost rollup for 50% and 100% sludge models

Order of Magnitude Estimation of Capital Expense 100% use of Available Sewage Sludge	
Description	Amount
Receiving Station	$223,000
Digester	$1,518,000
Dewatering	$552,300
Cogeneration (CHP) System	$954,500
Building	$525,000
Site Civil	$367,000
subtotal	$ 4,139,800
Contingency (25%)	$ 1,034,950
Design Engineering and Construction Management (8%)	$413,980
Project Management (3%)	$155,243
GC OH&P (7.5%)	$388,106
Total Estimated Construction Costs	**$ 6,132,079**

Order of Magnitude Estimation of Capital Expense 50% use of Available Sewage Sludge	
Description	Amount
Receiving Station	$223,000
Digester	$1,116,683
Dewatering	$452,300
Cogeneration (CHP) System	$704,500
Building	$525,000
Site Civil	$367,000
subtotal	$3,388,483
Contingency (25%)	$847,121
Design Engineering and Construction Management (8%)	$338,848
Project Management (3%)	$94,878
GC OH&P (7.5%)	$317,670
Total Estimated Construction Costs	**$ 4,987,000**

Important Note: It should be noted that conversations with waste water treatment plant management staff yield concerns on the practicality of the 50/100% diversion of sewage sludge. A main concern was the potential to have untreated sludge being left in supply pipelines at the plant and being co-mingled with treated sludge. If this were to happen, it would potentially cause an issue with Michigan DEQ biosolids regulations compliance. Staff did believe that it was an issue that would need further attention but did create an overarching obstacle that could not be overcome through amendments to operating protocol or additional infrastructure. It is recommended that this issue be included for further study if the City should decide to perform a higher level of analysis.

Model Inputs: Revenues and Expenses

The economic model incorporated a set of revenues and expenses for the on-going operation of the biodigester.

Revenue is generated in a variety of ways:

- Cost savings developed as part of the reduction of material inherent in the biodigestion process
- Monies generated from the receipt of tipping fees and
- Production and sale of electricity.

Expense values were developed from various sources that utilized historical data from actual digester capital and operating costs, current consumable material costs, and conservative labor expenses.

Revenues from External Waste Tip Fees

One of the critical ways that the biodigester remains viable is to earn tipping fees by accepting waste organic materials. For all versions of this analysis, the model assumed the following tipping fees:

FOG: $0.10/gallon, delivered to the biodigester via FOG haulers

Sugar water: $0.06/gallon delivered to the biodigester from food processor

Dairy Waste: $0.05/gallon, delivered to the biodigester from local dairy

A roll-up for the tipping fee revenues is shown in Table 11 and Table 12 for 50% sludge and 100% sludge, respectively.

Table 11: Tipping Fee Revenue when accepting 50% of WWTP sludge

Model, 50% WWTP Sludge	Total daily volume of substrate (gpd)	Total weekly volume (gal)	total yearly volume of substrates (gal)	tip fee per gallon of feedstock	Yearly tip Fee Revenue
WWTP sludge	30,000	214,623	10,950,000	$0.05	$528,950
FOG	1,000	7,000	365,000	$0.10	$36,500
Sugar water	1,000	7,000	365,000	$0.06	$21,900
Dairy Waste	2,000	14,000	730,000	$0.05	$36,500
Food Waste	4,300	30,100	1,569,500	$0.07	$113,000
Net	**38,989**	**272,723**	**13,979,500**		**$736,850**

Table 12: Tipping Fee Revenue when accepting 100% of WWTP sludge

Model, 100% WWTP Sludge	Total daily volume of substrate (gpd)	Total weekly volume (gal)	total yearly volume of substrates (gal)	Tip Fee per gallon of feedstock	Yearly tip Fee Revenue
WWTP sludge	60,000	429,246	21,900,000	$0.05	$1,057,900
FOG	1,000	7,000	365,000	$0.10	$36,500
Sugar water	1,000	7,000	365,000	$0.06	$21,900
Dairy Waste	2,000	14,000	730,000	$0.05	$36,500
Food Waste	4,300	30,100	1,569,500	$0.07	$113,000
Net	**68,300**	**487,346**	**24,929,500**		**$1,265,800**

Revenues from Waste Water Treatment Plant Sludge

One of the major advantages of the proposed model is that the Ann Arbor WWTP will see substantially decreased disposal costs if sludge is processed in the biodigester. Table 13 uses data obtained from the City staff at the AA WWTP to compare the current costs of processing sludge with the cost of diverting sludge to the biodigester. Table 13 assumes that 100% of the available sewage sludge is used as a feed stock for the digester facility.

For profitability calculations, the model considers the current WWTP operating cost as an avoided cost, and coverts this to a revenue input for the biodigester project. Specifically, $1,057,000 is considered revenue, and $573,700 is allocated as an expense to the biodigester, leaving a net gain of $483,300 annually by processing sludge at the biodigeser.

Table 13: Comparison of Annual Sludge Processing Costs

Cost Comparison for WWTP sludge processing for using landfill, land application, or anaerobic digestion [annual $]				
Description	Current WWTP Process		Proposed Process	Notes
	Landfill	Land Application	Biodigestion	
Dewatering	$186,600	$0	$107,000	Polymer purchases 7/1/2013-6/30/2014
Dewatering Equipment O&M	$35,000	$0	$25,000	Includes electricity and maintenance
Hauling to site	$214,000	$416,700	$212,000	From WWTP to Digester
Tip fee			$209,000	To compost site
Lime for Class B biosolids and odor control	$46,100	$125,000	$0	No lime required post-digestion
Michigan DEQ Biosolids	0	$34,500	$20,700	
Totals	$481,700	$576,200	$573,700	
Grand Total	**$1,057,900**		**$573,700**	
	Processing Costs for WWTP		**Processing Costs for BioDigester**	
Net Revenue Gain from Biodigestion	**$473,300**			

It should be noted that the City staff at the Ann Arbor WWTP were well versed on the potential cost savings via anaerobic digestion. However, the unique landlocked nature of the Ann Arbor WWTP facility on the Old Dixboro Road cannot accommodate this alternative approach, specifically tankage. For this reason, they were open to exploring alternative solutions.

Operating Expenses

Operational costs have been included in each version of the model and are shown in Table 14. Note that the costs associated with the recycle streams from dewatering digestate (and ultimately sent back to the City's waste water treatment plant) were not included in the models as an operational expense. It was assumed that because the majority of any recycle streams sent to the treatment plant would be produced as a result of digesting sewage sludge, a fee to the digester operation would not be assessed.

Table 14: Operational Expenses used in the Economic Model

Annual Operating Costs	
Description	Amount
Labor (operations, maintenance, admin, management)	$275,000
Raw Materials and Consumables (electricity, dewatering polymer, equipment parts, etc.)	$306,000
Internal Charges (sludge transfer to digester, lab testing, central cost allocation, etc.)	$313,000
External Charges (compost tip fees, external maintenance services, state biosolids fees)	$274,000
Long Term Equipment Replacement	$25,000
Total	$1,193,000

Modeling Approach

Figure 20 shows the step-wise approach taken to assessing the economic viability of the proposed Ann Arbor Biodigester.

1. The first step compared the Project Profitability using either 100% of the available sludge from the Ann Arbor WWTP (**Case 1a**), or 50% of the sludge (**Case 1b**).
2. The second step compared Project Profitability using public or private financing**, Case 2a** and **Case 2b**, respectively. The terms for public vs private are shown in Figure 8.
3. Finally, the model compared the Project Profitability using the revenue from two different electrical rates:
    - **Case 3**: An electric Rate of 9 ¢/kWh, which is the current rate paid at the Materials Recovery Facility, and
    - **Case 4**: An electric Rate of 5.5 ¢/kWh, which is approximately the rate paid by DTE Energy under a typical Net-metering arrangement.

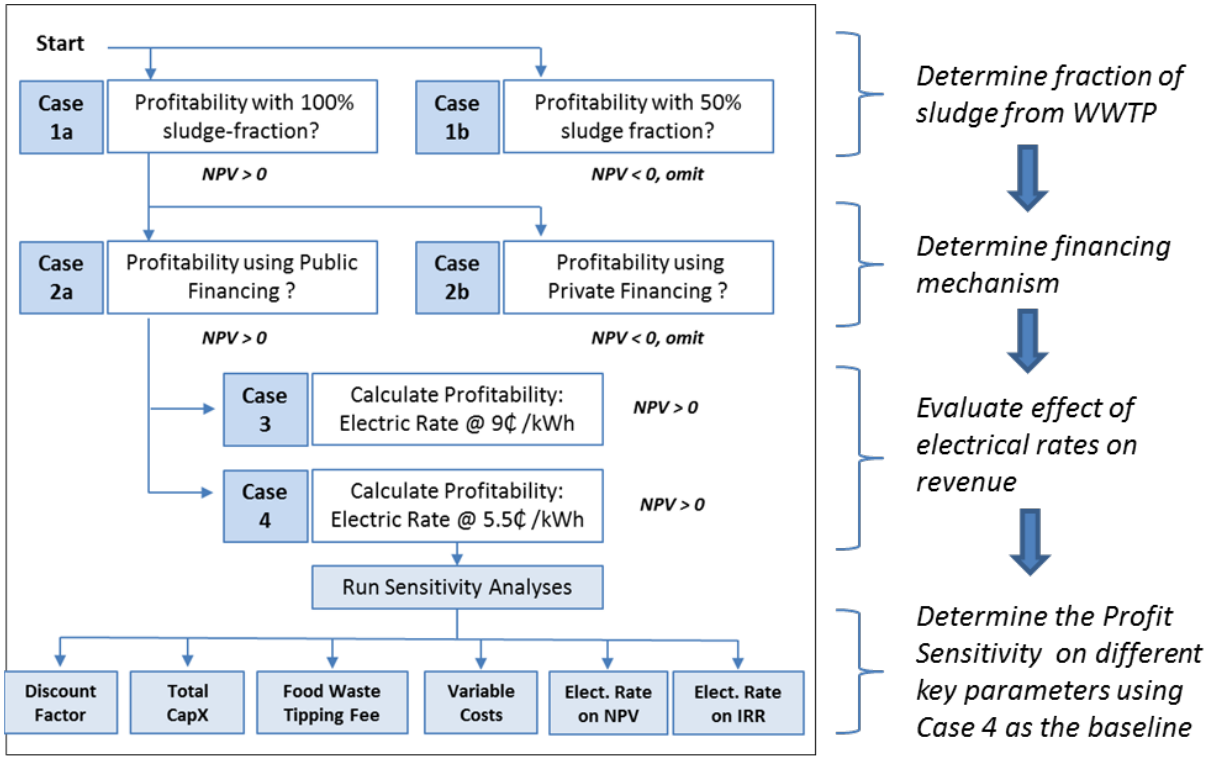


Figure 20: Modeling Flowchart

Model Results

Modeling **Case 1a** and **Case 1b** showed that only **Case 1a** (processing 100% of the sewage sludge) provided a favorable return of investment. For this reason, the balance of the modeling omitted the 50% sludge treatment option since the NPV was negative.

Comparing **Case 2a** and **Case 2b**, the model showed that only **Case 2a** (public financing) would provide financial viability. Project profitability was negative for private financing terms.

The results for **Case 3** and **Case 4** are shown in **Error! Reference source not found.**. Both cases have a positive NPV, with **Case 3** obviously earning more due to a more generous electrical rate. However, to assure that the modeling was not over optimistic, all subsequent modeling used Public financing with 5.5¢/kWh earned from electrical sales.

Important Note: Both **Case 3** and **Case 4** assumed the use of 100% of the available sludge fraction and the use of public financing for the bidigester project.
A graphical view of the project profitability is shown in Figure 21. Note that for all subsequent sensitivity analyses, the baseline is **Case 4**, using 100% sludge, public financing and 5.5 ¢/kWh for electrical revenue.

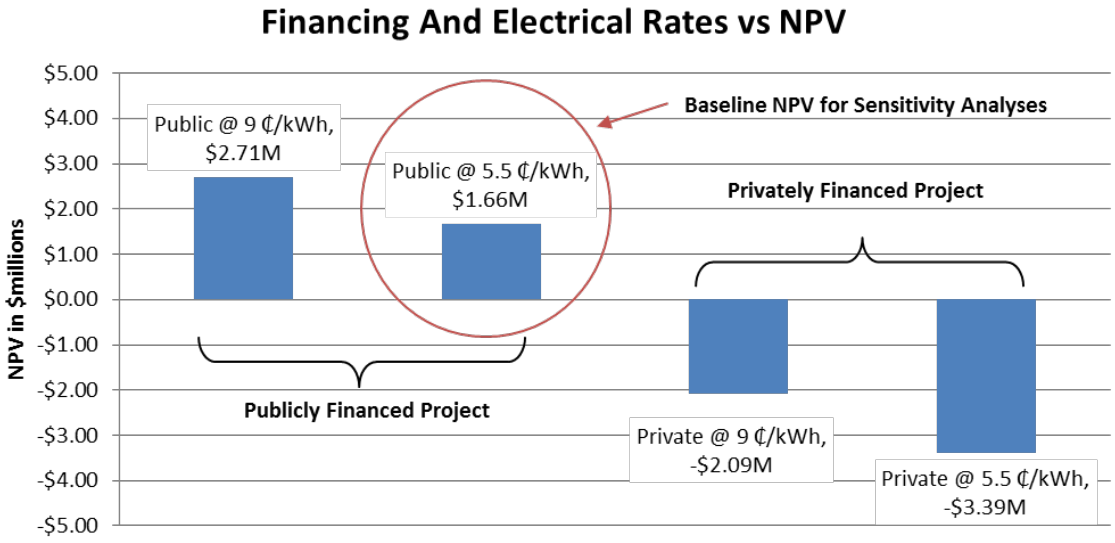


Figure 21: NPV vs Financing Method

Table 15: Model results for Cases 3 and 4

Case #	Type of financing	Fraction of sludge	Cost of Electricity ¢/kWh	Discount Rate, %	Cost of Money %	Term, years	Return on Investment, %	Internal Rate of Return, %	NPV
3	Public	100%	9 ¢/kWh	2.1%	3.5%	10	13.5%	6.06%	$2,705,235
4			5.5 ¢/kWh				15.6%	4.58%	$1,658,744

Financial Impact of Filtrate Disposal

One variable in the financial model required more in-depth analysis: namely, the potential cost of "dewatering" the material in the digester before final disposal (composting, landfilling or incineration.) Dewatering involves removing the excess water in the digestate using a filter

press in order to separate the liquids and solids in the digested material. After dewatering, two components remain:

1. A cake-like (low moisture) solid material and
2. A nutrient rich, watery material called "filtrate".

The models for Case 3 and Case 4 assumed that the filtrate would be returned to the City's wastewater treatment plant through the sanitary sewer system. Since the raw sludge feedstock had already been paid for upon entering the WWTP via standard user fees, no cost was assigned to the material being sent to Ann Arbor WWTP. (The volume of filtrate generated at the biodigester from sewage sludge nearly the same as the treatment plant sees today.) It should be noted that the existing operations at the WWTP also create a filtrate stream through thickening and dewatering sewage sludge prior to its application to agricultural lands or landfilling.

City staff have indicated that inter-departmental budgeting at the City may not allow the transfer of filtrate between the biodigester to the WWTP at no cost. Therefore, two variations of Case 4 model were developed:

> ***Case 4b:*** In this variation, the biodigester would be charged by the Ann Arbor WWTP for accepting the filtrate from the non-sludge fraction of the feedstocks. The logic behind Case 4b is that the filtrate from the sludge had previously been accepted under a fee-basis at the head of the WWTP, but the other feedstocks had not been paid for. As Figure 19 shows, the fraction of non-sludge feedstock is approximately 12% of the total material.
>
> ***Case 4c:*** This variation modeled the biodigester paying the WWTP for the filtrate from all feedstocks (including sludge).

In both cases, the charge for filtrate accepted at the WWTP was $3.65/ccf.

Table 16: Financial impact of paying for filtrate sent to the Ann Arbor WWTP

Model Parameters:	Case	Case Variations	Internal Rate of Return, %	NPV
• Fraction of AA WWTP Sludge = 100% • Cost of Electricity, 5.5 ¢/kWh • Interest Rate = 3.5% for 10 years • Discount Rate = 2.1 %	4	Baseline Case 4, no payment for filtrate returned to WWTP	4.58%	$1,658,744
	4b	Pay WWTP for filtrate from all non-sludge feedstocks	4.29%	$1,450,888
	4c	Pay WWTP for filtrate from all feedstocks (incl. sludge)	1.95%	$-94,259

The results of Case 4, Case 4b and Case 4c are shown in Table 16. The financial performance of Case 4b is only slightly worse than Case 4a, but still profitable. Case 4c is not profitable (NPV<0).

Technical Note on Filtrate: The nutrient loading from the filtrate placed on the WWTP will be somewhat different than the filtrate from sludge. A biodigester converts proteins in the feedstock into available ammonium, and also transforms phosphorous into its soluble format (orthophosphate). Both of these nutrients may cause additional attention and treatment at the wastewater treatment plant; however, given the relatively small volume of filtrate in Case 4b, hydraulic and nutrient loading is not expected to negatively impact the wastewater treatment plant. City staff at the Ann Arbor WWTP can readily determine this impact.

As an alternative, the filtrate could be collected from the dewatering process, stored and land applied as a liquid fertilizer. In order to use land application as an alternative to composting, the biodigester would need to be configured to provide storage or alternative disposal methods (composting and or landfilling) during times of the year that land application is not permitted. Utilizing land application as a disposal alternative would increase the capital expense of the project by approximately $950,000 for an installation of a storage tank and a thickener.

It is recommended that further evaluation of filtrate disposal and or reuse be conducted as part of any future biodigester feasibility study.

Sensitivity Analyses

To determine the impact of specific parameters on the results of the model, a number of sensitivity analyses were calculated for the public financing with 5.5¢/kWh electrical sales. Selected variables include:

Sensitivity to Discount Factor

Table 17 shows the sensitivity of Case 4 to the Discount Factor. The baseline Discount Factor (Public Case) was selected to be 2.1%, which is typical for a project financed with tax-exempt bonds. Note that if the Discount Factor rises to 2.52%, the Net Present Value for the project will decrease by nearly 20%.

Discount factor's impact on profitability

Discount factor	1.68 %	1.89 %	2.10 %	2.31 %	2.52 %
Change, %	-20.0 %	-10.0 %	0.0 %	+10.0 %	+20.0 %
Net Present Value (NPV)	2,001,277	1,827,429	1,658,744	1,495,042	1,336,150
Change, %	+20.7 %	+10.2 %	0.0 %	-9.9 %	-19.4 %

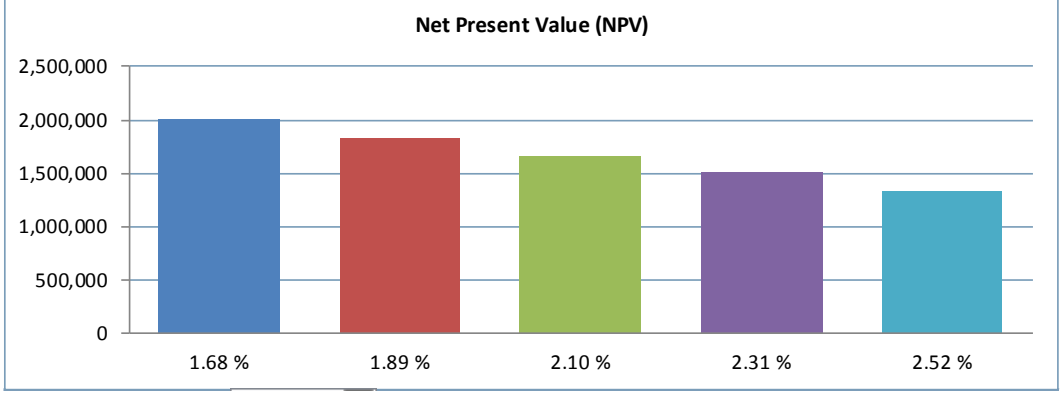


Table 17: Sensitivity to Discount Factor

Sensitivity to Total Investment

The total capital investment for Case 4 is calculated to be $6,132,079. The following chart shows the effect on Net Present Value of changing the capital investment by +/- 20%. The effect on profitability is significant, with a decrease of over 70% in the NPV if the cost increases by 20%

Total investment's impact on profitability

Total investment, USD	-4,905,663	-5,518,871	-6,132,079	-6,745,287	-7,358,495
Change, %	-20.0 %	-10.0 %	0.0 %	+10.0 %	+20.0 %
Net Present Value (NPV)	2,885,159	2,271,952	1,658,744	1,045,536	432,328
Change, %	+73.9 %	+37.0 %	0.0 %	-37.0 %	-73.9 %

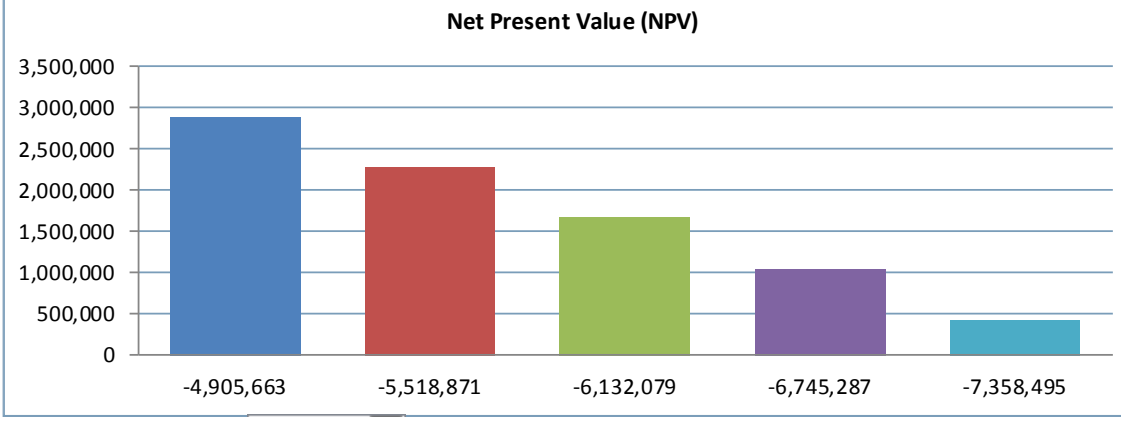


Table 18: Sensitivity to total capital costs

Sensitivity to changes in the Food Waste Tipping Fee

The tipping fee for the food waste delivered to the biodigester is assumed to be $21.80/ton. This is a 15% discount from the current transfer and disposal costs for City trash of $25.87/ton.

Income variable´s impact on profitability

Variable	External Substrate - Food Waste Tip Fee, $/ton				
Change in value, %	-20.0 %	-10.0 %	0.0 %	+10.0 %	+20.0 %
Sample value 12/2016	17.5	19.6	21.8	24.0	26.2
Net Present Value (NPV)	1,291,240	1,474,992	1,658,744	1,842,495	2,026,247
Change, %	-22.2 %	-11.1 %	0.0 %	+11.1 %	+22.2 %

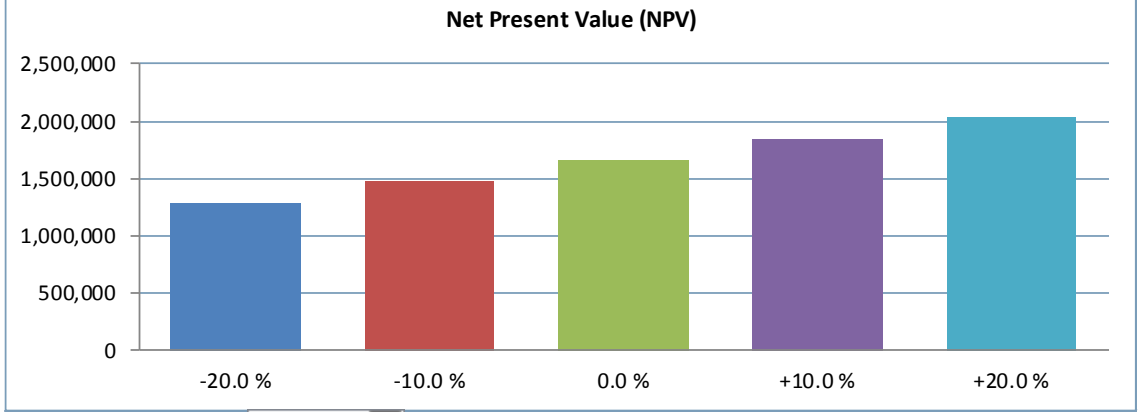


Table 19: Sensitivity to increases in Food Waste Tipping Fees

Discussions with City staff indicate that the current T&D costs escalate at 2.3% per year, and are likely to increase substantially when the current disposal contact expires in 2017. For this reason, the Sensitivity Analysis in Table 19 is particularly valuable.

Note that the food waste tipping fee is earned by the biodigester, not the landfill, and is therefore considered revenue in this model. As landfill rates escalate, so does the implicit value of the food waste increase to the biodigester's finances. An increase in 20% in landfill rates yields an increase in NPV of over 22%.

Sensitivity to Variable Costs

The effect of changes in the variable costs for the system is also substantial. Varible charges can come from two main areas: Raw Materials/Consumables used on a daily basis in the plant, and External Charges for items outside the plant. The model assumes that these costs escalate at the rate of inflation for the term of the model (nominally 2% annually.)

Variable Charges			
Raw materials and consumables		**External Charges**	
Dewatering Polymer	Equipment O&M	Trucking Fee for WWTP sludge	Building Maintenance (water, heat, repairs)
Electricity, kWh/yr	CHP maintenance	Lab Testing, $/year	City Central Cost Allocation
Electrical Rate	Gas Cleaning Costs	Centrate disposal fee	External Maintenance
Plant Electricity	Replacement of Long Term Equipment	State Biosolids Fee	

Table 20: Variable Costs in the Model

As Table 21 shows, the NPV is highly sensitive to changes in variable cost, where a 20% increase in total variable costs results in the NPV becoming negative (i.e. not economically viable.)

Variable cost's impact on profitability

Change in Variable costs, %	-20.0 %	-10.0 %	0.0 %	+10.0 %	+20.0 %
Net Present Value (NPV)	4,992,950	3,325,847	1,658,744	-8,360	-1,675,463
Change, %	+201.0 %	+100.5 %	0.0 %	-100.5 %	-201.0 %

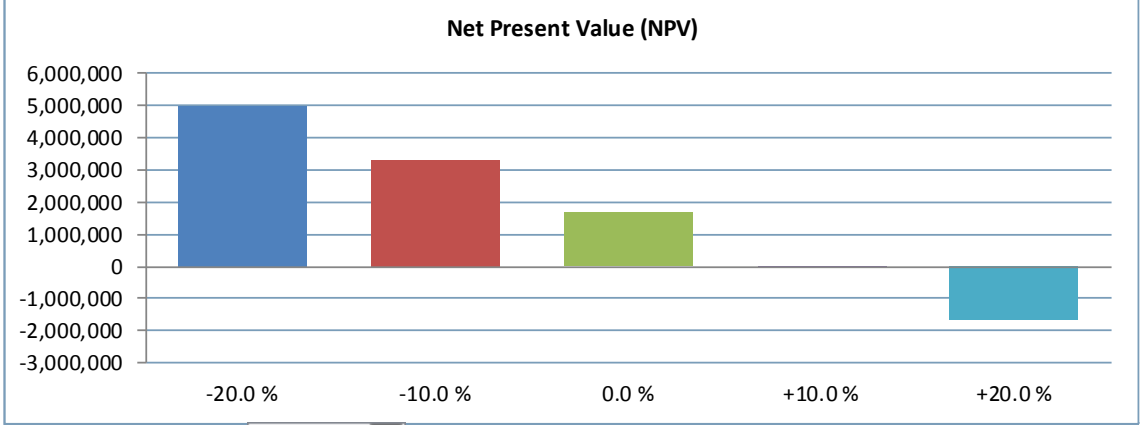


Table 21: Sensitivity to Variable Cost

Sensitivity of NPV and IRR on changes in electrical rate

The effect of earning more or less revenue from electrical generation is shown in Table 22 and Table 23. Table 22 shows the sensitivity of NPV on the electrical revenue, where $274,626 is the amount earned at 5.5¢/kWh.

Income variable´s impact on profitability

Variable	Electrical Revenue				
Change in value, %	**-20.0 %**	**-10.0 %**	**0.0 %**	**+10.0 %**	**+20.0 %**
Sample value 12/2016	219,700.8	247,163.4	274,626.0	302,088.6	329,551.2
Net Present Value (NPV)	541,833	1,100,288	1,658,744	2,217,199	2,775,654
Change, %	-67.3 %	-33.7 %	0.0 %	+33.7 %	+67.3 %

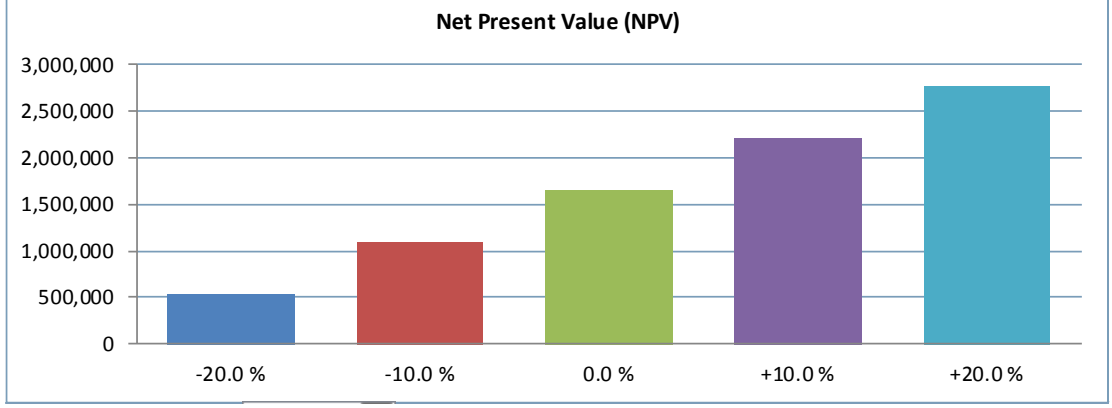


Table 22: Sensitivity to changes in Electrical Revenue

The sensitivity of the Internal Rate of Return is shown in Table 23.

Income variable´s impact on profitability

Variable	Electrical Rate, $/kWh				
Change in value, %	**-20.0 %**	**-10.0 %**	**0.0 %**	**+10.0 %**	**+20.0 %**
Sample value 12/2016	0.044	0.050	0.055	0.061	0.066
Internal Rate of Return (IRR)	3.1%	3.9%	4.6%	5.3%	6.0%
Change, %	-32.4 %	-15.9 %	0.0 %	+15.3 %	+30.0 %

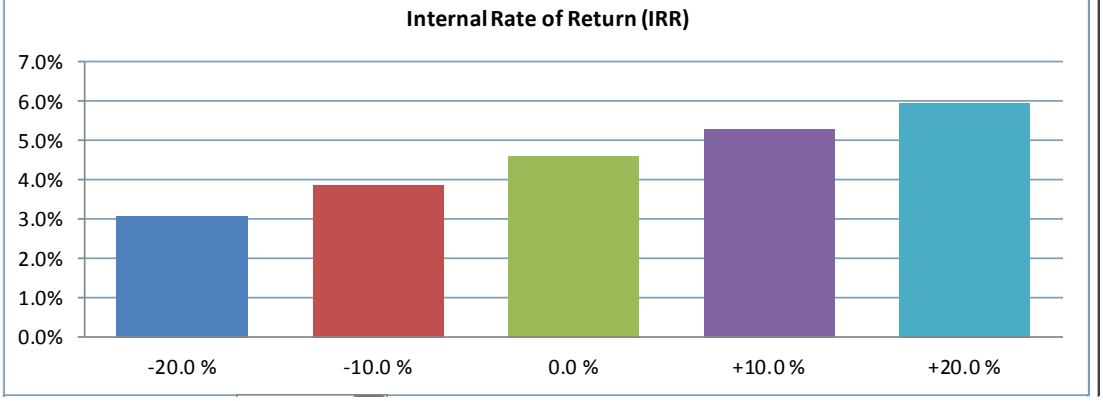


Table 23: Sensitivity of the system IRR to changes in electrical rate (Netmetering)

The Sensitivity Analyses on electrical revenue and rates show that the project has a high sensitivity to the revenue earned by electrical production. An increase in electrical revenue to nearly $330k will increase the system's profitability by over 67% Even a modest increase in electrical rates to 6.6¢/kWh will increase the project's IRR by 30%.

Conclusions: Economic Model

In general, the economic viability of the proposed Ann Arbor Biodigester relies on three critical factors. These are:

1) The availability of an adequate volume of WWTP sludge to achieve a sufficient economy-of-scale. Revenues to the biodigester come from the avoided costs of landfilling or land application of sludge, plus the elimination of expenses for lime, polymer and other required materials if treated sludge is land applied or landfilled.

2) The availability of public money to finance the project. With an estimated capital cost of over $6M, the cost of debt between public and private sources is substantial. Luckily, Ann Arbor has an excellent credit rating (AA+) and can borrow funds on the tax-exempt market at extremely good rates. (See Table 9.)

3) The availability of food waste and other organics to increase biogas production. As the sensitivity analysis on electrical revenue and rates showed (Table 22 and Table 23), the project's profitability has a moderately high sensitivity to revenue from electrical generation. This means that the more food waste/FOG/dairy waste, the better. These feedstocks have much higher biogas production potential than WWTP sludge, so additional quantities have a disproportionally positive impact on project revenue.

If these three factors can be met, then it is recommended that the City of Ann Arbor invest in the development of a biodigester system. The economic modeling in this Study shows that the City will benefit from a profitable waste-to-energy system, assuming the correct feedstock mix.

8. Sustainability Benefits of a Biodigester.

In 2011, Ann Arbor developed a Sustainability Framework project started in January 2011 with the goal of creating one unified vision of sustainability for the city. The Sustainability Framework includes 16 high level sustainability goals[xiii]. The following compliance matrix identifies how a biodigester can work to meet specific goals in the framework

[xiii] http://www.a2gov.org/sustainability/Documents/Ann%20Arbor%20Sustainability%20Framework%20051313.pdf

Framework Goal	Biodigester Feature	Comment
Sustainable Energy –Increase the use of renewable energy.	Biogas Production for heat, or to generate electricity in a gen-set. Biogas is a byproduct of material decomposition	Using biogas also destroys the methane in biogas. Methane is a powerful greenhouse gas.
Clean Air and Water - Eliminate pollutants in our air and water systems	The liquid fraction of the digested material is essentially pathogen-free after digestion.	Digesters are sealed, eliminating leakage of leachate into the groundwater under landfills.
Sustainable Systems - Plan for and manage constructed and natural infrastructure systems to meet the current and future needs of our community	The digested solids from biodigesters convert complex food waste material into readily accessible soil nutrients. Water can be used as a liquid fertilizer.	Digestion and composting are part of a continuous cycle of returning nutrients and water back to the environment.
Responsible Resource Use - Produce zero waste and optimize the use and reuse of resources in our community	.Biodigestion reduces the volume of material by as much as 40%. Digested solids can be used as a soil amendment.	Diversion of food waste is part of a larger strategy to put all waste products to beneficial use. Ultimately, zero waste goals can be achieved

Table 24: Sustainability benefits of biodigestion

The 2013 Solid Waste Resource Plan[xiv] contains a detailed list of key actions to execute to meet the 16 goals in the Sustainability Framework. One of the Key Actions under ***Responsible Resource Use*** called for the following:

> *"Research options to collect and process all food waste produced within the city, including but not limited to biodigesters. Include a review of options to potentially manage diapers and pet waste. Conduct a feasibility study of the ability of the City's compost facility, operated by WeCare Organics, to handle full-scale food waste composting. Complete feasibility study by January 2014. "*

The RFP 889 issued by the City of Ann Arbor in February of 2014 was focused on the use of a biodigester to process food waste, and this Feasibility Study by Quantalux is the resulting document. Previous work by our firm has researched the processing diapers and pet waste, and has concluded that both items are unsuitable for biodigesters:

> ***Diapers:*** Disposable diapers contain a range of materials, including plastic sheeting to prevent fluids from leaking. While biodigesters can safely process human waste, the plastic sheeting and plastic absorbent material is currently non-biodegradable, and will foul both

[xiv] http://www.a2gov.org/Documents/A2_WasteLessFive-YearPlan_APPENDIX_10-7-13.pdf

compost systems and biodigesters. Furthermore, the mixers in a biodigester will become clogged with disposable diapers.

Pet Waste: Biodigesters can also safely process pet waste, however, the litter that typically accompanies pet waste is made from diatomaceous earth. This clay-like material will settle in biodigester vessels, and will ultimately plug the system's pumps and vessels.

9. Conclusions and Next Steps

In conclusion, the deployment of a biodigester in Ann Arbor for food waste and WWTP sludge has the potential to be a good financial investment for the City, but only under certain conditions. These include:

Large Scale: The biodigester must be of adequate scale to be financially viable, and be publically financed using inexpensive monies available to a city like Ann Arbor with excellent credit. The issue of scale requires a judicious selection of available organic feedstocks for optimum performance, with large quantities of feedstocks needed for daily operation.

Diverse Feedstocks: Food waste is an excellent candidate feedstock because of its outstanding biogas production potential. The ideal source of food waste is a food processor because the supply of material is typically well-characterized, and can be delivered on a regular schedule. Large amounts of food waste are also produced in restaurants and at other institutions; however, the efficient collection of food waste from municipal sources is still in its relative infancy, with cheap landfill options remaining a barrier to deployment.

Sludge as a major feedstock: Diversion of a large fraction of the sludge from the Ann Arbor WWTP is a key source of revenue for the Biodigester. This is a viable approach since many wastewater plants across the US routinely use biodigestion to process their sewage sludge. Augmenting the Ann Arbor WWTP with a biodigester offers an alternative processing solution, and can offer both the City's WWTP and the Solid Waste group long-term savings in their disposal costs. This is particularly true if landfill or land application costs continue to escalate.

Sustainability: From a sustainability perspective, biodigestion is far superior to the current disposal for Ann Arbor's sludge (landfilling or land application). Biodigestion generates renewable energy, and also naturally reduces the amount of material for subsequent processing (to compost) or disposal.

Logistical challenges: Collection and transport of food waste is a challenging prospect due to its distributed nature, and the food waste's rapid decomposition. Efficient logistics systems will be needed to cost effectively gather and transport food waste from commercial locations such as restaurants.

Recommended Next Steps

This initial Feasibility Study shows the potential for a biodigester in the Ann Arbor area. The following items are recommended as key elements to include in any follow-on study:

- The ideal method for determining food waste totals is to conduct a rigorous food sort. A food sort for multiple restaurants is recommended in order to tally the available food-waste feedstock in a structured manner.
- FOG is a valuable feedstock for biodigestion, but is difficult to guarantee as a feedstock since multiple independent haulers mange the pickup and disposal of the material. A franchise model requiring all FOG within Ann Arbor city limits to be diverted to a common location (biodigester) should be explored.
- Similarly, a franchise model for the collection food waste produced within the city limit of Ann Arbor should be explored. A consistent supply of food waste and FOG to the digester will assure maximum biogas production, leading to enhanced financial stability and profitability.
- Further study is recommended to determine more precise estimates of biogas production from the sludge material available from the Ann Arbor WWTP.
- Commercial composting participation should be further evaluated to determine the fraction of food waste diverted to composting, and in turn, the fractions of pre-consumer food waste, and post-consumer food waste.
- A site assessment for the biodigester should be conducted to determine the optimum location based on available feedstocks. Another criterion for site selection will be any limits on renewable electrical production that may exist in Michigan's utility regulations.
- It is critical to determine how the cost-accounting structure at City departments will affect options for filtrate disposal.
- Future economic models should evaluate the addition of REC and Carbon Credit revenues. At the current time, these markets are uncertain. However, there are indications that limits on carbon producers may be imposed by the EPA, meaning that the positive carbon credits earned by the Ann Arbor Biodigester may (at some point) have significant monetary value.

Appendix A: Pro Forma for Case 4

A full 20 year Pro Forma listing for the Biodigester Case 4 (see Table 15) is listed in the Appendix A following the References.

10. References Cited

[1] "Municipal Solid Waste (MSW) in the United States: Facts and Figures 2012."*EPA*. Environmental Protection Agency, Web. 12 June 2014.

[2] "Analysis of U.S. Food Waste Among Food Manufacturers, Retailers, and Wholesalers." *FWRA Food Waste Reduction Alliance*. BSR, Apr. 2013. Web. 12 June 2014.

[3] Lawitts, Steven. "Commercial Food Waste Disposal Study." (2008): New York City Department of Environmental Protection, 31 Dec. 2008. Web. 12 June 2014.

[4] De la Houssaye, M. and A. White." Economics of New York City Commercial MSW Collection & Disposal and Source-Separated Food Waste Collection & Composting: Opportunities to Reduce Costs of Food Waste Collection & Recovery." 2008.

[5] Greer, Diane. "Commercial Food Waste Recovery In New York City." *BioCycle*., Dec. 2012. Web. 12 June 2014

[6] "Food Scraps Recycling." East Bay Municipal Utility District, Web. 12 June 2014.

[7] Hagey, Paul. "Utility District Ramps Up Food Waste To Energy Program."*BioCycle*. Nov. 2011. Web. 12 June 2014.

[8] "Executive Director Approval Of: Building Permit and East Bay Municipal Utilities District's Main Wastewater Treatment Plant (MWWTP) Land Use Master Plan Environmental Impact Report (EIR) and the First Addendum to the EIR for Recology's Organic-Rich Materials Preprocessing Facility 2020 Wake Ave (EBMUD Site)." Port of Oakland, 11 June 2012. Web. 12 June 2014.

[9] AECOM. "Food Waste Digester Phase 1 Feasibility Report." Dane County Dept. of Public Works, Solid Waste Division, June 2011. Web. 13 June 2014.

[10] "Analysis of U.S. Food Waste Among Food Manufacturers, Retailers, and Wholesalers." *FWRA Food Waste Reduction Alliance*. BSR, Apr. 2013. Web. 12 June 2014.

[11] "Food Waste Estimation Guide." *RecyclingWorks Massachusetts*. Web. 12 June 2014. <http://www.recyclingworksma.com/food-waste-estimation-guide/#Jump06>

[12] "Food Waste Management Cost Calculator." *EPA*. Environmental Protection Agency, Web. 12 June 2014. <http://www.epa.gov/waste/conserve/foodwaste/tools/index.htm>.

[13] "Standard Waste Generated in Weight for Building/Business Type." The Rosenthal Group. Web. 12 June 2014. <http://www.the-rosenthal-group.com/Standard%20Waste%20Generated.pdf>.

[14] Cascadia Consulting Group. *Targeted Statewide Waste Characterization Study: Waste Disposal and Diversion Findings for Selected Industry Groups*. June 2006. Web. 12 June 2014. <http://www.calrecycle.ca.gov/publications/Documents/Disposal/34106006.pdf>.

INVESTMENTS ( ) / REALIZATIONS (+)

Imputed depreciation	1/2016	12/2016	12/2017	12/2018	12/2019	12/2020	12/2021	12/2022	12/2023	12/2024	12/2025	12/2026	12/2027	12/2028	12/2029	12/2030	12/2031	12/2032	12/2033	12/2034	12/2035	Residual
Investments	**-6,132,079**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Book value	6,132,079	5,544,143	4,956,208	4,368,272	3,780,337	3,192,401	2,604,466	2,016,530	1,700,635	1,430,079	1,159,524	888,968	618,413	347,857	77,302	0	0	0	0	0	0	0

INCOME STATEMENT

USD	1/2016	12/2016	12/2017	12/2018	12/2019	12/2020	12/2021	12/2022	12/2023	12/2024	12/2025	12/2026	12/2027	12/2028	12/2029	12/2030	12/2031	12/2032	12/2033	12/2034	12/2035	Residual
Months per interval		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	(12/2035)
Income specified:																						
Electrical Generation		449,388	458,376	467,543	476,894	486,432	496,161	506,084	516,206	526,530	537,060	547,801	558,757	569,933	581,331	592,958	604,817	616,913	629,252	641,837	654,673	
Generator Capacity, kW		600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	
Generator availability, %		95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	
Electrical Rate, $/kWh		0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.13	0.13	0.13	
+ Electrical Revenue		449,388	458,376	467,543	476,894	486,432	496,161	506,084	516,206	526,530	537,060	547,801	558,757	569,933	581,331	592,958	604,817	616,913	629,252	641,837	654,673	
External Tip Fees		208,364	210,189	212,060	213,977	215,942	217,957	220,022	222,138	224,307	226,531	228,810	231,146	233,541	235,995	238,511	241,090	243,733	246,442	249,219	252,065	
Grease Trap Waste Tip Fee, $/gallon		0.10	0.10	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.14	0.14	0.14	0.15	0.15	0.16	0.16	
Annual Volume Accepted, gallons		365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	
+ Annual Tip Fee		36,500	37,413	38,348	39,307	40,289	41,296	42,329	43,387	44,472	45,583	46,723	47,891	49,088	50,316	51,574	52,863	54,184	55,539	56,928	58,351	
External Substrate Tip Fee, $/gallon		0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	
Annual Volume Accepted, gallons		730,000	730,000	730,000	730,000	730,000	730,000	730,000	730,000	730,000	730,000	730,000	730,000	730,000	730,000	730,000	730,000	730,000	730,000	730,000	730,000	
+ Annual Tip Fee, $/yr		36,500	37,413	38,348	39,307	40,289	41,296	42,329	43,387	44,472	45,583	46,723	47,891	49,088	50,316	51,574	52,863	54,184	55,539	56,928	58,351	
External Substrate Tip Fee, $/gallon		0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.10	
Annual Volume Accepted, gallons		365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	
+ Annual Tip Fee, $/yr		21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	
External Substrate - Food Waste Tip Fee, $/gallon		21.82	22.366	22.925	23.498	24.085	24.687	25.305	25.937	26.586	27.250	27.931	28.630	29.345	30.079	30.831	31.602	32.392	33.202	34.032	34.883	
Annual Volume Accepted, tons/yr		5,200	5,200	5,200	5,200	5,200	5,200	5,200	5,200	5,200	5,200	5,200	5,200	5,200	5,200	5,200	5,200	5,200	5,200	5,200	5,200	
+ Annual Tip Fee, $/yr		113,464	113,464	113,464	113,464	113,464	113,464	113,464	113,464	113,464	113,464	113,464	113,464	113,464	113,464	113,464	113,464	113,464	113,464	113,464	113,464	
WWTP Cost Savings		1,022,507	1,048,070	1,074,272	1,101,129	1,128,657	1,156,873	1,185,795	1,215,440	1,245,826	1,276,972	1,308,896	1,341,618	1,375,159	1,409,538	1,444,776	1,480,895	1,517,918	1,555,866	1,594,762	1,634,632	
+ Annual Lime Savings		171,163	175,442	179,828	184,324	188,932	193,656	198,497	203,459	208,546	213,760	219,104	224,581	230,196	235,951	241,849	247,896	254,093	260,445	266,956	273,630	
+ Annual Land App Savings		416,744	427,163	437,842	448,788	460,007	471,508	483,295	495,378	507,762	520,456	533,468	546,804	560,474	574,486	588,848	603,570	618,659	634,125	649,978	666,228	
+ Annual Landfill Savings		214,000	219,350	224,834	230,455	236,216	242,121	248,174	254,379	260,738	267,257	273,938	280,787	287,806	295,001	302,376	309,936	317,684	325,626	333,767	342,111	
+ Annual dewatering Polymer savings		186,600	191,265	196,047	200,948	205,971	211,121	216,399	221,809	227,354	233,038	238,864	244,835	250,956	257,230	263,661	270,252	277,009	283,934	291,032	298,308	
+ State Biosolids Fees		34,000	34,850	35,721	36,614	37,530	38,468	39,430	40,415	41,426	42,461	43,523	44,611	45,726	46,869	48,041	49,242	50,473	51,735	53,028	54,354	
Income	**0**	**1,680,259**	**1,716,635**	**1,753,875**	**1,792,000**	**1,831,031**	**1,870,991**	**1,911,901**	**1,953,784**	**1,996,663**	**2,040,563**	**2,085,507**	**2,131,522**	**2,178,632**	**2,226,864**	**2,276,245**	**2,326,802**	**2,378,564**	**2,431,560**	**2,485,818**	**2,541,370**	**0**
(cumulative financial year)		1,680,259	1,716,635	1,753,875	1,792,000	1,831,031	1,870,991	1,911,901	1,953,784	1,996,663	2,040,563	2,085,507	2,131,522	2,178,632	2,226,864	2,276,245	2,326,802	2,378,564	2,431,560	2,485,818	2,541,370	
Other operating income																						
Variable costs	0	-917,409	-940,850	-964,896	-989,565	-1,014,873	-1,040,837	-1,067,473	-1,094,801	-1,122,837	-1,151,601	-1,181,112	-1,211,391	-1,242,456	-1,274,330	-1,307,033	-1,340,588	-1,375,017	-1,410,344	-1,446,592	-1,483,787	0
Raw materials and consumables		-306,043	-314,199	-322,579	-331,190	-340,039	-349,132	-358,476	-368,078	-377,946	-388,088	-398,511	-409,225	-420,236	-431,554	-443,188	-455,146	-467,440	-480,077	-493,069	-506,425	
- Dewatering Polymer		106,853	109,524	112,262	115,069	117,945	120,894	123,916	127,014	130,190	133,444	136,781	140,200	143,705	147,298	150,980	154,755	158,623	162,589	166,654	170,820	
Electrcricity, kWh/yr		365,000	370,475	376,032	381,673	387,398	393,209	399,107	405,093	411,170	417,337	423,597	429,951	436,401	442,947	449,591	456,335	463,180	470,127	477,179	484,337	
Electrical Rate		0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.14	0.14	0.14	
- Plant Electricity		32,850	34,176	35,556	36,992	38,485	40,039	41,656	43,338	45,087	46,908	48,802	50,772	52,822	54,955	57,173	59,482	61,883	64,382	66,981	69,686	
- Equipment O&M		30,000	30,750	31,519	32,307	33,114	33,942	34,791	35,661	36,552	37,466	38,403	39,363	40,347	41,355	42,389	43,449	44,535	45,649	46,790	47,960	
Misc		7,500	7,688	7,880	8,077	8,279	8,486	8,698	8,915	9,138	9,366	9,601	9,841	10,087	10,339	10,597	10,862	11,134	11,412	11,697	11,990	
- CHP maintenance		78,840	80,811	82,831	84,902	87,025	89,200	91,430	93,716	96,059	98,460	100,922	103,445	106,031	108,682	111,399	114,184	117,038	119,964	122,963	126,038	
- Gas Cleaning Costs		50,000	51,250	52,531	53,845	55,191	56,570	57,985	59,434	60,920	62,443	64,004	65,604	67,244	68,926	70,649	72,415	74,225	76,081	77,983	79,933	
External charges		-586,367	-601,026	-616,051	-631,453	-647,239	-663,420	-680,006	-697,006	-714,431	-732,292	-750,599	-769,364	-788,598	-808,313	-828,521	-849,234	-870,465	-892,226	-914,532	-937,395	
- Trucking Fee for WWTP sludge		300,000	307,500	315,188	323,067	331,144	339,422	347,908	356,606	365,521	374,659	384,025	393,626	403,467	413,553	423,892	434,489	445,352	456,485	467,898	479,595	
- Cake Disposal Cost (compost)		238,467	244,428	250,539	256,803	263,223	269,803	276,548	283,462	290,548	297,812	305,257	312,889	320,711	328,729	336,947	345,371	354,005	362,855	371,927	381,225	
- Lab Testing, $/year		5,000	5,125	5,253	5,384	5,519	5,657	5,798	5,943	6,092	6,244	6,400	6,560	6,724	6,893	7,065	7,241	7,423	7,608	7,798	7,993	
- Centrate disposal fee		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
- State Biosolids Fee		20,400	20,910	21,433	21,969	22,518	23,081	23,658	24,249	24,855	25,477	26,114	26,767	27,436	28,122	28,825	29,545	30,284	31,041	31,817	32,612	
- Building Maintenance (water, heat, misc repairs)		2,500	2,563	2,627	2,692	2,760	2,829	2,899	2,972	3,046	3,122	3,200	3,280	3,362	3,446	3,532	3,621	3,711	3,804	3,899	3,997	
- City Central Cost Allocation		7,500	7,688	7,880	8,077	8,279	8,486	8,698	8,915	9,138	9,366	9,601	9,841	10,087	10,339	10,597	10,862	11,134	11,412	11,697	11,990	
- External Maintenance		12,500	12,813	13,133	13,461	13,798	14,143	14,496	14,859	15,230	15,611	16,001	16,401	16,811	17,231	17,662	18,104	18,556	19,020	19,496	19,983	
Long Term Equipment Replacement		-25,000	-25,625	-26,266	-26,922	-27,595	-28,285	-28,992	-29,717	-30,460	-31,222	-32,002	-32,802	-33,622	-34,463	-35,324	-36,207	-37,113	-38,040	-38,991	-39,966	
- Long Term Equipment Replacement		25,000	25,625	26,266	26,922	27,595	28,285	28,992	29,717	30,460	31,222	32,002	32,802	33,622	34,463	35,324	36,207	37,113	38,040	38,991	39,966	
Other variable costs																						
Gross margin	**0**	**762,850**	**775,785**	**788,978**	**802,434**	**816,158**	**830,154**	**844,427**	**858,983**	**873,826**	**888,962**	**904,395**	**920,131**	**936,176**	**952,535**	**969,212**	**986,215**	**1,003,547**	**1,021,216**	**1,039,226**	**1,057,584**	**0**
(cumulative financial year)		762,850	775,785	788,978	802,434	816,158	830,154	844,427	858,983	873,826	888,962	904,395	920,131	936,176	952,535	969,212	986,215	1,003,547	1,021,216	1,039,226	1,057,584	
% (cumulative financial year)		45.4%	45.2%	45.0%	44.8%	44.6%	44.4%	44.2%	44.0%	43.8%	43.6%	43.4%	43.2%	43.0%	42.8%	42.6%	42.4%	42.2%	42.0%	41.8%	41.6%	
Fixed costs	0	-275,000	-281,875	-288,922	-296,145	-303,549	-311,137	-318,916	-326,889	-335,061	-343,437	-352,023	-360,824	-369,844	-379,091	-388,568	-398,282	-408,239	-418,445	-428,906	-439,629	0
Staff costs		-275,000	-281,875	-288,922	-296,145	-303,549	-311,137	-318,916	-326,889	-335,061	-343,437	-352,023	-360,824	-369,844	-379,091	-388,568	-398,282	-408,239	-418,445	-428,906	-439,629	
- Admin (25% utilization)		30,000	30,750	31,519	32,307	33,114	33,942	34,791	35,661	36,552	37,466	38,403	39,363	40,347	41,355	42,389	43,449	44,535	45,649	46,790	47,960	
- Manager (20% utilization)		50,000	51,250	52,531	53,845	55,191	56,570	57,985	59,434	60,920	62,443	64,004	65,604	67,244	68,926	70,649	72,415	74,225	76,081	77,983	79,933	
- Operator		78,000	79,950	81,949	83,997	86,097	88,250	90,456	92,717	95,035	97,411	99,847	102,343	104,901	107,524	110,212	112,967	115,791	118,686	121,653	124,695	
- Operator		78,000	79,950	81,949	83,997	86,097	88,250	90,456	92,717	95,035	97,411	99,847	102,343	104,901	107,524	110,212	112,967	115,791	118,686	121,653	124,695	
- Mechanic (50% utilization)		39,000	39,975	40,974	41,999	43,049	44,125	45,228	46,359	47,518	48,706	49,923	51,171	52,451	53,762	55,106	56,484	57,896	59,343	60,827	62,347	
Rents																						
Other fixed costs																						
Provisions, increase (-) / decrease (+)																						
EBITDA; Operating income before depreciation	**0**	**487,850**	**493,910**	**500,056**	**506,289**	**512,609**	**519,016**	**525,511**	**532,094**	**538,765**	**545,524**	**552,372**	**559,308**	**566,332**	**573,444**	**580,645**	**587,933**	**595,308**	**602,771**	**610,320**	**617,955**	**0**
(cumulative financial year)		487,850	493,910	500,056	506,289	512,609	519,016	525,511	532,094	538,765	545,524	552,372	559,308	566,332	573,444	580,645	587,933	595,308	602,771	610,320	617,955	
% (cumulative financial year)		29.0%	28.8%	28.5%	28.3%	28.0%	27.7%	27.5%	27.2%	27.0%	26.7%	26.5%	26.2%	26.0%	25.8%	25.5%	25.3%	25.0%	24.8%	24.6%	24.3%	
Depreciation	0	-587,936	-587,936	-587,936	-587,936	-587,936	-587,936	-587,936	-315,896	-270,556	-270,556	-270,556	-270,556	-270,556	-270,556	-77,302	0	0	0	0	0	0
EBIT; Operating income	**0**	**-100,086**	**-94,025**	**-87,879**	**-81,646**	**-75,326**	**-68,919**	**-62,424**	**216,199**	**268,210**	**274,969**	**281,816**	**288,752**	**295,776**	**302,889**	**503,343**	**587,933**	**595,308**	**602,771**	**610,320**	**617,955**	**0**
(cumulative financial year)	0	-100,086	-94,025	-87,879	-81,646	-75,326	-68,919	-62,424	216,199	268,210	274,969	281,816	288,752	295,776	302,889	503,343	587,933	595,308	602,771	610,320	617,955	
% (cumulative financial year)		-6.0%	-5.5%	-5.0%	-4.6%	-4.1%	-3.7%	-3.3%	11.1%	13.5%	13.5%	13.4%	13.5%	13.6%	13.6%	22.1%	25.3%	25.0%	24.8%	24.6%	24.3%	
Financing income and expenses	0	-227,500	-216,125	-204,750	-193,375	-182,000	-170,625	-159,250	-147,875	-136,500	-125,125	-113,750	-102,375	-91,000	-79,625	-68,250	-56,875	-45,500	-34,125	-22,750	-11,375	0
Financing income and expenses	0	-227,500	-216,125	-204,750	-193,375	-182,000	-170,625	-159,250	-147,875	-136,500	-125,125	-113,750	-102,375	-91,000	-79,625	-68,250	-56,875	-45,500	-34,125	-22,750	-11,375	
Interest Rate		3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	
- Interest, $/A		227,500	216,125	204,750	193,375	182,000	170,625	159,250	147,875	136,500	125,125	113,750	102,375	91,000	79,625	68,250	56,875	45,500	34,125	22,750	11,375	
EBT; Income after financing items	**0**	**-327,586**	**-310,151**	**-292,629**	**-275,021**	**-257,326**	**-239,544**	**-221,674**	**68,324**	**131,709**	**149,844**	**168,066**	**186,377**	**204,776**	**223,264**	**435,093**	**531,058**	**549,808**	**568,646**	**587,570**	**606,580**	**0**
Extraordinary income and charges	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Realization profit (-loss)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other extraordinary income (-charges)																						
Income before appropriations and taxes	**0**	**-327,586**	**-310,151**	**-292,629**	**-275,021**	**-257,326**	**-239,544**	**-221,674**	**68,324**	**131,709**	**149,844**	**168,066**	**186,377**	**204,776**	**223,264**	**435,093**	**531,058**	**549,808**	**568,646**	**587,570**	**606,580**	**0**
Change in appropriations																						
Appropriations, increase (-) / decrease (+)																						
Income tax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deferred tax																						
Minority interest																						
Net income for the period	**0**	**-327,586**	**-310,151**	**-292,629**	**-275,021**	**-257,326**	**-239,544**	**-221,674**	**68,324**	**131,709**	**149,844**	**168,066**	**186,377**	**204,776**	**223,264**	**435,093**	**531,058**	**549,808**	**568,646**	**587,570**	**606,580**	**0**
(cumulative financial year)	0	-327,586	-310,151	-292,629	-275,021	-257,326	-239,544	-221,674	68,324	131,709	149,844	168,066	186,377	204,776	223,264	435,093	531,058	549,808	568,646	587,570	606,580	606,580
% (cumulative financial year)		-19.5%	-18.1%	-16.7%	-15.3%	-14.1%	-12.8%	-11.6%	3.5%	6.6%	7.3%	8.1%	8.7%	9.4%	10.0%	19.1%	22.8%	23.1%	23.4%	23.6%	23.9%	
Return on net assets (RONA), %		**-1.7 %**	**-1.8 %**	**-1.9 %**	**-2.0 %**	**-2.2 %**	**-2.4 %**	**-2.7 %**	**11.6 %**	**17.1 %**	**21.2 %**	**27.5 %**	**38.3 %**	**61.2 %**	**142.5 %**	**1302.3 %**	-	-	-	-	-	
Economic Value Added (EVA)		**-222,686**	**-204,279**	**-185,786**	**-167,207**	**-148,540**	**-129,786**	**-110,945**	**177,168**	**235,337**	**247,778**	**260,307**	**272,925**	**285,630**	**298,425**	**502,531**	**587,933**	**595,308**	**602,771**	**610,320**	**617,955**	**0**

WORKING CAPITAL

USD	1/2016	12/2016	12/2017	12/2018	12/2019	12/2020	12/2021	12/2022	12/2023	12/2024	12/2025	12/2026	12/2027	12/2028	12/2029	12/2030	12/2031	12/2032	12/2033	12/2034	12/2035	Residual
Change in working capital	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Net working capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

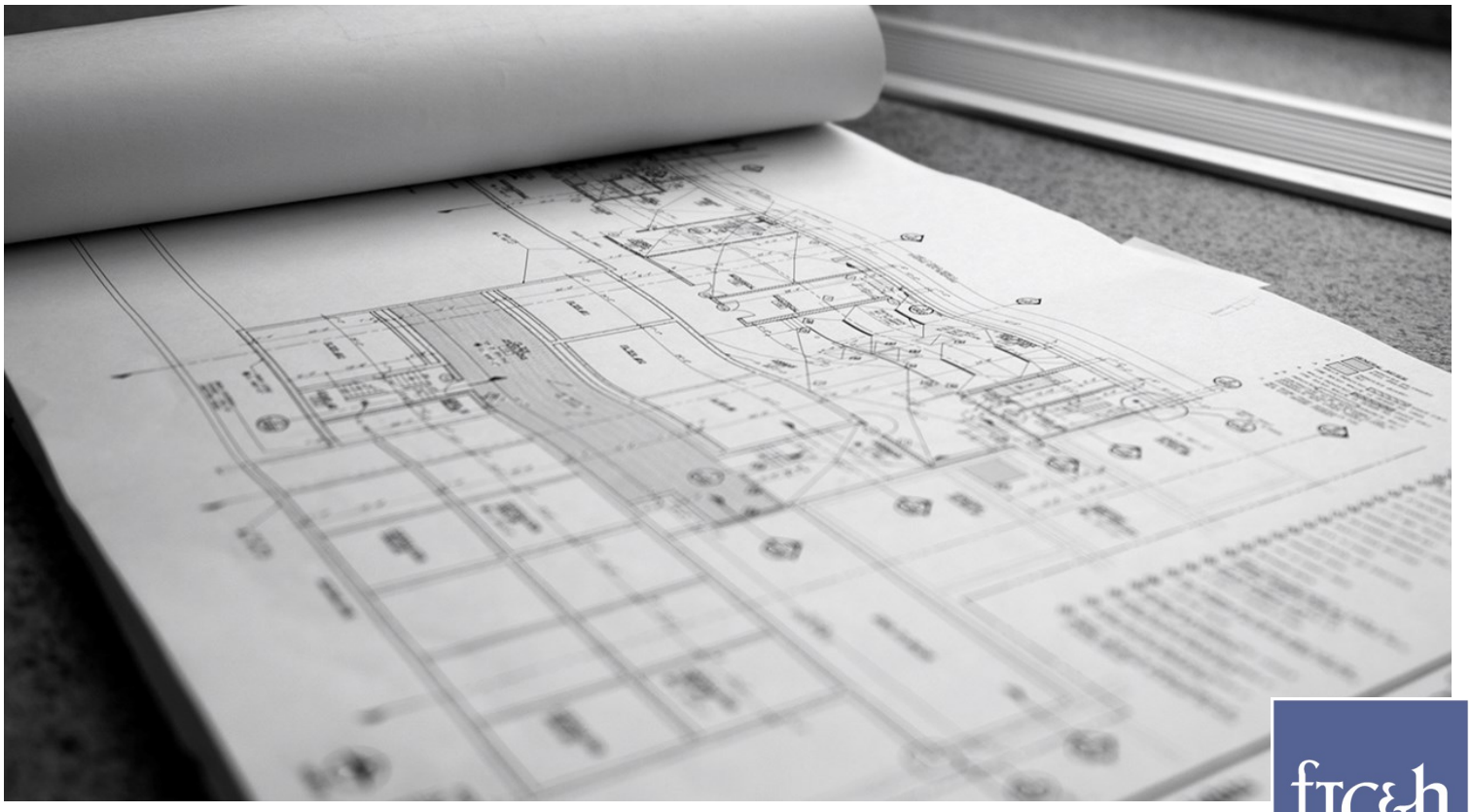
CASH FLOW STATEMENT

USD	1/2016	12/2016	12/2017	12/2018	12/2019	12/2020	12/2021	12/2022	12/2023	12/2024	12/2025	12/2026	12/2027	12/2028	12/2029	12/2030	12/2031	12/2032	12/2033	12/2034	12/2035	Residual
Months per interval		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	(12/2035)
Cash flow from operations																						
Income	0	1,680,259	1,716,635	1,753,875	1,792,000	1,831,031	1,870,991	1,911,901	1,953,784	1,996,663	2,040,563	2,085,507	2,131,522	2,178,632	2,226,864	2,276,245	2,326,802	2,378,564	2,431,560	2,485,818	2,541,370	0
Variable costs	0	-917,409	-940,850	-964,896	-989,565	-1,014,873	-1,040,837	-1,067,473	-1,094,801	-1,122,837	-1,151,601	-1,181,112	-1,211,391	-1,242,456	-1,274,330	-1,307,033	-1,340,588	-1,375,017	-1,410,344	-1,446,592	-1,483,787	0
Fixed costs	0	-275,000	-281,875	-288,922	-296,145	-303,549	-311,137	-318,916	-326,889	-335,061	-343,437	-352,023	-360,824	-369,844	-379,091	-388,568	-398,282	-408,239	-418,445	-428,906	-439,629	0
Extraordinary income & expenses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Income tax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Change in working capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash flow from operations	**0**	**487,850**	**493,910**	**500,056**	**506,289**	**512,609**	**519,016**	**525,511**	**532,094**	**538,765**	**545,524**	**552,372**	**559,308**	**566,332**	**573,444**	**580,645**	**587,933**	**595,308**	**602,771**	**610,320**	**617,955**	**0**
Asset investments and realizations	-6,132,079	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Free cash flow (FCF)	**-6,132,079**	**487,850**	**493,910**	**500,056**	**506,289**	**512,609**	**519,016**	**525,511**	**532,094**	**538,765**	**545,524**	**552,372**	**559,308**	**566,332**	**573,444**	**580,645**	**587,933**	**595,308**	**602,771**	**610,320**	**617,955**	**0**
Discounted free cash flow (DFCF)	-6,132,079	477,816	473,801	469,831	465,903	462,017	458,170	454,362	450,591	446,856	443,156	439,489	435,855	432,251	428,678	425,132	421,615	418,123	414,657	411,215	407,795	0
Cumulative discounted free cash flow	-6,132,079	-5,654,263	-5,180,462	-4,710,631	-4,244,727	-3,782,711	-3,324,541	-2,870,179	-2,419,588	-1,972,731	-1,529,575	-1,090,086	-654,231	-221,980	206,698	631,830	1,053,445	1,471,568	1,886,225	2,297,440	2,705,235	2,705,235
Information																						
Financial cash flow																						
Financial income and expenses	0	-227,500	-216,125	-204,750	-193,375	-182,000	-170,625	-159,250	-147,875	-136,500	-125,125	-113,750	-102,375	-91,000	-79,625	-68,250	-56,875	-45,500	-34,125	-22,750	-11,375	0
Correction of income tax for financial items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long-term debt, increase (+) / decrease (-)	0	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	0
Changes in interest-bearing long-term debt	0	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	0
Long-term debt, increase (+) / decrease (-)	0	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	-325,000	
Long Term Debt	6,132,079	6,500,004	6,175,004	5,850,003	5,525,003	5,200,003	4,875,003	4,550,003	4,225,002	3,900,002	3,575,002	3,250,002	2,925,002	2,600,001	2,275,001	1,950,001	1,625,001	1,300,001	975,001	650,000	325,000	
- Amortization (15 years)		325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000	
Interest Over Contruction	367,925																					
Remianing Long Term Debt		6,175,004	5,850,003	5,525,003	5,200,003	4,875,003	4,550,003	4,225,002	3,900,002	3,575,002	3,250,002	2,925,002	2,600,001	2,275,001	1,950,001	1,625,001	1,300,001	975,001	650,000	325,000	0	
Changes in interest-free long-term debt																						
Changes in short-term borrowings																						
Equity, increase (+) / decrease (-)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total cash flow	**-6,132,079**	**-64,650**	**-47,215**	**-29,694**	**-12,086**	**5,609**	**23,391**	**41,261**	**59,219**	**77,265**	**95,399**	**113,622**	**131,932**	**150,332**	**168,819**	**187,394**	**206,058**	**224,808**	**243,646**	**262,570**	**281,580**	**0**

Ann Arbor Biodigester Feasibility Study

City of Ann Arbor, Michigan

Project No. G160116
June 2017



Fishbeck, Thompson, Carr & Huber, Inc.
engineers | scientists | architects | constructors

ANN ARBOR BIODIGESTER FEASIBILITY STUDY

PREPARED FOR:

CITY OF ANN ARBOR, MICHIGAN

JUNE 2017
PROJECT NO. 160116

STUDY TEAM

BioWorks Energy LLC
Advanced organics processing

MOORE & BRUGGINK, INC.
engineering clean water

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LIST OF ABBREVIATIONS/ACRONYMS

FTCH	Fishbeck, Thompson, Carr & Huber, Inc.
FOG	gats, oil, and grease
GTW	grease trap waste
GWP	greenhouse warming potential
LCFS	low carbon fuel standard
NPV	Net Present Value
NAICS	North American Industry Classification System
PPA	purchase price agreement
RFP	Request for Proposal
RWM	Recycling Works Massachusetts
SSC	social cost of carbon
USEPA	United States Environmental Protection Agency
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

This Biodigester Feasibility Study continues the investigation and evaluation of a biodigestion facility for the City of Ann Arbor. Installation of a biodigester offers the City of Ann Arbor a diversified method for managing sludge generated at the Ann Arbor Wastewater Treatment Plant (WWTP), and also provides the City with a sustainable option for processing organic material such as food wastes and fat, oils, and grease (FOG) collected within the City. Co-digestion of sludge and organic wastes in a biodigester can produce renewable bioenergy for a variety of uses, which supports one of the key Climate and Energy goals of City's Sustainability Framework.

The study focused on the following main goals:

1. Expand the analysis of biomass availability.
2. Develop a schematic biodigester design.
3. Generate an Excel-based spreadsheet to model different uses for the biogas and digested solids.
4. Create an Excel-based financial model to evaluate the potential performance of different financing structures for implementing a biodigester.
5. Cite specific environmental benefits gained from operating a biodigester, and identify how these benefits meet the specific goals in the Ann Arbor Sustainability Framework (2013).

The study determined that the initial size of the biodigester should be based on the volume of sludge generated at the WWTP that would be diverted to the proposed facility in lieu of the current sludge processing method. Wastewater sludge offers a stable anaerobic digestion environment for processing additional organic co-feedstocks such food waste material and FOG collected within the City limits. These co-feedstocks enhance the biomethane potential substantially, and are essential for robust biogas production. Based on the results of a detailed biomass investigation, the Study determined there is adequate liquid and solid food waste to support a biodigestion process within the City. (Data from this Study can complement the results of a parallel study currently underway by the City. This parallel effort is evaluating the collection process of organic feedstocks such as food waste and FOG by waste haulers.) The collection and reuse of organic material is major goal within the Resource Management section of the City's Sustainability Framework.

A key financial factor for any successful biodigestion facility is a strong revenue stream. Revenue can be generated from a variety of sources such as: a) tipping fees for accepting organic feedstocks, b) production of renewable energy using biogas to produce electricity or biomethane-based vehicle fuel and offsetting operational costs, c) selling the stabilized digestate as a soil amendment, and d) the avoided costs for land application or landfilling of the raw waste material. A steady revenue stream generated by a biodigestion facility project is necessary to offset the initial construction cost and financial debt associated to implementing the program. The Study determined that the relatively low landfill tipping fees, modest cost of electrical energy, and minimal reimbursement for renewable energy generation are critical factors that challenge the biodigestion facility's ability to establish rates that are both competitive and allow for sufficient revenue generation to sustain the long-term financial need of the project.

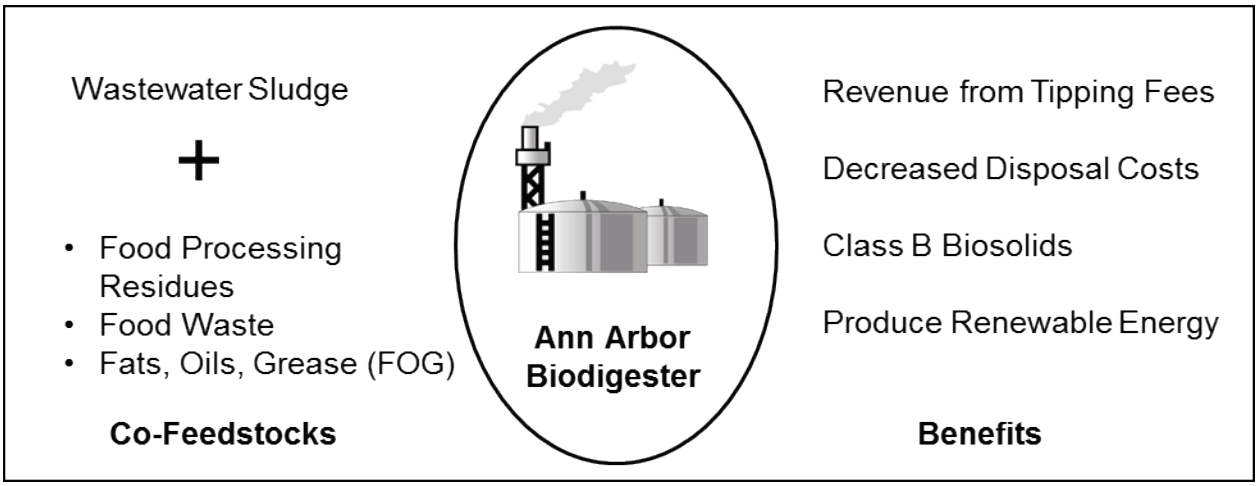
A financial analysis was conducted to determine the net present value (NPV) of the project, which is a measure of the profitability of the project. At the time of this study, it is estimated that the NPV for the biodigester project is $-4.4 million based on conversion of the biogas to biomethane, and $-10.2 million based on using the biogas as a fuel source for generating electricity. Two key factors that contribute to

this negative forecast are the expected lower revenue generated by tipping fees and the currently modest cost of electricity and natural gas.

Presently, there are no legislative actions being taken to increase landfill tipping fees, and the cost of natural gas and electricity are projected to remain modest for the foreseeable future. The remaining barrier to financial viability (i.e. achieving a positive project-NPV) is the need to lower the initial project cost. One option for decreasing project cost is for the City to pursue funding from a combination of public or private grants that are designed to enhance sustainable practices. Another option is to negotiate a more favorable feed-in tariff with local utilities interested in investing in green infrastructure, or by partnering with those utilities seeking a public-private partnership for more sustainable practices. Having the biodigester facility as a service may allow the City to establish an enterprise fund that is locally supported by the users through a fee-based structure similar to other services provided to the community. The next step for the project is for Ann Arbor to proactively seek policy changes at the State (or Federal) level, or financial incentives for alternative energy programs that provide City the ability to recover the high capital cost associated with the construction of the biodigester infrastructure.

INTRODUCTION

The City of Ann Arbor (City) issued request for proposal (RFP) 949 to conduct a Biodigester Feasibility Study in October 2015. The purpose of the study is to continue and expand the June 2014 investigation on the feasibility of using biodigestion to manage biosolids generated at the City's WWTP, and adding organic material from FOG to enhance the biogas generated by the process. The continued interest in developing a biodigestion process is guided by a number of previous reports, including (a) a 2014 Ann Arbor Biodigester Feasibility Study which concluded that, under specific financial conditions, a biodigester had the potential to be a good investment for the City, (b) the 2013 Ann Arbor Solid Waste Resource Plan, which calls for the City to research and develop options to collect and process organic wastes generated within the City, and (c) the 2013 City of Ann Arbor Sustainability Framework, which identified goals to provide a more sustainable Ann Arbor.



Biodigestion processes existing wastewater sludge with available organic waste, resulting in additional revenue streams, decreased costs and more sustainable operations.

This Biodigester Feasibility Study further investigates the availability of organic feedstocks and budgetary costs associated with implementing and operating an area-wide biodigester that supports sustainability advocated in the City's planning for community betterment. The goals in this study were to:

- Expand the analysis of biomass availability.
- Develop a schematic biodigester design with considerations for input handling, digester tank conceptual design, gas handling and processing concepts, system concepts for handling digested residual solids, potential for nutrient recovery, opinions on construction and operation costs, site size, and considerations for redundancy and reliability.
- Generate an Excel-based spreadsheet to model different uses for the biogas and digested solids. The model will consider the inputs used for the basis of the schematic design to estimate the biogas production and digested solids generated.
- Create an Excel-based financial model to evaluate the potential performance of different financing structures for implementing a biodigester, including municipal debt with City staff operation, municipal debt with contracted operation, and private development, including financing and contract operation, to allow the City to consider alternative financial pathways.

- Cite specific environmental benefits gained from operating a biodigester, and identify how these benefits conform to the City's sustainability goals as outline in the 2013 Ann Arbor Sustainability Framework.

Using the results refined in this feasibility report, the City of Ann Arbor can evaluate the options for biodigestion as a process and a utility service that will enhance the City's desire to divert organic waste matter to a sustainable program with community benefits.

The study team for this project, led by Fishbeck, Thompson, Carr & Huber, Inc. (FTCH), included the following firms:

- BioWorks Energy LLC, Flint, Michigan
- Moore and Bruggink, Inc., Grand Rapids, Michigan
- Quantalux LLC, Ann Arbor, Michigan

SCOPE OF WORK

This study focused on the following areas to further evaluate an Ann Arbor biodigestion program:

- Provide a forum through the kickoff meeting for key stakeholders to provide Ann Arbor and the report Team with information or data that may be beneficial for the evaluation.
- Expand the biomass and FOG feedstock analysis and availability from within Ann Arbor, as supported by the allotted budget for the project.
- Review the availability of the biomass and FOG feedstock from the nearby (50-mile radius) region outside of the Ann Arbor city center.
- Create a schematic design for the biodigester facility, including feedstock input handling systems, conceptual volumetric digester sizing and number of vessels, a gas handling and processing system, a post-digestion solids handling system, consideration for nutrient handling, and an optimal site size and utility requirements.
- Analyze the expected redundancy and reliability of the biodigester facility and components to meet the City's needs.
- Determine a conceptual budgetary capital cost for the facility.
- Undertake an expanded analysis of the biodigester outputs, including biogas and digested solids, for potential beneficial use.
- Create a financial model that will allow Ann Arbor to evaluate up to three scenarios.
- Evaluate the environmental benefits of the biodigester towards supporting the sustainability goals of Ann Arbor.

SECTION 1: INFORMATION GATHERING

1.1 METHODOLOGY FOR DETERMINING FOOD WASTE GENERATION VOLUMES

This Section focuses on reviewing the potential sources of food waste in Ann Arbor and Washtenaw County. The research work for Section 1 utilized the information and data gathered in the 2014 Feasibility Study in combination with detailed surveys of selected entities within the greater Ann Arbor area. These selected entities were separated into the five major groups listed below:

- Group 1: Major food processing companies.
- Group 2: Grease trap haulers.
- Group 3: Restaurants.
- Group 4: Schools, groceries, hospitals, hotels, and food banks.
- Group 5: Sewage sludge from surrounding wastewater treatment plants.

The individual entities contacted for each group are detailed in Appendix 1. In an attempt to gather as much background information as possible, a questionnaire was developed and sent to each of the entities which was created to be directly relevant to their particular business category. Responses to the questionnaires provided important data on the amount of food waste generated by the specific industry or group. The questionnaires for the major categories are provided in Appendix 2. Key metrics for the questionnaires were based on previous organic waste assessments conducted by Cal Recycle[1] and

[1] California's Department of Resources Recycling and Recovery (CalRecycle) – California's environmental stewardship program combining the state's recycling and waste management programs. http://www.calrecycle.ca.gov

Recycling Works Massachusetts[2] (RWM). These past studies have developed practical tools for estimating the quantities of food waste generated from different types of businesses that generate organic waste that could be diverted to a biodigestion or composting operation. Based on the similarities of East coast cities to Mid-west cities, the RWM estimating tools were implemented for this study. To assure that the RWM estimation tools were used correctly, staff interviewed Mr. Lorenzo Macaluso at the Center for Eco Technology and RWM. The discussion focused on the intended use of the RWM tools and their relative accuracy in estimating food waste quantities. Mr. Macaluso clarified the estimating tools from RWM are designed to be used in combination with each other to collect and synthesize multiple points of data and evaluate the similarities, or lack thereof. He emphasized that while the tools provide good baseline estimates, additional onsite inventory efforts are recommended to increase the accuracy of the research on generated food waste. Mr. Macaluso also stated that there was no method to accurately predict food wastes from a single facility aside from the labor-intensive approach of physically measuring the daily output.

The waste generation rates found in the formulas below were taken from RWM and used to estimate the amount of food waste generated by Groups 3 and 4.

Formula for food wastes from restaurants:

Organic food wastes (lbs/year) = number of employees * 1,500 (lbs/employee/year)

Formula for food wastes from grocery stores:

Organic food wastes (lbs/year) = number of employees * 3,000 (lbs/employee/year)

Formula for food wastes from hospitals:

Hospital food waste (lbs/year) = # of beds * 3.4 lbs of food waste/bed/days * 365 (days/year)

Hospital food waste (lbs/year) = # of meals/day * 0.6 lbs food waste/meal*365 (days/year)

1.2 RESULTS OF FOOD WASTE GENERATION EVALUATION

1.2.1 Group 1: Major Food Producers

Three major food processing companies were contacted during research on food waste generation. All three companies reported that the waste from their food processing activities was captured and diverted for use as an input for producing animal feed. The businesses determined that diverting their food waste materials to produce animal feed resulted in a lower, or a no-cost, alternative to landfilling. The recent implementation of Food Safety and Modernization Act may negatively impact the amount of food processing waste that is currently going to animal feed. Once the requirements of this program are fully defined, more of the waste generated by this group may be made available for anaerobic digestion. It is recommended to monitor the administration and implementation of the new rules to determine the effect on available food waste for a biodigestion facility.

1.2.2 Group 2: Grease Trap Waste

Six grease trap waste collection companies known to operate in the Ann Arbor area were contacted to gather information for the report. These companies were surveyed to determine the amount of grease

[2] Recycling Works in Massachusetts – Massachusetts' recycling assistance program that helps businesses and institutions with their recycling, reuse, and composting opportunities. http://www.recyclingworksma.com

trap waste (GTW) collected in both Ann Arbor and Washtenaw County. Unlike the estimating tools provided by Cal Recycle and RWM, the research of this business group did not find an industry standard for basing an estimate of generated waste. No formulas have been developed to estimate the amount of GTW generated using an indicator metric that is either based on the number of meals served or number of employees on staff at a business. For this reason, staff gathered actual data on grease trap waste from a subset of the haulers that operate in the Ann Arbor area. The business entities contacted provided information based of their records of the estimated annual volume of GTW collected.

Table 1 details the amount of GTW within Ann Arbor and Washtenaw County provided by the surveyed GTW collection companies. Annual volume data in Table 1 can be extrapolated to indicate the total potential GTW available to an Ann Arbor Biodigester.

Table 1 – Group 2: Grease Trap Waste Research Results

Company	Collects within AA	Collects within Washtenaw Co.	Annual volume in AA (gallons)	Annual volume in Washtenaw Co. (gallons)	Cost ($/gal) of disposal	Location of Current Disposal
B&B Grease Trap	yes	yes	NA	7,000	$ 0.30	Dearborn Heights-Environsolids
Mahoney Environmental	yes	yes	40,000	150,000	$0.045 to 0.075	Lowell AD, MSU AD
Great Lakes Grease	yes	yes	40,000	50,000	$0.38	Envirosolids, US ecology
Dover Grease Trap	yes	yes	50,000	100,000	$0.06 to 0.38	BioWorks Energy, Envirosolids
Plummer's Waste Group	No Response					
Michigan Power Vac	No Response					
Totals			130,000	307,000		

1.2.3 Group 3: Restaurants

The City of Ann Arbor staff assisted the research by emailing the survey questionnaire to approximately 410 food establishments. The email list was generated by the City to aid in the research for this segment of potential food waste sources. Twenty-three responses to the questionnaire were received with fifty percent of the respondents providing information on the mass of food waste generated at their business. Table 2 provides an outline of the data collected from the research of this group.

Due to the low number of respondents, the North American Industry Classification System (NAICS) was used to provide additional points of data to support a reasonable estimate of the volume of food waste generated by this group. The NAICS database contains a variety of different data points for the reporting businesses. The reported number of persons employed by a business is included in the NAISC database. The NAICS database yielded measurements that provided supporting information for 340 food establishments within the City of Ann Arbor.

Additionally, the database was also queried for the food establishments within Washtenaw County. The results of the Washtenaw County research resulted in a count of 712 food establishments. The NAICS database yielded measurements that supported information evaluated for the food establishments within Washtenaw County.

Table 2 – Group 3: Ann Arbor Restaurant Food Waste Generation Research Results

Company Name	Restaurants Type	Number of Employees	Per Annum		Current Disposal Method	Current Disposal Cost	Type of Waste	Notes
			Meals Served	Volume of Organic Waste, lbs				
Jerusalem Garden	Full Service	25	200,000	36,000	Compost (April - November), Landfill	"next to nothing"	Pre and post-consumer	
Main Street Ventures (Real Sea Food)	Full Service	60	100,000	NP*	Landfill	NP*	Pre and post-consumer	
Mission Restaurant Group	Full Service	260	700,000	NP	Landfill	NP	Pre and post-consumer	Includes two small brew pubs - spent grain goes to farmers
Unknown SM #23	Full Service	80	54,000	NP	Landfill	NP	Kitchen Scraps	
Carrols Corporation	Fast food	24	138,000	NP	Landfill	NP	Expired product, consumer waste	
Unknown SM #21	Full Service	NP	NP	NP	NP	NP	NP	
Unknown SM #20	Full Service	NP	NP	120,000	NP	NP	NP	
Unknown SM #19	Full Service	99	218,400	NP	Landfill	NP	all types	
Panda Restaurants	Full Service	1	14,000	24000 cy	Landfill	$68/month	Pre and post-consumer	
Chef Joe Wiitala	Full Service	1	7,200	100 gallons	Landfill	NP	food, plastic, cardboard	
Carrols Corp. (Burger King)	Fast food	10	137,000	300 gallons	Landfill	NP	little food, mostly paper products	
Casey's Tavern	Full Service	17	83,000	a full dumpster worth per week	Landfill	$1,500 per year	Pre and post-consumer	
Real Baked Goods	Bakery	1	7,000	very little	Back Door Food Pantry	$0	Baked goods	Baked goods go to local food bank
Food and Logic	Full Service	1	900	400	Compost and gardening	NP	Pre and post-consumer	Kitchen Prep (fruits and Veggies)
Kensington Hotel	Full Service	180	100,000	120 cy	Landfill	$900	Pre and post-consumer	
Tios Mexican Café	Full Service	20	125,000	NP	Landfill	Not sure	Pre and post-consumer	
Zingermans	Full Service	200	NP	300 to 400 cy (at 50% capture)	Compost	$12,000	Pre and post-consumer	
Tios on Liberty	Full Service	8	110,000	1.5 tons (estimate)	Landfill	NP	Pre and post-consumer	
Red Hawk	Full Service	25	100,000	NP	Landfill	NP	Pre and post-consumer	
Ruth's Chris Steak House	Full Service	15	26000	NP	Landfill	NP	Pre and post-consumer	
Unknown SM #2	Fast food	6	100000	10 cy	Landfill	NP	NP	
Kach LLC	Fast food	6	40000	100 lbs	Landfill	$0.50/lb	Pre and post-consumer	

*NP = Not provided

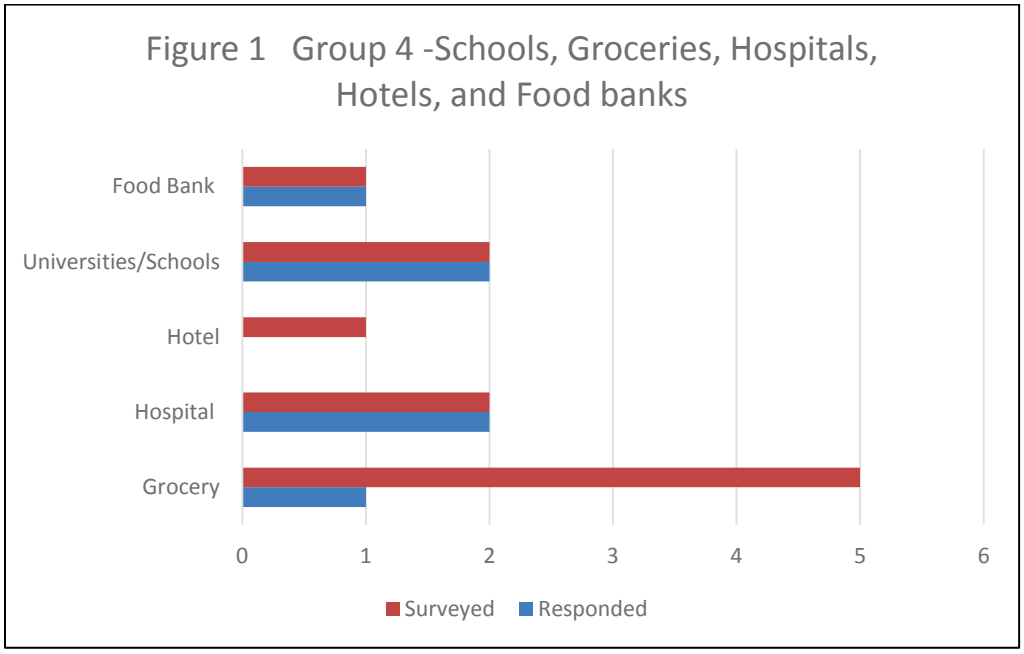
Table 3 provides the estimated amount of annual food waste generated within the City and Washtenaw County using the NAICS code and a constant of 1,500 pounds per year per employee. The survey data from the respondents was compared to the results using the NAICS database. No direct correlations were observed from food waste volumes and the number of employees provided via the survey responses to the RWM multiplier of 1,500 pounds per employee per year.

Table 3 – Group 3: Estimate of Annual Restaurant Food Waste Based on NAICS

Location	Food Waste, tons/year
City of Ann Arbor	6,400
Washtenaw County	10,800

1.2.4 Group 4: Schools, Groceries, Hospitals, Hotels, and Food banks

As with the restaurants, surveys were sent to 11 different organizations that were either a school system, grocery, hospital, or food bank. The responses from the organizations within this group also varied greatly in regard to the data provided. The distribution of the types of businesses and the resulting number of responses from the organizations contacted is provided in Figure 1.



Follow-up phone conversations and emails to the individual organizations were performed to elicit information that would provide a better understanding of the mass of food waste generated by this group. These follow-ups attempted to improve the overall accuracy as compared to using the RWM multipliers. Only a few of the responding organizations actually tracked the mass of food waste generated. This food waste data was used to support the resulting estimate of available food waste for a biodigester. For organizations that did not provide sufficient, or any, food waste mass data, the information presented in the study is calculated using RWM multipliers. No correlations were observed between the mass of food waste data, number of meals served, number of beds, and/or number of employees provided by the respondents to the RWM multipliers used for the calculation of mass food waste generated by an organization. Table 4 provides an outline of the data collected from the research for this group.

Table 4 – Group 4: Schools, Groceries, Hospitals, Hotels and Food Banks Research Results

Company Name	Org. Type	Response	No. of Employees	Per Annum				Current Disposal Method	Current Disposal Cost	Type of Waste	Notes
				Meals Served	Number of Beds	No. of Guests	Volume of Organic Waste, lbs				
Meijer	Grocery	1	NP	NA	NA	NA	657,000	Landfill	NP	Expired produce, deli cuts, prepared foods	Meijer is tracking their organic waste volumes
Kroger	Grocery	0	No Response								
Busch's	Grocery	0	No Response								
Whole Foods	Grocery	0	No Response								
VA Ann Arbor Healthcare System	Hospital	1	NA	54,750	102	NA	NP	100% WWTP	NP- WWTP	Kitchen Prep, Pre and Post Consumer	Follow up questions in que with Yvette, (answered)
VA Ann Arbor Healthcare System - Veteran Canteen Service (VCS)	Hospital	1	13	575,000	NA	NA	NP	MSW	$15.37/ton + transport	Kitchen Prep, Pre and Post Consumer	
University Hospital	Hospital	1	NA	800,000	984	NA	115,440	Mostly landfill, some composting	NP - $2,300 per year	Kitchen Prep, Pre and Post Consumer	
University Hospital - Picasso Restaurant	Hospital	1	NA	24,444	NA	NA	7,983	Landfill, Food Gatherers when able	NP	Kitchen Prep, Pre - Consumer	
University Hospital - Aramark	Hospital	1	150	1,300,000	NA	NA	20,000 to 28,000	Compactor - (landfill)	NP	"food waste"	
Campus (Graduate) Inn	Hotel	0	No Response								
University of Michigan	University	1	NA	NA	NA	NA	805,000	Compost (City of AA, small portion to Tuthill Farms	$38/ton	Kitchen Prep, Pre and Post Consumer	Info from T. Artley
Ann Arbor City Schools	School System	1	NP	NP	NA	NA	49,500				
Trader Joes	Grocery	0	No Response								
Food Gatherers	Food Bank	1	NA	NP	NA	NA	600,000	Landfill	$10,500/yr	packaged goods	
Food Gatherers	Food Bank		NA	NP	NA	NA	250,000	Animal Feed	$7,020/yr	non packaged	
Food Gatherers	Food Bank		NA	NP	NA	NA	250,000	Onsite aerobic processing	$11,800/yr	Pre-consumer	

1.2.5 Food Waste Volumes – Compiled Data

Tables 5 and 6 provide the mass of food waste generated within the City and Washtenaw County respectively, as determined through a combination of data from:

- Survey results for Group 2: Grease trap waste.
- NAICS database for Group 3: Restaurants.
- Survey results for Group 4: Schools, groceries, hospitals, hotels, and food banks.
- Michigan Department of Environmental Quality for Group 5: Sewage Sludge.

Table 5 – Food Waste Survey and NAICS Results within Ann Arbor

Substrate Description	Volume, gallons/yr*	Volume, gallons/day*	Mass, tons/yr
GTW – Ann Arbor	130,000	356	565
Food Waste, Restaurant NAISC + Food Waste Survey Data HIGH ESTIMATE	2,829,063	7,751	8,487
Food Waste, Restaurant NAISC + Food Waste Survey Data LOW ESTIMATE	2,584,012	7,079	7,752
AA WWTP Sludge	21,470,588	58,824	91,250

Table 6 – Food Waste Survey and NAISC Results within Washtenaw County

Substrate Description	Volume, gallons/yr*	Volume, gallons/day*	Mass, tons/yr
GTW - Washtenaw County	307,000	841	1,335
AA Food Waste, Restaurant NAISC + Food Waste Survey Data HIGH ESTIMATE	4,291,479	11,757	12,874
AA Food Waste, Restaurant NAISC + Food Waste Survey Data LOW ESTIMATE	4,045,722	11,084	12,137
AA WWTP Sludge	21,470,588	58,824	91,250
Sewage Sludge within Washtenaw Co. (excluding YUCA)	27,287,059	74,759	115,970

SECTION 2: DESCRIPTION OF CONCEPTUAL BIODIGESTER PROCESS AND SYSTEMS

Section 2 presents a schematic biodigester design for a biodigester system that is consistent with the feedstock data from the previous section. The intent of the schematic design is to provide the City of Ann Arbor with a high-level view of the different processes and systems in an operational biodigester system. The schematic design can also support a future implementation program.

The biodigester facility will consist of several components that focus on three main areas: (1) Material receiving area; (2) Material Anaerobic Digestion Processing; (3) Digestate and Biogas Handling; and (4) Administration and Staffing. The following paragraphs provide a conceptual design outline that is used for the conceptual construction budgets used in the financial analysis.

2.1 INPUT HANDLING SYSTEMS

2.1.1 Food Waste Receiving Station

The food waste receiving station is designed to accept different types of organic wastes delivered to the site by collection trucks. For the conceptual design, the food waste reception tank will be constructed of concrete. This tank will be covered to allow the collection of the foul air to mitigate nuisance odors by sending the air through an odor treatment system. The food waste reception tank includes heating tubes embedded in the concrete walls to allow the waste to be preheated prior to injection into the anaerobic digester. This tank will be equipped with a large garage-door style hatch covering the opening that will be used to allow trucks to empty their food waste load. The floor of this tank will be sloped towards grinders that will chop and recirculate food waste. Liquid from the liquid waste receiving station reception chamber will be fed into the food waste reception tank to allow the grinders to fluidize the solids during the chopping and recirculating process. The food reception tank will have a negative pressure drawn by the odor control system. It is anticipated that the food waste truck discharge area will be enclosed in a building to further contain fugitive odors released during the discharge of food waste by trucks.

The building used for food waste reception will also house de-packaging equipment so that pre-packaged food materials can be prepared for the digester. Examples of pre-packaged food includes cartons of spoiled milk, expired yogurt, and baby food in individual containers. The de-packaging process separates the organic material from the paper/plastic waste, storing the food in a food-waste holding tank. A portion of the building dedicated to storing the waste bulk packaging for later disposal. The food waste tank will feed material to the chamber that pumps the feed stock directly into the digesters. The digester feed pumps will have the ability to recirculate the liquid blend of food waste either to the solid waste receiving station, to the liquid waste receiving station, or to feed directly to the digesters. Figure 2 provides a schematic process flow diagram of the Waste Receiving Station for food waste.

2.1.2 Bulk Liquid Waste Receiving Station

The biodigester facility may receive bulk liquid waste from other sources such as dairy milk waste and FOG from food preparation sources. For the basis of this study, the liquid waste receiving station will consist of multiple chambers. Several will be used to receive the liquid waste; there will be one chamber to house pumps used to feed the digester. The receiving station is expected to include a large, covered reception chamber using several metered feed connections to allow trucked liquid waste to be discharged into the liquid waste receiving station. The chamber material is anticipated to be concrete with the interior walls coated to protect the concrete from the pH ranges that may be associated with the accepted liquid wastes. Odor control will be accomplished by maintaining a slightly negative atmosphere in the chamber and sending the collected air through an odor treatment system. The chamber is also expected to have

several hatches that allow for visual inspection of the chamber, physical access into the chamber, and for equipment retrieval from the chamber to allow for maintenance or replacement. The design of similar facilities allows for the incoming liquid waste to be preheated to improve digester performance. To accomplish this, the designs of liquid waste receiving stations have allowed for tubes to be embedded into the chamber's concrete walls. These tubes will carry the heated water needed for preheating the incoming liquid waste. The heated water will be supplied from the cogeneration system that is part of the biodigester facility. The conceptual design of the receiving station chamber is based on using chopper type pump/mixers to assure a homogeneous feedstock can be pumped into the digesters for processing. These mixing pumps will also distribute liquid throughout the reception chamber to fluidize the material temporarily stored between deliveries or feeding cycles. The reception chamber floor will be sloped towards the mixing pumps to improve the suction hydraulics of the system. The digester feed piping connecting the reception chamber to the digester feed pump chamber will include a rock trap and macerators to protect downstream equipment. Positive displacement type digester feed pumps capable of handling liquids with a high solids content will be housed in the adjacent digester feed pump chamber. Figure 2 provides a schematic process flow diagram of the Waste Receiving Station for liquid waste.

2.2 DIGESTION PROCESSING SYSTEMS

2.2.1 Pretreatment/Equalization Tank

The pretreatment/equalization tank (PT/EQ tank) will allow for an even distribution of homogeneous feed stock material into the downstream digester at a rate that is measured to assure the proper predetermined quantity of food is available for optimum digester operation. By maintaining the maximum efficiency of the digestion process, there will be greater biogas production and process stability. The pretreatment/ equalization tank is based on using a glass-fused bolted steel tank that is insulated to maintain the processing temperature. The tank will also be equipped with gas safety equipment on a fixed dome cover. The tank will be completely mixed using a jet mixing system. A smaller pump will recirculate a portion of the homogenized liquid through a heat exchanger to maintain the food waste in the tank at the appropriate feed temperature for the digester. To allow for a steady feed rage, positive displacement pumps were included in the conceptual design of this system. Biogas generated in this vessel will be collected and piped to the digestate storage tank for storage and later use. Figure 3 provides a schematic of the Biodigester Process Flow Diagram of the Pretreatment/Equalization Tank.

2.2.2 Digester System and Digestate Storage

The digester will process the organics in the combined wastewater sludge and food stock co-feeds. The digester operation is based on a mesophilic process. Processing these materials in this manner will help reduce the volume of solids, stabilize the digested materials, and generate biogas that can be used as an alternative energy fuel source. The pathogens in the biosolids will be reduced and the digested solids will qualify as a Class B product as defined by the Part 503 Biosolids Regulations[3].

[3] The Standards for the Use or Disposal of Sewage Sludge (Title 40 of the Code of Federal Regulations [CFR], Part 503), published in the Federal Register (58 FR 9248 to 9404) on February 19, 1993, became effective March 22, 1993. Referred to as "the Part 503 rule" or "Part 503."

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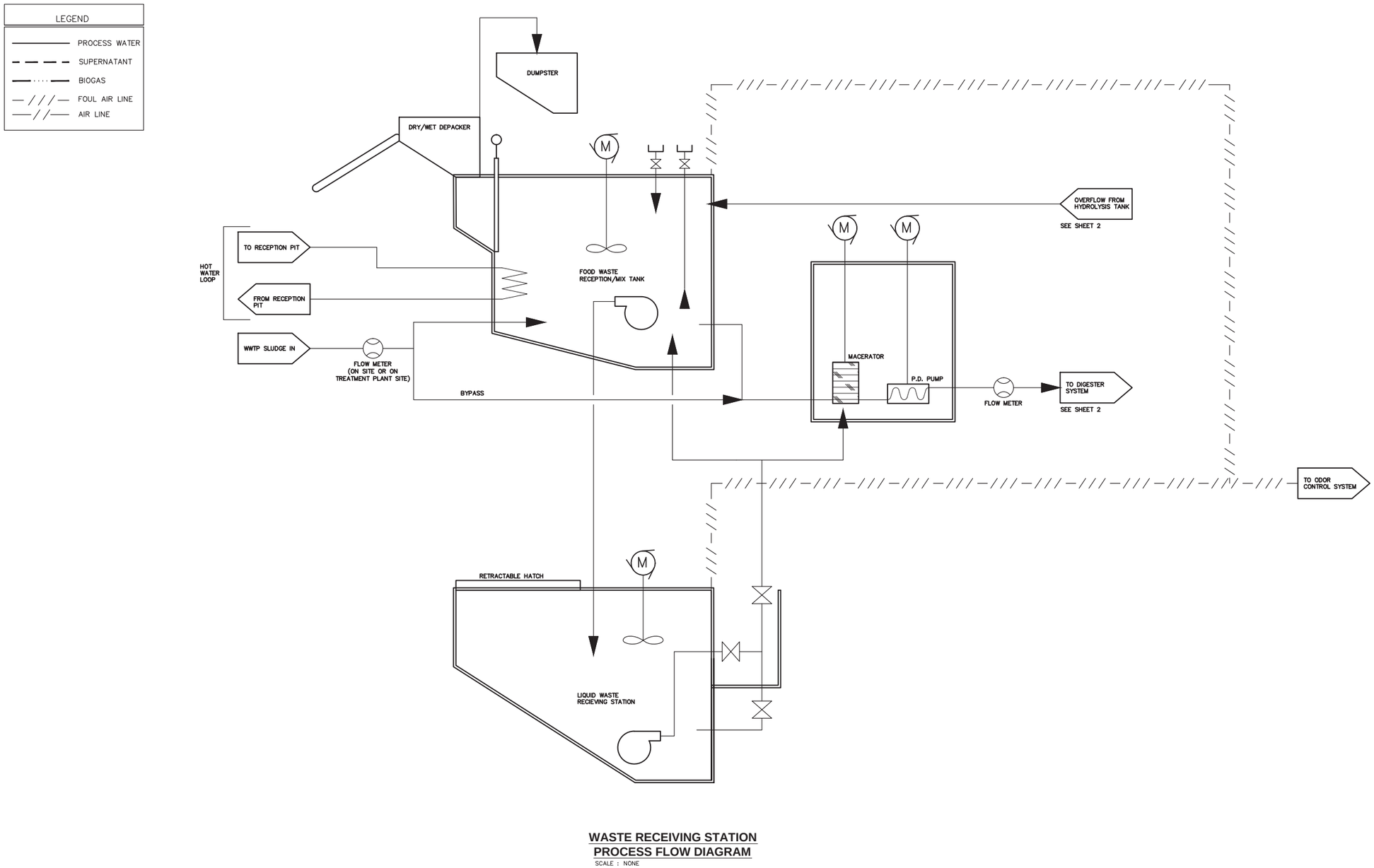

WASTE RECEIVING STATION
PROCESS FLOW DIAGRAM
SCALE : NONE

PRELIMINARY - NOT FOR CONSTRUCTION

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BioWorks Energy LLC
Advanced organics processing

MOORE & BRUGGINK, INC.
engineering clean water

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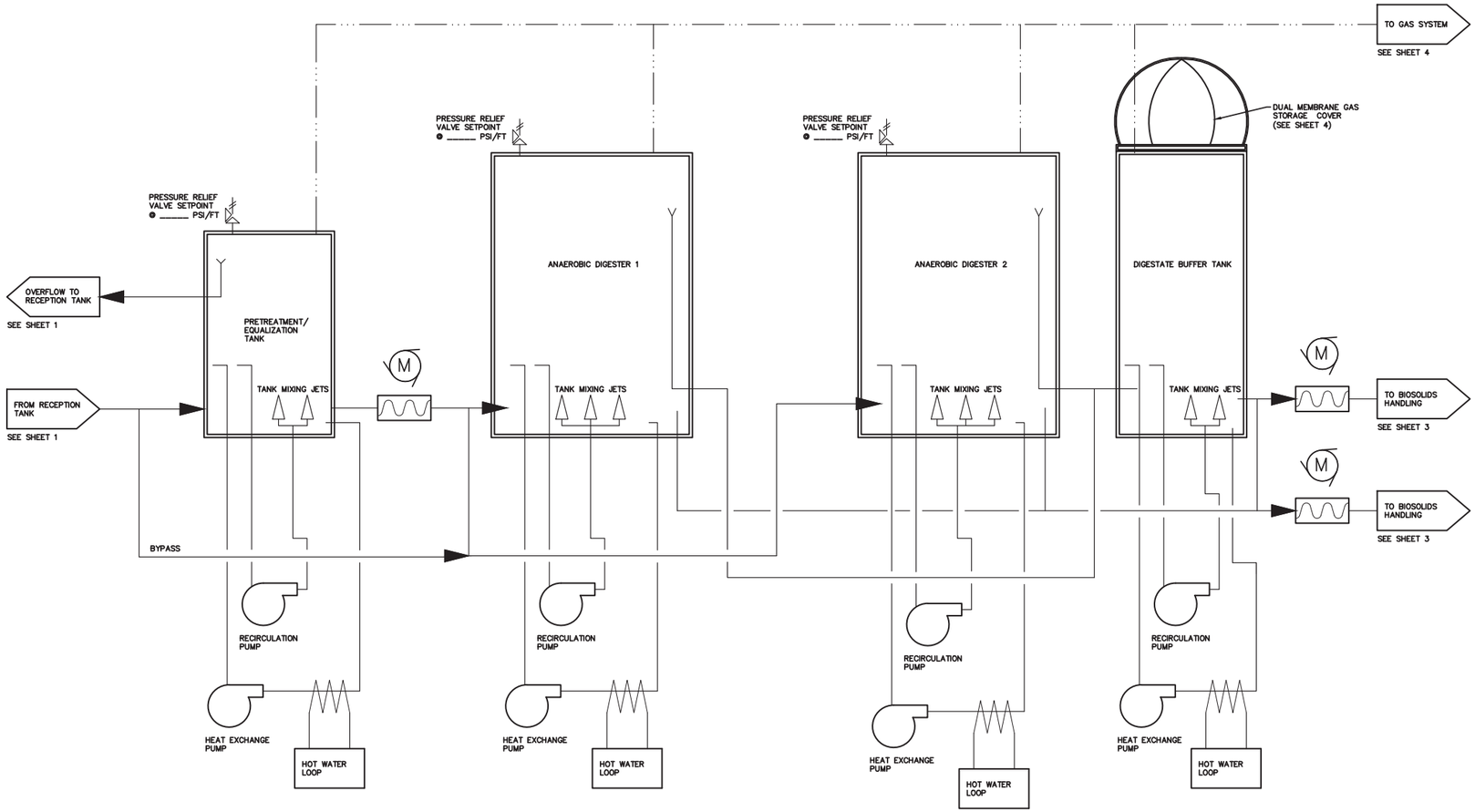
Washtenaw County, Michigan
Biodigester Feasibility Study

FIGURE
2

LEGEND

- PROCESS WATER
- SUPERNATANT
- BIOGAS
- FOUL AIR LINE
- AIR LINE



BIODIGESTER PROCESS FLOW DIAGRAM

SCALE : NONE

PRELIMINARY - NOT FOR CONSTRUCTION

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Advanced organics processing

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City of Ann Arbor
Washtenaw County, Michigan

Biodigester Feasibility Study

FIGURE
3

To assure reliability and redundancy, the digestion process will consist of two steel, glass-fused bolted steel tanks with fixed dome covers. Both tanks will be insulated and include gas safety equipment for the storage and collection. A jet mixing system will be used to keep the tanks thoroughly mixed. To maintain the digestate temperature, smaller pumps will continually circulate the digestate through heat exchangers. The digesters will have an overflow into a digestate storage tank. Positive displacement pumps will be used to transfer the digestate from the digesters to the digestate storage tank or feed the digestate directly to downstream biosolids thickening or dewatering equipment.

Digestate is a by-product of the anaerobic digestion process used by biodigesters to break down substrates to release biogas. The digestate is comprised of the processed sludge and organic food waste. The digestate storage tank is intended to provide storage of both biogas and digestate. The digestate storage tank will be a glass-fused bolted steel tank. The tank will be equipped with a dual membrane gas holder/cover to store the biogas generated by digestion. A jet mixing system will be used to keep the digestate storage tank mixed and prevent stratification. The tank digestate will be fed to dewatering and/or thickening equipment using positive displacement pumps.

The dual membrane gas storage cover includes a gas sensor between the membranes that alerts the facility staff of a biogas leak. The membrane cover is designed to maintain a constant pressure on the biogas to feed the equipment used to further purify the gas or directly feed the gas to equipment designed to use biogas as a fuel. Figure 3 provides a schematic of the Biodigester Process Flow Diagram of the Anaerobic Digester and Digestate Buffer Tank. Figure 4 provides a schematic of the Digestate Process Flow Diagram.

2.3 BIOGAS HANDLING AND PROCESSING SYSTEMS

2.3.1 Biogas Cleaning, Safety and Use for Cogeneration

Prior to using the stored biogas in an engine generator, the biogas will need to have the moisture removed and the gas cleaned of contaminants, including siloxanes and hydrogen sulfide. The use of un-scrubbed biogas directly can cause inefficient operation of the engines that run generators and result in excessive maintenance needs. The biogas cleaning system used as the basis of this study included equipment that compresses the gas to the pressures that are necessary to allow the engines to operate at optimum efficiency and capacity.

The biogas safety equipment included in the conceptual design includes an emergency flare to allow for the controlled combustion of excess biogas, pressure relief valves, flame arrestors, drip traps, and other safety equipment associated with storing, handling, and delivering digester biogas.

The conceptual plan for the biodigester facility includes two internal combustion engines to power generators for the production of electricity. The heat from the engine's water-cooled jackets and engine exhaust will be captured using heat exchangers. The captured heat will be distributed throughout the facility to provide heat for the food waste receiving stations, digester pretreatment / equalization tanks and anaerobic digesters. Heat dump radiators will be included in the piping system loop to allow for the removal of excess heat and assure proper engine operation. A hot water heater will also be included in the heating system loop to provide heat to the biodigester facility components during startup or maintain temperatures during periods of engine generator maintenance. The hot water heater is expected to be configured to use biogas or natural gas. Figure 5 provides a schematic of the Biogas Process Flow Diagram of the Biogas Treatment and Biogas use for on-site power generation and waste heat recovery.

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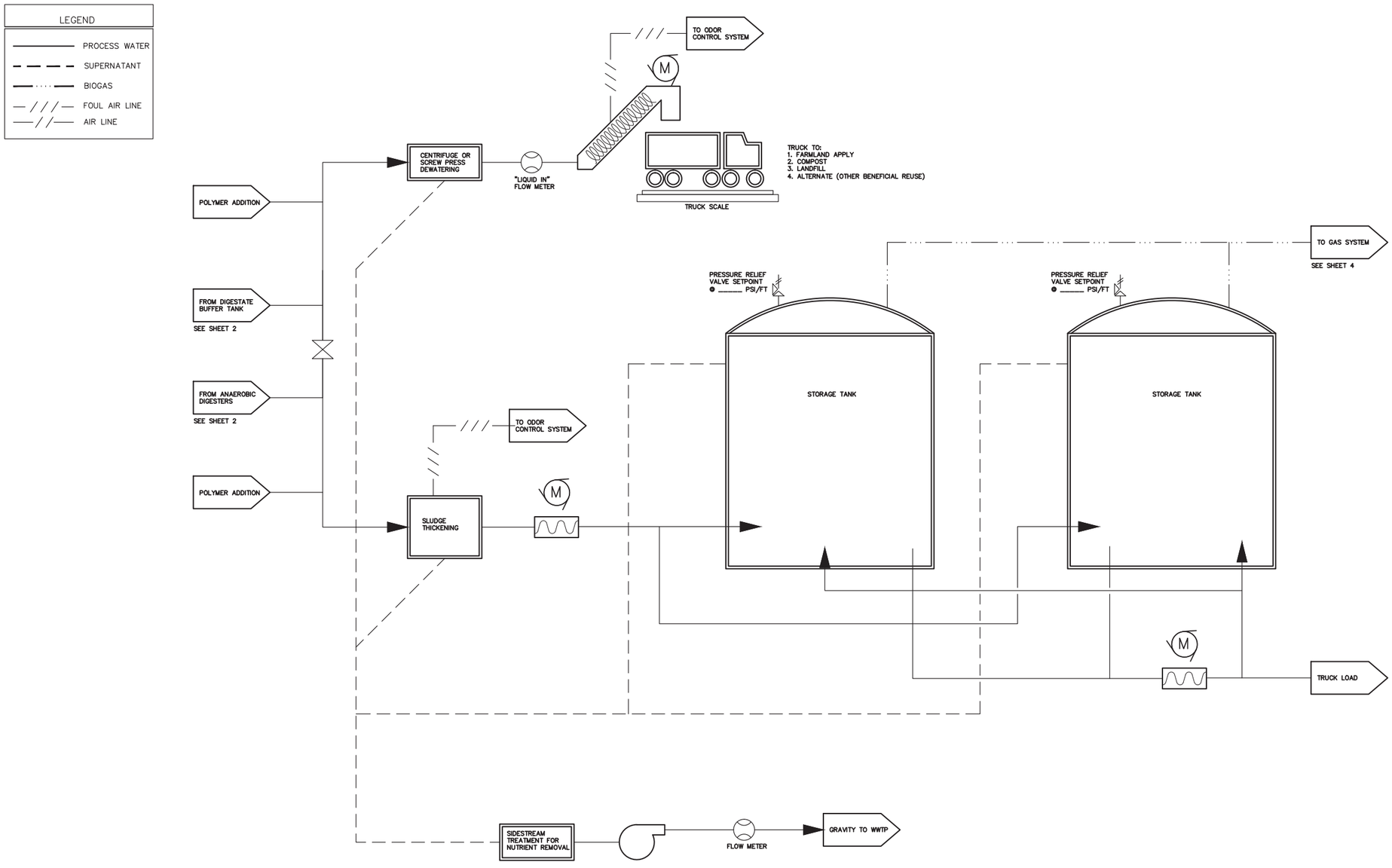

DIGESTATE PROCESS FLOW DIAGRAM

SCALE : NONE

PRELIMINARY - NOT FOR CONSTRUCTION

FTCH Fishbeck, Thompson, Carr & Huber engineers • scientists • architects • constructors

BioWorks Energy LLC Advanced organics processing

MOORE & BRUGGINK, INC. engineering clean water

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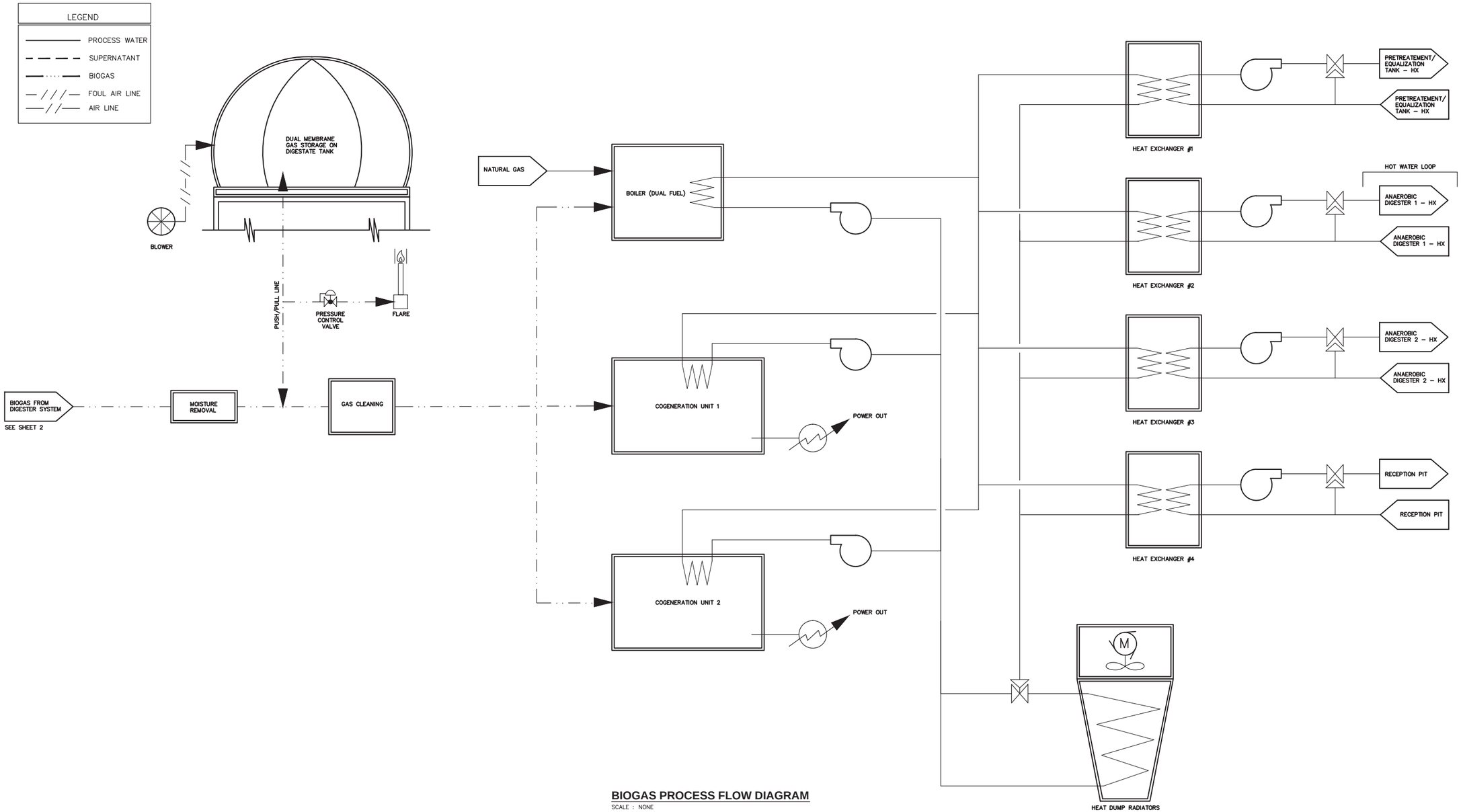
FIGURE **4**

PLOT INFO: M:\160124\ANN ARBOR BIODIGESTER STUDY\160124_PROCESS AND INSTRUMENTATION DIAGRAMS.DWG LAYOUT: PFD-4 DATE: 6/5/2017 TIME: 2:33:27 PM USER: JARCID



BIOGAS PROCESS FLOW DIAGRAM

SCALE : NONE

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FIGURE
5

2.4 DIGESTED SOLIDS HANDLING SYSTEMS

2.4.1 Digestate Thickening, Dewatering and Storage

To provide recycling flexibility of the digestate, the biodigester facility concept includes equipment to allow for digestate thickening or dewatering. Potential outlets for the digestate include landfilling, land application, and off-site composting.

To improve the economics of liquid digestate land application, thickening equipment and a post thickened digestate storage tank have been included as part of the facilities plan. Thickening can be accomplished using a gravity belt, rotary drum thickener, or centrifuge. The glass-fused bolted steel thickened digestate storage tank size is based on sixty days of thickened digestate storage. The tank will be mixed to prevent stratification of the stored digestate. To allow for either liquid or thickened digestate recycling, a truck loading facility that includes pumping and automatic controls will be part of the proposed project.

Dewatering equipment has also been specified in the design to prepare digestate solids for land application, off-site composting, or disposal in a landfill. The dewatering and thickening equipment will be housed in a building and it will be odor-controlled. Dewatered digestate solids are planned to be loaded into lined, roll-off boxes for transportation off site. Figure 4 also provides a schematic process flow diagram of the digested solids handling systems.

Figures 6 and 7 provide a conceptual facility layout for planning the area requirements for a potential site. Figure 6 represents a layout using tank sizing based on the sludge volume from the wastewater treatment plant as an initial step for a biodigester development. The intent would be to begin to bring in food substrates and offset the added volume by accepting less sludge. Once the food substrate program is stabilized the facility would expand. The larger facility is represented in Figure 7.

2.5 ANCILLARY ITEMS

2.5.1 Odor Abatement System

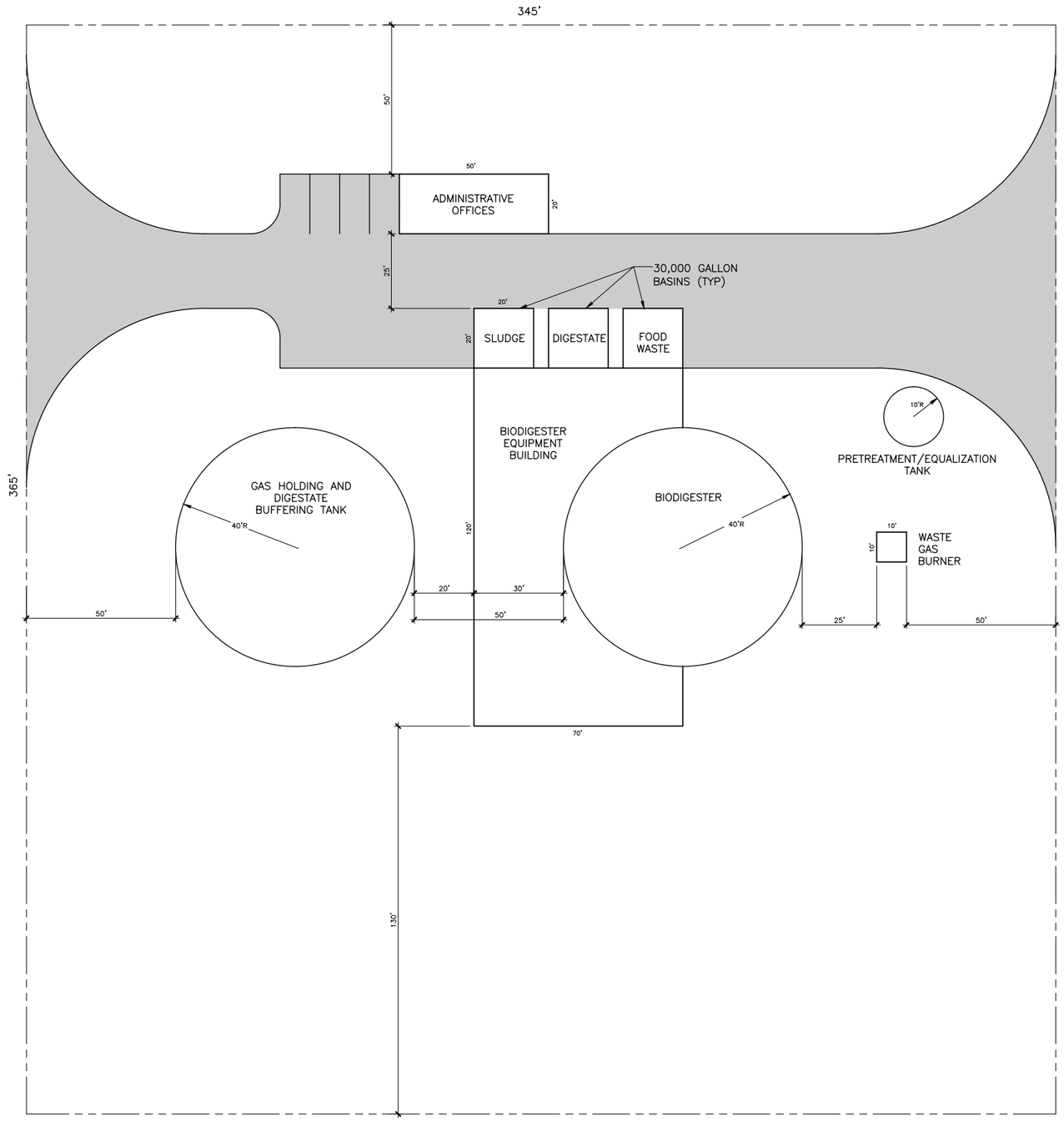
An odor abatement system is included in the conceptual plan to assure normal nuisance odors periodically generated during operations are captured and treated before the air is released. Odor treatment must be correctly implemented for individual processes as part of a system-wide odor abatement strategy.

2.5.2 SCADA Communications

To monitor and control the processing components that will be included in the biodigestion facility, the process equipment will to be tied into a central facility-wide SCADA (Supervisory Control and Data Acquisition) system. It is anticipated that the SCADA system for the biodigester facility will be integrated into the existing WWTP SCADA system to allow utility managers to comprehensively monitor the overall facility performance. The biodigestion SCADA system will support automatic operation for selected pieces of equipment, and provide the monitoring necessary for staff that are not physically performing the operations local to the equipment. As with most SCADA systems, the biodigester will gather/store data over time to document performance and evaluate trends in performance

2.5.3 Nutrient Recovery System

While the major source of revenue for a biodigester facility will be earnings from tipping fees and energy generation, there is also value in the nutrients present in the digested material. Digestate contains valuable nutrients such as phosphorus, potassium, and sulfur that can be extracted from the digestate and sold to increase the revenue of a biodigester facility. Using enhanced separation technology, nutrients can be harvested and packaged as fertilizers and soil conditioners that can be used by golf courses, home gardening, and lawn care.



BIODIGESTER LAYOUT 1

SCALE: 1" = 20'

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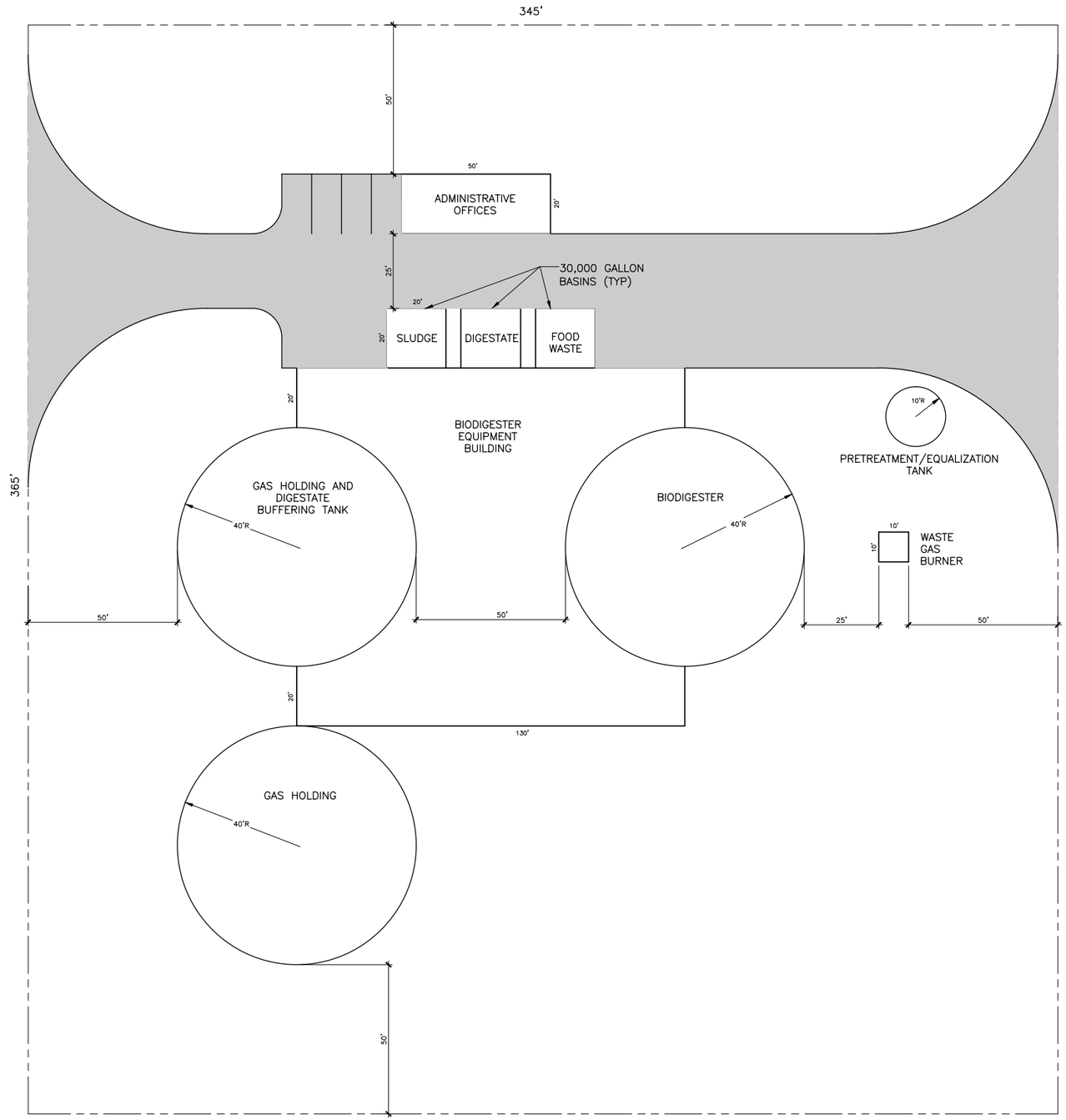
FIGURE
6



BIODIGESTER LAYOUT 2

SCALE: 1" = 20'

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FIGURE
7

There are several emerging nutrient recovery processes available that may be employed to extract nutrients from biodigester digestate. Ultimately, nutrient recovery needs to be economically viable, easy to maintain and operate, and capable of producing a marketable product. However, because nutrient recovery technology is evolving, it is recommended that the City of Ann Arbor survey potential nutrient recovery solutions as part of any follow-on design/implementation in order to identify the most appropriate equipment. The City should also explore partnership arrangements whereby the developers of these processes will also aid in the distribution and sales of the nutrients.

2.6 WWTP IMPROVEMENTS

2.6.1 Sludge Thickening, Handling, and Transportation

Sludge from the WWTP will need to be delivered to the biodigester site for processing. Sludge transfer options include pumping through a direct pipeline or loading the sludge into trucks, transporting the sludge from the WWTP site to a receiving facility at the biodigester site.

For the purposes of this study, it was assumed that the WWTP sludge would be transported using tanker trucks for an assumed five-mile distance between the two locations. To reduce the expense of hauling the WWTP sludge, the sludge can be thickened by the same process used by the existing WWTP. We note, however, that additional improvements at the WWTP may be needed to allow thickening for the additional quantities of sludge processed by the WWTP. Improvements will likely include an additional sludge thickener, ancillary process equipment such as pumps and chemical feed systems, and an odor abatement system.

SECTION 3: BIOGAS USE AND FINANCIAL MODELS

3.1 MODEL BACKGROUND

Detailed financial modeling for the biodigester was undertaken as part of this feasibility study. The financial model developed is designed to determine the overall economic viability of the biodigester as a community resource. The model can be adjusted to examine important financing factors or approaches to the project. The model in the report is based on the project being owned and operated by the City of Ann Arbor.

The primary focus of the model was to utilize the biogas generated by the digester to produce electrical power or biomethane. Based on the assumption that the system would be located at the Wheeler Center site owned by the City, there are a limited number of outlets to take advantage of the thermal power from the heated water generated through the production of electricity.

The model provides a good financial representation due to the many similarities shared by alternative project delivery approaches. All of the approaches will use biogas as the pathway to generate the main source of revenue.

3.2 COMMON MODEL ASSUMPTIONS

Below are the common assumptions that were used to develop the financial models developed for this analysis.

3.2.1 Project Ownership, Funding, Delivery, and Key Financing Factors

Several delivery methods for the proposed system were discussed with the City. They include:

- 100% Public financing.
- Private – Public partnership.
- 100% Private financing.

Several factors were considered when evaluating the financing pathway to deliver the project. Factors that greatly affect the project include:

- Financing term.
- Bond rating/interest rate.
- Required rate of return on investment (and length of term).
- Free cash flow.
- Bonding capacity.
- Market stability/vulnerability.
- Ability to utilize federal/state incentives.

In addition, there are significant differences between the financial requirements for public and private investors, primarily the interest rate, discount rate, and the number of years to achieve full return-on-investment. Table 7 provides a comparison of these factors.

Table 7 – Comparison of Key Funding and Financing Factors for Private and Public Project Delivery

Description	Public	Private
Interest Rate	1 – 3%	5 – 7%
Discount Rate	0.5 – 1.5%	12 – 20%
Return on Investment, years	20 – 30	5 – 10

At the time of this report, it is financially advantageous for Ann Arbor to use public financing as the delivery method to determine the viability of the project. The opinion is based on the low interest rates the City of Ann Arbor is able to obtain (which is a result of the City's financial stability) and the City's less aggressive requirements for a return on investment for this type of project.

Comment on Public/Private Partnerships (PPP): In addition to solely public or private biodigester project development projects, many biodigester facilities are constructed using public funds for capital expenditures, but are operated by private companies under contract to the municipality. This business model usually involves the contractor receiving payments for per dry ton processing charges plus additional expenses incurred by operating the plant. Revenue earned by tipping fees is usually shared between the contractor and the municipality at a negotiated percentage. The contractor also manages the electrical generation portion of the contract, earning a fee based on per kWh generated by the biogas generator.

Because of the wide number of potential features of any given public/private partnership (usually based on specific negotiations), a PPP scenario was not modeled as part of this feasibility study.

3.2.2 Market Status

The current market conditions are not favorable for the development of a commercial anaerobic digester via private financing. Factors detracting from the development of digester projects in Michigan include:

- Low landfill disposal cost including transportation, tip fees and disposal.
- Abundance of landfill space.
- Lack of State legislation to require or incentivize food waste diversion.
- Low natural gas cost.
- Low electrical power rates.
- Lack of incentives for production of "green" electricity through renewable portfolio standards.
- Lack of public awareness for food waste diversion.

There are a number of anaerobic digester facilities operating within a 100-mile radius of the City of Ann Arbor. Most of these facilities are potential competitors, since they can accept organic wastes such as food waste in addition to processing municipal sludge. Figure 8 maps these facilities and the general location, distance from Ann Arbor, and the type of treatment facility operated at the location identified on the map.

3.2.3 Model Time Line

The economics for the proposed facility were analyzed over a 30-year period. The period was selected based on the full financial depreciation of the proposed assets. A residual value for the assets was assumed to equal zero since the City would not plan on recovering any monies from a sale of the facility.

Green Meadows Farms
6400 N Hollister Rd, Elsie, MI 48831

City of Flint/BioWorks Energy
G-4652 Beecher Road Flint, MI 48532

Lowell Energy Anaerobic Digester
625 Chatham St., Lowell MI 49331

Michigan State University
4090 College Rd Lansing, MI 48910

64 miles

52 miles

93 miles

43 miles

City of Ann Arbor

55 miles

64 miles

Mill Creek Farms
20858 Co Rd P, Alvordton, OH 43501

Napoleon Biogas Llc
12329 Township Road P3, Napoleon, OH 43545

LEGEND

- WRRF with Anaerobic Digester
- City of Ann Arbor
- Existing Biodigester Facility
- 25 Mile Buffer Ann Arbor
- 50 Mile Buffer Ann Arbor

EXISTING BIODIGESTER FACILITIES

SCALE: 1" = 6 MILES

0 3 6 12

DATA SOURCES:

Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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FIGURE
8

PLOT INFO: Z:\2016\160116\CAD_FIGURES\DIGESTER 1.DWG LAYOUT: FIG-08-EX FACILITIES DATE: 6/8/2017 TIME: 12:03:25 PM USER: RS2

3.2.4 Capital, Operation and Maintenance Costs

3.2.4.1 Assumptions on Location and Labor-Sharing

3.2.4.1.1 Facility Location

The Wheeler Center was selected as the location of the proposed improvements. The selected site is approximately 5.5 miles from the City's WWTP. This information was used in calculating the cost of transporting thickened sludge from the WWTP to the biodigester. Figure 9 provides an aerial map showing the area within a five-mile radius of the Ann Arbor WWTP.

3.2.4.1.2 Labor Sharing

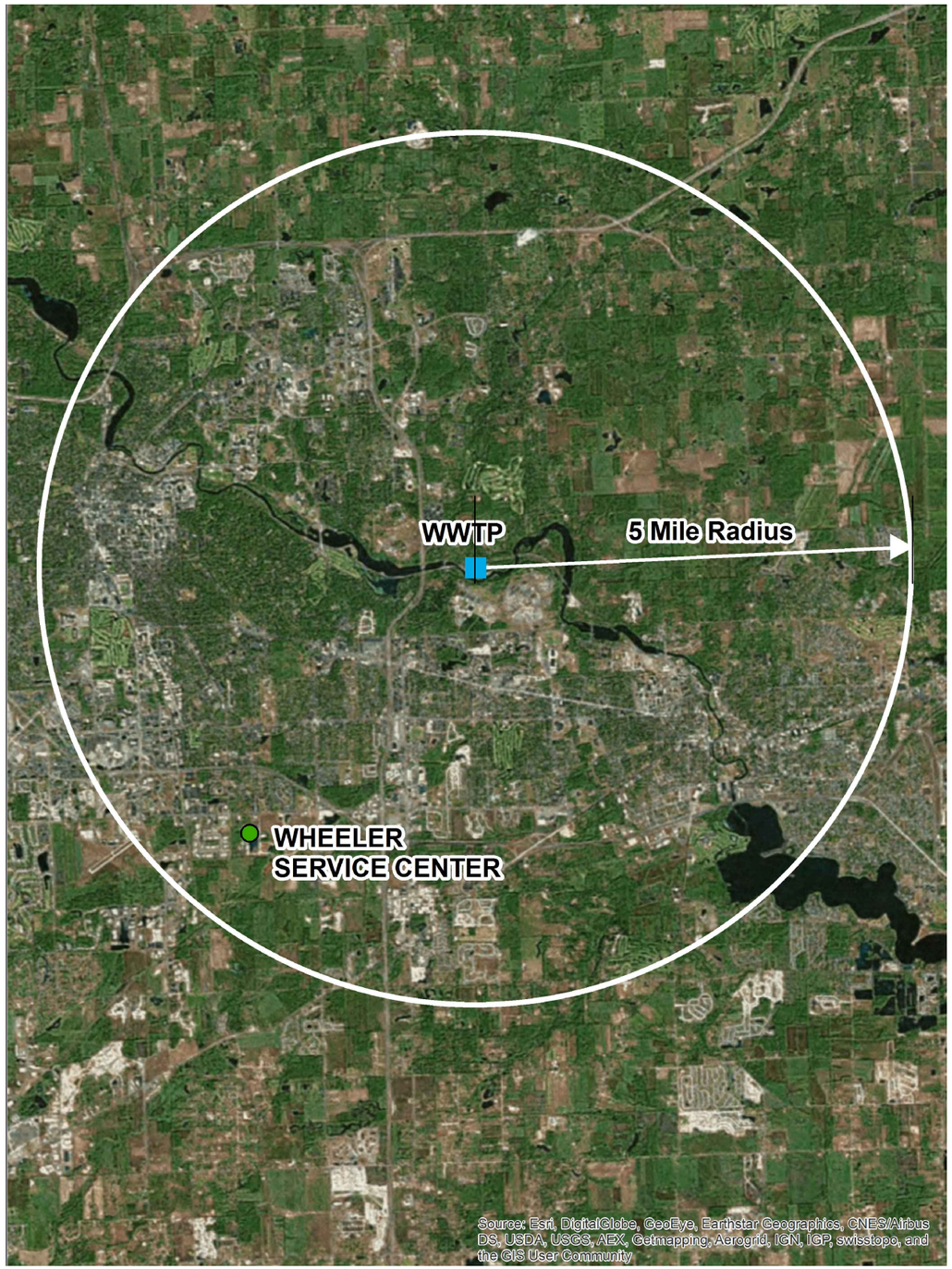
The biodigester contemplated in this study would be considered an extension of the processes and services normally associated with the WWTP, with the assumption that the staff at the existing WWTP would be instrumental in operating the biodigester.

This is a good strategy for the City, because many of the technical skills necessary for the efficient operation of a WWTP are identical to those needed to operate a biodigester to process the sludge solids generated as part of their overall wastewater treatment operation. Like WWTPs, operation of anaerobic digesters can be complex. Different characteristics such as the overall design features, management and operational requirements, and organic loading require the facility to have a competent and skilled staff. Maintaining a highly-trained staff will result in a successful operation. The existing City WWTP staff is well qualified to operate an anaerobic digestion system, with experience in the following critical areas:

- Facility operation on a continuous, 24-hour-per-day, year-round basis.
- Processing of waste materials.
- Navigation of the regulatory environment for proper residuals disposal.
- Management of complaints from citizens.
- Biological waste treatment process control.
- Commitment to long term, sustainable operations for the benefit of the City and its citizens.
- Dedication to continuous improvement through training.
- Efficient and effective response to spills, equipment failures, and upsets of the various processes.

3.2.4.2 Labor Costs

Labor expense for the biodigester was based on the current pay rates and job descriptions utilized at the City's WWTP. Staffing of the proposed system, pay rates, and overall duties are detailed in Table 8. The facility waste receiving schedule was set at 8 hours per day and 5 days per week. This analysis also included the additional cost of a highly-automated system that would be capable of processing organics received during hours in which employees are not onsite. As with all wastewater treatment systems, an allowance for overtime has been included in the model.



WWTP SITE

SCALE: 1" = 4000'

0 2000 4000 8000

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Biodigester Feasibility Study

FIGURE
9

PLOT INFO: Z:\2016\16016\CAD_FIGURES\DIGESTER 1.DWG LAYOUT: FIG09-WWTP 5 MILE DATE: 3/28/2017 TIME: 8:16:30 AM USER: RS2

3.2.4.2.1 Labor Considerations

A large-scale digestion facility such as the one proposed in this study requires multiple levels of responsibility to manage the operation and maintenance for the long-term success of the service. The facility will require multiple staff members for a variety of daily tasks. The decision on the appropriate staffing levels to include in the labor plan were selected based on discussions with the City. The proposed staffing for the biodigester facility leverages the effective use of staff already working at the City's WWTP and the nearby material recovery facility (MRF). Table 8 details the anticipated allocation of the City's existing staff to digester management and operations. The MRF scale attendant's labor cost was not included in the model due to the small number of deliveries to the biodigester in comparison the MRF. With the responsibility of the sewage sludge stabilization shifting from the WWTP to the biodigester facility, the required workforce needed for sludge processing at the WWTP is expected to be reduced. The reduced labor demand allows for some of those staff members to be transferred to the biodigester labor force.

Table 8 – Labor Costs – Fully Burdened

Position	Annual Escalation Rate	Annual Expense to City*	Existing Position	New Hire	Resource Allocation, %
Administrative Assistant	3%	$ 82,400	X		10
Manager	3%	$ 133,900	X		25
Operator-Mechanic	3%	$ 115,356		X	100
Operator-Mechanic	3%	$ 115,356		X	100
Operator- Mechanic (transferred from WWTP)	3%	$ 115,356	X		100
Weigh Scale Attendant	NA	NA	X		As needed
Overtime - Provided to cover cost of WWTP operators covering open shifts and overtime as needed.	3%	$ 41,445	NA	NA	NA

*Rates are based on data for wages and benefits at WWTP

3.2.4.3 Financing Costs and Discount Rate

The cost of financing was based on the project being funded by the City. The City retains an excellent bond rating for both revenue and general obligation bonds. The City of Ann Arbor (AA+ rating) is currently issuing tax exempt debt with the same terms as the US Treasury. A 1.8% interest rate was used to establish debt service payments following discussions with the City's financial staff. An amortization period of the debt was established as being equal to the overall model timeline of 30 years.

The discount rate is the interest rate used to discount a stream of future cash flows to their present value. Typically, rates used as the discount rate are an institution's cost of capital. The discount rate here refers to the required rate of return on the investment capital. This corresponds to the annual yield required of investments of similar type. Following discussions with the City staff, it was determined that the City's investments are of very low yield, risk, and term. As a result, the decision was made to set the discount rate at 0% for the financial evaluation for this feasibility study. The City only requires the biodigester facility to not financially burden the citizens of the Ann Arbor through increased fees or rates.

3.2.4.4 Depreciation

Depreciation of the assets was not utilized as added economic value. Municipalities do not receive a corporate tax benefit from reduced income through depreciation.

3.2.4.5 Taxes

State and local taxes were not included as part of the models.

3.2.4.6 Operating Expenses

Operating expenses were determined for the model utilizing current market pricing for labor, consumables, and services. Details of the expenses accounted for in the models are provided in Table 9. The baseline data and escalation rates in Table 9 were used to generate the overall cost savings by the WWTP under a scenario where the biodigester facility is used to process and dispose of the WWTP sludge solids.

Table 9 – Baseline Unit Cost of Goods and Services – Year 1 of Financial Modeling

Item	Base Price	Rate of escalation	Service by	Notes
Lime, $/ton	$131	2%	Bid	
Land application of digested sludge, $/gallon	$0.033	3%	Contractor	
Electrical power @ digester, $/kWh	$0.09	5%	DTE	
Electrical power @ WWTP, $/kWh	$0.065	2%	DTE	
Polymer for dewatering and thickening, $/lb	$1.70	2%	Bid	
Odor control chemical (at WWTP), $/gallon	$61.00	2%	Bid	
Labor	See Table 8			
Landfill tip fees, $/ton	16.70	5%	Bid	
Liquid hauling of WWTP sludge, $/hr	$100.00	1%	Contractor	Highly dependent on fuel costs
Combined Heat and Power (CHP) maintenance, $/kWh	$0.02	1%		
Biogas upgrading system maintenance, $/year	$34,000			

3.2.5 Revenues

3.2.5.1 Wastewater Treatment Cost Savings

The models considered the current practices of the City's WWTP and the costs savings that would be realized by anaerobically treating the primary and secondary sludge generated by the plant. The cost avoidance was treated as a revenue stream to the digester operations. Cost savings at the WWTP accounted for in the model included the following:

- Sharing of work force labor.
- Decreasing the volume of solids being land applied and landfilled.
- Reducing the amount of chemicals (polymer, odor control, and lime).
- Lowering the consumption of electrical power used to dewater or thicken sludge.
- Lowering the regulatory fees associated with land application of biosolids.

The items in Table 9 are based on the existing treatment plant's historical data and forecasted industrial trends. This data was based on input from the City's staff.

3.2.5.2 Tipping Fees from External Food Waste

Tipping fees from food waste were included as a revenue source to the biodigester operations. Tipping fees for expected substrates are detailed in Table 10.

The selected tipping fees for grease trap wastes were based on the current market conditions and the food waste inventory conducted for this study. Grease trap tipping fees currently range between $0.045 and $0.38 per gallon. It was found that landfilling of solidified grease trap waste had the highest tipping fees, whereas anaerobic digesters in the region charged the lowest fee to accept this waste. Based on the current market established by regional anaerobic digesters, a tipping fee of $0.10 per gallon was selected for the models.

Food processing tip fees, estimated at $35/ton, were based on the gate fees for food waste at the City's composting operations. Although most of the food processing waste generated within the City is disposed at local landfills at a lesser rate than the City's compost site, the City would have the option to require food processing waste to be handled by the proposed biodigester. The concept of diverting organic waste from landfills is a policy that is gaining popularity with some states. Currently, several states have organic waste diversion policies in effect, including Massachusetts, Connecticut, Vermont, Minnesota, and California.

Table 10 – Financial Model Baseline Food Stock Tipping Fees

Feedstock Description	Tip Fee	Notes
Grease Trap Waste	$0.10/gallon	Volatile market as grease trap collection companies are looking to turn expense into revenue
Food Waste	$35/ton	

3.2.5.3 Revenue from Electricity

Using biogas to generate electricity is a common pathway for making revenue in states where there are financial incentives for renewable energy, high electric rates, or both. Revenue from electrical power generated by using biogas from the Ann Arbor Biodigester can be collected through two sources.

1. The first source is through net metering based on the biodigester being located at, or near, the Wheeler Center. It was estimated by the City that the Wheeler Center's daily demand averages 100 kW of power. The Center currently has an electrical rate of $0.09/kWh. The electrical power generated could be used to offset power consumed from the grid, thereby creating a cost savings to the City of approximately $80,000 per year. The balance of the power could be sold through the City's existing power purchase agreement with DTE Energy, the local power utility.
2. The second source to create revenue could be by using the generated electrical power to charge electric-powered vehicles. To take advantage of this option, the City would need to invest in charging stations at the Wheeler Center since current state law does not allow for the power to be "wheeled" to other locations for the purposes of net metering.

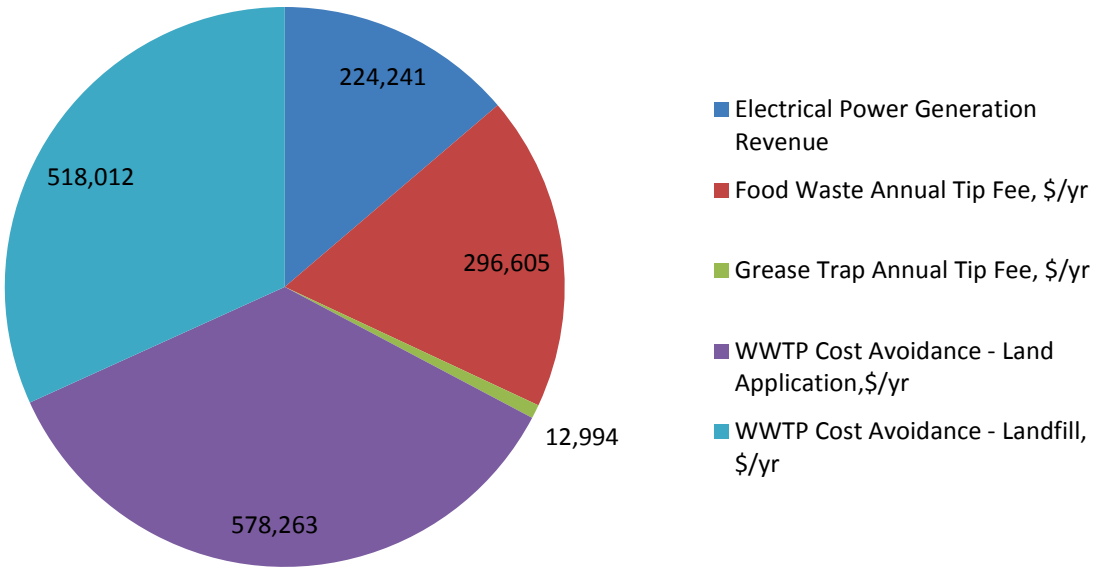
In late 2016, the State of Michigan increased their Renewable Portfolio Standard (RPS) from 10% to 15%. The increase in the RPS, however, does not obligate electrical power utilities to purchase a certain portion of their RPS requirement from third party developers, such as the City. Electrical power utilities can build their own renewable energy projects thus reducing the potential for third-party developers to invest in this market.

Figures 10 and 11 detail the forecasted revenues and expenses for the proposed Ann Arbor biodigester facility using the biogas to generate electricity.

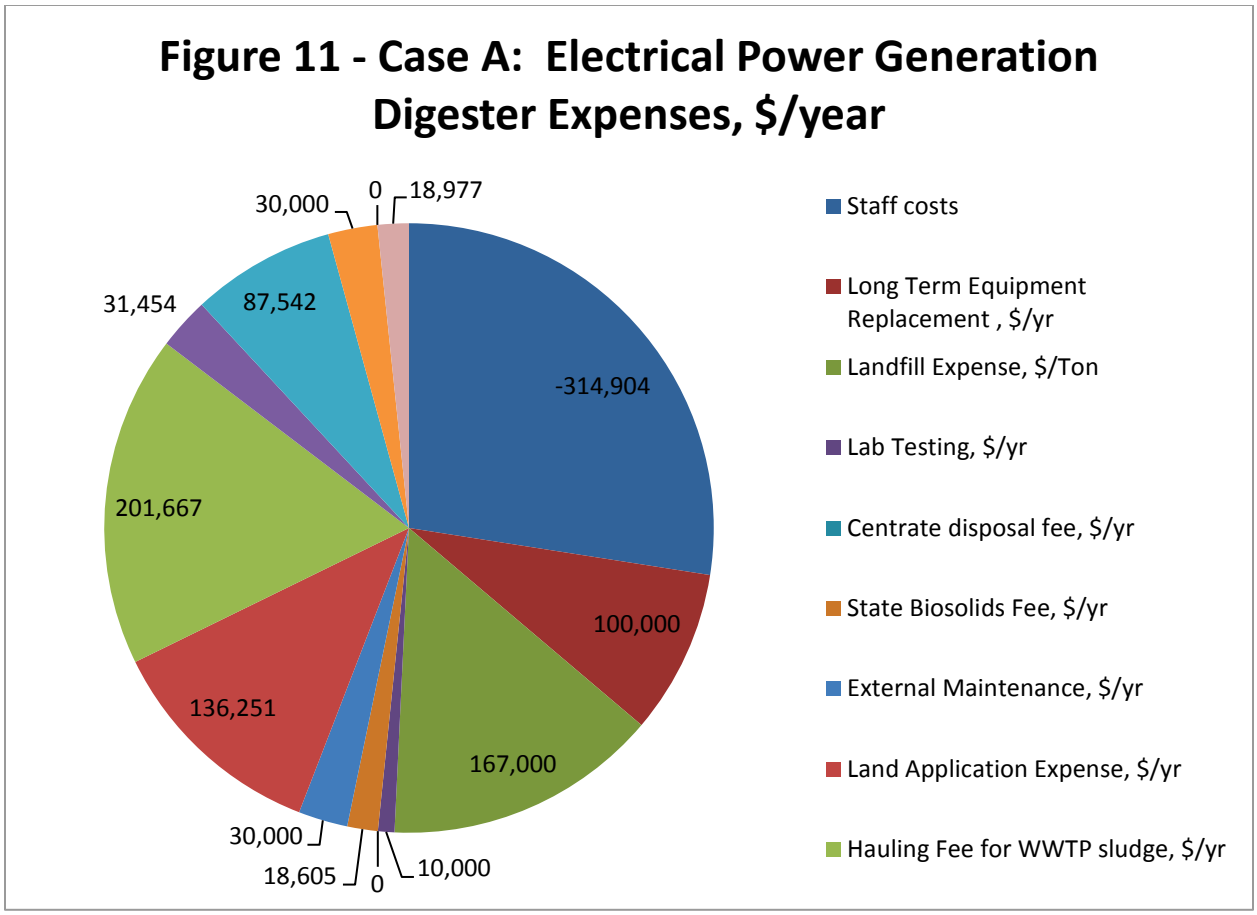
Comment on Revenue from Carbon Credits: Several jurisdictions operate carbon markets in an effort to decrease the greenhouse gases (GHGs) emitted in those areas. Biogas from a biodigester is approximately 65% methane (CH4), which is considered a moderately powerful GHG. Burning biogas (i.e. methane) in a combustion engine will decrease the greenhouse warming potential (GWP) of the gas by a factor of approximately 9[4].

At the current time, no carbon markets exist for the Michigan area per se. A cap-and-trade program was established in California in 2013 (in collaborate with the Province of Quebec), but the program has seen very weak demand for credits. At the current time, any potential income from carbon credits from the Ann Arbor Biodigester is highly speculative. For this reason, carbon credits were not included as potential revenue sources. See Section 4 for an additional discussion on the Social Cost of Carbon.

Figure 10 - Case A: Digester Operating Revenues from electrical power production and feedstock tip fees



[4] The most accurate calculation of reductions in GWP must account for the mass differences between the gas in question and carbon dioxide. An oft-cited value for the GWP of methane is cited at 25:1 (meaning that the GWP has been reduced by a factor of 25), but the more accurate reduction is a factor of approximately 9:1.



3.2.5.4 Revenue from Biomethane

3.2.5.4.1 Biomethane as a Natural Gas Replacement

After biomethane gas is cleaned of impurities, it is suitable to be used as a natural gas replacement. The cleaned biomethane gas could be used to offset the natural gas used to heat buildings on the Wheeler site. Henry Hub[5] pricing over the past 12 months reported by the Energy Information Administration (EIA) averaged $2.39 per MCF (1000 cubic feet). The natural gas pricing has been at historical lows during this period. For biomethane to be used as a natural gas replacement, price per MCF for natural gas must double to compete with the revenue opportunity that is available through electrical power production. The difference between the potential revenue from these sources is known as "spark spread." The EIA defines spark spread as the difference between the price received by a generator for electricity produced and the cost of the natural gas needed to produce that electricity. Figure 12 details the spark spread for the electrical power and biomethane production using biogas generated at 10,000 cubic feet per hour.

[5] Henry Hub – A natural gas distribution hub in Louisiana that connects 9 interstate and 4 intrastate distribution lines of the natural gas pipeline system. The Henry Hub is important segment of the natural gas distribution system and lends its name to the pricing point for natural gas.

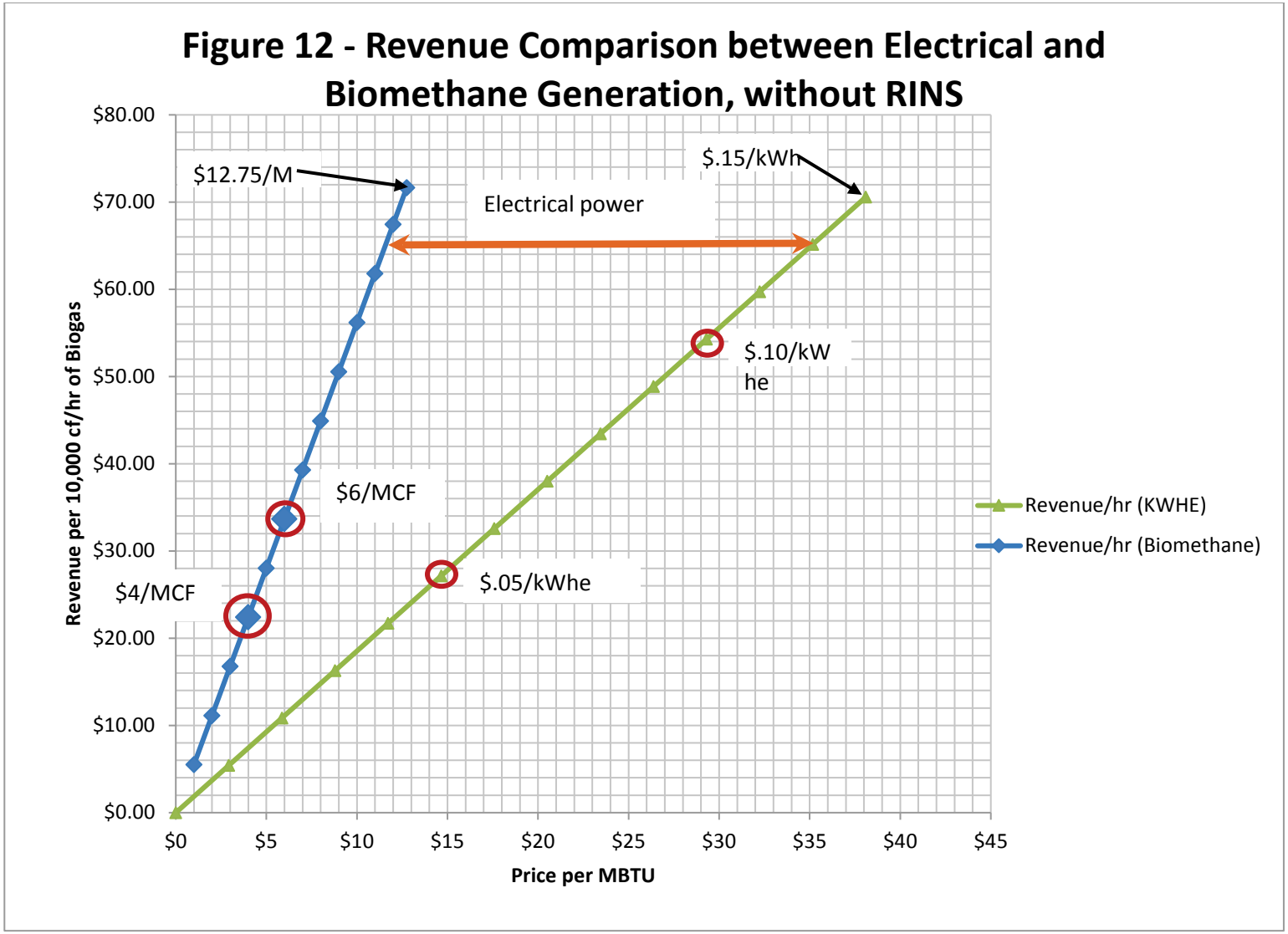


Figure 12 - Revenue Comparison between Electrical and Biomethane Generation, without RINS
$80.00
$70.00
$60.00
$50.00
$40.00
$30.00
$20.00
$10.00
$0.00
Revenue per 10,000 cf/hr of Biogas
$0
$5
$10
$15
$20
$25
$30
$35
$40
$45
Price per MBTU
$12.75/M
$.15/kWh
Electrical power
$.10/kW he
$6/MCF
$4/MCF
$.05/kWhe
Revenue/hr (KWHE)
Revenue/hr (Biomethane)

The City's purchase price for electrical power from DTE is presently $0.055/kWh. For biomethane to be a viable energy alternative, either Federal financial incentives are needed to subsidize alternative energy sources or the price of natural gas would need to at least double. Either of these occurrences would allow biomethane to be considered as a natural gas replacement for electrical power generation.

3.2.5.4.2 Biomethane as Vehicle Fuel

Unlike the use of biomethane as a natural gas replacement, biomethane as a vehicle fuel currently has federal incentives that greatly increases its value as a vehicle fuel replacement. In 2005, Congress created the renewable fuel standard (RFS) program to reduce greenhouse gas emissions and expand the nation's renewable fuels sector to reduce the nation's reliance on imported oil. The RFS program is administered by the U.S. Environmental Protection Agency (USEPA). This program requires refiners and/or importers of gasoline and/or diesel fuel to either blend renewable fuels or purchase credits, also known as Renewable Identification Numbers (RINs), to be compliant with the federal law. The law extends to year 2022. Since the law's inception, the volume of renewable fuel to be produced has increased. The 2022 congressionally-mandated target for renewable fuel generation is 36 billion gallons.

Presently, the pricing for biomethane as a vehicle fuel is determined by the BTU value of the fuel and the price of RINs. Note that the value of a given RIN anywhere in the US is enhanced by the demand for RINs in California. California enacted targets for GHG reductions by establishing the Low Carbon Fuel Standard (LCFS), thereby increasing the broader market for RINs.

Note, however, that the market for RINs is highly volatile. At the current time, the California LCFS market is at capacity, which in turn has decreased the market for RINs across the US. Without RIN support, biomethane is valued at the same price as natural gas. As detailed in Figure 11, current natural gas pricing does not provide sufficient economic return for the production of biomethane to be used as a fuel replacement for vehicles.

As a part of this study, vehicle fuel pricing research sought to provide suitable pricing expectations for biomethane as an input to a financial model. Like many commodities, RINs are either sold on the spot market or through a long-term contract that is similar to a Purchase Price Agreement (PPA) for electricity. Spot market RIN pricing for 2016 ranged between $1.90 and $2.10. Pricing for a multi-year contract will be heavily dependent on the overall contract term time period and take into account the risk of regulatory change that could negatively impact the sale of RINS. Based on discussions with RIN brokers it was determined that contract terms greater than seven years were unlikely at this time. The brokers thought the RINs market was uncertain based on the possibility of a RFS extension past 2022 and therefore too risky for a long-term contract. Based on this research, pricing of biomethane as a vehicle fuel for a seven-year contract was used in the economic evaluation for the project. The anticipated pricing structure for biomethane as a vehicle fuel is detailed in Table 11.

Table 11 – 7-Year Contract for Biomethane as Vehicle Fuel

Methane %	65%
Natural Gas Price, $/MMBtu	$2.39
RIN, $	$ 0.88
RIN: MMBtu	11.72
RIN, $/MMBtu	$10.31
Total Value, $/MMBtu	**$12.70**

3.2.5.4.3 RINs through Electrical Power Production

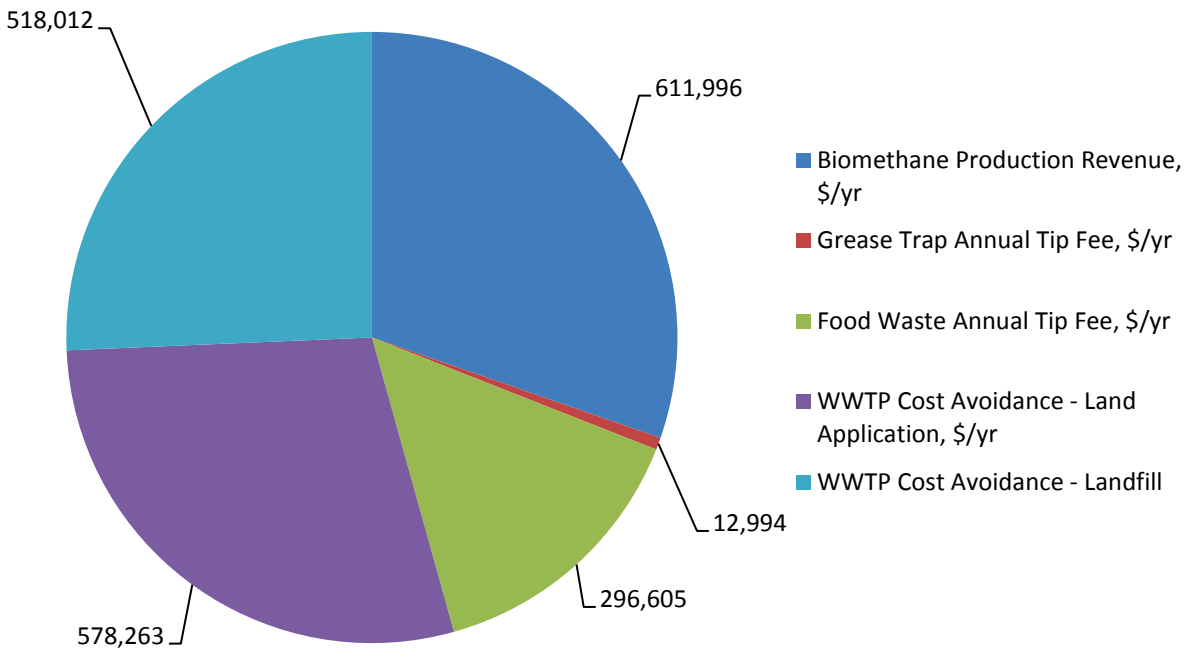
As with biomethane used as vehicle fuel, the RFS does allow for electrical power generated by biogas and used as a vehicle fuel to be eligible for RINs. To date, the EPA has not approved any projects utilizing electrical power for vehicle fuel because of compliance issues with verifying RIN tracking. The USEPA is actively looking to eliminate the current roadblocks related to RINs generated from biogas produced electricity[6].

3.2.5.5 Biogas to Biomethane as Vehicle Fuel

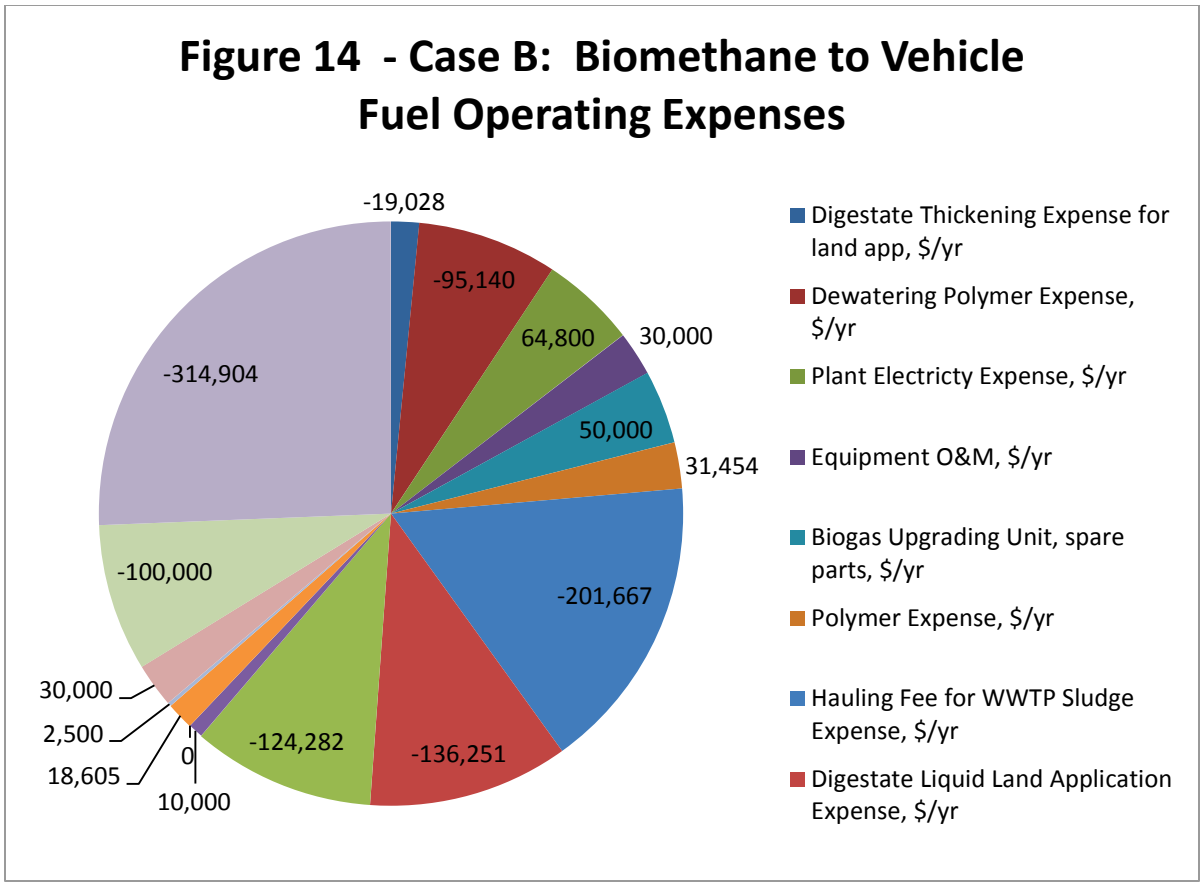
3.2.5.5.1 Distribution of Revenues and Expenses

Figures 13 and 14 detail the revenues and expenses related to the production of biomethane sold as vehicle fuel and the capture of RFS incentives for the first year of proposed biodigester facility operations. With the exception of RIN revenue, overall revenues and expenses in the following years of operation are adjusted by the escalation values as detailed in Table 9. Revenues from the sale of RINs are per the contracted value of $0.88/RIN for seven years. After expiration of the RIN contract, revenues from the sale of biomethane as vehicle fuel decrease substantially.

Figure 13 - Case B: Biomethane to Vehicle Fuel Operating Revenues, $/yr



[6] Federal Register / Vol. 81, No. 221 / Wednesday, November 16, 2016 / Proposed Rules page 80890.



3.2.5.5.2 Cost Accounting across Departments

One of the benefits of a biodigester is that many of the costs typically incurred by the WWTP are avoided. For example, the anaerobic digestion process itself will decrease the volume of material to process by approximately 25%. This in turn leads to a 25% savings in disposal costs since disposal is charged on a 'per-ton' or 'per gallon' basis. Furthermore, the WWTP saves on consumables like lime and polymer, which are used to stabilize sludge that is aerobically processed.

To correctly allocate the benefits of these avoided-costs, many municipalities will consider the avoided-cost to be revenue to a different department. Figure 15 shows how the avoided cost of sludge processing (which includes volume reduction, and less lime/polymer) can be booked as revenue.

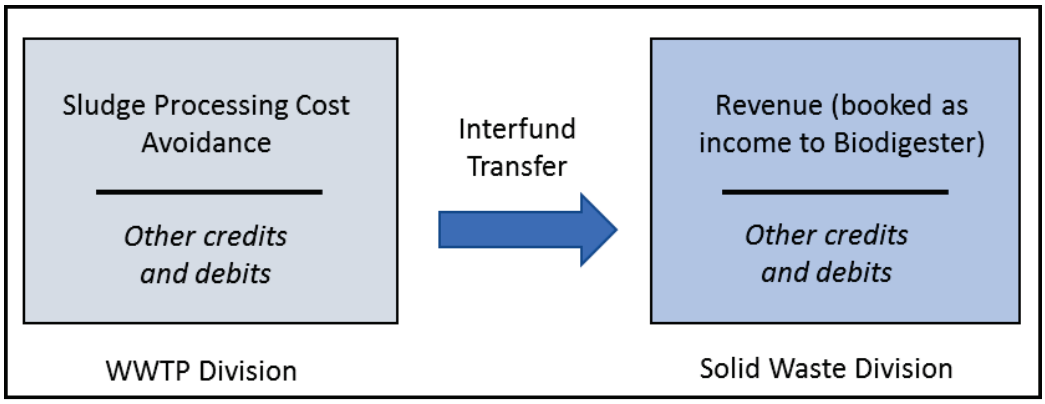
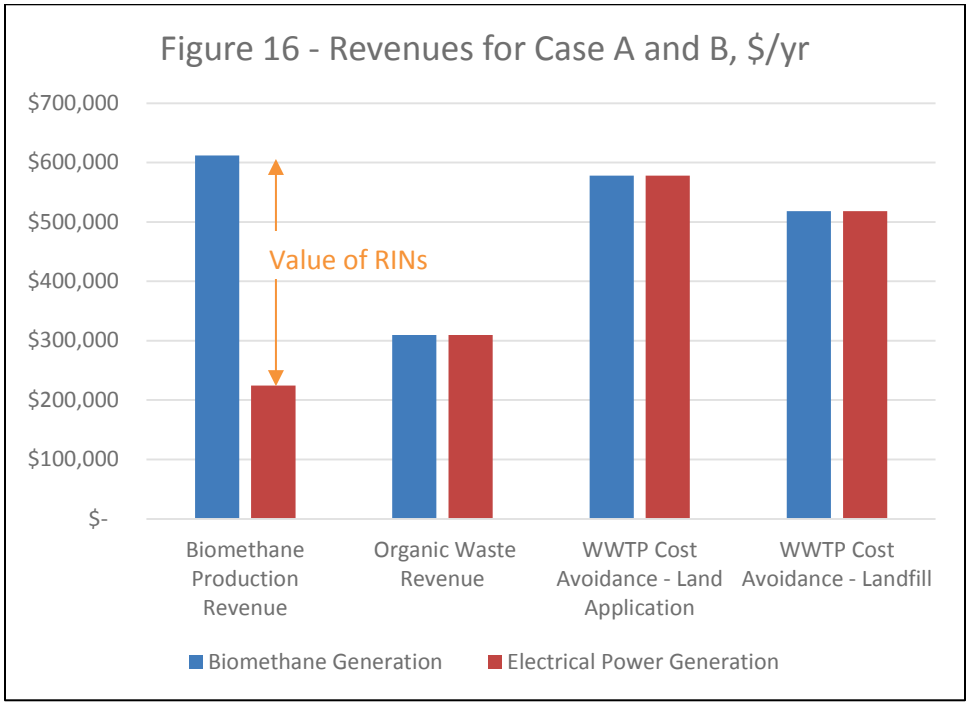


Figure 15: Accounting transfers between municipal departments are used to correctly allocate the value of the decreased cost of sludge processing.

3.3 COMPARISON OF REVENUE AND EXPENSES

Figures 16 through 19 provide the comparison of the revenues and expenses for each case. As can be seen from the Figure 16, biomethane revenues are higher as compared to revenues from electrical power production. The higher revenues are observed over the first seven years of the projects. After year seven, biomethane revenues drop off to approximately ½ of their value due to the expiry of the RIN contracts.



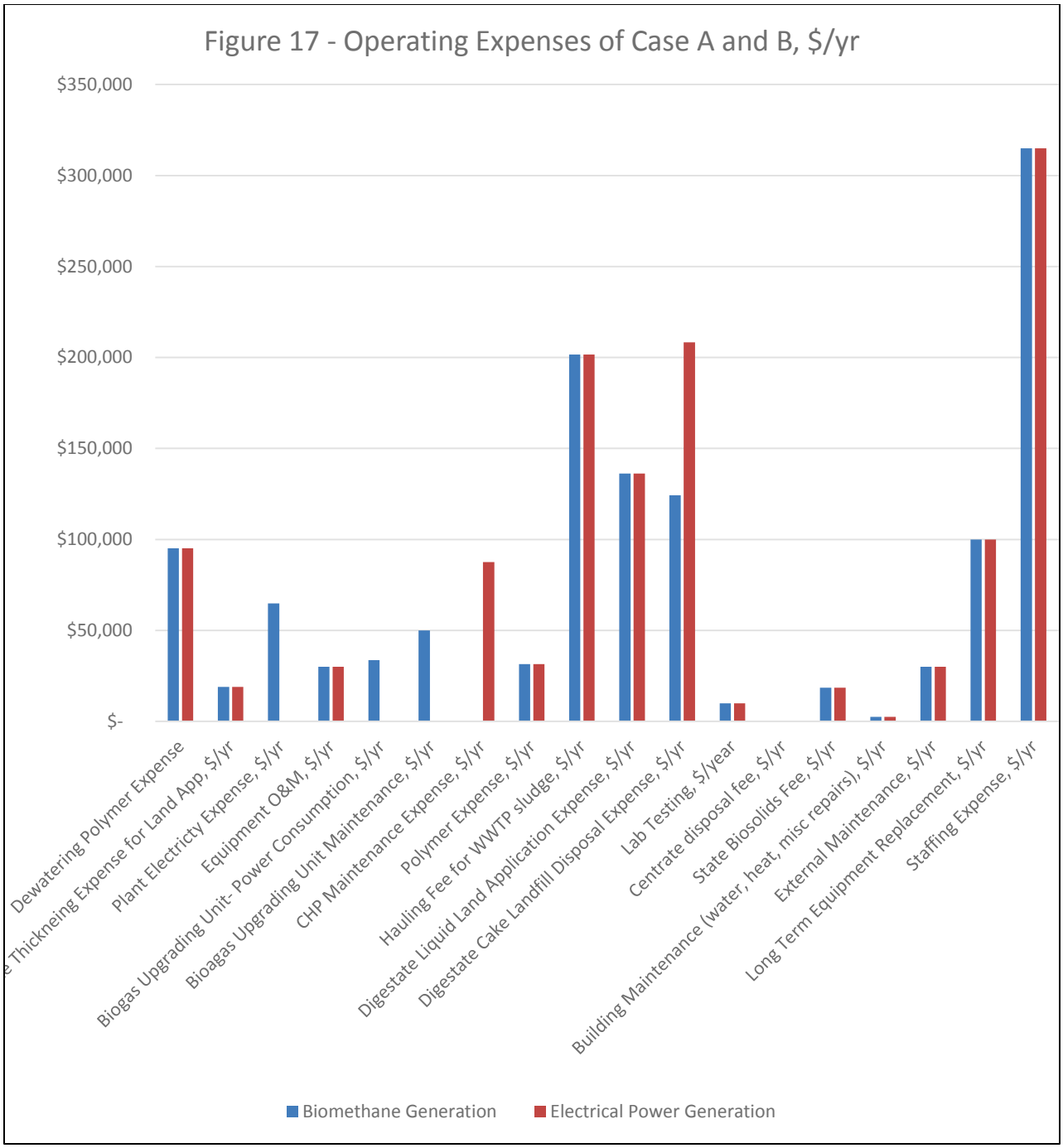
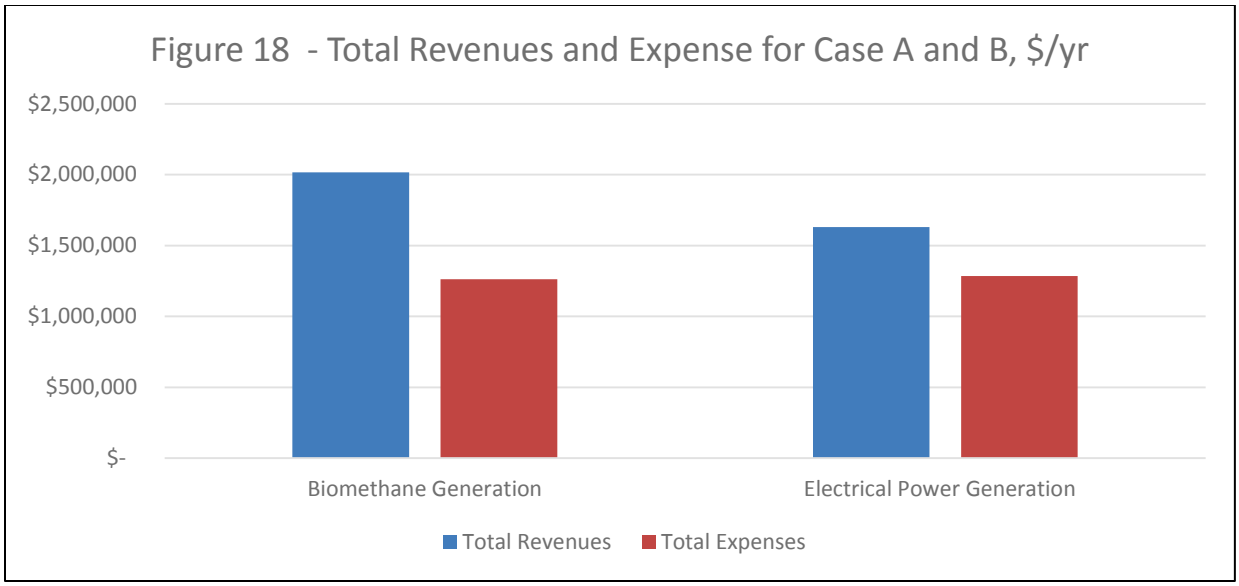


Figure 17 - Operating Expenses of Case A and B, $/yr
$350,000
$300,000
$250,000
$200,000
$150,000
$100,000
$50,000
$-
Dewatering Polymer Expense
e Thickneing Expense for Land App, $/yr
Plant Electricty Expense, $/yr
Equipment O&M, $/yr
Biogas Upgrading Unit- Power Consumption, $/yr
Bioagas Upgrading Unit Maintenance, $/yr
CHP Maintenance Expense, $/yr
Polymer Expense, $/yr
Hauling Fee for WWTP sludge, $/yr
Digestate Liquid Land Application Expense, $/yr
Digestate Cake Landfill Disposal Expense, $/yr
Lab Testing, $/year
Centrate disposal fee, $/yr
State Biosolids Fee, $/yr
Building Maintenance (water, heat, misc repairs), $/yr
External Maintenance, $/yr
Long Term Equipment Replacement, $/yr
Staffing Expense, $/yr
Biomethane Generation
Electrical Power Generation



3.4 MODEL RESULTS

The results of the models are detailed below in Tables 12 through 14.

Table 12 – Profitability Analysis Case A – Electrical Power Generation

	Project Description	Case A- Ann Arbor Anaerobic Digester Electrical Power				USD
	Nominal value of all investments		27,168,559		Discounted investments	27,168,559
	Required rate of return		0.00 %			
	Calculation term		30.0		years	1/2018 - 12/2047
	Calculation point		1/2018		(In the beginning of period)	
	Present value of business cash flows				Notes	
±	PV of operative cash flow		12,498,827			
+	PV of residual value		0			
	Present value of business cash flows		**12,498,827**			
-	Present value of reinvestments (maintenance etc.)		0			
	Total Present Value (PV)		**12,498,827**			
	Investment proposal	Nominal	PV			
-	Proposed investments in assets	-27,168,559	-27,168,559			
	Investment proposal	-27,168,559	-27,168,559			
	Net Present Value (NPV)		**-14,669,732**		< 0	
	Internal Rate of Return (IRR)		-4.95%		< 0 %	
	Profitability Index (PI)		0.46		< 1	
	Payback time, years		-		Based on discounted FCF	

Table 13 – Profitability Analysis Case B – Biomethane Generation

Project Description	Case B - Ann Arbor Anaerobic Digester - Biomethane			USD
Nominal value of all investments		27,546,128	Discounted investments	27,546,128
Required rate of return		0.00 %		
Calculation term		30.0	years	1/2018 - 12/2047
Calculation point		1/2018	(In the beginning of period)	
Present value of business cash flows				
PV of operative cash flow		20,576,997		
PV of residual value		0		
Present value of business cash flows		**20,576,997**		
Present value of reinvestments (maintenance etc.)		0		
Total Present Value (PV)		**20,576,997**		
Investment proposal	Nominal	PV		
Proposed investments in assets	-27,546,128	-27,546,128		
Investment subventions	0	0		
Investment proposal	-27,546,128	-27,546,128		
Net Present Value (NPV)		**-6,969,132**	< 0	
NPV as a monthly annuity		-		
Internal Rate of Return (IRR)		-1.82%	< 0 %	
Profitability Index (PI)		0.75	< 1	
Payback time, years		-	Based on discounted FCF	

Table 14 – Profitability Comparison of Case A and Case B

Project Description		Case A- Ann Arbor Anaerobic Digester - Electrical Power	Case B - Ann Arbor Anaerobic Digester - Biomethane
Nominal value of all investments		**27,168,559**	**27,546,128**
Required rate of return		**0.00%**	**0.00%**
Calculation term (years)		**30**	**30**
Calculation term		1/2018 - 12/2047	1/2018 - 12/2047
Calculation point		1/2018	1/2018
Interval length (months)		12	12
PV of operative cash flow		12,498,827	20,576,997
PV of residual value		0	0
Present value of business cash flows		12,498,827	20,576,997
Present value of reinvestments		0	0
Total Present Value (PV)		**12,498,827**	**20,576,997**
Proposed investments in assets		-27,168,559	-27,546,128
Investment subventions		0	0
Investment proposal		-27,168,559	-27,546,128
Net Present Value (NPV)		**-14,669,732**	**-6,969,132**
NPV as a monthly annuity		-	-
Internal Rate of Return (IRR)		-4.95%	-1.82%
Modified Internal Rate of Return		-2.55%	-0.97%
Profitability Index (PI)		0.46	0.75

3.3.1 Project Financing Results

The results of the models indicate that financing the biodigester will be difficult based on the anticipated unfavorable economic performance of the project. There are perceived and real risks associated with the revenue streams that are needed to offset the initial capital and longer-term operating costs associated with a new biodigester facility. Current tipping fees related to feed stocks for the biodigester and the value of the biogas that would be generated are currently too low. It does not appear that there is a near-term potential of either legislative initiatives to increase tipping fees or increase the natural gas price that will benefit an investment into a biodigester facility.

Most biodigesters are located at WWTPs to be closer to the main source of feed stock for the facility and management and operations staff skilled enough to operate the facility. In the case of Ann Arbor, the City's WWTP is built out to completely occupy the available land at the site. Site expansion is limited by the land features and adjacent development. As a result, an alternative location is necessary. This adds cost to the transport on the feed stock and also to the management and operation labor cost related to the remote placement from the WWTP.

The most expensive investment is capital equipment needed to construct the anaerobic digester and systems related to the intake of feed stock as well as the distribution of the digestate. For a financial analysis, these structures and the associated equipment have no reuse value that can be input into the model to offset their initial cost. The implementation of a City-owned-and-operated biodigester to

support processing of wastewater sludge and organics as inventoried in this feasibility study was found to be not economically feasible at this time.

3.3.2 Sensitivity Analysis

A sensitivity analysis of key parameters can show how sensitive the model is to the given assumptions. Key parameters that were analyzed are presented below.

1. Capital expense.
2. Biomethane revenue.
3. Food waste tipping revenue.
4. Landfill tipping fees.
5. Land application expense of biosolids.
6. Electricity revenue.
7. Biomethane revenue.

The results of the sensitivity analysis are provided below in graphical form in Tables 15 through 21 and Figure 19.

Table 15 – Sensitivity of Capital Expense Case A – Biomethane Generation

Total investment, USD	-15,000,000	-20,000,000	-27,546,128	-30,300,741	-33,055,354
Change, %	-45.5 %	-27.4 %	0.0 %	+10.0 %	+20.0 %
Net Present Value (NPV)	5,576,997	576,997	-6,969,132	-9,723,744	-12,478,357
Change, %	+180.0 %	+108.3 %	0.0 %	-39.5 %	-79.1 %

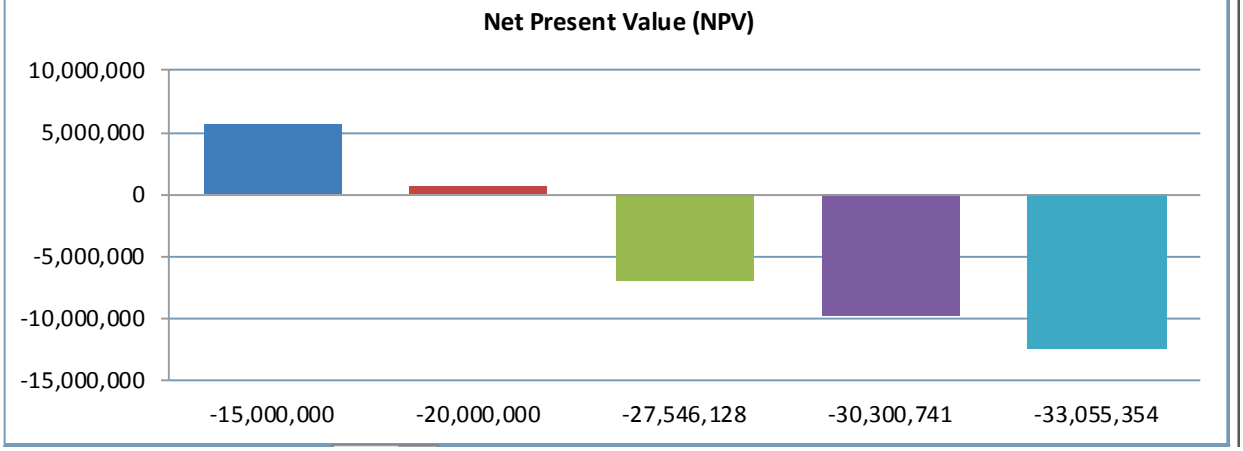


Table 16 – Sensitivity of Capital Expense Case B – Electrical Power Generation

Total investment, USD	-12,000,000	-20,000,000	-27,168,559	-29,885,415	-32,602,271
Change, %	-55.8 %	-26.4 %	0.0 %	+10.0 %	+20.0 %
Net Present Value (NPV)	498,827	-7,501,173	-14,669,732	-17,386,588	-20,103,444
Change, %	+103.4 %	+48.9 %	0.0 %	-18.5 %	-37.0 %

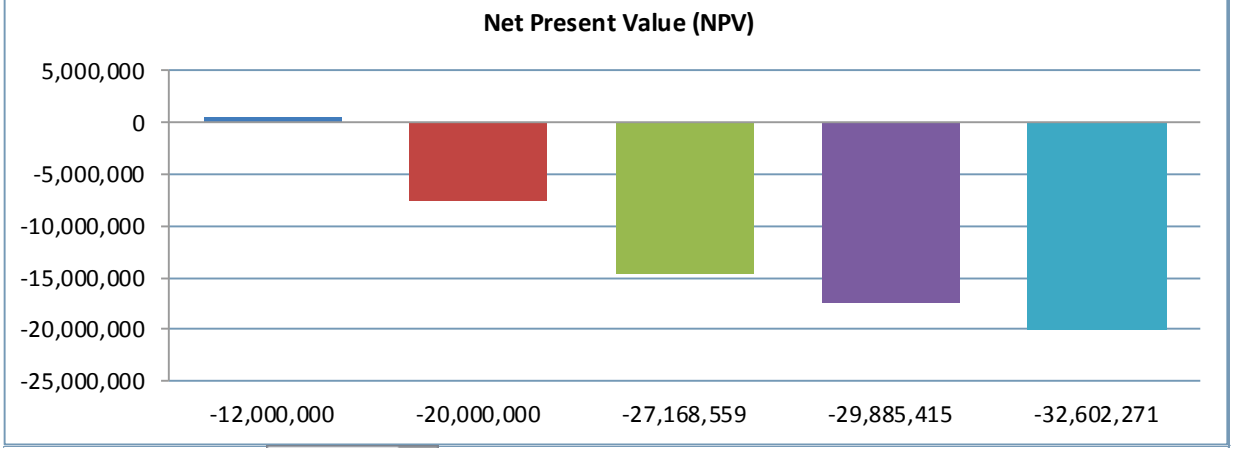


Table 17– Case A Sensitivity of Electrical Rate to NPV of Electrical Power Production

Variable	Electrical Rate, $/kWh				
Change in value, %	+50.0 %	+10.0 %	0.0 %	+75.0 %	+100.0 %
Sample value 12/2018	0.083	0.061	0.055	0.096	0.110
Net Present Value (NPV)	-12,488,715	-14,233,529	-14,669,732	-11,398,206	-10,307,698
Change, %	+14.9 %	+3.0 %	0.0 %	+22.3 %	+29.7 %

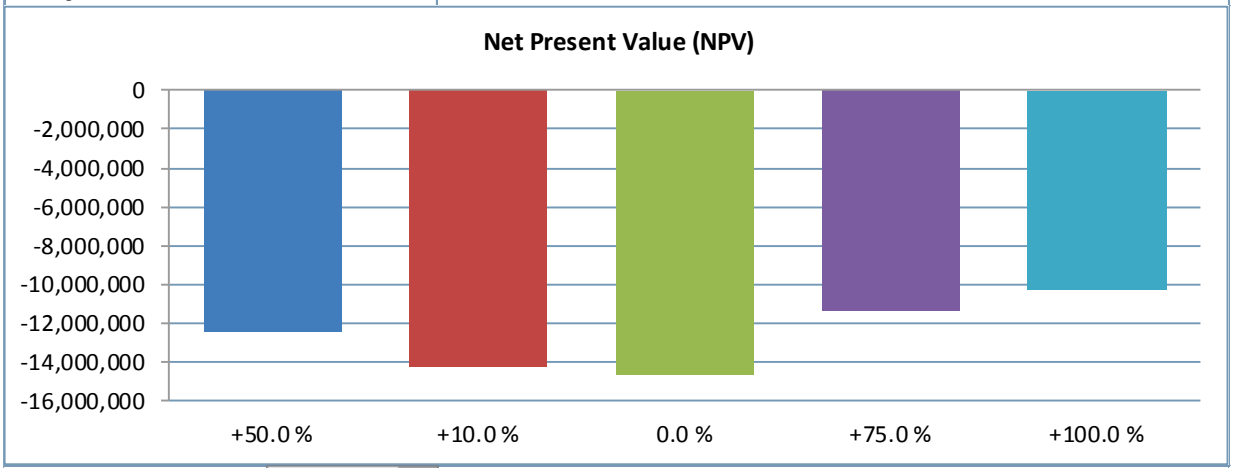


Table 18– Case A Sensitivity of Biomethane Rate Including Fuel and RIN Values

Total investment, USD	-15,000,000	-20,000,000	-27,546,128	-30,300,741	-33,055,354
Change, %	-45.5 %	-27.4 %	0.0 %	+10.0 %	+20.0 %
Net Present Value (NPV)	5,576,997	576,997	-6,969,132	-9,723,744	-12,478,357
Change, %	+180.0 %	+108.3 %	0.0 %	-39.5 %	-79.1 %

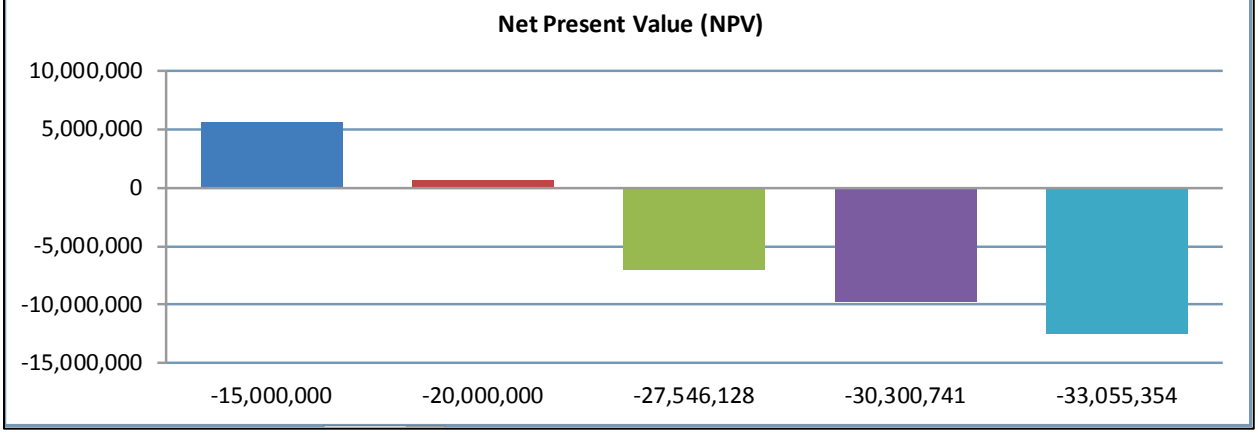


Table 19 – Sensitivity of Food Waste Tipping Revenue – Electrical Power Generation

Variable	Organic Waste Revenue				
Change in value, %	+50.0 %	+10.0 %	0.0 %	+75.0 %	+100.0 %
Sample value 12/2018	464,398.990	340,559.259	309,599.327	541,798.821	619,198.653
Net Present Value (NPV)	-7,261,282	-13,188,042	-14,669,732	-3,557,057	147,168
Change, %	+50.5 %	+10.1 %	0.0 %	+75.8 %	+101.0 %

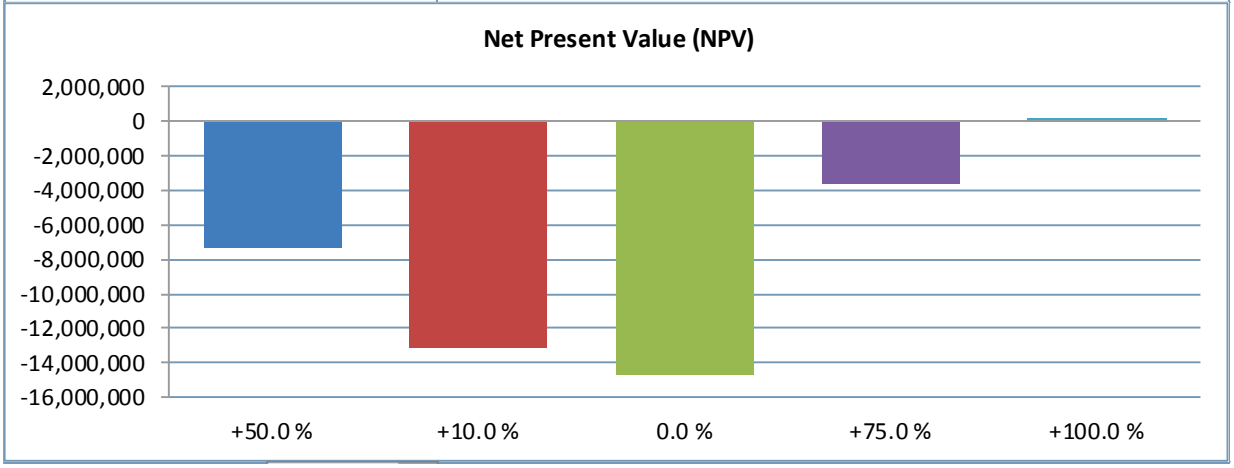
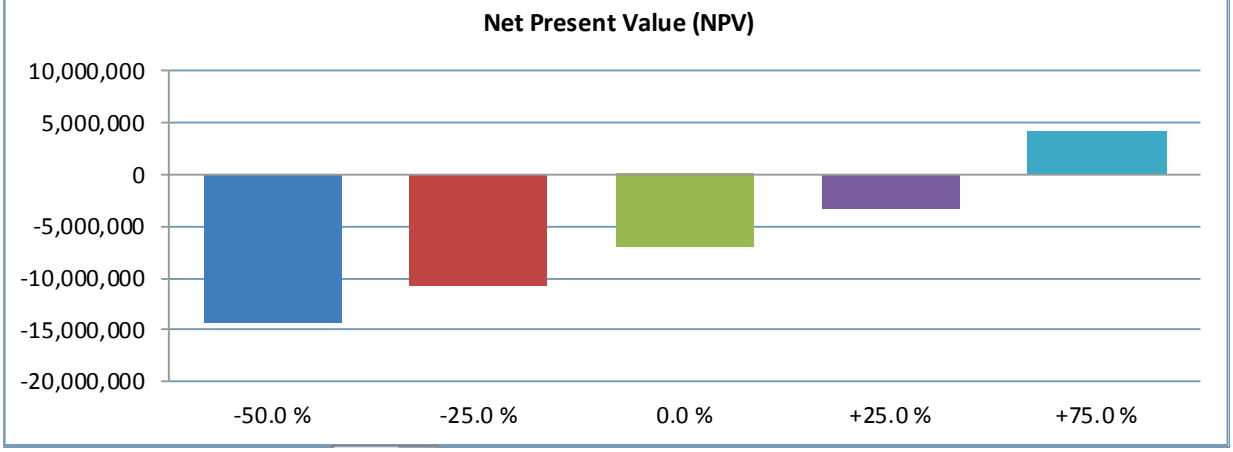


Table 20 – Sensitivity of Food Waste Tipping Revenue – Biomethane Generation

Variable	Organic Waste Revenue, $/yr				
Change in value, %	**-50.0 %**	**-25.0 %**	**0.0 %**	**+25.0 %**	**+75.0 %**
Sample value	154,799.663	232,199.495	309,599.327	386,999.158	541,798.821
Net Present Value (NPV)	-14,377,582	-10,673,357	-6,969,132	-3,264,907	4,143,544
Change, %	-106.3 %	-53.2 %	0.0 %	+53.2 %	+159.5 %



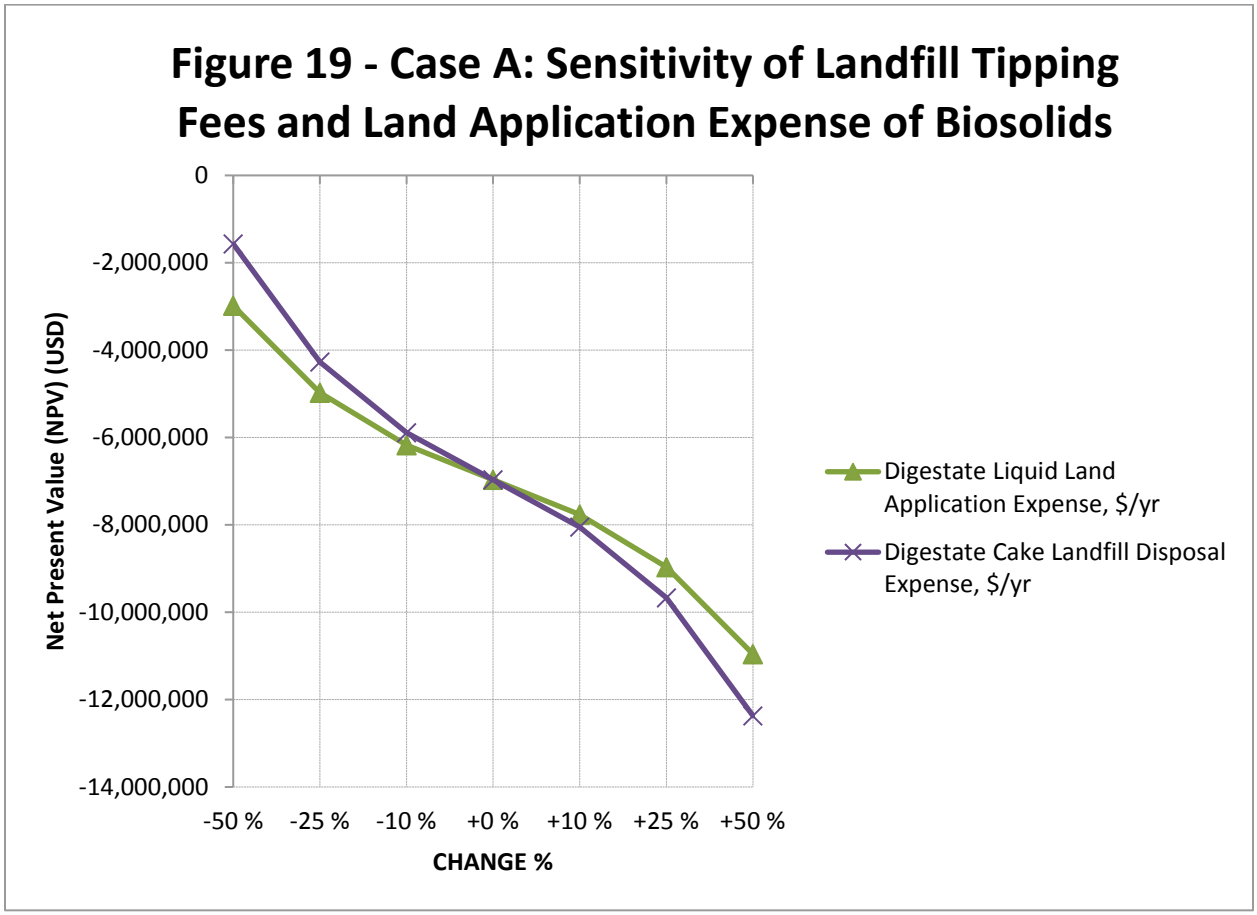
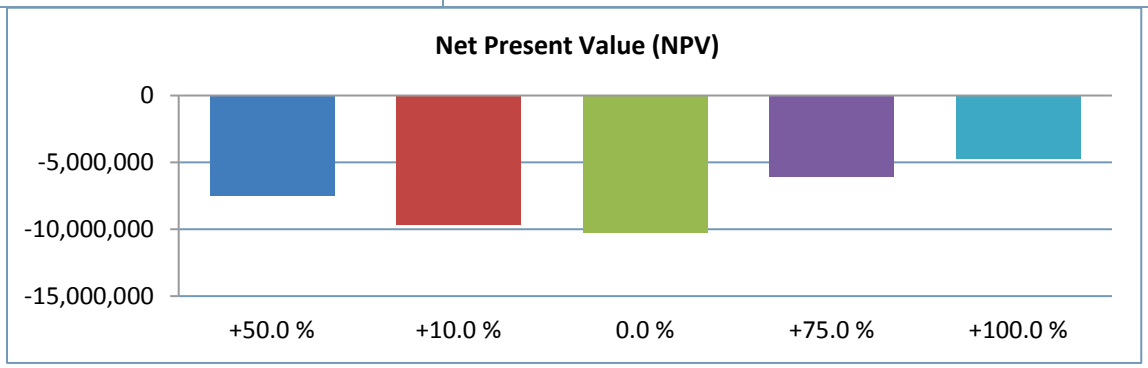


Table 21 – Sensitivity of Electrical Rate ($/kW) for Sale of Electrical Power

Variable		Electrical Rate, $/kWh				
Change in value, %		**+50.0 %**	**+10.0 %**	**0.0 %**	**+75.0 %**	**+100.0 %**
Sample value	12/2018	0.083	0.061	0.055	0.096	0.110
Net Present Value (NPV)		**-7,496,710**	**-9,691,911**	**-10,240,711**	**-6,124,710**	**-4,752,710**
Change, %		+26.8 %	+5.4 %	0.0 %	+40.2 %	+53.6 %



In addition, a breakeven scenario was evaluated using the volume of food waste collected as the key variable. The analysis evaluated the financial performance of the digester if the food waste from the 117,000 residences was collected. Assumptions for the analysis utilized USEPA data[7] for the percentage of food waste in municipal solid waste and waste generation rates (mass per capita). If 95% of the food waste could be captured by the digester processing equipment, the current residential population could generate approximately 51 tons per day of organic material. Table 22 and 23 detail the financial model results for Case A and B. As can be seen from these tables, the addition of residential food waste to the feedstock of grease trap waste and sewage sludge causes the both cases of the biodigester to be financially feasible.

[7] EPA Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012

Table 22 – Sensitivity Analysis of Total Investment Utilizing Residential Food Waste for Electrical Power Generation

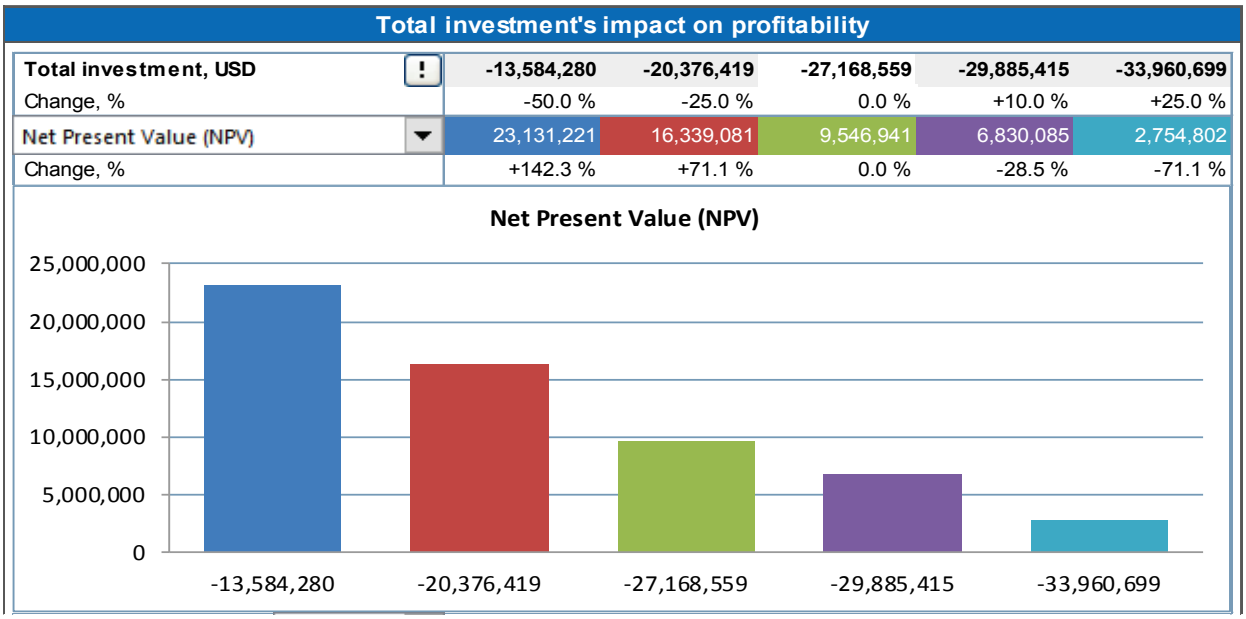


Table 23 – Sensitivity Analysis of Total Investment Utilizing Residential Food Waste for Biomethane Vehicle Fuel Production

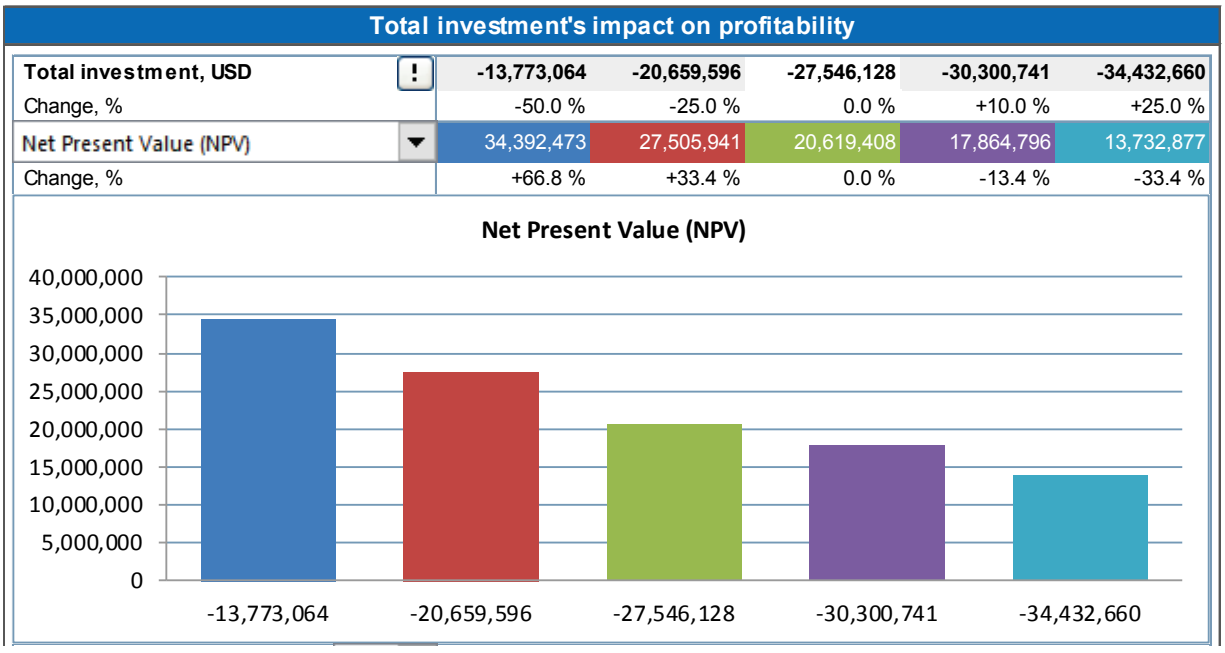
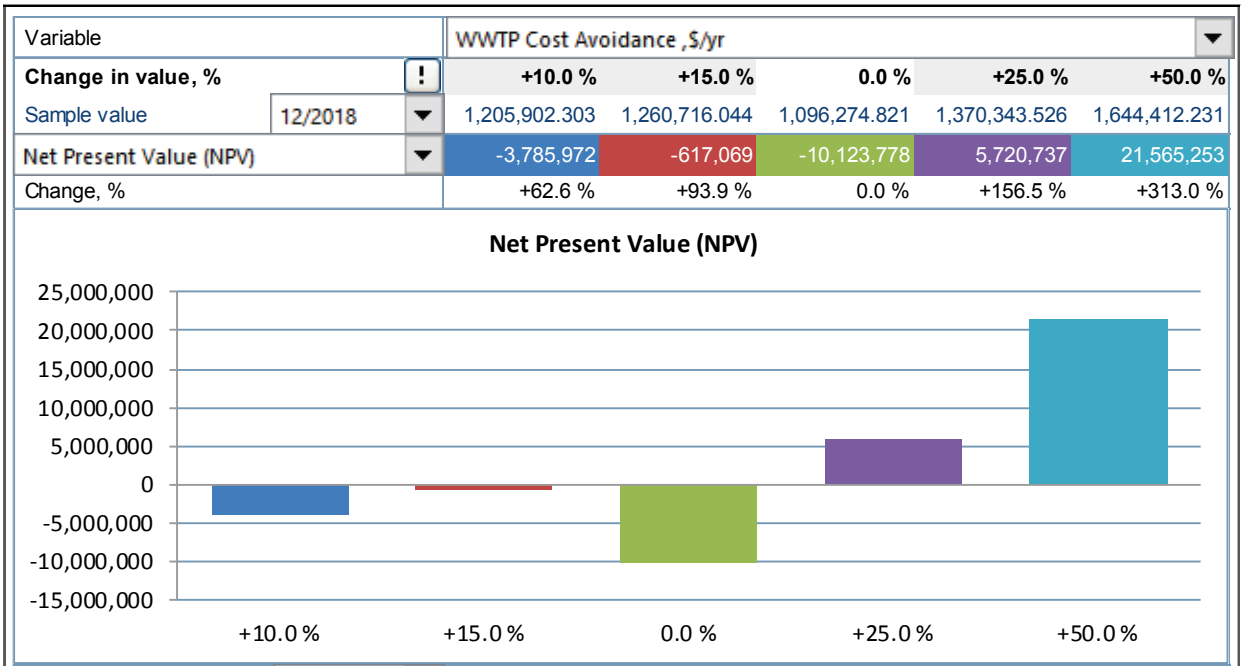


Table 24 details the sensitivity of the WWTP cost avoidance to the Net Present Value of Case A (electrical power generation). As detailed in Section 3.2.5, the WWTP Cost Avoidance is a revenue source to the digester operations. A positive NPV of $5,720,737 is realized with increase of the revenue from the WWTP to the biodigester by approximately $400,000 per year (2018 dollars).

Table 24 – Sensitivity of WWTP Cost Avoidance

Variable	WWTP Cost Avoidance ,$/yr				
Change in value, %	**+10.0 %**	**+15.0 %**	**0.0 %**	**+25.0 %**	**+50.0 %**
Sample value 12/2018	1,205,902.303	1,260,716.044	1,096,274.821	1,370,343.526	1,644,412.231
Net Present Value (NPV)	-3,785,972	-617,069	-10,123,778	5,720,737	21,565,253
Change, %	+62.6 %	+93.9 %	0.0 %	+156.5 %	+313.0 %



SECTION 4: ENVIRONMENTAL BENEFITS

The City of Ann Arbor has a history of being proactive as a sustainable community by promoting this culture with the public through its governing framework for the environment, economy, and equity. In 2013, Ann Arbor developed a Sustainability Framework that consolidated 20 City and local planning documents into a unified program that focused these efforts into 16 sustainability goals. These goals allow Ann Arbor to evaluate projects and programs to ensure the overarching sustainability goals are met. As part of this feasibility study, several parameters were compared to allow the financial model to be developed. Tables 25 and 26 look at ways a biodigester project will help the City of Ann Arbor continue down the path toward being a community that promotes a sustainable future for their residents and leads other cities toward achieving a similar goal.

Table 25 – Biodigestion as a Sustainable Resource – Resource Management

Clean Air and Water	
Reduction in greenhouse gas emissions by biodigester with cogeneration unit enhances air quality and reduces emission from fossil-fuels sources (coal). **BENEFIT:** Reduced CO_2 emissions https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle-0	Reduced lime use for biosolids disposal will reduce chemicals in run-off of land applied biosolids. **BENEFIT:** Tons of lime saved = 0.33 tons of lime per dry ton of sludge processed, an estimated 5,450 dry tons of sludge per year with half land applied and half landfilled. Estimated total lime tonnage saved per year is 0.33x5,450x0.5 = ~900 tons.
Healthy Ecosystems	
Reduced chemical usage reduces community impact on local ecosystems. **BENEFIT:** Reduced use of lime for processing sludge.	Waste diversion from landfills decreases potential for leachate fouling ground water. **BENEFIT:** Groundwater protection.
Responsible Resource Use	
Landfill diversion contributes to the goal of "zero waste", and will help optimize the positive use of waste in the community. **BENEFIT:** Estimated tons of sludge diverted from landfill (5450x0.5) ~2725 tons of sludge.	Conversion of organic waste into economic value by avoided costs, direct payments for electricity, and potential nutrient recovery. **BENEFIT:** Reduced operating cost.

Table 26 – Biodigestion as a Sustainable Resource – Climate and Energy

Sustainable Energy
Local generation of energy for local use. Mitigate impact of City vehicles by using renewable biofuels. **BENEFIT:** The estimated GGE (gasoline gallon equivalents) for biomethane – 375,000 GGE/year or DGE (Diesel gallon equivalents) for biomethane –329,000 DGE/year for sludge hauling vehicles used by City.
Energy Conservation (See Discussion on SCC below).
Decrease greenhouse gas emissions via biogas combustion. **BENEFIT:** 8.8 kg of CO_2 per gallon of gasoline burned as vehicle fuel (from tail pipe). The program is estimated to save 375,000 gallons of gasoline, therefore an estimated reduction of 3,300 metric tons of CO_2. Or, 10.2 kg of CO_2 per gallon of diesel burned as vehicle fuel (from tail pipe). The program is estimated to save 329,000 gallons of gasoline, therefor and estimated reduction of 3,356 metric tons of CO_2.
Sustainable Buildings
Heat from the cogeneration unit could be used to heat any of the buildings associated with the project. **BENEFIT:** The estimated heat recovered based on buildings and processes associated with the program: 8,700 cu ft/hr of biogas generated at 650 Btu/cf = 44,600 MMBtu/yr x 40% available thermal energy from cooling fluid = 17,840 MMBtu/yr.

The Michigan Department of Environmental Quality (MDEQ) recently reported on the solid waste disposal at Michigan landfills. Michigan landfills have an estimated 27 years of remaining capacity based on the 2016 data analyzed for the report to the Michigan Legislature. [8] Ann Arbor should monitor the remaining capacity of nearby landfills as part of determining the need for a waste diversion program that involves the City's WWTP sludge and food solid waste. The benefits this project would provide to the City are presented in the tables above. At the time of this study, there are no significant quantifiable benefits that will offset the initial capital investment for the project.

Comment on the Social Cost of Carbon (SCC): Carbon reduction is part of any serious sustainability strategy, but assigning a specific dollar value to the impact of carbon emissions has long been a challenge. One approach to assessing the economic impact of carbon emissions is to evaluate the Social Cost of Carbon (SCC).

The SCC is a metric used by policy makers to quantify the economic benefits and costs of actions related to carbon reduction in the environment, primarily via the reduction of greenhouse gas emissions into the atmosphere. Developed during the Reagan administration, the SCC is intended to assign a single, uniform dollar value to carbon emissions that can be used across all federal and state agencies for cost-benefit analyses. Specifically, the SCC assigns a dollar value to the global or domestic harm caused from the emission of a ton of a greenhouse gas (measured in carbon dioxide equivalent tons, or tons-CO_2eq).

[8] Report of Solid Waste Landfilled in Michigan for Fiscal Year (FY) 2016 – C. Heidi Grether, Director MDEQ, February 27, 2017 memorandum to the Michigan Legislature.

The SCC captures a wide range of societal impacts due to carbon emissions, ranging from diminished crop yields to the cost of flooding on coastal properties.[9] The fact that SCC includes a diverse set of potential impacts results in SCC values that are understandably very wide, ranging from $11 to over $100 per tons-$CO_2$eq. In spite of the imprecise value, the SCC is a critical component to a cost-benefit analysis of any regulation or activity designed to control carbon emissions.

However, we note that the SCC was not used in the financial model for the Ann Arbor Biodigester. This intentional omission is justified by several important facts:

1. There is currently no consensus on the correct formulation for the SCC. Recent Federal actions have sought to modify the way in which the SCC is calculated by adjusting several parameters (discount rate and scope-of-impact), both of which will substantially decrease the resulting per value of the SCC in $/ tons-$CO_2$eq. [10] [11] A science-based procedure for determining the value of SCC is under development by the National Academy of Sciences, Engineering, and Medicine, but is not yet available.[12]
2. Existing carbon markets are underperforming. At the current time, carbon markets in North America (cap and trade programs) are not functioning as intended. For example, the recent auction of carbon credits in the California Cap and Trade program resulted in only 18% of the available credits being purchased.[13]

Because of the strong uncertainty surrounding SCC calculations, its use in the Financial model would be based on a speculative value, and either over- or understate the true financial performance of the project.

[9] Why the Social Cost of Carbon Is Critical for America to Make Sound Policies, World Resources Institute, http://www.wri.org/blog/2017/03/why-social-cost-carbon-critical-america-make-sound-policies

[10] The social costs of carbon, Testimony by Ted Gayer to the Members of the Subcommittees on Environment and on Oversight, US House of Representatives, February 28, 2017. https://www.brookings.edu/testimonies/the-social-costs-of-carbon/

[11] President Trump Takes On The Social Cost Of Carbon, Forbes, March 30, 2017, https://www.forbes.com/sites/susandudley/2017/03/30/president-trump-takes-on-the-social-cost-of-carbon/2/#3107bfb10762 .

[12] Assessing Approaches to Updating the Social Cost of Carbon, Board of Environmental Change and Society, National Academy of Sciences, Engineering, and Medicine. http://sites.nationalacademies.org/DBASSE/BECS/CurrentProjects/DBASSE_167526

[13] California carbon market sees weak demand for permits, March 1, 2017, Reuters http://www.reuters.com/article/us-california-carbon-auction-idUSKBN169063

SECTION 5: CONCLUSION

This feasibility study supports the earlier investigation that there is adequate liquid and solid food waste to support a biodigester if the majority of the feed stock is the Ann Arbor WWTP sludge. Based on the research of regulation, investigation of potential feed stock, and model analysis of the project's financial viability, it is forecasted that implementing the project at this time would result in the loss of money over the expected project life span. Factors that contribute to this forecast are the expected lower revenue generated by tipping fees and the current energy market for prices associated with electricity and natural gas. A biodigester project has a high capital cost associated with the infrastructure that is needed to operate as a sustainable utility for Ann Arbor. Using current funding strategies such as the Clean Michigan Bond, State Revolving Fund Green Michigan Funds, or DTE incentives will help to close the funding gap. There are presently no legislative actions to increase landfill tipping fees, the cost of natural gas, or the cost of electricity. Without policy changes at the State or Federal level or financial incentives for alternative energy programs, this project will not financially support itself. The City would need to establish a separate enterprise fund for this service or attach the biodigester budget to an existing City enterprise funded service to provide local financial support for the program. It is recommended that the City review the results of these findings within five years to revisit the potential of using a biodigester facility as part of the City's overall sustainability program for processing the WWTP sludge and food waste from within the City.

Appendix 1

ANN ARBOR BIODIGESTER FEASIBILITY STUDY - APPENDIX 1
Major Food Producers

followup email 5/24/2016	followup Phone call 5/25/206	Response Received	Company Name	Contact Name	Address	City	State	Zip	Phone #	email
x		x	American Soy	Ron Roller - Plant Manager	1474 Woodland Dr	Saline	MI	48176	734-429-2310	rroller@americansoy.com
		x	United Northern Brewing	Tony Grant - CEO	2319 Bishop Cir E	Dexter	MI	48130	734-426-4962	tony@nubco.net
	x	x	Chelsea Milling Company (Jiffy Mixes)	Rob Whitaker	201 West North St	Chelsea	MI	48118-04600	734-475-1361, 517-315-7630	rob.whitaker@jiffymix.com

ANN ARBOR BIODIGESTER FEASIBILITY STUDY - APPENDIX 1

Grease Trap

Company Name	Contact Name	Address	City	State	Zip	Phone #	email
Dover Grease Trap	Mitch Simon	16585 East 13 mlle Road	Fraser	MI	48026	586-293-0033	Mitch.Simon@dovergt.com
B&B grease trap	Pat or Marta (did not want to provide last names)	20800 Dequindre Rd	Warren	MI	48091	586-486-7762	bandbgrease@yahoo.com
Great Lakes Grease	Tim Lewis	13806 bernice	Warren	MI	48089	313-365-1300, 586-243-2951	greatlakesvacuumservices@yahoo.com
Mahoney Environmental	Vito DiPietra	275 Millard Ave	Toledo	Oh	43065	815-272-2093	VitoD@mahoneyes.com
Michigan Power Vac	Dave (last name unknown)	44300 Grand River Ave	Novi	MI	48375	248-912-9975	mailto:service@yourworkorder.com
Plummers Waste Group	John Plummer	4750 Clyde Park Ave SW	Wyoming	MI	49509	616-532-3996	richard@industrialwasterecovery.com

Legal Name	Doing Business as (DBA)	Address	City	State	ZIP Code
A C Cubs' Inc		1950 S Industrial Hwy	Ann Arbor	MI	48104
A-1 Premier Catering		2259 W Liberty St	Ann Arbor	MI	48103
A2 Pizza PI LLC		829 W Washington St	Ann Arbor	MI	48103
AMA Bistro		215 S State St	Ann Arbor	MI	48104
Achilles Restaurant		3075 Packard St	Ann Arbor	MI	48108
Afternoon Delight Inc	Afternoon Delight	251 E Liberty St	Ann Arbor	MI	48104
Ahmo's Mediterranian Grill		530 S State St	Ann Arbor	MI	48109
Ahmon		341 E Huron St	Ann Arbor	MI	48104
Ahmos' Gyro & Deli		341 E Huron St	Ann Arbor	MI	48104
Ahmos' Gyro & Deli		2505 Ann Arbor Saline Rd	Ann Arbor	MI	48103
Ali-Baba		601 Packard St	Ann Arbor	MI	48104
Alley Bar		112 W Liberty St	Ann Arbor	MI	48104
Polkryst Inc	Amadeus Cafe	122 E Washington St Ste B	Ann Arbor	MI	48104
Ambrosia 33064		326 Maynard St	Ann Arbor	MI	48104
Amer's Inc		611 Church St Ste 2	Ann Arbor	MI	48104
Amer's Inc	Amer's Mediterranean Deli	312 S State St FL 1	Ann Arbor	MI	48104
Vangelatos Inc	Angelo's	1100 Catherine St Ste 1	Ann Arbor	MI	48104
Ann Arbor Club		103 E Liberty St Ste 300	Ann Arbor	MI	48104
Apex Cuisine		834 W Washington St	Ann Arbor	MI	48103
Applebee's International, Inc.	Applebee's	2310 Green Rd	Ann Arbor	MI	48105
Applebee's International, Inc.	Applebee's	1005 W Eisenhower Pkwy	Ann Arbor	MI	48103
Aramark Services, Inc.	Aramark	1500 E Medical Center Dr #	Ann Arbor	MI	48109
Ashley's Restaurants Ltd		338 S State St	Ann Arbor	MI	48104
Asian Legend Inc		516 E William St	Ann Arbor	MI	48104
M.P.B. Inc	Aut Bar	315 Braun CT	Ann Arbor	MI	48104
Aventura		216 E Washington St	Ann Arbor	MI	48104
Ayaka		1205 S University Ave	Ann Arbor	MI	48104
Ayses Courtyard Cafe	Ayse's Turkish Cafe	1703 Plymouth Rd	Ann Arbor	MI	48105
B Tb Cantina		1140 S University Ave	Ann Arbor	MI	48104
BAC Holdings I, L.L.C.		3601 Washtenaw Ave	Ann Arbor	MI	48104
Diversified Restaurant Holdings, Inc.	Bagger Dave's	859 W Eisenhower Pkwy	Ann Arbor	MI	48103
Bandito's California Style Mexican Food		216 S 4th Ave	Ann Arbor	MI	48104
A C Banfield Inc	Banfield's Bar & Grill	3140 Packard St	Ann Arbor	MI	48108
Bar Louie-Ann Arbor		401 E Liberty St	Ann Arbor	MI	48104
Baskin-Robbins	Baskin-Robbins	1952 W Stadium Blvd	Ann Arbor	MI	48103
Bear Claw Coffee Co		2460 Washtenaw Ave	Ann Arbor	MI	48104
Kascorp Inc	Bearclaw Coffee	3220 Old Hickory Pl	Ann Arbor	MI	48104
Bell's Diner		2167 W Stadium Blvd	Ann Arbor	MI	48103
B Ball Pizza Inc	Bell's Pizza	700 Packard St	Ann Arbor	MI	48104
Bella Italia Pizza & Subs		895 W Eisenhower Pkwy	Ann Arbor	MI	48103
Belly Deli Inc		1317 S University Ave	Ann Arbor	MI	48104
Benny's Family Dining		1952 S Industrial Hwy	Ann Arbor	MI	48104
Best Western	Best Western	2900 Jackson Ave	Ann Arbor	MI	48103
Bewon		3574 Plymouth Rd	Ann Arbor	MI	48105
J & J Hospitality Inc	Big Boy Restaurant	3611 Plymouth Rd	Ann Arbor	MI	48105
Big Boy Restaurants International LLC	Big Boy-Red Roof Inn 40	3611 Plymouth Rd	Ann Arbor	MI	48105
Big Ten Burrito		810 S State St	Ann Arbor	MI	48104
Bigalora		3050 Washtenaw Ave	Ann Arbor	MI	48104
Biggby Coffee		3354 Washtenaw Ave	Ann Arbor	MI	48104
Biggby Coffee		2550 W Stadium Blvd	Ann Arbor	MI	48103
Bigger Than Ten LLC		1140 S University Ave	Ann Arbor	MI	48104
Blank Slate Creamery		300 W Liberty St	Ann Arbor	MI	48103
U Ventures, Inc.	Blue Leprechaun	1220 S University Ave # 109	Ann Arbor	MI	48104
Kaffa House Inc	Blue Nile	221 E Washington St	Ann Arbor	MI	48104
Blue Tractor		205 E Washington St	Ann Arbor	MI	48104
Boston Market Corporation	Boston Market	3325 Washtenaw Ave	Ann Arbor	MI	48104
Argos Ltd	Brown Jug Restaurant	1204 S University Ave	Ann Arbor	MI	48104
Buffalo Wild Wings, Inc.	Buffalo Wild Wings	3150 Boardwalk St	Ann Arbor	MI	48108
Buffalo Wild Wings, Inc.	Buffalo Wild Wings	205 S State St	Ann Arbor	MI	48104

Three S Enterprises Inc	Burger King	725 Victors Way	Ann Arbor	MI	48108
Burgerfi		1235 S University Ave	Ann Arbor	MI	48104
Cafe Dujour		117 W Washington St	Ann Arbor	MI	48104
Patricia Landrum	Cafe Felix	204 S Main St	Ann Arbor	MI	48104
Cafe Rondez Vous		1110 S University Ave	Ann Arbor	MI	48104
Cafe Verde		214 N 4th Ave Ste 1	Ann Arbor	MI	48104
Z Squared Inc	Cafe Zola	112 W Washington St	Ann Arbor	MI	48104
California Pizza Kitchen, Inc.		870 Briarwood Cir	Ann Arbor	MI	48108
Dennis A Dahlmann	Campus Inn	615 E Huron St	Ann Arbor	MI	48104
Cardamom Restaurant		1739 Plymouth Rd	Ann Arbor	MI	48105
Carinos of Westland LLC		2008 S State St	Ann Arbor	MI	48104
Carson's American Bistro		2000 Commonwealth Blvd	Ann Arbor	MI	48105
Ann Arbor Party Center Inc	Catering Ala Cart	1612 Jackson Ave	Ann Arbor	MI	48103
Our Town Deli & Coffee Beanery	Cava Java	312 S State St FL 2	Ann Arbor	MI	48104
Chan Gardens		2265 W Liberty St	Ann Arbor	MI	48103
Chela's Restaurant & Taqueria		693 S Maple Rd	Ann Arbor	MI	48103
Chelsea Cafe Inc Chelsea Cafe Inc		2780 Lakehurst Ln	Ann Arbor	MI	48105
Chia Shiang Restaurants		2016 Packard St	Ann Arbor	MI	48104
Chick		3031 Cedarbrook Rd	Ann Arbor	MI	48105
Chili's Inc	Chili's	3795 Washtenaw Ave	Ann Arbor	MI	48104
China Data Center		1080 S University Ave	Ann Arbor	MI	48109
China Gate Restaurant Inc		1201 S University Ave	Ann Arbor	MI	48104
Chipotle Mexican Grill, Inc.	Chipotle Mexican Grill	235 S State St	Ann Arbor	MI	48104
Chipotle Mexican Grill, Inc.	Chipotle Mexican Grill	3354 Washtenaw Ave Ste A	Ann Arbor	MI	48104
Chipotle Mexican Grill, Inc.	Chipotle Mexican Grill	858 Briarwood Cir	Ann Arbor	MI	48108
Chop Sticks Inc		882 W Eisenhower Pkwy	Ann Arbor	MI	48103
Cielo Coffee LLC		2821 Maplewood Ave	Ann Arbor	MI	48104
Ciro's Italian Restaurant Inc		2554 W Stadium Blvd	Ann Arbor	MI	48103
Cloverleaf Lunch		201 E Liberty St Frnt	Ann Arbor	MI	48104
Nick Stamadianos	Cloverleaf Restaurant	201 E Liberty St Frnt	Ann Arbor	MI	48104
Cold Stone Creamery	Cold Stone Creamery	3597b Washtenaw Ave	Ann Arbor	MI	48104
Gaelic Concepts LLC	Conor O'Neill's	318 S Main St	Ann Arbor	MI	48104
Cottage Inn Carry Out and Delivery, Inc.	Cottage Inn Carry Out 104	546 Packard St	Ann Arbor	MI	48104
Cottage Inn Carry Out and Delivery, Inc.		2301 W Stadium Blvd	Ann Arbor	MI	48103
Cottage Inn Carry Out and Delivery, Inc.		1141 Broadway St	Ann Arbor	MI	48105
Cottage Inn Carry Out and Delivery, Inc.		2900 S State St Ste 5	Ann Arbor	MI	48104
Curry On		2711 Plymouth Rd	Ann Arbor	MI	48105
Dadisms LLC		326 Maynard St	Ann Arbor	MI	48104
Dairy Queen	Dairy Queen	1805 Packard St	Ann Arbor	MI	48104
Delights Shaved Snow & Asian Patisserie		635 S Main St	Ann Arbor	MI	48104
Denny's, Inc.	Denny's	3310 Washtenaw Ave	Ann Arbor	MI	48104
Dibellas Old Fashioned Submarine		904 W Eisenhower Pkwy	Ann Arbor	MI	48103
Karim & Mary Dimo	Dimo's Deli & Donuts	2030 W Stadium Blvd	Ann Arbor	MI	48103
Dog Time LLC		703 S Main St	Ann Arbor	MI	48104
Casa Dominick's	Dominicks	812 Monroe St	Ann Arbor	MI	48104
Hoyt D Jones	Domino's Pizza	2601 Plymouth Rd Ste B	Ann Arbor	MI	48105
Hoyt D Jones	Domino's Pizza	2282 S Main St	Ann Arbor	MI	48103
Don Juan		2135 W Stadium Blvd	Ann Arbor	MI	48103
Earle's Garage Inc	Earle Restaurant, The	121 W Washington St # 101	Ann Arbor	MI	48104
Earthen Jar		311 S 5th Ave Ste 1	Ann Arbor	MI	48104
Eat LLC		1906 Packard St	Ann Arbor	MI	48104
Eat LLC		738 Miller Ave	Ann Arbor	MI	48103
Eck Investments, Inc		120 E Liberty St FL 2nd	Ann Arbor	MI	48104
El Harissa Market Cafe		1516 N Maple Rd	Ann Arbor	MI	48103
Wholesame Foods LLC	Elevation Burger	3365 Washtenaw Ave Ste M	Ann Arbor	MI	48104
Espresso Caffe Corporation		214 S Main St Ste 210	Ann Arbor	MI	48104
Espresso Caffe Corporation	Espresso Royale Caffe	214 S Main St Ste 210	Ann Arbor	MI	48104
Evergreen Oriental Inc		2771 Plymouth Rd	Ann Arbor	MI	48105
Everyday Inc		625 S Main St	Ann Arbor	MI	48104
Espresso Caffe Corporation	Expresso Royale	324 S State St	Ann Arbor	MI	48104
Frank's Pizza Inc		1200 Packard St	Ann Arbor	MI	48104

Frank's Restaurant		334 Maynard St	Ann Arbor	MI	48104
Frita Batido		117 W Washington St	Ann Arbor	MI	48104
C. A. Muer Corporation	Gandy Dancer	401 Depot St	Ann Arbor	MI	48104
Get Some Burritos		707 Packard St	Ann Arbor	MI	48104
Globaltron Franchise Development LLC		100 S 4th Ave	Ann Arbor	MI	48104
Good Friends Music		1810 Alhambra Dr	Ann Arbor	MI	48103
Charlies Goodtime	Good Time Charleys Bar & Grill	1140 S University Ave	Ann Arbor	MI	48104
Ssf Inc	Gourmet Garden	2255 W Stadium Blvd	Ann Arbor	MI	48103
Granger Tavern LLC	Grange Kitchen & Bar	118 W Liberty St	Ann Arbor	MI	48104
Downtown Ventures Inc	Gratzi	326 S Main St	Ann Arbor	MI	48104
Great Plains Burger Co.		1771 Plymouth Rd APT 102	Ann Arbor	MI	48105
Grilled Cheezerie		709 Packard St	Ann Arbor	MI	48104
Gpbc Inc	Grizzly Peak Brewing Company	120 W Washington St Ste 1	Ann Arbor	MI	48104
Guy Holerins		3600 Plymouth Rd	Ann Arbor	MI	48105
Happy Wok Food		1916 W Stadium Blvd FL 1	Ann Arbor	MI	48103
Happy's Pizza Bar		640 Packard St	Ann Arbor	MI	48104
Happy's Pizza Company		600 S Main St	Ann Arbor	MI	48104
Heidelberg Bar Inc	Heidelberg Restaurant, The	215 N Main St	Ann Arbor	MI	48104
A-L-W, Inc.	Holiday's Restaurant	2080 W Stadium Blvd	Ann Arbor	MI	48103
Iha of Ann Arbor PC		2000 Commonwealth Blvd	Ann Arbor	MI	48105
India Cafe		1143 Broadway St	Ann Arbor	MI	48105
Iorio's Gelateria		522 E William St	Ann Arbor	MI	48104
Cascabel Ventures, L.L.C.	Isalita	341 E Liberty St	Ann Arbor	MI	48104
Izzy's Hoagie Shop		1924 W Stadium Blvd	Ann Arbor	MI	48103
J C Rich		1313 S University Ave	Ann Arbor	MI	48104
Jamaican Jerk Pit		314 S Thayer St	Ann Arbor	MI	48104
Jersey Mike's Subs	Jersey Mike's Subs	2561 Jackson Ave	Ann Arbor	MI	48103
Jerusalem Garden		314 E Liberty St	Ann Arbor	MI	48104
Jets Pizza		1749 Plymouth Rd	Ann Arbor	MI	48105
Jimmy Johns Gourmet	Jimmy John's	2615 Plymouth Rd	Ann Arbor	MI	48105
Jimmy John's Gourmet Sandwich Shop Inc	Jimmy John's	1205 S University Ave	Ann Arbor	MI	48104
John's, Jimmie Gourmet Sandwich Shop	Jimmy Johns Gourmet	929 E Ann St	Ann Arbor	MI	48104
Jolly Pumpkin Artisan Ales LLC		311 S Main St	Ann Arbor	MI	48104
Just Baked		2463 W Stadium Blvd	Ann Arbor	MI	48103
K Hut Inc		727 Watersedge Dr	Ann Arbor	MI	48105
Kana Korean Restaurant	Kana Korean Cuisine	114 W Liberty St	Ann Arbor	MI	48104
Graham Hotel Systems, Inc.	Kensington Court	610 Hilton Blvd	Ann Arbor	MI	48108
Knight's Restaurant		600 E Liberty St	Ann Arbor	MI	48104
Knights Bar/Restaurant Inc	Knight's Steakhouse	2324 Dexter Ave	Ann Arbor	MI	48103
Coffee Break	Korean Restaurant	1327 S University Ave	Ann Arbor	MI	48104
Le Dog		306 S Main St Ste 1e	Ann Arbor	MI	48104
Lena		226 S Main St	Ann Arbor	MI	48104
Lil Porkys' Pizza N More		2529 Dexter Rd	Ann Arbor	MI	48103
Little Caesar's	Little Caesar's	3000 Packard St Ste B	Ann Arbor	MI	48108
Stephens Brothers Inc	Little Caesar's	1944 W Stadium Blvd	Ann Arbor	MI	48103
Little Caesars Pizza	Little Caesar's	2715 Plymouth Rd	Ann Arbor	MI	48105
Logan An American Restaurant		115 W Washington St	Ann Arbor	MI	48104
Lucky Kitchen Chinese Carry-Out & Delvry		1753 Plymouth Rd	Ann Arbor	MI	48105
Lunch Room LLC		407 N 5th Ave	Ann Arbor	MI	48104
M Totoro		215 S State St	Ann Arbor	MI	48104
Mac's Blue Note Cafe		2565 Plymouth Rd	Ann Arbor	MI	48105
Madras Masala Kitchens Inc		328 Maynard St	Ann Arbor	MI	48104
Main Street Ventures Inc	Mainstreet Ventures	322 S Main St	Ann Arbor	MI	48104
Mainstreet Ventures, Inc.		605 S Main St Ste 2	Ann Arbor	MI	48104
Edward Brothers Food, Inc	Maize "n" Blue Deli & Eatery	1329 S University Ave	Ann Arbor	MI	48104
Mani Osteria		341 E Liberty St	Ann Arbor	MI	48104
Zaco Inc	Marco's Pizza	1752 Plymouth Rd	Ann Arbor	MI	48105
Mark's Midtown Coney Island		3586 Plymouth Rd	Ann Arbor	MI	48105
Marnee Thai Restaurant		414 S Main St Ste 130	Ann Arbor	MI	48104
Mary's Fabulous Chicken		3220 Packard St	Ann Arbor	MI	48108
Max & Erma's Limited	Max & Erma's	455 E Eisenhower Pkwy # 1	Ann Arbor	MI	48108

Nan Bitner	Mc Donald's 10950	2310 W Stadium Blvd	Ann Arbor	MI	48103
McStadium Mcdonald's, Inc.	McDonald's	2310 W Stadium Blvd	Ann Arbor	MI	48103
McDonald's	McDonald's	2675 Plymouth Rd	Ann Arbor	MI	48105
David Beschles	McDonald's	3752 S State Rd	Ann Arbor	MI	48108
McDonald's	McDonald's	3325 Washtenaw Ave	Ann Arbor	MI	48104
Mediterrano Restaurant		2900 S State St Ste 7	Ann Arbor	MI	48104
Melange Bistro	Melange	314 S Main St	Ann Arbor	MI	48104
Shaw Restaurants II Inc	Melting Pot	309 S Main St	Ann Arbor	MI	48104
Menna's Joint		607 E William St	Ann Arbor	MI	48104
Mezes Greek Grill		715 N University Ave	Ann Arbor	MI	48104
Michaels Chophouse		3200 Boardwalk St	Ann Arbor	MI	48108
Middle Kingdom Inc		332 S Main St	Ann Arbor	MI	48104
Assoc Restaurant Management	Miki Japanese Restaurant	106 S 1st St	Ann Arbor	MI	48104
Moe's Restaurant Incorporated	Moe's Southwest Grill	857 W Eisenhower Pkwy	Ann Arbor	MI	48103
Mr Greeks Coney Island Inc		215 S State St Ste 4	Ann Arbor	MI	48104
T K X Inc	Mr Spots	808 S State St	Ann Arbor	MI	48104
Nagomi Sushi & Noodles		1754 Plymouth Rd	Ann Arbor	MI	48105
Neopapalis of Ann Arbor LLC		500 E William St	Ann Arbor	MI	48104
Molfetta Inc	New York Pizza Depot	605 E William St	Ann Arbor	MI	48104
No Thai		1745 Plymouth Rd	Ann Arbor	MI	48105
No Thai		226 N 4th Ave	Ann Arbor	MI	48104
No Thai		1300 S University Ave # 3	Ann Arbor	MI	48104
Noodles & Company	Noodles & Company	3601 Washtenaw Ave Ste A	Ann Arbor	MI	48104
Noodles Company	Noodles & Company	320 S State St	Ann Arbor	MI	48104
Noodles & Company	Noodles & Company 8015	2245 W Stadium Blvd	Ann Arbor	MI	48103
Oasis Deli		1106 S University Ave	Ann Arbor	MI	48104
Siam Kitchen Inc	Old Siam, The	2509 Jackson Ave	Ann Arbor	MI	48103
Old Town Tavern	Old Town	122 W Liberty St	Ann Arbor	MI	48104
Olga's Kitchen Inc	Olga's Kitchen	3399 Plymouth Rd	Ann Arbor	MI	48105
Olga's Kitchen, Inc.	Olga's Kitchen	452 Briarwood Cir	Ann Arbor	MI	48108
Gmri, Inc.	Olive Garden	445 E Eisenhower Pkwy	Ann Arbor	MI	48108
Orange Leaf Frozen Yogurt		2613 Plymouth Rd	Ann Arbor	MI	48105
Pacific Rim By Kana, Inc.		114 W Liberty St	Ann Arbor	MI	48104
S & R Inc	Paesano's Restourant	3411 Washtenaw Ave	Ann Arbor	MI	48104
347 Corporation Inc	Palio	347 S Main St	Ann Arbor	MI	48104
Little Donkeys Inc	Panchero's Mexican Restaurant	1208 S University Ave	Ann Arbor	MI	48104
Panda Express, Inc.	Panda Express	2101 Bonisteel Blvd	Ann Arbor	MI	48109
Panda Express, Inc.	Panda Express 1723	530 S State St	Ann Arbor	MI	48109
Panda Express, Inc.	Panda Express 2101	620 Briarwood Cir	Ann Arbor	MI	48108
Panda House		229 N Maple Rd	Ann Arbor	MI	48103
Panda Korean Chinese Foods		3020 Packard St	Ann Arbor	MI	48108
Panera Bread 1366	Panera Bread	777 N University Ave	Ann Arbor	MI	48104
Panera Bread Company	Panera Bread	3205 Washtenaw Ave	Ann Arbor	MI	48104
Panera Bread Company	Panera Bread 1105	1773 Plymouth Rd	Ann Arbor	MI	48105
Panera Bread Company	Panera Bread 874	903 W Eisenhower Pkwy	Ann Arbor	MI	48103
Papa John's	Papa John's	2145 W Stadium Blvd	Ann Arbor	MI	48103
Joe Carman	Papa John's	401 E Huron St	Ann Arbor	MI	48104
Paradise Restaurant		883 W Eisenhower Pkwy	Ann Arbor	MI	48103
Pastry Peddler Bakery and Cafe		619 Packard St	Ann Arbor	MI	48104
Perfect Cup		530 S State St	Ann Arbor	MI	48109
P.F. Chang's China Bistro, Inc.	Pf Changs China Bistro	720 Briarwood Cir	Ann Arbor	MI	48108
Pilar's		2261 W Liberty St	Ann Arbor	MI	48103
Pita Kabob Grill		619 E William St	Ann Arbor	MI	48104
Pizza Bob's		814 S State St	Ann Arbor	MI	48104
Pizza House Ann Arbor Inc	Pizza House	618 Church St	Ann Arbor	MI	48104
Pizza Pino		221 W Liberty St	Ann Arbor	MI	48104
Potbelly Corporation	Potbelly	3785 Washtenaw Ave	Ann Arbor	MI	48104
Potbelly Corporation		300 S State St	Ann Arbor	MI	48104
Potbelly Sandwich Works Store 197		980 W Eisenhower Pkwy	Ann Arbor	MI	48103
Prickly Pear Cafe Inc	Prickly Pear Cafe	328 S Main St FL 1	Ann Arbor	MI	48104
Qdoba Mexican Grill		1771 Plymouth Rd APT 103	Ann Arbor	MI	48105

Qdoba Mexican Grill		3279 Washtenaw Ave	Ann Arbor	MI	48104
Qdoba Mexican Grill		2252 S Main St	Ann Arbor	MI	48103
Queen Pooka		803 Gott St	Ann Arbor	MI	48103
Quizno Sub's		3584 Plymouth Rd	Ann Arbor	MI	48105
Raja Rani Inc		400 S Division St Ste 1	Ann Arbor	MI	48104
Real Seafood Company of Ann Arbor, Inc		341 S Main St	Ann Arbor	MI	48104
Real Seafood Company of International		605 S Main St Ste 2	Ann Arbor	MI	48104
Red Hawk Corporation	Red Hawk Bar & Grill	316 S State St	Ann Arbor	MI	48104
East U Provisions LLC	Revive & Replenish	619 E University Ave	Ann Arbor	MI	48104
Rick's Cafe Inc	Rick's American Cafe	611 Church St Ste 1	Ann Arbor	MI	48104
Zingerman's Roadhouse, LLC	Roadhouse, The	2501 Jackson Ave	Ann Arbor	MI	48103
Robin Ann Arbor Inc		575 Briarwood Cir	Ann Arbor	MI	48108
Rod's Diner Inc		812 S State St	Ann Arbor	MI	48104
Romano's Macaroni Grill, Inc.	Romano's Macaroni Grill	3010 S State St	Ann Arbor	MI	48108
Royale Espresso		1101 S University Ave # 1	Ann Arbor	MI	48104
Royale Espresso		2264 S Main St	Ann Arbor	MI	48103
Rcaa Development, LLC	Ruths Chris Steak House	314 S 4th Ave	Ann Arbor	MI	48104
Sabor Latino Rest		211 N Main St	Ann Arbor	MI	48104
Sadako Japanese Restaurant		1321 S University Ave	Ann Arbor	MI	48104
Saica Corporation	Saica Restaurant	1733 Plymouth Rd	Ann Arbor	MI	48105
Saigon Garden		1220 S University Ave # 110	Ann Arbor	MI	48104
Salads Up, LLC		611 E Liberty St	Ann Arbor	MI	48104
San Fu Oriental Cuisine		625 S Main St	Ann Arbor	MI	48104
Satchel's Bbq, L.L.C.		3035 Washtenaw Ave	Ann Arbor	MI	48104
Sra2, LLC	Sava's Restaurant	216 S State St	Ann Arbor	MI	48104
Sava's State Street Cafe LLC		211 S State St Ste A	Ann Arbor	MI	48104
Savas Cafe		216 S State St Ste 1	Ann Arbor	MI	48104
Gamekeepers of Michigan, Inc	Scorekeepers	310 Maynard St	Ann Arbor	MI	48104
Selma Cafe		722 Soule Blvd	Ann Arbor	MI	48103
Em & M Inc.	Seoul Garden Restaurant	3125 Boardwalk St	Ann Arbor	MI	48108
Seoul Street		1771 Plymouth Rd	Ann Arbor	MI	48105
Seva Inc	Seva Restaurant	2541 Jackson Ave	Ann Arbor	MI	48103
Shalimar of Ann Arbor, Inc		307 S Main St	Ann Arbor	MI	48104
Marvin A Zetley	Sheraton	3200 Boardwalk St	Ann Arbor	MI	48108
Siam Square		3750 Washtenaw Ave	Ann Arbor	MI	48104
Silbio's Organic Pizza		715 N University Ave	Ann Arbor	MI	48104
Songco LLC		2707 Plymouth Rd	Ann Arbor	MI	48105
Sottini Sub Shop		205 S 4th Ave	Ann Arbor	MI	48104
Spencer		113 E Liberty St	Ann Arbor	MI	48104
Star In Your Heart		1729 Charlton St	Ann Arbor	MI	48103
Starbucks Corporation	Starbucks	100 Briarwood Mall Cir	Ann Arbor	MI	48108
Starbucks Corporation	Starbucks	1214 S University Ave S100	Ann Arbor	MI	48104
Starbucks Corporation	Starbucks	222 S State St	Ann Arbor	MI	48104
Starbucks Corporation	Starbucks	3601 Washtenaw Ave	Ann Arbor	MI	48104
Starbucks Corporation	Starbucks	300 S Main St	Ann Arbor	MI	48104
Stars Cafe		2575 Jackson Ave	Ann Arbor	MI	48103
Stonefire Pizza		3370 Burbank Dr	Ann Arbor	MI	48105
Subway	Subway	411 E Washington St	Ann Arbor	MI	48104
Subway	Subway	2410 W Stadium Blvd	Ann Arbor	MI	48103
Subway	Subway	3395 Plymouth Rd	Ann Arbor	MI	48105
Subway	Subway	530 S State St	Ann Arbor	MI	48109
Subway Sandwiches	Subway	3384 Washtenaw Ave	Ann Arbor	MI	48104
Subway	Subway	3098 Platt Rd	Ann Arbor	MI	48108
Subway	Subway	1251 N Maple Rd Ste 2	Ann Arbor	MI	48103
Sisters Enterprises Inc	Subway	1315 S University Ave	Ann Arbor	MI	48104
Dortch & Dortch Subway	Subway	885 W Eisenhower Pkwy	Ann Arbor	MI	48103
Subway	Subway	4009 Carptr Rd Arbor Sq	Ann Arbor	MI	48103
Sushi Comz Fresh		715 N University Ave # 10	Ann Arbor	MI	48104
Sushi Patsu		100 Briarwood Cir	Ann Arbor	MI	48108
Sushi Town		740 Packard St Ste 1	Ann Arbor	MI	48104
Sweetwater Coffee & Tea		407 N 5th Ave	Ann Arbor	MI	48104
Sweet Waters Cafe	Sweetwaters Cafe	123 W Washington St	Ann Arbor	MI	48104
Taco Bell Corp	Taco Bell	2280 W Stadium Blvd	Ann Arbor	MI	48103
Natron Corporation	Taco Bell	615 E University Ave	Ann Arbor	MI	48104
Taste of India LLC		217 S State St	Ann Arbor	MI	48104

Dino's Lamplighter Inc.	Thano's Lamplighter	3303 Tacoma Cir	Ann Arbor	MI	48108
The Arena Restaurant		203 E Washington St	Ann Arbor	MI	48104
The Big Salad		2793 Plymouth Rd Ste C	Ann Arbor	MI	48105
The Broken Egg		221 N Main St	Ann Arbor	MI	48104
The County Coffee Shop		101 E Huron St	Ann Arbor	MI	48104
The Fraser's Pub Inc		2045 Packard St	Ann Arbor	MI	48104
Three Diamonds Internet Cafe		893 W Eisenhower Pkwy	Ann Arbor	MI	48103
Tianchu Restaurant		613 E William St	Ann Arbor	MI	48104
Time Teriyaki		314 Detroit St	Ann Arbor	MI	48104
S A Panzda Inc	Tios	333 E Huron St	Ann Arbor	MI	48104
Tk Wu		510 E Liberty St	Ann Arbor	MI	48104
Tmaz Taqueria		3182 Packard St	Ann Arbor	MI	48108
Tracklements Smokery		212 E Kingsley St	Ann Arbor	MI	48104
Tropical Smoothie Cafe		607 E Liberty St Mi15	Ann Arbor	MI	48104
Tubby's Sub Shops, Inc	Tubby's Grilled Subs	800 S State St	Ann Arbor	MI	48104
US Canada & China Cultural and Economic		3543 Burbank Dr	Ann Arbor	MI	48105
Umi Sushi		3393 Plymouth Rd	Ann Arbor	MI	48105
University Cafe		621 Church St	Ann Arbor	MI	48104
Victor's Restaurant		615 E Huron St	Ann Arbor	MI	48104
Eleni Inc	Village Kitchen	241 N Maple Rd	Ann Arbor	MI	48103
Weber's, Inc.	Weber's Inn	3050 Jackson Ave	Ann Arbor	MI	48103
J Stanton David & Associates Inc	Wendy's	3100 Boardwalk St	Ann Arbor	MI	48108
J Stanton David & Associates Inc	Wendy's	1655 Plymouth Rd	Ann Arbor	MI	48105
J Stanton David & Associates Inc	Wendys Old Fashioned Hmbgs 28	530 S State St	Ann Arbor	MI	48109
J Stanton David & Associates Inc	Wendys Old Fashioned Hmbgs 40	911 N University Ave	Ann Arbor	MI	48109
Pangaea Restaurant Ltd	West End Grill	120 W Liberty St	Ann Arbor	MI	48104
Which Wich		301 E Liberty St	Ann Arbor	MI	48104
William Michael Foods Inc		3098 Platt Rd	Ann Arbor	MI	48108
Zamaan Cafe		3580 Plymouth Rd	Ann Arbor	MI	48105
Zamaan Cafe Three Inc		865 W Eisenhower Pkwy	Ann Arbor	MI	48103
Zingerman's Delicatessen, Inc.		422 Detroit St	Ann Arbor	MI	48104
Zingerman's Delicatessen, Inc.	Zingermans Del	422 Detroit St	Ann Arbor	MI	48104
K Z Magner Company	Zrazy Jim's Blimpee Burger	551 S Division St	Ann Arbor	MI	48104

Legal Name	Doing Business as (DBA)	Address	City
2 Your Door LLC		9214 Lake Crest Dr	Whitmore Lake
A C Cubs' Inc		1950 S Industrial Hwy	Ann Arbor
A Taste of Soul		97 Spring St	Ypsilanti
A & W Root Beer Drive In of Dexter	A&W Restaurant	8220 Dexter Chelsea Rd	Dexter
A-1 Premier Catering		2259 W Liberty St	Ann Arbor
A2 Pizza PI LLC		829 W Washington St	Ann Arbor
AMA Bistro		215 S State St	Ann Arbor
Abe's Coney Island Restaurant Inc	Abe's Coney Island	402 W Michigan Ave	Ypsilanti
Achilles Restaurant		3075 Packard St	Ann Arbor
Adrian & Blissfield Railroad Company		2634 Island Hills Dr	Dexter
Afternoon Delight Inc	Afternoon Delight	251 E Liberty St	Ann Arbor
Ahmo's Mediterranian Grill		530 S State St	Ann Arbor
Ahmon		341 E Huron St	Ann Arbor
Ahmos' Gyro & Deli		341 E Huron St	Ann Arbor
Ahmos' Gyro & Deli		4001 Stone School Rd	Ann Arbor
Ahmos' Gyro & Deli		2505 Ann Arbor Saline Rd	Ann Arbor
Ali-Baba		601 Packard St	Ann Arbor
Alley Bar		112 W Liberty St	Ann Arbor
Alpha Coney Island		7049 Dexter Ann Arbor Rd	Dexter
Alpha Koney Rash		2833 Oak Valley Dr	Ann Arbor
Ambrosia 33064		326 Maynard St	Ann Arbor
Amer's Inc		611 Church St Ste 2	Ann Arbor
Amer's Inc	Amer's Mediterranean Deli	312 S State St FL 1	Ann Arbor
American Grille Inc		1450 Holmes Rd	Ypsilanti
Ann Arbor Club		103 E Liberty St Ste 300	Ann Arbor
Ann Arbor Tortilla		727 W Ellsworth Rd Ste 6	Ann Arbor
Antonio's Coney Island		2896 Washtenaw Rd	Ypsilanti
Apex Cuisine		834 W Washington St	Ann Arbor
Applebee's International, Inc.	Applebee's	2310 Green Rd	Ann Arbor
Cameli, John	Applebee's	3819 Carpenter Rd	Ypsilanti
Applebee's International, Inc.	Applebee's	1005 W Eisenhower Pkwy	Ann Arbor
Aramark Services, Inc.	Aramark	1500 E Medical Center Dr # 5057	Ann Arbor
Aramark Services, Inc.	Aramark	Mc Kean & Textile Rd	Ypsilanti
Arbys Rest Pilot Corp	Arby's	195 Baker Rd	Dexter
ABS Enterprises, Inc.	Arby's	5660 Jackson Rd	Ann Arbor
Forsh, Inc	Arby's	3305 Windshadow Dr	Ann Arbor
Arirang Restaurant		3135 Oak Valley Dr	Ann Arbor
Ashley's Restaurants Ltd		338 S State St	Ann Arbor
Asian Legend Inc		516 E William St	Ann Arbor
Athenas		1497 Ecorse Rd	Ypsilanti
Aubree's Pizza 1, L.L.C.		2122 Whittaker Rd	Ypsilanti
Aubree's Saloon Inc		39 E Cross St Ste 41	Ypsilanti
Aubrees Pizza		39 E Cross St	Ypsilanti
Auburn Dexter		8031 Main St Ste 101	Dexter
M.P.B. Inc	Aut Bar	315 Braun CT	Ann Arbor
Aventura		216 E Washington St	Ann Arbor
Ayaka		1205 S University Ave	Ann Arbor
Ayses Courtyard Cafe	Ayse's Turkish Cafe	1703 Plymouth Rd	Ann Arbor
B Tb Cantina		1140 S University Ave	Ann Arbor
BAC Holdings I, L.L.C.		3601 Washtenaw Ave	Ann Arbor
Backwood's Beef Jerky LLC		12855 E Old US Highway 12	Chelsea
Diversified Restaurant Holdings, Inc.	Bagger Dave's	859 W Eisenhower Pkwy	Ann Arbor

Bandito's California Style Mexican Food		216 S 4th Ave	Ann Arbor
A C Banfield Inc	Banfield's Bar & Grill	3140 Packard St	Ann Arbor
Bangkok Cruisine Express Number Three Inc		4119 Stone School Rd	Ann Arbor
Bar Louie-Ann Arbor		401 E Liberty St	Ann Arbor
Baskin-Robbins	Baskin-Robbins	1952 W Stadium Blvd	Ann Arbor
Bay-Bays Rib Shack		2004 Mary Catherine St	Ypsilanti
Christos Ventures Inc.	Bayou Grille, The	7532 Oakland Hills Dr	Ypsilanti
Bear Claw Coffee Co		2460 Washtenaw Ave	Ann Arbor
Kascorp Inc	Bearclaw Coffee	3220 Old Hickory Pl	Ann Arbor
Beezy's LLC		20 N Washington St	Ypsilanti
Bell's Diner		2167 W Stadium Blvd	Ann Arbor
B Ball Pizza Inc	Bell's Pizza	700 Packard St	Ann Arbor
Bella Italia Pizza & Subs		895 W Eisenhower Pkwy	Ann Arbor
Belly Deli Inc		1317 S University Ave	Ann Arbor
Benito's Pizza		1088 N Huron River Dr	Ypsilanti
Benitos Pizza		100 S Ann Arbor St Ste A	Saline
Benny's Family Dining		1952 S Industrial Hwy	Ann Arbor
Best Western	Best Western	2900 Jackson Ave	Ann Arbor
Bewon		3574 Plymouth Rd	Ann Arbor
J & J Hospitality Inc	Big Boy Restaurant	3611 Plymouth Rd	Ann Arbor
Big Boy of Washtenaw Inc	Big Boy Restaurant	2800 Washtenaw Rd	Ypsilanti
A P Z Inc	Big Boy Restaurant	1510 S Main St	Chelsea
Ghneim Restaurants Inc	Big Boy Restaurant	9899 Main St	Whitmore Lake
Big Boy Restaurants International LLC	Big Boy-Red Roof Inn 40	3611 Plymouth Rd	Ann Arbor
Big Sky Diner		1340 Ecorse Rd	Ypsilanti
Big Ten Burrito		810 S State St	Ann Arbor
Bigalora		3050 Washtenaw Ave	Ann Arbor
Biggby Coffee		6961 E Michigan Ave	Saline
Biggby Coffee		3354 Washtenaw Ave	Ann Arbor
Biggby Coffee		2550 W Stadium Blvd	Ann Arbor
Biggby Coffee		5245 Jackson Rd	Ann Arbor
Biggby Coffee 291		1171 S Main St	Chelsea
Bigger Than Ten LLC		1140 S University Ave	Ann Arbor
Bill's Inc	Bill's Drive-Ln	1292 E Michigan Ave	Ypsilanti
Biwako Sushi		1355 E Michigan Ave	Saline
Blank Slate Creamery		300 W Liberty St	Ann Arbor
Kaffa House Inc	Blue Nile	221 E Washington St	Ann Arbor
Blue Tractor		205 E Washington St	Ann Arbor
Bob Evans Farms, LLC	Bob Evans	2411 Carpenter Rd	Ann Arbor
Bobberdown Grill		8475 Main St	Whitmore Lake
Boston Market Corporation	Boston Market	3325 Washtenaw Ave	Ann Arbor
Bread Basket Deli		4003 Carpenter Rd	Ypsilanti
Brecon Grille		101 W Michigan Ave	Saline
Brewed Awakenings Cafe		1378 Wedgewood Dr	Saline
Brookey's Cafe		1785 Washtenaw Rd	Ypsilanti
Argos Ltd	Brown Jug Restaurant	1204 S University Ave	Ann Arbor
Buffalo Wild Wings, Inc.	Buffalo Wild Wings	3150 Boardwalk St	Ann Arbor
Buffalo Wild Wings, Inc.	Buffalo Wild Wings	205 S State St	Ann Arbor
Awbw Corp	Buffalo Wild Wings	216 James L Hart Pkwy	Ypsilanti
Bravokilo Inc	Burger King	1073 E Michigan Ave	Ypsilanti
Excell Services Inc	Burger King	525 E Michigan Ave 403	Saline
Carrols Corporation	Burger King	6190 W Michigan Ave	Ypsilanti
Burger King Corporation	Burger King	9774 E M 36	Whitmore Lake

Carrols Corporation	Burger King 232	4885 Washtenaw Ave	Ann Arbor
Burgerfi		1235 S University Ave	Ann Arbor
Cafe Dujour		117 W Washington St	Ann Arbor
Patricia Landrum	Cafe Felix	204 S Main St	Ann Arbor
Cafe Ollie LLC		42 E Cross St	Ypsilanti
Cafe Racer		10 E Cross St	Ypsilanti
Cafe Rondez Vous		1110 S University Ave	Ann Arbor
Cafe Verde		214 N 4th Ave Ste 1	Ann Arbor
California Pizza Kitchen, Inc.		870 Briarwood Cir	Ann Arbor
Campus Chefs		2277 Glencoe Hills Dr	Ann Arbor
Dennis A Dahlmann	Campus Inn	615 E Huron St	Ann Arbor
Cancun Mexico Grill		405 E Michigan Ave	Saline
Captain Joes		9901 Main St	Whitmore Lake
Cardamom Restaurant		1739 Plymouth Rd	Ann Arbor
Carinos of Westland LLC		2008 S State St	Ann Arbor
Carrigan Cafe		107 S Ann Arbor St	Saline
Carson's American Bistro		2000 Commonwealth Blvd	Ann Arbor
Caseros LLC		114 W Middle St	Chelsea
Ann Arbor Party Center Inc	Catering Ala Cart	1612 Jackson Ave	Ann Arbor
Our Town Deli & Coffee Beanery	Cava Java	312 S State St FL 2	Ann Arbor
Chan Gardens		2265 W Liberty St	Ann Arbor
Charlie's Pizza of S Canton Inc		2835 S Wagner Rd Unit 246	Ann Arbor
Chef Chris		457 Territorial Rd	Manchester
Chef Restaurant Mediterrameam Cuisine		1098 N Huron River Dr	Ypsilanti
Chela's Restaurant & Taqueria		693 S Maple Rd	Ann Arbor
Chelsea Cafe Inc Chelsea Cafe Inc		2780 Lakehurst Ln	Ann Arbor
C.A.T. Inc	Chesy's American Bar and Grill	5484 W Michigan Ave	Ypsilanti
Chia Shiang Restaurants		2016 Packard St	Ann Arbor
Chick		3031 Cedarbrook Rd	Ann Arbor
Chick Inn Drive In		501 Holmes Rd	Ypsilanti
Chili's Inc	Chili's	3795 Washtenaw Ave	Ann Arbor
China Chef Inc		2870 Washtenaw Rd	Ypsilanti
China Data Center		1080 S University Ave	Ann Arbor
First China	China Garden	11930 Whitmore Lake Rd F	Whitmore Lake
China Garden		1165 S Main St	Chelsea
China Gate Restaurant Inc		1201 S University Ave	Ann Arbor
China King		3901 Jackson Rd	Ann Arbor
China Star		1047 Emerick St	Ypsilanti
Chinese Tonite Company	Chinese Tonite	1127 S Main St	Chelsea
Chipotle Mexican Grill, Inc.	Chipotle Mexican Grill	235 S State St	Ann Arbor
Chipotle Mexican Grill, Inc.	Chipotle Mexican Grill	3354 Washtenaw Ave Ste A	Ann Arbor
Chipotle Mexican Grill, Inc.	Chipotle Mexican Grill	858 Briarwood Cir	Ann Arbor
Chop Sticks Inc		882 W Eisenhower Pkwy	Ann Arbor
Cec Entertainment, Inc.	Chuck E. Cheese's	2655 Oak Valley Dr	Ann Arbor
Cielo Coffee LLC		2821 Maplewood Ave	Ann Arbor
Ciro's Italian Restaurant Inc		2554 W Stadium Blvd	Ann Arbor
Classic Catering By Tina		104 E Main St	Manchester
Classic Cup Cafe		4389 Jackson Rd	Ann Arbor
Classic Pizza Inc		8015 Huron St Ste A	Dexter
Pat's Woodshed Pub Inc	Cleary's Pub	113 S Main St	Chelsea
Cloverleaf Lunch		201 E Liberty St Frnt	Ann Arbor
Nick Stamadianos	Cloverleaf Restaurant	201 E Liberty St Frnt	Ann Arbor
Coffee House Creamery		3780 Jackson Rd Ste C	Ann Arbor

Cold Stone Creamery	Cold Stone Creamery	3597b Washtenaw Ave	Ann Arbor
Collins Pizza Inc		20311 Island Lake Rd	Chelsea
Craig's, Inc	Common Grill	112 S Main St	Chelsea
Gaelic Concepts LLC	Conor O'Neill's	318 S Main St	Ann Arbor
Constructive Eating, Inc.		525 Avis Dr Ste 16	Ann Arbor
Corner Brewery, LLC	Corner Brewery	720 Norris St	Ypsilanti
Cottage Inn Carry Out and Delivery, Inc.	Cottage Inn Carry Out 104	546 Packard St	Ann Arbor
Cottage Inn Carry Out and Delivery, Inc.		2301 W Stadium Blvd	Ann Arbor
Cottage Inn Carry Out and Delivery, Inc.		1141 Broadway St	Ann Arbor
Cottage Inn Carry Out and Delivery, Inc.		7890 Ann Arbor St	Dexter
Cottage Inn Carry Out and Delivery, Inc.		2900 S State St Ste 5	Ann Arbor
Cottage Inn Carry Out and Delivery, Inc.		244 Joe Hall Dr	Ypsilanti
Cottage Inn Carry Out and Delivery, Inc.		4860 Washtenaw Ave Ste G	Ann Arbor
Cottage Inn Carry Out and Delivery, Inc.	Cottage Inn Pizza	4390 Concourse Dr	Ann Arbor
Cottage Inn	Cottage Inn Pizza	501 E Michigan Ave	Saline
Cottage Inn Carry Out and Delivery, Inc.	Cottage Inn Pizza	520 S Main St	Chelsea
Country Rd. Diner		220 W Michigan Ave	Saline
N C P Inc	Cousins Heritage Inn	3672 Highlander Way E	Ann Arbor
Creekview Restaurants Inc		4349 Yarmouth Xing	Ypsilanti
Crunchy Chicken & Fish		4975 Washtenaw Ave	Ann Arbor
Culvers of Scio		5910 Jackson Rd	Ann Arbor
Cuppys Best Soulful Deli		1451 Ecorse Rd	Ypsilanti
Curry On		2711 Plymouth Rd	Ann Arbor
Domino's Pizza, Inc.	DOMINO'S PIZZA	30 Frank Lloyd Wright Dr	Ann Arbor
Dabu		4037 Carpenter Rd	Ypsilanti
Dadisms LLC		326 Maynard St	Ann Arbor
Dads Grill		8853 Stony Creek Rd	Ypsilanti
Dairy Queen	Dairy Queen	1805 Packard St	Ann Arbor
Albert F Serra	Dairy Queen	1801 Washtenaw Rd	Ypsilanti
Manchester Dairy Queen Inc	Dairy Queen	213 E Main St	Manchester
Diane Kerr	Dairy Queen	5821 Saline Ann Arbor Rd	Saline
Dalat Restaurant		100 W Michigan Ave	Ypsilanti
Day Go Cafe		1192 Henlon Cir	Saline
Deli On The Net LLC		1489 Bishop Rd	Saline
Delights Shaved Snow & Asian Patisserie		635 S Main St	Ann Arbor
Denny's, Inc.	Denny's	3310 Washtenaw Ave	Ann Arbor
Dibellas Old Fashioned Submarine		904 W Eisenhower Pkwy	Ann Arbor
Karim & Mary Dimo	Dimo's Deli & Donuts	2030 W Stadium Blvd	Ann Arbor
Dining Services		Lower Level Dc1 # 1	Ypsilanti
Divergent Brewing Company LLC		3410 Daleview Dr	Ann Arbor
Dky Sushi		283 S Zeeb Rd Ste H	Ann Arbor
Dky Sushi & Thai		1828 Whittaker Rd	Ypsilanti
Dog Time LLC		703 S Main St	Ann Arbor
Casa Dominick's	Dominicks	812 Monroe St	Ann Arbor
Domino S Pizza Franchising LLC		24 Frank Lloyd Wright Dr	Ann Arbor
Domino's Pizza LLC	Domino's Pizza	30 Frank Lloyd Wright Dr	Ann Arbor
Domino's Pizza	Domino's Pizza	4611 E Joy Rd	Ann Arbor
Dominos Ip Holder LLC	Domino's Pizza	30 Frank Lloyd Wright Dr	Ann Arbor
Domino's Pizza International, Inc.	Domino's Pizza	30 Frank Lloyd Wright Dr	Ann Arbor
Hoyt D Jones	Domino's Pizza	2601 Plymouth Rd Ste B	Ann Arbor
Hoyt D Jones	Domino's Pizza	4910 Washtenaw Ave	Ann Arbor
Hoyt D Jones	Domino's Pizza	2282 S Main St	Ann Arbor
Hoyt D Jones	Domino's Pizza	401 E Michigan Ave	Saline

Dominos Pizza LLC	Domino's Pizza	2121 S Grove St	Ypsilanti
Hoyt D Jones	Domino's Pizza	953 Washtenaw Rd	Ypsilanti
Domino's, Inc.	Domino's Pizza	30 Frank Lloyd Wright Dr	Ann Arbor
Don Juan		2135 W Stadium Blvd	Ann Arbor
Dr Lu's Healing Cuisine LLC		268 Indian River Pl	Ann Arbor
Earle's Garage Inc	Earle Restaurant, The	121 W Washington St # 101	Ann Arbor
Earthen Jar		311 S 5th Ave Ste 1	Ann Arbor
Eastern Coney Island, Inc		533 W Cross St	Ypsilanti
Eat LLC		1906 Packard St	Ann Arbor
Eat LLC		738 Miller Ave	Ann Arbor
Eat Local Eat Natural LLC		119 Jackson Industrial Dr	Ann Arbor
Eba Limited		30 Frank Lloyd Wright Dr	Ann Arbor
Eck Investments, Inc		120 E Liberty St FL 2nd	Ann Arbor
El Harissa Market Cafe		1516 N Maple Rd	Ann Arbor
Ellie's Chocolate Cafe		17325 Waterloo Rd	Chelsea
Emerald City Restaurant Inc		4905 Washtenaw Ave	Ann Arbor
Espresso Caffe Corporation		214 S Main St Ste 210	Ann Arbor
Espresso Caffe Corporation	Espresso Royale Caffe	214 S Main St Ste 210	Ann Arbor
Evergreen Oriental Inc		2771 Plymouth Rd	Ann Arbor
Everyday Inc		625 S Main St	Ann Arbor
Express Fish & Chicken		3015 E Michigan Ave	Ypsilanti
Espresso Caffe Corporation	Expresso Royale	324 S State St	Ann Arbor
Family Fried Chicken		510 W Michigan Ave	Ypsilanti
Famous Recipe Fried Chicken of Taylor, Inc		5785 Ellis Rd	Ypsilanti
Farha Group No 6 Inc		2570 Seminole Rd	Ann Arbor
Fat Philly's & Burgers		2224 Washtenaw Rd	Ypsilanti
Five Guys Burgers and Fries	Five Guys	3145 Ann Arbor Saline Rd	Ann Arbor
Food System Economic Partnership		705 N Zeeb Rd	Ann Arbor
France Cuisine		2821 Bateson CT	Ann Arbor
Frank's Pizza Inc		1200 Packard St	Ann Arbor
Frank's Italian Restaurant & Pizzeria Inc	Frank's Place	104 E Main St	Manchester
Frank's Restaurant		334 Maynard St	Ann Arbor
Frita Batido		117 W Washington St	Ann Arbor
Frosty Boy LLC		1466 Fox Pointe Cir	Ann Arbor
Gabriel's Steak Sandwich Shop	Gabriel's Hoggie Shop	2585 E Michigan Ave	Ypsilanti
C. A. Muer Corporation	Gandy Dancer	401 Depot St	Ann Arbor
Get Some Burritos		707 Packard St	Ann Arbor
Globaltron Franchise Development LLC		100 S 4th Ave	Ann Arbor
Godaiko Ann Arbor Inc		3105 Oak Valley Dr	Ann Arbor
Godaiko Japanese Restaurant		3115 Oak Valley Dr	Ann Arbor
Golden Wall		421 W Cross St	Ypsilanti
Good Friends Music		1810 Alhambra Dr	Ann Arbor
Charlies Goodtime	Good Time Charleys Bar & Grill	1140 S University Ave	Ann Arbor
Granger Tavern LLC	Grange Kitchen & Bar	118 W Liberty St	Ann Arbor
Downtown Ventures Inc	Gratzi	326 S Main St	Ann Arbor
Great Plains Burger Co.		1771 Plymouth Rd APT 102	Ann Arbor
Great Wall Chinese Restaurant		2128 Whittaker Rd	Ypsilanti
Grilled Cheezerie		709 Packard St	Ann Arbor
Gpbc Inc	Grizzly Peak Brewing Company	120 W Washington St Ste 1	Ann Arbor
Guy Holerins		3600 Plymouth Rd	Ann Arbor
Haab's Restaurant Inc		18 W Michigan Ave	Ypsilanti
Haifa Falasel		4585 Washtenaw Ave	Ann Arbor
Hana Korean Restaurant		1346 E Michigan Ave	Ypsilanti
Happy Wok Food		1916 W Stadium Blvd FL 1	Ann Arbor

Happy's Pizza Bar		640 Packard St	Ann Arbor
Happy's Pizza Company		600 S Main St	Ann Arbor
Harvest Kitchen		32 E Cross St	Ypsilanti
Heidelberg Bar Inc	Heidelberg Restaurant, The	215 N Main St	Ann Arbor
Hidden Dragon LLC	Hidden Dragon Restaurant	15 W Michigan Ave	Ypsilanti
A-L-W, Inc.	Holiday's Restaurant	2080 W Stadium Blvd	Ann Arbor
Holmes Road Diner		1450 Holmes Rd	Ypsilanti
Hong Kong Restaurant		2339 Ellsworth Rd	Ypsilanti
Howard's Hoagies, Inc	Howard's Hoagies Restaurant	2013 McCartney Ave	Ypsilanti
Howies P Hungry		11930 Whitmore Lake Rd H	Whitmore Lake
Hungry Howie's Pizza & Subs 10	Hungry Howie's Pizza	215 S Ford Blvd	Ypsilanti
Hungry Howie's Pizza & Subs	Hungry Howie's Pizza	2614 Washtenaw Rd	Ypsilanti
Hungry Wolf, LLC		20400 E Austin Rd	Manchester
Huron Fuel Plaza		244 Joe Hall Dr	Ypsilanti
Huron Pizza House		530 N Huron St	Ypsilanti
Hyperion Coffee Company		306 N River St	Ypsilanti
Farah Franchise LLC	IHOP	4221 E Ellsworth	Ann Arbor
Ichiban Japanese Steakhouse & Sushi Bar		4641 Washtenaw Ave	Ann Arbor
Iha of Ann Arbor PC		2000 Commonwealth Blvd	Ann Arbor
India Cafe		1143 Broadway St	Ann Arbor
Interfaith Round Table of Washtenaw County		6879 Daly Rd	Dexter
Iorio's Gelateria		522 E William St	Ann Arbor
Cascabel Ventures, L.L.C.	Isalita	341 E Liberty St	Ann Arbor
Izzy's Hoagie Shop		1924 W Stadium Blvd	Ann Arbor
J C Rich		1313 S University Ave	Ann Arbor
J D'S Pizza and Grinders		5561 Carpenter Rd	Ypsilanti
JMJ Group, LLC			Ypsilanti
Jamaican Jerk Pit		314 S Thayer St	Ann Arbor
Jennys Pizza Perfect Inc		332 S Ford Blvd	Ypsilanti
Jersey Mike's Subs	Jersey Mike's Subs	2561 Jackson Ave	Ann Arbor
Michway LLC DBA Jersey Mikes Subs	Jersey Mike's Subs	3650 Carpenter Rd	Ypsilanti
Jerusalem Garden		314 E Liberty St	Ann Arbor
Jet Pizza	Jet's Pizza	506 N Main St	Chelsea
Jets Pizza of Ann Arbor	Jet's Pizza	3127 Oak Valley Dr	Ann Arbor
Jet's Pizza		7011 Dexter Ann Arbor Rd	Dexter
Jet's Pizza Ypsilanti	Jet's Pizza	1298 Anna J Stepp Dr	Ypsilanti
Jets Pizza		1749 Plymouth Rd	Ann Arbor
Jimmy Johns Gourmet	Jimmy John's	2615 Plymouth Rd	Ann Arbor
Jimmy John's Gourmet Sandwich Shop Inc	Jimmy John's	1205 S University Ave	Ann Arbor
Jimmy John's Gourmet Sandwiches	Jimmy John's	537 W Cross St	Ypsilanti
Crlt Group LLC	Jimmy Johns	19742 Deerfield CT	Chelsea
Jimmy Johns		1149 S Main St	Chelsea
John's, Jimmie Gourmet Sandwich Shop	Jimmy Johns Gourmet	929 E Ann St	Ann Arbor
Joe Rosie		8074 Main St	Dexter
Joe's Crab Shack - Texas, Inc.	Joe's Crab Shack	3020 Lohr Rd	Ann Arbor
Jolly Pumpkin Artisan Ales LLC		311 S Main St	Ann Arbor
Jfr-Wayne Inc	Jonathan's Family Restaurant	4389 Jackson Rd	Ann Arbor
Joyful House Inc	Joyful House	515 E Michigan Ave	Saline
Just Baked		2463 W Stadium Blvd	Ann Arbor
K Hut Inc		727 Watersedge Dr	Ann Arbor
Earlee Enterprises Inc	KFC	502 E Michigan Ave	Saline
K F C National Management Company	KFC	39 E Michigan Ave	Ypsilanti
K F C National Management Company	KFC	4040 Washtenaw Ave # 20	Ann Arbor
Kai Garden Inc		908 Gallery Ln	Ann Arbor
Kana Korean Restaurant	Kana Korean Cuisine	114 W Liberty St	Ann Arbor
Graham Hotel Systems, Inc.	Kensington Court	610 Hilton Blvd	Ann Arbor
King Shing of Ann Arbor Inc	King Shing	2865 Carpenter Rd	Ann Arbor

Knight's Restaurant		600 E Liberty St	Ann Arbor
Knights Bar/Restaurant Inc	Knight's Steakhouse	2324 Dexter Ave	Ann Arbor
Coffee Break	Korean Restaurant	1327 S University Ave	Ann Arbor
La Fiesta Mexicana Inc		529 W Cross St	Ypsilanti
La Fuente Mexican Restaurant		1930 Whittaker Rd	Ypsilanti
La Torre Taquerlla		1525 Washtenaw Rd	Ypsilanti
La's Cafe' LLC		7120 Dexter Ann Arbor Rd	Dexter
Lai Lai Restaurant, Inc		4023 Carpenter Rd	Ypsilanti
Lake Whitmore Tavern Inc		9839 Main St	Whitmore Lake
Le Dog		306 S Main St Ste 1e	Ann Arbor
Lena		226 S Main St	Ann Arbor
Leo's Coney Island		1342 Anna J Stepp Dr	Ypsilanti
Leo's Coney Island		6889 State Rd Ste B	Saline
Lil Porkys' Pizza N More		2529 Dexter Rd	Ann Arbor
Lin Gui Restaurant		711 W Michigan Ave	Saline
Lindas Diner LLC		9610 MI State Road 52	Manchester
Links At Whitmore Lake Inc		1111 Six Mile Rd	Whitmore Lake
Little Caesar's	Little Caesar's	3000 Packard St Ste B	Ann Arbor
Little Caesars Pizza	Little Caesar's	2715 Plymouth Rd	Ann Arbor
Little Caesar Enterprises Inc	Little Caesar's	1783 Washtenaw Rd	Ypsilanti
Little Cesears Pizza		1595 Holmes Rd	Ypsilanti
Little Porkys		52 Barker Rd	Whitmore Lake
Logan An American Restaurant		115 W Washington St	Ann Arbor
Lord Fox		5400 Plymouth Rd	Ann Arbor
Los Amigos LLC		2851 E Michigan Ave	Ypsilanti
Lotus Thai Restaurant		2803 Oak Valley Dr	Ann Arbor
Luca's Coney Island		2469 Washtenaw Rd	Ypsilanti
Lucas Coney Island		309 E Michigan Ave	Ypsilanti
Lucky 7 Chinese Food		1777 Washtenaw Rd	Ypsilanti
Lucky Garden Chinese		1072 N Huron River Dr	Ypsilanti
Lucky Kitchen Chinese Carry-Out & Delvry		1753 Plymouth Rd	Ann Arbor
Lunch Room LLC		407 N 5th Ave	Ann Arbor
M Totoro		215 S State St	Ann Arbor
MI Zarape		7025 E Michigan Ave	Saline
Mac's Blue Note Cafe		2565 Plymouth Rd	Ann Arbor
Madras Masala Kitchens Inc		328 Maynard St	Ann Arbor
Main Street Coney Island		1555 S Main St	Chelsea
Main Street Ventures Inc	Mainstreet Ventures	322 S Main St	Ann Arbor
Mainstreet Ventures, Inc.		605 S Main St Ste 2	Ann Arbor
Edward Brothers Food, Inc	Maize "n" Blue Deli & Eatery	1329 S University Ave	Ann Arbor
Mama Mia's		997 Emerick St	Ypsilanti
Mancino's Grinders & Pizza		2883 Carpenter Rd	Ann Arbor
Mancinos Pizza & Grinders		1323 E Michigan Ave	Saline
Mangiamo Italian Grill		105 W Michigan Ave	Saline
Mani Osteria		341 E Liberty St	Ann Arbor
Marco's Pizza	Marco's Pizza	4068 Packard St	Ann Arbor
Nico Inc	Marco's Pizza	148 Barker Rd	Whitmore Lake
M & M Midtown Coney Island Inc	Mark Smth Midtown Coney Island	3672 S State St	Ann Arbor
Mark's Midtown Coney Island		529 E Michigan Ave	Saline
Mark's Midtown Coney Island		3586 Plymouth Rd	Ann Arbor
Marnee Thai Restaurant		414 S Main St Ste 130	Ann Arbor
Mary's Fabulous Chicken		3220 Packard St	Ann Arbor
Max & Erma's Limited	Max & Erma's	455 E Eisenhower Pkwy # 1	Ann Arbor
Nan Bitner	Mc Donald's 10950	2310 W Stadium Blvd	Ann Arbor
McStadium Mcdonald's, Inc.	McDonald's	2310 W Stadium Blvd	Ann Arbor
McDonald's Restaurants of Michigan, Inc	McDonald's	11033 Whitmore Lake Rd	Whitmore Lake
McDonald's Restaurants of Michigan, Inc	McDonald's	16 Ecorse Rd	Ypsilanti

McDonald's Restaurants of Michigan, Inc	McDonald's	1535 S Main St	Chelsea
McDonald's Restaurants of Michigan, Inc	McDonald's	373 N Zeeb Rd	Ann Arbor
Alrose Inc	McDonald's	166 James L Hart Pkwy	Ypsilanti
McDonald's	McDonald's	2675 Plymouth Rd	Ann Arbor
Alrose Inc	McDonald's	4775 Washtenaw Ave	Ann Arbor
Kalene Enterprises, Inc	McDonald's	166 James L Hart Pkwy	Ypsilanti
Christy Taylor	McDonald's	3001 Waters Rd	Ann Arbor
David Beschles	McDonald's	3752 S State Rd	Ann Arbor
McDonalds 24999	McDonald's	101 Baker Rd	Dexter
Alrose Inc	McDonald's	1070 N Huron River Dr	Ypsilanti
McDonald's	McDonald's	3811 Carpenter Rd	Ypsilanti
McDonald's	McDonald's	3325 Washtenaw Ave	Ann Arbor
Mediterrano Restaurant		2900 S State St Ste 7	Ann Arbor
Mei's Organic Chinese Kitchen		8280 S Warwick CT	Ypsilanti
Melange Bistro	Melange	314 S Main St	Ann Arbor
Menna's Joint		607 E William St	Ann Arbor
Metzger's German Restaurant Inc		305 N Zeeb Rd	Ann Arbor
Mezes Greek Grill		715 N University Ave	Ann Arbor
Michaels Chophouse		3200 Boardwalk St	Ann Arbor
Mickeys Dairy Twist		751 W Michigan Ave	Saline
Mickeys' Pizza, LLC		8230 Main St	Whitmore Lake
Middle Kingdom Inc		332 S Main St	Ann Arbor
Assoc Restaurant Management	Miki Japanese Restaurant	106 S 1st St	Ann Arbor
Ming's House Inc		1127 S Main St	Chelsea
Mocha Monkey Cafe		401 Courtland St	Ypsilanti
Moe's Restaurant Incorporated	Moe's Southwest Grill	857 W Eisenhower Pkwy	Ann Arbor
Moonwinks Cafi		5151 Plymouth Rd	Ann Arbor
Gerald Mound Designs	Mound, Gerald Interior Design	8576 Barrington Dr	Ypsilanti
Mr Greeks Coney Island Inc		215 S State St Ste 4	Ann Arbor
Mr Mike's Lounge		1425 Ecorse Rd	Ypsilanti
Mr Pizza		1484 Washtenaw Rd	Ypsilanti
Mr Pizza Enterprises Inc	Mr Pizza	800 Ecorse Rd	Ypsilanti
Mr Pizza and The Burrito Joint		889 Twin Towers St	Ypsilanti
Mr. C Pizza Company		138 E Main St	Manchester
My Favorite Cafe		101 S Ann Arbor St # 105	Saline
Nagomi Sushi & Noodles		1754 Plymouth Rd	Ann Arbor
Neopapalis of Ann Arbor LLC		500 E William St	Ann Arbor
New China		6889 State Rd Ste D	Saline
Molfetta Inc	New York Pizza Depot	605 E William St	Ann Arbor
Nippon Sushi Bar LLC		1182 Oak Valley Dr	Ann Arbor
Nirmal Indian Cuisine		2874 Washtenaw Rd	Ypsilanti
No Thai		1745 Plymouth Rd	Ann Arbor
No Thai		226 N 4th Ave	Ann Arbor
No Thai		1300 S University Ave # 3	Ann Arbor
Noodles & Company	Noodles & Company	3601 Washtenaw Ave Ste A	Ann Arbor
Noodles Company	Noodles & Company	320 S State St	Ann Arbor
Noodles & Company	Noodles & Company 8015	2245 W Stadium Blvd	Ann Arbor
Nypd Restaurant		308 Perrin St	Ypsilanti
Oasis Deli		1106 S University Ave	Ann Arbor
Old Town Tavern	Old Town	122 W Liberty St	Ann Arbor
Olga's Kitchen Inc	Olga's Kitchen	3399 Plymouth Rd	Ann Arbor
Olga's Kitchen, Inc.	Olga's Kitchen	452 Briarwood Cir	Ann Arbor
Gmri, Inc.	Olive Garden	445 E Eisenhower Pkwy	Ann Arbor
Olivias Touch		2957 W Clark Rd APT 102	Ypsilanti
Ollie's Main Street Pizza		138 E Main St	Manchester
Om Cafe		5501 Morgan Rd	Ypsilanti
Orange Leaf Frozen Yogurt		2613 Plymouth Rd	Ann Arbor

Cottage Inn, Inc.	Original Cottage Inn, The	4390 Concourse Dr	Ann Arbor
Miwings, LLC	Oscar's Bar and Grill	6877 State Rd Ste D	Saline
Oscar's Cafe & Deli		2008 Hogback Rd	Ann Arbor
Outback Steakhouse of Florida, Inc.	Outback Steakhouse	3173 Oak Valley Dr	Ann Arbor
Over The Edge Pizza Inc		138 E Main St	Manchester
Pacific Beach Burritos		7440 Nollar Rd	Whitmore Lake
Pacific Rim By Kana, Inc.		114 W Liberty St	Ann Arbor
347 Corporation Inc	Palio	347 S Main St	Ann Arbor
Palm Palace, L.L.C.		2370 Carpenter Rd	Ann Arbor
Pittsfield Mexican, LLC	Panchero Mexican Grill	3155 Annarbor Rd Ste C	Ann Arbor
Little Donkeys Inc	Panchero's Mexican Restaurant	1208 S University Ave	Ann Arbor
Panda Express, Inc.	Panda Express	2101 Bonisteel Blvd	Ann Arbor
Panda Express, Inc.	Panda Express 1723	530 S State St	Ann Arbor
Panda Express, Inc.	Panda Express 2101	620 Briarwood Cir	Ann Arbor
Panda House		229 N Maple Rd	Ann Arbor
Panda Inn, Inc.	Panda Inn	640 Avis Dr	Ann Arbor
Panda Korean Chinese Foods		3020 Packard St	Ann Arbor
Panera Bread 1366	Panera Bread	777 N University Ave	Ann Arbor
Panera Bread Company	Panera Bread	3205 Washtenaw Ave	Ann Arbor
Panera Bread Company	Panera Bread	5340 Jackson Rd	Ann Arbor
Panera Bread Company	Panera Bread 1105	1773 Plymouth Rd	Ann Arbor
Panera Bread Company	Panera Bread 874	903 W Eisenhower Pkwy	Ann Arbor
Papa John's	Papa John's	2145 W Stadium Blvd	Ann Arbor
Joe Carman	Papa John's	401 E Huron St	Ann Arbor
Paradise Restaurant		883 W Eisenhower Pkwy	Ann Arbor
Pastry Peddler Bakery and Cafe		619 Packard St	Ann Arbor
Pea Pod Inn Inc		330 Ecorse Rd	Ypsilanti
Perfect Cup		530 S State St	Ann Arbor
Perfect Pizza Pie, Inc.		1055 Towsley Ln	Ann Arbor
P.F. Chang's China Bistro, Inc.	Pf Changs China Bistro	720 Briarwood Cir	Ann Arbor
Picasso Cafe, Inc.	Picasso Restaurant Group	24 Frank Lloyd Wright Dr	Ann Arbor
Pilar's		2261 W Liberty St	Ann Arbor
Pita Kabob Grill		619 E William St	Ann Arbor
Pita Pita		2649 Washtenaw Rd	Ypsilanti
Ansara Restaurant Group, Inc.	Red Robin	3797 Carpenter Rd	Ypsilanti
East U Provisions LLC	Revive & Replenish	619 E University Ave	Ann Arbor
Gamekeepers of Michigan, Inc	Scorekeepers	310 Maynard St	Ann Arbor
Em & M Inc.	Seoul Garden Restaurant	3125 Boardwalk St	Ann Arbor
Marvin A Zetley	Sheraton	3200 Boardwalk St	Ann Arbor
French Quarter Inc	Shill	1494 Ecorse Rd	Ypsilanti
Golden Falcon Inc	Smoke House Blues Memphis	4855 Washtenaw Ave	Ann Arbor
Petro Limited Inc	Subway	3150 W Michigan Ave	Ypsilanti
Dortch & Dortch Subway	Subway	885 W Eisenhower Pkwy	Ann Arbor
Dexter Clark Inc	Subway	8135 Main St	Dexter
CJ & Dis Inc	Subway	2868 Washtenaw Rd	Ypsilanti
Great Lakes Dining, Inc	TGI Friday's	3015 Lohr Rd	Ann Arbor
Old West Properties LLC	Taco Bell	210 Ecorse Rd	Ypsilanti
Natron Corporation	Taco Bell	615 E University Ave	Ann Arbor
Natron Corporation	Taco Bell	5650 Jackson Rd	Ann Arbor
Dino's Lamplighter Inc.	Thano's Lamplighter	3303 Tacoma Cir	Ann Arbor
Eleni Inc	Village Kitchen	241 N Maple Rd	Ann Arbor
J Stanton David & Associates Inc	Wendy's	3100 Boardwalk St	Ann Arbor
J Stanton David & Associates Inc	Wendy's	1640 Commerce Park Dr	Chelsea
J Stanton David & Associates Inc	Wendy's	2735 Washtenaw Rd	Ypsilanti
J Stanton David & Associates Inc	Wendy's	750 S Hewitt Rd	Ypsilanti
J Stanton David & Associates Inc	Wendy's	1655 Plymouth Rd	Ann Arbor
J Stanton David & Associates Inc	Wendy's	4020 Carpenter Rd	Ypsilanti

Douglas Corporation of Michigan	Wendy's	9410 York Woods Dr	Saline
J Stanton David & Associates Inc	Wendys Old Fashioned Hmbgs 28	530 S State St	Ann Arbor
J Stanton David & Associates Inc	Wendys Old Fashioned Hmbgs 31	760 E Michigan Ave	Saline
J Stanton David & Associates Inc	Wendys Old Fashioned Hmbgs 40	911 N University Ave	Ann Arbor
Pangaea Restaurant Ltd	West End Grill	120 W Liberty St	Ann Arbor
K Z Magner Company	Zrazy Jim's Blimpee Burger	551 S Division St	Ann Arbor
Polkryst Inc	Amadeus Cafe	122 E Washington St Ste B	Ann Arbor
Whitmore Lanes Inc	Anchor Bay	9455 Main St	Whitmore Lake
Vangelatos Inc	Angelo's	1100 Catherine St Ste 1	Ann Arbor
Sybra, LLC	Arby's	9747 E M 36	Whitmore Lake
Sybra, LLC	Arby's	3015 Washtenaw Rd	Ypsilanti
U Ventures, Inc.	Blue Leprechaun	1220 S University Ave # 109	Ann Arbor
Quality Dining Incorporated	Burger King	151 S Zeeb Rd	Ann Arbor
Snpm, Inc.	Burger King	1851 Ridgewood Cir	Saline
Three S Enterprises Inc	Burger King	725 Victors Way	Ann Arbor
Z Squared Inc	Cafe Zola	112 W Washington St	Ann Arbor
Trr Enterprises, LLC	Carlyle Grill	3660 Jackson Rd	Ann Arbor
Ztf Corporation	Chelsea Cottage Inn Pizza	520 S Main St	Chelsea
Sljm II Corporation	Cold Stone Creamery	8498 Jack Pine Cir	Ypsilanti
Sljm IV Corporation	Cold Stone Creamery	8498 Jack Pine Cir	Ypsilanti
Saline Dairy Queen	Dairy Queen	400 E Michigan Ave	Saline
The Dexter Dairy Queen	Dairy Queen	8041 Main St	Dexter
Saline Tavern Inc	Dan's Downtown Tavern	103 E Michigan Ave	Saline
Pizza Pride, Llc(2)	Domino's Pizza	25 Jackson Industrial Dr # 600	Ann Arbor
Wholesame Foods LLC	Elevation Burger	3365 Washtenaw Ave Ste M	Ann Arbor
Ssf Inc	Gourmet Garden	2255 W Stadium Blvd	Ann Arbor
Tj Squared LLC	Jet's Pizza	978 E Michigan Ave	Saline
Saline Chop House Inc	Kelly's 107 Saline Cafe	162 Nichols Dr	Saline
Stephens Brothers Inc	Little Caesar's	1944 W Stadium Blvd	Ann Arbor
Zaco Inc	Marco's Pizza	1752 Plymouth Rd	Ann Arbor
Shaw Restaurants II Inc	Melting Pot	309 S Main St	Ann Arbor
T K X Inc	Mr Spots	808 S State St	Ann Arbor
Siam Kitchen Inc	Old Siam, The	2509 Jackson Ave	Ann Arbor
S & R Inc	Paesano's Restourant	3411 Washtenaw Ave	Ann Arbor
Walden Foods Ods Papa John's Ann Arbor LLC	Papa John's	4559 Washtenaw Ave	Ann Arbor
Pittsfield Mexican, LLC		3155 Annarbor Rd	Ann Arbor
Pizza Bob's		814 S State St	Ann Arbor
Pizza House Ann Arbor Inc	Pizza House	618 Church St	Ann Arbor
Taco Bell Corporation	Pizza Hut	3860 S State Rd	Ann Arbor
Pizza Hut, Inc.	Pizza Hut	3045 Carpenter Rd	Ypsilanti
Pizza Hut, Inc.	Pizza Hut	5630 Jackson Rd	Ann Arbor
Pizza Pino		221 W Liberty St	Ann Arbor
Plaza Tapatia		2845 E Michigan Ave	Ypsilanti
Potbelly Corporation	Potbelly	3785 Washtenaw Ave	Ann Arbor
Potbelly Corporation		300 S State St	Ann Arbor
Potbelly Sandwich Works Store 197		980 W Eisenhower Pkwy	Ann Arbor
Prickly Pear Cafe Inc	Prickly Pear Cafe	328 S Main St FL 1	Ann Arbor
Qdoba Mexican Grill		1771 Plymouth Rd APT 103	Ann Arbor
Qdoba Mexican Grill		3279 Washtenaw Ave	Ann Arbor
Qdoba Mexican Grill		2252 S Main St	Ann Arbor
Queen Bee and ME		1676 Sylvan Rd	Chelsea
Queen Pooka		803 Gott St	Ann Arbor
Quizno Sub's		3584 Plymouth Rd	Ann Arbor
Quizno's Classic Subs	Quizno's Subs	8448 Barrington Dr	Ypsilanti
Quizno's	Quizno's Subs	5645 Jackson Rd	Ann Arbor
Raja Rani Inc		400 S Division St Ste 1	Ann Arbor
Real Seafood Company of Ann Arbor, Inc		341 S Main St	Ann Arbor

Real Seafood Company of International Park LLC		605 S Main St Ste 2	Ann Arbor
Red Hawk Corporation	Red Hawk Bar & Grill	316 S State St	Ann Arbor
Red Lobster Hospitality LLC	Red Lobster 260	2420 Carpenter Rd	Ann Arbor
Red Rock Downtown Bbq		207 W Michigan Ave	Ypsilanti
Reddeman Farms Golf Course	Reddeman Farms Golf Club	555 Dancer Rd	Chelsea
Rick's Cafe Inc	Rick's American Cafe	611 Church St Ste 1	Ann Arbor
Rio Wrap		1334 Anna J Stepp Dr	Ypsilanti
Zingerman's Roadhouse, LLC	Roadhouse, The	2501 Jackson Ave	Ann Arbor
Robin Ann Arbor Inc		575 Briarwood Cir	Ann Arbor
Rod's Diner Inc		812 S State St	Ann Arbor
Romano's Macaroni Grill, Inc.	Romano's Macaroni Grill	3010 S State St	Ann Arbor
Ron Roadside Bbq		5850 Pontiac Trl	Ann Arbor
Round Haus Pizza & Party Shop Inc		5970 Bridge Rd	Ypsilanti
Round Tree Terrace Cafe LLC	Roundtree Restaurant	2203 Ellsworth Rd Ste 19	Ypsilanti
Roy's Hamburger and Barbeque	Roy's Squeeze Inn	1315 E Michigan Ave	Ypsilanti
Royale Espresso		1101 S University Ave # 1	Ann Arbor
Royale Espresso		2264 S Main St	Ann Arbor
Ruby Tuesday Inc.	Ruby Tuesday	1375 E Michigan Ave	Saline
Rustic Glen Golf Club LLC	Rustic Glen Golf Course	12090 W Michigan Ave	Saline
Rcaa Development, LLC	Ruths Chris Steak House	314 S 4th Ave	Ann Arbor
Sabor Latino Rest		211 N Main St	Ann Arbor
Sadako Japanese Restaurant		1321 S University Ave	Ann Arbor
Sahra International Grill		2447 Ellsworth Rd	Ypsilanti
Saica Corporation	Saica Restaurant	1733 Plymouth Rd	Ann Arbor
Saigon Garden		1220 S University Ave # 110	Ann Arbor
Salads Up, LLC		611 E Liberty St	Ann Arbor
Saline Inn, Inc		434 E Michigan Ave	Saline
Salt Springs Brewery LLC		117 S Ann Arbor St	Saline
San Fu Oriental Cuisine		625 S Main St	Ann Arbor
Satchel's Bbq, L.L.C.		3035 Washtenaw Ave	Ann Arbor
Sra2, LLC	Sava's Restaurant	216 S State St	Ann Arbor
Sava's State Street Cafe LLC		211 S State St Ste A	Ann Arbor
Savas Cafe		216 S State St Ste 1	Ann Arbor
Seitz's Tavern, Inc		110 W Middle St	Chelsea
Selby Inc		10404 Island Lake Rd	Dexter
Selma Cafe		722 Soule Blvd	Ann Arbor
Seoul Street		1771 Plymouth Rd	Ann Arbor
Sethpitality USA Holdings		1311 Anna J Stepp Dr	Ypsilanti
Seva Inc	Seva Restaurant	2541 Jackson Ave	Ann Arbor
Shalimar of Ann Arbor, Inc		307 S Main St	Ann Arbor
Siam Square		3750 Washtenaw Ave	Ann Arbor
Silbio's Organic Pizza		715 N University Ave	Ann Arbor
Silverdale Dairy Queen LLC		9771 Bunton Rd	Willis
Sinbads Coney Island		2563 Ellsworth Rd	Ypsilanti
Skip's Pizza & Party Store		11485 N Territorial Rd	Dexter
Smokehouse Fiftytwo		125 S Main St	Chelsea
Songco LLC		2707 Plymouth Rd	Ann Arbor
Sottini Sub Shop		205 S 4th Ave	Ann Arbor
Spencer		113 E Liberty St	Ann Arbor
Star In Your Heart		1729 Charlton St	Ann Arbor
Starbucks Corporation	Starbucks	3650 Carpenter Rd	Ypsilanti
Starbucks Corporation	Starbucks	100 Briarwood Mall Cir	Ann Arbor
Starbucks Corporation	Starbucks	1214 S University Ave S100	Ann Arbor
Starbucks Corporation	Starbucks	222 S State St	Ann Arbor
Starbucks Corporation	Starbucks	3601 Washtenaw Ave	Ann Arbor
Starbucks Corporation	Starbucks	300 S Main St	Ann Arbor
Starbucks Corporation	Starbucks	4585 Washtenaw Ave	Ann Arbor

Stars Cafe		2575 Jackson Ave	Ann Arbor
Steak N Shake Operations, Inc	Steak 'n Shake	4120 Ellsworth Rd	Ypsilanti
Stivers		11 S Fletcher Rd	Chelsea
Stockwell's Home Cookin		114 Adrian St	Manchester
Stonefire Pizza		3370 Burbank Dr	Ann Arbor
Stoopid Rooster		6584 Stony Creek Rd	Ypsilanti
Subway Number Two Five One Three	Subway	2124 Whittaker Rd	Ypsilanti
Subway	Subway	411 E Washington St	Ann Arbor
Subway	Subway	2515 Ellsworth Rd	Ypsilanti
Subway	Subway	900 Oakwood St	Ypsilanti
Subway	Subway	7000 E Michigan Ave	Saline
Subway	Subway	2410 W Stadium Blvd	Ann Arbor
Subway	Subway	3395 Plymouth Rd	Ann Arbor
Subway	Subway	530 S State St	Ann Arbor
Subway Sandwiches	Subway	3384 Washtenaw Ave	Ann Arbor
Subway Best Way	Subway	10955 Willis Rd	Willis
Subway	Subway	510 Ann Arbor St	Manchester
Subway	Subway	5 S Fletcher Rd	Chelsea
Subway	Subway	11930 Whitmore Lake Rd D	Whitmore Lake
Subway	Subway	3650 S State St	Ann Arbor
Subway	Subway	750 Baker Rd	Dexter
Subway	Subway	4800 E Huron River Dr	Ann Arbor
Subway	Subway	3098 Platt Rd	Ann Arbor
Subway	Subway	1251 N Maple Rd Ste 2	Ann Arbor
Subway	Subway	7050 Dexter Ann Arbor Rd # 600	Dexter
Subway	Subway	2570 Seminole Rd	Ann Arbor
Sisters Enterprises Inc	Subway	1315 S University Ave	Ann Arbor
Stephlynn Inc	Subway	1478 Ecorse Rd	Ypsilanti
Sadhu, Bavi	Subway	4444 White Pine CT	Ann Arbor
Subway Sandwich	Subway	1010 E Michigan Ave	Saline
Subway	Subway	4009 Carptr Rd Arbor Sq	Ann Arbor
Subway of Ypsilanti	Subway	501 E Michigan Ave	Ypsilanti
Subway of Chelsea Inc	Subway	1107 S Main St	Chelsea
Subway	Subway	9662 Chilson Commons Cir	Whitmore Lake
Subway Sandwiches and Sal		25 Jackson Industrial Dr	Ann Arbor
Sushi Comz Fresh		715 N University Ave # 10	Ann Arbor
Sushi Nara LLC		4037 Carpenter Rd	Ypsilanti
Sushi Patsu		100 Briarwood Cir	Ann Arbor
Sushi Town		740 Packard St Ste 1	Ann Arbor
Sweetwater Coffee & Tea		407 N 5th Ave	Ann Arbor
Sweet Waters Cafe	Sweetwaters Cafe	123 W Washington St	Ann Arbor
Tables Inc		8536 Ashton CT	Ypsilanti
Taco Bell	Taco Bell	1085 E Michigan Ave	Ypsilanti
Taco Bell	Taco Bell	1590 S Main St	Chelsea
Taco Bell Corp	Taco Bell	2280 W Stadium Blvd	Ann Arbor
Taco Bell Corp	Taco Bell	2655 Washtenaw Rd	Ypsilanti
Tank U Assoc LLC		3646 Tanglewood Dr	Ann Arbor
Taste of India LLC		217 S State St	Ann Arbor
The Arena Restaurant		203 E Washington St	Ann Arbor
The Artic Breakaway		501 Coliseum Dr	Chelsea
The Big Salad		2793 Plymouth Rd Ste C	Ann Arbor
The Bomber Restaurant		306 E Michigan Ave	Ypsilanti
The Brinery		6235 Jackson Rd	Ann Arbor
The Broken Egg		221 N Main St	Ann Arbor
The Chelsea Grill		1120 S Main St	Chelsea
The County Coffee Shop		101 E Huron St	Ann Arbor
The Fraser's Pub Inc		2045 Packard St	Ann Arbor

The Full House Inc		57 Ecorse Rd	Ypsilanti
The Quickgrill LLC		3073 Promenade Cir	Ann Arbor
The Village Tab		237 E Main St	Manchester
Thompson S Pizzeria Inc		20700 W Old US Highway 12	Chelsea
Three Diamonds Internet Cafe		893 W Eisenhower Pkwy	Ann Arbor
Tianchu Restaurant		613 E William St	Ann Arbor
Time Teriyaki		314 Detroit St	Ann Arbor
S A Panzda Inc	Tios	333 E Huron St	Ann Arbor
Tk Wu		510 E Liberty St	Ann Arbor
Tmaz Taqueria		3182 Packard St	Ann Arbor
Tonight Rest Chinese		1127 S Main St	Chelsea
Tonys Grill & Restaurant Inc		2660 Washtenaw Rd	Ypsilanti
Tonys Red Baron Pizza		1559 Beverly Ave	Ypsilanti
Tower Inn Restaurant of Ypsilanti Inc	Tower Inn	701 W Cross St	Ypsilanti
Tracklements Smokery		212 E Kingsley St	Ann Arbor
Travelcenters of America LLC	Travel Centers of America 89	I-94 Exit 167	Dexter
Tropical Smoothie Cafe		607 E Liberty St Mi15	Ann Arbor
Tubby's Sub Shops, Inc	Tubby's Grilled Subs	800 S State St	Ann Arbor
Tuckerscatering		1555 Harvest Ln	Ypsilanti
Tuptim, LLC	Tuptim Thai Cuisine	4896 Washtenaw Ave	Ann Arbor
Twisters Ice Cream		901 S Main St	Chelsea
US Canada & China Cultural and Economic		3543 Burbank Dr	Ann Arbor
Umi Sushi		3393 Plymouth Rd	Ann Arbor
University Cafe		621 Church St	Ann Arbor
Variety Food Service		4800 W Huron River Dr	Ann Arbor
Vdv Concessions LLC		4390 Lohr Rd	Ann Arbor
Vellum		1672 Snowberry Ridge Rd	Ann Arbor
Victor's Restaurant		615 E Huron St	Ann Arbor
Weber's, Inc.	Weber's Inn	3050 Jackson Ave	Ann Arbor
What's Cooking		3744 Plaza Dr	Ann Arbor
Whats In Your Cup Juice & Smoothie Cafe LLC		1816 Whittaker Rd	Ypsilanti
Which Wich		301 E Liberty St	Ann Arbor
White Castle System, Inc.	White Castle	3953 Packard St	Ann Arbor
William Michael Foods Inc		3098 Platt Rd	Ann Arbor
Williams Party Store & Deli Inc		5915 W Michigan Ave	Ypsilanti
Wings Pizza N Things		6877 State Rd Ste A	Saline
Wise Guyz Pizza		701 W Cross St	Ypsilanti
Wolverine Grill Restaurant		228 W Michigan Ave	Ypsilanti
Xingsheng Inc		2905 Washtenaw Rd	Ypsilanti
Yotsuba Japanese Rest		330 Meadow Creek Dr	Ann Arbor
Yotsuba Japanese Restaurant		2222 Hogback Rd	Ann Arbor
Zamaan Cafe		3580 Plymouth Rd	Ann Arbor
Zamaan Cafe Three Inc		865 W Eisenhower Pkwy	Ann Arbor
Zeeb Restaurant LLC		497 N Zeeb Rd	Ann Arbor
Zingerman's Delicatessen, Inc.		422 Detroit St	Ann Arbor
Zingerman's Delicatessen, Inc.	Zingermans Del	422 Detroit St	Ann Arbor
Zou Zou's		101 N Main St	Chelsea

ANN ARBOR BIODIGESTER FEASIBILITY STUDY - APPENDIX 1
Follow Up to M Naud

Company Name	Contact Name	Address	City	State	Zip	Phone #	email
Kroger	Suzanne Lindsay	1014 Vine	Cincinnati	Oh	45202	513-762-4983	suzanne.lindsay-walker@kroger.com
Ann Arbor City Schools	Heather Holland (Chartwll Dining Services)	2555 South State Street	Ann Arbor	MI	48104	734-994-1670	holland@aaps.k12.mi.us
Trader Joes	Steve Hebda					857-400-3400, 857-288-9335	
Michigan Power Vac	Dave (last name unknown)	44300 Grand River Ave	Novi	MI	48375	248-912-9975	service@yourworkorder.com

Appendix 2

DATE

Company Address

As part of its sustainability effort, the City of Ann Arbor has engaged a team of consultants lead by Fishbeck, Thompson, Carr & Huber, Inc. (FTCH) to study the feasibility of constructing a biodigester to process organic wastes (including grease trap waste) in and around the City of Ann Arbor. Biodigestion is a proven technology that provides an alternative to landfilling these materials as well as producing renewable energy and nutrient rich soil amendments.

As part of the City-sponsored Feasibility Study, Team FTCH is tasked with identifying the volume and types of food waste available in the local area that are suitable for processing by the proposed Ann Arbor Biodigester. One of the FTCH team members, BioWorks Energy, is leading the effort to quantify the volume and types of food waste available in the local area that is suitable and may be processed by the proposed digestion system.

As a company doing business in the greater Ann Arbor/Washtenaw County area, ***Company Name*** has been selected to help with the feasibility study by providing certain information that is critical for this evaluation. All information provided will remain confidential unless you agree to let us release it. Enclosed are questions that address information that will aid our team in this important City of Ann Arbor study. Alternatively, an online survey has been established at https://www.surveymonkey.com/r/BRMQ8XD for your use.

The data collected from the survey is a key component to a successful study. We appreciate your assistance in gathering this important information.

Responses to these questions can be emailed to our consultant Chad Antle at BioWorks Energy using the following address: chad.antle@bioworksenergy.com

Based on the information that you provide, Mr. Antle may follow up with you with any needed clarifications.

We appreciate your willingness to assist the City of Ann Arbor with this important study. Please feel free to contact me with any questions about the study.

Matthew Naud
Environmental Coordinator
mnaud@a2gov.org

1. Do you collect grease trap waste within the City of Ann Arbor? Yes/No

2. Do you collect grease trap waste within Washtenaw County? Yes/ No

3. What is the annual volume (gallons) of grease trap waste collected within Ann Arbor by your company?

4. What is the annual volume (gallons) of grease trap waste collected within Washtenaw County (not including the City of Ann Arbor) by your company?

5. Where is the grease trap waste that you collect currently being reused/disposed?

6. What is the cost of disposal (per unit basis)?

7. Would you be interested in using a facility located in Ann Arbor for the processing of grease trap waste?

8. What price point for grease trap waste would the biodigester need to charge in order to be competitive with your current disposal vendor?

9. Company contact information:

   Name:
   Position:
   Email Address:
   Phone Number:

Date

Company Address

As part of its sustainability effort, the City of Ann Arbor has engaged a team of consultants lead by Fishbeck, Thompson, Carr & Huber, Inc. (FTCH) to study the feasibility of constructing a biodigester to process organic wastes (including pre and post-consumer food waste) in and around the City of Ann Arbor. Biodigestion is a proven technology that provides an alternative to landfilling these materials as well as producing renewable energy and nutrient rich soil amendments.

As part of the City-sponsored Feasibility Study, the FTCH team is tasked with identifying the volume and types of food waste available in the local area that are suitable for processing by the proposed Ann Arbor Biodigester. One of the FTCH team members, BioWorks Energy, is leading the effort to quantify the volume and types of food waste available in the local area that is suitable and may be processed by the proposed digestion system.

As a company doing business in the greater Ann Arbor/Washtenaw County area, ***Company Name*** has been selected to help with the feasibility study by providing certain information that is critical for this evaluation. All information provided will remain confidential unless you agree to let us release it. We have provided questions enclosed with this correspondence that address information that will aid our consulting team in this important City of Ann Arbor study. Alternatively, an online survey has been established at https://www.surveymonkey.com/r/QPQSLGK for your use.

We appreciate you taking the time to assist us by answering the questions. Responses to these questions can be emailed to our consultant Chad Antle at BioWorks Energy using the following address: chad.antle@bioworksenergy.com

Based on the information that you provide, Mr. Antle may follow up with you with any needed clarifications.

We appreciate your willingness to assist the City of Ann Arbor with this important study. Please feel free to contact me with any questions about the study.

Matthew Naud
Environmental Coordinator
mnaud@a2gov.org

City of Ann Arbor
Biodigester Feasibility Study – Food Waste Inventory Survey

1. Does your company have an initiative or policy to be landfill "free"? Yes/No

2. Does your company have sustainability policies or practices in place? Yes/No

3. If "yes" to question 2, please provide information on your sustainable practices in regards to food waste?

4. What type of food waste is produced by your company (If there are various streams, please provide a description of each stream)?

5. What is the annual quantity of food waste produced (gallons per year, tons per year, cubic yards per year)?

6. Where is the food waste currently being resused/disposed?

7. What is the cost of disposal (per unit basis)?

8. Company contact information:

   Name:
   Title:
   Email Address:
   Phone Number:

Any questions about the survey? Please contact Chad Antle of BioWorks Energy at chad.antle@bioworksenergy.com or 740-972-2499.

Date

Company Address

As part of its sustainability effort, the City of Ann Arbor has engaged a team of consultants led by Fishbeck, Thompson, Carr & Huber, Inc. (FTCH) to study the feasibility of constructing a biodigester to process organic wastes (including pre and post-consumer food waste) in and around the City of Ann Arbor. Biodigestion is a proven technology that provides an alternative to landfilling these materials as well as producing renewable energy and nutrient rich soil amendments.

As part of the City-sponsored Feasibility Study, the FTCH team is tasked with identifying the volume and types of food waste available in the local area that are suitable for processing by the proposed Ann Arbor Biodigester. One of the FTCH team members, BioWorks Energy, is leading the effort to quantify the volume and types of food waste available in the local area that is suitable and may be processed by the proposed digestion system.

What is food waste? Examples of food waste include table scraps, organic waste generated by the preparation of food and or beverages, and expired food products.

As a company doing business in the greater Ann Arbor/Washtenaw County area, ***Company Name*** has been selected to help with the feasibility study by providing certain information that is critical for this evaluation. All information provided will remain confidential unless you agree to let us release it. We have provided questions enclosed with this correspondence that address information that will aid our consulting team in this important City of Ann Arbor study. Alternatively, an online survey has been established at https://www.surveymonkey.com/r/WQGZC8G for your use.

The data collected from the survey will be a key component to a successful study. We appreciate you taking the time to assist us by answering the above questions. Responses to these questions can be emailed to our consultant Chad Antle at BioWorks Energy using the following address: chad.antle@bioworksenergy.com

Based on the information that you provide, Mr. Antle may follow up with you with any needed clarifications.

We appreciate your willingness to assist the City of Ann Arbor with this important study. Please feel free to contact me with any questions about the study.

Matthew Naud

Environmental Coordinator

mnaud@a2gov.org

1. What type of facility do you represent?
    a. Hospital_____
    b. University/School_____

c. Fast food restaurant_____
d. Full service restaurant_____
e. Grocery _____
f. Hotel_____

2. Does your company have sustainability policies or practices in place? Yes/No

3. If "yes" to Question 2, please provide information on your sustainable practices in regards to food waste.

4. Does your company have an initiative or policy to be landfill "free"? Yes/No

5. What type of food waste is produced by your company? (If there are various streams, please provide a description of each stream)

6. What is the annual quantity of food waste produced? (gallons per year, tons per year, cubic yards per year)

7. Depending on the type of establishment you are associated with, please provide the following information:

    a. **Hotels:** Number of guests per year_____
    b. **Hospitals:** Number of Beds =_____; Number of meals served per year_____
    c. **Restaurants**: Number of meals served per year_____; Number of full time employees_____
    d. **Grocery Stores**: Number of full time employees_____
    e. **Schools**: Number of students_____; Number of meals served per year_____

8. Where is the food waste currently being reused/disposed?

9. What is your cost of disposal (per unit basis) for food waste?

10. Would you be interested in using a facility located in Ann Arbor for the processing of food waste? Yes/No

11. Company contact information:

    Name:
    Title:
    Email Address:
    Phone Number:

Any questions about the survey? Please contact Chad Antle of BioWorks Energy at chad.antle@bioworksenergy.com or 740-972-2499.

ATTACHMENT B
LEGAL STATUS OF OFFEROR

(The Respondent shall fill out the provision and strike out the remaining ones.)

The Respondent is:

- A corporation organized and doing business under the laws of the state of _____, for whom _____ bearing the office title of _____, whose signature is affixed to this proposal, is authorized to execute contracts on behalf of respondent.*

  *If not incorporated in Michigan, please attach the corporation's Certificate of Authority

- A limited liability company doing business under the laws of the State of _____, whom _____ bearing the title of _____ whose signature is affixed to this proposal, is authorized to execute contract on behalf of the LLC.

- A partnership organized under the laws of the State of _____ and filed with the County of _____ , whose members are (attach list including street and mailing address for each.)

- An individual, whose signature with address, is affixed to this RFP.

Respondent has examined the basic requirements of this RFP and its scope of services, including all Addendum (if applicable) and hereby agrees to offer the services as specified in the RFP.

_____Date: _____,
Signature

(Print) Name _____ Title _____

Firm: _____

Address: _____

Contact Phone _____ Fax _____

Email _____

ATTACHMENT C
CITY OF ANN ARBOR DECLARATION OF COMPLIANCE

Non-Discrimination Ordinance

The "non discrimination by city contractors" provision of the City of Ann Arbor Non-Discrimination Ordinance (Ann Arbor City Code Chapter 112, Section 9:158) requires all contractors proposing to do business with the City to treat employees in a manner which provides equal employment opportunity and does not discriminate against any of their employees, any City employee working with them, or any applicant for employment on the basis of actual or perceived age, arrest record, color, disability, educational association, familial status, family responsibilities, gender expression, gender identity, genetic information, height, HIV status, marital status, national origin, political beliefs, race, religion, sex, sexual orientation, source of income, veteran status, victim of domestic violence or stalking, or weight. It also requires that the contractors include a similar provision in all subcontracts that they execute for City work or programs.

In addition the City Non-Discrimination Ordinance requires that all contractors proposing to do business with the City of Ann Arbor must satisfy the contract compliance administrative policy adopted by the City Administrator. A copy of that policy may be obtained from the Purchasing Manager

The Contractor agrees:

(a) To comply with the terms of the City of Ann Arbor's Non-Discrimination Ordinance and contract compliance administrative policy.

(b) To post the City of Ann Arbor's Non-Discrimination Ordinance Notice in every work place or other location in which employees or other persons are contracted to provide services under a contract with the City.

(c) To provide documentation within the specified time frame in connection with any workforce verification, compliance review or complaint investigation.

(d) To permit access to employees and work sites to City representatives for the purposes of monitoring compliance, or investigating complaints of non-compliance.

The undersigned states that he/she has the requisite authority to act on behalf of his/her employer in these matters and has offered to provide the services in accordance with the terms of the Ann Arbor Non-Discrimination Ordinance. The undersigned certifies that he/she has read and is familiar with the terms of the Non-Discrimination Ordinance, obligates the Contractor to those terms and acknowledges that if his/her employer is found to be in violation of Ordinance it may be subject to civil penalties and termination of the awarded contract.

_____
Company Name

_____
Signature of Authorized Representative Date

_____
Print Name and Title

_____
Address, City, State, Zip

_____
Phone/Email address

Questions about the Notice or the City Administrative Policy, Please contact:
Procurement Office of the City of Ann Arbor
(734) 794-6500

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ATTACHMENT D
CITY OF ANN ARBOR
LIVING WAGE ORDINANCE DECLARATION OF COMPLIANCE

The Ann Arbor Living Wage Ordinance (Section 1:811-1:821 of Chapter 23 of Title I of the Code) requires that an employer who is (a) a contractor providing services to or for the City for a value greater than $10,000 for any twelve-month contract term, or (b) a recipient of federal, state, or local grant funding administered by the City for a value greater than $10,000, or (c) a recipient of financial assistance awarded by the City for a value greater than $10,000, shall pay its employees a prescribed minimum level of compensation (i.e., Living Wage) for the time those employees perform work on the contract or in connection with the grant or financial assistance. The Living Wage must be paid to these employees for the length of the contract/program.

Companies employing fewer than 5 persons and non-profits employing fewer than 10 persons are exempt from compliance with the Living Wage Ordinance. If this exemption applies to your company/non-profit agency please check here [___] *No. of employees__*

The Contractor or Grantee agrees:

(a) To pay each of its employees whose wage level is not required to comply with federal, state or local prevailing wage law, for work covered or funded by a contract with or grant from the City, no less than the Living Wage. The current Living Wage is defined as $14.05/hour for those employers that provide employee health care (as defined in the Ordinance at Section 1:815 Sec. 1 (a)), or no less than $15.66/hour for those employers that do not provide health care. The Contractor or Grantor understands that the Living Wage is adjusted and established annually on April 30 in accordance with the Ordinance and covered employers shall be required to pay the adjusted amount thereafter to be in compliance with Section 1:815(3).

Check the applicable box below which applies to your workforce

[___] Employees who are assigned to any covered City contract/grant will be paid at or above the applicable living wage without health benefits

[___] Employees who are assigned to any covered City contract/grant will be paid at or above the applicable living wage with health benefits

(b) To post a notice approved by the City regarding the applicability of the Living Wage Ordinance in every work place or other location in which employees or other persons contracting for employment are working.

(c) To provide to the City payroll records or other documentation within ten (10) business days from the receipt of a request by the City.

(d) To permit access to work sites to City representatives for the purposes of monitoring compliance and investigating complaints or non-compliance.

(e) To take no action that would reduce the compensation, wages, fringe benefits, or leave available to any employee covered by the Living Wage Ordinance or any person contracted for employment and covered by the Living Wage Ordinance in order to pay the living wage required by the Living Wage Ordinance.

The undersigned states that he/she has the requisite authority to act on behalf of his/her employer in these matters and has offered to provide the services or agrees to accept financial assistance in accordance with the terms of the Living Wage Ordinance. The undersigned certifies that he/she has read and is familiar with the terms of the Living Wage Ordinance, obligates the Employer/Grantee to those terms and acknowledges that if his/her employer is found to be in violation of Ordinance it may be subject to civil penalties and termination of the awarded contract or grant of financial assistance.

Company Name	Street Address
Signature of Authorized Representative Date	City, State, Zip
Print Name and Title	Phone/Email address

ATTACHMENT E

VENDOR CONFLICT OF INTEREST DISCLOSURE FORM

All vendors interested in conducting business with the City of Ann Arbor must complete and return the Vendor Conflict of Interest Disclosure Form in order to be eligible to be awarded a contract. Please note that all vendors are subject to comply with the City of Ann Arbor's conflict of interest policies as stated within the certification section below.

If a vendor has a relationship with a City of Ann Arbor official or employee, an immediate family member of a City of Ann Arbor official or employee, the vendor shall disclose the information required below.

1. No City official or employee or City employee's immediate family member has an ownership interest in vendor's company or is deriving personal financial gain from this contract.
2. No retired or separated City official or employee who has been retired or separated from the City for less than one (1) year has an ownership interest in vendor's Company.
3. No City employee is contemporaneously employed or prospectively to be employed with the vendor.
4. Vendor hereby declares it has not and will not provide gifts or hospitality of any dollar value or any other gratuities to any City employee or elected official to obtain or maintain a contract.
5. Please note any exceptions below:

Conflict of Interest Disclosure*	
Name of City of Ann Arbor employees, elected officials or immediate family members with whom there may be a potential conflict of interest.	( ) Relationship to employee ( ) Interest in vendor's company ( ) Other (please describe in box below)

*Disclosing a potential conflict of interest does not disqualify vendors. In the event vendors do not disclose potential conflicts of interest and they are detected by the City, vendor will be exempt from doing business with the City.

I certify that this Conflict of Interest Disclosure has been examined by me and that its contents are true and correct to my knowledge and belief and I have the authority to so certify on behalf of the Vendor by my signature below:		
Vendor Name	**Vendor Phone Number**	
Signature of Vendor Authorized Representative	**Date**	**Printed Name of Vendor Authorized Representative**

Questions about this form? Contact Procurement Office City of Ann Arbor Phone: 734/794-6500, procurement@a2gov.org

ATTACHMENT F
CITY OF ANN ARBOR NON-DISCRIMINATION ORDINANCE

Relevant provisions of Chapter 112, Nondiscrimination, of the Ann Arbor City Code are included below. You can review the entire ordinance at www.a2gov.org/humanrights.

Intent: **It is the intent of the city that no individual be denied equal protection of the laws; nor shall any individual be denied the enjoyment of his or her civil or political rights or be discriminated against because of actual or perceived age, arrest record, color, disability, educational association, familial status, family responsibilities, gender expression, gender identity, genetic information, height, HIV status, marital status, national origin, political beliefs, race, religion, sex, sexual orientation, source of income, veteran status, victim of domestic violence or stalking, or weight.**

Discriminatory Employment Practices: **No person shall discriminate in the hire, employment, compensation, work classifications, conditions or terms, promotion or demotion, or termination of employment of any individual. No person shall discriminate in limiting membership, conditions of membership or termination of membership in any labor union or apprenticeship program.**

Discriminatory Effects: **No person shall adopt, enforce or employ any policy or requirement which has the effect of creating unequal opportunities according to actual or perceived age, arrest record, color, disability, educational association, familial status, family responsibilities, gender expression, gender identity, genetic information, height, HIV status, marital status, national origin, political beliefs, race, religion, sex, sexual orientation, source of income, veteran status, victim of domestic violence or stalking, or weight for an individual to obtain housing, employment or public accommodation, except for a bona fide business necessity. Such a necessity does not arise due to a mere inconvenience or because of suspected objection to such a person by neighbors, customers or other persons.**

Nondiscrimination by City Contractors: **All contractors proposing to do business with the City of Ann Arbor shall satisfy the contract compliance administrative policy adopted by the City Administrator in accordance with the guidelines of this section. All city contractors shall ensure that applicants are employed and that employees are treated during employment in a manner which provides equal employment opportunity and tends to eliminate inequality based upon any classification protected by this chapter. All contractors shall agree not to discriminate against an employee or applicant for employment with respect to hire, tenure, terms, conditions, or privileges of employment, or a matter directly or indirectly related to employment, because of any applicable protected classification. All contractors shall be required to post a copy of Ann Arbor's Non-Discrimination Ordinance at all work locations where its employees provide services under a contract with the city.**

Complaint Procedure: **If any individual believes there has been a violation of this chapter, he/she may file a complaint with the City's Human Rights Commission. The complaint must be filed within 180 calendar days from the date of the individual's knowledge of the allegedly discriminatory action or 180 calendar days from the date when the individual should have known of the allegedly discriminatory action. A complaint that is not filed within this timeframe cannot be considered by the Human Rights Commission. To file a complaint, first complete the complaint form, which is available at www.a2gov.org/humanrights. Then submit it to the Human Rights Commission by e-mail (hrc@a2gov.org), by mail (Ann Arbor Human Rights Commission, PO Box 8647, Ann Arbor, MI 48107), or in person (City Clerk's Office). For further information, please call the commission at 734-794-6141 or e-mail the commission at hrc@a2gov.org.**

Private Actions For Damages or Injunctive Relief: **To the extent allowed by law, an individual who is the victim of discriminatory action in violation of this chapter may bring a civil action for appropriate injunctive relief or damages or both against the person(s) who acted in violation of this chapter.**

THIS IS AN OFFICIAL GOVERNMENT NOTICE AND
MUST BE DISPLAYED WHERE EMPLOYEES CAN READILY SEE IT.

ATTACHMENT G

CITY OF ANN ARBOR LIVING WAGE ORDINANCE

RATE EFFECTIVE APRIL 30, 2021 - ENDING APRIL 29, 2022

$14.05 per hour
If the employer provides health care benefits*

$15.66 per hour
If the employer does **NOT** provide health care benefits*

Employers providing services to or for the City of Ann Arbor or recipients of grants or financial assistance from the City of Ann Arbor for a value of more than $10,000 in a twelve-month period of time must pay those employees performing work on a City of Ann Arbor contract or grant, the above living wage.

ENFORCEMENT

The City of Ann Arbor may recover back wages either administratively or through court action for the employees that have been underpaid in violation of the law. Persons denied payment of the living wage have the right to bring a civil action for damages in addition to any action taken by the City.

Violation of this Ordinance is punishable by fines of not more than $500/violation plus costs, with each day being considered a separate violation. Additionally, the City of Ann Arbor has the right to modify, terminate, cancel or suspend a contract in the event of a violation of the Ordinance.

* Health Care benefits include those paid for by the employer or making an employer contribution toward the purchase of health care. The employee contribution must not exceed $.50 an hour for an average work week; and the employer cost or contribution must equal no less than $1/hr for the average work week.

The Law Requires Employers to Display This Poster Where Employees Can Readily See It.

For Additional Information or to File a Complaint contact
Colin Spencer at 734/794-6500 or cspencer@a2gov.org

Revised 2/4/2021

APPENDIX A: SAMPLE PROFESSIONAL SERVICES AGREEMENT

If a contract is awarded, the selected Firm(s) will be required to adhere to a set of general contract provisions which will become a part of any formal agreement. These provisions are general principles which apply to all contractors/service providers to the City of Ann Arbor. The required provisions are:

(2020 PSA over $25,000 NO Auto AI Rev. 1)

This agreement ("Agreement") is between the City of Ann Arbor, a Michigan municipal corporation, having its offices at 301 E. Huron St. Ann Arbor, Michigan 48104 ("City"), and _____ ("Contractor"), a(n) _____ _____, with its address at
(State where organized) (Partnership, Sole Proprietorship, or Corporation)
_____. City and Contractor are referred to collectively herein as the "Parties." The Parties agree as follows:

I. DEFINITIONS

Administering Service Area/Unit means _____.

Contract Administrator means _____, acting personally or through any assistants authorized by the Administrator/Manager of the Administering Service Area/Unit.

Deliverables means all Plans, Specifications, Reports, Recommendations, and other materials developed for and delivered to City by Contractor under this Agreement.

Project means _____.
Project name

II. DURATION

Contractor shall commence performance on _____, 20___ ("Commencement Date"). This Agreement shall remain in effect until satisfactory completion of the Services specified below unless terminated as provided for in Article XI. The terms and conditions of this Agreement shall apply to the earlier of the Effective Date or Commencement Date.

III. SERVICES

A. The Contractor agrees to provide _____

Type of service

("Services") in connection with the Project as described in Exhibit A. The City retains the right to make changes to the quantities of service within the general scope of the Agreement at any time by a written order. If the changes add to or deduct from the extent of the services, the compensation shall be adjusted

accordingly. All such changes shall be executed under the conditions of the original Agreement.

B. Quality of Services under this Agreement shall be of the level of quality performed by persons regularly rendering this type of service. Determination of acceptable quality shall be made solely by the Contract Administrator.

C. The Contractor shall perform its Services for the Project in compliance with all statutory, regulatory, and contractual requirements now or hereafter in effect as may be applicable to the rights and obligations set forth in the Agreement. The Contractor shall also comply with and be subject to the City of Ann Arbor policies applicable to independent contractors.

D. The Contractor may rely upon the accuracy of reports and surveys provided to it by the City (if any) except when defects should have been apparent to a reasonably competent professional or when it has actual notice of any defects in the reports and surveys.

IV. INDEPENDENT CONTRACTOR

The Parties agree that at all times and for all purposes under the terms of this Agreement each Party's relationship to any other Party shall be that of an independent contractor. Each Party will be solely responsible for the acts of its own employees, agents, and servants. No liability, right, or benefit arising out of any employer/employee relationship, either express or implied, shall arise or accrue to any Party as a result of this Agreement.

Contractor does not have any authority to execute any contract or agreement on behalf of the City, and is not granted any authority to assume or create any obligation or liability on the City's behalf, or to bind the City in any way.

V. COMPENSATION OF CONTRACTOR

A. The Contractor shall be paid in the manner set forth in Exhibit B. Payment shall be made monthly, unless another payment term is specified in Exhibit B, following receipt of invoices submitted by the Contractor, and approved by the Contract Administrator.

B. The Contractor will be compensated for Services performed in addition to the Services described in Article III, only when the scope of and compensation for those additional Services have received prior written approval of the Contract Administrator.

C. The Contractor shall keep complete records of work performed (e.g. tasks performed, hours allocated, etc.) so that the City may verify invoices submitted by the Contractor. Such records shall be made available to the City upon request and submitted in summary form with each invoice.

VI. INSURANCE/INDEMNIFICATION

A. The Contractor shall procure and maintain from the Effective Date or Commencement Date of this Agreement (whichever is earlier) through the conclusion of this Agreement, such insurance policies, including those set forth in Exhibit C, as will protect itself and the City from all claims for bodily injuries, death or property damage that may arise under this Agreement; whether the act(s) or omission(s) giving rise to the claim were made by the Contractor, any subcontractor, or anyone employed by them directly or indirectly. Prior to commencement of work under this Agreement, Contractor shall provide to the City documentation satisfactory to the City, through City-approved means (currently myCOI), demonstrating it has obtained the policies and endorsements required by Exhibit C. Contractor shall add registration@mycoitracking.com to its safe sender's list so that it will receive necessary communication from myCOI. When requested, Contractor shall provide the same documentation for its subcontractor(s) (if any).

B. Any insurance provider of Contractor shall be authorized to do business in the State of Michigan and shall carry and maintain a minimum rating assigned by A.M. Best & Company's Key Rating Guide of "A-" Overall and a minimum Financial Size Category of "V". Insurance policies and certificates issued by non-authorized insurance companies are not acceptable unless approved in writing by the City.

C. To the fullest extent permitted by law, Contractor shall indemnify, defend, and hold the City, its officers, employees and agents harmless from all suits, claims, judgments and expenses, including attorney's fees, resulting or alleged to result, from any acts or omissions by Contractor or its employees and agents occurring in the performance of or breach in this Agreement, except to the extent that any suit, claim, judgment or expense are finally judicially determined to have resulted from the City's negligence or willful misconduct or its failure to comply with any of its material obligations set forth in this Agreement.

VII. COMPLIANCE REQUIREMENTS

A. Nondiscrimination. The Contractor agrees to comply, and to require its subcontractor(s) to comply, with the nondiscrimination provisions of MCL 37.2209. The Contractor further agrees to comply with the provisions of Section 9:158 of Chapter 112 of the Ann Arbor City Code and to assure that applicants are employed and that employees are treated during employment in a manner which provides equal employment opportunity.

B. Living Wage. If the Contractor is a "covered employer" as defined in Chapter 23 of the Ann Arbor City Code, the Contractor agrees to comply with the living wage provisions of Chapter 23 of the Ann Arbor City Code. The Contractor agrees to pay those employees providing Services to the City under this Agreement a "living wage," as defined in Section 1:815 of the Ann Arbor City Code, as adjusted in accordance with Section 1:815(3); to post a notice approved by the City of the applicability of Chapter 23 in every location in which regular or contract employees providing services under this Agreement are working; to maintain records of compliance; if requested by the City, to provide documentation to verify compliance; to take no action that would reduce the compensation, wages, fringe benefits, or leave available to any employee or person contracted for employment in order to pay the living wage required by Section 1:815; and otherwise to comply with the requirements of Chapter 23.

VIII. WARRANTIES BY THE CONTRACTOR

A. The Contractor warrants that the quality of its Services under this Agreement shall conform to the level of quality performed by persons regularly rendering this type of service.

B. The Contractor warrants that it has all the skills, experience, and professional licenses (if applicable) necessary to perform the Services pursuant to this Agreement.

C. The Contractor warrants that it has available, or will engage, at its own expense, sufficient trained employees to provide the Services pursuant to this Agreement.

D. The Contractor warrants that it has no personal or financial interest in the Project other than the fee it is to receive under this Agreement. The Contractor further certifies that it shall not acquire any such interest, direct or indirect, which would conflict in any manner with the performance of the Services it is to provide pursuant to this Agreement. Further Contractor agrees and certifies that it does not and will not employ or engage any person with a personal or financial interest in this Agreement.

E. The Contractor warrants that it is not, and shall not become overdue or in default to the City for any contract, debt, or any other obligation to the City including real and personal property taxes. Further Contractor agrees that the City shall have the right to set off any such debt against compensation awarded for Services under this Agreement.

F. The Contractor warrants that its proposal for services was made in good faith, it arrived at the costs of its proposal independently, without consultation, communication or agreement, for the purpose of restricting completion as to any matter relating to such fees with any competitor for these Services; and no attempt has been made or shall be made by the Contractor to induce any other person or firm to submit or not to submit a proposal for the purpose of restricting competition.

G. The person signing this Agreement on behalf of Contractor represents and warrants that she/he has express authority to sign this Agreement for Contractor and agrees to hold the City harmless for any costs or consequences of the absence of actual authority to sign.

IX. OBLIGATIONS OF THE CITY

A. The City agrees to give the Contractor access to the Project area and other City-owned properties as required to perform the necessary Services under this Agreement.

B. The City shall notify the Contractor of any defects in the Services of which the Contract Administrator has actual notice.

X. ASSIGNMENT

A. The Contractor shall not subcontract or assign any portion of any right or obligation under this Agreement without prior written consent from the City. Notwithstanding any consent by the City to any assignment, Contractor shall at all times remain bound to all warranties, certifications, indemnifications, promises and performances, however described, as are required of it under the Agreement unless specifically released from the requirement, in writing, by the City.

B. The Contractor shall retain the right to pledge payment(s) due and payable under this Agreement to third parties.

XI. TERMINATION OF AGREEMENT

A. If either party is in breach of this Agreement for a period of fifteen (15) days following receipt of notice from the non-breaching party with respect to a breach, the non-breaching party may pursue any remedies available to it against the breaching party under applicable law, including but not limited to, the right to terminate this Agreement without further notice. The waiver of any breach by any party to this Agreement shall not waive any subsequent breach by any party.

B. The City may terminate this Agreement, on at least thirty (30) days advance notice, for any reason, including convenience, without incurring any penalty, expense or liability to Contractor, except the obligation to pay for Services actually performed under the Agreement before the termination date.

C. Contractor acknowledges that, if this Agreement extends for several fiscal years, continuation of this Agreement is subject to appropriation of funds for this Project. If funds to enable the City to effect continued payment under this Agreement are not appropriated or otherwise made available, the City shall have the right to terminate this Agreement without penalty at the end of the last period for which funds have been appropriated or otherwise made available by giving written notice of termination to Contractor. The Contract Administrator shall give Contractor written notice of such non-appropriation within thirty (30) days after it receives

notice of such non-appropriation.

D. The provisions of Articles VI and VIII shall survive the expiration or earlier termination of this Agreement for any reason. The expiration or termination of this Agreement, for any reason, shall not release either party from any obligation or liability to the other party, including any payment obligation that has already accrued and Contractor's obligation to deliver all Deliverables due as of the date of termination of the Agreement.

XII. REMEDIES

A. This Agreement does not, and is not intended to, impair, divest, delegate or contravene any constitutional, statutory and/or other legal right, privilege, power, obligation, duty or immunity of the Parties.

B. All rights and remedies provided in this Agreement are cumulative and not exclusive, and the exercise by either party of any right or remedy does not preclude the exercise of any other rights or remedies that may now or subsequently be available at law, in equity, by statute, in any agreement between the parties or otherwise.

C. Absent a written waiver, no act, failure, or delay by a Party to pursue or enforce any rights or remedies under this Agreement shall constitute a waiver of those rights with regard to any existing or subsequent breach of this Agreement. No waiver of any term, condition, or provision of this Agreement, whether by conduct or otherwise, in one or more instances, shall be deemed or construed as a continuing waiver of any term, condition, or provision of this Agreement. No waiver by either Party shall subsequently effect its right to require strict performance of this Agreement.

XIII. NOTICE

All notices and submissions required under this Agreement shall be delivered to the respective party in the manner described herein to the address stated below or such other address as either party may designate by prior written notice to the other. Notices given under this Agreement shall be in writing and shall be personally delivered, sent by next day express delivery service, certified mail, or first class U.S. mail postage prepaid, and addressed to the person listed below. Notice will be deemed given on the date when one of the following first occur: (1) the date of actual receipt; (2) the next business day when notice is sent next day express delivery service or personal delivery; or (3) three days after mailing first class or certified U.S. mail.

If Notice is sent to the CONTRACTOR, it shall be addressed and sent to:

If Notice is sent to the CITY, it shall be addressed and sent to:

City of Ann Arbor

_____
(insert name of Administering Service Area Administrator)

301 E. Huron St.
Ann Arbor, Michigan 48104

With a copy to: The City of Ann Arbor
ATTN: Office of the City Attorney
301 East Huron Street, 3rd Floor
Ann Arbor, Michigan 48104

XIV. CHOICE OF LAW AND FORUM

This Agreement will be governed and controlled in all respects by the laws of the State of Michigan, including interpretation, enforceability, validity and construction, excepting the principles of conflicts of law. The parties submit to the jurisdiction and venue of the Circuit Court for Washtenaw County, State of Michigan, or, if original jurisdiction can be established, the United States District Court for the Eastern District of Michigan, Southern Division, with respect to any action arising, directly or indirectly, out of this Agreement or the performance or breach of this Agreement. The parties stipulate that the venues referenced in this Agreement are convenient and waive any claim of non-convenience.

XV. OWNERSHIP OF DOCUMENTS

Upon completion or termination of this Agreement, all documents (i.e., Deliverables) prepared by or obtained by the Contractor as provided under the terms of this Agreement shall be delivered to and become the property of the City. Original basic survey notes, sketches, charts, drawings, partially completed drawings, computations, quantities and other data shall remain inthe possession of the Contractor as instruments of service unless specifically incorporated in a deliverable, but shall be made available, upon request, to the City without restriction or limitation on their use. The City acknowledges that the documents are prepared only for the Project. Prior to completion of the contracted Services the City shall have a recognized proprietary interest in the work product of the Contractor.

XVI. CONFLICTS OF INTEREST OR REPRESENTATION

Contractor certifies it has no financial interest in the Services to be provided under this Agreement other than the compensation specified herein. Contractor further certifies that it presently has no personal or financial interest, and shall not acquire any such interest, direct or indirect, which would conflict in any manner with its performance of the Services under this Agreement.

Contractor agrees to advise the City if Contractor has been or is retained to handle any matter in which its representation is adverse to the City. The City's prospective consent to the Contractor's representation of a client in matters adverse to the City, as identified above, will not apply in any instance where, as the result of Contractor's representation, the Contractor has obtained

sensitive, proprietary or otherwise confidential information of a non-public nature that, if known to another client of the Contractor, could be used in any such other matter by the other client to the material disadvantage of the City. Each matter will be reviewed on a case by case basis.

XVII. SEVERABILITY OF PROVISIONS

Whenever possible, each provision of this Agreement will be interpreted in a manner as to be effective and valid under applicable law. However, if any provision of this Agreement or the application of any provision to any party or circumstance will be prohibited by or invalid under applicable law, that provision will be ineffective to the extent of the prohibition or invalidity without invalidating the remainder of the provisions of this Agreement or the application of the provision to other parties and circumstances.

XVIII. EXTENT OF AGREEMENT

This Agreement, together Exhibits A, B, and C, constitutes the entire understanding between the City and the Contractor with respect to the subject matter of the Agreement and it supersedes, unless otherwise incorporated by reference herein, all prior representations, negotiations, agreements or understandings whether written or oral. Neither party has relied on any prior representations, of any kind or nature, in entering into this Agreement. No terms or conditions of either party's invoice, purchase order or other administrative document shall modify the terms and conditions of this Agreement, regardless of the other party's failure to object to such form. This Agreement shall be binding on and shall inure to the benefit of the parties to this Agreement and their permitted successors and permitted assigns and nothing in this Agreement, express or implied, is intended to or shall confer on any other person or entity any legal or equitable right, benefit, or remedy of any nature whatsoever under or by reason of this Agreement. This Agreement may only be altered, amended or modified by written amendment signed by the Contractor and the City. This Agreement may be executed in counterparts, each of which shall be deemed an original, but all of which together shall be deemed to be one and the same agreement.

XIX. ELECTRONIC TRANSACTION

The parties agree that signatures on this Agreement may be delivered electronically in lieu of an original signature and agree to treat electronic signatures as original signatures that bind them to this Agreement. This Agreement may be executed and delivered by facsimile and upon such delivery, the facsimile signature will be deemed to have the same effect as if the original signature had been delivered to the other party.

XX. EFFECTIVE DATE

This Agreement will become effective when all parties have signed it. The Effective Date of this Agreement will be the date this Agreement is signed by the last party to sign it.

[REMAINDER OF PAGE LEFT BLANK; SIGNATURE PAGE FOLLOWS]

FOR CONTRACTOR

By _____
Type Name

Its

Date: _____

FOR THE CITY OF ANN ARBOR

By _____
Christopher Taylor, Mayor

By _____
Jacqueline Beaudry, City Clerk

Date: _____

Approved as to substance

_____
Type Name
Service Area Administrator

_____
Milton Dohoney Jr., Interim City Administrator

Approved as to form and content

_____
Stephen K. Postema, City Attorney

EXHIBIT A
SCOPE OF SERVICES

(Insert/Attach Scope of Work & Deliverables Schedule)

EXHIBIT B
COMPENSATION

General

Contractor shall be paid for those Services performed pursuant to this Agreement inclusive of all reimbursable expenses (if applicable), in accordance with the terms and conditions herein. The Compensation Schedule below/attached states nature and amount of compensation the Contractor may charge the City:

(insert/Attach Negotiated Fee Arrangement)

EXHIBIT C
INSURANCE REQUIREMENTS

From the earlier of the Effective Date or the Commencement Date of this Agreement, and continuing without interruption during the term of this Agreement, Contractor shall have, at a minimum, the following insurance, including all endorsements necessary for Contractor to have or provide the required coverage.

A. The Contractor shall have insurance that meets the following minimum requirements:

1. Professional Liability Insurance or Errors and Omissions Insurance protecting the Contractor and its employees in an amount not less than $1,000,000.

2. Worker's Compensation Insurance in accordance with all applicable state and federal statutes. Further, Employers Liability Coverage shall be obtained in the following minimum amounts:

   Bodily Injury by Accident - $500,000 each accident
   Bodily Injury by Disease - $500,000 each employee
   Bodily Injury by Disease - $500,000 each policy limit

3. Commercial General Liability Insurance equivalent to, as a minimum, Insurance Services Office form CG 00 01 04 13 or current equivalent. The City of Ann Arbor shall be an additional insured. There shall be no added exclusions or limiting endorsements that diminish the City's protections as an additional insured under the policy. Further, the following minimum limits of liability are required:

$1,000,000	Each occurrence as respect Bodily Injury Liability or Property Damage Liability, or both combined
$2,000,000	Per Project General Aggregate
$1,000,000	Personal and Advertising Injury

4. Motor Vehicle Liability Insurance equivalent to, as a minimum, Insurance Services Office form CA 00 01 10 13 or current equivalent. Coverage shall include all owned vehicles, all non-owned vehicles and all hired vehicles. There shall be no added exclusions or limiting endorsements that diminish the City's protections as an additional insured under the policy. Further, the limits of liability shall be $1,000,000 for each occurrence as respects Bodily Injury Liability or Property Damage Liability, or both combined.

5. Umbrella/Excess Liability Insurance shall be provided to apply in excess of the Commercial General Liability, Employers Liability and the Motor Vehicle coverage enumerated above, for each occurrence and for aggregate in the amount of $1,000,000.

B. Insurance required under A.3 and A.4 above shall be considered primary as respects any other valid or collectible insurance that the City may possess, including any self-insured retentions the City may have; and any other insurance the City does possess shall be considered excess insurance only and shall not be required to contribute with this insurance. Further, the Contractor agrees to waive any right of recovery by its insurer against the City for any insurance listed herein.

C. Insurance companies and policy forms are subject to approval of the City Attorney, which approval shall not be unreasonably withheld. Documentation must provide and demonstrate an unconditional and unqualified 30-day written notice of cancellation in favor of the City of Ann Arbor. Further, the documentation must explicitly state the following: (a) the policy number(s); name of insurance company; name(s), email address(es), and address(es) of the agent or authorized representative; name and address of insured; project name; policy expiration date; and specific coverage amounts; (b) any deductibles or self-insured retentions, which may be approved by the City in its sole discretion; (c) that the policy conforms to the requirements specified. Contractor shall furnish the City with satisfactory certificates of insurance and endorsements prior to commencement of any work. If any of the above coverages expire by their terms during the term of this Agreement, the Contractor shall deliver proof of renewal and/or new policies and endorsements to the Administering Service Area/Unit at least ten days prior to the expiration date.