City of Bloomington Utilities Resource Recovery Program Feasibility Study

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Prepared by: Energy Power Partners — Renewable Investments With Sustainable Results

In partnership with: Kokosing Industrial, Donohue, Material Matters, Inc.

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Abbreviations

AASI	Aqua-Aerobics Systems, Inc.
AC	Air changes
ACI	American Concrete Institute
AD	Anaerobic digester/digestion
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
BFP	Belt Filter Press
BIN	Business Information Network
BOD_5	5-day Biochemical Oxygen Demand
BOT	Build operate transfer
CAPEX	Capital expenditure
CBU	City of Bloomington Utilities
CED	Contaminants of emerging concern
CF	Cubic Feet
CFR	Code of Federal Regulations
CFS	Cloth Filter Solids
CHP	Combined heat and power
CNG	Compressed natural gas
DAF	Dissolved air flotation
EPA	Environmental Protection Agency
EPP	Energy Power Partners
EQ	Exceptional quality
F&B	Food & Beverage
FIPS	Federal Information Processing Standard
FOG	Fats, oils, and grease
FSP	Full service provider
ft	Feet
GBT	Gravity Belt Thickener
GGE	Gallon of gasoline equivalent
gph	Gallons per hour
gpm	Gallons per minute
HMI	Human/Machine Interface
hp	Horsepower
hr	Hour
HRPF	High Rate Primary Filtration
HSOW	High strength organic waste
I&C	Instrumentation and Controls
I/O	Input / Output
IDEM	Indiana Department of Environmental Management
In	Inch
ITC	Investment tax credit

kV	Kilo volt
KVA	Kilo volt amps
LED	Light Emitting Diode
LNG	Liquefied Natural Gas
LOS	Line of Sight
MAD	Mesophilic anaerobic digestion
MCC	Motor Control Center
MCM	Million circular mils
ML	Mixed Liquor
MSW	Municipal solid waste
MT CO2e	Metric ton carbon dioxide equivalent
NEC	National Electric Code
NEMA	National Electric Manufacturers Association
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
NPV	Net present value
O&M	Operations and maintenance
OIU	Operator Interface Unit
OLQ	Office of Land Quality
OPCC	Opinion of probable construction cost
OPEX	Operational expenditure
P3/PPP	Public private partnership
PCI	Precast Concrete Institute
PCN	Process Control Network
PCS	Process Control System
PFAS	Per and polyfluoroalkyl substances
PLC	Programmable Logic Controller
PR	Pathogen reduction
psig	Pounds per square inch, gauge
PVAR	Process vector attraction reduction
PVC	Polyvinyl Chloride
RAS	Return activated sludge
REC	Renewable Energy Credits
RIN	Renewable identification numbers
RNG	Renewable natural gas
rpm	Revolutions per minute
SCADA	Supervisory Control and Data Acquisition
scfm	standard cubic feet per minute
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SMP	Self-managed program
SRE	Small refinery exemptions
TPC	Third party managed program

TSS	Total Suspended Solids
UL	Underwriters Laboratory
UPS	Uninterruptible Power Supply
USAEPA	United States Environmental Protection Agency
V	Volt
VAR	Vector attraction reduction
WWTP	Waste Water Treatment Plant

1. Executive Summary

Scope Summary & Team Introduction

Energy Power Partners (EPP) was requested by the City of Bloomington Utilities (CBU) to build on previous analyses and prepare a comprehensive feasibility study to assist CBU in assessing the technical, economic, and environmental merits of establishing a resource recovery program to include wastewater treatment plant improvements, anaerobic digestion, biosolids reuse and biogas utilization facilities. EPP established a team of well-qualified firms (the Project Team) with local experience to assist in completing the scope.

Energy Power Partners: Industry leading investor in renewable energy projects that owns and operates a portfolio of 48 projects, with 30 of those projects involving biogas and 18 being delivered via public private partnership by EPP staff. EPP managed the overall project and led the biogas utilization, funding mechanisms, financial modeling, and triple bottom line portions of the scope.

Kokosing Industrial: As one of the largest wastewater contractors in the country with deep experience executing projects within Indiana, Kokosing Industrial was responsible for performing constructability reviews as well as providing cost estimates for the project. Kokosing is known to Bloomington Utilities, having delivered upgrades to the Dillman Road WWTP.

Donohue: A leading wastewater engineering design firm in the Midwest, Donohue has an intimate understanding of CBU's existing wastewater treatment plants and operations. Donohue was responsible for being the technical and engineering lead on the project and completing the project's design basis.

Material Matters: A consulting and advisory firm with substantial experience throughout the Midwest, including Indiana, in evaluating biosolids beneficial use markets as well as feedstock availability. Material Matters was responsible for leading the feedstock market and residual biosolids beneficial reuse tasks.

Primary Findings

1) **Dillman Road WWTP as the preferred project location –** previous studies have evaluated both the Blucher Poole and Dillman Road WWTPs and come to different conclusions about the preferred location. The Project Team has evaluated all previous work and definitively come to the recommendation that Dillman Road is the preferred location due to:
    a. The plant processing 80% of CBU biosolids – it will be more feasible to truck Blucher Poole solids to Dillman Road for digestion than vice versa and there will be a large baseload of biosolids for co-digestion with high strength organic waste (HSOW) should trucking Blucher Poole solids not prove feasible
    b. The plant has sufficient capacity to process residual liquid sidestreams with high nutrient loadings – Blucher Poole would likely require addition of sidestream treatment
    c. The plant has significantly better truck access for receiving incoming (HSOW) loads and transporting outgoing loads of digested solids for beneficial reuse than Blucher Poole

2) **Implementing grit removal and high rate primary filtration at Dillman Road WWTP will benefit CBU existing operations & the resource recovery project –** The current single-stage nitrification plant design shows elevated loading rates to the aeration basins that the plant may struggle to handle as flows increase over time. Furthermore, the anerobic digestion project will benefit by diverting BOD and solids to the digester to produce more renewable energy rather than procuring fossil derived electricity to degrade them in the aeration basins and aerobic digester. Previous studies have shown traditional primary clarifies to not be cost effective, however, with the emergence of high rate primary filtration, capital costs will be lower and BOD removal will be higher.

3) **Volumes of HSOW in the region can support meaningful tip fee revenue and increased biogas production**
An assessment of the region surrounding Bloomington identified additional volumes of FOG, food processing residuals and other forms of HSOW that can add valuable tip fees and additional biogas production to the project. No direct organics management outlets are present in the area, providing CBU an opportunity to be a first mover in an emerging market and provide a sustainable alternative to citizens and businesses in the region.

4) **Viable biogas use alternatives include combined heat and power (CHP) and renewable natural gas (RNG) with CHP having strong economic potential**
Boiler fuel and RNG for CNG fueling were deemed not feasible, however both CHP and RNG options can generate significant revenue for the project through sales of energy and environmental attributes (primarily renewable identification numbers (RINs). With the forthcoming potential for eRINs, the CHP has stronger financials and aligns better with the City's climate and sustainability goals.

5) **Class B land application is a more sustainable and viable alternative than landfilling residual biosolids with Class A being a potential additional product**
Implementing a Class B land application program for the biosolids produce by the anaerobic digestion facility is feasible to permit with IDEM, cost competitive with landfilling, and a more sustainable practice. It's also possible to further enhance the residual product and gain access to new markets and customers by creating a Class A product either through future improvements to the resource recovery facility or by partnering with a compost partner.

6) **Recent tax credit legislation can offset up to 50% of eligible project costs**
The Inflation Reduction Act provides an extremely valuable incentive by offering a tax credit for private entities or a direct pay mechanism for tax exempt entities of up to 50% of eligible anaerobic digestion and biogas project costs.

7) **Project has the potential to be cost neutral with sufficient HSOW volumes, tax credits and environmental credit value realized**
As described below the financial analysis shows that in many scenarios the project suffers from its small scale and cannot be self-sustaining without continued investment from CBU and its ratepayers. However, there are select scenarios that are positive net present value (NPV).

8) **The resource recovery program will directly address at least ten different goals set forth in the City of Bloomington's Climate Action Plan and Sustainability Plan at a cost that is likely less than other alternatives to achieve those same goals**
The project will lead to a minimum MT CO2e reduction of ~10,000 tons per year while also significantly increasing the City's renewable and distributed energy production. Substantial progress will be made in particular on City facility, energy use and waste diversion goals. Even in scenarios where the project does not reach cost neutrality, the annual expense associated with achieving the Climate Action Plan and Sustainability Plan is likely less than expenses associated with other projects to achieve the same results.

Financial Summary

The Project Team analyzed 16 different scenarios for financial analysis across a variety of project options including HSOW volumes, biogas utilization alternatives and funding sources. CBU expressed a goal of creating a resource recovery program that would be able to achieve significant environmental benefits that are cost effective when compared with other alternatives and does not overly burden CBU with exorbitant annual costs in downside scenarios. Based on the financial analysis performed to date, this goal does appear to be attainable under the right project configuration. Of the 16 different scenarios modeled, the most likely 10 scenarios span a 20 year NPV of -$32.5M to $15.5M. Even in the worst modeled case for CHP the 20 year NPV averages approximately ~$1M per year in exchange for significant progress towards the City's climate and sustainability goals. While there are many drivers and dynamic assumptions behind this analysis, the following overarching conclusions were drawn from the financial modeling:

- Depending on the amount of HSOW designed for and biogas utilization alternative, the resource recovery project is estimated to cost $50M-$64M, with $8.3M of that cost being for Dillman Road plant improvements that are contemplated in CBU's recent capital improvement plan.

- CBU does not process enough wastewater to make anaerobic digestion financially self-sustaining without support from increased rates.

- The project will need to fully capitalize on available investment tax credits and environmental credit value to minimize capital costs.

- The project has the potential to reach the economy of scale necessary to be financially self-sustaining if sufficient volumes of HSOW bearing enough biomethane potential and tip fee revenue are secured.

- A private party financing the project under a public private partnership (Build-Operate-Transfer) will have a higher cost of capital than CBU and will require CBU paying more than its current baseline practices to enable the private party to achieve its desired returns, therefore suggesting that CBU consider its options for self-funding at least a portion of the project. The facilities require for improvements to the wastewater treatment plant (grit removal, primary filtration, thickening) are natural scope items for CBU to assume responsibility for. Private entities still likely will need to be involved to execute on much of the scope that CBU does not have current capabilities to self-perform.

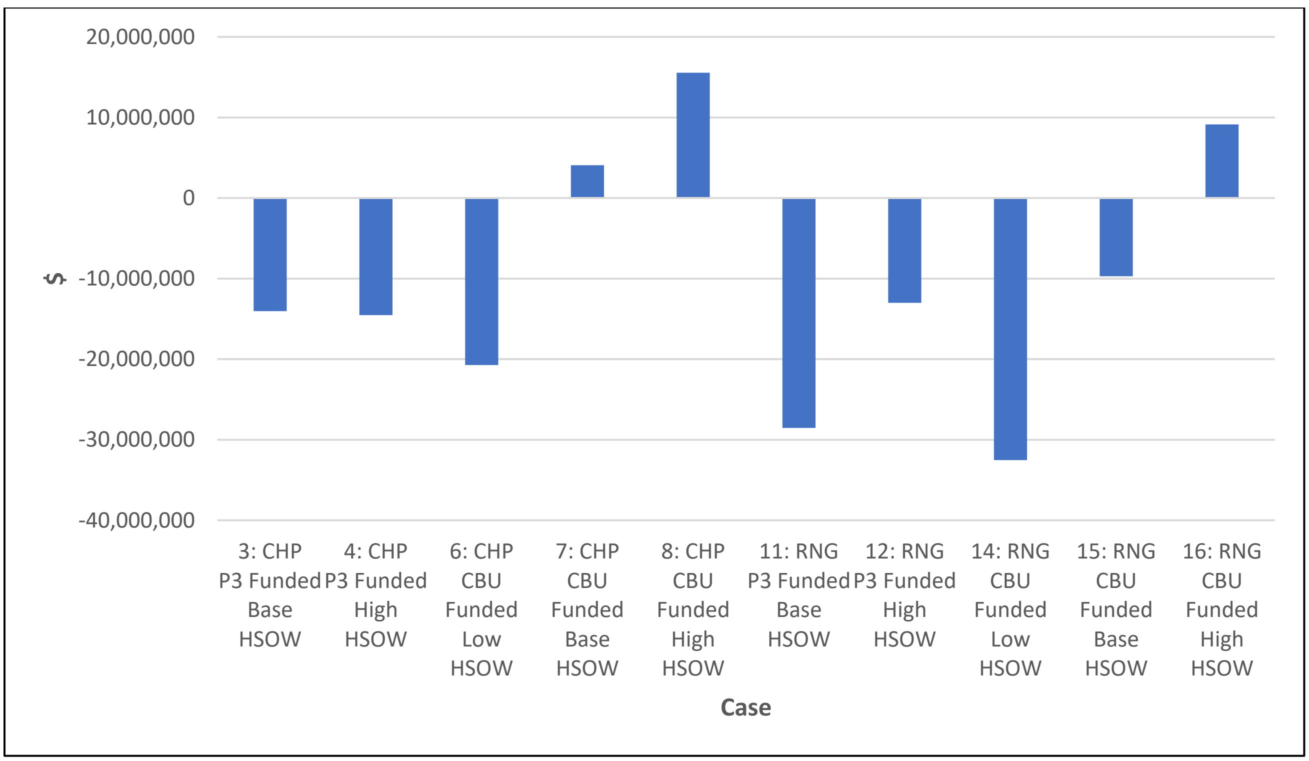
- There is a significant amount of both regulatory and market risk in undertaking a project of this nature and if assumptions are not fully met the project may require an increase in rates at a future date to sustain operations. Conversely if assumptions are exceeded the project could turn a former cost center into a revenue generating asset.

A summary of the NPVs for the various cases can be found in the table below. A more complete discussion of this analysis can be found in Section 8 and the accompanying financial model.

Table 1: Financial Analysis Summary Most Likely Scenarios

	NPV ($M)	HSOW Volume	Funding Source	Biogas Utilization
Case 3	-$14.0M	Medium (Base)	Private Party P3	CHP
Case 4	-$14.5M	High	Private Party P3	CHP
Case 6	-$20.7M	Low	CBU Self Funded	CHP
Case 7	$4.1M	Medium (Base)	CBU Self Funded	CHP
Case 8	$15.5M	High	CBU Self Funded	CHP
Case 11	-$28.5M	Medium (Base)	Private Party P3	RNG
Case 12	-$13.0M	High	Private Party P3	RNG
Case 14	-$32.5M	Low	CBU Self Funded	RNG
Case 15	-$9.7M	Medium (Base)	CBU Self Funded	RNG
Case 16	$9.1M	High	CBU Self Funded	RNG

Figure 1: Financial Analysis 20 Year NPV Comparison Most Likely Scenarios



Environmental Benefits Summary

Beyond the financial impacts the resource recovery project will have a substantial impact on both the City of Bloomington's Climate Action Plan and Sustainability Action Plan goals, with significant progress made towards at least 10 different goals between the two documents.

Table 2: City of Bloomington Climate Action Plan and Sustainability Goals Impact

Plan	Goal	Project Impact (Base Case)
Climate Action Plan	Reducing community greenhouse gas emissions 25% below 2018 emissions levels of 1.3M metric tons of carbon dioxide equivalent (MT CO2e) by 2030 and achieve carbon neutrality by 2050.	Reduction of ~10,000 MT CO2e from Scope 2 and Scope 3 emissions at a minimum from reduced grid electric and CBU biosolids landfill emissions with other benefits to be quantified.
	Increasing distributed renewable energy to 250,000 MWH of total generation annually by 2030.	Nearly 8,700 MWH/year increase in renewable energy generation
	Supporting decarbonization of the local electricity grid	Local grid further decarbonized by an adding an additional renewable distributed generation asset
	Increase landfill solid waste diversion by 30% of 2018 values, 26,500 tons of waste reduction	Minimum of 11,000 CBU tons of biosolids diverted, potential for significantly more with landfill diverted HSOW.
	Educate, engage and empower the public for climate health and safety. Attract, create, and support businesses that are committed to sustainability and climate goals	CBU is leading by example and the project provides Opportunities for public engagement and education
	Educate, motivate, and empower the public to achieve waste reduction and diversion	
Sustainability Action Plan	Reducing GHG emissions from municipal operations 12% relative to a baseline of 33,702 metric tons in 2015	~10,000 MT CO2e Scope 2 and Scope 3 emissions reduction from reduced electric consumption and emissions associate with landfilled biosolids.
	Reducing non-renewable energy use in City owned and operated facilities 12% relative to a baseline usage of 155,282 MMBTUs in 2015	80%+ reduction in Dillman Road non-renewable energy use, 12% reduction in Blucher Poole non-renewable energy use, representing nearly 30,000 MMBTU reduction – achieving the full goal]
	Reduce energy use associated with treating and transporting water and wastewater by 10% of 2018 values	12% reduction in Blucher Poole existing processes, net reduction in Dillman Road. energy use if self-generated power credited in accounting
	Increase local agricultural resilience to climate shocks	Improved soil health from land application of biosolids

2. High Strength Organic Waste (HSOW) Market Assessment

2.1. HSOW Market Assessment Executive Summary

The City of Bloomington (Bloomington) engaged the Project Team to conduct a high strength organic waste (HSOW) market assessment to better understand the potential for Bloomington to expand the organic waste feedstocks it receives as part of a proposed anaerobic digestion system addition at the Dillman Road Wastewater Treatment Plant (WWTP). The benefits of expanding a hauled-in waste program include increasing renewable energy production, generating tip fees, and providing a sustainable waste management facility for the region.

The market assessment included three major tasks: identifying HSOW feedstocks generated within an approximately 75 aerial-mile radius of the Dillman Road WWTP, investigating market competition and drivers, and summarizing the marketing tools and pricing strategies recommended for HSOW program expansion.

2.1.1. Available HSOW: Reported Quantity by Type

Over 220 potential HSOW generators and haulers were identified and contacted in the assessment. Approximately 15% of contacted parties were interviewed, with ~60% of interviewed parties showing interest in transporting HSOW to the Dillman Road WWTP.

Interested HSOW generators and haulers reported combined regional management of approximately 173,750 gallons of liquid and 120 tons of dewatered solid HSOW per week as shown in Figure 2 and Figure 3.

Figure 2: Gallons of Liquid HSOW Managed by Interested Parties per Week

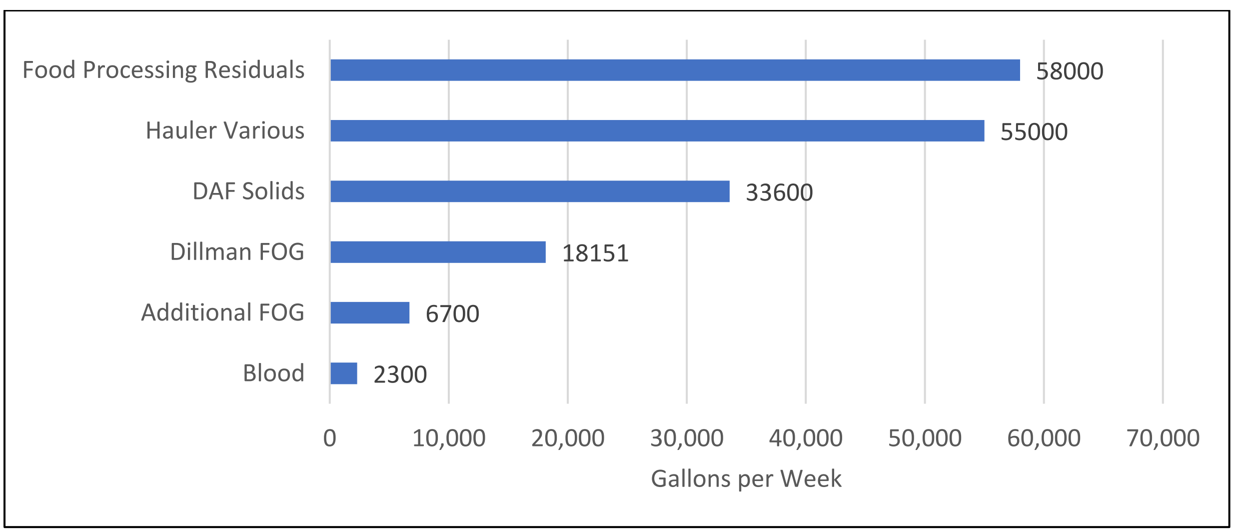
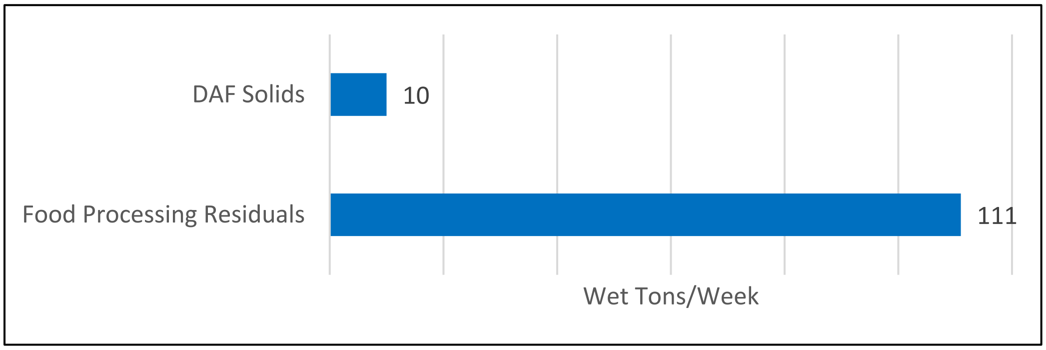


Figure 3: Wet Tons/Week of Solid HSOW Managed by Interested Parties



2.1.2. Market Competition and Drivers

The market assessment reviewed potential HSOW competitors in the region (within 75 aerial miles) for HSOW to understand the type and location of competition and existing market pricing. Competitor markets reviewed include municipal WWTPs and private anaerobic digesters (ADs), compost facilities, and landfills.

Market findings reveal the overall competition from these outlets in the immediate region is limited. Only two of 10 interviewed utilities with design flows >5 million gallons per day (mgd) accept HSOW, with tipping fees ranging from $0.056 to $0.42/gallon. Of the six compost facilities interviewed, only a single facility accepts HSOW from a commercial facility; all other compost facilities accept residential yard and/or food waste only. Three landfills accept dewatered HSOW, with tipping fees ranging from $24 to $44/wet ton as shown in Table 3.

Notably, while competition in the three identified outlet markets is limited, interviews with HSOW generators reveal land application and direct discharge into a local WWTP collection system to be commonly practiced, with cost-effective management costs of $0.02 per gallon or less.

Table 3: Summary of Competition and Tipping Fees

Competitor Type	Quantity Identified	Quantity Interviewed	Quantity Accept Liquid HSOW	Reported Tipping Fee Range	Quantity Accept Commercial Non-Liquid HSOW	Reported Tipping Fee Range
Municipal WWTPs and Private ADs	18	10	2	Non-FOG HSOW: $0.056 FOG: $0.08 - $0.42	N/A	N/A
Compost Facilities	12	6	0	N/A	1	NP
Landfills	12	5	2	NP	3	$24 - $44

Note: HSOW = high strength organic waste; AD = anaerobic digester; WWTP = Wastewater treatment plant; N/A = Not applicable – waste type not compatible with outlet; NP = not provided – information not provided during interview.

2.1.3. Transportation Logistics

Additional non-economic factors of importance reported by HSOW haulers relate to receiving station logistics and hauled-waste program restrictions. These factors are said to increase the likelihood of haulers utilizing an outlet and include the following.

1. Expanded hours of operation (to avoid high traffic periods).
2. Acceptance of outside-the-county waste.

Two surveyed haulers reported an interest in expanded hours of operation during weekdays and accessibility during weekends to increase the likelihood and quantity of HSOW that would be transported to the Dillman Road WWTP. Additionally, more than half of surveyed haulers reported an interest in transporting additional FOG to Dillman Road if the facility allows for acceptance of out-of-county waste.

2.1.4. Considerations for HSOW Market Expansion and Pricing Strategy for Bloomington

The following strategies are recommended to enhance Bloomington's ability to access the liquid and dewatered cake HSOW that is currently managed in the region.

1. ***Connect directly with haulers.*** Engaging with haulers appears to be the most promising option to increase opportunities to expand Bloomington's hauled-in organic waste program. Haulers are often responsible for selecting the final disposition for a waste stream and both sources reported a high interest in an alternative outlet due to their limited options within the region.

2. ***Provide competitive tipping fees***. Viable tip fees in the market for hauled-in waste are currently $0.02 to $0.056/gallon for non-FOG HSOW, $0.08 - $0.42 per gallon for FOG, and $15 to $44/wt for non-liquid HSOW. However, there are limited parties in the area accepting non-FOG HSOW and haulers expressed a willingness to pay up to

$0.15/gallon for these materials. For the purposes of this study the Project Team has assumed tip fees of $.125/gallon for liquids and $38.50/wet ton for solids with the commencement of the project in 2027.

3. ***Expand hours of operation.*** Haulers noted limited hours as a challenge and expanded hours (i.e., 24 hours per day/7 days per week) as a benefit, Operating the program with expanded hours will add to the convenience of haulers and encourage hauling to the Dillman Road WWTP. It should be noted that since these comments were made CBU has implemented its preferred pumper program providing expanded access to preferred haulers which has been well received and resulted in an increase in delivered FOG volumes.

4. ***Acceptance of Out-of-County Waste***: Market findings reveal the Dillman Road WWTP only accepts in-county waste. Understanding there is a limited number of local WWTPs accepting HSOW, allowing for acceptance of out-of-county waste is anticipated to increase access to the market, as is revealed by haulers reporting nearly 100% increase of FOG if out-of-county waste is accepted.

2.2. HSOW Background

2.2.1. Introduction

Bloomington owns and operates the Dillman Road and Blucher Poole WWTPs, which are designed for an average annual daily flow of 20 million gallons per day (mgd) and 6 mgd, respectively. Solids generated at the Dillman Road WWTP are aerobically digested, dewatered, and transported for landfill disposal. Solids handling at the Blucher Poole WWTP includes dewatering (without any formal digestion), and transportation for landfill disposal.

In addition to the liquid and solids treatment processes, Bloomington maintains a liquid hauled waste program at the Dillman Road WWTP. Current materials accepted include septage, and fats, oils, and grease (FOG). While the current hauled waste program generates revenue for the City, the utility's treatment process does not include anaerobic digestion, and therefore does not benefit from the potential energy generation possible by accepting and anaerobically digesting these materials.

2.2.2. Goals and Objectives

Bloomington engaged the Project Team to evaluate the availability of HSOW as part of the Team's overall economic evaluation of the implementation of anaerobic digestion at the utility. For the intent of this study, it was assumed HSOW will be accepted at the Dillman Road WWTP for processing. High strength organic wastes include materials sourced from food and drink production and processing facilities, such as food processing wastes, off-spec beverage products, dairy wastes, brewery wastes, and FOG. Typically, these waste streams are highly biodegradable, have higher volatile solids content than municipal wastewater solids, and can increase biogas production if digested along with the solids produced or received at the WWTP.

The HSOW market assessment was completed to achieve two major goals:

1. Identify sources, volumes, and types of regionally available HSOW available for co-digestion at the Dillman Road WWTP; and
2. Identify market drivers that influence HSOW management, including competitors currently accepting HSOW, with a focus on current tipping fees and available capacity.

Information gathered from the market assessment was used to evaluate the regional availability and economic viability of accepting additional HSOW at the Dillman Road WWTP.

2.2.3. Previous Work

This market assessment builds on the findings and recommendations of the work completed by the *Waste-to-Energy Task Force* in 2020. In 2019, the *Waste-to-Energy Task Force* was developed to assess the feasibility of anaerobic digestion at the Dillman Road WWTP. The feasibility study included an estimate of the biogas generation potential and the financial impact of proposed project.

The proposed project suggested replacement of the City's existing aerobic digestion process with anaerobic digestion to generate energy from the City's wastewater solids. To maximize biogas (and in turn, energy) generation, the project also recommended the addition of primary clarifiers (primary solids have significantly more energy potential than waste activated solids) and the acceptance of hauled-in HSOW. Proposed sources of HSOW identified in the report included:

1. Fats, oils, and grease (FOG)
2. Food waste collected from restaurants, businesses, residences, Monroe County Management District, and Indiana University[1]; and
3. Blucher Poole WWTP wastewater solids.

While the 2019 efforts identified and quantified known HSOW sources, the report did not include an assessment of additional HSOW available in the region from food processors and other large organic waste generators, and other regional competition (i.e., other facilities with hauled-in waste programs, compost facilities, landfills, etc.).

2.3. Approach

The market assessment approach includes defining HSOW to be targeted, identifying potential HSOW generators and haulers, developing and implementing a HSOW scoring matrix, and gathering information about competition.

2.3.1. Defining High Strength Organic Waste to be Targeted

High strength organic wastes are sourced from a variety of entities, which includes food and beverage (F&B) production and/or processing facilities. HSOW is also generated by industries that consume and/or distribute large quantities of food such as grocery stores, college campuses, etc. Due to the diverse markets generating HSOW, these materials have a wide range of physical and chemical properties and potential impact to the digestion and wastewater system.

Target feedstocks for co-digestion at the Dillman Road WWTP, which was the primary focus for the organics market assessment include.

1. Fats, oils, and grease (FOG) (e.g., grease, dissolved air flotation (DAF) solids from side-stream processing), that have limited impact on the liquid treatment processes.

[1] At the time, it was reported FOG and food waste from Indiana University were currently hauled and received at the Dillman Road WWTP

2. Liquid wastes with high chemical oxygen demand (COD) or biological oxygen demand (BOD) waste streams.

Additional secondary feedstocks, which will be estimated, based on book values and previous work completed for the City and County include the following.

1. Grocery chains
1. Post-consumer waste
2. Residential organics

Some feedstock materials with high nitrogen (N) concentration (i.e., blood from meat processing) will generate a side stream that may impact the N-loading to the liquid treatment process that could impact the effluent N concentration and is not ideal for co-digestion (See scoring evaluation for additional HSOW scoring parameters).

The HSOW generators and corresponding HSOW identified for inclusion in the market assessment are shown in Table 4. As illustrated, liquid waste streams identified and evaluated in the Bloomington region include those generated by F&B, meat and dairy processors, wineries and breweries, airports, animal feed, large post-consumer generators, and HSOW managed by organic waste haulers.

Table 4: HSOW Sources and Potential Waste Streams of Interest

High Strength Waste Generator Type	Primary Feedstock	Secondary Feedstock	Potential Waste Streams of Interest
Food & Beverage (F&B) Manufacturer or Processor	X		• Process wash-water • Out-of-spec product (liquid) • Treatment side streams • High strength liquid waste streams (juice, soda, concentrated by-products)
Winery	X		• Juice/product • Barrel/tank rinse • Yeast residuals
Brewery/Distillery	X		• Spent grain and yeast • Liquid by-products • Tank rinsate • Off-spec product
Renderer	X		• Wastewater from meat processing • Grease/other oily wastes • Blood process water
Dairy Processor	X		• Whey • Treatment side streams • Off-spec (liquid) product • Process wash water
Airport	X		• De-icing fluid
Animal Feed	X		• Process wash-water • Out-of-spec product • Treatment side streams • High strength liquid waste streams
Hauler	X		• Waste streams generated by F&B industry and other HSOW generators • Fats, oils, and grease (FOG)
Municipal Wastewater Treatment Plants	X		• Municipal Wastewater Solids/Biosolids
Large Post-Consumer Generator		X	• Fruit and vegetable waste (grocery stores) • Source separated prepared food (grocery stores and Indiana University)
Residential Organics		X	• Source separated organics from households • Non-source separated organics from households

2.3.2. Identifying Potential Generators and Haulers

A review of HSOW generators within 75 aerial miles of the Dillman Road WWTP was conducted to identify the types of feedstocks produced regionally. A list of parties hauling and/or managing HSOW within 75 miles of the Dillman Road WWTP was compiled through an internet search and references through a regional industry data base. The hauler list developed by combining the existing City of Bloomington hauler list with other businesses identified through an industry database. The list of HSOW generators and haulers is found in Appendix A.

To gather information about most HSOW generator types, survey questions were developed to ensure adequate and consistent data collection and compilation of each survey. The surveys were conducted via phone and email correspondence, and the data and findings were compiled, organized, and analyzed. Generators and haulers were contacted for interviews to obtain direct feedback about market pricing and disposition trends. HSOW generation quantities for the Large Post-Consumer Generator and Residential Organics categories were estimated based on industry estimates and previous studies completed by the City.

2.3.3. Scoring Evaluation

An evaluation rubric was developed to score the relative viability of individual HSOW sources for acceptance at the Dillman Road WWTP. Scores were developed for each generator based on the distance from their facility to the Dillman Road WWTP, interest in hauling waste to the plant, treatability, nutrient level, discharge frequency, and average weekly volume as shown in Table *5*.

Table 5: Scoring Evaluation Rubric

Parameter	● Not feasible	● Poor	● Medium	● Good
Points	0	1	2	3
Distance	>100 miles	100-75 miles	75-50 miles	< 50
Source Motivation	Unable to contact after multiple attempts	No interest, current outlet is cheap or free	Willing to discuss further	High interest
Treatability at Bloomington	Packaged waste	Solid	Chunky liquid	FOG or liquid
Nutrient Level	--	Excessive Nutrients	--	Proportionate nutrients
Discharge Frequency	Discharge to sewer	Monthly	Weekly	Daily
Average Weekly Volume	Drum or tote	<5,000 gal	5,000 - 10,000 gal	>10,000 gal
Methane Potential	BOD equivalent to sanitary sewage	BOD < 10,000 mg/L	BOD > 10,000 mg/L	Fats, Oils or Grease (FOG)
Quantitative Score	0	>0 – 7	>7 – 14	>14 – 21

2.3.4. Identifying Competition

Understanding regional competition for HSOW, including capacity, location, and tipping fees is critical for implementation of a successful HSOW program. Competitors for HSOW, including private and municipal anaerobic digesters and facilities with hauled-in waste programs, compost facilities, and landfills. Municipal WWTPs were narrowed based on design flow (>5 mgd) and location (within 75 aerial miles of Bloomington). All other facilities were identified through use of publicly available databases and internet searches. Survey questions were developed, competition was interviewed, and findings were compiled, organized, and analyzed.

2.4. Market Assessment Findings

A detailed description of the market assessment findings, including information on the HSOW identified and evaluated and HSOW competition is summarized herein.

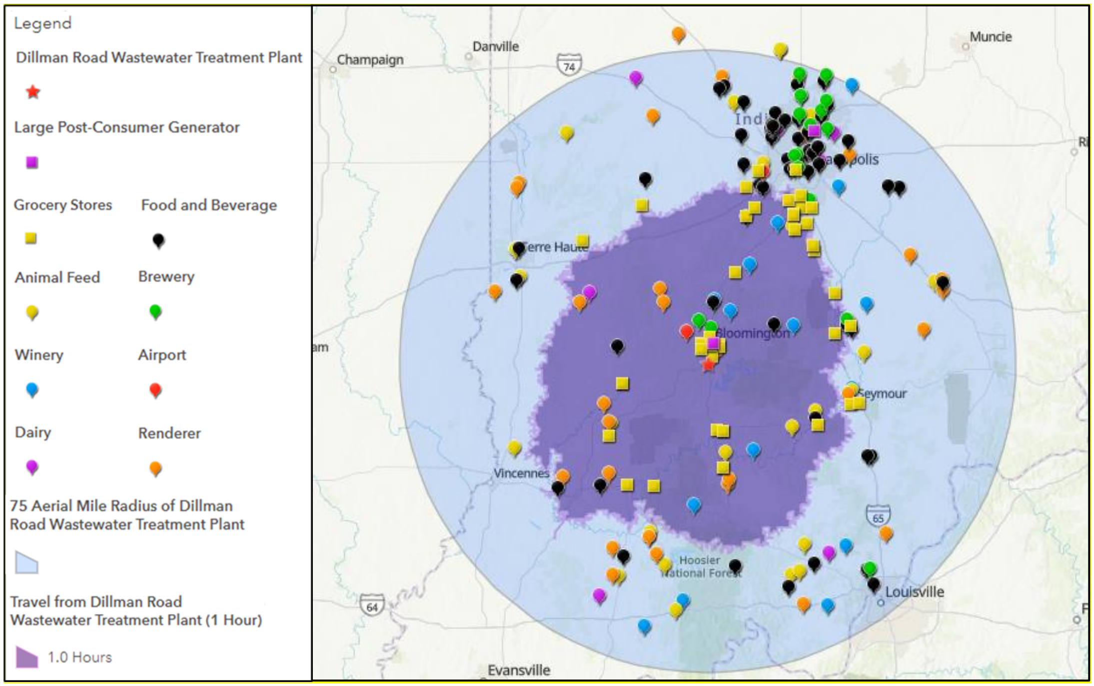
2.4.1. High Strength Organic Waste Identified

Over 200 HSOW generators and haulers were identified within 75 aerial miles of the Dillman Road WWTP, including over 220 HSOW generators and nearly 20 HSOW haulers. The market assessment identified 222 HSOW generators within the nine targeted HSOW categories Table 6. The location of each entity is depicted in Figure 4. Notably, fewer than 70 HSOW generators (including ~30 grocery stores) are located within a one-hour drive of the Dillman Road WWTP, with 15 interviewed and four showing interest in transporting HSOW to the Dillman Road WWTP. Approximately 70 HSOW generators are located in the Indianapolis area, and an additional 13 HSOW generators are located in the Louisville area.

Table 6: Potential HSOW Generators

Category	No. of HSOW Generators <75 mi.	No. HSOW Generators Interviewed	No. HSOW Generators Interested	% HSOW Generators Interviewed Showing Interest
Food & Beverage (F&B) Manufacturer or Processor	64	4	0	0%
Winery	16	2	1	50%
Brewery/Distillery	18	0	0	N/A
Renderer	37	10	9	90%
Dairy Processor	8	2	0	0%
Airport	2	0	0	N/A
Animal Feed	26	2	0	0%
Municipal Wastewater Treatment Plants	6	1	0	0%
Large Post-Consumer Generators	45	0	0	N/A
Total	**222**	**21**	**10**	**59%**

Figure 4: HSOW Generator Location by Waste Type

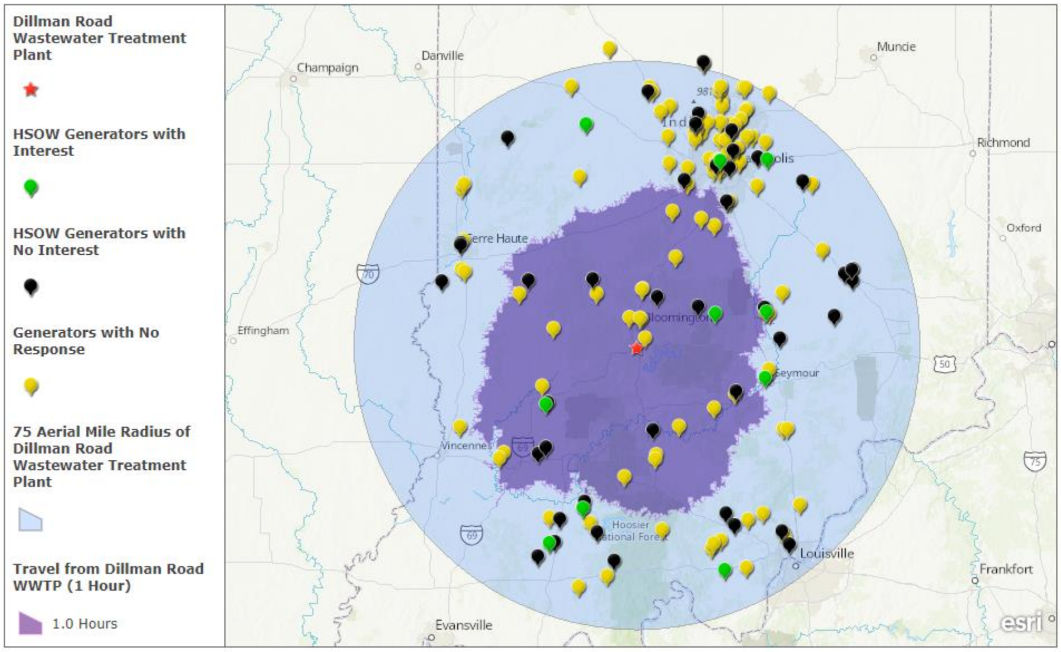


2.4.2. Interviewed Generators

The 177 entities in all categories except Large Post-Consumer Generators and Residential Waste Categories were contacted. HSOW generation rates for the Large Post-Consumer Generator and Residential Organics categories were estimated based on industry data and previous studies. Twenty-one entities were successfully interviewed, with 12 reporting an interest in transporting HSOW to the Dillman Road WWTP. The remaining 156 potential HSOW generators were non-responsive despite multiple attempts (126) to contact or do not create any wastewater (30). It is understood the main reasons for non-responsiveness include the following.

1. Lack of time to complete the survey;
2. Lack of interest in responding to an unsolicited call;
3. Challenges connecting with “decision-makers” responsible for HSOW management;
4. Lack of believe the facility would materialize; and
5. Limited quantities of waste to be managed.

Figure 5: HSOW Generators Location by Interest Level



Of the 12 interested generators, five received “Good” scores (highly favorable) and seven received “Medium” (low to moderately favorable) as HSOW sources for the proposed Dillman Road WWTP anaerobic digesters.

The five most promising producers:

- Generate over 120 tons of non-liquid waste and 80,000 gallons of liquid waste per week.
- Have existing management costs of $0.02 (liquid) (anticipated to rise markedly due to process changes) and $15 - $40/wt (solid)
- Are seeking additional HSOW management outlets and/or lower costs.

The seven low scoring producers, accounting for eight HSOW sources:

- Either directly discharge to a municipal WWTP or are receiving payment for their HSOW
- Are satisfied with existing management option; have low source motivation.

Table 7: High Scoring Interested HSOW Generators

Company Name	**Farbest Foods, Inc.**	**Tyson Foods**	**Rose Acre Farms**	**Wabash Valley Produce, Inc.**	**The Smoking Goose, LLC**
Description	DAF solids (6.8% TS)	Food processing residuals (8-10% TS)	DAF solids	Egg product	FOG (Grease trap waste)
Distance from site to Dillman Road WWTP	● 75	● 90	● 55	● 59	● 61
Current Management Practice	Land application	Land application	Hauled – Landfill	Land application	Hauled off-site (unknown location)
Current Hauling/Tipping Fee	Not Provided	Not Provided	$38-40/wt	$15/wt	Not Provided
Source Motivation	● Looking for an outlet for DAF solids	● Looking for different options for FPR management	● Interested in finding lower cost outlet	● Consider sending to Bloomington instead of buying FPR press	● Willing to discuss further, cost
Treatability at Bloomington	● 6.8%TS	● 8-10% TS	● Dewatered DAF solids	● 8.4%TS	● FOG
Nutrient Level	● Proportionate nutrients	● Proportionate nutrients assumed (needs to be confirmed)	● Proportionate nutrients assumed (needs to be confirmed)	●TBD	● Proportionate nutrients assumed (needs to be confirmed)
Discharge Frequency	● Daily	● Daily	● Weekly	●TBD	● Bi-monthly
Average Weekly Volume	● 33,600 gallons	● ~58,000 gallons	●7-10 wt	●111 tons	● TBD
Methane Potential	●DAF solids	● Medium	●DAF solids	● Medium	●FOG
Limitations	Far distance to Bloomington	Far distance to Bloomington	Medora Landfill in closer proximity	Considered purchasing sludge press	Little FOG produced
TOTAL SCORE	**20**	**16**	**15**	**14**	**16**
QUALITATIVE SCORE	**●Good**	**●Good**	**●Good**	**● Good**	**●Good**

Table 8: Low Scoring Interested HSOW Generators

Company Name	Peer Foods Group, Inc. - Columbus	Peer Foods Group, Inc. - Greenfield	ADM Milling Co	Odon Locker, Inc.	Odon Locker, Inc.	Brown County Wine, Inc.	Ladoga Frozen Food-Locker Service	JFS Milling, Inc.
Description	Wastewater	Wastewater	flour waste	Blood	Meat, fat, bones	Skins of grapes	Bones, fat, organs, blood	Boiler/truck wash water
Distance from site to Dillman Road WWTP	● 43	● 72	● 59	● 38		● 29	● 75	●57
Current Management Practice	Discharge to City of Columbus	Discharge to Cumberland WWTP	Landfill disposal	Dar Pro (Renderer)		Compost pile in winery	Dar Pro (renderer)	Discharge to Patoka Lake WWTP
Current Hauling/Tip Fee	Not Provided	Not Provided	Not Provided	Dar Pro pays Odon Locker $400/pick-up;		No fee	Base fee	Monthly fee
Source Motivation	● Low interest	● Low interest	● Low interest	● Low interest		● Low interest	● Low interest	● Low interest
Treatability at Bloomington	● Liquid	● Liquid	● Flour Waste, solids	● Liquid	● Chunky liquid	● TBD	● Chunky Liquid	● Liquid
Nutrient Level	● TBD	● TBD	● Proportionate nutrients	● Excessive nutrients	● TBD	● TBD	●Excessive nutrients	● TBD
Discharge Frequency	● Direct discharge to WWTP	● Direct discharge to WWTP	● TBD	● Weekly	● 2 pick-ups/week	● Infrequent, does not haul often	● Weekly	● Direct discharge to WWTP
Average Weekly Volume	● TBD	● TBD	● TBD	● 75-100 gallons	● 1+ ton/week	● Depends on fruit	● 2,200 gallons	● 400,000 gallons
Methane Potential	● Assumed to be low	● Assumed to be low	●	● Assumed to be low		● Assumed to be low	● Assumed to be low	● Assumed to be low
Limitations	Direct discharge	Direct discharge	Reliable disposal	Must be willing to pay company for material		No current fee; Little produced	Sometimes gets paid for product	Direct discharge
TOTAL SCORE	**10**	**9**	**8**	**11**	**11**	**8**	**10**	**11**
QUALITATIVE SCORE	● **Medium**	● **Medium**	● **Medium**	● **Medium**		● **Medium**	● **Medium**	● **Medium**

2.4.3. Grocery Stores

Forty-three grocery stores were identified within ~50 mile aerial radius of the Dillman Road WWTP, with approximately 30 stores within a one hour drive. It was estimated that each grocery store generates roughly 3 tons of food waste each week. Therefore, it is estimated up to 130 tons of food waste are generated by grocery stores in the region on a weekly basis. Food waste generated by grocery stores includes both bulk and individually packaged materials, both which require preprocessing prior to acceptance at a digester through depackaging and/or macerating equipment.

2.4.4. Residential Organics

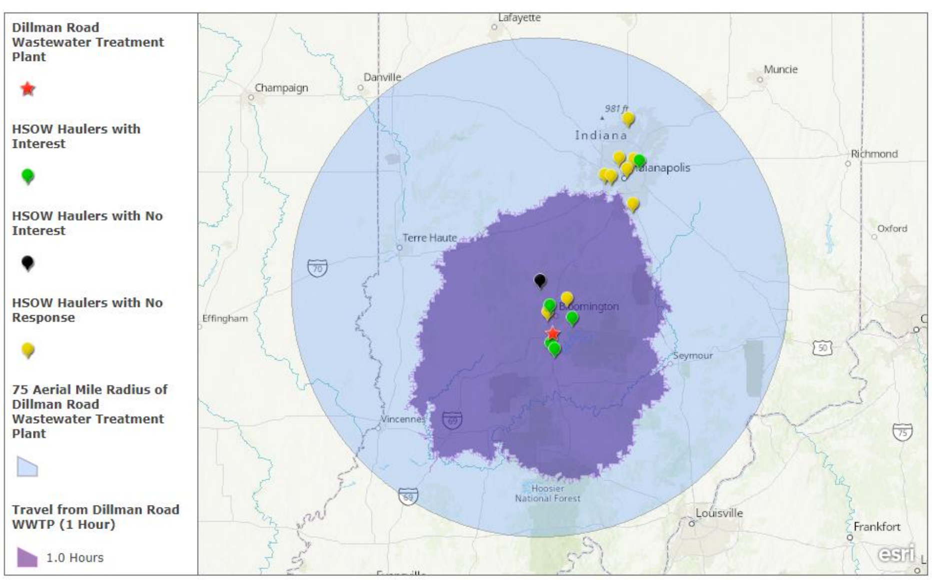
Previous studies conducted by Monroe County Solid Waste showed that municipal solid waste (MSW) streams within Monroe County contained approximately 25,400 wet tons per year of organic material.

Currently, apart from some relatively modest levels of composting facilitated by regional drop off centers most residential organics are comingled in the MSW stream and landfilled. There are no immediate plans for offering residential organics collection services for Bloomington or Monroe County residents, though it may be an aspirational future long term goal. This organics stream will be very difficult to separate to be made suitable for anaerobic digestion.

2.4.5. High Strength Organic Waste Haulers and Aggregators

Eighteen HSOW haulers were identified and contacted within a 75 aerial-mile radius, with eight responding to interviews, and six reporting interest. One additional entity is a regional firm that does not have a physical location within the 75 aerial mile radius but does service customers in Indiana and has significant interest.

Figure 6: HSOW Haulers Location by Interest Level



The six strongly interested entities transport FOG, with all interested haulers currently transporting FOG to the Dillman Road WWTP. Two of the interested haulers reported the Dillman Road WWTP does not currently accept out-of-county waste; both haulers transport out-of-county waste to alternative municipal WWTPs, with one noting taking solids to Merrell Brothers, located in Speedway, Indiana.

The two haulers who reported limited interest in transporting HSOW to Bloomington (101 Inc and quasar) noted the location of their existing HSOW sources are generally too far (2 hours+ from Bloomington, with 101 Inc's sources in central/northern Indiana and quasar's sources in the Cincinnati, OH and Fort Wayne, IN regions), to make economic sense to transport to Bloomington. Furthermore, their existing outlets are reliable and are sufficient to meet their current needs. However, if their future HSOW portfolio include sources closer to Bloomington (within ~1 hour or so), both haulers reported they would be interested in diverting material to a digester in Bloomington.

Key findings from interested HSOW haulers includes the following.

1. Seven businesses combined haul more than 67,000 gallons per week.
2. If Dillman Road accepted out-of-county waste, four of the haulers noted that they could haul additional FOG and HSOW
3. Haulers reported a strong interest in expanding the hauled-in waste acceptance hours to allow for weekend discharge and/or access 24/7.

A summary scoring table of interested haulers can be found in Table *9*.

Table 9: Interested Haulers Summary Scoring

Company Name	Todd Septic Services	American Grease and Septic	Affordable Septic	Hardin Septic Service	A&A Quick Pump	Koorsen Environmental	quasar
Description	FOG	FOG	FOG	FOG	FOG	FOG	FOG/HSOW
Distance from site to Dillman WWTP	10	116	9	8	8	68	Various
Current Management Practice	Dillman Road WWTP	Owensboro, KY WWTP	Dillman Road WWTP	Dillman Road WWTP	Dillman Road WWTP	Dillman Road WWTP; Merrell Bros Speedway Digester	Self-owned digesters in OH; Fort Wayne WWTP in IN
Current Tipping Fee	Not Provided	In County: $0.07/gal; Out-of-County: $0.14/gal	Not Provided	Not Provided	Not Provided	Dillman: $0.08/gal; Merrell Brothers: $0.15/gal	$0.15/gallon
Source Motivation	●High Interest	●High Interest	●High Interest	●High Interest	●High Interest	●High Interest	●High Interest
Treatability at Bloomington	● FOG	● FOG	● FOG	● FOG	● FOG	● FOG	● FOG / Liquid HSOW
Nutrient Level	● Proportionate Nutrients	● Proportionate Nutrients	● Proportionate Nutrients	● Proportionate Nutrients	● Proportionate Nutrients	● Proportionate Nutrients	● Proportionate Nutrients
Frequency	● Daily	● Daily	● Daily	● Daily	● Daily	● Daily	● Daily
Current Gallons/Week Dillman Road	● 3,560 gal/week to Dillman WWTP	● 385 gal/week to Dillman WWTP	● 385 gal/week to Dillman WWTP	Not Provided	● 1,440 gal/week to Dillman Road WWTP	● 1,920 gal/week to Dillman Road WWTP	None
Future Gallons/Week Dillman Road	962 gal/week	1,154 gal/week	0 gal/week	0 gal/week	4,615 gal/week	N/A haul total of ~125,000 gallons/year	Up to 60,000 gallons per week
Methane Potential	● FOG	● FOG	● FOG	● FOG	● FOG	● FOG	● FOG / liquid HSOW
Limitations	Out-of-county acceptance	Distance from Dillman Road	Hours of Operation	Limited FOG hauling	Out-of-county acceptance	Out-of-county waste acceptance	Potential to send to closer ADs
TOTAL SCORE	**●21**	**●21**	**●21**	**●21**	**●21**	**●21**	**●21**
QUALITATIVE SCORE	**●Good**	**●Good**	**●Good**	**●Good**	**●Good**	**●Good**	**●Good**

2.5. Combined Generator and Hauler Findings

The generator and hauler survey responses show that over 173,750 gallons of liquid HSOW and 120 tons of solid HSOW are generated and transported weekly in the region by six generators and seven haulers. High-scoring available HSOW includes FOG, DAF solids, food processing residuals, and egg waste.

With respect to FOG, currently 18,150 gallons of HSOW (as FOG) is already transported to the Dillman Road WWTP per week. Market assessment findings reveal an additional 6,700 gallons of FOG is produced in the region weekly and could be accepted by Bloomington if the City allows acceptance of out-of-county HSOW. Factors associated with securing additional HSOW includes competitive tipping fees and reliability. These volumes represent a floor for the amount of HSOW the program could process without doing any additional work or taking on any additional risk, summarized in the Low HSOW scenario.

Understanding that only ~15% of identified HSOW generators responded to interview requests and 50% of those interviewed reported interest in transporting HSOW to the Dillman Road WWTP, it is likely that the amount of HSOW generated within 75 aerial miles of the Dillman Road WWTP is much greater than the amount quantified within this report. Despite this large volume of HSOW produced locally, interview responses with both the generators and haulers indicates competition from alternative outlets in the region. Additional information with respect to competition is detailed in Section 2.6

Given that the amount of HSOW secured for the project will undoubtedly change and fluctuate over time as generators grow or consolidate their business and the market competition changes, the Project Team proposed to evaluate three various scenarios for HSOW volumes process by the project as show in Table 10.

Table 10: HSOW Scenarios for Design Basis

		Low	Medium (Base Case)	High
Company	**Category**	**Gallons per Day**	**Gallons per Day**	**Gallons per Day**
Tyson Foods	Food Processing Residuals - Liquids	0	8,286	8,286
Wabash Valley Produce (Egg)	Food Processing Residuals - Solids	0	3,773	3,773
Farbest Foods	DAF Solids - Liquids	0	4,800	4,800
Rose Acre Farms	DAF Solids - Solids	0	343	343
quasar	Hauler - Various	0	3,929	7,857
Multiple haulers	Dillman FOG	0	2,593	2,593
Multiple haulers	Additional FOG	957	957	957
Various stores	Grocery Stores	0	772	1,235
Indiana University	Indiana University	0	232	232
TBD	Unidentified Food Processing / DAF	0	3,440	8,601
TBD	Unidentified FOG	0	411	1,029
Residential/ Commercial	Residential/Commercial Organics	0	0	6,683
	Total	3,550	29,834	47,134

The various assumptions behind the volumes in each scenario are shown in Table 11 below.

Table 11: HSOW Scenario Assumptions

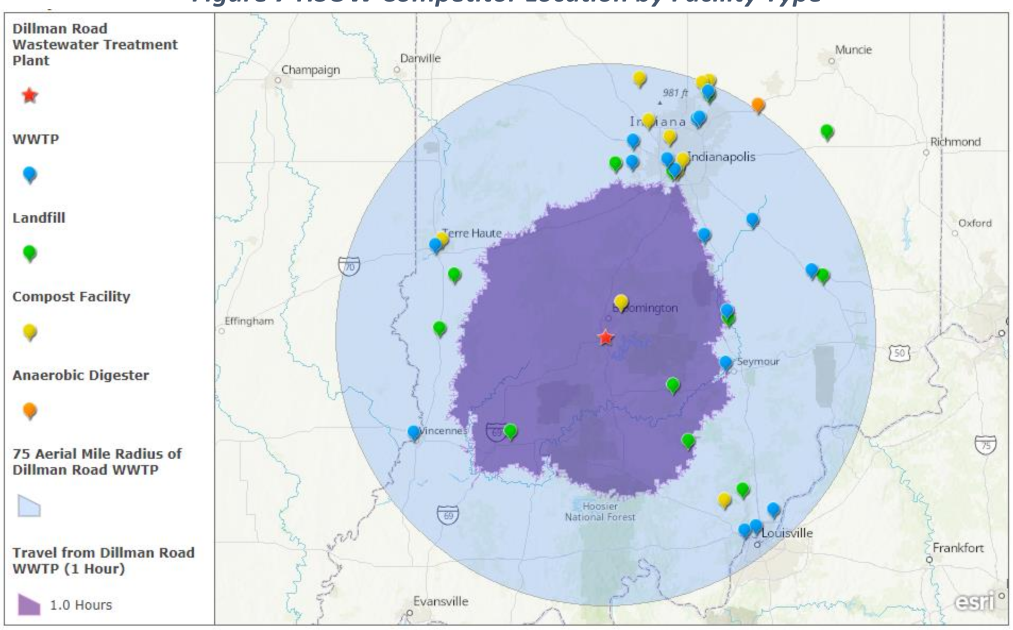
	Low	Medium (Base Case)	High
HSOW / Haulers / FOG	Current Dillman Road FOG volumes only to represent a floor volume of HSOW that does not require procuring any new volumes	HSOW Market Research Findings minus half of quasar volumes due to distance and other competitor outlets + some modest (20%) unidentified volume	HSOW Market Research Findings + aggressive (50%) assumptions on unidentified volume
Grocery Stores	Not Included	25% capture of stores within 1 hour drive	40% capture of stores within 1 hour drive
Residential / Commercial In County Organics	Not Included	Not Included	40% capture

The Project Team recommends analyzing the volumes of Medium HSOW as the Base Case for this analysis. While the exact volumes from each of the companies identified may not materialize for various reasons, we believe that these volumes are reasonably achievable targets based on the market research performed to date. The Low HSOW should be seen as an extremely conservative floor target and the High HSOW should be seen as an aspirational number that likely would be difficult to achieve from the onset and would require further off-site collection and processing infrastructure to access the residential organics that is outside of the scope of this study.

2.6. Competition

Three potential competitor categories for HSOW were identified within 75 miles of the Dillman Road WWTP: municipal and private hauled-in waste and anaerobic digesters (ADs) facilities, composting facilities, and landfills (Figure 7).

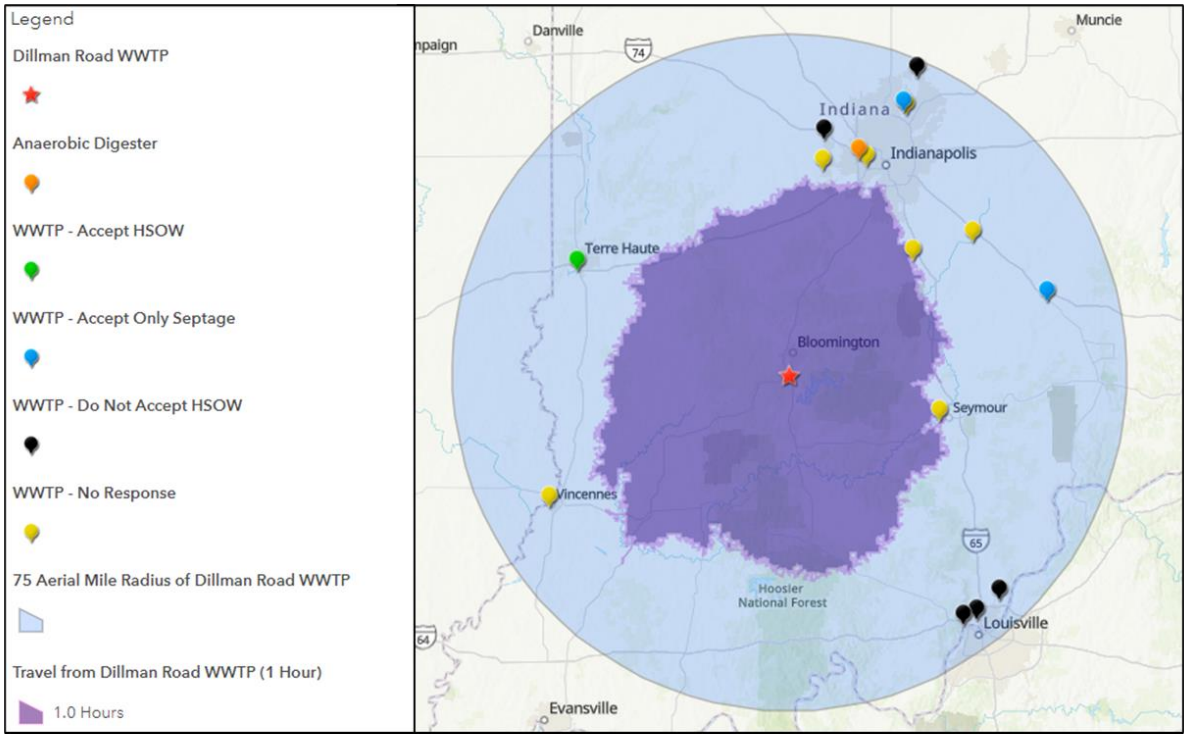
Figure 7 HSOW Competitor Location by Facility Type



2.6.1. Municipal and Private Anaerobic Digesters / Facilities with Hauled-In Waste Programs

One private AD (Merrell Brothers) and 17 municipal WWTPs with potential hauled-in waste programs (with design flows >5 mgd) were identified within 75 miles of the Dillman Road WWTP (Figure 8). Seventeen wastewater treatments plants were contacted, ten were surveyed, and five accept hauled in waste. Merrell Brothers did not respond to an interview request.

Figure 8: Competitor WWTP and Anaerobic Digester Facility Locations



Of the five municipal WWTPs reporting accepting hauled in waste, three only accept septage. Two WWTPs reported acceptance of HSOW: Indianapolis (Belmont) and Terra Haute. Pricing information for Merrell Brothers was also provided by a hauler.

1. A representative from Terra Haute reported acceptance of septage, FOG, landfill leachate, and out-of-state industrial wastewater. Tipping fees for septage and FOG are $0.08 for in-county waste and $0.20 for out-of-county waste.
2. The City of Indianapolis accepts septage, liquid non-FOG HSOW, and FOG. Pricing for septage and liquid non-FOG HSOW is $0.056/gallon, with FOG pricing of $0.42/gallon.
3. One hauler reported the tipping fee for FOG at the Merrell Brothers' Speedway facility to be $0.15/gallon. Pricing information for other waste streams at this facility was not provided.

A summary table detailing type of waste accepted, tipping fees, and weekly volume accepted are outlined in Table 12.

Table 12: WWTP and Anaerobic Digester Competitor Summary

Utility / Private Digester	Interviewed?	Hauled-In Waste?	Type of Waste Accepted	Tipping Fee	Weekly Volume Accepted
Brownsburg WWTP	Yes	No	N/A	N/A	N/A
Carmel WWTP	Yes	Yes	Septage	Not Provided	175,000 gal/wk.
Clarksville WWTP	Yes	No	N/A	N/A	N/A
Columbus WWTP	Yes	Yes	Septage	$0.04/gallon + $4.42/truck	87,500 gal/wk.
Fishers Cheeney Creek WWTP	No	TBD	TBD	TBD	TBD
Franklin WWTP	No	TBD	TBD	TBD	TBD
Greensburg WWTP	Yes	Yes	Septage	Not Provided	Not Provided
Indianapolis Belmont and Southport AWTP	Yes	Yes	Septage; FOG; Liquid HSOW	Septage and other non-FOG liquids: $0.056/gallon FOG: $0.42/gallon	TBD
Jeffersonville North Water Reclamation Facility	Yes	No	N/A	N/A	N/A
New Albany WWTP	Yes	No	N/A	N/A	N/A
Noblesville WWTP	Yes	No	N/A	N/A	N/A
Seymour WWTP	No	TBD	TBD	TBD	TBD
Shelbyville WWTP	No	TBD	TBD	TBD	TBD
Speedway WWTP	No	TBD	TBD	TBD	TBD
Terre Haute WWTP	Yes	Yes	Septage; FOG; Landfill Leachate; Out-of-State Industrial Wastewater	In County: $0.08/gallon; Out-of-County: $0.20/gallon	Not Provided
Vincennes WWTP	No	TBD	TBD	TBD	TBD
West Central Conservancy District	No	TBD	TBD	TBD	TBD
Merrell Brothers	No	Yes	FOG	FOG: $0.15/gallon	TBD

2.6.2. Compost Facilities

Eleven HSOW composting facilities were identified within a 75 aerial mile radius (Figure 9). Six entities responded to interviews. Key reported findings from representatives of the six interviewed composting facilities follows.

1. All facilities (6 of 6) compost residential produce and food scraps.
2. Only 1 facility accepts HSOW from a non-residential source – Indianapolis Fruit.
3. Most facilities (4 of 6) compost food waste with other feedstocks including yard waste, horse and turkey manure, and brown paper products.
4. None of the facilities depackage organic waste on their sites.
5. Most facilities (4 of 6) do not provide transportation services; HSOW is transported to the facility by residents.
6. The fee structure varies based on facility, but is based on a time-based payment (e.g., $XX/month) vs. a weight or volume based structure (e.g., $XX/ton)

Notably, EarthKeepers, a long-time residential organics food collection facility in Monroe County, was contacted and was not interested in an interview due to concerns of liability and competition with their existing organics recycling program.
Overall, due to the limited amount of commercially accepted HSOW, compost facilities do not appear to be a major competitor for non-residential HSOW in the region.
A summary table including distance, outlet, volume, types of waste accepted, and pricing is detailed in Table 13.

Figure 9: Competitor Compost Facility Locations

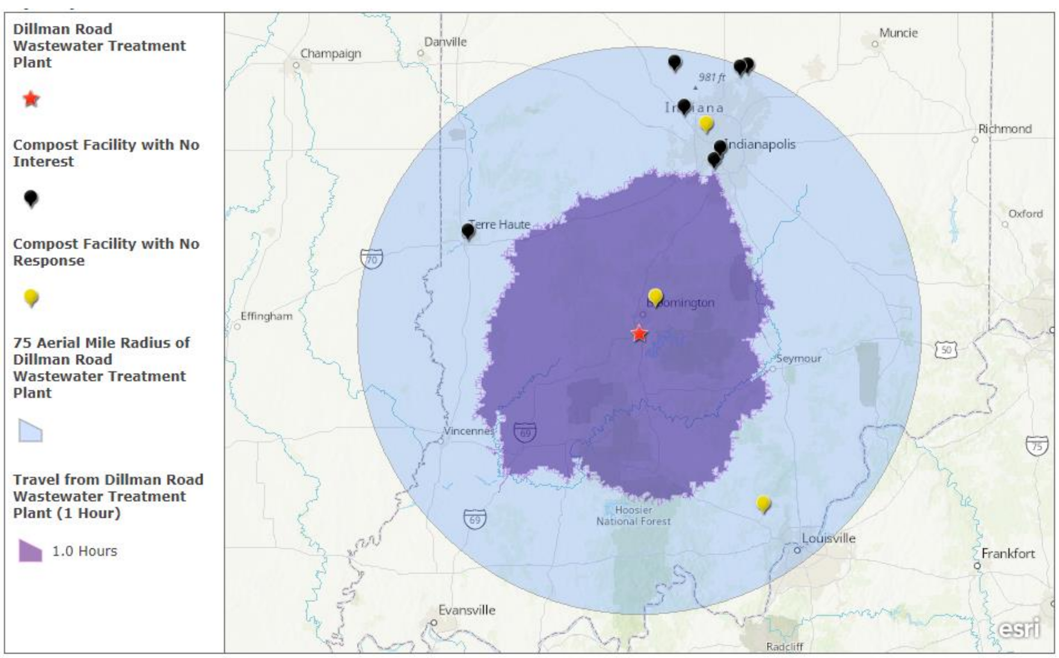


Table 13: Compost Facilities Overview

Facility Name	GreenCycle Indy North Compost	GreenCycle Indy Central Compost	AgRecycle	Earth Mama	Wabash ReThink	Indy Go Green
Type of Processing	Compost	Compost	Compost	Compost	Compost	Compost
Distance	92	52	85	66	60	57
Location	Noblesville, IN	Indianapolis, IN	Lebanon, IN	Indianapolis, IN	Terre Haute, IN	Indianapolis, IN
Outlet for Waste	GreenCycle Indy North	GreenCycle Indy Central	AgRecycle	GreenCycle Indy Northwest	Community gardens and compost bins	GreenCycle Indy Central
Volume	Not Provided	Not Provided	50 tons/week	3,846 lbs/week	Not Provided	50 lbs/week
Types of Waste Accepted	Fruits, vegetables	Fruits, vegetables	Produce, horse and turkey manure, yard waste	Community food waste, paper products	Community food waste	Community food waste, yard waste, brown paper products
Pricing	$15/truck, $35/single axle, $55/tri axle	Varies person to person	Not Provided	$5-$10/biweekly pick-up	$60/year	$25/month

2.6.3. Landfills

Twelve landfills located within 75 miles of the Dillman Road WWTP were identified and contacted. Five landfills were surveyed, and three reported capacity to accept non-liquid HSOW in the form of a dewatered cake (Figure 10).

Figure 10: Competitor Landfills by Capacity to Accept Liquid HSOW

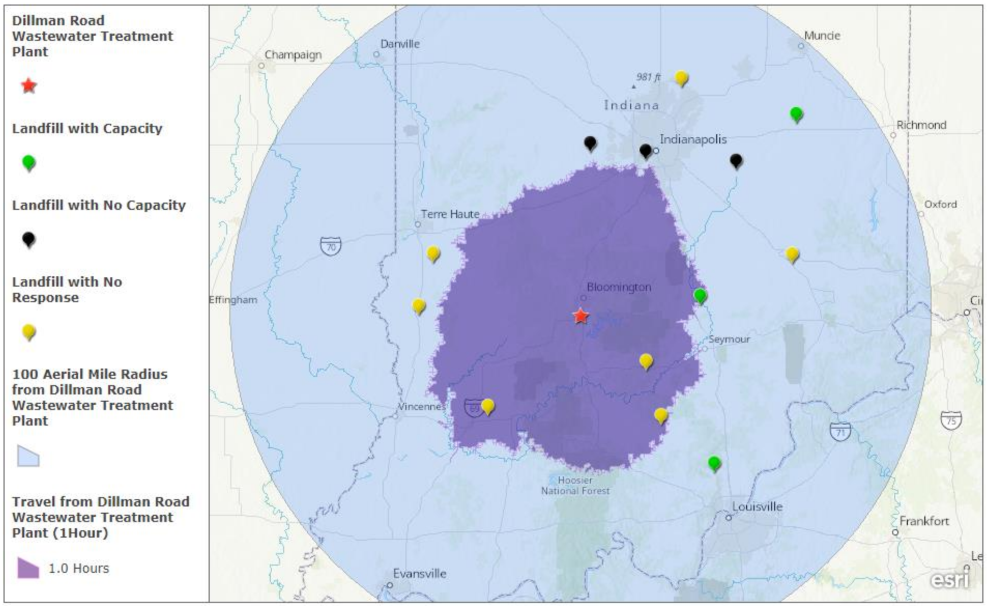


Table 14 summarizes the data collected during specific interviews with landfills. A summary of landfill findings.

1. Landfill tipping fees range from $24-$44 per wet ton for dewatered cake. One landfill, Clark-Floyd Landfill, has tipping fees based on the waste profile. The remaining surveyed landfills have a flat rate for their tipping fees.
2. Remaining lifespan of these landfills range from 23 years to 98 years.
3. Of the five surveyed landfills, out of county waste is accepted for at least three: Clark-Floyd Landfill, South Side Landfill, Inc., and Twin Bridges Recycling and Disposal Facility.
4. Bartholomew County Landfill must have only 10% of their total volume be wet waste. Taking this into consideration, the amount of HSOW accepted will vary daily depending on the wastes already accepted.
5. Clark-Floyd Landfill and Twin Bridges RDF have solidification services, and Hayes Landfill and Twin Bridges RDF have transportation services.

Being that two landfills provide solidification services, three landfills accept out-of-county waste and three reported capacity to accept dewatered HSOW, landfills appear to serve as a moderate competitor for dewatered HSOW in the region. The level of competition with respect to collection and processing of residential HSOW is not easily characterized or quantified.

Table 14: Competitor Landfill Summary

Landfill Name	Owner	Distance	Remaining Lifespan (Years)	Capacity for Non-Liquid/Dewatered HSOW	Tipping Fee
Bartholomew County Landfill II	Bartholomew County Solid Waste Management	42	83	Yes	$33
Clark-Floyd Landfill	Clark County, IN; Floyd County, IN	70	98	Yes	$42-$44
Decatur Hills Landfill	600 Land, Inc	78	38	TBD	$42
Hayes Landfill	Hayes Landfill, Inc	104	69	Yes	$34
Medora Landfill	Rumpke of Indiana, LLC	41	70	TBD	$24
South Side Landfill, Inc.	600 Land, Inc	59	68	No	TBD
Twin Bridges RDF	Waste Management, Inc.	58	66	No	$110-$125
Washington County Landfill	Washington County Commissioners	51	92	TBD	TBD
Noblesville Landfill Inc	Not Provided	88	TBD	TBD	TBD
Daviess County Landfill	Daviess County Commissioners	58	66	TBD	TBD
Sullivan County Landfill	Sullivan County Commissioners	56	23	TBD	TBD
Republic Services Sycamore Ridge Landfill	Republic Services, Inc.	66	79	TBD	TBD

2.7. Market Summary & Considerations

Market assessment findings conclude that over 173,750 gallons of liquid HSOW and 120 tons of solid HSOW are generated, processed, and hauled each week within a 75-aerial mile radius of the Dillman Road WWTP.

Interested generators and haulers were scored based on factors that make the waste streams most viable for acceptance at the Dillman Road WWTP, such as transportation distance, interest in hauling waste to the plant, treatability, nutrient level, production frequency, and average weekly volume. A summary of the highest scoring HSOW sources are found in Table 15.

Table 15 Most promising high strength organic waste identified in the market assessment

High Strength Organic Waste Category	Gallons per Week	Tons per Week	Score
Food Processing Residuals	58,000	111	Good
DAF Solids	28,000	10	Good
FOG going to Dillman Road	18,150	-	Good
Addition FOG interest	6,700	-	Good
Blood	2,300	-	Medium

While the identified materials show promise for acceptance at the Dillman Road WWTP, it is notable that surveyed businesses represent only 15% of the total number of potential HSOW generators identified in the region. Because of the limited responses to surveys, the exact quantity of HSOW generated in the region and overall willingness to diver to the Dillman Road WWTP is difficult to fully quantify.

With respect to competition, the market assessment identified a limited number of liquid hauled-in waste programs in the region, with pricing ranging from $0.056 (liquid, non-FOG) to $0.42/gallon (FOG), providing Bloomington with the opportunity for market penetration. While the number of local hauled-in waste programs are limited, land application programs and direct discharge to the collection system do appear to be notable competition for Bloomington, with approximately 50% of surveyed generators reporting cost-effective programs via the use of land application or direct discharge to the sewer.

2.7.1. Market Considerations

Findings from the Market Assessment indicate the following actions will provide the Dillman Road WWTP the best opportunity to access the liquid and dewatered cake HSOW that is currently managed in the region.

1. ***Connect directly with haulers.*** Engaging with haulers appears to be the most promising option to increase opportunities to expand Bloomington's hauled-in organic waste program. Haulers are often responsible for selecting the final disposition for a waste stream and both sources reported a high interest in an alternative outlet due to their limited options within the region.
2. ***Provide competitive tipping fees***. Viable tip fees in the market for hauled-in waste are $0.02 to $0.15/gallon for non-FOG HSOW, $0.08 - $0.42 per gallon for FOG, and $15 to $44/wt for non-liquid HSOW.
3. ***Expand hours of operation.*** Haulers noted limited hours as a challenge and expanded hours (i.e., 24 hours per day/7 days per week) a benefit. Operating the program with expanded hours will add to the convenience of haulers and encourage hauling to the Dillman Road WWTP. It should be noted that since these comments were made CBU has implemented its preferred pumper program providing expanded access to preferred haulers which has been well received and resulted in an increase in delivered FOG volumes.

4. ***Acceptance of Out-of-County Waste***: Market findings reveal the Dillman Road WWTP only accepts in-county waste. Understanding there is a limited number of local WWTPs accepting HSOW, allowing for acceptance of out-of-county waste is anticipated to increase access to the market, as is revealed by haulers reporting nearly 100% increase of FOG if out-of-county waste is accepted.

3. Residual Biosolids Beneficial Reuse Market Assessment

3.1. Beneficial Use Definitions

Key terms are used throughout the Biosolids Market Assessment technical memorandum to describe types of distribution pathways and associated product management expenses. Definitions specific to the Market Assessment are provided herein.

Self-Managed Program (SMP): Bloomington personnel or a hired consultant/marketing agent is responsible for the permitting, reporting, marketing, and/or management of biosolids disposition and beneficial use.

Third-Party Managed Program: Biosolids management services are selected or solicited through bids or requests for proposals and contracted to Full-Service Provider (FSP) or Third-Party Contractors (TPC).

Full-Service Providers (FSP): Third-party managed program that provides processing, operations and maintenance (O&M), permitting, marketing, transportation, and beneficial use/final disposition.

Third-Party Contractors (TPC): Third-party managed program that provides beneficial use and/or disposal only.

Outside-the-Gate Expenses (Revenues): Outside-the-gate expenses refer to those expenses incurred through transport and beneficial use/final disposition only, and do not include Bloomington's operations and maintenance (O&M) or capital costs for processing. Transportation services refer to loading, transporting, and offloading at beneficial use (or disposal) sites and are typically quoted as an average price per wet ton (wt) from wastewater treatment plant to end use site. Beneficial use services include program oversight, demonstration and marketing, and revenue from product sales.

3.2. Beneficial Use Executive Summary

This memorandum presents the findings of the preliminary Biosolids Market Assessment conducted on behalf of the City of Bloomington (Bloomington) for the solids produced at the Dillman Road and Blucher Poole Wastewater Treatment Plants (WWTPs).

Bloomington engaged the Energy Power Partners/Material Matters team to complete a preliminary Market Assessment to identify local markets and corresponding economics associated with managing various biosolids products under consideration.
The Assessment includes a review of state beneficial use regulatory considerations, as well as a review of selected biosolids management technologies and associated products, outlined below.

1. Class B digested cake
2. Class B or A/Exceptional Quality (EQ) alkaline stabilized cake
3. Class A/EQ compost
4. Class A/EQ dried granules
5. Class A liquid (produced by the Lystek thermo-chemical hydrolysis process)
6. Class A/EQ biosolids char

3.2.1. Market Assessment Findings

The high-level market assessment revealed the following conclusions.

1. State beneficial use regulations for the land application of biosolids does not incentivize treatment to Class A/EQ standards over treating to Class B. However, opportunities may present themselves with local composting partners or future improvements to the resource recovery facilities to produce a Class A/EQ product that has more widespread use applications.
2. State regulators encourage a hybrid permitting option for land application which combines the site-specific and non-site-specific land application permits, allowing for greater program flexibility.
3. The counties surrounding Bloomington offer more the 650,000 acres of crops best suited for land application of Class A/EQ and Class B biosolids. This is far in excess of the estimated acreage required for managing the residual material produced by the anaerobic digestion facilities.
4. Seasonal (Spring and Fall) land application of biosolids is common in Indiana, with 130 land application permits issued in the state.

To ensure the proposed technologies will lead to a successful biosolids management program for Bloomington, the following recommendations are offered.

1. ***Further Market Evaluation***: Upon adoption of a new processing technology, a more detailed market evaluation can provide additional details on pricing and outlet opportunities.
2. ***Hybrid Permitting Option:*** Pursuit of a hybrid permitting option for the land application of biosolids offers the most flexibility among other permitting options.

3. ***On-site biosolids storage:*** Lack of onsite (at the WWTP) storage limits program flexibility and decreases product value as market demand changes seasonally. Providing product storage year-round results in the ability to manage biosolids during seasons with low demand. It is recommended that Bloomington utilize its existing on-site storage capacity and consider expanding the facility as needed in the future.

3.3. Beneficial Use Introduction

This document presents the findings of the preliminary *Biosolids Market Assessment* (Market Assessment) conducted on behalf of the City of Bloomington (Bloomington) to evaluate the demand for biosolids products generated by selected technologies under consideration.

Two wastewater treatment plants (WWTPs), owned and operated by Bloomington, were included in the assessment: Dillman Road and Blucher Poole. The Dillman Road WWTP has a design flow of 15 million gallons per day (mgd), and the Blucher Poole WWTP has a design flow of 4.6 mgd. In total, approximately 11,550 wet tons (wt) of unstabilized solids are generated annually by the two WWTPs.

The current solids management method of landfill disposal is cost effective at $35/wt for transportation and disposal. However, questionable reliability, rising tipping fees across the country, and the desire to reduce the quantity of solids going to landfill has served as the impetus for Bloomington to pursue an evaluation of the regulatory considerations and potential outlets associated with biosolids management technologies and associated products, outline below.

1. Class B digested cake
2. Class B or A/Exceptional Quality (EQ) alkaline stabilized cake
3. Class A/EQ compost
4. Class A/EQ dried granules
5. Class A liquid (produced by the Lystek thermo-chemical hydrolysis process)
6. Class A/EQ biosolids char

3.3.1. Goals and Objectives

Bloomington engaged the Energy Power Partners/Material Matters team to complete a high-level Regulatory Review and preliminary Market Assessment. The preliminary *Market Assessment* seeks to achieve the following two objectives.

1. Conduct a high-level regulatory review to understand the permitting requirements associated with Class A/EQ and Class B beneficial use; and
2. Conduct a preliminary Market Assessment to opportunities for the beneficial use of biosolids products within the bulk agriculture market.

3.3.2. Approach

The *Market Assessment* was conducted in a systematic manner including four major tasks.

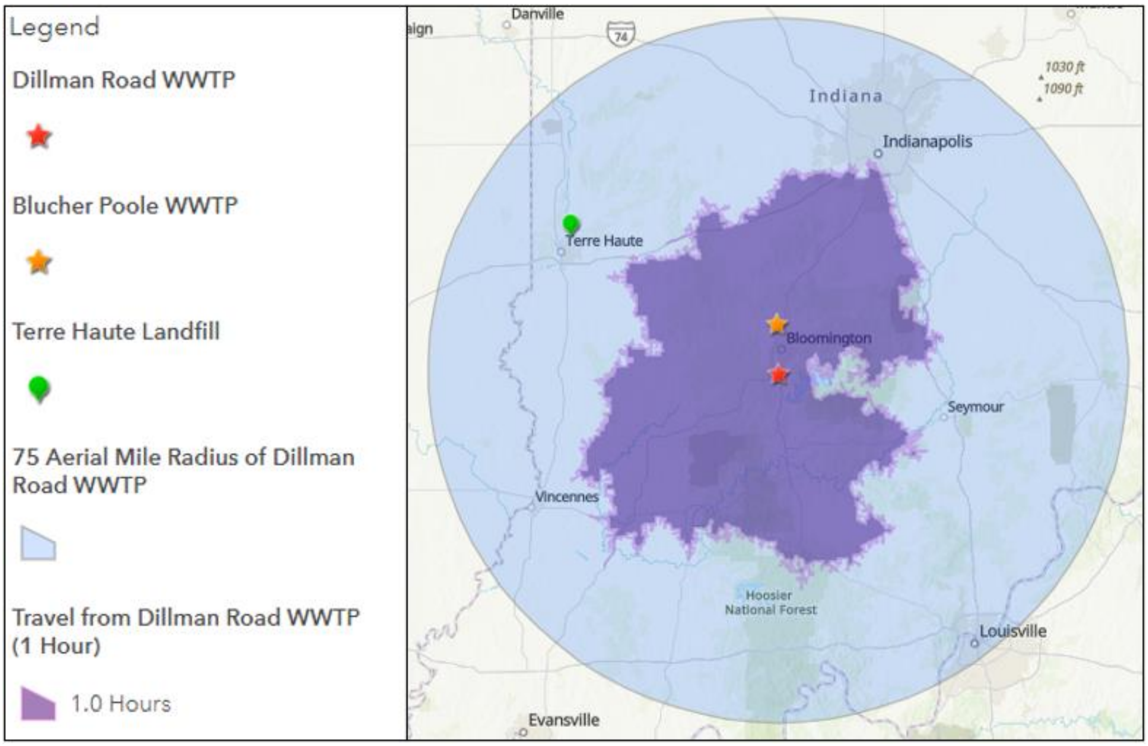
1. Summarize the baseline solids management program;
2. Review regulatory considerations and permitting requirements of each product;
3. Characterize products generated by each process; and
4. Summarize Indiana bulk agriculture beneficial use market.

Information gathered in each step was used to identify opportunities and challenges associated with selected products as it pertains specifically to Bloomington.

3.4. Baseline Solids Management Program

Combined, the two Bloomington-owned WWTPs produced ~11,550 wt of unstabilized solids in 2021, ranging between 15% to 17% total solids (TS). Currently, the Bloomington's solids are managed via landfill disposal. The estimated combined tipping and transportation fee for landfill disposal at the Terre Haute landfill is ~$35/wt. The landfill, located in Terre Haute, IN, is between 50 and 60 miles from either WWTP, shown in Figure 11.

Figure 11 Location of the current landfill disposal site in relation to Bloomington WWTPs.



3.5. Regulatory Considerations

To be considered suitable for beneficial use, biosolids must meet both federal and state technical standards. While federal regulations provide the base standards for biosolids beneficial use, each state has developed unique requirements associated with product management. Both federal and state regulations will apply.

At the state level, beneficial use of biosolids is regulated by the Indiana Department of Environmental Management (IDEM) Office of Land Quality (OLQ). Indiana State regulations for pollutants, pathogen reduction, and vector attraction reduction all refer back to the United States Environmental Protection Agency (USAEPA) CFR Chapter 40, Part 503 technical standards for product quality and management practices. A detailed summary of federal regulations and standards can be found in Appendix B.

3.5.1. Federal Beneficial Use Regulations

Biosolids are regulated at the federal level by the USEPA and are found in Chapter 40 of the Code of Federal Regulations (CFR), Part 503 (Part 503). The federal biosolids program outlines the technical standards for quality and management practices and sets a foundation for state regulations. Product quality is measured by three parameters.

1. Pollutants (regulated metals),
2. Pathogen reduction (PR), and

3.5.2. Vector attraction reduction (VAR).

Biosolids management options are dictated by meeting established technical standards for each parameter. A brief overview of requirements for meeting the federal pollutant, PR, and VAR regulatory beneficial use standards is included in Sections 3.2 through 3.4. For additional information related to federal technical standards, see Appendix B.

3.5.3. Regulated Pollutants

Nine metals are regulated as pollutants by Part 503 with two sets of defined limits, Ceiling Concentration limits (Table 1 of Part 503) and more stringent Monthly Average Pollutant Concentration limits (Table 3 of Part 503). The USEPA Ceiling and Monthly Average Concentration limits are shown in Table 16**.** The pollutant concentration in biosolids products will dictate the market options available for biosolids use; exceeding regulated pollutant concentrations can jeopardize an otherwise successful beneficial use program. Furthermore, specific regulated pollutants, such as copper and zinc are micronutrients that are valued by agricultural markets. As shown in Table 16, the baseline unstabilized solids produced by Bloomington, meet federal and state regulations for pollutant concentration limits.

Table 16: CBU biosolids pollutant concentrations vs. USEPA and IDEM pollutant limits

Pollutants	USEPA Table 1 Avg Monthly Conc.	USEPA Table 3 Avg Monthly Conc.	Indiana Avg Monthly Conc.	Bloomington Baseline Unstabilized Solids [a]
	mg/kg dry weight basis			
Arsenic	75	41	41	4.91
Cadmium	85	39	39	0.89
Copper	4,300	1,500	1,500	207
Lead	840	300	300	38.6
Mercury	57	17	17	0.21
Molybdenum	75	N/A	N/A	10.6
Nickel	420	420	420	53.9
Selenium	100	100	100	3.37
Zinc	7,500	2,800	2,800	497

[a] Based-on Belt Filter Press Solids sample from 08/23/2022.

3.5.4. Pathogen Reduction

The federal regulations categorize biosolids into two PR Classes, Class B or Class A, based on level of treatment. The Part 503 regulations provide technical standards for three Class B PR treatment Alternatives and six Class A PR treatment Alternatives. Additional information and the technical description of each PR Alternative is included in Appendix B.

Class B PR standards are limited by regulation to markets with low public access (generally agriculture and disturbed land reclamation) and are subject to additional setbacks and site restrictions.

To qualify for Class A with respect to PR, in addition to undergoing treatment via one of the Class A Alternatives, biosolids must either have a density of fecal coliform of less than 1,000 MPN per gram of total solids (TS) dry weight basis (dwb) or a density of Salmonella bacteria of less than 3 MPN per four grams of TS (dwb). Class A products achieve a higher level of PR treatment and are permitted for use under federal regulation in a variety of markets with both high public access (i.e., residential, municipal, and commercial uses) and low public access (i.e., agriculture, disturbed land reclamation).

3.5.5. Vector Attraction Reduction

Vector attraction represents the principal route to transport pathogens away from the application site where vectors (e.g., flies, birds) may have come in contact with and transmit pathogens. There are ten approved Options for reducing vector attraction, grouped into two types: process VAR (PVAR) and barrier methods. The PVAR treatment methods involve biosolids stabilization processes employed at the treatment plant. Barrier methods (incorporation or injection) create a physical barrier between the biosolids and potential vectors and are employed at the land application site. Additional information and the technical description of each VAR Option is included in Appendix B.

3.5.6. Exceptional Quality (EQ) Biosolids

Biosolids products that meet a Class A PR, PVAR, and do not exceed Table 16 Average Monthly pollutant limits are recognized as Exceptional Quality (EQ) biosolids. Federal regulations allow EQ biosolids to be used in a wide variety of applications without the need for site restrictions for use in areas with high public access.

3.5.7. Biosolids Permitting

State biosolids permitting options available in Indiana including beneficial use options, pathogen requirements, public notification requirements, site restrictions, and pollutant limits can be found in Table 17.

Table 17: Indiana biosolids permitting options

Permit Options	Beneficial Use Option	Pathogen Requirements	Public Notification Required	Site Restrictions [a]	Pollutant Limits
Marketing and Distribution Permit	Land application or specialty markets (landscaping, soil blending, etc.)	Class A	No	None	Monthly Average Concentration Limits
Land Application Permit (Site-Specific)	Limited to specific farmland sites listed on permit	Class A or Class B	Yes, to adjacent landowners	Standard setbacks (300' from residence, 200' from potable wells)	Ceiling Concentration Limits
Land Application Permit (County Specific)	Limited to farmland in specified counties	Class A or Class B	Yes, to counties	Standard plus increased setbacks (660' from residence)	Monthly Average Concentration Limits
Land Application Permit (Hybrid)	Limited to farmland in specified counties and some sites are pre-approved and listed in permit	Class A or Class B	Yes, to counties and adjacent landowners for specific sites	Standard plus increased setback (660' from residence)	Monthly Average Concentration Limits

[a] Refer to 327 IAC 6.1 – 4 through 6.

Notably, IDEM encourages a hybrid approach permitting option. The hybrid approach combines site-specific and non-site-specific permits which allows utilities significant flexibility for land application of biosolids regardless of classification. With the hybrid approach, increased setbacks would only be applicable for county-wide approvals, whereas per-identified sites would only be subject to the standard set of setbacks.
Summarized below are the regulatory findings for Class A/EQ and Class B biosolids beneficial use.

1. For land application of biosolids, there is no incentives to treat beyond Class B standards.
2. No fee associated with any IDEM Land Application permit.
3. If an application requires public notification, there is a public review process that includes a 30-day public comment period.
4. Permits are issued for 5-years, 10-year renewal periods.

3.6. Future Regulatory Considerations

In addition to existing federal, state, and local regulations, Bloomington must also be aware of emerging topics related to beneficial use of biosolids, particularly 'contaminants of emerging concern.

3.6.1. Contaminants of Emerging Concern

Contaminants of emerging concern (CEC) is an umbrella term used for various chemicals and compounds including nanoparticles, pharmaceuticals, personal care products (PCPs), estrogen-like compounds, flame retardants, detergents, and some industrial compounds (e.g., per- and polyfluoroalkyl substances (PFAS)). CECs are persistent in the environment and are found in low levels in surface water, groundwater, wastewater, and biosolids and there is concern that these compounds may have an impact on human health and aquatic life (EPA, 2021).

Due to the potential presence of CECs in biosolids, a biosolids risk assessment modeling tool is under development by the USEPA with a goal to assess 352 pollutants that may be present in biosolids.

The EPA modeling approach for biosolids risk chemical assessment includes:

1. a chemical prioritization method;
2. a Biosolids Screening Tool for deterministic, screening-level assessment; and
3. a probabilistic risk assessment framework for chemicals that fail at the screening level (USEPA, 2020).

The EPA prioritization method will be applied to all CEC measured in biosolids (USEPA, 2020).

3.6.2. Per- and Polyfluoroalkyl Substances (PFAS)

Per- and polyfluoroalkyl substances (PFAS) are a group of CECs selected for priority inclusion in the USEPA biosolids risk assessment due their persistence in the environment and increasing investigation by water and wastewater communities in recent years. There are over 4,000 PFAS compounds, with uses in the manufacturing of products such as non-cook cookware (Teflon®), carpet and textiles products (Scotchgard™) and Firefighting foam. While PFAS compounds are not used in the wastewater treatment process, they are transmitted into wastewater through residential and industrial use. Because PFAS compounds are not destroyed by conventional wastewater treatment processes, they are found in WWTP effluent and biosolids.

3.7. Product Characterization

A summary of initial selected products and corresponding processing technologies are summarized in Table 18 and discussed in detail in the following sections.

Table 18: Products under Consideration and Example Technologies

Product	Processing Technology
Class B digested cake	Mesophilic anaerobic digestion (MAD) or aerobic digestion
Class B or A/Exceptional Quality (EQ) alkaline stabilized cake	Alkaline stabilization
Class A/EQ compost	Composting
Class A/EQ dried granules	Thermal drying
Class A liquid	Thermo-Chemical Hydrolysis
Class A/EQ biosolids char	Pyrolysis or Gasification

Product characteristics are detailed in the following sections.

3.7.1. Class B Digested Cake

Class B digested cake is produced through mesophilic anaerobic digestion (MAD) or aerobic digestion. In MAD, organic solids are broken down by microbes in an “oxygen poor” environment. Conversely, in aerobic digestion, organic solids are broken down by microbes in an aerobic or “oxygen-rich” environment. Digestion facilities with appropriate sizing and mixing will satisfy USEPA Part 503 regulations for Class B pathogen reduction (PR) and process vector attraction reduction (PVAR) requirements necessary for beneficial use.

In general, digested biosolids will have low to moderate nuisance odor potential. Digested biosolids meet the less restrictive Class B quality standards. As a result, they are limited to use in areas with low public access such as bulk agriculture.

While most digested biosolids are used in agriculture, they are an unbalanced fertilizer, in that applying biosolids at a “nitrogen” (N) rate to meet crop needs will provide 2 to 3 times the amount of phosphorus (P) required by the crop.

Digested biosolids have been successfully spread using a variety of traditional manure spreaders including both “side-slinger” variety (typical for spreading steer manure) and rear discharge paddle spreaders (typical for spreading poultry litter). An example of a Class B, anaerobically digested cake is seen in Figure 12.

Figure 12 Example of a Class B anaerobically digested product.

3.7.2. Class B or A/EQ Alkaline Stabilized Cake

Class B and Class A/EQ alkaline stabilized cake is produced by alkaline stabilization, a process achieved with addition of hydrated lime, quicklime, or lime containing kiln dust or fly ash, in sufficient quantities to raise the pH above 12 for two hours or more after contact, and 11.5 for 24 hours after contact. Complete mixing must be achieved to ensure the entire mass comes in contact with the lime to meet Class B PR and PVAR technical standards through pH and time requirements. Class A/EQ through alkaline addition can be achieved with multiple processes, typically the Bioset process, which adds sulfamic acid and increased temperature to achieve Class A through pasteurization. Alkaline addition increases total production (on both wet weight and dwb). Alkaline stabilization creates a tan cake product with friable to sticky texture, stackable to six feet, as seen in Figure 13. The product has a high pH (>12) and low nutrient value (<2% N on wet weight basis). Alkaline stabilized cake has low to moderate odor potential and is suitable for agriculture and disturbed land reclamation. Alkaline stabilized cake must be spread with a side-slinger type manure spreader, which is commonly used for spreading dairy or beef manure.

Figure 13 Example of alkaline stabilized cake.

3.7.3. Class A/EQ Compost (Composting

Class A/EQ compost is produced via composting, an aerobic process in which biosolids are blended with a high-carbon feedstock (woody material), which promotes aerobic decomposition and elevated temperatures necessary to meet Class A PR and PVAR. Composting adds woody waste, reduces the volatile solids content, and increases the %TS of the final biosolids product. Compost is a low nutrient product (<2% N) that is typically used for its organic matter content. If composted and cured effectively, the finished compost will have a rich, earthy (musty) odor that the public does not find offensive. Class A biosolids compost is a direct substitute for other compost products, allowing for beneficial use in a wide variety of markets including soil blending, turf production, and rate payers (homeowners). An example of Class A/EQ compost is shown in Figure 14.

Figure 14 Example of EQ compost.

3.7.4. Class A/EQ Dried Granules

Class A/EQ dried granules are produced through thermal drying, a process in which dewatered biosolids are fed into a dryer and subjected to temperatures greater than 200°F to evaporate water that cannot be mechanically removed with a conventional dewatering device. Biosolids dried to ≥90% TS will meet Class A processing requirements through PR Alternative 5 (PFRP, thermal drying), PVAR Option 8 (increase TS to ≥90%) and will significantly reduce production quantities. The exact physical characteristics and marketability of dried biosolids varies based on the feedstock and the dryer type.

1. Dried products with low bulk density, elevated levels of dust, nuisance odor potential, and/or low (size) uniformity, considered to be "granules," are limited to the bulk agriculture market or, in some cases, limited to landfill disposal only.

2. Dried products that more closely mirror conventional fertilizers (i.e., high bulk density, low dust content, and tight size uniformity), as spherical "prills," provide more flexibility for distribution into other markets such as soil blending, turf production, landscaping, and others.

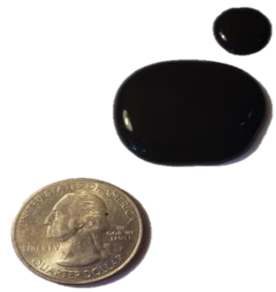
On an "as-is" basis, dried biosolids will have 2 to 4 times higher nutrient content than other biosolids products due to the reduced moisture content. Products from three of the most common dyer technologies can be seen in Figure 15.

Figure 15 Example of paddle dryer (left), belt dryer (middle), and drum dried (right) biosolids product. Paddle and belt dried products tend to be more irregular with lower bulk density relative to drum-dried products.

3.7.5. Class A Liquid

Class A liquid is produced by thermo-chemical hydrolysis (the Lystek process), which exposes dewatered biosolids to heat, alkalinity (elevation of pH to between 10 and 10.5), and high-speed sheering to create a high solid, flowable Class A product branded as LysteGro. LysteGro meets regulatory processing requirements for PR Alternative 1 (time and temperature) and meets "barrier" VAR requiring injection. The Lystek process will produce approximately the same quantities as lime stabilization*,* due to a combination of reduced lime usage and reduction in percent total solids. LysteGro is a high solid (~12 to 15% TS), black liquid, with the consistency of thick paint as seen in Figure 16. LysteGro has a similar nutrient content when compared with unstabilized cake. The Lystek products have a slightly elevated pH (9+) and has a moderate odor (especially after storage), which is mitigated through injection into the soil. Because the Lystek product *does not* employ PVAR, the product is limited to the bulk agriculture market.

Figure 16 Example of LysteGro Class A liquid product.



3.7.6. Class A/EQ Biosolids Char

Biosolids Char is a fine-grained, highly porous carbon rich material produced from a two-stage process: drying followed by a pressurized high temperature (400°-1650°F) oxygen-limited process (gasification) or oxygen-depleted treatment process (pyrolysis). Both gasification and pyrolysis meet Class A/EQ processing requirements and PVAR. Gasification and pyrolysis will achieve the greatest volume reduction relative to any technology (also comparable to sewage sludge incineration ash), where production is reduced due to significant reduction of volatile solids and moisture content. The pyrolysis process results in thermal decomposition and generates syngas, bio-oil, and a biosolids char product with 30-35% carbon content and ≥90% TS as seen in Figure 17. The gasification process converts volatile solids found in the dried biosolids into syngas; therefore, any non-volatile metal or nutrient will be concentrated in the biosolids char. Except for mercury, which has a low evaporation temperature (660°F), metal concentrations are anticipated to increase by one to two times in the char sample relative to the MAD cake (on a dry weight basis).

The final product will be a high solid (>99 %TS) product, that is granular or dusty, depending on the technology. Some technologies have implemented spraying systems at the discharge, which adds up to 20% moisture to reduce dust potential and improve handleability. Because biosolids char contains high %TS, the product should be stored under roof, and preferably in a storage tote bag.

Figure 17 Example of biosolids char.

3.8. Market Assessment

The preliminary Market Assessment looked at Indiana's most prominent market for the beneficial use of biosolids, bulk agriculture. The Market Assessment was completed by analyzing local agricultural practices, identifying local Third Party Contractors (TPCs), and conducting interviews to understand the corresponding economics associated with managing selected products.
The bulk agriculture market includes the production of feed crops (crops consumed by livestock), including corn, hay, small grains, and forage grasses. The bulk agriculture market is a low value, high volume market. A wide variety of products are used and accepted in the bulk agriculture market nationwide including Class B and Class A/EQ cake. Land applied biosolids replace and/or supplement conventional fertilizer and soil amendments to provide a recycled source of nutrients, and organic matter.

3.8.1. Local Agricultural Practices

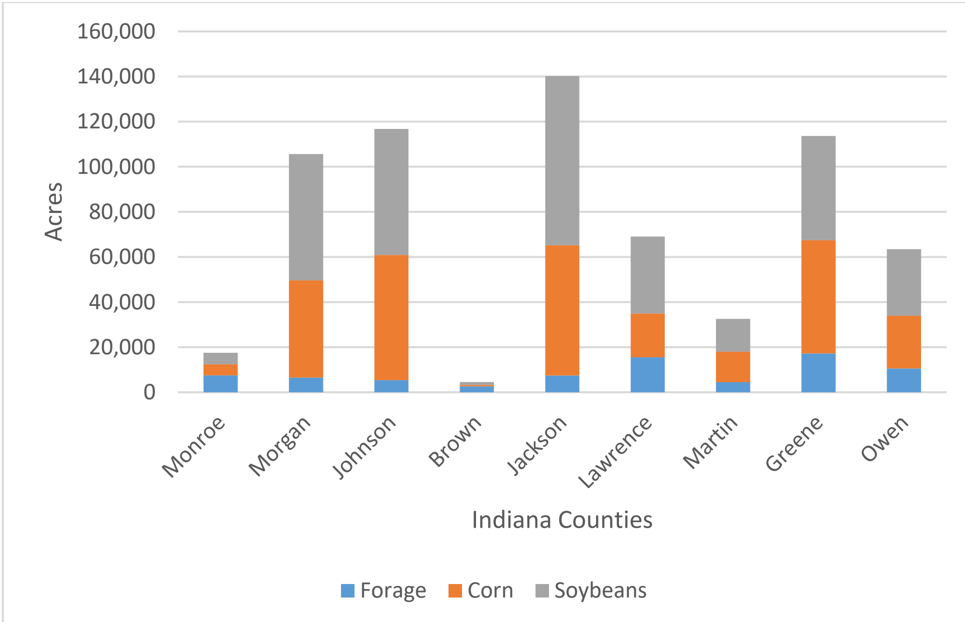
To assess the existing bulk agriculture market, agricultural data was gathered from the United States Department of Agriculture (USDA) Census to understand current cropping patterns and trends in the counties near Bloomington.
A review of local agricultural practices reveals counties immediately surrounding Monroe County (Morgan, Johnson, Brown, Jackson, Lawrence, Martin, Greene, and Owen) have more than 650,000 acres of land in corn, soybeans, and forages – the crops best suited for biosolids application, as shown in Figure 18.

An estimate of the acreage required for land application of the Bloomington's biosolids was calculated, based on application rates for a Class B aerobically digested cake product of ~13.33 wt/acre after accounting for seasonal land application limitations. Assuming sufficient storage is available to meet seasonal needs, Bloomington will require the following acreage to manage the volume of residual product in each scenario of the resource recovery program:

Table 19: Acreage Needed for Land Application

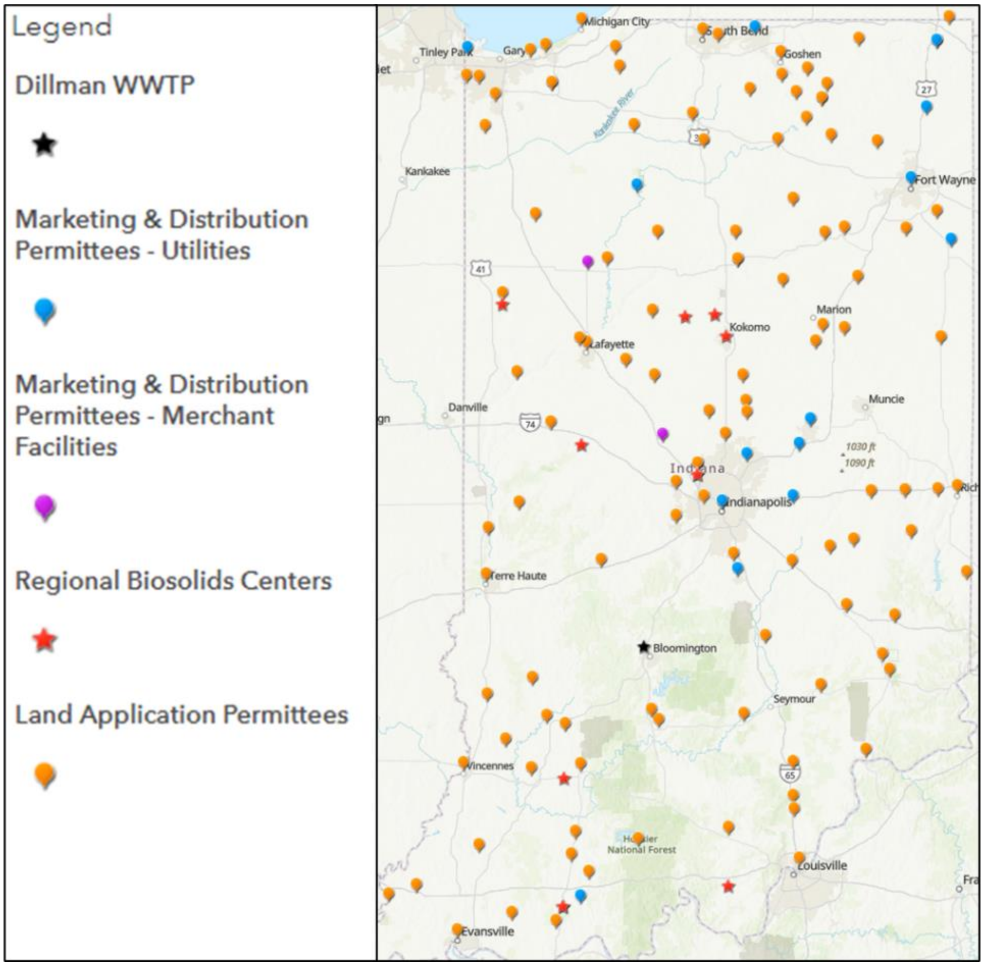
	No HSOW	Low HSOW	Medium HSOW	High HSOW
Acres	900	920	1,330	1,790

Figure 18 Acreage in feed crops commonly used for biosolids application in counties surrounding Bloomington.



Furthermore, the land application of biosolids, although seasonal (Fall and Spring), is very common throughout the state. As shown in Figure 19 over 130 biosolids land application permits are issues throughout the state of Indiana.

Figure 19 Location of Indiana beneficial use permittees.



3.8.2. Third Party Contractors

Merrell Brothers, who offers biosolids management services in Indiana, was contacted to assess opportunities and estimate expenses associated with various biosolids products. Information from the interview with Merrell Brothers is summarized below:

1. Representatives reported a strong interest in a Class B digested cake, noting high demand for digested cake in the local agriculture market.
2. Estimated tipping and transportation fees were reported to be between $35 and $40/wt for nearly all biosolids products, with representatives noting no reduction in tipping fees for a Class A/EQ product.
3. Six months of on-site storage is required unless Bloomington engages in a long-term (10+ year) contract.
4. Representatives expressed a low interest in a Class A/EQ compost, noting limited revenue opportunities within the agriculture market.

A summary of the estimated tipping and transportation fees for TPC management compared to the estimated capital and processing costs associated with each selected product can be seen in Table 20.

Table 20 Estimated tipping/transportation fees associated with TPC management compared to estimated capital and processing costs associated with selected products.

Management Type	Class B Cake	Class A/EQ Cake	Class A/EQ Compost	Class A Liquid	Class A/EQ Dried Granule	Class A/EQ Biochar
Combined Tipping and Transportation Fee	\$35-\$40/wt	\$35-\$40/wt	\$25-\$30/wt	\$0.05/gal	\$35-\$40/wt	N/A
Estimated Capital and Processing Costs (low, medium, high)	Low	Medium	Medium	Medium	High	N/A

3.8.3. Class A Potential Collaboration

While Class B is the recommended baseline beneficial use option, there may be potential to produce a Class A product which would expand the potential markets that the Class A product could be used in. Appendix B provides a summary of the Part 503 federal regulations governing classification of Class B and Class A biosolids products. One potential means to achieving Class A is via composting which potentially could be implemented in collaboration with Monroe County Solid Waste and its composting partners. Biosolids provide a high nitrogen complement to yard and green waste composting. By producing a Class A product not only are there less regulatory restrictions for land application but the product could also be used for City and County landscaping projects or for public use.

3.9. Summary and Recommendations

The following conclusions were made based on the Market Assessment findings.

1. State beneficial use regulations for the land application of biosolids does not incentivize treatment to Class A/EQ standards over treating to Class B.
2. The counties surrounding Bloomington offer more the 650,000 acres of crops best suited for land application of biosolids.
3. Land application of biosolids is common in Indiana, with over 130 land application permits in the state.

Based on the Market Assessment findings, it is recommended that Bloomington move forward with a more detailed market evaluation to provide additional detail on pricing and outlet opportunities upon selecting a new processing technology. To ensure the proposed technologies will lead to a successful biosolids management program for Bloomington, the following recommendations are offered.

1. ***Further Market Evaluation***: Upon adoption of a new processing technology, a more detailed market evaluation can provide additional details on pricing and outlet opportunities.
2. ***Hybrid Permitting Option:*** Pursuit of a hybrid permitting option for the land application of biosolids offers the most flexibility among other permitting options.

3. ***On-site biosolids storage:*** Lack of onsite storage limits program flexibility and decreases product value as market demand changes seasonally. Providing product storage year-round results in the ability to manage biosolids during seasons with low demand. It is recommended that Bloomington ensure its existing on-site storage will provide a minimum of 60-90 days storage.

4. Biogas Utilization Alternatives

4.1. Overview of Biogas Alternatives

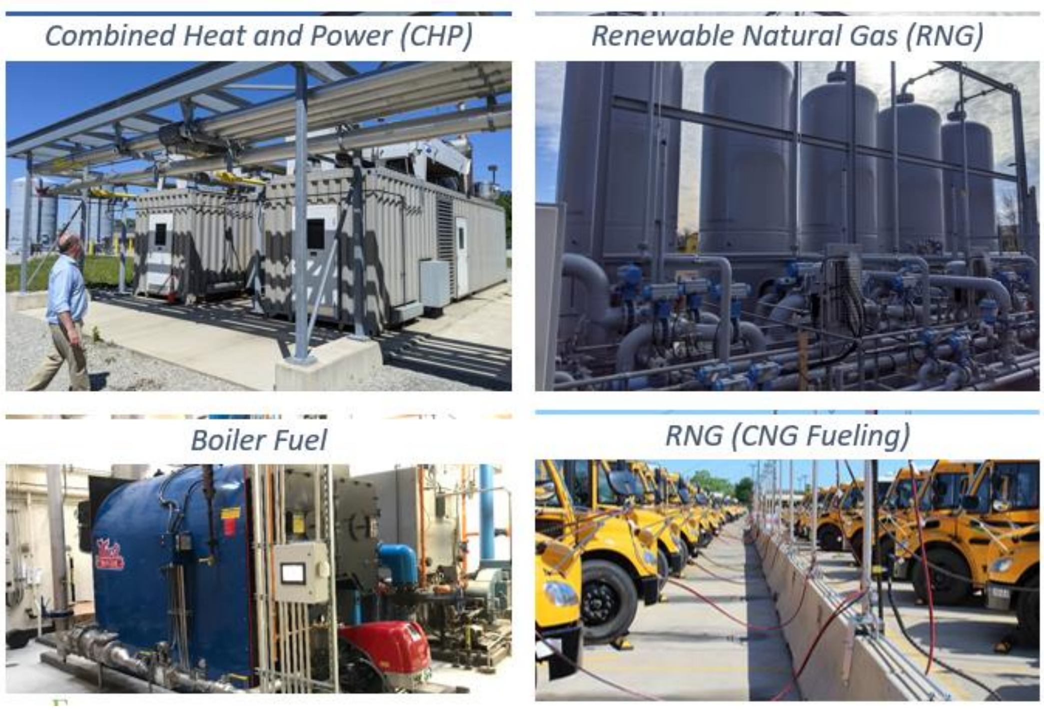
One of the primary benefits of implementing anaerobic digestion is the production of biogas, a flexible fuel that can be used in a variety of renewable energy applications. Biogas derived from anerobic digestion of wastewater and food waste is approximately a mixture of approximately ~60% methane, ~40% carbon dioxide and trace amounts of oxygen, nitrogen, hydrogen sulfide, siloxanes and volatile organic compounds (VOCs). At the outset of this study the Project Team and CBU analyzed the following four biogas utilization alternatives:

- Boiler Fuel: combustion of biogas in a boiler to provide process and building heat for the Dillman Road WWTP

- Combined Heat and Power (CHP): combustion of biogas in a reciprocating engine or other prime mover to produce electricity through a generator and capture waste heat for use in anaerobic digestion heating at the Dillman Road WWTP

- Renewable Natural Gas (RNG): clean up of the biogas to remove carbon dioxide, hydrogen sulfide, siloxanes and VOCs to reach pipeline quality natural gas and injection into a nearby pipeline for transport and sale to off-site customers

- Renewable Natural Gas (RNG) for Compressed Natural Gas (CNG) Fueling: production of RNG and on-site compression for use as on-site or nearby transport to a fleet for CNG fueling



Each of the alternatives has distinct requirements for processing equipment, operations and maintenance and interconnecting infrastructure with local utilities. A summary of these requirements is shown below:

Table 21: Biogas Utilization Options Comparison

	Processing Equipment	O&M Requirements	Utility Infrastructure
Boiler Fuel	Limited – dual fuel boiler necessary with little to no biogas treatment	Limited – minimal maintenance requirements	None
Combined Heat and Power (CHP)	Moderate – limited biogas treatment, engine, generator, heat recovery equipment	Moderate – High; monthly planned maintenance, unplanned maintenance as well	Interconnection with electrical utility for net metering if viable
Renewable Natural Gas (RNG)	Moderate – compression, CO2 removal, H2S removal	Moderate; annual planned maintenance, unplanned maintenance as well	Interconnecting pipeline and metering & receipt station
Renewable Natural Gas (RNG) for CNG Fueling	High – RNG equipment, compression and fueling equipment needed	Moderate; annual planned maintenance, unplanned maintenance as well	None

Each of the biogas alternatives also carries different value for the product produced. Typically, the underlying commodity, whether it be natural gas or electricity has value, and then there is additional value created through environmental attributes (credits) associated with the renewable fuel. The markets in which each biogas alternative will derive its value is summarized below:

Table 22: Biogas Product Value

	Physical Commodity Value	Environmental Attribute Value
Boiler Fuel	Natural gas utility cost savings	Limited – some potential value voluntary attribute value
Combined Heat and Power (CHP)	Natural gas utility cost savings Electric utility cost savings	Renewable Energy Credits (RECs)- no market in Indiana Renewable Identification Numbers (RINs) – pending pathway for grid connected biogas to electric projects
Renewable Natural Gas (RNG)	Commodity natural gas sales	Renewable Identification Numbers (RINs) Voluntary Renewable Attributes
Renewable Natural Gas (RNG) for CNG Fueling	CNG (GGE) sales	Renewable Identification Numbers (RINs)

After discussion with CBU staff during a scoping workshop as part of this study, the CHP and RNG alternatives were selected, and the following alternatives were eliminated for consideration:

Boiler Fuel: While likely the most straightforward alternative to implement, using the biogas as boiler fuel would not be the highest and best use of the biogas from a value standpoint. Furthermore, apart from the new anaerobic digestion there is not a major need for heat at the Dillman Road WWTP and it is likely that some of the biogas would not be utilized.

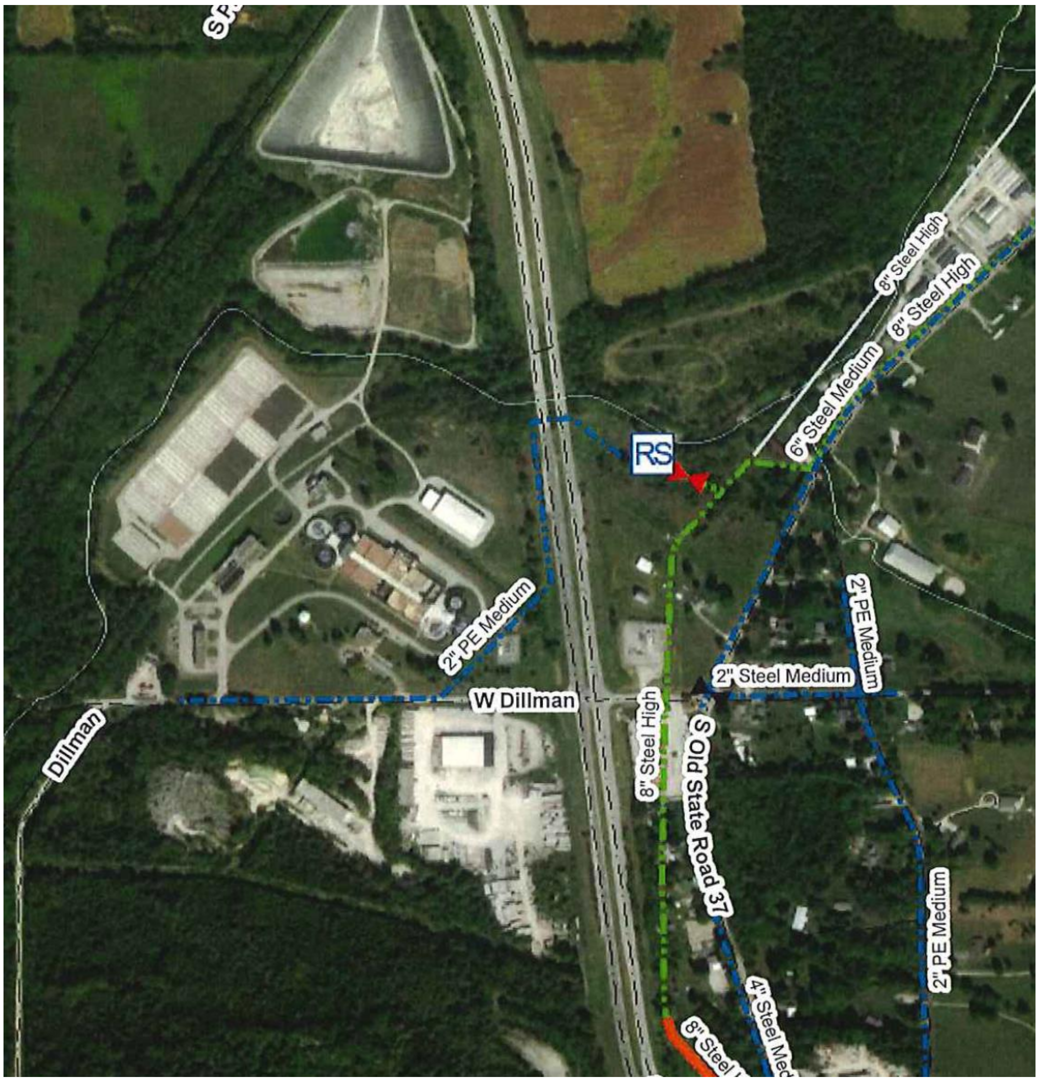
RNG CNG Fueling: Integral to pursuing this alternative would be finding a large enough CNG fueled fleet consume the CNG fuel produced from the anaerobic digestion complex. Given that the City of Bloomington does not have any CNG vehicles and is transitioning to an electric bus fleet this is not an attractive alternative. Even if a private fleet were to be found, there is limited space available at Dillman Road WWTP for fueling the fleet and transporting the CNG elsewhere would be logistically challenging.

4.2. RNG Alternative

4.2.1. Interconnection Process

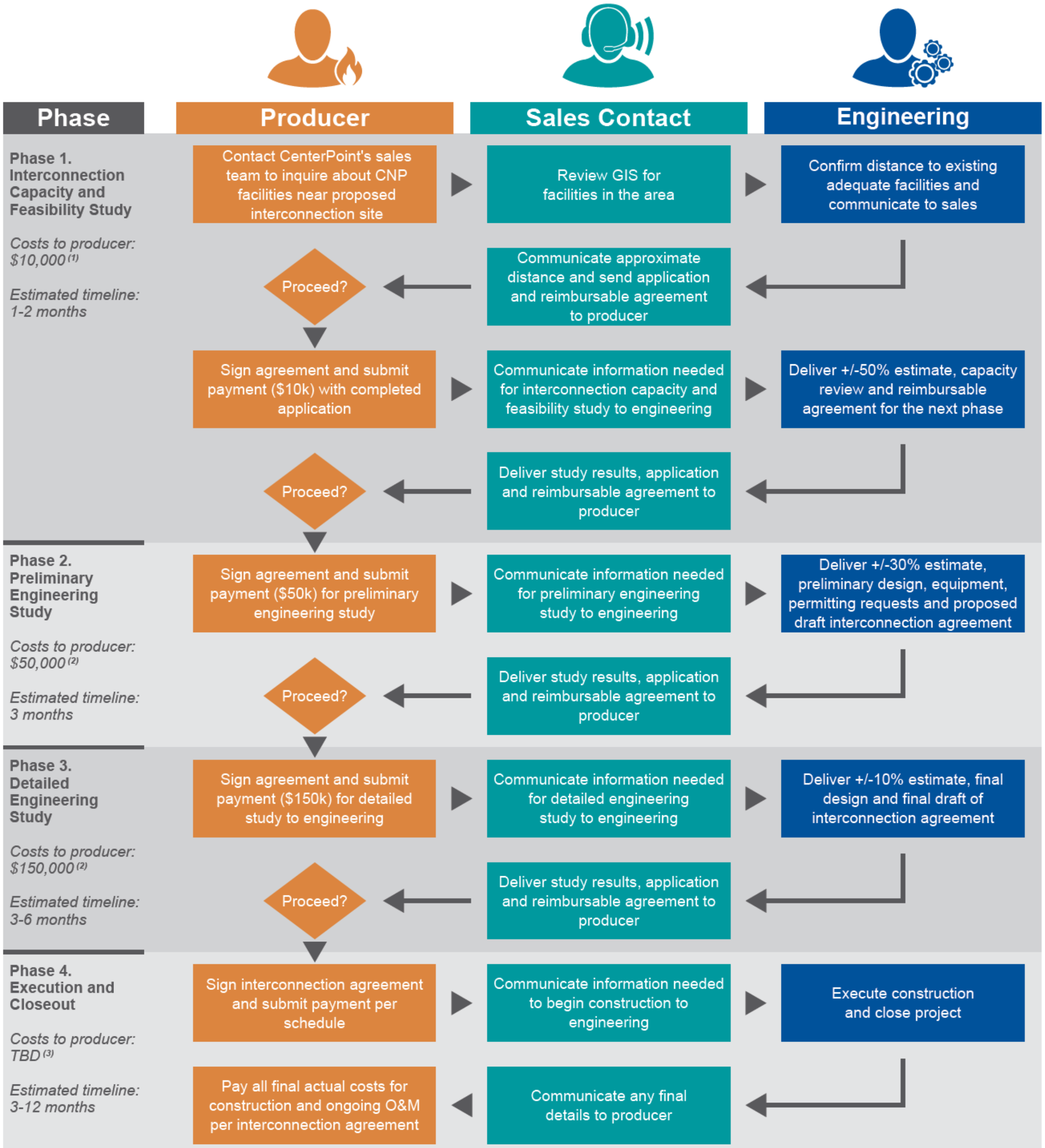
In order to monetize the RNG produced from the facility, the project will need to interconnect to a local CenterPoint Energy pipeline. The nearest infrastructure is an 8" steel line less than a half mile away from the Dillman Road WWTP, shown in the image below in green. The operating pressure of the pipeline is 300-500psi.

Figure 20: RNG Interconnection Location



There is a rather extensive process for interconnection which is estimated to cost approximately $210,000 in engineering costs and 7-10 months. CenterPoint has estimated that the metering and receipt station will cost $1.7M, and additional funds will be needed for the extension of the pipeline. The steps in the process are shown in the flow chart below.

Figure 21: CenterPoint Energy Interconnection Process



The gas quality standards for CenterPoint Energy are reasonable when compared against other pipeline specifications for RNG across the country. Expected ranges for anaerobic digestion biogas and the outlet requirements from the RNG plant are shown below.

Table 23: Biogas Quality vs. CenterPoint Energy RNG Standards

	Typical AD Biogas	CenterPoint Energy Requirements
BTU	555-660	> 975
CH4%	55-65%	N/A
CO2%	35-45%	< 3%
O2%	0-1%	< 0.4%
N2%	0-2%	N/A
Total Inerts	35-45%	< 4%
H2S (ppm)	<200	<4ppm

4.2.2. Markets for RNG

Renewable Fuel Standard (RFS) and Renewable Identification Numbers (RIN)

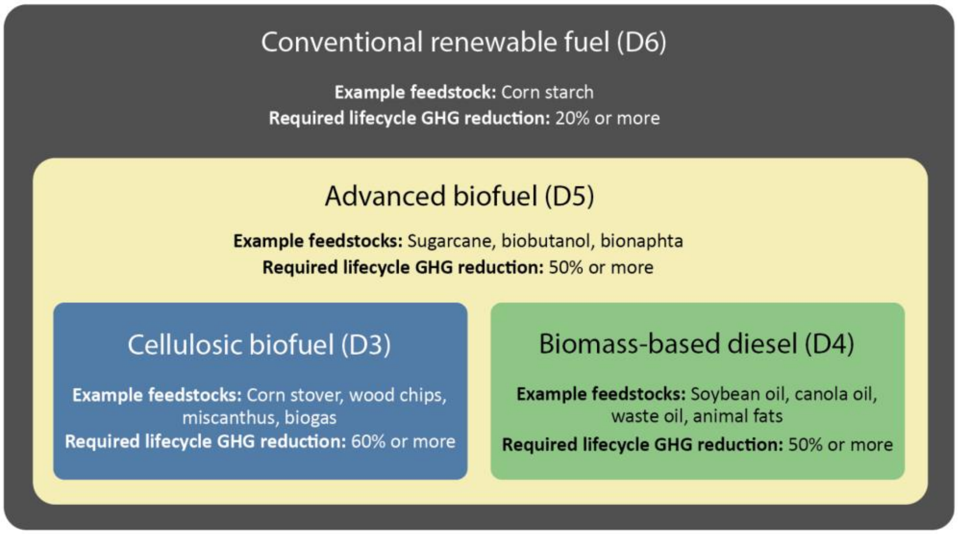
Historically the strongest market for RNG has been in selling RNG as transportation fuel for use in CNG and liquified natural gas (LNG) vehicles and generating valuable RINs under the federal Renewable Fuel Standard. The RFS is a US national policy that dates back to 2005 which encourages domestic production of biofuels to both strength domestic supply of fuel and reduce greenhouse gas emissions emission in the transportation sector. Renewable fuel producers generate RINs when eligible biofuels and produced and used for transportation.

The RFS was established by an act of Congress and the Environmental Protection Agency (EPA) administers the program. Each year there are different volume requirements set by the EPA for the volumes of biofuel to be produced. Oil refiners, known as obligated parties, must purchase RINs to comply with the volumes set under the program. Under the RFS there are different classifications of biofuels, with each generation a specific type of RIN. These categories are:

D6 – Conventional Biofuels (Ethanol)
D5 – Other Advanced Biofuels
D4 – Biomass Based Diesel
D3 – Cellulosic Biofuels

The RFS program's four renewable fuel standards are nested within each other. This means that a fuel with a higher GHG reduction threshold can be used to meet the standards for a lower GHG reduction threshold. For example, fuels or RINs for advanced biofuel (e.g., cellulosic, biodiesel, or sugarcane ethanol) can be used to meet the total renewable fuel standard (e.g., corn ethanol).

Figure 22: RFS Nested RIN Structure



Biogas derived RNG from this project falls under two approved pathways from the EPA. The first is that biogas produced from municipal wastewater treatment sludge generates a D3 RIN, and biogas produced from “waste digesters” which includes food waste generates a D5 RIN. The applicable pathways are shown from Table 1 to § 80.1426 below.

Table 24: RFS Biogas Pathways

Q	Renewable Compressed Natural Gas, Renewable Liquefied Natural Gas, Renewable Electricity.	Biogas from landfills, municipal wastewater treatment facility digesters, agricultural digesters, and separated MSW digesters; and biogas from the cellulosic components of biomass processed in other waste digesters.	Any	3 (cellulosic biofuel)

T	Renewable Compressed Natural Gas, Renewable Liquefied Natural Gas, and Renewable Electricity.	Biogas from waste digesters	Any	5 (advanced)

RINs are sold to obligated parties on the open market and the price fluctuates as the supply of biofuels and annual requirements (demand) varies over time. D3 RINs are more valuable, because as detailed above they can be used to meet both the D5 and D6 volume requirements. Historical RIN pricing is shown in the chart below. The large dip in prices in 2019 was due to the EPA granting under the Trump administration an unprecedented amount of small refinery exemptions (SREs) which led to a decrease in the obligatory targets and an oversupplied market. EPA has since stated that they do not intend to issue SREs again in the future, however the risk of oversupply is still present given that EPA sets the demand. Since the EPA's last update of this chart RIN prices have fallen to around ~$2.00 an MMBTU given the initial low proposed volumes for 2023.

Every MMBTU of RNG produced produces 11.727 RINs. RNG is injected into the pipeline and can be purchased and used for transportation on a book and claim basis for any CNG/LNG fueling application that is connected to a common carrier pipeline in the contiguous US. Historically, because there has been less RNG supply than demand for CNG/LNG production, the biogas producer has retained the majority of the RIN value. Other parties in the value chain, including a marketer/broker, the CNG/LNG dispenser, and the CNG/LNG fleet owner typically will require a share of the RINs in the RNG purchase agreements. For this study it was assumed that the RIN share that the project will retain is 80%, declining over time to 60% as supply and demand becomes more balanced.

Voluntary Fixed Price Contracts

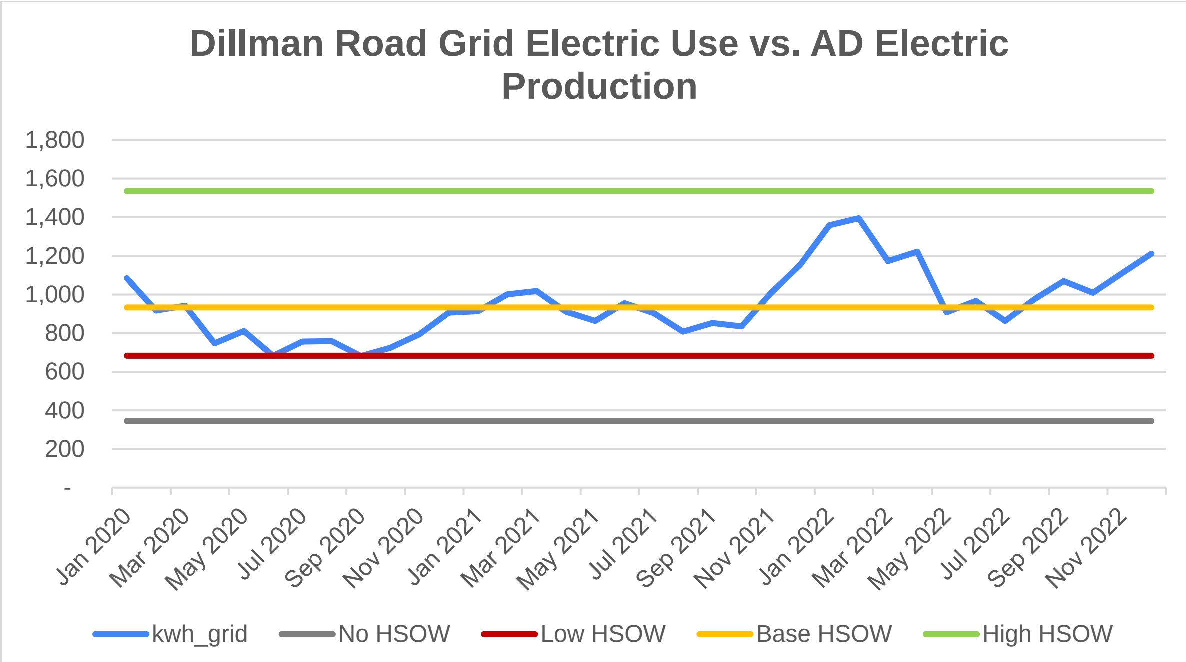
An alternative market that has been growing rapidly in recent years is the voluntary market for RNG. These RNG buyers are not obligated to purchase RNG for any regulatory program but nonetheless have demand for the sustainable fuel, typically to decrease their carbon footprint and better position themselves for environmentally conscious customers. Common voluntary buyers include natural gas utilities, large Fortune 500 companies and universities. These contracts are typically fixed price in nature, at times with an annual escalator, and are not based on any environmental commodity market. Contracts can range in length from 10 years to 25 years and provide a stable and predictable revenue source.

Some buyers value the carbon intensity of the RNG, with livestock based RNG valued the highest due to its carbon negative nature and landfill gas generally being the highest carbon intensity and lowest value. Wastewater derived RNG is in the middle, with one of the benefits being that co-digestion projects can benefit from negative carbon intensities as the food waste that is diverted from the landfill gets credit for avoided methane emissions associated with landfill operations. For this study it was assumed that the project could secure a fixed price off-take of $30.00 per MMBTU, inclusive of both the natural gas commodity and the rights to all associated environmental attributes.

4.3. CHP Alternative

Production Potential vs. Plant Load

The CHP alternative has the potential to rapidly advance CBU's steps towards becoming an energy neutral facility by producing a significant amount of on-site renewable electricity to complement the existing solar array. Below the potential electric production of the various scenarios for the project is overlayed with the past three years of historical grid consumption at Dillman Road. While the overall load will increase slightly due to the additional parasitic load of the improvements, the Base HSOW case is well sized to nearly meet all of Dillman Road's electrical needs. The High HSOW case is significantly above the plant's current load and would necessitate filing for interconnection as a qualifying facility at a lower overall power rate, as discussed in the interconnection section below.



Interconnection Process

While the CHP alternative provides the option to connect directly to the Dillman Road plant load, establishing a small microgrid and not interconnect with the grid, as detailed below the project will not be able to participate in the eRIN market under the RFS and therefore it is more advantageous to pursue interconnection with the local utility Duke Energy.

Unfortunately, in Indiana Senate Enrolled Act No. 309 allowed utilities to phase out net metering when net metering hit 1.5% of their summer peak loads, or July 1, 2022, whichever came sooner. Duke Energy acted on this and ended their customers' access to net metering on July 1st, 2022. In place of net-metering they are directing customers to Rider No. 54 - Excess Distributed Generation. To participate in this rider, the following requirements must be met for the distributed generation resource:

(1) It must have a rated nameplate capacity of not greater than one (1) megawatt AC; It must be sized not to exceed the customers' annual average energy consumption absent the generating resource.
(2) It must be located on the customer's premise and owned by the customer; and
(3) Is connected in parallel with the Company's electric distribution or transmission system; subject to an executed Duke Energy Indiana Interconnection Agreement.

Under this tariff, the metering equipment instantaneously (30-minute increments) measures the power imported and power exported. Power imported is billed at normal billing rates and power exported is assigned a credit equal to 1.25 times the marginal price of energy paid by Duke Energy in the most recent calendar year, which is currently equal to $0.052160 per kWh.

In conversations with Duke Energy, Duke had advised that CBU's existing 776kW solar array at Dillman Road would impact the first requirement listed above for the distributed generation resource being <1 MW. Duke suggested that the 1 MW capacity applies to the aggregate capacity of all distributed generation resources on-site. Under this scenario the project would then deliver energy under Rider No. 50 – Parallel Operation for Qualifying Facility which would result in a lower value for energy produced, equal to the marginal price of energy paid by Duke energy in the most recent calendar year. For this study it was assumed that only 5% of the time would the CHP production exceed the Dillman Road WWTP plant load and thus be exporting power. In those circumstances the project would qualify at a minimum for Rider No. 50 'Parallel Operation for Qualifying Facility'. The remaining 95% of production behind the meter would receive full retail credit due to not pushing any electricity out onto the grid.

The interconnection application process involves completion of first a System Impact Study which is expected to be $5,000 or less, and then followed by a more detailed Facility Study. The Study's determine if there are any improvements needed on the local grid to accommodate the interconnecting facility. The process for arriving at an interconnection agreement typically takes six months or less.

<u>Markets for Biogas Based Renewable Electricity</u>

Renewable Fuel Standard (RFS) and Renewable Identification Numbers (RIN)

Historically, despite biogas based renewable electricity being a valid pathway under Pathway Q and T as shown in the table above, these facilities have not been able to generate RINs as EPA has yet to approve an application for facility registration. Complexities in how to properly administer the program and differing objectives from various administrations have prevented the EPA from taking action in the past. However, under the Biden administration and its push for greater electrification of the US transportation fleet the EPA is poised to finally enact the eligible pathways and approve biogas based electric projects beginning on January 1st, 2024. This program is commonly referred to as the eRIN program.

The EPA issued the proposed rules for the program in late 2022 and is expected to finalize the rule by June 2023. The program is very similar to all of the tenants explained above for the RNG scenario:

- D3 and D5 RINs can be generated from anaerobic digestion projects
- The book and claim rules still apply with biogas based electricity being able to be used anywhere in the contiguous US, so long as the project is interconnected with the local electric grid
- RINs are sold to obligated parties and RIN value is split amongst different entities in the value chain

A few unique points of the eRIN rule:

- To generate eRINs biogas based electricity providers must contract with automobile manufacturers and enter into "RIN generation agreements" whereby the renewable electricity is matched to an equal quantity of electricity used for vehicle charging
- Only light duty vehicles currently qualify as eligible vehicle charging
- The equivalency value is 6.5kWh = 1 RIN

At an assumption of $2.00 per D3 RIN and $1.75 per D5 RIN the total value of the eRIN is $0.31/kWh for D3 eligible electricity and $0.27/kWh for D5 eligible electricity. Unlike the CNG/LNG market currently today the amount of biogas production is greater than the demand for electric vehicle charging. Therefore, the share of RIN value that remains with the biogas based electricity producer is lower. However, as electric vehicle adoption grows significantly faster than biogas based electricity production, those dynamics will soon change, likely in advance of the plant achieving commercial operations. Therefore, the model estimates that the project will retain 60% of the RIN share to begin and grow to 80% of the RIN share over time.

5. Preliminary Design Basis & Scope

5.1. – Introduction

5.1.1. Purpose

This Design Basis Report for Energy Power Management describes proposed improvements to the Dillman Road Wastewater Treatment Plant (WWTP). Chapters 2 through 7 of the report detail the basis of design for materials and equipment by discipline.

5.1.2. Overview

The City of Bloomington, IN Utilities (CBU) owns and operates the Dillman Road and Blucher Poole WWTPs. The proposed Dillman Road WWTP improvements generally include:

- New grit handling facilities
- Providing primary treatment
- Repurposing existing aerobic digester tankage and equipment into gravity thickeners, blend tanks and sludge storage
- Constructing new anaerobic digesters
- Providing high strength organic waste (HSOW) receiving and processing through anaerobic digestion
- Constructing a solids receiving station for hauled Blucher Poole dewatered solids and solid HSOW
- Utilizing digester gas via either combined heat and power (CHP) or renewable natural gas (RNG)
- Providing ancillary systems to support the improvements.

The proposed scope would vary for each of the following scenarios which vary in the amount of High Strength Organic Waste (HSOW) volume, or mass of volatile solids, processed: No HSOW, Low HSOW, Medium (Base Case) HSOW, and High HSOW. This design basis report mainly addresses the base case (medium HSOW) scenario and makes reference to additional infrastructure proposed for full build-out for the high HSOW scenario. Table 25 generally compares scope for the four scenarios.

Table 25: Comparison of Proposed Scope of Project for Four HSOW Scenarios

Proposed Scope Item	No HSOW Scenario	Low HSOW Scenario	Medium (Base Case) HSOW Scenario	High HSOW Scenario
Grit Handling / Influent Flow Measurement	Yes	Yes	Yes	Yes
High Rate Primary Filtration (Primary Treatment)	Yes	Yes	Yes	Yes
Co-Thickening Building and Rotary Drum Thickeners	Yes	Yes	Yes	Yes

Repurposing Aerobic Digesters and Equipment for 3 Unit Processes	Yes	Yes	Yes	Yes
Constructing New Anaerobic Digesters - # of Digesters	2	2	2	3
Constructing New Anaerobic Digester Building	Comparatively Smaller	Comparatively Smaller	Comparatively Smaller	Larger
Provide HSOW Receiving/Processing - # of Storage Tanks	-	2	3	4
Constructing Solids Receiving Station for Blucher Poole	Yes	Yes	Yes	Yes
Digester Gas Handling Equipment and Flare	Yes	Yes	Yes	Yes
CHP Systems (kW)	400	1000	1000	2000
RNG System (scfm)	100	200	300	500

5.1.2.1. Site Selection for Anaerobic Digestion Facilities

The Dillman Road WWTP is the preferred location for HSOW receiving, anaerobic digestion, and beneficial use of biogas, in comparison to Blucher Poole WWTP. Dillman Road processes roughly 80% of the total flow and loadings that both CBU WWTPs receive. Having a greater volume of WWTP solids will result in a more consistent digester loading and a higher likelihood of maintaining the digester biological stability and health while co-digesting HSOW.

Dillman Road has a larger plant capacity to deal with the digester side streams that contain high levels of nutrient loadings. Larger wastewater flows result in increased plant energy usage. These can be potentially offset with electricity and heat produced from the digester gas.

The facility is also accessible from both I-69 and State Road 37. Increased traffic is anticipated with the proposed HSOW receiving station and it allows for decreased costs in hauling solids.

Blucher Poole is smaller, receiving around 20% of the total flow and produces less biosolids. Hauling biosolids from Blucher Poole to Dillman Road is more feasible and economical.

5.1.2.2. Dillman Road Process Considerations

Donohue's baseline analysis included anaerobically digesting Dillman Road and Blucher Poole solids without the addition of HSOW. The analysis considered current elevated organic loading rates to the Dillman Road single-stage nitrification process. For single-stage nitrification, Ten State Standards recommends that the aeration tank organic (BOD_5) loading rate not exceed 15 lbs/d/1000 cubic feet of tank volume (without demonstration or submittal of modeling or mass balances to request higher loadings from IDEM). In practice, Donohue recommends that organic loading rates not exceed 23-25 lbs/d/1000 CF of aeration volume. Indiana Department of Environmental Management (IDEM) has previously approved these loadings for new plant construction.

Dillman Road's current aeration organic loading rate is 20.6 lbs/d/1000 CF. As influent flows are increased to the plant design flow (20 mgd) the organic loadings would approach 40.3 lbs/d/1000 CF and thus exceed the recommended 23-25 range. Higher organic loading rates reduce capacity to treat recycle flow streams in the biological process (aeration tanks), particularly the ammonia loads that need to be biologically treated. Adding primary treatment decreases the aeration organic loading rates. Primary treatment facilitates additional capacity for processing recycle flow streams from anaerobic digestion and solids dewatering processes. This positions the City to treat future flow increases up to the 20 MGD design capacity. Table 26: Current/Design Organic Loading Rates with Primary Clarification Technology. presents design organic loading rates for the existing condition, addition of conventional primary treatment and high rate primary filtration (HRPF). HRPF dramatically decreases the organic loading rate to below Ten States Standards at the design average flow.

Table 26: Current/Design Organic Loading Rates with Primary Clarification Technology

Current/Design Parameter	No Primary Clarifiers with AD	Conv Primary Clarifiers with AD	High Rate Primary Filters with AD
Current/Design Average Daily Flow	13.5 MGD / 20 MGD	13.5 MGD / 20 MGD	13.5 MGD / 20 MGD
(1)Organic Loading Rate, lbs BOD/1000 CF of Aeration Volume(2)	20.6 / 40.3 lbs/d/1000 CF	14.1 / 28.2 lbs/d/1000 CF	10.8(1) / 14.1 lbs/d/1000 CF

(1) Organic Loading Rate is not dependent on anaerobic digestion, but it indicates aeration basin capacity for sidestream treatment
(2) Donohue recommends the organic loading rate not exceed 25 lbs BOD/d/1000 CF

Another benefit of primary treatment is carbon diversion to the anaerobic digestion process. Adding conventional primary clarifiers increases the amount of carbon converted to methane by approximately 20% (from 14% to 34% based on a representative case study project by Wan et al, 2016)). However, as CBU has seen in prior studies, the cost of adding large circular, conventional primary clarifiers and all associated infrastructure to the Dillman Road WWTP is generally cost prohibitive. To reduce costs and increase primary removal performance, HRPF is proposed. HRPF could increase carbon diversion toward the higher end of the BOD_5 removal range in Table 27 and the projected construction costs is estimated to be approximately $7M less than constructing large, deep, circular primary clarifiers and large influent/effluent flow splitter and convergence structures. Implementing HRPF (or any primary treatment) would change the hydraulic profile of the plant. Upstream grit removal would need to be at a higher hydraulic grade line than the existing aerated grit tanks. Since the City was planning in the current capital improvement plan (CIP) and associated rate-case, to install new vortex grit removal tanks, this Project includes two vortex grit tanks for 40 MGD capacity and associated grit pumps, grit handling equipment, and building. New flow measurement is also included for the rerouted 36" pump station discharge to the new grit tank location.
Table 28 presents a comparison of various primary treatment technologies including their ability remove TSS and BOD_5.

Table 27: Technologies for Enhanced Primary Treatment

Primary Treatment	Removal Mechanisms	Typical Treatment Efficiency (TSS)	Typical Treatment Efficiency (BOD_5)
Conventional	Sedimentation, gravity	50-60%	25-40%
Chemically Enhanced	Sedimentation with chemicals	60-90%	40-70%

Mechanical: Filters	Mechanical separation; Physical barrier	70-90%	60-70%

HRPF would utilize outside-in flow pattern cloth media disk filtration (CMDF). While CMDF has been employed in wastewater treatment for decades, it has historically been tertiary treatment applications, filtering secondary effluent prior to disinfection (same as Dillman Road WWTP's tertiary filter application). However, outside-in flow technology and advancements in cloth media have enabled CMDF to be used successfully for combined sewer overflow (raw sewage, sometimes concentrated and other times dilute) and high rate primary filtration applications. The outside-in flow pattern allows for scum removal (a necessary primary treatment step), allows for heavier solids to settle and be removed without filtration (another necessary primary treatment process quality), and provides a 5-micron barrier against solids breakthrough that removes approximately 70%-90% TSS and 60-70% BOD removal. BOD removal improves when sodium aluminate, or other coagulant in dosages that may be added for phosphorus precipitation, are added to the feed. The coagulant causes flocculation and grouping of particles such that smaller, colloidal-size, BOD may be removed. Soluble BOD and ammonia nitrogen, requiring downstream biological secondary treatment, pass through the 5-micron filter media barrier.

Donohue designed Rushville combination CSO/tertiary Filters, operational since 2018. Elkhart WWTP is currently under construction for a CMDF process of 30 MGD of wet weather flow capacity. Elkhart CMDF process will treat screened/degritted raw sewage flows in parallel with the activated sludge process to increase the plant capacity to a sustained 60 MGD, with flows recombined upstream of disinfection. For that Project, a Consent Decree Modification was required taking several years and proving the advanced technology, not available in 2011 when the City entered into the federal consent decree. For Rushville, Elkhart, Richmond, and Hammond Indiana CSO applications, Donohue performed pilot testing with the manufacturer and for three of these to date proved the processes to IDEM's satisfaction. As a result, IDEM no longer requires pilot testing for CMDF CSO applications in Indiana. Donohue also designed HRPF for Four Rivers Sanitation District in Rockport, Illinois after years of extensive testing at that facility by the CMDF manufacturer and other consultants. In that case, Project was approved by Illinois EPA. That HRPF application is currently under construction. The manufacturer has a growing list of other CSO applications and primary filtration applications throughout the US and beyond. At WEFTEC 2022, disc filtration technology was promoted and/or debuted by many manufacturers citing CSO and HRPF type applications. To date though, most are inside-out flow pattern, limited to 10-micron media pore size, or not fully submerged filter disc, thereby not including necessary primary treatment application characteristics or requiring larger footprints, requiring more equipment, concrete, and in some cases polymer addition to perform similarly to a 5-micron media, fully submerged, outside-in flow pattern CMDF system as proposed.

5.1.3. Scope of Work

The major scope items proposed for the Dillman Road WWTP upgrades are as follows:

- Provide two Vortex Grit Removal Tanks, Grit Pumps, and two Grit Washers.
- Provide two High Rate Primary Filters, with associated Backwash and Solids Removal Pumps.

- Construct Grit Removal and HRPF Pump Rooms in a common underground structure with small Electrical/Controls Building and larger Grit Handling Building with truck/container access above grade.
- Route new primary effluent piping to the existing flow splitter structure upstream of the aeration basins.
- Construct HSOW Receiving Station (for liquid).
- Provide Blucher Poole / solid HSOW receiving, live-bin, hopper and dilution pump system in small above/below grade structure.
- Construct two new heated and mixed anaerobic digesters and all associated pumping, piping, gas safety equipment, covers, mixers and heating systems (possibly a third Digester in a 2nd project phase with increased volumes of HSOW).
- Construct Digester Control Building including the following Rooms and planned Equipment:
  - AD Heating Room including boilers and heat exchangers, one per Digester.
  - Gas Handling Equipment Room.
  - Mechanical Room, Electrical Room.
  - HSOW Receiving Room (grade level) for liquids HSOW, with Pump Room below including 2 pumps for pumping into HSOW Storage Tanks and 2 pumps for transferring from HSOW Storage-to-Digesters or Digester-to-Digester.
  - AD Mix Pump Room with 3 mix pumps for 2 digesters, and fourth mix pump added with addition of a third digester. Grinder mix pumps are part of the planned nozzle mixing systems. Digested sludge transfer pumps, with concept design dependent on digester tank type selected, would be included to transfer digested solids back to the Digested Sludge Storage Tanks, at the existing basin complex, to await belt filter press dewatering.
- Provide two HSOW Storage Tanks with big-bubble mixing systems.
- Provide two Rotary Drum Thickeners (possible third in 2nd phase) for Co-Thickening of blended HRPF (primary) sludge, Dillman Road WAS, and Blucher Poole solids.
- Construct of a Co-Thickening Building including Rotary Drum Thickeners, Electrical Room, Mechanical Room, and Polymer Room on the ground level. Partial Basement including two wells, two Digester Feed Pumps, and influent piping, flowmeters, and valve distribution for thickening.
- Convert two existing aerobic digesters and associated infrastructure (pumps, pipelines, blowers, diffusers, etc.) into the following:
  - Two 40-foot diameter Gravity Thickeners to thicken HRPF sludge to 1%.
  - Two Digested Sludge Holding Tanks (prior to dewatering with existing Belt Filter Presses). Tanks will use existing blowers/diffusers to perform limited ammonia-nitrogen reduction.
  - Two Blend Tanks to blend all municipal sludge (thickened primary, Dillman WAS, and Blucher Poole solids).
  - Reuse of many pumps/pipe/valves to support the above processes and installation of two new gravity thickener pumps to transfer sludge to blend tank. Existing piping systems of existing pumps will be modified in the existing Basin Complex.

- Provide biogas cleaning system.
- Provide combined heat and power (CHP) engine system or renewable natural gas (RNG) system with associated containers/enclosures as needed to house process and biogas cleaning equipment. CHP or RNG options are under evaluation.
- Provide odor control facilities for select processes.
- Incorporate process controls and communications into the existing plant's fiber optic network as needed to accommodate the system upgrades.

This report does not take into account additional WWTP upgrades which may be required to achieve the increase in average daily capacity from 15 to 20 MGD. The Phase 1 Improvements Project was recently completed, and it is understood that with a planned Phase 2 Improvements Project, CBU will propose to IDEM that the WWTP rated average day capacity be increased to 20 MGD. Based on the Construction Permit Application submitted for the recent Phase 1 Project, a peak hourly flow rate of 40 MGD is the basis of proposed facilities along with the future permitted average daily design flow rate of 20 MGD.

5.1.4. References

- Dillman Road and Blucher Poole Monthly Reports of Operation (MRO) data 2019-2021
- Dillman Road 2020 IDEM Construction Permit
- Dillman Road and Blucher Poole National Pollutant Discharge Elimination System (NPDES) Permit (effective until August 31, 2024)
- Historical (existing) drawings
- Recommended Standards for Wastewater Facilities (Ten States Standards) 2014 Edition
- 327 Indiana Administrative Code (IAC) Article 3. WASTEWATER TREATMENT FACILITIES; ISSUANCE OF PERMITS; CONSTRUCTION AND PERMIT REQUIREMENTS

5.2. – Process Design Basis

5.2.1. Process Design Basis

For the purposes of this report, current average Dillman Road WWTP influent flowrate is 13.5 MGD, design average daily flow rate is (the future value of) 20 MGD and peak hourly flow rate is 40 MGD. Table 28 summarizes the design loading rates. Figure 23 and Figure 24 (on the two following pages) illustrate the WWTP process flows highlighting proposed improvements. The figures include average day and maximum month conditions, respectively, each with solids loadings for design and current flow/loading scenarios. Low, medium, and high volumes of HSOW are also included as part of the mass balance. Appendix C itemizes solids system sizing calculations for the proposed modifications. Table 28 presents design basis influent concentrations that design loadings are based upon. These concentrations are consistent with those found in the most recent IDEM Construction Permit Application for Dillman Road WWTP.

Table 28 Design Basis Loading Rates

Load	Units	Design Basis Average Condition
Average BOD Concentration	mg/l	152
Average TSS Concentration	mg/l	192
Average Ammonia Concentration	mg/l	19
Average Phosphorus Concentration	mg/l	4

The Dillman Road Wastewater Treatment Plant is permitted to discharge to Clear Creek under the NPDES Permit No. IN0035718 approved by the Indiana Department of Environmental Management. The current Permit was effective on September 1, 2019, and it will be active until August 31, 2024. The existing permit limits are shown in Table 29. For the purposes of this Design Report, it is assumed that these limits will not be changed, nor will new limits be added, for the proposed increase in capacity at the facility as part of the next permit cycle.

Table 29 Existing NPDES Permit Limits

Parameter	Units	Monthly Ave	Weekly Ave	
Flow	MGD	--	--	
CBOD	mg/l	10	15	
TSS	mg/l	10	15	
Ammonia-Nitrogen	mg/l			
Summer	mg/l	1.5	2.3	
Winter	mg/l	2.9	4.4	
Phosphorus	mg/l	1.0	--	
Parameter	**Units**	**Daily Min**	**Monthly Ave**	**Daily Max**
pH	s.u.	6.0	--	9.0
Dissolved Oxygen				
Summer	mg/l	6.0	--	--
Winter	mg/l	5.0	--	--
Final Effluent Total Residual Chlorine	mg/l	0.01	0.02	--
E. coli	cfu/100 ml	--	125	235

Figure 23 Process Flow Diagram (Average Day Condition - Design/Current Scenarios)

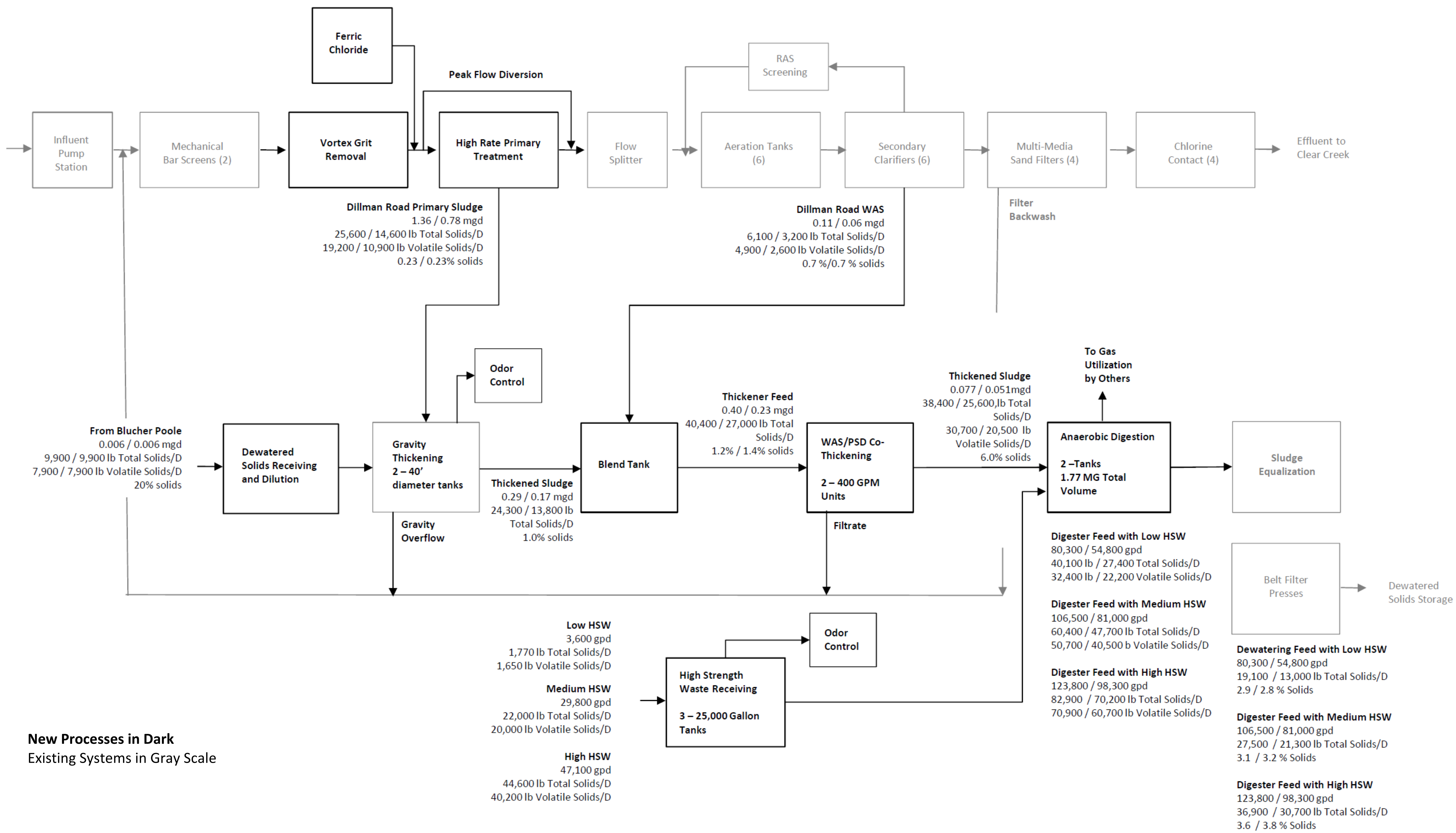
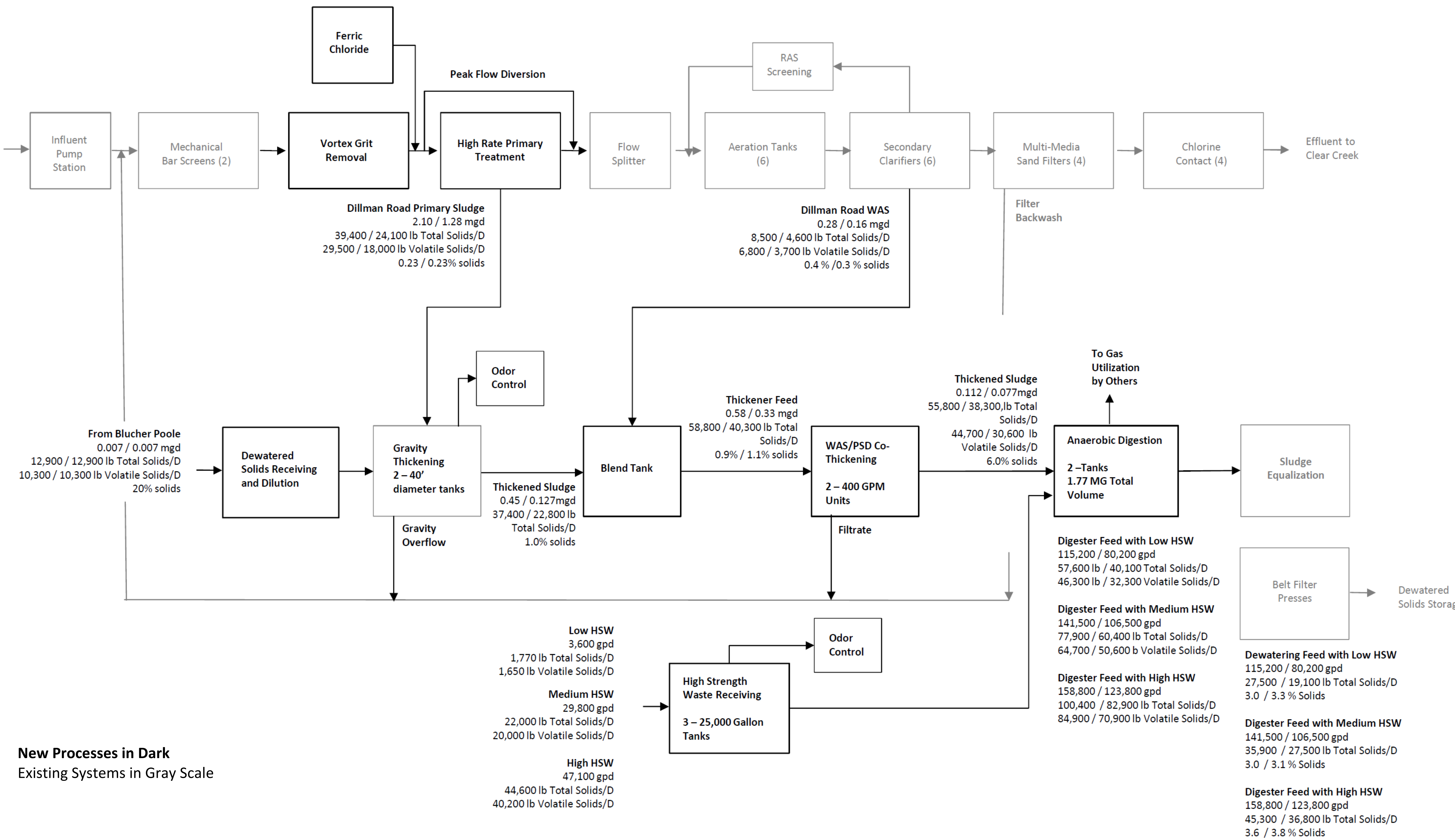


Figure 24: Process Flow Diagram (Maximum Month Condition - Design/Current Scenarios)



5.2.2. Conceptual Design

Conceptual process design and sizing for cost opinion purposes is discussed in this Section. Refer to the existing Dillman Road WWTP Site Plan, Proposed Site Plan, and Flow Diagram in Appendix D.

For development of the cost opinion, Donohue provided the Project Team with an array of drawing mark-ups from prior, similarly sized processes/applications with guidance on scaling and necessary modifications. In addition, Donohue's experience from prior studies for items such as potential grading required to site facilities as shown, potential geotechnical concerns such as rock, and other factors relevant to these proposed processes and facilities were used to provide background for the development of the cost opinion. In some cases, equipment representatives were contacted for updated budgetary pricing and in other cases, such as pumps, the EPP Team made informed estimates based on pump types and consideration of approximate capacities and pressures.

The following subsections describe the major proposed processes and facilities needed to implement this conceptual design. While details are limited at this conceptual design stage, all EPP Team Members worked together with the objective of developing a conceptual construction cost opinion that is comprehensive relative to the actual level of the design.

5.2.2.1. Re-Route Influent Piping

Currently, a 36" force main directs the influent flow from the Raw Influent Pumping Station to the aerated grit chambers, adjacent to the aeration basins. The 36" force main will be re-routed with new piping to bring the flow to the new grit removal structure. Along the route to the grit removal structure, a flow meter vault will be installed with 36-inch magnetic flow meter and bypass piping and valves.

The effluent from grit removal will flow by gravity to the high rate primary treatment process, then through a new 48" gravity pipe to the existing aeration basin flow splitter box.

5.2.2.2. Grit Removal and Washing

The facility currently uses aerated grit chambers to provide grit removal. However, newer grit removal technology can increase performance while reducing energy costs. The equipment associated with this system includes two vortex Grit Chambers, two grit pumps, and two Grit Classifiers. These systems will be automatically controlled through the SCADA system. One unit will handle dry weather flow and both systems are required for peak flow rates.

5.2.2.3. Merged Grit Removal, Grit Handling, and High Rate Primary Filter Structures

The below grade Grit Pump Room will be contiguous and attached to the HRPF Pump Room, with tanks and channels forming one concrete structure. The Grit Tank Effluent Channel and HRP Filter influent channel will be the same channel. Above the HRPF Pump Room, a small building will house electrical and I&C for the process. A larger building will house the above grade grit handling equipment that will discharge into dumpsters in an open bay area accessible via overhead doors and located for truck/equipment access.

Two HRP Filters will be constructed on the north side of the plant, due north of the Existing Belt Filter Press Dewatering Building. Each filter would be sized for 10 MGD of the 20 MGD design average flow, and 20 MGD each for the plant peak flow capacity. If beyond 20 MGD per filter, and solids loadings are such that the backwash pump capacity is exceeded, then wet weather flow would bypass the primary filters.

An AquaPrime Filter Design Summary by Aqua-Aerobics Systems Inc. (AASI) is included in Appendix E. The AASI equipment package includes pumps, VFDs, PLC control panels, automated valves, flow meters, instrumentation, and other appurtenances for each filter. Each disk filter will include 24 disks, 3-m in diameter. Filters continue to process flow during backwash. When filter tank level rises, based on headloss of flow passing through the 5-micron filter media to the center tube and effluent weir chamber, the elevated water level triggers a backwash.

For a backwash the filter shaft is rotated, and 8 filter disks are backwashed at once (with filtered process flow) while the filter remains in service processing flow. Each set of 8 disks has a backwash control valve, and the 3 backwash control valves per filter are sequentially opened while the backwash pump pulls suction through a suction shoe that clamps around each side of the 8 disks. Every 3 to 4 backwashes generally, solids are sequentially pulled from 2 solids trough areas in the bottom of the tank, with a solids pump. Backwash pumps and solids waste pumps are made interchangeable with one cross-connection actuated valve, in the event that one pump is out of service. In an absolute worst case of heavy solids and high flow rates, the total filter solids (backwash and solids) will total no more than 8% of the influent flow.

Generally, the filter solids flow is a smaller percentage of process flow, however the solids stream is dilute for primary sludge, approximately 0.20 to 0.25 percent solids. Therefore, the backwash and solids pumps will manifold into one 8-inch discharge line per filter unit, and discharge Cloth Filter Solids (CFS) to the gravity thickeners. In the Basin Complex basement, valves will be installed to direct CFS from either filter unit to either of two gravity thickeners (to be built inside the existing aerobic digesters as described below). Effluent from the HRP Filters will combine and be conveyed to the existing aeration basin flow splitter as described above.

5.2.2.4. Primary Sludge Gravity Thickeners

Two 40-ft. diameter gravity thickeners will receive the dilute primary sludge from the HRPF process. Gravity thickening will be high-rate in that Gravity Thickener Transfer Pumps will be sized to remove sludge rapidly with the goal of achieving a 1 percent solids content (approximate four-fold thickening with influent solids averaging 0.25%). In the Basin Complex basement, two small centrifugal, screw impeller pumps with VFDs are planned to serve each gravity thickener (four pumps total). The circular gravity thickeners will be constructed within the existing 77.5’x 150’ aerobic digesters. Gravity thickeners will have significantly sloped bottoms and picket-fence type sludge collection mechanisms. The gravity thickeners are proposed to be positioned near the basin complex basement for pump and sludge withdrawal pipe installation and away from the tunnel where blowers and air supply are located, since the process does not require air like others needed in the existing aerobic digester tankage. Gravity thickeners are planned with flat covers for foul air withdrawal to odor control.

Large diameter basin complex drains, below the basin complex slab, will be sufficient for the gravity thickener overflow, directed back to the existing Raw Sewage Pump Station wet wells. Dome type covers are planned on the gravity thickeners with foul air withdrawal to an odor control system.

5.2.2.5. Blucher Poole Solids and Solid HSOW Receiving

A small building with odor control is planned to house the solid waste receiving facility, designed to receive Blucher Poole WWTP solids and HSOW solids. Trucks would unload into a grated opening, with retractable cover, into a live-bottom sludge hopper sized to handle a truck load. From the hopper, solids would be directed into a single stage progressive cavity (PC), open-throat, blend pump. A simple modification to a typical open-throat PC pump for high-solids, the blend pump receives a 3-inch to 4-inch dilution line to the open throat hopper on the PC pump. Sized for 60 to 75 psi maximum discharge pressure and pump dilution stream from the Blend Tank, the pump will discharge Blucher Poole solids to the Blend Tank. The blend tanks will receive only municipal sludge from Dillman Road and Blucher Poole or other municipal facilities. For the provision of also receiving and diluting HSOW, a second valved discharge line will be directed to the HSOW storage tanks.

It is recommended that Blucher Poole solids be trucked to Dillman Road approximately every 3 days as discussed below.

5.2.2.6. Blend Tanks

The Blend Tanks will be the majority of the existing 77.5' x 150' Aerobic Digesters. Aside from tank volume utilized on the Basin Complex basement end for the gravity thickeners and digested sludge storage tanks, the remainder of each tank volume will be a blend tank. No changes will be made for blend tanks other than minor modification to diffusers where walls are constructed for the aforementioned structures. Existing dedicated, positive displacement blowers installed in the recent Phase 1 Project will continue to be used along with the existing medium bubble membrane diffusers. Modest aeration will be used to keep the blended sludge fresh, mixed, and homogeneous for downstream co-thickening.

Blend tanks will receive Dillman Road primary sludge from the gravity thickeners, WAS from the secondary clarifiers (requiring no changes), and the diluted Blucher Poole solids. At the Basin Complex basement end of the tank, the Blend Tank will extend between the new Gravity Thickener and Digested Sludge Storage Tank. In this way, the existing sludge pump suction piping can be reused and modified such that pumps can be multi-purpose at each tank for redundancy with the center of the 3 pumps in each location pulling from either location. This will reduce the rotary lobe sludge pumps required and reuse a significant amount of existing piping. Also, existing aerobic digester decant piping can be modified (trimmed) and decant wells can continue to be used from Blend Tanks as an option. From the blend tank, sludge will be transferred to the co-thickening process by rotary drum thickener (RDT) feed pumps. Of the six existing Gravity Belt Thickener (GBT) and Belt Filter Press (BFP) pumps in the Basin Complex Basement currently serving the aerobic digesters, it is anticipated that three new RDT Feed Pumps will be installed in place of 3 of the pumps, and the existing BFP Feed Pumps to the Existing BFPs will remain unchanged.

Blend tanks would be managed to achieve the following goals as needed: 1) storage/equalization, and 2) consistency in the blend of municipal sludge continuously fed to the anaerobic digesters. Blend Tanks offer a large volume and are deep with an approximate 20' side-water-depth. If one of two tanks is generally in service and maintained at 2/3 full, the tanks provide a buffer for digester feed sludge storage in the event of unforeseen equipment or process outages to allow response time for operators. Conversely, while Dillman Road primary sludge loadings and WAS loadings will be relatively consistent and equalized through the blend tanks for a homogeneous feed to the digesters, the Blucher Poole solids will offer more variability. It is recommended that the frequency of Blucher Poole solids deliveries to Dillman Road be on the order of no more than every 3 days, such that it approximately correlates with and does not exceed by much, the detention time through the Blend Tank(s). By maintaining higher levels in the Blend Tank at times, the detention time is increased and the buffering capacity for intermittent loads of Blucher Poole solids is increased.

While it will be possible and optional to decant the Blend Tanks with the same infrastructure used now to decant the aerobic digesters, with upstream gravity thickeners for the thin primary filter solids and the downstream fully automated 24/7/365 co-thickening process, the manual operation of tank decanting should not be required.

Note on Future Plant Expansion Impact on Aeration Basins:

Regarding aeration basin capacity should the Dillman Road WWTP someday expand to and average daily design flow of 25 MGD. To summarize Section 92.31 of the current (2014 edition) of the Recommended Ten State Standards for Wastewater Facilities, "The size of aeration tank for any particular adaptation of the (activated sludge) process shall be determined by full scale experience, pilot plant studies, or rational calculations based mainly on solids retention time, food to micro-organism ratio, and mixed liquor suspended solids levels." In other words, aeration basins are primarily sized based on organic loadings and not flow rates. Secondary Clarifiers needed downstream of aeration tanks, are sized directly proportional to design flow rates and as such more capacity would be needed to increase plant design flow to 25 MGD. For aeration basins, if high rate primary filtration is added (or any other form of primary treatment), loadings to aeration basins will be lessened to the point that no additional aeration basin volume or tankage would be needed to increase Dillman Road plant design flow to 25 MGD someday in the future.

5.2.2.7. Co-Thickening Building and Rotary Drum Thickeners

A Co-Thickening Building is planned for the rotary drum thickening process. The RDT pumps, in the Basin Complex basement, will pump to the RDTs in the Co-Thickening Building located north of the existing Sludge Storage Building, with other new solids handling and biogas handling facilities. Space will be provided for three RDTs, each 400 gpm capacity.

Thickened sludge at 6% to 7% solids will be transferred from the RDTs to the anaerobic digesters. Two thickened sludge wells are planned in the basement for temporary sludge storage. Digester Feed Pumps would pull from either RDT sludge well and transfer solids to the anaerobic digesters on a 24/7/365 schedule, for optimum process stability. The Co-Thickening Building have and appropriate HVAC system, but foul air for odor control would only be withdrawn from a 6-inch vent from each enclosed RDT.

5.2.2.8. HSOW Storage Tanks

For the low estimate of HSOW, only two HSOW Storage Tanks are planned, each with an approximate 25,000 gallon capacity to receive liquid HSOW from the HSOW Receiving Room of the Digester Control Building or diluted HSOW solids so that they can be pumped from the Blucher Poole Solids Receiving Station. For the medium (base case) estimate of HSOW, three HSOW Storage Tanks are planned and a fourth would be added for the high estimate of HSOW.

Liquid HSOW will be grinded and pumped from the HSOW Receiving Station. The pumped diluted HSOW solids line will be routed through the HSOW Receiving Room basement to include valves and wye fitting to feed either tank. HSOW Storage Tanks will also have transfer pumps in the Digester Control Building to pump from the HSOW Storage Tanks and discharge to the anaerobic digesters.

HSOW Storage Tanks will be equipped with big bubble mixing systems and be designed for varying liquid levels to absorb and equalize intermittent HSOW loads, to maintain the HSOW feed as consistent as possible to the anaerobic digesters. Foul air from the storage tanks would be ducted to odor control. The HSOW storage was generally based on providing 3 days of detention time for medium HSOW volumes. The HSOW volumes and characteristics are summarized in Table 30.

Table 30 HSOW Conditions

Parameter	Design Condition	
Total HSOW Average Load (lbs/d)	1,170	lb/d
Total HSOW Average VSS Load	1,650	lb/d
HSOW Flow	3,600	GPD
Total HSOW Average Load (lbs/d)	22,000	lb/d
Total HSOW Average VSS Load	20,000	Days
HSOW Flow	29,800	GPD
HSOW Average Load (lbs/d)	44,600	lb/d
HSOW Average VSS Load	40,200	lb/d
HSOW Flow	47,100	GPD

5.2.2.9. Anaerobic Digesters

For the low and medium (base case) volumes of HSOW, two anaerobic digesters of approximate 880,000 gallon capacity each will be required. For full build-out and high volumes of HSOW brought to the site, a third, equal size anaerobic digester would need to be added in a future project phase.

Two types of digester tanks have been evaluated to date. Conventional concrete anaerobic digesters that have historically been used for municipal anaerobic digester applications and a European technology used worldwide for an array of anaerobic digestion applications, used in recent years in the US for high-rate and agricultural applications, and more recently applied to municipal anaerobic digestion applications in the US. Design and construction of these newer tanks is by ‘double fold robotic coil assembly system’ per the manufacturer’s description and they would be above ground, cylindrical tanks of type 316L stainless steel construction. Proposal received was for approximate 73-foot diameter tanks, with 31.2-ft. cylinder walls, and 28.2-ft. filling height. During detailed design, manufacturer options could be considered that may decrease diameter (and associated tank foundation) and increase height toward 50-ft. or more as is sometimes the case with this technology. These tanks would need to be constructed away from the Digester Control Building walls. Conversely, conventional anaerobic digesters for this application would be 80’ diameter with and approximate 24’ side-water depth, and approximate 6 feet deep cone hopper. Conventional digesters built the same time as the Digester Control Building can be designed with common wall construction as shown on the concept site plan. If a third digester is added later, a building expansion would also be required.

A duplex variable speed pumping system will be used to continuously pump sludge from the blend tank to the anaerobic digesters.

5.2.2.10. Digester Control Building

A Digester Control Building is planned to be located north of the existing Sludge Storage Barn. Common wall construction may be employed, dependent of selected digester construction type (conventional concrete or steel bolted). Within the Digester Control Building, the following spaces are planned at ground level: HSOW Receiving, Mechanical Room, Electrical Room, and Anaerobic Digester Heating Room that would house boilers and heat exchangers for the digesters.

The Digester Control Building lower level would serve as the Digester Mix Pump Room, housing large centrifugal grinder pumps for digester tank nozzle system mixing, a Digester Gas Room, and Pump Rooms for the HSOW Pumps and Digested Sludge Pumps. Two sets of two rotary lobe pumps are planned for HSOW transfer. Two rotary lobe pumps protected by grinders will initially transfer HSOW received to the HSOW Storage Tanks. These pumps will likely be sized for up to 30 psi. Two other rotary lobe pumps, Transfer Pumps, will be able to pull from either the HSOW Storage Tanks or any Anaerobic Digester, and discharge into any available digester. These pumps may be up to 30 psi, or in the 30-60 psi discharge pressure range, dependent on digester tank selection and height. Lastly, the Digested Sludge Pump system to transfer digested sludge to the Digested Sludge Storage Tanks will be located in a basement with arrangement dependent on digester tank selection.

5.2.2.11. Biogas Conditioning and Combined Heat and Power (CHP) Facilities

One of the options under consideration for biogas utilization is a CHP facility. While the biogas quality of the future anaerobic digesters is unknown, biogas conditioning to remove moisture, hydrogen sulfide (H2S) and siloxanes will likely be needed. Biogas Conditioning Facilities will be located near the digester complex and receive biogas from the Gas Handling Equipment Room. The Biogas Conditioning Facilities will be located outdoors on concrete pads. The biogas will pass through a vessel filled with dry granular media for H2S removal. The gas will be chilled and pass through a particulate filter to remove moisture and a blower will compress the gas to the required inlet pressure for the combined heat and power system. Finally, prior to combustion in the CHP, the gas will pass through a lead lag configured media based siloxane and volatile organic compound (VOC) removal system.

For the base case the CHP system will consist of a reciprocating engine with exhaust and jacket water heat recovery and a generator with a gross output of 1MW. A parallel 1MW system can be added in a future phase for the high volume HSOW scenario. The waste heat from the engine is recovered and used to offset digester heat needs. The CHPs will be housed in an enclosure. Up to 1MW of gross CHP capacity can be interconnected to the grid and qualify for net metering under Indiana’s net metering regulations.

5.2.2.12. Renewable Natural Gas (RNG) Facilities

Another option being considered is the production of RNG. In this scenario the biogas is not combusted on-site but rather cleaned to a pipeline quality natural gas equivalent and injected into a nearby CenterPoint Energy pipeline. While there are a variety of technologies available to clean biogas to RNG including pressure swing adsorption (PSA), amine, selexol, water wash, and membrane, the design basis for this study was a membrane system. Membranes are well suited for the relatively small flows of biogas associated with the project, have been commonly used in the anaerobic digester and broader RNG industry and are relatively easy to operate. Similar to the gas conditioning facilities, H2S, moisture, and siloxanes/VOCs are removed, however the gas is compressed to a much higher treatment pressure for passing through multiple stages of membrane that separate carbon dioxide (CO2) from the biogas. Given the low volumes of oxygen and nitrogen associated with biogas from anerobic digestion, and the reasonable standards required by CenterPoint, no oxygen or nitrogen removal is anticipated to be used. The discharge pressure of the RNG system will be approximately 190psi to meet the pipeline requirement.

5.2.2.13. Digested Sludge Storage Tank

Two Digested Sludge Storage Tanks will be constructed in a part of the existing aerobic digester tanks. Existing medium-bubble, membrane diffusers and dedicated PD blowers installed in the recent Phase 1 Project will be reused to serve these tanks. Each tank will require a new 6” air header, by installing a Tee on the existing 10” header, new 6” piping and minor diffuser grid modifications where the new tankage, positioned in the corner of the existing tank, will require construction of two new walls. Digested Sludge Storage Tanks are positioned on the Basin Complex Basement side of the existing aerobic digesters to make use of existing space for pumps, existing sludge pump and piping systems. As described in the blend tank section, of the 6 existing pumps in this basement (3 existing GBT feed pumps and 3 existing BFP feed pumps) it is anticipated that 3 will be reused and 3 will be replaced. The GBT feed pumps would be replaced with three new RDT Feed Pumps. Near each existing aerobic digester, piping for the center pump is planned to be modified such that it can pull from the Blend Tank (existing aerobic digester sludge sump) or the common-wall Digested Sludge Storage Tank. New RDT Feed Pumps, with variable frequency drives, pull from the Blend Tank to feed the RDTs with new discharge piping and new distribution piping in the Co-Thickening Building basement. Existing BFP Feed Pumps pull from the Digester Sludge Storage Tank side of the common-wall and discharge to the existing BFPs for solids dewatering – as they do now with no needed changes to piping except possibly on suction side to pull from the newly constructed tank in existing tankage. Digested sludge storage tanks are planned to have flat covers to withdrawal foul air for odor control.

To allow the new Blend Tanks (former aerobic digesters) to have ‘frontal’ space on the Basin Complex basement side also, each Digested Sludge Storage Tank measures 15’ to 16’ x approximately 45’ with varying side-water-depth up to 20’. This allows the Blend Tanks to also have approximately 15’ to 16’ of ‘frontal’ space, along the basement wall, therefore allowing for reuse and repurposing of much infrastructure and allowing space for new process equipment and piping.

5.2.2.14. Existing Belt Filter Press Dewatering and Biosolids Storage

The existing belt filter press (BFP) dewatering process is over 20 years old. Both the two 2-m, 3-belt, Komline-Sanderson BFPs and the BFP Building itself appear to be in good condition and suitable for continued use.

By reusing this infrastructure and not installing dewatering units of greater capacity, the tradeoff is in hours of operation. Table 31 summarizes BFP operating conditions for the following:

- Design and current operating conditions
- Low Medium and High estimates for HSOW
- Average day and maximum month conditions
- Varying BFP operating times including 24 hours per day 7 days per week, 8 hours per day 7 days per week and 8 hours per day 5 days per week.

The assumed capacity operating both BFPs is 3,000 lb/hr of dry solids and 200 gallons per minute. Conditions exceeding these thresholds are highlighted in red. Medium and high HSOW loadings will require operating more than 8 hours per day/5 days a week toward a 24 hours per day/7 days per week schedule. For simplicity, Table 31 shows BFP operations as 8hr/d, 5 d/wk; 8hrs/d, 7d/wk; and 24hr/d, 7 d/wk) where actual operation will be somewhere between these extremes. Again, if a number is red in the table below, the loading or flow rate is too great for that particular loading scenario. Low volumes of HSOW at current operating conditions allows for reduced operating time.

Table 31 BFP Operating Schedule

Parameter	Design		Current	
Low HSOW Volume				
Average Day				
Total Dry Solids to Dewatering (24/7)	797	lbs/hr	542	lbs/hr
Total Dry Solids to Dewatering (8/7)	2,391	lbs/hr	1,625	lbs/hr
Total Dry Solids to Dewatering (8/5)	3,347	lbs/hr	2,276	lbs/hr
Dewatering Feed Flow (24/7)	56	GPM	38	GPM
Dewatering Feed Flow (8/7)	167	GPM	114	GPM
Dewatering Feed Flow (8/5)	234	GPM	160	GPM
Max Month				
Total Dry Solids to Dewatering (24/7)	1,147	lbs/hr	796	lbs/hr
Total Dry Solids to Dewatering (8/7)	3,440	lbs/hr	2,388	lbs/hr
Total Dry Solids to Dewatering (8/5)	4,816	lbs/hr	3,344	lbs/hr
Dewatering Feed Flow (24/7)	80	GPM	56	GPM
Dewatering Feed Flow (8/7)	240	GPM	167	GPM
Dewatering Feed Flow (8/5)	336	GPM	234	GPM
Medium HSOW Volume				
Average Day				
Total Dry Solids to Dewatering (24/7)	1,145	lbs/hr	890	lbs/hr
Total Dry Solids to Dewatering (8/7)	4,485	lbs/hr	2,670	lbs/hr
Total Dry Solids to Dewatering (8/5)	6,279	lbs/hr	3,738	lbs/hr

Parameter	Design		Current	
Dewatering Feed Flow (24/7)	98	GPM	56	GPM
Dewatering Feed Flow (8/7)	295	GPM	169	GPM
Dewatering Feed Flow (8/5)	413	GPM	236	GPM
Max Month				
Total Dry Solids to Dewatering (24/7)	1,495	lbs/hr	1,144	lbs/hr
Total Dry Solids to Dewatering (8/7)	4,485	lbs/hr	3,433	lbs/hr
Total Dry Solids to Dewatering (8/5)	6,279	lbs/hr	4,807	lbs/hr
Dewatering Feed Flow (24/7)	98	GPM	74	GPM
Dewatering Feed Flow (8/7)	295	GPM	222	GPM
Dewatering Feed Flow (8/5)	413	GPM	311	GPM
High HSOW Volume				
Average Day				
Total Dry Solids to Dewatering (24/7)	1,536	lbs/hr	1,280	lbs/hr
Total Dry Solids to Dewatering (8/7)	4,607	lbs/hr	3,841	lbs/hr
Total Dry Solids to Dewatering (8/5)	6,449	lbs/hr	5,378	lbs/hr
Dewatering Feed Flow (24/7)	86	GPM	68	GPM
Dewatering Feed Flow (8/7)	258	GPM	205	GPM
Dewatering Feed Flow (8/5)	361	GPM	287	GPM
Max Month				
Total Dry Solids to Dewatering (24/7)	1,885	lbs/hr	1,535	lbs/hr
Total Dry Solids to Dewatering (8/7)	5,656	lbs/hr	4,604	lbs/hr
Total Dry Solids to Dewatering (8/5)	7,919	lbs/hr	6,446	lbs/hr
Dewatering Feed Flow (24/7)	110	GPM	86	GPM
Dewatering Feed Flow (8/7)	331	GPM	258	GPM
Dewatering Feed Flow (8/5)	463	GPM	361	GPM

5.2.2.15. Piping

Potentially required process piping is summarized in Table 32. This table is not intended to be all encompassing at this conceptual design phase.

Table 32 Pipe Schedule

Pipe Name	Abbreviation	Diameter	Description
RWW Force Main	RWW FM	36”	Connection from existing force main to new Vortex Grit Influent Channel
Primary Influent	PI	48” or 54” TBD	Connection from new High Rate Primary Filtration to existing Aeration Basin Flow Splitter Structure
Cloth Filter Solids	CFS	Two @ 8”	Backwash and Solids from HRP Filters to Gravity Thickeners via existing Basin Complex basement for valving/distribution
Gravity Thickener Overflow	GTO	Two @ 12” TBD	From each new Gravity Thickener effluent launder to existing Decant Well (one serving each tank) served by existing 18” drains to Influent Pump Station
Blended Sludge	BS	Two 12” or three @ 8” TBD	Sludge from new Blend Tanks to new Co-Thickening Building for feed to RDTs. Could flow split at destination or pump individually at source.
Thickened Sludge	TS	6”	From RDT Wells to Anaerobic Digesters – valving/distribution in Digester Control Building basement
HSOW to Storage	HSW	2 @ 4” or 6” TBD	From HSOW Receiving Pumps to each HSOW Storage Tank
HSOW from Storage for Transfer	HSW	36	From HSOW Storage Tanks to pumps in basement of HSOW Receiving
Sludge to Digesters – Digester Feed	DF	4”	From pumps in basement of HSOW

			Receiving to each Digester
Sludge from Anaerobic Digesters	DS	6”	From each anaerobic digester to basement of Digester Control Building
Digested Sludge	DS	4”	Digested Sludge from Digester Control Building to Digested Sludge Storage Tanks – valving/distribution in Basin Complex basement
Digester Gas	DG	8”	Digester gas connection to Biogas Conditioning
Biogas	BG	8”	Conditioned Biogas to RNG Facilities or CHP Engines

5.2.2.16. Odor Control Facilities

An allowance has been included in this conceptual planning for odor control. Planned odor control systems are for hydrogen sulfide and sulfide compounds. It is anticipated that during detailed design, an odor control consultant would be a part of the design team. At that time, the appropriate evaluations can be completed regarding potential odor sources from the proposed facilities, proximity of nearby odor receptors, potential receptor perceptions, and City prioritization on various levels of odor control. At this time, those complexities have not yet been evaluated or adequately considered. Instead, an allowance for two planned odor control systems has been included, roughly based only on similar installations provided with a moderate level of odor control.

The two odor control systems are planned to serve two different locations on the plant site. First, a single stage biofilter is planned to serve facilities around the existing basin complex. This odor control system may be located north of Clarifier Nos. 5 and 6, across the plant drive from the Influent Pump Station. This Biofilter may be sized for approximately 2,000 cubic feet per minute (CFM) to serve the nearby Gravity Thickeners and Digested Sludge Storage Tanks. The biofilter vessel for this capacity may be approximately 30’ x 30’ and additional chambers would be provided for irrigation equipment. The engineered media used in the biofilter would have a design life of 15 years.

The second planned odor control facility would be located north of the Existing Sludge Storage Building in proximity to the new solids handling facilities. This second facility is planned as a two-stage system consisting of an approximate 2,000 CFM capacity, engineered media, biofilter followed by carbon adsorption vessels. This second facility is planned to serve the enclosed RDTs, the HSOW Storage Tanks, the HSOW Receiving Room, and the Dewatered Solids Receiving Station. The odor control system allowance for these two roughly planned systems is $1,000,000.

5.2.2.17. Nutrient Recycle Management

Nutrients including nitrogen and phosphorus in influent wastewater are processed at Dillman Road. The effluent limits are summarized in the excerpt below (taken from IDEM letter to Greeley and Hansen dated April 6, 2018)

This letter is in response to your request for updated preliminary effluent limitations for a proposed upgrade of the Bloomington-Dillman Road Wastewater Treatment Plant. As indicated in your request, the upgrade will consist of modifying the Class IV, 15 MGD activated sludge treatment plant to a Class IV, 20 MGD treatment plant. The facility would continue to discharge via the existing outfall location to Clear Creek. The $Q_{7,10}$ low-flow of the receiving stream at the point of discharge is considered to be zero cfs.

A Wasteload Allocation Analysis (WLA002342) was performed by this Office's staff on March 16, 2018 for a proposed facility upgrade to 20 MGD. The following effluent limits are appropriate for the aforementioned wastewater treatment plant with an average design flow of 20 MGD with continuous discharge to Clear Creek:

TABLE 1

	Summer		Winter		
Parameter	Monthly Average	Weekly Average	Monthly Average	Weekly Average	Units
$CBOD_5$	10	15	10	15	mg/l
TSS	10	15	10	15	mg/l
Ammonia-nitrogen	1.5	2.3	2.9	4.4	mg/l
Phosphorus	1.0	----	1.0	----	mg/l

The ammonia-nitrogen limit is achieved through the conversion of ammonia in the aeration basins. The total phosphorus limit is achieved with the addition of sodium aluminate to the secondary clarifiers.

Table 33 summarizes ammonia-N and soluble phosphorus removal as part of the existing operation. The table also includes estimates for future recycle ammonia and soluble phosphorus loads.

Ammonium Recycle - The project assumes ammonia recycled from anaerobic digestion can be managed through storing digested sludge in aerated equalization prior to dewatering. Additionally, sufficient volume is available in the existing aeration system to convert ammonium in the dewatering recycle to achieve effluent NPDES requirements.

Phosphorus Recycle - Table 33 summarizes the sodium aluminate estimates applied to the current system to achieve effluent total phosphorus limits. The project assumes additional sodium aluminate will be necessary to precipitate soluble phosphorus from anaerobic digestion. The table identifies recycle soluble phosphorus loads created from municipal digestion as well as a range of HSOW digestion. The assumptions for volatile solids nutrient ratios, nutrient recycle, and molar ratios are included in Appendix C Basis of Design worksheets.

Table 33 Estimated Nutrient Removal Requirements

Parameters	Design	Units	Current	Units
WWTP Influent Phosphorus				
Influent Ammonia-N	3,169	lbs/d	1,582	lbs/d
Sol P Reacted	250	lbs/d	169	lbs/d
Sodium Aluminate Solution (assumes removing 1.5 mg/l of soluble P)	344	gal/d	233	gal/d
Nutrient Recycle from Municipal Solids Digestion				
Recycle Ammonia-N	138	lbs/d	72	lbs/d
Recycle Sol P	23	lbs/d	12	lbs/d
Sodium Aluminate Solution	32	gal/d	17	gal/d
Low HSOW Volume				
Recycle Ammonia-N	17	lbs/d	17	lbs/d
Recycle Sol P	4	lbs/d	4	lbs/d
Sodium Aluminate Solution	6	gal/d	6	gal/d
Medium HSOW Volume				
Recycle Ammonia-N	200	lbs/d	200	lbs/d
Recycle Sol P	50	lbs/d	50	lbs/d
Sodium Aluminate Solution	69	gal/d	69	gal/d
High HSOW Volume				
Recycle Ammonia-N	402	lbs/d	402	lbs/d
Recycle Sol P	100	lbs/d	100	lbs/d
Sodium Aluminate Solution	138	gal/d	138	gal/d

5.3. – Civil Design Basis

5.3.1.1. General

The work for this project will be performed inside the wastewater treatment plant property.

County: Monroe
Municipality: Bloomington, IN
Parcel ID: 53-08-29-300-008.000-008
Parcel Size: 37.33 acres
Zoning: TBD (typ. M-1 or Special Use)

5.3.1.2. Codes

The following laws, regulations and codes will be followed for design of this project:

The Indiana Department of Environmental Management has the responsibility of issuing construction permits for wastewater treatment plants. In addition to following Indiana codes, the project will also be designed using the guidelines outlined in the *Recommended Standards for Wastewater Facilities (Ten States Standards).*

5.3.1.3. Permits and Reviews

The permits foreseen for this project are:

1. IDEM Wastewater Plant Construction Permit
2. Monroe County SWCD Rule 5 Permit
3. IDEM Notice of Intent (NOI)
4. IDEM Air Emissions Permit

5.3.2. Environmental

The following environmental aspects have been reviewed for the Dillman Road Wastewater Treatment Plant site.

5.3.2.1. Floodplain

The IDNR floodplain mapping tool was used to verify floodway and floodplain limits on site. According to the mapping tool, which still needs to be verified by an official eFARA document from DNR, the 100-yr floodplain on the property ranges between 627.3 and 630.8. The floodplain delineation shows a portion of the stream inside the floodplain. Construction inside the floodplain does not require a permit through IDNR if it is outside of the 100-year floodway boundary. However, the top and entrance into all structures needs to be at least 2 feet above the 100-year flood elevation in a flood plain.

5.3.2.2. Stormwater Management

The stream located between the main plant and the existing solids handling building will need to be crossed with a new 36” forcemain from the Raw Sewage Pump Station and approximate 48” primary effluent line back to the Aeration Basin Complex. The construction activities in this stream may require coordination with USACE and will require coordination with IDEM and the Monroe County Drainage Board to determine which, if any, permits are necessary. Full stream crossing restoration will be required.

5.3.2.3. Grading Work and Erosion Control

The impacted construction area is expected to be significantly over 1 acre, therefore a General Construction Stormwater (GCS) permit will need to be obtained. Permit review documents will first need to be obtained from the Monroe County Soil and Water Conservation District (SWCD). Prior to construction the Notice of Intent (NOI) will need to be submitted by the Contractor to IDEM at least 48 hours before construction begins. Multiple site inspections by the Monroe County SWCD and IDEM should be expected during construction.

There will also be significant grading changes on site. Preliminary concept-level grading plans from work performed several years ago were provided to account for grading costs in the areas of the proposed improvements. The grading will not change the overall drainage pattern.

5.3.2.4. Buried Plant Piping

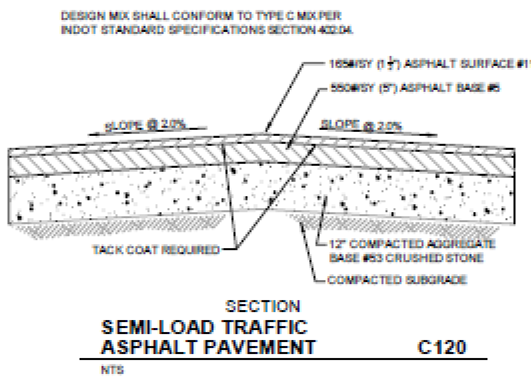
There is a significant amount of proposed site piping. The proposed underground piping is included in the overall piping schedule provided in Table 32.

5.3.2.5. Contractor Access and Staging/Storage Area

The contractor can access the project site from Dillman Road, just west of the Plant Administration Building. Staging areas can be determined as the design-build process progresses.

5.3.2.6. Roadways

No public roadways will be impacted by construction. There will be new asphalt drives designed to the anaerobic digesters and other solids and biogas handling facilities from east of the Sludge Storage Building, then wrapping around the primary filters and grit complex, before tying back into existing roads. The existing bridge across the creek will be reused to tie in from the west side of the existing Belt Filter Press Dewatering Building.



5.3.2.7. Site Restoration

Site restoration will be required post-construction. Any special landscaping is yet to be determined, but in general, the site will be returned to its original state prior to construction. All turf areas will be reseeded and all damaged concrete or asphalt pavement will be repaired/repaved.

5.4. – Structural Design Basis

5.4.1.1. Codes

1. International Building Code – 2012 Edition with 2014 Indiana Amendments
2. ACI 318: Building Code Requirements for Structural Concrete
3. ACI 350: Code Requirements for Environmental Engineering Concrete Structures
4. ACI 530: Building Code Requirements for Masonry Structures
5. ASCE 7: Minimum Design Loads for Buildings and Other Structures
6. AISC 360: Specification for Structural Steel Buildings
7. PCI: Precast and Pre-stressed Concrete

5.4.1.2. Foundations

1. Information from geotechnical investigations (performed during detailed design) will be used for the design of the new facilities foundations.
2. Surface fill materials will be excavated and replaced with compacted granular fill beneath structures.

3. Ground water elevation for design will be based on projected high water levels from the geotechnical investigations, but not less than the 100 year flood elevation.
4. The new structures will be supported on mat type foundations or conventional spread footing foundations. During detailed design, alternate foundation types can be explored.
5. Bottom of excavations will be covered by mud mat or 12 inches of compacted granular material.
6. Backfill in trenches and excavations below pavements and structures shall be compacted granular material.
7. Exterior foundation insulation shall be provided along new building foundations.

5.4.1.3. Rock Removal

1. According to as-built information provided for the Phase 1 improvements performed in the year 2000, we anticipate encountering bedrock in most of the excavation activities anticipated for the project. On average, bedrock will be encountered between elevation 630 and 640, with exception to some areas where it could be encountered slightly higher or lower than this elevation range. Based on this range, we anticipate encountering bedrock 5-12 feet below existing grade. Further geotechnical analysis is recommended to confirm the depth and type of bedrock to be encountered in all areas of new construction anticipated for the project.
2. Due to the type of bedrock historically encountered in this area, construction activity may require line drilling in some areas to excavate the anticipated rock.
3. Information from geotechnical investigations will be used for the rock removal methods, requirements and limits.
4. Rock profiles will be considered when determining the structure locations and configurations.
5. Rock will be removed a minimum of 12 inches beyond all foundations.
6. Layer of granular fill will be placed between all rock surfaces and the foundations.

5.4.1.4. Cast-In-Place Concrete

1. Reinforcement: Deformed bars, ASTM A615, Grade 60.
2. Welded Wire Fabric: ASTM A185.
3. Concrete: 4500 psi.
4. Fill Concrete: 3000 psi, fiber reinforced.
5. Waterstop: PVC or Gasket type. Place in construction joints of dry structures below grade and water holding structure.
6. Precast concrete plank ceilings.
7. Slab Finish:
   - Floors: Slope ¼ in/ft to drains, troweled and sealed
   - Submerged and Interior Slabs: Float
   - Exterior Slabs: Float and broom finish
8. Wall Finish:
   - Buried or Submerged: As cast
   - Interior Exposed: Repair surface and prepare for specified finish.
   - Exterior Exposed: Repair surface and rub with finishing grout.

5.4.1.5. Masonry

1. Concrete Masonry Units (CMU):

- ASTM C90, Normal weight
- Nominal size 16”x8”. Depth defined on drawings.
- Cavity wall system consisting of cmu, insulation, air gap and stone veneer.
- Stone Exterior: To somewhat/closely match existing buildings.

5.4.1.6. Metals

1. Structural Steel:
   - W Shapes: ASTM A992, 50 ksi
   - M Shapes: ASTM A36
   - S, C and MC Shapes: ASTM A36
   - L Shapes: ASTM A36
   - HP Shapes: ASTM A572 Grade 50
   - HSS Square and Rectangular Shapes: ASTM A500, Grade B, 46 ksi
   - HSS Round Shapes: ASTM A500, Grade B, 42 ksi
   - Pipe Shapes: ASTM A53, Grade B, 35 ksi
   - Plates and Bars: ASTM A36
2. Aluminum: Alloy 6061-T6 or 6063-T6
3. Stainless Steel: AISI Type 316 exterior and submerged, Type 304 or 316 interior
4. Ladders: Aluminum
5. Stairs and Elevated Walkways: Aluminum stringers and framing, serrated aluminum bar grating treads and platforms.
6. Grating: Aluminum or fiberglass open grating or solid plank grating.
7. Railings: Aluminum
8. Aluminum floor access hatches, with safety netting/grating.

5.4.1.7. Thermal and Moisture Protection

1. Rigid Insulation:
   - Polyisocyanurate Board Insulation: ASTM C 1289, 25 psi, unless otherwise indicated.
   - Minimum thermal resistance "R" per inch: 5.0
2. Roofing Membrane:
   - Single-ply EPDM fully adhered membrane roofing and flashing system.
   - Thickness: 45 mils, nominal.
3. Sheet Metal Flashing and Trim:
   - Through-Wall Metal Flashing: Rubber membrane with stainless steel drip edge.
   - Copings: .050 inch thick Prefinished Aluminum.

5.4.1.8. Openings

1. Hollow metal door and window frames.
2. Egress door shall be equipped with exit devices where code required.
3. 1 inch thick double pane insulated glass only on non-fire rated doors, where required.
4. Door locksets shall be equipped with cylinders to suit master keying system.
5. Door handles shall be level type.
6. Insulated steel overhead coiling doors with operators as appropriate.

5.4.1.9. Coatings

1. Submerged steel and ductile iron: 1 coat polyurethane primer and 2 coats epoxy.

2. Concrete (only where noted): 3 coats epoxy.
3. Interior concrete block: 3 coats epoxy.
4. Interior exposed steel and ductile iron: 1 coat polyurethane primer and 2 coats epoxy.
5. Exterior exposed steel and ductile iron: 1 coat polyurethane primer, 1 coat epoxy, 1 coat polyurethane.
6. Dissimilar metal protection: 1 coat epoxy.
7. Provide chemical resistant coatings for concrete where required.

5.5. – Building Mechanical/ Plumbing Design Basis

5.5.1.1. Codes

1. Indiana Mechanical Code, 2012 International Mechanical Code with Indiana Amendments.
2. Indiana Plumbing Code, 2006 International Mechanical Code with Indiana Amendments.
3. Indiana Energy Code.
4. NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
5. Ten States Standards for Wastewater Facilities.

5.5.1.2. Design

1. Heating equipment will be sized to maintain 72°F in the electrical rooms. All other spaces will be designed for 55°F.
2. Electrical and Control Rooms will be air conditioned to maintain a space temperature of 80°F.

5.5.1.3. Ductwork

1. Fabricated and installed in accordance with SMACNA standards.
2. All ductwork shall be of aluminum construction.
3. All air grilles will be of aluminum construction.
4. Ductwork will be routed to provide a sweeping of fresh supply air across potential operator positions and exhausted at points of moisture and odor collection while providing access to the air grilles.

5.5.1.4. HVAC Equipment

1. Makeup air units will be of double wall construction. Interior will be coated or lined with 304 stainless steel liners.

2. Heat for the Digester Complex may be hot water to take advantage of available heat from the digester gas. All other buildings will be heated with natural gas heaters.

3. Exhaust fans will be either roof or wall mounted, aluminum construction ventilators.

4. All ventilation rates will be established based on the recommendations of 10 States Standards and NFPA 820. Generally, spaces containing gas handling equipment or with exposure to raw wastewater will be continuously ventilated at a rate of 12 air changes per hour (AC/Hr). All spaces with digester gas utilization equipment or below grade sludge pumping will be continuously ventilated at a rate of 6-AC/Hr. All other spaces without a code recommended

ventilation rate will be thermostatically ventilated at a rate dictated by heat generated within the space.

5.5.1.5. HVAC Piping

1. All above grade natural gas piping downstream of pressure reducing valves in each structure will be threaded black steel for smaller than 2-1/2" and welded black steel for 2-1/2" and larger.

2. Heating water piping will be black steel, welded for 2-1/2" and larger and threaded for smaller.

3. All below grade natural gas piping shall be HDPE piping.

5.5.1.6. Plumbing Piping

1. Donohue identified the following as standard:

   a) W1 is potable water
   b) W2 is non-potable water
   c) W3 is plant effluent

2. All sanitary piping to be of PVC construction except for hub drains. Hub drains will be of cast iron construction and transition to PVC below slab.
3. All sanitary vent piping to be of PVC construction
4. All potable water piping will be stainless steel or CPVC.
5. All non-potable water piping will be stainless steel or PVC.
6. All water lines will be insulated with 1" fiberglass insulation with PVC jacketing.

5.6. – Electrical Design Basis

5.6.1.1. Codes

1. NEC: National Electric Code
2. NEMA: National Electric Manufacturers Association
3. NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities
4. Recommended Standards for Wastewater Facilities (Ten State Standards)
5. UL: Underwriters Laboratory

5.6.1.2. Power Distribution

The existing system description is based on information contained in the year 2000 Dillman Road Wastewater Treatment Plant Improvements – Phase 1 Project drawings. If electrical distribution improvements have been performed in recent years, they are not reflected here.
Electrical service enters the site through a Duke Energy owned substation receiving two separate 34.5 kilovolt (kV) feeds. Both sources enter the plant from the east over US-37 and terminate within a jointly owned substation. Each of the feeds terminates on a separate set of overhead bussing which is connected via a manually operated tie switch; each set of bussing connects to a substation style transformer through primary fusing.

The transformers are rated 34.5-4.16 kV, 7,500 kVA and are delta-grounded wye with the neutral bushing connected to the ground grid through a resistor. The secondary conductors are the demarcation point between Duke and the City. Each transformer secondary feeds a separate 4.16 kV switchgear bus that is resistance grounded. The switchgear is installed in a weatherproof walk-in enclosure located within the City owned and fenced in portion of the substation.
The switchgear is split-bus with a main-tie-main automatic throw-over system to control power flow. Each main breaker is cable connected to a Duke transformer via underground conduit. The switchgear is housing draw-out circuit breakers, cold sequenced utility metering equipment, and automatic throw-over system. Each of the main breakers are normally closed and the tie breaker is normally open. Each switchgear bus is rated 1200 amperes (A) has three feeder breakers and one spare breaker; feeders S1, S3 and S5 are connected to Bus A while feeders S2, S4, and S6 are connected to Bus B.

Feeders S1 and S2 are connected through a series of key interlocked unit substations feeding the Intermediate Basin Complex, Final Basin Complex, and Pumping Station. Feeders S3 and S4 are connected to a split bus, key interlocked, main-tie-main circuit 4.16 kV breaker switchgear in the Basin Complex powering the Aeration Blowers. Feeders S5 and S6 are connected through a series of key interlocked unit substations feeding the Administration Building, Centrifuge Building, and Filter Building. The Pumping Station and Filter Builder have dual unit substations feeding split bus, main-tie-main 480 V motor control centers (MCC). The remaining unit substations feed single bus MCC's.
The 4.16 kV switchgear and enclosure is over 40 years old, and may warrant replacement due to the lack of spare parts, long-term functionality and operational concerns. Examination of the existing equipment condition and additional cost analysis is recommended to make a definitive determination of whether the switchgear should be replaced. However, replacement of switchgear is not a part of this concept project scope at this time.

Based on review several years ago, the plant has peaked at one third of the existing capacity of the Duke transformers and has capacity for the new load. Each bus would have a feeder connected to a pad-mount transformer outside of the Digester Control Building. The transformer will step down the voltage to 480 V, and feed a split bus, main-tie-main MCC. The MCC will be the distribution point to the new facilities.

For the Grit Removal and HRP Filter Facilities, 480-V power may be able to be extended from the Existing Raw Sewage Pump Station.

5.6.1.3. Outdoor Pad-mounted Transformers

1. Two transformers near the Digester Control Building. Each transformer will have the capacity to power the entire load of the building in the event of a transformer or feeder failure.
2. 4,160Δ - 480/277Y volt transformers.
3. Pad-mount oil-filled with FR3 or Biotemp.

5.6.1.4. Variable Frequency Drives

1. The adjustable speed loads will have engineered drives.
2. Wall-mounted, located external to the MCC's.
3. Pulse width modulated (PWM) variable frequency drives.
4. The VFD's will be 6-pulse PWM drives.
5. Contain a dedicated circuit breaker disconnect

6. Equipped with Ethernet/IP Communications.
7. Passive harmonic filter with capacitor disconnect contactor manufactured by MTE or Mirus.
8. Surge protection.
9. NEMA 12 enclosure, suitable for 50° C (122° F).
10. UL labeled with 65,000 AIC short circuit current rating.

5.6.1.5. Motor Control Centers

1. The MCC's will contain motor starters and circuit breakers to power the facility motors and equipment.
2. Manufactured by Eaton or others – to be determined with CBU.

5.6.1.6. Power Panel Board – 480V

1. The 480V power panelboards will power smaller 480V equipment in the buildings that don't require motor starters.
2. 42-circuit panelboard.

5.6.1.7. Lighting Panel Board – 120/208V

1. The 120/208V lighting panelboards will power the lighting and 120V loads in the buildings.
2. 42-circuit panelboard.

5.6.1.8. Motor Starters

1. Motor Starters with motor circuit protectors in the motor control centers.
2. Combination starters with disconnect and motor circuit protector.
3. Integral to MCC's
4. Minimum Size: NEMA 1

5.6.1.9. Surge Protection

1. Surge protection will be included on motor control centers, panelboards, lighting panel and other critical electrical devices.

5.6.1.10. Local Disconnects

1. Motors and pumps shall have local disconnects for local control at these locations.

5.6.1.11. Conduit

1. Exterior Conduit
    a) Underground – Concrete encased with reinforcing and Schedule 40 PVC conduit for power and control; galvanized rigid steel conduits for instrumentation. Underground bends, elbows, and stub-ups will be PVC coated galvanized rigid steel conduit.
    b) In Slabs – Schedule 40 PVC conduit. Transition to PVC coated rigid steel conduit 5'-0" before exiting the slab and for conduit stub-ups and conduit elbows.
    c) Exposed – PVC coated rigid steel conduit.
    d) Duct banks will be provided with steel reinforcement; concrete will be dyed red.
2. Interior Conduit
    a) Exposed Dry Locations – Galvanized rigid steel conduit.
    b) Exposed Corrosive and Wet Locations – PVC coated rigid steel conduit.

c) Flexible Conduit – Liquid flexible metal conduit.

3. Hazardous Locations
   a) Exposed – Galvanized rigid steel conduit.
   b) Flexible Conduit – Stainless steel braid suitable for hazardous locations.
4. Minimum Size: ¾” unless otherwise noted.
5. Threaded, no set screw or indenter type fittings.

5.6.1.12. Conductors (600V and Less)

1. Branch Circuits – Single conductor THHN / THWN copper conductors.
2. Control Circuits – Single Conductor THHN / THWN copper conductors.
3. Feeders and Conduit Duct Banks – Single conductor XHHW-2
4. Minimum Size: #12 AWG and #14 for Control Circuits unless otherwise noted.

5.6.1.13. Medium Voltage Conductors

1. Generals - Single conductor type MV-105.
2. Cable - Ethylene propylene rubber (EPR) insulated.
3. Conductors - Class B stranded copper.
4. Strand Screen: Energy suppression layer concentrically extruded over stranded conductor
5. Insulation: Type ethylene propylene rubber (EPR) with insulation thickness corresponding to 133% insulation level.
6. Insulation Screen: Outer energy suppression layer concentrically extruded directly over insulation.
7. Metallic Shielding: Copper shielding tape, helically applied over semiconducting insulation shield or evenly spaced solid copper wires applied concentrically over semiconducting conductor shielding.
8. Jacket: Black polyvinyl chloride (PVC) outer jacket.
9. Manufactured by Okonite Company, General Cable or Kerite Company.

5.6.1.14. Heat Trace

1. Heat trace shall be installed above ground and below ground at a depth of 5 feet at miscellaneous locations that require freeze protection on insulated piping.

5.6.1.15. Lighting

1. Interior Lighting (as required during detailed design)
   a) Light emitting diode (LED) fixtures.
   b) Adequate lighting for a bright well-lit environment.
   c) Light fixtures will be located to allow the fixtures to be relamped.
2. Exterior Lighting (as required during detailed design)
   a) Light emitting diode (LED) fixtures.
   b) Adequate lighting for a bright well-lit environment.
   c) Light fixtures will be located to allow the fixtures to be relamped.

5.7. – Instrumentation and Controls Design Basis

5.7.1.1. Codes and Standards

1. IEEE: Institute of Electrical and Electronics Engineers
2. ISA: International Society of Automation
3. NEC: National Electric Code
4. NEMA: National Electrical Manufacturers Association
5. NFPA: National Fire Protection Agency
6. UL: Underwriters Laboratory

5.7.1.2. Existing Conditions

The existing system description is based on information contained in the year 2000 Dillman Road Wastewater Treatment Plant Improvements – Phase 1 Project drawings.

1. Programmable Logic Controllers (PLC's)

   a. Process control of the facilities is performed by Rockwell Automation SLC® 5/05 series of controllers. This is dated technology for which replacement parts and additional new boards for expansion of connections are becoming more expensive if still available. It is possible that East and West Basin Complex PLCs were upgraded in the recently completed Phase 1 Project. These processors support and are connected to the Process Control Network described below.
   b. 5 PLCs are located at the plant. These include:

      i. East Basin Complex PLC-EB
      ii. West Basin Complex PLC-WB
      iii. BFP/GBT No. 1 PLC
      iv. BFP/GBT No. 2 PLC
      v. Pump Station Building PLC

2. Process Control Network (PCN)

   a. The PCN allows the PLC processors to exchange information amongst themselves and deliver and receive information to the Human Machine Interface (HMI).
   b. The PCN used at the Dillman Road WWTP utilizes the Ethernet/IP protocol. Copper cabling is used for inter-building links less than 300 feet, while 6-strand fiber optic cabling is used for links between buildings.
   c. The plant-wide fiber PCN is setup in a ring topology.

3. Human Machine Interface (HMI)

   a. HMI functions for the Process Control System (PCS) are based on the Intellution IFix software platform. Again, upgrades may have occurred in the recently completed Project.
   b. Four HMI computers exist at the facility, located at the Administration, East Basin Complex, West Basin Complex, and the Press Buildings.

5.7.1.3. Network Design

Ethernet is the de-facto standard used for communications between servers, computers, PLC's, and a multitude of other devices used for process control. The existing Ethernet fiber optic ring network has been well maintained and will continue to serve the network needs of the facility into the foreseeable future.

A fiber optic network loop extension is planned and proposed process improvements will continue to use the Ethernet protocol as established at the facility.

The 2000 improvements project describes the network electronics as Ethernet hubs. Hub based technology has been replaced by Ethernet switches more than 10 years ago. Switches offer 10 to 100 times increased speed and eliminates broadcast traffic on the network. Replacement of the existing hubs with switches is recommended. For new process areas, Ethernet switches will be installed.

The existing fiber optic ring will be extended to the new PLCs in the Grit Removal, Primary Filter, Co-Thickening, and Digester Control Buildings.

5.7.1.4. Programmable Logic Controllers

New PLCS are planned to be installed in the Grit Removal, Primary Filter, Co-Thickening, and Digester Control Buildings.

5.7.1.5. SCADA System Considerations

New HMI screens will be developed for all new unit processes.

6. Funding Mechanisms

The Project Team evaluated two primary funding mechanisms:

<u>CBU Self-Funded via State Revolving Fund (SRF) Loan Program</u>
Under this option, CBU would finance the project using SRF funding available through the State of Indiana. While CBU typically funds projects with a 20-year bond that at this point in time is expected to carry a 5-6% interest rate, SRF funding currently has much lower interest rates. With Bloomington having a low median household income and the project being green and sustainable in nature, current SRF rates are expected to be between 1.5% and 2.5%. The project model conservatively assumes a 2.5% interest rate.

The primary benefit of this funding mechanism is the lower cost of capital than what private parties would likely require under a public private partnership arrangement. However, under this scenario there would be significantly more scope that the City would need to coordinate and either build new internal capacities or contract externally for.

<u>Public Private Partnership (Build – Operate – Transfer)</u>
With this alternative, CBU would enter into a long term public private partnership with a private entity to finance, build, own, and operate and maintain the portions of the resource recovery project downstream of the necessary wastewater treatment improvements (grit removal, primary filtration,

thickening) which the City would fund utilizing SRF funding. Under Indiana code, a viable project delivery method is Build-Operate-Transfer, with the transfer representing an opportunity for the private party to transfer the project to CBU at some point in the future.

The private entity would recoup its expended funds for capital and operating costs by retaining the vast majority of the project revenues associated with HSOW tip fees and energy sales (electric or RNG and all associated attributes). Additional funds for managing CBU's biosolids and the residual solids from the anaerobic digester would be needed. Instead of paying a private party to haul Blucher Poole and Dillman Road WWTPs' biosolids to the landfill, CBU would make payments to the private party for managing the biosolids via anaerobic digestion.

Given the size and level of risk associated with the project for securing HSOW feedstocks and managing residual products it is likely that any private parties interested in the project would finance the project with equity rather than debt financing. Cost of capital and return requirements will vary depending on the companies, however for this study it was assumed that a 10% internal rate of return would be required.

While a higher cost of capital, the public private partnership brings the advantage of having a single party who is uniquely familiar with biogas projects responsible for execution of the project. Having invested significant capital into the project, the private party has more investment into the project than a typical municipal contractor and is well aligned and motivated to ensure the project is successful.

Inflation Reduction Act of 2022 (IRA)

Signed into law by President Biden on August 16th, the Inflation Reduction Act of 2022, in addition to other measures, allocates $369 billion in spending and tax incentives over the next ten years to address climate change by providing incentives to encourage the production and use of domestic clean energy – including energy produced from wastewater derived biogas.

Section 48C Investment Tax Credit (ITC)
The ITC was extended for facilities placed in service after 12/31/22 and that begin construction prior to 1/1/25. and expanded to include qualified biogas property which includes anaerobic digesters and biogas conditioning and upgrading equipment. Credit values range from 6% to 50% of eligible project costs based on the following:

- 6% base credit value
- 2% base credit bonus for projects meeting domestic content requirements
- 2% base credit bonus for projects located in an "energy community"
- 5x base credit bonus for projects that mean prevailing wage and apprenticeship requirements

An energy community is yet to be fully defined by the IRS, but initial language in the IRA includes CERCLA brownfield sites, metropolitan or non-metropolitan areas that at any time since 2010 have met qualifying criteria for oil and gas activity (employment, tax revenues, unemployment), census tracts or directly adjoining census tracts with a coal mine or coal fired generating unit closure.

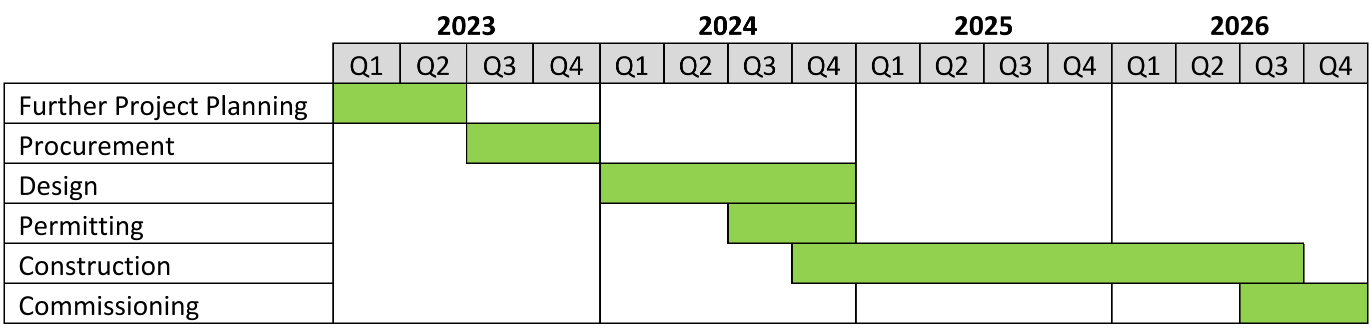
For this study it was assumed that the project would qualify for at least 40% of eligible project costs due to meeting domestic content requirements, and the prevailing wage and apprenticeship requirements.

Direct Pay Option for Tax Exempt Entities
Historically most tax incentives have been for the benefit of private corporations with tax liability, however, Section 13801 of the IRA allows tax exempt and government entities to elect for receiving a direct payment of the tax credit value. The amount that can be accepted as direct payment is reduced based on projects that do not meet the domestic content requirements.

This is a tremendous benefit to the CBU self-funded option as there is significantly less complexity in securing the project funding and 100% of the tax credit value is retained. Under the Public Private Partnership, the private entity will either need to involve a tax equity sponsor that has tax appetite, or under new rules included in the IRA, transfer (sell) the credit to an entity with sufficient tax appetite, likely at some discount to the tax credit. For the purposes of this study, it was assumed that 90% of the tax credit would be retained to the benefit of the project.

7. Project Schedule

The Project Team estimates that the CBU resource recovery project could begin construction in advance of the deadline of 12/31/24 to qualify for the 48C Investment Tax Credit as described above and the facility could be fully commercially operational by the beginning of 2027. Should construction be delayed, CBU could qualify by beginning Physical Work of a significant nature, which would entail ordering equipment specific to the project in advance of the deadline. A high-level schedule is shown below:



8. Capital Cost Estimates and Project Financials

8.1. Capital Cost Estimates

The Project Team, led by Kokosing Industrial, one of the most experienced wastewater contractors in the Midwest, provided capital cost estimates based on the basis of design which was led by Donohue. The estimate was generated using Kokosing's internal project estimating tool and used a variety of inputs including vendor quotes specific to this project, historical project costs, current labor rates and indirect project costs. The project estimate was generated in current dollars and then escalated for assumed increase in costs between now and when the project is executed. The estimates shown below are preliminary in nature, based on limited project design details and subject to further adjustment as the scope is more defined.

Table 34: CAPEX Estimates - CHP Options

48C ITC Eligible	In CBU CIP?	P3 Funded?	Scope Area	None	Low	Base	High
No	Yes	No	Planning/Design - WWTP Improvements	$ 2.7	$ 2.7	$ 2.7	$ 2.7
Yes	No	Yes	Planning/Design - Resource Recovery	$ 2.6	$ 2.8	$ 2.9	$ 4.0
No	Yes	No	Vortex Grit Removal	$ 4.9	$ 4.9	$ 4.9	$ 4.9
No	No	No	High Rate Primary Treatment	$ 10.4	$ 10.4	$ 10.4	$ 10.4
Yes	No	Yes	Solids Receiving	$ 1.9	$ 1.9	$ 1.9	$ 1.9
Yes	No	Yes	HSOW Receiving (Liquid)	$ -	$ 0.6	$ 1.0	$ 1.4
No	No	No	Gravity Thickening	$ 3.0	$ 3.0	$ 3.0	$ 3.0
No	No	No	Rotary Drum Thikcening	$ 4.7	$ 4.7	$ 4.7	$ 4.7
Yes	No	Yes	Anaerobic Digesters	$ 14.1	$ 14.1	$ 14.1	$ 19.8
Yes	No	Yes	Biogas Utilization	$ 3.2	$ 4.6	$ 4.6	$ 7.9
No	No	No	General Site Work	$ 2.0	$ 2.0	$ 2.0	$ 2.0
Yes	No	Yes	Odor Control	$ 0.9	$ 1.1	$ 1.1	$ 1.3
			Total	$ 50.3	$ 52.8	$ 53.3	$ 64.1
			CBU CIP Project Budget	$ 8.3	$ 8.3	$ 8.3	$ 8.3
			Resource Recovery Project Costs	$ 42.0	$ 44.5	$ 45.0	$ 55.8
			48C ITC Elgible CAPEX	$ 22.6	$ 25.1	$ 25.6	$ 36.4
			P3 Cases				
			P3 Funded Resource Recovery Project Costs	$ 22.6	$ 25.1	$ 25.6	$ 36.4
			CBU Funded Resource Recovery Project Costs	$ 19.4	$ 19.4	$ 19.4	$ 19.4
			P3 48C ITC Eligible CAPEX	$ 22.6	$ 25.1	$ 25.6	$ 36.4
			CBU 48C ITC Eligible CAPEX	$ -	$ -	$ -	$ -

Table 35: CAPEX Estimates - RNG Options

48C ITC Eligible	In CBU CIP?	P3 Funded?	Scope Area	None	Low	Base	High
No	Yes	No	Planning/Design - WWTP Improvements	$ 2.7	$ 2.7	$ 2.7	$ 2.7
Yes	No	Yes	Planning/Design - Resource Recovery	$ 3.0	$ 3.1	$ 3.2	$ 4.1
No	Yes	No	Vortex Grit Removal	$ 4.9	$ 4.9	$ 4.9	$ 4.9
No	No	No	High Rate Primary Treatment	$ 10.4	$ 10.4	$ 10.4	$ 10.4
Yes	No	Yes	Solids Receiving	$ 1.9	$ 1.9	$ 1.9	$ 1.9
Yes	No	Yes	HSOW Receiving (Liquid)	$ -	$ 0.6	$ 1.0	$ 1.4
No	No	No	Gravity Thickening	$ 3.0	$ 3.0	$ 3.0	$ 3.0
No	No	No	Rotary Drum Thikcening	$ 4.7	$ 4.7	$ 4.7	$ 4.7
Yes	No	Yes	Anaerobic Digesters	$ 14.1	$ 14.1	$ 14.1	$ 19.8
Yes	No	Yes	Biogas Utilization	$ 6.4	$ 6.6	$ 7.0	$ 8.9
No	No	No	General Site Work	$ 2.0	$ 2.0	$ 2.0	$ 2.0
Yes	No	Yes	Odor Control	$ 0.8	$ 1.1	$ 1.1	$ 1.3
			Total	$ 53.9	$ 55.1	$ 56.0	$ 65.2
			CBU CIP Project Budget	$ 8.3	$ 8.3	$ 8.3	$ 8.3
			Resource Recovery Project Costs	$ 45.6	$ 46.8	$ 47.7	$ 56.9
			48C ITC Elgible CAPEX	$ 26.2	$ 27.4	$ 28.3	$ 37.5
			P3 Cases				
			P3 Funded Resource Recovery Project Costs	$ 26.2	$ 27.4	$ 28.3	$ 37.5
			CBU Funded Resource Recovery Project Costs	$ 19.4	$ 19.4	$ 19.4	$ 19.4
			P3 48C ITC Eligible CAPEX	$ 26.2	$ 27.4	$ 28.3	$ 37.5
			CBU 48C ITC Eligible CAPEX	$ -	$ -	$ -	$ -

8.1.1. Capital Improvement Plan Project Costs vs. Resource Recovery Project Costs

Upon discussing the proposed project scope with CBU, staff indicated that several of the Dillman Road WWTP improvements were improvements that were contemplated in CBU's capital improvement plans and therefore should be not included in the analysis of the financials of this project. These costs total $18M and represent the enhanced grit removal and high rate primary filtration improvements. The remaining resource recovery scope includes all improvements downstream of high rate primary filtration and equal $32M-$46M depending on the scenario, which represents the capital costs used in the financial analysis.

8.1.2. 48C Investment Tax Credit Eligible Costs

IRS has yet to release full guidance on the definition of "qualified biogas property" used for the 48C Investment Tax Credit, however the langue used in the law is as follows:

``(7) Qualified biogas property.—

``(A) In general.--The term `qualified biogas property' means property comprising a system which--
``(i) converts biomass (as defined in section 45K(c)(3), as in effect on the date of enactment of this paragraph) into a gas which--
``(I) consists of not less than 52 percent methane by volume, or
``(II) is concentrated by such system into a gas which consists of not less than 52 percent methane, and
``(ii) captures such gas for sale or productive use, and not for disposal via combustion.

``(B) Inclusion of cleaning and conditioning property.--The term `qualified biogas property' includes any property which is part of such system which cleans or conditions such gas.

``(C) Termination.--The term `qualified biogas property' shall not include any property the construction of which begins after December 31, 2024."

Based on this limited information, the Project Team has assumed that all project components dealing with processing of HSOW, the anaerobic digester and the biogas utilization equipment will all be eligible for the ITC, while any improvements specifically related to the Dillman Road WWTP, upstream of the HSOW receiving and digester, are not eligible.

8.2. 20 Year Financial Model

The Project Team, led by Energy Power Partners, an experienced investor, owner, and operator of waste to energy and biogas facilities, constructed a 20 year financial model to analyze the project economics. This financial model can be found in excel format accompanying this report. The model was developed using current operational costs, assumptions based on market research performed as part of this study, other similar operational projects, and EPP's experience in selling electricity and RNG, to name a few sources. The model analyzes 16 scenarios based on the following options:

HSOW Volumes

- None

- Low
- Medium (Base Case)
- High

Funding Source
- CBU Self Funded
- P3 Private Party Funded [Anaerobic Digestion and Biogas Utilization Improvements Only]

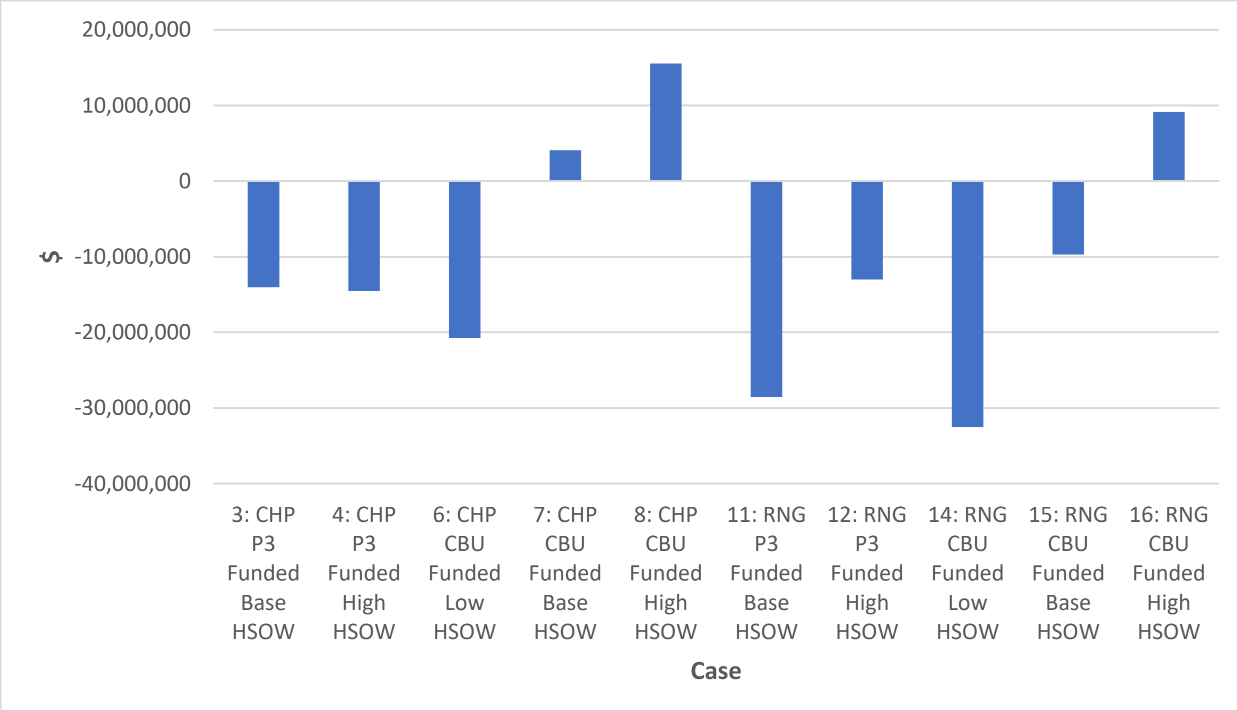
Biogas Utilization
- CHP
- RNG

The following is a brief description of each case and the corresponding 20 year NPV for CBU as of 12/31/2025 based on a 5.5% discount rate.

Table 36: Case Summary Most Likely Scenarios

	NPV ($M)	HSOW Volume	Funding Source	Biogas Utilization
Case 3	-$14.0M	Medium (Base)	Private Party P3	CHP
Case 4	-$14.5M	High	Private Party P3	CHP
Case 6	-$20.7M	Low	CBU Self Funded	CHP
Case 7	$4.1M	Medium (Base)	CBU Self Funded	CHP
Case 8	$15.5M	High	CBU Self Funded	CHP
Case 11	-$28.5M	Medium (Base)	Private Party P3	RNG
Case 12	-$13.0M	High	Private Party P3	RNG
Case 14	-$32.5M	Low	CBU Self Funded	RNG
Case 15	-$9.7M	Medium (Base)	CBU Self Funded	RNG
Case 16	$9.1M	High	CBU Self Funded	RNG

Figure 25: Financial Analysis NPV Comparison



With the current set of assumptions, the three most promising NPV cases are Case 7, Case 8 and Case 16, all of which are CBU Self-Funded options with significant quantities of HSOW and utilization of the biogas in a CHP.

In the other cases the capital and operational expenses outweigh the project's cost savings and revenue generation for CBU, mainly due to a combination of a) high project capital costs for RNG cases, b) low volumes of HSOW, or c) higher cost of capital for private party P3 cases.

There are dozens of assumptions that go into each case, all of which can be found in the excel model and altered as more information becomes available and/or as the project advances. A sensitivity analysis for various assumptions is shown below for Case 7, with the impact to the NPV should various assumptions change. This analysis shows that the following assumptions are most impactful:

- ITC Value Realized
- Volumes of HSOW
- Operational Assumptions
- Capital Costs
- RNG/RIN Pricing
- HSOW Tip Fees
- Solids Disposal/Beneficial Reuse Expense

Table 37: Case 7 (Base HSOW, CBU Self-Funded, CHP) Sensitivity Analysis

Sensitivities	Change	Incremental NPV
Base Case - CAPEX (0%)	-	-
CAPEX Savings	-20.0%	8,566,208
CAPEX Savings	-10.0%	4,283,104
CAPEX Overrun	10.0%	-4,283,104
CAPEX Overrun	20.0%	-8,566,208
Base Case - ITC Realized (40%)	-	
ITC Realized	50.0%	2,492,984
ITC Realized	30.0%	-2,492,984
ITC Realized	0.0%	-9,971,936
Base Case - HSOW Volume Impact (0%)	-	
Volume Reduction	-20.0%	-9,054,332
Volume Reduction	-10.0%	-4,526,724
Volume Increase	10.0%	3,751,211
Volume Increase	20.0%	7,415,743
Base Case - HSOW Pricing Impact (0%)	-	
Pricing Reduction	-20.0%	-5,459,547
Pricing Reduction	-10.0%	-2,729,773
Pricing Increase	10.0%	2,729,773
Pricing Increase	20.0%	5,459,547
Base Case - RNG/RIN Pricing (0%)	-	
Pricing Reduction	-20.0%	-5,008,624
Pricing Reduction	-10.0%	-2,504,312
Pricing Increase	10.0%	2,504,312
Pricing Increase	20.0%	5,008,624
Base Case - OPEX (0%)	-	
OPEX Savings	-20.0%	6,883,320
OPEX Savings	-10.0%	3,441,660
OPEX Overrun	10.0%	-3,441,660
OPEX Overrun	20.0%	-6,883,320
Base Case - Solids Disposal (0%)	-	
Pricing Reduction	-20.0%	3,064,317
Pricing Reduction	-10.0%	1,532,159
Pricing Increase	10.0%	-1,532,159
Pricing Increase	20.0%	-3,064,317

All assumptions and calculations can be found in the accompanying Excel model.

9. Regional Collaboration Potential

As discussed above in the project financials and shown in the model, the project economics improve as the project grows larger and achieves greater economies of scale. As an alternative to sourcing larger volumes of HSOW, which may prove difficult to secure, CBU could consider partnering with nearby municipalities on a regional project.

One potential partner is the City of Columbus, Indiana located approximately an hour to the east of Bloomington. Bloomington and Columbus' mayors enjoy a strong working relationship and have already engaged in efforts to collaborate on other sustainability measures. In evaluating the partnership potential with Columbus or other municipal entities the following questions should be considered:

- How does the municipality manage its biosolids produced at the wastewater treatment plant(s) and at what cost?
- Does the municipality have any HSOW generators located within its service territory that could participate in the project?
- Where is the ideal location for siting the project?

The Project Team encourages CBU to explore partnership opportunities with other municipalities in the region, however, acknowledges that there may be challenges in fully integrating multiple communities under a single common project.

10. Triple Bottom Line Analysis

Triple Bottom Line is a concept that encourages the evaluation of investments and business practices through a multi-faceted lens of profit, people, and planet. Profit is explored in detail in other sections of this report, however there are substantial societal and environmental benefits to a project of this nature as well.

10.1. Environmental

Environmental benefits of the project can be summarized in three key areas:

<u>Renewable Energy Production</u>
Under both biogas utilization options considered for this project the resulting energy displaces fossil fuel derived energy generation, either in the form of grid power or natural gas fueling. According to the EPA's Greenhouse Gas Emissions Calculator, approximately 6,000 tons of carbon dioxide equivalent would be avoided by the electricity produced by the anaerobic digester under the CHP scenario.

<u>Avoided Landfilling of CBU Biosolids & Organic Wastes</u>
Landfills are only partially effective at capturing methane emission associated with the decomposition of organic wastes, according to the EPA's 2021 Greenhouse Gas Emissions Reporting the Sycamore Ridge Landfill that CBU biosolids are dispose at only had a 49% capture efficiency for methane emissions associated with the landfill operations. Given the biomethane potential associated with CBU's biosolids, this represents approximately 4,750 MT CO_2e of emissions associate with landfilling CBU's biosolids.

Not all contemplated HSOW feedstocks are currently landfilled but any HSOW that is diverted from landfill, such as the FOG currently processed at Dillman Road WWTP, will represent additional avoided emissions.

Recycle of Nutrients in Biosolids to Agriculture
Today all the nitrogen, phosphorous and other micronutrients present in CBU's biosolids are buried in a landfill. With this project the biosolids produced will be a Class B product suitable for land application and use in local agriculture. The use of biosolids will offset conventional fertilizer use which is typically manufactured using large quantities of fossil fuels. Moreover, the bacteria and micronutrients found in biosolids has been shown to improve soil health vs. conventional fertilizer use.

The environmental benefits of this project are numerous, and the project aligns very well with the City of Bloomington's Climate & Sustainability Action Plans and is specifically mentioned as one of the strategies to help the City achieve its goals.

A few of the goals that this project will directly help address include:

1) Climate Action Plan goals of:
    a. Reducing community greenhouse gas emissions 25% below 2018 emissions levels of 1.3M metric tons of carbon dioxide equivalent (MT CO2e) by 2030 and achieve carbon neutrality by 2050. **[~10,000 MT CO2e from Scope 2 and Scope 3 emissions]**
    b. Increasing distributed renewable energy to 250,000 MWH of total generation annually by 2030 **[nearly 8,700 MWH/year]**
    c. Supporting decarbonization of the local electricity grid
    d. Increase landfill solid waste diversion by 30% of 2018 values, 26,500 tons of waste reduction **[minimum of 11,000 CBU tons of biosolids diverted, potential for significantly more with landfill diverted HSOW]**
2) The City's stated Sustainability Action Plan goals of:
    a. Reducing GHG emissions from municipal operations 12% relative to a baseline of 33,702 metric tons in 2015. **[~6,100 MT CO2e Scope 2 emissions]**
    b. Reducing non-renewable energy use in City owned and operated facilities 12% relative to a baseline usage of 155,282 MMBTUs in 2015 **[80%+ reduction in Dillman Road non-renewable energy use, 12% reduction in Blucher Poole non-renewable energy use, representing nearly 30,000 MMBTU reduction – achieving the full goal]**
    c. Reduce energy use associated with treating and transporting water and wastewater by 10% of 2018 values **[12% reduction in Blucher Poole existing processes, net reduction in Dillman Road. energy use if self-generated power credited in accounting]**
    d. Increase local agricultural resilience to climate shocks

10.2. Societal

While perhaps not as obvious as the environmental benefits, there are significant positive social benefits to implementing the resource recovery program as well, across the following major categories:

Job Creation
A project of this magnitude will create dozens of local construction jobs and at a minimum ~5 full-time operations positions as well.

Sustainable Organics Disposal Facility for City and Regional Businesses
Today options are limited for businesses attempting to minimize their waste sent to landfill. With the addition of this facility businesses will be able to have a competitive means to lower cost and more sustainable organics disposal options. In some select instances anaerobic digestion infrastructure has been impactful in attracting food and beverage manufacturers to a region who are looking for reliable sustainable management options for their byproducts.

Community Education
A resource recovery program and facility would provide a unique platform to educate ratepayers and the broader community on the importance of sustainable practices for waste management and renewable energy creation. At a minimum, tours could be facilitated and there is also potential to further broaden the outreach by setting up an education center either at the facility or off-site. This project will support to further Climate Action Plan societal goals such as:

- “Educate, engage and empower the public for climate health and safety
  Attract, create, and support businesses that are committed to sustainability and climate goals”
- “Educate, motivate, and empower the public to achieve waste reduction and diversion”

11. Appendix

11.1. Appendix A: List of HSOW Generators

11.2. Appendix B: Beneficial Use Federal Regulations & Standards

11.3. Appendix C: Basis of Design Sizing Worksheets

11.4. Appendix D: Existing and Proposed Site Plans and Flow Diagram Drawings

11.5. Appendix E: Primary Filter Design Summary