W.B. Casey WRRF Biosolids Management Facilities

Preliminary Engineering Report

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Clayton County Water Authority

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Executive Summary

Project Overview

The W.B. Casey Water Resource Recovery Facility (WRRF) is one of three water reclamation facilities owned and operated by Clayton County Water Authority (CCWA). A new wasteload allocation was received for the W.B. Casey WRRF in October 2019 that would allow a capacity expansion from 24 to 32 million gallons per day (mgd). As part of the subsequent capacity analysis, revised flow projections indicated a reduced urgency to expand the liquid stream facilities. However, the existing biosolids facility is operating near capacity, is at the end of its useful life, and represents safety concerns.

The purpose of the W.B. Casey WRRF Biosolids Management Facilities Preliminary Engineering Report is to present the design concept and to guide implementation of new Biosolids Management Facilities project. The purpose of this design is to replace the existing biosolids facilities with facilities sized for 32-mgd plant capacity. The additional and expanded processes include primary sludge (PS) anaerobic digestion, dewatering, cake receiving, and thermal drying.

Summary of Improvements

Existing waste activated sludge (WAS) thickening and proposed PS thickening (PST) are used to improve performance of downstream dewatering; PST also minimizes the volume of the anaerobic digesters. Sludge screening is used to remove debris that would diminish pellet quality. W.B. Casey WRRF's preliminary treatment includes screening, but it lacks the capacity to treat all influent flows.

Anaerobic digestion of thickened PS eliminates the constraint of maintaining sufficiently low PS to WAS ratio for high-quality pellets. By digesting only PS, the size and cost of the digester facility are minimized. Dewatering is used to produce the necessary feed concentration for thermal drying. Cake receiving allows dewatered cake from the Northeast Water Reclamation Facility (NEWRF) to be dried at the Dewatering/Thermal Drying Facility. Thermal drying produces a salable pellet that is classified as Class A Exceptional Quality biosolids. CCWA has been producing this product for over 40 years.

Existing biosolids facilities which are incorporated into the Biosolids Management Facilities project include:

- Pellet Storage Bay
- WAS Thickening Facility
- W.B. Casey Raw Sewage Pump Station (RSPS)
- W.B. Casey RSPS Electrical Building
- WAS/Scum Pump Station

The following are the new biosolids facilities proposed as part of the Biosolids Management Facility project:

- PST Facility
- Thickened Sludge Screening Facility
- Digester 1
- Digester 2
- Digester Building
- Dewatering Feed Tanks and Pump Station

- Dewatering/Thermal Drying Facility
- Cake Receiving Facility

Selected processes and facilities for the Biosolids Management Facilities project at the W.B. Casey WRRF are further described below:

- ***WAS Thickening Facility***: The existing WAS Thickening Facility is modified to allow thickened waste activated sludge (TWAS) to be diverted to a proposed Thickened Sludge Screening Facility prior to being conveyed to the dewatering feed tank. Modifications will also include piping and isolation valves to direct WAS to a shared standby rotary drum thickener (RDT) at the proposed PST Facility. The shared standby RDT will provide reliability and redundancy. Support processes include polymer storage and feed and odor control.
- ***PST Facility***: The proposed PST Facility includes four RDTs on an elevated concrete platform, discharging to vertical hoppers. Thickened primary sludge (TPS) is pumped by new progressing cavity type variable speed pumps to the proposed Thickened Sludge Screening Facility for further treatment prior to anaerobic digestion. Existing PS pumps will remain; however, flow control values and flow meters are proposed to provide even flow distribution to the operating RDTs.
- ***Thickened Sludge Screening Facility:*** The proposed Thickened Sludge Screening Facility is composed of two duty screens and one standby screen. The influent TPS and TWAS flow streams are individually conveyed to the dedicated screens from their respective thickening facilities. The proposed Thickened Sludge Screening Facility consists of an elevated concrete platform analogous to the existing WAS Thickening Facility and proposed PST Facility. As thickened sludge passes through the screens, screenings are separated and discharged to collection containers to be hauled away for disposal at a landfill. The two screened, thickened sludge streams are directed to their respective downstream facilities: anaerobic digesters for TPS and Dewatering Feed Tanks for TWAS. The lower level of the facility is enclosed to allow for simplified odor control.
- ***Anaerobic Digestion:*** Anaerobic digestion is proposed to process PS only to provide mass reduction and to resolve current PS management issues associated with the quality of the dried pellet product. The proposed anaerobic digestion process includes two 2.2-million-gallon circular concrete digesters operating in parallel and configured to allow transfer between digesters. The digesters are designed for mesophilic temperatures and include a fixed concrete cover. Area at the site of the existing Lab Building is reserved for the construction of a third digester when plant capacity is expanded beyond 32 mgd capacity. Provisions are made in the Digester Building to accommodate equipment associated with all three digesters, including spiral heat exchangers, sludge recirculation pumps, digester sludge withdrawal pumps, and chemical feed areas.
- ***Dewatering Feed Storage:*** Two rectangular concrete Dewatering Feed Tanks with a total volume of 750,000 gallons store and blend digested TPS and TWAS through pump recirculation by proposed variable speed non-clog horizontal chopper pumps.
- ***Digester Gas System***: The digester gas system is operated based on digester gas pressure within the gas collection system. Raw digester gas includes hydrogen sulfide, moisture, volatile organic compounds, and particulates; the digester gas treatment system includes unit processes to remove these constituents. Excess gas not used by the boilers or drying facility is flared using the waste gas burners. The waste gas burners are enclosed burner stack models which have no visible flame.
- ***Dewatering***: Currently, CCWA uses belt filter presses for dewatering. Centrifuges were selected for the upgrade to enable process optimization and improved control of the dewatered cake concentration. The dewatering system includes centrifuge feed pumps which are located at the Dewatering Feed Tanks. The remaining dewatering equipment is located in the Dewatering/Thermal Drying Facility and includes centrifuges, a discharge screw conveyor system, an emulsion polymer system, and a centrate

system for handling water removed by the centrifuge. The facility is also sized to accommodate odor control technology.

- ***Cake Receiving:*** Dewatered cake from the NEWRF is processed along with dewatered cake from the W.B. Casey WRRF at the Dewatering/Thermal Drying Facility. The proposed Cake Receiving Facility consists of a truck bay, a truck receiving bin, and pumping system to transfer cake to the adjacent proposed Dewatering/Thermal Drying Facility. All cake receiving components are located in an enclosed building configured to receive cake from a tipping trailer.
- ***Thermal Drying*****:** The existing drying system located in the existing Pelletizing Facility is replaced with an updated thermal drying system designed to treat projected solids production rates at 32-mgd plant capacity. The proposed system is sized to treat all of the solids from W.B. Casey WRRF and also will allow for treatment of a portion of dewatered sludge from the NEWRF in addition to a projected volume of solids produced onsite. Preliminary design is based on a proprietary Andritz thermal drying system which is located in the proposed Dewatering/Thermal Drying Facility. The drying system includes a cake bin, mixer, furnace, drying drum, emissions stack, and pneumatic transport system, among others.

  In addition to capacity improvements, the proposed Dewatering/Thermal Drying Facility is designed to meet current fire code requirements and is capable of utilizing a blend of natural gas and biogas produced by the proposed digester facilities (the benefit of using digester gas to offset natural gas was included in the cost analysis). This capability combined with exhaust treatment processes allow the proposed facility to produce high-quality, marketable pellets with a solids content of 92 to 95 percent with reduced operating costs while remaining compliant with regulatory requirements. The pellet quality is expected to improve with the addition of the anaerobic digestion process.
- ***Polymer Storage and Feed:*** Polymer emulsion is delivered to the site via chemical delivery truck and transferred to separate bulk storage tanks provided at the PST and Dewatering/Thermal Drying Facilities. Each facility has a dedicated truck unloading station. Additionally, polymer may be added to dewatered cake from NEWRF as a lubricant aid to convey cake from the piston pump to the drying facility.
- ***Odor Control:*** Several odor control technologies are under consideration to minimize offsite odors and to promote a pleasant environment for workers and visitors. Odor control systems are proposed for evaluation at the Cake Receiving Facility, Dewatering/Thermal Drying Facility, and PST and Thickened Sludge Screening Facilities.
- ***Electrical improvements:*** New load centers will be installed since the proposed Biosolids Management Facilities will increase the connected load of the plant. Existing load centers will remain in service throughout construction to support ongoing operations.
- ***Site/Civil improvements:*** Abandoned facilities are demolished and new facilities are installed on existing CCWA property at the W.B. Casey WRRF. New wide access roads are designed to support larger, heavier vehicles. Stormwater best management practices are proposed for adequate retention and treatment and to meet discharge requirements.

Construction Cost

Construction cost estimates were developed for several biosolids alternatives. These cost estimates are Class IV (+50%/-30%), as defined by AACE International. For the selected alternative (3b-2), the estimated capital cost is $91.1 million. At the end of detailed design, a cost estimate that includes a line item for cost of the proposed Cake Receiving Facility will be included. At that time, the cost of unclassified cake disposal will be known with greater certainty, which will allow CCWA to come to a decision on whether to construct the Cake Receiving Facility.

Table of Contents

Executive Summary **1**

Table of Contents ..... **iii**

Acronyms and Abbreviations ..... **vii**

1. Introduction **1-1**
- 1.1 Background 1-1
- 1.2 Alternatives Selection 1-2
- 1.3 Purpose and Scope 1-3
- 1.4 Project Location 1-3

2. Design Basis **2-1**
- 2.1 Mass Balance and Peaking Factors 2-1
- 2.2 Operating Schedule 2-1
- 2.3 Build-out Capacity Considerations 2-2

3. Process Overview **3-1**

4. Waste Activated Sludge Thickening **4-1**
- 4.1 Introduction 4-1
- 4.2 Process Description 4-1
- 4.3 Functional Description 4-2
- 4.4 Reliability and Redundancy 4-3

5. Primary Sludge Thickening **5-1**
- 5.1 Introduction 5-1
- 5.2 Process Description 5-1
- 5.3 Functional Description 5-2
- 5.4 Reliability and Redundancy 5-3

6. Thickened Sludge Screening **6-1**
- 6.1 Introduction 6-1
- 6.2 Process Description 6-1
- 6.3 Functional Description 6-2
- 6.4 Reliability and Redundancy 6-3

7. Anaerobic Digestion **7-1**
- 7.1 Introduction 7-1
- 7.2 Process Description 7-1
  - 7.2.1 Anaerobic Digesters 7-1
  - 7.2.2 Digester Mixing 7-2
  - 7.2.3 Digester Heating 7-3
  - 7.2.4 Digester Cleaning 7-5
  - 7.2.5 Digester Withdrawal 7-6
  - 7.2.6 Emergency Overflow 7-7

7.2.7 Nitrogen Feed Connections ... 7-7
7.2.8 Chemical Fill Connections ... 7-7
7.2.9 Waste Gas Burners ... 7-8
7.2.10 Gas Conditioning ... 7-9
7.2.11 Hot Water System ... 7-10
7.3 Functional Description ... 7-11
7.3.1 Anaerobic Digesters ... 7-11
7.3.2 Digester Mixing System ... 7-12
7.3.3 Digester Heating and Recirculation ... 7-12
7.3.4 Digester Cleaning ... 7-12
7.3.5 Digester Sludge Withdrawal ... 7-12
7.3.6 Emergency Overflow ... 7-12
7.3.7 Nitrogen Feed Connections ... 7-13
7.3.8 Digester Gas System ... 7-13
7.3.9 Waste Gas Burner ... 7-13
7.3.10 Gas Conditioning ... 7-14
7.3.11 Heating Water System ... 7-14
7.4 Reliability and Redundancy ... 7-14

8. Dewatering ... 8-1
8.1 Introduction ... 8-1
8.2 Process Description/Overview ... 8-1
8.3 Functional Description ... 8-3
8.4 Reliability and Redundancy ... 8-4

9. Cake Receiving ... 9-1
9.1 Introduction ... 9-1
9.2 Process Description/Overview ... 9-1
9.3 Functional Description ... 9-3
9.4 Reliability and Redundancy ... 9-4

10. Thermal Drying ... 10-1
10.1 Introduction ... 10-1
10.2 Process Description/Overview ... 10-2
10.3 Functional Description ... 10-5
10.4 Reliability and Redundancy ... 10-5

11. Polymer Storage and Feed ... 11-1
11.1 Introduction ... 11-1
11.2 Process Description ... 11-1
11.3 Functional Description ... 11-3
11.4 Reliability and Redundancy ... 11-3

12. Odor Control ... 12-1
12.1 Introduction ... 12-1
12.2 Design Criteria ... 12-1

12.3 Sources, Loading, and Technology Selection 12-2
12.3.1 Preliminary Air Loads 12-2
12.3.2 Loading of Odorous Compounds 12-2
12.3.3 Odor Control Technology Survey 12-3
12.3.4 Odor Control Technology Selection 12-4
12.4 Process Functional Description 12-5
12.5 Siting, Layout and Air Conveyance 12-5
12.6 Reliability and Redundancy 12-5
12.7 Loading and Technology Selection Summary 12-5

13. Electrical Distribution 13-1
13.1 Existing Distribution System 13-1
13.2 Preliminary Design Overview 13-1

14. Site Civil 14-1
14.1 Introduction 14-1
14.2 Applicable Codes, Standards, and Design Criteria 14-1
14.3 Site Description 14-1
14.3.1 Existing Site 14-1
14.3.2 Proposed Site 14-2
14.3.2.1 Access Roads and Walkways 14-2
14.3.2.2 Fences, Gates, and Site Security 14-3
14.3.2.3 Grading and Stormwater Drainage 14-3
14.4 Erosion Control 14-5
14.5 Existing Utilities and Yard Piping 14-5

15. Construction Cost 15-1

16. References 16-1

Appendix A Process Flow Diagrams 16-1

Appendix B Overall Site Plan 16-1

Appendixes

A Process Flow Diagrams
B Overall Site Plan

Tables

2-1 Biosolids Management Facilities Design Peaking Factors 2-1
4-1 Existing WAS Thickening Design Criteria 4-1
5-1 PS Thickening Design Criteria 5-2
6-1 Sludge Screening Design Criteria 6-2
7-1 Anaerobic Digester Design Criteria 7-1
7-2 Digester Mixing System Design Criteria 7-2

7-3 Digester Sludge Recirculation Pump Design Criteria 7-3
7-4 Digester Heat Exchanger Design Criteria 7-4
7-5 Hot Water Recirculation Pump Design Criteria (Secondary Loops) 7-5
7-6 Digester Cleaning Pump Design Criteria 7-5
7-7 Digester Sludge Withdrawal Pump Design Criteria 7-6
7-8 Digester Chemical Injection Pump Design Criteria 7-8
7-9 Waste Gas Burner Design Criteria 7-8
7-10 Digester Gas Conditioning Design Criteria 7-9
7-11 Hot Water Boiler Design Criteria 7-10
7-12 Boiler Hot Water Recirculation Pump Design Criteria (Primary Loop) 7-11
8-1 Dewatering Feed Tank Design Criteria 8-1
8-2 Dewatering System Design Criteria 8-3
9-1 Cake Receiving System Design Criteria 9-2
10-1 Thermal Drying System Design Criteria 10-4
11-1 Polymer Feed System Design Criteria 11-2
12-1 Biosolids Management Facilities Odor Control 12-6
14-1 Grading and Stormwater Design Criteria 14-4
15-1 Construction Cost of Alternatives 3b (original), 3b (revised), and 3b-2 15-1

Figures

1-1 Site Location Map 1-4
2-1 Mass Balance for Simulated Maximum Month Flow and Loads 2-3
10-1 Thermal Drying Facility – Simplified Process Flow Diagram 10-3
12-1 Odor Concentration versus Frequency Dynamic Affecting Public Perception 12-1
14-1 Existing Site 14-2
14-2 Flood Plain Map 14-4

Acronyms and Abbreviations

°F	degrees Fahrenheit (temperature)
F°	Fahrenheit degrees (temperature change)
BMP	best management practice
BOD_5	5-day biochemical oxygen demand
BTU	British Thermal Unit(s)
CCWA	Clayton County Water Authority
cfm	cubic feet per minute
CIP	clean-in-place
CW	Constructed Wetlands
D/T	dilution to threshold ratio
dBA	A-weighted decibel
FEMA	Federal Emergency Management Agency
GI	green infrastructure
gph	gallon(s) per hour
gpm	gallon(s) per minute
H_2S	hydrogen sulfide
HDPE	high-density polyethylene
hp	horsepower
HPU	hydraulic power unit
HVAC	heating, ventilation, and air conditioning
Jacobs	Jacobs Engineering Group Inc.
lb	pound(s)
lb/d	pound(s) per day
lb/hr	pound(s) per hour
MAD	mesophilic anaerobic digestion
MG	million gallons
mgd	million gallons per day
MMADF	maximum monthly average daily flow
MWADF	maximum week average daily flow rate
MMBTU	million British Thermal Unit(s)
$MMBTU_{th}$	million British Thermal Unit(s) (thermal)

NEWRF	Northeast Water Reclamation Facility
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
PC	progressing cavity
PLC	programmable logic controller
PLE	plant effluent
ppmv	parts per million by volume
PS	primary sludge
PST	Primary Sludge Thickening
psig	pound(s) per square inch gauge
RDT	rotary drum thickener
RSPS	Raw Sewage Pump Station
RTO	regenerative thermal oxidizer
SCADA	supervisory control and data acquisition
SCWRF	Shoal Creek Water Reclamation Facility
SRT	solids retention time
TBD	to be determined
THP	thermal hydrolysis process
TM	technical memorandum
TPS	thickened primary sludge
TS	total solids
TSS	total suspended solids
TWAS	thickened waste activated sludge
VFD	variable frequency drive
VOC	volatile organic compound
VSLR	volatile solids loading rate
w.c.g.	water column gauge
WAS	waste activated sludge
WRRF	Water Resource Recovery Facility
WT	wet ton (biosolids weight, including water)

1. Introduction

1.1 Background

The W.B. Casey Water Resource Recovery Facility (WRRF) is one of three water reclamation facilities owned and operated by Clayton County Water Authority (CCWA). The other facilities are Shoal Creek Water Reclamation Facility (SCWRF) (4.4 million gallons per day [mgd]) and Northeast Water Reclamation Facility (NEWRF) (10-mgd design capacity, 6-mgd permitted capacity). The W.B. Casey WRRF operates under National Pollutant Discharge Elimination System (NPDES) permit number GA0038423.

The W.B. Casey WRRF is an activated sludge treatment plant with a maximum monthly average daily flow (MMADF) capacity of 24 mgd. The W.B. Casey WRRF was originally built in 1958 at a capacity of 1.0 mgd. Expansions were constructed in 1965, 1974, 1979, and 2004 to reach the current capacity of 24 mgd. The biosolids Pelletizing Facility was built in 1979. Recent upgrades to the plant include a new secondary clarifier and new preliminary treatment facility constructed in 2015 to improve reliability and redundancy. Most recently, a phosphorus polishing facility (DensaDeg) was constructed to treat secondary effluent for discharge to the Flint River and rotary drum thickeners (RDTs) were installed for processing waste activated sludge (WAS).

The W.B. Casey WRRF liquid treatment processes include influent pumping, screening, grit removal, primary sedimentation, biological treatment with nutrient removal, secondary clarification, chlorine disinfection, and a new tertiary phosphorus polishing facility. The phosphorus polishing facility enables CCWA to discharge up to 6.6 mgd (maximum month basis) to the Flint River through a new outfall; the remainder of the secondary effluent (up to 17.4 mgd) is discharged to the E.L. Huie Jr Constructed Wetlands (CW) for final polishing before discharge into the tributaries of the Blalock Reservoir in the Ocmulgee River Basin. The W.B. Casey WRRF and the E.L. Huie Jr. CW are operated under the same permit. The phosphorus polishing facility includes flow splitting; phosphorus removal through coagulation, flocculation, and high rate clarification; ultraviolet disinfection; and cascade aeration. The solids facilities consist of WAS thickening with RDTs, thickened WAS (TWAS) and primary sludge (PS) blending, belt filter press dewatering, and thermal drying/pelletization. The pellet product is marketed and sold for agricultural use.

A new wasteload allocation was received for the W.B. Casey WRRF in October 2019 that would allow a capacity expansion from 24 to 32 mgd. An evaluation was completed to establish an approach for expanding all liquids and solids treatment and handling processes at the W.B. Casey WRRF from 24 to 32 mgd. With CCWA considering the closure of the SCWRF and transfer of the SCWRF flow to the W.B. Casey WRRF, the additional flow and loads from Shoal Creek were considered in the W.B. Casey WRRF Capacity Evaluation and was included in the mass balance developed to support the sizing of the Biosolids Management Facilities.

As the Capacity Evaluation progressed, revised flow projections reduced the urgency to decommission SCWRF, and limited funding led CCWA to defer the expansion of the W.B. Casey WRRF liquid stream facilities. Updated flow projections indicated that CCWA could defer the full plant expansion of the W.B. Casey WRRF until 2030, assuming implementation of improvements to address limitations with respect to raw sewage pumping capacity and secondary treatment air supply. However, the existing biosolids facility is operating near capacity, is at the end of its useful life, and represents safety concerns.

1.2 Alternatives Selection

The alternatives evaluation summarized here was presented in *Task 6 TM, Part 1 – W.B. Casey WRRF Biosolids Alternatives Evaluation* (Jacobs, 2019). Technology alternatives were evaluated to select a process train to replace the existing biosolids facilities. Biosolids management alternatives were selected to align with CCWA's strong preference for resource recovery. Technologies deemed most compatible with resource recovery included a thermal hydrolysis process (THP), anaerobic digestion (mesophilic or thermophilic), and rotary drum drying. The following six process train alternatives, which include various combinations of these technologies, were selected for evaluation:

- 3a – Mesophilic anaerobic digestion (MAD) with 12-day solids retention time (SRT) and thermal drying
- 3b – MAD (PS only) with 12-day SRT and thermal drying
- 3c – MAD with 15-day SRT
- 4a – THP (WAS only) and MAD with 12-day SRT and thermal drying
- 4b – THP and MAD with 12-day SRT
- 5 – Thermophilic anaerobic digestion with 8-day SRT

Process sizing, construction costs, and lifecycle costs were developed for each alternative. Additionally, non-monetary scoring was used to assess factors not captured in the lifecycle costs. One of the most significant non-monetary considerations was to reduce exposure to high disposal costs associated with unclassified biosolids by producing a stabilized, value-added material onsite.

Lifecycle costs over a 20-year lifecycle ranged from $129 million to $166 million, with the highest costs associated with alternatives including THP. Non-monetary criteria scores ranged from 51 to 73 (higher is better) with alternatives 3a, 3b, and 5 tied at 73. After consideration of the lifecycle costs and scores, staff agreed that they had a strong preference for thermal drying and continued production of Class A Exceptional Quality pellets. Alternative 3b was selected as it was the lowest cost alternative that resulted in a pelletized product.

Early in the biosolids alternatives evaluation, the possibility of processing biosolids from the NEWRF at the W.B. Casey WRRF was considered as a means to reduce the overall system cost. A follow-on analysis was completed to assess regionalization variations of the originally selected alternative (3b). As with the original evaluation, alternatives were compared on the basis of lifecycle cost and non-monetary criteria.

The baseline alternative 3b was compared to two different regionalization alternatives:

- 3b-1 – Drying facility would be upsized to process all NEWRF dewatered cake, and excess capacity throughout the lifecycle would be used to process non-CCWA biosolids. This alternative would include a larger drum dryer than alternatives 3b and 3b-2, and a larger cake receiving facility than 3b-2.
- 3b-2 – Drying facility size would be identical to the baseline. All NEWRF dewatered cake would be processed through year 2029 when the rated capacity of the dryer is reached. Starting in 2030 some NEWRF dewatered cake would be managed via other methods which would increase slightly each year with 15% expected for alternative management in year 2040. Non-CCWA cake would not be accepted under this option.

Lifecycle costs of each alternative were highly sensitive to the unit cost of unclassified cake disposal, which was assumed to range between $79/wet ton (WT) and $100/WT in the first year of the lifecycle. At the current unclassified cake disposal rate of $79/WT, regionalization did not have a cost advantage. Additionally, non-monetary scoring did not show a strong inclination towards regionalization. However, at a higher initial unclassified cake disposal rate of $100/WT, both regionalization alternatives 3b-1 and 3b-2 had a lower lifecycle cost than the baseline alternative.

While building larger facilities for alternative 3b-1 would enable CCWA to capture more revenue from non-CCWA cake, the additional capital cost was considered unfavorable. While alternative 3b-1 would have the highest lifecycle cost if the initial cost of unclassified cake disposal were $79/WT, it would have the lowest lifecycle cost if the initial cost of unclassified cake disposal were $100/WT which is the approximate prevailing haul and disposal cost currently in the Metro Atlanta region.

Given the uncertainty of unclassified cake disposal rates in the region, CCWA decided not to spend additional capital for alternative 3b-1 since processing non-CCWA biosolids was not the primary objective. However, CCWA preferred having multiple options for biosolids management and therefore selected the lower cost alternative 3b-2 as the basis of design. At the end of detailed design, an accurate cost estimate will be prepared that includes a line item for cost of the proposed Cake Receiving Facility. At that time, the cost of unclassified cake disposal will be known with greater certainty, which will allow CCWA to decide whether to construct the cake receiving facility.

The lifecycle costs, regionalization evaluation, and additional assessments were submitted during the course of the design project. Jacobs Engineering Group Inc. (Jacobs) provided a consolidated set of prior technical memoranda (TM) with an executive summary to CCWA on June 22, 2020.

1.3 Purpose and Scope

This Preliminary Engineering Report presents the design concept for the W.B. Casey WRRF Biosolids Management Facilities. The purpose of this design is to replace the existing biosolids facilities with facilities sized for 32-mgd plant capacity. The scope includes all facilities required to implement the 3b-2 alternative.

1.4 Project Location

The upgrade of the W.B. Casey WRRF will occur within the existing property boundary. A location map for the W.B. Casey WRRF is provided in Figure 1-1. The W.B. Casey WRRF is located outside the Jonesboro city limits.

Figure 1-1. Site Location Map
W.B. Casey WRRF Draft Preliminary Engineering Report

2. Design Basis

2.1 Mass Balance and Peaking Factors

The mass balance for design of the Biosolids Management Facilities was produced by simulating design maximum month load conditions corresponding to 32-mgd maximum monthly average flow plant capacity (Figure 2-1). In this simulation, influent characteristics were as defined in *Task 1 TM – W.B. Casey WRRF Design Basis* (Jacobs, 2020a). The simulator was calibrated to 2018 plant operation as described in *Task 3 TM – W.B. Casey WRRF Process Model Calibration and Plant Capacity Analysis* (Jacobs, 2020b).

Solids thickening and screening will be designed for maximum week average daily flow (MWADF) sludge production. Maximum week PS and WAS volumetric and mass flow rates were extrapolated from maximum month simulation results using peaking factors defined in the Task 1 TM. For PS, total suspended solids (TSS) peaking factors were used. For WAS, 5-day biochemical oxygen demand (BOD_5) peaking factors were used. In each case, maximum week peaking factors were assumed to be half way between maximum month and maximum day. Table 2-1 summarizes these peaking factors.

Table 2-1. Biosolids Management Facilities Design Peaking Factors
W.B. Casey WRRF Draft Preliminary Engineering Report

Peaking Factor	TSS Load (Primary Sludge)	BOD_5 Load (Waste Activated Sludge)
Maximum Month/Annual Average	1.31	1.18
Maximum Week/Annual Average	1.64	1.47
Maximum Day/Annual Average	1.96	1.76
Maximum Week/Maximum Month	1.25	1.25
Maximum Day/Maximum Month	1.50	1.49

The mass balance described above and the anticipated cake from the NEWRF were used to size the cake receiving station. This station will receive dewatered cake from the NEWRF but only in such quantities that dryer capacity at the W.B. Casey WRRF is not exceeded. Early in the lifecycle, there will be sufficient capacity for all NEWRF cake. The volume of cake produced at the W.B. Casey WRRF and received from the NEWRF will increase until the dryer capacity is reached. After that, cake produced at the W.B. Casey WRRF will continue to increase while cake hauled from the NEWRF to the W.B. Casey WRRF will decrease. (Starting in 2030, excess cake from the NEWRF will be managed by an alternative approach.) The cake receiving facility is sized for the maximum NEWRF cake to be received without an increase in the drying facility capacity.

2.2 Operating Schedule

PS and WAS thickening and screening facilities and anaerobic digestion facilities will operate 24 hours per day for 7 days per week (24/7). Dewatering, drying, and cake receiving facilities will be designed to operate 24 hours per day for 5 days per week (24/5) under maximum month loads and sludge production. For short-term loads above maximum month, these facilities will operate 6 days per week. In addition, the facilities could operate 24 hours per day, 7 days a week in response to operational needs. The overall plant staffing requirements are expected to increase by one full-time equivalent position.

2.3 Build-out Capacity Considerations

Based on flow projections and current site layout, a plant build-out capacity of 40 mgd was assumed. Assuming a proportional increase in flow and loads, this potential build-out capacity was considered in unit process sizing and laying out the facilities to ensure that the 32-mgd expansion approach would not restrict potential future plant upgrades.

Figure 2-1. Mass Balance for Simulated Maximum Month Flow and Load

W.B. Casey WRRF Draft Preliminary Engineering Report

Constituent	Raw Wastewater	Recycle Streams	Primary Influent	Primary Effluent	Secondary Clarifier Influent	Secondary Clarifier Effluent	W3
Flow (gallons/day)	32,000,000	5,332,607	37,332,543	36,452,025	54,678,038	36,095,965	4,097,623
Carbonaceous BOD_5 (lbs/day)	60,857	3,555	64,412	41,365	629,122	1,463	166
COD (lbs/day)	153,179	13,600	166,779	95,976	1,876,734	13,210	1,500
TSS (lbs/day)	95,066	9,911	104,977	31,493	1,530,948	3,012	342
VSS (lbs/day)	87,118	8,035	95,152	28,581	1,295,454	2,549	289
TKN (lbs/day)	6,441	1,169	7,610	6,176	80,713	683	78
NH_3-N (lbs-N/day)	4,331	779	5,110	4,989	70	46	5
NO_2-N (lbs-N/day)	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	0	82	82	80	1,006	664	75
Total Nitrogen (lbs-N/day)	6,441	1,251	7,692	6,256	81,719	1,347	153
TP (lbs-P/day)	1,149	474	1,622	840	39,663	81	9
Alkalinity (lbs/day as $CaCO_3$)	36,050	7,674	43,723	42,692	55,994	36,965	4,196
H_2S (lbs/day)	67	68	134	0	0	0	0
Temperature (^oC)	16.6	17	17	17	17	17	17
BOD_5 (mg/L)	228	80	207	136	1,379	5	5
COD (mg/L)	574	306	535	315	4,113	44	44
TSS (mg/L)	356	223	337	104	3,355	10	10
VSS (mg/L)	326	181	305	94	2,839	8	8
TKN (mg-N/L)	24	26	24	20	177	2	2
NH_3-N (mg-N/L)	16	18	16	16	0	0	0
NO_2-N (mg/L)	0	0	0	0	0	0	0
NO_3-N (mg-N/L)	0	2	0	0	2	2	2
Total Nitrogen (mg/L)	24	28	25	21	179	4	4
TP (mg-P/L)	4.30	11	5	3	87	0	0
Alkalinity (mg/L as $CaCO_3$)	135	172	140	140	123	123	123
H_2S (mg/L)	0	2	0	0	0	0	0

Constituent	DDEG Bypass	DDEG Influent	DDEG Sludge	DDEG Effluent	Plant Effluent	WAS Thickening Feed	WAS Thickening Recycle	Thickened WAS	PS Thickening Feed
Flow (gallons/day)	15,998,342	16,000,000	6,193	15,993,807	31,992,149	356,060	272,741	83,319	880,518
Carbonaceous BOD_5 (lbs/day)	648	649	383	265	914	12,027	602	11,424	23,305
COD (lbs/day)	5,855	5,855	1,137	4,718	10,573	35,708	1,853	33,855	70,772
TSS (lbs/day)	1,335	1,335	1,551	668	2,003	29,277	1,464	27,814	73,587
VSS (lbs/day)	1,130	1,130	945	407	1,537	24,774	1,239	23,535	63,403
TKN (lbs/day)	303	303	49	254	557	1,534	80	1,453	1,434
NH_3-N (lbs-N/day)	20	20	0	20	41	0	0	0	147
NO_2-N (lbs-N/day)	0	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	294	294	0	294	589	7	5	2	0
Total Nitrogen (lbs-N/day)	597	597	49	548	1,145	1,540	85	1,455	1,434
TP (lbs-P/day)	36	36	25	11	47	758	38	721	782
Alkalinity (lbs/day as $CaCO_3$)	16,383	16,385	6	15,139	31,522	365	279	85	838
H_2S (lbs/day)	0	0	0	0	0	0	0	0	0
Temperature (^oC)	17	17	17	17	17	17	17	17	17
BOD_5 (mg/L)	5	5	7,418	2	3	4,047	265	16,429	3,171
COD (mg/L)	44	44	21,999	35	40	12,017	814	48,689	9,631
TSS (mg/L)	10	10	30,000	5	8	9,853	643	40,000	10,014
VSS (mg/L)	8	8	18,290	3	6	8,337	544	33,847	8,628
TKN (mg-N/L)	2	2	944	2	2	516	35	2,090	195
NH_3-N (mg-N/L)	0	0	0	0	0	0	0	0	20
NO_2-N (mg/L)	0	0	0	0	0	0	0	0	0
NO_3-N (mg-N/L)	2	2	2	2	2	2	2	2	0
Total Nitrogen (mg/L)	4	4	947	4	4	518	38	2,092	195
TP (mg-P/L)	0	0	482	0	0	255	17	1,036	106
Alkalinity (mg/L as $CaCO_3$)	123	123	113	113	118	123	123	123	114
H_2S (mg/L)	0	0	0	0	0	0	0	0	0

Constituent	PS Thickening Recycle	Anaerobic Digester Influent	Anaerobic Digester Effluent	Dewatering Influent	Dewatering Recycle	Dewatered Sludge	Dryer Influent	Dryer Condensate	Pellet
Flow (gallons/day)	712,984	167,533	167,533	250,852	220,657	30,195	30,195	22,408	7,787
Carbonaceous BOD_5 (lbs/day)	1,535	21,443	4,575	15,998	548	15,337	15,337	321	15,014
COD (lbs/day)	4,834	65,937	40,993	74,848	2,764	72,083	72,083	1,512	70,544
TSS (lbs/day)	3,679	69,908	36,800	64,613	1,615	62,998	62,998	1,260	61,738
VSS (lbs/day)	3,170	60,233	30,200	53,735	1,343	52,392	52,392	1,048	51,344
TKN (lbs/day)	194	1,241	1,241	2,694	729	1,965	1,965	40	1,836
NH_3-N (lbs-N/day)	119	28	745	745	655	90	90	0	0
NO_2-N (lbs-N/day)	0	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	0	0	0	2	1	0	0	0	0
Total Nitrogen (lbs-N/day)	194	1,241	1,241	2,695	730	1,966	1,966	40	1,836
TP (lbs-P/day)	42	740	740	1,461	309	1,152	1,152	51	1,101
Alkalinity (lbs/day as $CaCO_3$)	678	159	2,510	2,595	2,283	312	312	232	81
H_2S (lbs/day)	0	0	70	70	61	8	8	6	2
Temperature (^oC)	17	17	35	29	29	29	29	0	0
BOD_5 (mg/L)	258	15,336	3,272	7,642	298	60,862	60,862	1,715	231,032
COD (mg/L)	812	47,160	29,319	35,753	1,501	286,055	286,055	8,086	1,085,501
TSS (mg/L)	618	50,000	26,320	30,864	877	250,000	250,000	6,738	950,000
VSS (mg/L)	533	43,080	21,600	25,668	730	207,911	207,911	5,603	790,063
TKN (mg-N/L)	33	887	887	1,287	396	7,799	7,799	214	28,247
NH_3-N (mg-N/L)	20	20	533	356	356	356	356	0	0
NO_2-N (mg/L)	0	0	0	0	0	0	0	0	0
NO_3-N (mg-N/L)	0	0	0	1	1	1	1	1	1
Total Nitrogen (mg/L)	33	887	887	1,288	396	7,800	7,800	215	28,248
TP (mg-P/L)	7	529	529	698	168	4,571	4,571	271	16,944
Alkalinity (mg/L as $CaCO_3$)	114	114	1,795	1,240	1,240	1,240	1,240	1,240	1,240
H_2S (mg/L)	0	0	50	33	33	33	33	33	33

3. Process Overview

An overall process flow diagram of the W.B. Casey WRRF (Drawing 001-G-001) is provided in Appendix A, with existing facilities shown in light line weight.

The following existing biosolids processes will be incorporated in the new process flow:

- WAS/Scum Pumping
- WAS Thickening
- WAS Thickening Polymer Storage and Feed
- WAS Thickening Odor Control
- Pellet Storage Bay

The following proposed processes/facilities are required for implementation of the Biosolids Management Facilities project:

- PS Thickening
- Sludge Screening
- Anaerobic Digestion
- Dewatering Feed Storage
- Dewatering
- Cake Receiving
- Thermal Drying
- Polymer Storage and Feed
- Odor Control

Existing WAS thickening and proposed PS thickening (PST) are used to improve performance of downstream dewatering; PS thickening also minimizes the volume of the anaerobic digesters. Sludge screening is used to remove debris that would diminish pellet quality. W.B. Casey WRRF's preliminary treatment includes screening, but it lacks the capacity to treat all influent flows.

Anaerobic digestion of thickened PS eliminates the constraint of maintaining sufficiently low PS to WAS ratio for high-quality pellets. By digesting only PS, the size and cost of the digester facility are minimized. Dewatering is used to produce the necessary feed concentration for thermal drying. Cake receiving allows dewatered cake from the NEWRF to be dried at the Dewatering/Thermal Drying Facility. Thermal drying produces a salable pellet that is classified as Class A Exceptional Quality biosolids. CCWA has been producing this product for over 40 years. Polymer is integral to several processes including PST, dewatering, and cake pumping (part of cake receiving). Odor control is used to create a pleasant environment for staff and visitors and to minimize detrimental impacts to residential neighbors.

4. Waste Activated Sludge Thickening

4.1 Introduction

WAS is currently thickened with RDTs in the WAS Thickening Facility to yield a thickened sludge with a minimum 4 percent dry solids. TWAS is pumped to the Sludge Blending Tank where it combines with PS prior to dewatering and pelletizing. While the existing WAS Thickening Facility will remain in place, modifications are required to integrate the system with the proposed facilities and to increase capacity. Modifications to the piping and controls of the existing WAS Thickening Facility are proposed to allow TWAS to be diverted to a proposed Combined Screening Facility. The existing facility, put into operation in 2020, was constructed to replace the former dissolved air flotation unit rather than to increase capacity. As part of the 32-mgd upgrade, WAS thickening capacity and redundancy will be addressed by implementing a shared standby RDT at the proposed PST Facility.

4.2 Process Description

In the WAS/Scum Pump Station located near the secondary clarifiers, WAS is combined with scum from the secondary clarifiers and blowdown sludge from the phosphorus polishing facility. Flow is pumped to the flocculation tanks at the WAS Thickening Facility. Polymer is injected upstream of the flocculation tanks where the polymer and WAS are mixed to form stable floc particles. WAS is then fed into the RDTs where an internal screw transports thickened solids out of the unit while liquid falls by gravity through the rotating drum. Separation of solids and liquid occurs along the length of the drum as the perforated metal allows water to pass but retains the flocculated sludge.

Wash water is constantly fed along the top of the drum, and filtrate is collected at the bottom of the unit and flows by gravity to the W.B. Casey Raw Sewage Pump Station (RSPS) where is it recycled to the head of the plant. Thickened sludge content is controlled by adjusting the rotational speeds of the drum and flocculator and the polymer dosage. These changes are made by the operator based on observation and performance experience.

Thickened sludge is discharged into vertical hoppers, which feed into a dedicated progressing cavity (PC) pump for each RDT. TWAS is currently pumped to the Sludge Blending Tank where it mixes with PS. As part of this project, TWAS will be diverted to a proposed Combined Screening Facility where it will be screened prior to being blended with screened and digested TPS in the proposed Dewatering Feed Tanks.

Design criteria for the existing WAS Thickening Facility are summarized in Table 4-1. The existing RDTs lack required redundancy at the design feed rate. This is addressed by implementing a shared standby RDT at the proposed PST Facility.

Table 4-1. Existing WAS Thickening Design Criteria

W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
WAS Thickeners	
Quantity	2 (both duty) *
Type	Rotary Drum Thickener
Manufacturer	FKC

Table 4-1. Existing WAS Thickening Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Capacity, Each	240 gpm **
Operating Schedule	24/7
Design Influent WAS Flow, MWADF	308 gpm
Influent WAS Solids Content	1%
Influent WAS Solids Loading MWADF	36,473 lb/d
Unit Solids Capture	95%
Minimum Thickened Solids Content	4%
TWAS Pumps	
Quantity	2 (1 per RDT)
Type	Progressing Cavity
Manufacturer	Seepex
Capacity, Each	70 gpm
Drive	Variable Speed

*A PS RDT serves as shared standby.

**Manufacturer's listed capacity is 275 gpm. Based on operational experience, it is recommended that design capacity is based on approximately 85 percent of listed capacity.

gpm = gallons per minute

lb/d = pounds per day

4.3 Functional Description

A process flow diagram of the WAS Thickening Facility (Drawing 100-N-001) is provided in Appendix A.

WAS and secondary scum flows are continuous while sludge blowdown from the tertiary polishing facility is intermittent. Flow from the WAS/Scum Pump Station is pumped continuously to the WAS Thickening Facility. Flow rate is controlled by wet well level. Flow is split evenly between each operational RDT using flow meters and flow control valves. Polymer feed rate is flow-paced based on the RDT feed flow rate and operator-selected polymer dose. The number of online RDTs is determined by the operator based on feed flow rate. The programmable logic controller (PLC) controls the startup, shutdown, and operation of each RDT.

RDT speeds are adjusted manually at each respective floc and drum drive using a speed potentiometer. Each of the discharge hoppers is equipped with a level sensor to determine the required operation of the TWAS pumps. The PC TWAS pumps send flow to the Thickened Sludge Screening facility.. These pumps, which are outfitted with variable frequency drives (VFDs), are operated based on the set-point selected by the operator. Adjustments to the drives are made in response to feedback from the level sensors included on each discharge hopper.

Proposed modifications to the WAS Thickening Facility include piping and isolation valves to direct WAS to the shared standby RDT at the proposed PST Facility as well as piping and isolation valves to direct TWAS to the proposed Combined Screening Facility.

4.4 Reliability and Redundancy

The following design features have been included for reliability and redundancy:

- One standby unit during MWADF conditions. The standby unit is shared between the WAS and PST Facilities.
- The size selected for the proposed RDTs assumes design capacity at 85 percent of the listed capacity.
- The existing installed units combined with the proposed shared redundant unit located at the PST Facility will meet estimated build-out needs if the plant is expanded from 32 to 40 mgd.

5. Primary Sludge Thickening

5.1 Introduction

PS at the W.B. Casey WRRF is currently routed to the Sludge Blending Tank where it is blended with TWAS prior to dewatering and drying. In the plant's current configuration, operators attempt to minimize PS flows to the existing biosolids treatment due to the negative impact of undigested PS on pellet quality. One goal of this project is to remove this limitation through anaerobic digestion of thickened primary sludge (TPS). This will allow all the PS to be used in pellet production eliminating the bypass of the primary clarifiers while maintaining CCWA's pellet quality standards. The first step in this process is the thickening of PS.

Thickening will be achieved using RDTs similar to those at the existing WAS thickening facility. The proposed PST Facility will consist of four RDTs positioned on an elevated concrete platform. As with the existing WAS Thickening Facility, these RDTs will discharge to vertical hoppers to feed PC pumps, which will convey TPS to the proposed Combined Screening Facility for further treatment before anaerobic digestion.

5.2 Process Description

PS is pumped from the existing primary clarifiers to the flocculation tanks upstream of the RDT drums. Polymer is injected upstream of each flocculation tank where the polymer and PS are mixed to form stable floc particles. PS is then fed into the RDT where an internal screw transports thickened solids out of the unit while liquid falls by gravity through the rotating drum. Separation of solids and liquid occurs along the length of the drum as the perforated metal allows water to pass but retains the flocculated sludge.

Wash water is constantly fed along the top of the drum, and filtrate is collected at the bottom of the unit and flows by gravity to the W.B. Casey RSPS where it is recycled to the head of the plant. Thickened sludge content is controlled by adjusting the rotational speeds of the drum and flocculator and the polymer dosage. These changes are made by the operator based on observation and performance experience. The RDT system yields TPS with 4 to 6 percent solids with a minimum solids capture rate of 95 percent.

Similar to the existing WAS Thickening Facility, TPS will be discharged from the end of each RDT to a dedicated vertical hopper, which supplies TPS to a dedicated PC pump for each thickening train. Each of these pumps then conveys the TPS to the Combined Screening Facility prior to digestion.

Selecting the same technology for PS and WAS thickening allows similar equipment to be used for both flow streams. While TWAS and TPS are handled differently, a common standby unit may be used for both processes. Therefore, cross-connections are provided to enable a shared standby and reduce the total quantity of units required. Given that the unit size required for PS thickening is larger than the existing WAS units, the shared standby will match the PS thickening units and will be located at the proposed PST Facility.

The design criteria for the proposed PST Facility and associated system components are summarized in Table 5-1.

Table 5-1. PS Thickening Design Criteria
W.B. Casey WRRF Draft Preliminary Design Report

Parameter	Value
Primary Sludge Thickeners	
Quantity	4 (3 Duty, 1 Standby) *
Type	Rotary Drum Thickener
Manufacturers	FKC, Parkson
Capacity, Each	340 gpm **
Capacity, Firm	1,020 gpm
Operating Schedule	24/7
Design PS flow MWADF	763 gpm
Influent PS Sludge Content	1%
Influent PS Solids Loading MWADF	91,700 lb/d
Unit Solids Capture	95%
Minimum Target Solids Content	5%
TPS Pumps	
Quantity	4 (1 per RDT)
Type	Progressing Cavity
Manufacturers	Seepex, Moyno
Capacity, Each	90 gpm
Drive	Variable Speed

*Standby unit to be shared with WAS thickening facility.

**Manufacturers' listed capacity is 400 gpm. Based on operational experience, it is recommended that design capacity be based on approximately 85 percent of listed capacity.

gpm = gallons per minute

lb/d = pounds per day

5.3 Functional Description

A process flow diagram of the PST Facility (Drawing 100-N-002) is provided in Appendix A.

PS is pumped continuously to the RDTs based on operator-selected flow set-point on the PS pumps. The PS pumps are existing, and piping configuration makes it impractical to dedicate a PS pump to a particular RDT. Therefore, flow control valves will be used in conjunction with flow meters to ensure that flow is split evenly across each RDT in operation. Polymer feed rate is flow-paced based on the PS flow rate and operator-selected polymer dose. The operator inputs for number of RDTs in operation and polymer dose will be input to the central PLC, which will automatically control the startup, shutdown, and operation of each RDT.

The RDT drum and flocculation tank drives have the capability to be adjusted manually at the units and from the plant's Supervisory Control and Data Acquisition (SCADA) system to achieve optimal thickening depending on feed characteristics. Each PS RDT discharges to a vertical hopper, which feeds the PC TPS pumps. These pumps, outfitted with VFDs, operate based on the operator-selected set point, with adjustments made in response to feedback from the level sensors included on each discharge hopper.

Process piping and isolation valves are configured to allow the proposed standby unit to provide redundancy to either the PST or WAS Thickening Facilities. If one of the WAS thickening trains is out of service, a portion of the WAS will be diverted to the shared standby unit at the PST Facility.

Screened TPS will be directed to the proposed anaerobic digester facility and screened TWAS will be conveyed to the Dewatering Feed Tanks. Therefore, actuated isolation valves are provided on the discharge side of the TPS pump associated with the shared standby RDT to allow for conveyance to either the TPS header or a TWAS discharge line that combines with the main TWAS discharge line upstream of the Combined Screening Facility.

5.4 Reliability and Redundancy

The following design features have been included for reliability and redundancy:

- One standby unit during MWADF conditions. The standby unit is shared between the WAS Thickening and PST Facilities.
- The size selected for the proposed RDTs assumes design capacity at 85 percent of the listed capacity.
- The installed units will meet estimated build-out capacity needs if the plant is expanded to 40 mgd.

6. Thickened Sludge Screening

6.1 Introduction

Although influent screens are provided at the head of the W.B. Casey WRRF, they do not treat all of the influent wastewater flows. Consequently, undesirable materials such as plastics and fibrous material may pass through to subsequent treatment processes. The majority of this material ultimately collects in plant sludge and scum. As flows are directed through biosolids treatment processes, these materials could accumulate, presenting maintenance problems; they could also pass on to the thermal drying facility, adversely affecting the quality of product pellets. To minimize such issues, the proposed Biosolids Management Facilities includes a Thickened Sludge Screening Facility.

The proposed Thickened Sludge Screening Facility receives TWAS and TPS from the WAS Thickening and PST Facilities, respectively. These thickened sludge flows are treated in parallel trains at the proposed Thickened Sludge Screening Facility to keep TWAS and TPS separated. The facility consists of an elevated concrete platform analogous to the existing WAS Thickening Facility and proposed PST Facility.

As thickened sludge passes through the screens, screenings are separated and discharged to collection containers to be hauled away for disposal at a landfill. The two screened, thickened sludge streams are directed to their respective downstream facilities: anaerobic digesters for TPS and Dewatering Feed Tanks for TWAS.

This arrangement allows for screened solids to be released into discharge chutes to collect in bins at the lower level for later removal. Although the screening units themselves are totally enclosed, in-line units operated under pressure, the discharge chutes below each unit provide a point for odorous air to be emitted. Consequently, the lower level of the facility is enclosed to allow for simplified odor control and to minimize the volume of odorous air to be treated. Odor control is discussed in Section 12.

6.2 Process Description

The proposed Thickened Sludge Screening Facility consists of one duty screen for TPS, one duty screen for TWAS and one shared standby screen. The influent TPS and TWAS flow streams are individually conveyed to the dedicated screens from their respective thickening facilities. From the inlet of the screen, sludge flows through a perforated cylinder with 5-millimeter openings. Thickened sludge passes through the cylinder and collects in the annular space of the screening unit. Screened TPS flows to the anaerobic digesters and the screened TWAS flows to the Dewatering Feed Tanks.

Coarse solids or “tramp materials” larger than the perforations are retained within the screen basket and transported to the dewatering zone by a rotating screw running longitudinally down each screen. The retained solids are further concentrated in the pressing zone at the end of each screening unit where they are compacted into a plug that releases excess water into the screened sludge stream in the annular space. As the plug is formed, the drive load increases, pushing the screenings against the backpressure cone to release the solids into discharge chutes. The backpressure, which is required to prevent a hydraulic break to atmosphere, is maintained via a dedicated compressed air system for each of the three screening units. The screenings exit the discharge chutes into collection container(s), which are periodically hauled away for disposal at a landfill.

The head pressure required to transfer TPS and TWAS to their respective downstream processes is maintained by the screening feed pumps. For TPS, the proposed TPS transfer pumps are sized to transfer TPS from the PST Facility to the digesters while accounting for the headloss through the screen. Given that the existing TWAS pumps were sized only to transfer TWAS from the thickening facility to the existing Sludge Blending Tank, it is assumed that proposed pumps are required to transfer TWAS through the screens and to the proposed Dewatering Feed Tanks.

The design criteria for the proposed Thickened Sludge Screening Facility are summarized in Table 6-1.

Table 6-1. Sludge Screening Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
TPS Screening	
Quantity	2 (1 Duty, 1 Shared Standby)
Manufacturers	Huber, HydroSludge
Type	Screw type screening
Operating Schedule	24/7
TPS flow	191 gpm
TPS total solids	5%
Screen Capacity	330 gpm @ 3% TS 260 gpm @ 5% TS
TWAS Screening	
Quantity	2 (1 Duty, 1 Shared Standby)
Manufacturer	Huber, HydroSludge
Type	Screw type screening
Operating Schedule	24/7
TWAS flow	72 gpm
TWAS total solid	4%
Screen Capacity	330 gpm @ 3% TS 260 gpm @ 5% TS

6.3 Functional Description

A process flow diagram of the Thickened Sludge Screening Facility (Drawing 100-N-003) is provided in Appendix A.

TPS and TWAS are pumped continuously from the respective thickening facilities. Flow meters are provided upstream of each screening unit to provide local feedback on feed flows and provide input to the facility PLC, which automatically adjusts the rotational speed of the screenings screw. Manual isolation valves direct TWAS to either Screen 1 (normal operation) or Screen 2 (standby). When Screen 2 (standby) is used to process either TPS or TWAS, manual isolation valves on the downstream side direct screened sludge to the proper destination—either the anaerobic digesters for screened TPS or the dewatering feed tanks for screened TWAS.

Each screen is outfitted with pressure indication to provide feedback to the associated compressed air systems and to ensure that sufficient backpressure is maintained at the screenings discharge interface. This operation is automated to ensure that air valves can be rapidly modulated to respond to real time variations.

Screenings production is anticipated to be low such that collection bins do not require automated monitoring. Collection bins are visually inspected to determine the need for landfill disposal.

6.4 Reliability and Redundancy

The following design features have been included for reliability and redundancy:

- One shared standby screen for the parallel TPS and TWAS screens.
- One standby pump to transfer TWAS through screening and to the Dewatering Feed Tanks.
- The installed screening unit (and shared standby unit) will meet estimated build-out capacity needs for TWAS if plant is expanded to 40 mgd.
- Additional footprint is provided to meet estimated build-out capacity needs for TPS if plant is expanded to 40 mgd. At 40-mgd plant capacity, TPS screening will be achieved with two duty units and one shared standby unit.

7. Anaerobic Digestion

7.1 Introduction

Anaerobic digestion will be added to the existing plant configuration to process screened TPS only. This process is being added for both mass reduction and to resolve current PS management issues. The current plant configuration is problematic with respect to the quality of the dried pellet product, which becomes dusty and undesirable to end users when too much undigested PS is included. As a result, excess PS is problematic, and plant staff often direct a portion of it to the secondary treatment process along with bypassing some preliminary effluent around the primary clarifiers.

7.2 Process Description

This section describes the proposed anaerobic digester process, which includes digester tanks, digester mixing systems, digester heating and recirculation pumps, digester heat exchangers, digester cleaning pumps, and digester withdrawal pumps. Equipment for biogas conditioning and flaring of excess biogas are also included.

7.2.1 Anaerobic Digesters

Two anaerobic digesters, Digester 1 and Digester 2, operate in parallel but are configured to allow transfer between the digesters. The digesters are designed for mesophilic temperatures only. Therefore, operating at thermophilic temperatures of 130 to 135 degrees Fahrenheit (°F) likely will not be possible in the future. A 10 percent safety factor has been added to the required effective volume of the digester to account for grit and scum accumulation. A fixed concrete cover is constructed as an integral part of the digester.

Area at the site of the existing Lab Building is reserved for construction of a third digester when plant capacity is expanded beyond 32-mgd capacity. Provisions are made in the Digester Building to accommodate equipment associated with all three digesters.

Table 7-1 includes design criteria for the proposed anaerobic digesters.

Table 7-1. Anaerobic Digester Design Criteria

W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Tank Type	Circular Concrete
Quantity	2
SRT @ Maximum Month Loads and 1 Digester Out of Service	12 days
Required Effective Volume of Each Digester	2.0 million gallons*
Actual Volume of Each Digester (10 Percent Safety Factor)	2.2 million gallons*
Volatile Solids Reduction (VSR) at Maximum Month Condition	50%
Volatile Solids Loading Rate (VSLR) at Maximum Month Condition	0.22 lb/ft^3/d

Table 7-1. Anaerobic Digester Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Digester Gas Production at Maximum Month Condition	240,000 ft^3/d
Total Solids Concentration in Digesters	2.6%
Maximum Height of Structure above Existing Grade	TBD
Inner Diameter	75 feet
Side Wall Height (Top of Cone to Bottom of Cover)	71 feet
Side Water Depth (Top of Cone to Normal Operating Level)	67 feet
Cone Angle	7 percent
Cover Type	Fixed Concrete
Maximum Operating Temperature	105°F

*Volume excludes cone bottom
TBD = to be determined
lb/cf/d = pounds per cubic foot per day
ft^3/d = cubic feet per day

7.2.2 Digester Mixing

The digester tank contents are mixed to optimize volatile solids reduction (VSR) and gas production. The digester is mixed with a pumped mixing system. Chopper-style pumps reduce particle size and the potential for nozzles to clog. Glass-lined ductile iron nozzles are mounted inside the digester to optimize digester mixing efficiency. The system is provided with floor-mounted nozzles, wall-mounted nozzles, and an integrated scum suppression system. VFDs installed on the pumps allow for mixing system turndown and energy savings.

Table 7-2 includes the digester mixing system design criteria. The mixing system will be designed by the manufacturer during detailed design, hence some criteria are designated “Preliminary.”

Table 7-2. Digester Mixing System Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Type	Non-Clog Horizontal Chopper
Quantity	4 (2 Duty + 2 Standby)*
Manufacturers	Vaughan, Siemens
Design Flow per Pump (Preliminary)	12,200 gpm
Head Pressure (Preliminary)	75 feet
Number of Nozzles per Digester	Manufacturer’s Recommendation

Table 7-2. Digester Mixing System Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
TS Concentration	1% - 4%
Motor Speed	Manufacturer's Recommendation
Motor Size (Preliminary)	350 hp
Drive	Variable Speed

hp = horsepower

TS = total solids

*During detailed design, potential to use four half-sized duty pumps with a cross connection between digesters will be considered.

7.2.3 Digester Heating

Heat exchangers are required to maintain sludge in the digesters at mesophilic temperatures. Heat is required to bring incoming sludge to the digester temperature and to offset heat loss from the digester to its surroundings. The heating system consists of sludge recirculation pumps, heat exchangers, water boilers, and two sets of hot water pumps. The system includes a primary hot water loop, and each heat exchanger has a secondary hot water loop. The primary hot water system is discussed in Section 7.2.11.

Sludge recirculation pumps withdraw solids from the tank and convey the solids through a heat exchanger and back to the digester. The digester feed lines connect to the sludge recirculation system downstream of the heat exchanger. This feature facilitates digester mixing by warming the feed sludge before it enters the digester. Table 7-3 includes design criteria for the digester sludge recirculation pumps.

Table 7-3. Digester Sludge Recirculation Pump Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Type	Non-Clog Horizontal Chopper
Quantity	3 (2 Duty + Standby)
Manufacturers	Vaughan, Siemens
Design Flow per Pump (Preliminary)	370 gpm
Head Pressure (Preliminary)	70 feet
TS Concentration	1.0% - 4.0%
Motor Speed	TBD
Motor Size (Preliminary)	15 hp
Drive	Constant Speed

A spiral heat exchanger is recommended for this application. A spiral heat exchanger consists of two rectangular channels wrapped helically around a split mandrel to create two curved channels for fluid flow. Each channel is typically constructed of two sheets of metal separated by welded studs. The spiral assembly is enclosed by a cylindrical shell, and two circular end covers are installed to seal the flow channels and provide distinct flow paths for each fluid. Heat exchange occurs across the metal coil.

Spiral heat exchangers have a small footprint and are relatively easy to maintain. The spiral design creates a self-cleaning process, where any blockages in the channel create a localized increase in fluid velocity. The velocity increase exerts a drag force on the fouled surface, which helps to dislodge and clear the blockage. The heat transfer surface is a thick metal plate, so leakage rarely occurs between channels. The spiral design has a high surface area-to-volume ratio, which results in a smaller footprint and higher heat transfer rate than tube-in-tube or shell-and-tube heat exchangers. The primary disadvantage of a spiral configuration is that the end cover for the water channel cannot be opened for maintenance access. However, maintenance on the water channel is rarely needed. The cost of spiral heat exchangers are approximately the same as tube-in-tube heat exchangers.

Table 7-4 lists the digester heat exchanger design criteria.

Table 7-4. Digester Heat Exchanger Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Heat Exchanger Type	Spiral
Quantity	2 (Both Duty)
Manufacturers	Alfa Laval, Gooch Thermal Systems
Cold fluid	Digested Solids @ 1.0% TS – 4.0% TS
Cold fluid temperature – Inlet	98°F
Cold fluid temperature – Outlet	108°F
Hot Fluid	Treated Potable Water
Hot fluid temperature – Inlet	140°F
Hot fluid temperature – Outlet	120°F
Maximum Overall Heat Transfer Coefficient	250 Btu/hour-square foot-°F
Heat Transfer Capacity	2.0 MMBTU/hr

BTU = British Thermal Units

MMBTU = million BTUs

Jacobs recommends the following guidelines on the heat exchanger design:

- Minimum sludge viscosity shall be 0.004 pound per foot per second.
- Sludge channels shall have no single dimension less than 1 inch.
- Sludge openings shall have no pins or other restrictions.
- Heat exchangers shall be designed for a maximum working pressure of 50 pounds per square inch gauge (psig) and temperature of 200°F.
- The minimum fouling factor assumed for all heat transfer calculations shall be 500 hour-square foot-°F per million British Thermal Units.

- Material of construction shall be carbon steel or stainless steel.
- Maximum sludge temperature increase shall not exceed 10 F°.
- Sludge channel velocities within the heat exchanger shall be between 3.0 and 7.0 feet per second.
- Heat exchangers shall be manufactured to American Society of Mechanical Engineers standards.

Each secondary hot water recirculation pump is on a secondary loop and provides heat to a particular heat exchanger. The secondary hot water recirculation pumps are constant speed with three-way valves adjusting the heat input to the secondary loops. To vary the output of the heat exchanger, secondary loops blend water leaving the heat exchanger with water from the primary loop using a motorized three-way blending valve. The three-way valve provides dilution and cooling to ensure a lower water temperature than the primary loop. Table 7-5 presents preliminary design criteria for the secondary digester hot water recirculation pumps.

Table 7-5. Hot Water Recirculation Pump Design Criteria (Secondary Loops)
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Pump type	Horizontal End-Suction Centrifugal
Quantity	2 (1 per Heat Exchanger)
Manufacturers	Cornell, Goulds, Peerless
Design Flow per Pump (Preliminary)	360 gpm
Head Pressure (Preliminary)	40 feet
Motor Speed	TBD
Motor Size (Preliminary)	7.5 hp
Drive	Constant speed

7.2.4 Digester Cleaning

Routine digester cleaning allows for maintenance to occur inside the digesters. The pump used to empty the digesters needs to be capable of handling a high grit and scum load. The design criteria for the digester cleaning pump are shown in Table 7-6.

Table 7-6. Digester Cleaning Pump Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Type	Recessed Impeller
Quantity	1
Manufacturer	Wemco
Time to Empty Digester	24 hours
Design Flow per Pump	1500 gpm
Maximum Head Pressure	100 feet

Table 7-6. Digester Cleaning Pump Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
TS concentration	1% - 6%
Motor Speed	TBD
Maximum Motor Size	100 hp
Drive	Constant Speed

7.2.5 Digester Withdrawal

Sludge withdrawal from the digesters is from either the liquid surface, digester side wall, or the bottom of the cone. Surface overflow limits foam and scum buildup at the liquid surface. The sloped floor bottom (cone withdrawal) facilitates the transfer of grit and debris through the digestion process. Side wall withdrawal is available for maintenance or other events. Under normal operations, solids withdrawal automatically switches between surface withdrawal and cone withdrawal. Alternatively, operators can manually control the withdrawal location. Jacobs recommends withdrawing predominantly from the digester standpipe (surface), with occasional withdrawal periods (initially set at 3 hours per day) from the bottom cone. The digester sludge withdrawal pumps convey digested solids to the Dewatering Feed Tanks.

During surface overflow operation, feed sludge displaces liquid from the digesters. A gravity overflow line discharges to a digester standpipe. As digested solids reach the elevation of this pipe, they overflow into the standpipe located adjacent to the digester. This design feature controls the digester normal liquid level. The standpipe is a 36-inch-diameter, 316L stainless steel pipe that runs vertically adjacent to the digester. Digested solids is pumped from the standpipe by the digester withdrawal pumps.

A 4-inch, 316L stainless steel equalization line connects the headspace of the digester to the headspace of the overflow standpipe. The line equalizes pressures between the two headspaces.

During cone withdrawal operation, speed control matches the pumped withdrawal rate to the measured flow entering the digesters. Alternatively, the withdrawal pumps can operate in level control mode based on the level in the digester.

Table 7-7 presents preliminary design criteria for the digester withdrawal pumps.

Table 7-7. Digester Sludge Withdrawal Pump Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Pump Type	Progressing Cavity
Quantity	3 (2 Duty + Standby)
Manufacturers	Moyno, Seepex, Netzsch
Design Flow per Pump (Preliminary)	120 gpm
Head Pressure (Preliminary)	50 feet

Table 7-7. Digester Sludge Withdrawal Pump Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
TS Concentration	1.0% - 4.0%
Motor Speed	TBD
Motor Size (Preliminary)	5 hp
Drive	Variable Speed

7.2.6 Emergency Overflow

An emergency overflow line is located at each digester. The invert of the emergency overflow is located 3 feet above the invert of the normal full tank overflow line in the digesters. This location allows free discharge of the emergency overflow such that levels and pressures in the digesters do not impact the structural integrity of the fixed cover systems.

The digester overflow is piped through a U-shaped trap with its vertical leg taller than the maximum operating pressure of the digester. The trap is filled with water to provide a gas seal. This feature prevents digester gas from escaping the tank. The emergency overflow trap is vented to atmosphere downstream of the “U” to prevent siphoning.

The emergency overflow system is constructed from 316L stainless steel. Emergency overflow events flow by gravity to the W.B. Casey RSPS. A flushing tap is connected to the emergency overflow to allow for trap priming and cleaning. No valves are provided on the emergency overflow line.

7.2.7 Nitrogen Feed Connections

The proposed digesters are equipped with a nitrogen gas connection. The nitrogen gas connection allows staff to backflush the headspace of the tank when putting it back in service. Backflushing reduces the possibility of creating an explosive mixture of methane and oxygen during these events. The nitrogen gas system consists of a 2-inch stainless steel pipe and appropriate valves to distribute nitrogen gas from an offloading truck to the gas headspace in the tank. The location of the nitrogen gas feed connection allows easy access to a quick-fill station.

7.2.8 Chemical Fill Connections

It may be beneficial to inject chemicals into the digester, such as alkalinity, defoamer, and iron salts, during upset conditions. Pump materials of construction are selected for compatibility with anticipated chemicals. Concrete pads and chemical injection pumps are provided to facilitate this process. The pads are sized to support a chemical tote and are located near a plant drain for easy cleanup in case of a spill.

Table 7-8 presents preliminary design criteria for the chemical injection pumps.

Table 7-8. Digester Chemical Injection Pump Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Pump Type	Progressing Cavity
Quantity	2
Manufacturers	Moyno, Seepex, Netzsch
Design Flow per Pump	50 gpm
Head Pressure	TBD
TS Concentration	0%
Motor Speed	TBD
Motor Size	TBD
Drive	Variable Speed

7.2.9 Waste Gas Burners

The waste gas burners are sized to burn the total future (40-mgd plant capacity) maximum day gas production, plus a safety factor. The waste gas burners are enclosed burner stack models, which have no visible flame and produce lower emissions of nitrogen oxides and carbon monoxide than open "candlestick-style" burners.

The waste gas burners operate on the pressure within the low-pressure biogas collection pipeline. As pressure increases, which indicates that instantaneous production is greater than consumption by hot water boilers and thermal dryers, the waste gas burners initiate the ignition sequence and begin burning biogas. If after a period of time, the pressure is increasing or unchanged, the additional burner initiates the ignition sequence and also begins burning digester gas. Table 7-9 summarizes the waste gas burner design criteria.

Table 7-9. Waste Gas Burner Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Waste Gas Burner Type	Enclosed
Quantity	2 (Duty + Standby)
Manufacturers	Varec Biogas, Shand & Jurs
Maximum Digester Gas Flowrate	TBD
Burner Turndown Ratio	Infinite
Minimum Inlet Pressure	> 0 inches w.c.g.
Minimum Methane Destruction Efficiency	99.5%

Table 7-9. Waste Gas Burner Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Maximum Noise Level	85 dBA @ 10 feet

dBA = A weighted decibel
w.c.g. = water column gauge

7.2.10 Gas Conditioning

Raw digester gas includes hydrogen sulfide (H_2S), moisture, and volatile organic compounds (VOCs), including siloxanes, which damage heat transfer surfaces, increase maintenance frequency, and decrease service life of boilers (Anaerobic Digester facility) and furnace (Thermal Drying facility). The digester gas treatment system includes unit processes for H_2S removal, moisture removal, siloxane removal, and particulate removal. H_2S is removed using iron sponge media. Moisture is removed using multi-stage cooling to 40ºF and reheating to approximately 80ºF for a target relative humidity of 25 percent. Siloxanes are removed using activated carbon adsorbent. Table 7-10 incudes preliminary design criteria for the digester gas treatment.

Table 7-10. Digester Gas Conditioning Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Overall System Criteria	
Manufacturer	Unison
Inlet H_2S Concentration	500 ppmv (assumed)
Inlet Total Siloxane Concentration	5 ppmv (assumed)
System Rated Flow	TBD
Outlet Pressure	5 psig
Outlet H_2S Concentration	10 ppmv (maximum)
Dew point	40°F
Outlet Total Siloxane Concentration	200 ppbv (maximum)
Particulate Removal	99.5% @ >3 microns
Minimum Bed Life (H_2S and siloxane removal)	6 months per vessel
H_2S Removal	
Quantity of Tanks	1
Construction Material	Type 304L Stainless steel
Media	Pelletized ferric hydroxide
Gas Compression and Moisture Removal	
Quantity of Gas Compressors	2 (Duty + Standby)

Table 7-10. Digester Gas Conditioning Design Criteria

W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Gas Compressor Capacity	TBD
Gas Compressor Type	Rotary Lobe, Belt-Driven
Gas Compressor Drive	Variable Speed
Moisture Removal	Dual-Core Heat Exchanger with Chilled Water and Gas Reheat
Chiller System	Packaged System with Dual Pumps and Dual Refrigerant Compressors
Siloxane Removal	
Quantity of Tanks	2 (Lead, Lag)
Construction Material	Type 304L Stainless Steel
Media	Pelletized Activated Carbon

ppbv = parts per billion by volume

ppmv = parts per million by volume

7.2.11 Hot Water System

Hot water for digester and space heating (to be evaluated during detailed design) is provided by a hot water system. Heat input to the primary hot water loop is provided by water boilers. Table 7-11 summarizes the boiler design criteria.

Table 7-11. Hot Water Boiler Design Criteria

W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Boiler Quantity	3 (2 Duty + Standby)
Manufacturers	Superior, Cleaver Brooks
Capacity, Each (Preliminary)	2.0 $MMBTU_{th}$/hr output
Fuel trains	Natural Gas and Digester Gas

MMBTUth = million British Thermal Units (thermal)

The primary hot water recirculation pumps are VFD-driven so that flow can be adjusted to match the actual heat load. These pumps are designed for flow rates corresponding to the heat loads. Piping layouts and hydraulic calculations will be performed during detailed design to determine pump head and horsepower requirements. Preliminary pump sizing is summarized in Table 7-12.

Table 7-12. Boiler Hot Water Recirculation Pump Design Criteria (Primary Loop)
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Pump Type	Horizontal End-Suction Centrifugal
Quantity	2 (Duty + Standby)
Manufacturer	Cornell, Goulds, Peerless
Design Flow per Pump	130 gpm
Head Pressure	30 feet
Motor Speed	TBD
Motor Size	5
Drive	Variable Speed

7.3 Functional Description

Process flow diagrams for the anaerobic digestion facilities (Drawings 100-N-004 through 100-N-013) are provided in Appendix A.

7.3.1 Anaerobic Digesters

The key functional parameters for the anaerobic digesters are the SRT, volatile solids loading rate (VSLR), and digester level. SRT corresponds to digester hydraulic loading and is calculated as the total volume of the operational digesters divided by the raw feed flow. Maintaining a minimum SRT ensures that the anaerobic microorganisms have enough time to grow in the digester before being transferred out of the tank. The VSLR measures the organic loading capacity and is measured by dividing the digester volatile solids loading by the active volume of the operating digesters. Exceeding the maximum VSLR can result in gas entrainment, foaming, microbial inhibition, and difficulty mixing or conveying the digested solids.

Except during digester maintenance, both digesters are operated, resulting in 24-day SRT under design maximum month conditions. During digester maintenance, the other digester is operated, resulting in 12-day SRT under design maximum month conditions.

Digester level is measured using both a pressure indicating transmitter at the base of the digester and a radar level indicating transmitter (LIT) on top of the digester. The pressure indicating transmitter (PIT) measures the weight of the water column above the transmitter. The radar LIT measures the physical surface of the water level. When operating optimally, the radar LIT and PITs return the same digester level and provide redundant level readings if one is out of service. However, the difference between these measurements can indicate digester foaming or gas entrainment. Foaming and gas entrainment are physical phenomena that occur when digester gas cannot exit the aqueous phase and either form as bubbles at the digester surface (foaming) or remain in the digester liquid (gas entrainment). A constant level reading from the radar instrument and a decreasing level reading from the pressure instrument represents increasing gas entrainment.

7.3.2 Digester Mixing System

The digester mixing system consists primarily of digester mixing pumps and mixing nozzles mounted inside the digester. The location and orientation of the nozzles is set by the mixing system manufacturer during installation. The mixing pumps are equipped with a VFD to allow the operator to adjust the amount of mixing energy imparted into the digester liquid. Usually, the mixing system is commissioned and tested when the mixing pumps are operating at full speed, and then the speed can by manually reduced by operators to determine the minimum speed required to achieve optimal digester performance.

7.3.3 Digester Heating and Recirculation

Digester heating is controlled by modulating the heating water inlet temperature to the secondary hot water loop and heat exchanger based on the inlet sludge temperature. As the inlet sludge temperature decreases below the mesophilic temperature set-point, the three-way valve on the secondary hot water loop opens to allow more heating water into the secondary loop from the primary loop. The reverse process occurs when the digester solids temperature increases above the set-point. The following limitations are placed on the secondary heating loop control:

- Maximum solids temperature rise of 10F° across heat exchanger
- Maximum inlet heating water temperature of 160°F

7.3.4 Digester Cleaning

Digester cleaning is a manual operation. When the digester is taken out of service for cleaning or maintenance, the discharge valves on the digester cleaning pumps are manually opened and the pumps are turned on to convey grit-laden sludge from the digester cone.

7.3.5 Digester Sludge Withdrawal

Digester sludge withdrawal switches between surface and cone withdrawal by automatically actuating control valves at the bottom of the digester standpipe and from the digester cone. Withdrawal usually occurs from the surface via the digester standpipe with occasional withdrawal from the cone. The cone withdrawal interval is operator-adjustable. Surface withdrawal helps remove floatables, filaments, and other materials that aggregate at the digester liquid surface. Cone withdrawal helps remove grit and other dense material that accumulate in the digester cone. When withdrawing from the digester surface, the digester withdrawal pumps are controlled to maintain a constant level near the middle of the standpipe using a proportional integral derivative (PID) controller. When withdrawing from the cone, the withdrawal pumps are controlled using the liquid level returned from either of the level transmitters (radar or pressure).

7.3.6 Emergency Overflow

The emergency overflow apparatus is a passive safety device that is always available to convey emergency overflows from the digester to a safe location, which in this case is the W.B. Casey RSPS. A gas seal is maintained by a U-trap with a water column that exceeds the maximum digester gas headspace pressure. To maintain a gas seal, level switches inside the U-trap water column activate at low- and high-set-points to allow water into the U-trap.

7.3.7 Nitrogen Feed Connections

The nitrogen feed connections are manual valves used during digester startup and shutdown. The nitrogen purge sequence is a manual event that requires operator oversight.

7.3.8 Digester Gas System

The digester gas system is operated based on digester gas pressure within the gas collection system, as shown in Table 7-13. The boilers use digester gas (or natural gas) as needed to maintain the heating loop temperature set-point. The dryer uses digester gas (or natural gas) as needed for the drying process. Excess gas not used by the boilers or drying facility is flared using the waste gas burners (there is not enough excess gas expected to warrant the installation of an electrical generator). As pressure in the gas header increases beyond pressure set-points, the waste gas burners are ramped up progressively. If pressures continue to increase, pressure relief valves and emergency relief hatches on top of the digesters open. Because these are contingency devices, they are not connected to odor control. As pressures decrease below pressure set-points, digester gas flow to the Dewatering/Thermal Drying Facility and boilers is decreased or eliminated. If pressures continue to decrease, emergency vacuum relief valves on top of the digester.

Table 7-13. Operational Set-points of the Digester Gas Handling System
W.B. Casey WRRF Draft Preliminary Engineering Report

Action	Pressure Set-point, in. w.c.g.
Emergency Pressure Relief Open	24
Pressure Relief Valve Full Open Pressure	22
Pressure Relief Valve Crack Pressure	20
Lag Waste Gas Burner On	19
Lead Waste Gas Burner On	18
Digester Gas Maximum Normal Operating Pressure	18
Lag Waste Gas Burner Off	17
Lead Waste Gas Burner Off	16
Target Digester Gas Operational Pressure	15
Digester Gas Minimum Normal Operating Pressure	12
Vacuum Relief Valve Crack Pressure	-2
Emergency Vacuum Relief Valve Crack Pressure	-3
Vacuum Relief Valve Full Open	-4
Emergency Vacuum Relief Valve Full Open	-4

7.3.9 Waste Gas Burner

The waste gas burners automatically activate (ignite) at the pressure set-points specified in Table 7-13. As the pressure reaches the activation set-points of each waste gas burner, the pilot ignites, and the waste gas burner runs a series of internal checks to ensure that the pilot system has activated and the burner is ready to operate. Once ready, a motorized control valve on the digester gas feed line to each waste gas burner opens and the main flame ignites. The waste gas burner continues to operate until the motorized control valve closes at the indicated pressures.

7.3.10 Gas Conditioning

The digester gas treatment system includes a local control panel. The digester gas treatment system is normally in operation whenever the boilers or Dewatering/Thermal Drying Facility are operated on digester gas. The gas treatment system is a package system, and detailed control strategies will be provided by the manufacturer. The system is normally controlled by the gas treatment local control panel, but an operator can operate the system remotely. The gas treatment system provides a READY permissive to SCADA to allow operation. The gas compressors target a discharge pressure of 5 psig using a PID controller. As the discharge pressure increases, the compressor speed decreases to achieve the set-point. As the discharge pressure decreases, the gas compressors increase speed.

7.3.11 Heating Water System

Overall plant heat demand is tracked by changes in primary heating water loop temperature. As the plant heat demand increases, the temperature reading from the heating water return temperature indicating transmitter decreases. Output from the boilers automatically increases to achieve the target supply temperature. The opposite occurs when plant heat demand decreases. The target supply temperature is 180°F.

7.4 Reliability and Redundancy

The following design features are included for reliability and redundancy:

- One digester capable of handling MMADF conditions
- Standby pump for digester mixing, sludge recirculation, and withdrawal pumping systems
- Standby biogas compressor and burner
- Standby water boiler and primary heating loop pump

Redundancy is not provided directly for heat exchangers or secondary hot water loop pumps. This equipment is associated with a particular digester, and one digester can meet requirements under design conditions.

8. Dewatering

8.1 Introduction

Digested TPS and TWAS are blended in a dewatering feed tanks. Centrifuges provide dewatering of the blended sludge (digested TPS and screened TWAS) prior to thermal drying. Currently, CCWA uses belt filter presses for dewatering. Centrifuges were selected for the upgrade to enable process optimization and improved control of the dewatered cake concentration. Centrifuges can be easily adjusted to reliably achieve the target dewatered cake concentration of 22 to 25 percent, which is the optimal range for thermal drying. The dewatering system includes centrifuge feed pumps which are located at the Dewatering Feed Tanks. The remaining dewatering equipment is located in the Dewatering/Thermal Drying Facility and includes centrifuges, a discharge screw conveyor system, an emulsion polymer system, and a centrate system for handling water removed by the centrifuge.

8.2 Process Description/Overview

Having dedicated digested solids storage tank(s) is a best engineering practice to ensure maximum digestion capacity is maintained and dewatering feed can be optimally controlled. Two dewatering feed tanks receive digested TPS and TWAS. These tanks use pumped mixing. Table 8-1 summarizes the design criteria for the dewatering feed tanks and mix pumps which will be located in the Dewatering Feed Tanks and Pump Station building. The mixing system will be designed by the manufacturer during detailed design, hence some criteria are designated “Preliminary.”

Table 8-1. Dewatering Feed Tank Design Criteria

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Parameter	Value
Dewatering Feed Tanks	
Tank Type	Rectangular Concrete
Quantity	2
Retention Time @ Maximum Month Loads	3 days (1.5 days per tank)*
Tank Volume	750,000 gallons (375,000 gallons each)
Inner Length (Each)	42.3 feet
Inner Width (Each)	42.3 feet
Side Wall Height (Top of Slab to Top of Tank Wall)	32.0 feet
Side Water Depth (Emergency Overflow Height)	28.0 feet
Floor Slope	Minimal, For Drainage
Dewatering Feed Tank Mix Pumps	
Pump Type	Non-Clog Horizontal Chopper
Quantity	3 (2 Duty + Standby)
Manufacturers	Vaughan, Siemens

Table 8-1. Dewatering Feed Tank Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Design Flow per Pump (Preliminary)	2,100 gpm
Maximum Head Pressure (Preliminary)	75 feet
TS Concentration	1.0% - 4.0%
Motor Speed	TBD
Maximum Motor Size (Preliminary)	60 hp
Drive	Variable Speed

* At 40-mgd plant capacity, residence times will be 20 percent less.

Digester gas is formed in the dewatering feed tanks. Like the anaerobic digesters, the dewatering feed tanks are gas tight and protected by pressure/vacuum relief valves. The headspace of these tanks is connected to the digester gas system.

Blended sludge has a solids concentration of approximately 3 percent. The blended anaerobically digested TPS and TWAS is pumped by two PC feed pumps (one per centrifuge with crossover capabilities). Pumps are equipped with VFDs to optimize feed to the two centrifuges in the proposed Dewatering/Thermal Drying Facility. Each line between the centrifuge feed pumps and centrifuges is equipped with a static mixer for polymer and sludge mixing. Two polymer injection rings are provided, one in front of the static mixer and a second at the centrifuges. This approach provides operational flexibility to use polymers that require a longer retention time for proper mixing with the feed sludge.

Two centrifuges are provided, one normally operating to handle maximum month conditions and one standby. Space for a third centrifuge is reserved for when the plant expands beyond 32-mgd capacity.

The dewatered sludge produced by each centrifuge drops through a chute onto an inclined reversible screw conveyor that carries the dewatered sludge to a shared screw conveyor located between the two centrifuges. The shared screw conveyor transfers the dewatered sludge to the thermal dryer wet cake bin, which is used to store the dewatered sludge and the sludge from the Cake Receiving Facility.

The centrate flows from the centrate chute to the centrate pipe and then by gravity to the W.B. Casey RSPS. On an intermittent basis, when the centrifuge starts up and shuts down, the thin “sloppy cake” is discharged to the centrate pipe. Washwater resulting from cleaning sequences is also discharged to the centrate pipe. These cleaning sequences include a clean-in-place (CIP) sequence that follows an alarm condition and a normal washdown sequence that follows machine shutdown.

The design criteria for the dewatering system are summarized in Table 8-2.

Table 8-2. Dewatering System Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Applicable Loading Condition	Maximum Month
Centrifuge Feed Pumps	
Quantity	2 (Duty + Standby)
Type	Progressing Cavity
Manufacturers	Robbins and Myers (Moyno), Seepex, Netzsch
Pump Capacity	285 gpm
Drive	Variable Speed
Centrifuges	
Quantity	2 (Duty + Standby)
Manufacturers (Model)	Andritz (D7LL) GEA Westfalia (CF 8000) Alfa Laval (G3 125)
Operating Schedule	24/5
Hydraulic Loading	283 gpm
Feed Solids	3.1%
Solids Loading Capacity	4,480 lb/hr
Target Dewatered Cake Solids	22-25%
Capture	97.5%
Non-Potable Water	100 gpm*
Power Required	Variable

*Estimated. These intermittent flows have typical durations of 10 and 15 minutes for CIP and shutdown washing sequences, respectively.
lb/hr = pounds per hour

8.3 Functional Description

The dewatering feed tank level is measured and controlled using a radar level indicating transmitter located on top of each tank. Level switches located inside each tank are used to indicate low, high, and high-high levels. At low level, the dewatering feed tank mixing pumps turn off to prevent dry running and possible damage to the pumps. At high level, the system alarms. At high-high level, all pumps feeding the dewatering feed tanks are shut off until the alarm is cleared.

The centrifuge feed pumps operate in Local or Remote modes and with Manual or Automatic operation. In Automatic operation, each centrifuge feed pump operates based on requests from the centrifuge PLC and SCADA control set-points (for example, biosolids feed rate or operating speed). Under Manual operation, the pumps are started and stopped by the operator through SCADA or the local control panel. Pumps are equipped with VFDs to enable direct control of blended sludge flow rates to the centrifuges.

Typical operation utilizes one centrifuge at a time running continuously for up to 5 days per week. A centrifuge feed pump, static mixer, and polymer pump are associated with a specific centrifuge with cross connections enabling the flexibility to use either centrifuge feed pump with either centrifuge. Each centrifuge package has a dedicated local panel with PLC and associated operator interface terminal. The centrifuge system PLCs communicate with the dewatering complex PLC enabling fully automated control.

Each centrifuge can be controlled Locally or Remotely from plantwide SCADA. The operator selects between Manual and Automatic mode. Under normal operating conditions, Automatic mode is used, and the operation of the centrifuge is determined by the set-points for differential speed and torque in the centrifuge panel PLC. The centrifuge controller selects automatically between differential speed mode and torque mode depending on the measured torque. The operator has the ability to modify set-points for bowl speed, differential speed, and torque. In differential speed mode, the centrifuge controller limits the differential speed based on the minimum differential speed set-point. In torque mode, the centrifuge controller limits the maximum torque based on the maximum torque set-point.

The SCADA system sends and receives information to and from the centrifuge PLC, including alarms, permissions, set-points, interlocks, flows, and speeds. A series of interlocks are in place when a centrifuge starts in Automatic mode to ensure feed pumps, polymer system, and screw conveyor are operational. When the centrifuge shuts down, commands are sent to the ancillary equipment to stop operating.

When the centrifuge startup sequence begins, the inclined screw conveyor runs in reverse and the “sloppy cake” flows to the centrate line and then to the W.B. Casey RSPS by gravity. After approximately 3 to 5 minutes of initial operation, the influent feed sludge in the centrifuge creates a “seal,” which signals the inclined screw conveyor to run forward or in the “uphill” direction and transfer the dewatered cake to the combined screw conveyor. Under normal operating conditions, the inclined screw conveyor direction is controlled by the centrifuge PLC.

8.4 Reliability and Redundancy

The dewatering facility meets or surpasses the following reliability and redundancy requirements:

- One standby dewatering feed tank mix pump
- One standby centrifuge at design MMADF conditions
- One standby centrifuge feed pump and polymer blending unit with cross connections enabling use with either centrifuge

9. Cake Receiving

9.1 Introduction

The W.B. Casey WRRF receives dewatered cake from the NEWRF. The cake is processed along with dewatered cake from the W.B. Casey WRRF at the proposed Dewatering / Thermal Drying Facility. The proposed Cake Receiving Facility will receive dewatered cake from the NEWRF but only in such quantities that dryer capacity at W.B. Casey WRRF is not exceeded. Early in the lifecycle, there will be sufficient capacity for all NEWRF cake. Amounts of cake produced at the W.B. Casey WRRF and the NEWRF will increase until the dryer capacity is reached. Thereafter, cake produced at the W.B. Casey WRRF will continue to increase, while cake hauled from the NEWRF to the W.B. Casey WRRF will decrease (excess NEWRF cake will be managed by an alternative approach starting in 2030). The cake receiving facility is sized for the maximum NEWRF cake to be received without an increase in the drying facility capacity.

The proposed Cake Receiving Facility consists of a truck bay, a truck receiving bin, and pumping system to transfer cake to the adjacent Dewatering/Thermal Drying Facility. All cake-receiving components are located in an enclosed building configured to receive cake from a tipping trailer.

9.2 Process Description/Overview

Cake is delivered in a tipping trailer that is backed into an enclosed truck bay. The truck bay is sized such that the trailer and truck are completely contained within the building and the overhead door can be closed during the tipping operation. The tipping trailer discharges cake into a receiving bin equipped with a bi-fold door at the top and a live bottom hopper. The receiving bin is sized for 53 cubic yards of cake, which corresponds to 3 days of storage under maximum month conditions at the NEWRF. The selected bin volume holds 1.8 full trailer loads.

A sliding frame discharger located on the bottom of the bin dispenses cake to two extraction screw conveyors by sliding back and forth. Each screw conveyor is equipped with a slide gate to dispense cake to a screw feeder. Twin screw feeders feed into piston pumps, which pump the cake to the Dewatering/ Thermal Drying Facility. Polymer solution or water (to be determined during detailed design) is added to the cake immediately downstream of the piston pumps to lubricate the pipeline and reduce the pressure requirement. The system runs on three hydraulic power units (HPUs) with one powering the sliding frame discharger, slide gate, and bi-fold door on the receiving bin and one each powering the piston pumps.

The design criteria for the cake receiving system are summarized in Table 9-1.

Table 9-1. Cake Receiving System Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Overall System Criteria	
Cake Received	12.3 wet ton/day annual average 14.8 wet ton/day maximum month 17.5 cubic yards/day maximum month
Storage Interval at Maximum Month	3 days
Storage Volume at Maximum Month	53 cubic yards
Manufacturers	Schwing Bioset, Putzmeister*
Receiving Bin	
Quantity	1
Diameter	14.8 feet
Sidewall Height	11 feet
Bar Gate Opening for Cake Receiving	10 feet by 10 feet
Length of Sliding Frame Cake Discharge	14.8 feet
Capacity	62 cubic yards (53 cubic yards at 45° angle of repose)
Extraction Screw Conveyor	
Quantity	2 (Duty + Standby)
Length (each)	15 feet
Discharge Rate	20 gpm
Discharge Slide Gate (One per Conveyor)	17 inches by 17 inches.
Motor	7.5 hp
Drive	Variable Speed
Hydraulic Power Unit – Bin	
Quantity	1
Model	110-15 hp
Reservoir Volume	30 gallons
Motor	15 hp
Drive (Volts/Hertz/Phases)	480/60/3
Twin Screw Feeder	
Quantity	2 (duty + standby)
Model	SD 350HD

Table 9-1. Cake Receiving System Design Criteria

W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Piston Pump	
Quantity	2 (duty + standby)
Capacity	3.5 to 20 gpm
Model	KSP 12 V(HD)L
Hydraulic Power Units – Pump	
Quantity	2 (duty + standby)
Model	440L-100 hp
Reservoir Volume	115 gallons
Motor	100 hp
Drive	480/60/3

Equipment sizes and models shown are specific to Schwing Bioset. Similar equipment can be provided by Putzmeister, but standard sizes vary.

9.3 Functional Description

The cake receiving facility is able to operate in Local/Remote and Manual/Automatic modes. The system utilizes two control panels—one for the bin HPU (designated “HPU-bin”) and one for the two pump HPUs (designated “HPU-pump”).

Cake is received intermittently on a schedule coordinated between the W.B. Casey WRRF and NEWRF operators. A truck load is accepted only if sufficient capacity is available in the receiving bin. Upon arrival, the operator opens the truck bay, drives the truck and trailer into the bay, closes the door, and initiates the offloading process. The receiving bin opens, and the operator tips the trailer to transfer cake into the bin. During offloading, foul air is directed to a carbon adsorption unit, which is described in Section 12.

The Bin Control Panel provides control and monitoring of the bin roof level sensor, two conveyor discharge pressure sensors, the bi-fold door, sliding frame discharger, and slide gates. The bin is equipped with one level instrument, which monitors the height of cake. If a cake low level point is reached, an alarm is sent to the SCADA system and the piston pumps shut down. Piston pump speed is adjusted from the drying facility via plant SCADA based on an operator-selected transfer rate.

The sliding frame discharger includes a hydraulic cylinder, which includes two proximal switches to direct flow of oil. The slide gates are set automatically to close upon loss of power from the HPU or by activating the systems emergency stop (e-stop).

An extraction screw conveyor and associated piston pump is selected by the operator. In automatic mode, when pumping is initiated, the sliding frame and selected screw conveyor start, and the associated slide gate opens. Each extraction screw conveyor includes a motion sensor alarm and pressure sensors at the screw discharge for speed modulation. A pressure transducer automatically controls the screw feeder speed for the twin screw feeder transition to the piston pumps. The feeder is equipped with a three-position solenoid valve to control the augers located in the HPU with FORWARD/STOP/REVERSE controls.

The starter panels for the HPUs includes starters for the piston pump, sliding frames, and twin screw feeder proportional valves and provides electrical power for the valves. A recirculating hydraulic oil conditioning loop includes a constant volume hydraulic pump, water-cooled heat exchanger, shutoff valves, and a temperature sensor and solenoid valve to regulate water flow.

The piston pumps use a pressure transmitter and pressure switch on the discharge. Polymer feed is controlled based on the pressure measurement. High pressure switches alarm and shut down the pump. Flow is determined from calculations by monitoring the pump speed and multiplying by pump displacement per piston cycle.

9.4 Reliability and Redundancy

Based on operations at other cake receiving facilities, no redundancy is provided for the cake receiving bin or HPU-bin. When the system is shut down, dewatered cake from the NEWRF will not be delivered to the W.B. Casey WRRF. The system maintains redundancy of all other mechanical equipment. This includes two separate trains (one duty and one standby), each with a piston pump for transfer of biosolids from the cake receiving bin to the thermal drying facility, an extraction screw conveyor, a twin-screw feeder, and an HPU-pump.

10. Thermal Drying

10.1 Introduction

Currently, biosolids at the W.B. Casey WRRF are dewatered before being conveyed to the existing pelletizing equipment located in the same building. The existing Pelletizing Facility utilizes a thermal drying process to remove water content from the dewatered cake to yield a product that is approximately 95 percent solids by weight. The final products of this process are dried pellets that are classified as Class A Exceptional Quality, biosolids and have agricultural value as a fertilizer. By selling these pellets, CCWA avoids operating costs associated with disposal of dewatered solids and instead generates revenue. The existing pelletizing facility is a highly valued treatment process at the W.B. Casey WRRF. However, the current facility is over 40 years old, resulting in frequent equipment maintenance. Further, the facility was sized for biosolids production associated with 19-mgd plant capacity and represents safety concerns. The existing thermal drying facility has reached the end of its service life and needs to be replaced.

The existing Pelletizing Facility is replaced with an updated thermal drying system designed to treat projected solids production rates at 32-mgd plant capacity. The proposed system is sized to treat all of the solids from W.B. Casey WRRF and also will allow for treatment of a portion of dewatered sludge from the NEWRF. With projections accounting for potential diversion of wastewater flows from the SCWRF to the W.B. Casey WRRF within the planning horizon, this approach allows for all of CCWA's biosolids to be processed into marketable pellets in the near-term. As total system flows increase, the proposed facility's maximum capacity will be reached, limiting the amount of dewatered cake from the NEWRF that may be treated; however, at the end of the proposed facility's useful life, greater than 80 percent of the NEWRF's dewatered solids can still be treated at the W.B. Casey WRRF.

In addition to capacity improvements, the proposed Pelletizing Facility is designed to meet code requirements that have changed since the construction of the existing facility, including National Fire Protection Associated (NFPA) 652 and 654 standards. Also, the proposed facility is capable of utilizing a blend of natural gas and biogas produced by the proposed digester facilities described in Section 7. This capability combined with exhaust treatment processes allow the proposed facility to produce high-quality, marketable pellets with a solids content of 92 to 95 percent with reduced operating costs while remaining compliant with regulatory requirements.

In addition to the thermal drying equipment that dries the incoming cake, the Dewatering/Thermal Drying Facility includes processes to maintain compliance with emissions regulations and to reduce odors. All major process equipment included in these processes is supplied as a vendor package. For preliminary design, Andritz is the basis for thermal drying equipment, and all thermal drying design details included in this report are based on the Andritz DDS-50 system.

All constituent equipment included in the DDS-50 system is housed within a new, steel-framed building with a minimum vertical clearance of 60 feet. This is much taller than the existing building but accommodates the multi-level mezzanine configuration commonly found in modern Andritz facilities. This arrangement, with equipment positioned on elevated platforms, allows for a substantial reduction in overall footprint and minimizes pumping/conveyance requirements. All major components of the Andritz system are housed within this building except for the regenerative thermal oxidizer (RTO) used to control air emissions from the dryer. In addition to the thermal drying equipment, the building houses all dewatering equipment including centrifuges, conveyance equipment, and dewatering polymer equipment described elsewhere in this report. Finally, to provide a similar level of service as the existing pelletizing facility, the proposed facility includes a control room, office space, and restrooms. The footprint provided on the site plan in Appendix B accounts for these support spaces and the space required for the RTO in addition to the dewatering and drying facility equipment. Notably, a product storage area is not accounted for in the footprint provided because pellets will be conveyed pneumatically to the existing facility's storage/loading bay, which will be retained after the existing Pelletizing Facility is decommissioned.

When the W.B. Casey WRRF is expanded beyond 32-mgd capacity, an expansion of the Dewatering/ Thermal Drying Facility will be constructed south of the proposed facility. Building expandability will be considered during design.

10.2 Process Description/Overview

A simplified process flow diagram of the thermal drying system is provided on Figure 10-1, and detailed process flow diagrams are provided in Appendix A of this report (Drawings 100-N-017 through -022).

The major components of the facility are as follows:

- Cake Bin
- Mixer (for cake and recycled product)
- Furnace with Burner
- Drying Drum
- Pre-Separator
- Polycyclone
- Sizing Screen
- Crusher
- Recycled Material Bin
- Product Pellet Cooler
- Dense Phase Transporter (Pneumatic)
- Main Exhaust Fan
- Condenser
- Venturi Scrubber
- RTO
- Emissions Stack
- Pneumatic Transport System
- Pellet Storage (existing)

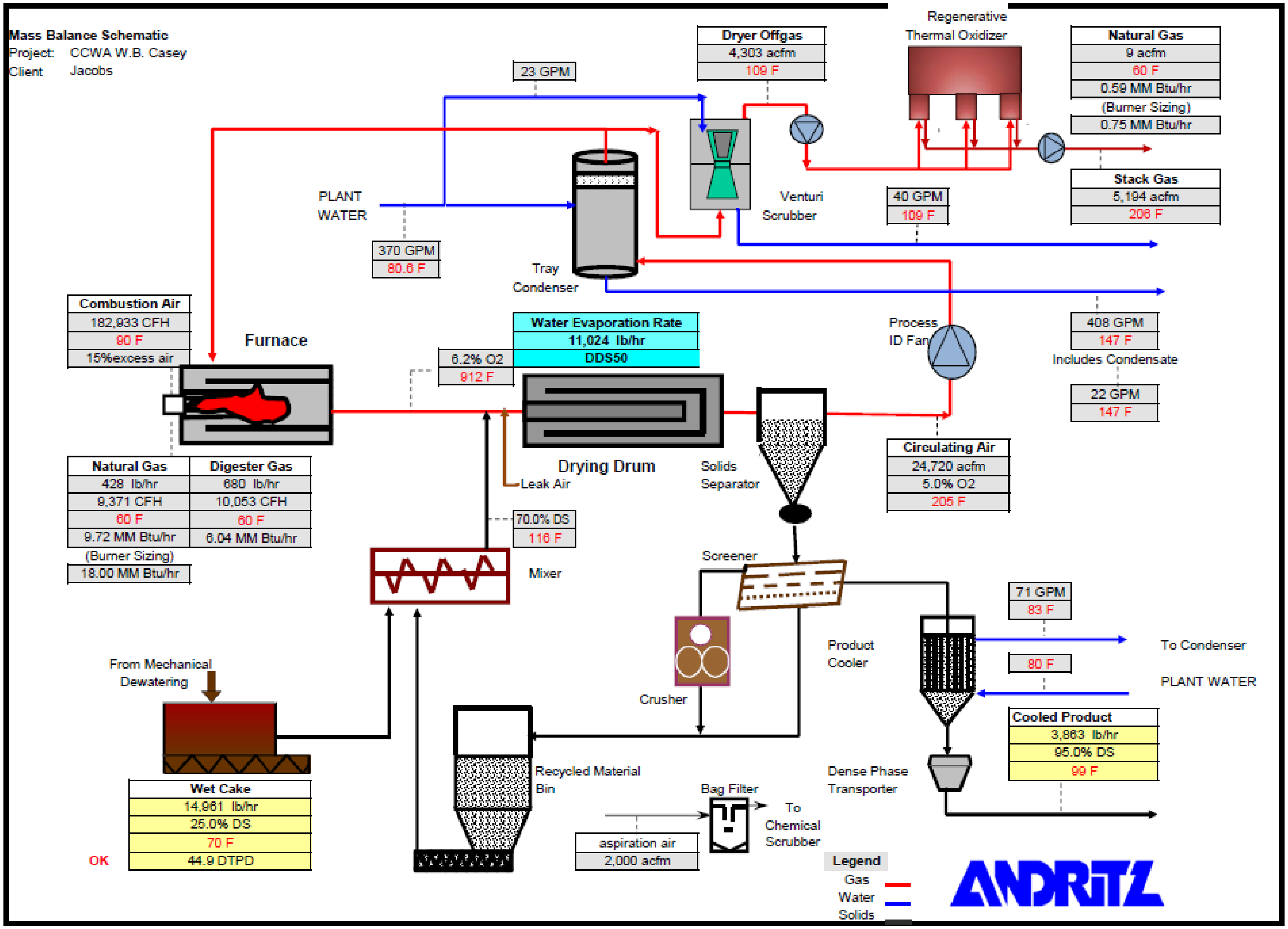


Figure 10-1. Thermal Drying Facility – Simplified Process Flow Diagram

W.B. Casey WRRF Draft Preliminary Engineering Report

Dewatered sludge cake from the centrifuges and Cake Receiving Facility are separately conveyed to the wet cake bin. The cake from this bin is fed to cake pump(s) via extraction screw conveyor(s). The cake pump(s) pump dewatered cake to the mixer unit where recycled solids are reintroduced and mixed with the incoming dewatered cake. (The quantity of conveyors and cake pumps will be resolved during detailed design in tandem with the decision for how to transfer dewatered cake to a trailer when the drying facility is not operational.) The recycled solids provide a nucleus for the wet cake to coat and form a granule. The outlet of the mixing unit discharges to the drying drum, where heated air from the furnace comes in contact with the granules to remove moisture and yield a product with 92 to 95 percent solids content. Air and solids are then separated in the solids separator unit (consisting of pre-separator and polycyclone) to create diverging air and solids flow streams.

Solids exiting the separator and polycyclone discharge to a screw conveyor, which feeds the dried solids to a vibrating screen where solids are separated into three fractions according to size. Oversize pellets are separated first and diverted to the crusher where the solids are crushed into small particles. Product sized pellets (0.5 to 4-millimeter diameter) are sent to the product cooler system. Solids that pass through the screen are undersized. These undersized solids and the crushed solids exiting the crusher are combined and discharged to a screw conveyor, which feeds the dried solids to a bucket elevator and then to the recycled material bin. The fine recycled solids in this bin are conveyed via screw conveyor to the mixer to be reintroduced to the drying drum.

The product pellets exiting the sizing screen are discharged to a separate bucket elevator that carries the pellets to the product pellet cooler. The cooler acts as a non-contact heat exchanger where plant process water passes through the unit and serves as a heat sink. The cooled pellets discharged from the cooler are then fed to the pneumatic transport system where compressed air conveys the finished pellets to the existing storage/loading area at the south end of the existing pelletizing facility. The need for a pellet cooler can be assessed in more detail during the design phase.

The air stream runs in conjunction with the solids stream at the drying facility. This stream begins with the furnace where a natural gas/digester gas mixture is combusted to heat influent and recycled air. The heated air is conveyed to the dryer where it evaporates moisture from the granules, retains it, and conveys it via the separator/polycyclone to the downstream condenser where moisture is removed. Air exiting the condenser is partitioned such that a major portion flows back to the furnace to supplement influent air to the furnace and the remainder passes to the venturi scrubber. At the scrubber, the process air undergoes countercurrent flow with plant process water to remove particulates. Exhaust gas is then passed to the natural gas-fired RTO, which destroys VOCs as required to meet emissions regulations and prevent odors. Finally, the RTO exhausts to a stack which discharges to the atmosphere.

The design criteria for the proposed thermal drying system are summarized in Table 10-1.

Table 10-1. Thermal Drying System Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Quantity	1
Type	Rotary drum drying system with heated air in contact with biosolids
Manufacturer	Andritz
Model	DDS-50
Operating Schedule	24/5
Design solids loading, maximum month average	441,000 dry lb/week 88,200 dry lb/d (5 d/week operation)

Table 10-1. Thermal Drying System Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Design solids feed	25%
Target solids content	92-95%
Evaporation Rate	10,900 lb/hr H_2O
Unit solids capture	98%
Pellet Production Rate	3,790 wet lb/hr

10.3 Functional Description

Flow through the Dewatering / Thermal Drying Facility is driven by production rates of dewatered cake from the centrifuges as well as the Cake Receiving Facility. The ratio of dewatered cake to recycled solids is operator adjustable, and the ratio is typically set during commissioning and only requires resetting if there is a change in cake feed characteristics. Flow through the facility is correspondingly modulated through the operation of variable speed drives on the various screw conveyors and bucket elevators throughout the facility, with individual automated control governed by the central PLC provided and programmed by the dryer vendor.

The vendor-provided control system also coordinates these feed rates to ensure that the natural gas/digester gas influent valves are appropriately modulated to supply the furnace with combustible gas at an appropriate rate. This is carefully coordinated with the dryer gas outlet temperature, which regulates the fuel flow to the burner. The main centrifugal fan provides the draft necessary to maintain the required airflow through the system. The venturi exhaust fan and the RTO exhaust fan regulate the quantity of air exhausted to the atmosphere. As pellets are produced in the thermal drying process, level indication in the product cooler unit informs operation of the pneumatic transport system such that air flow rates can appropriately provide conveyance of finished pellets to storage as they are produced.

10.4 Reliability and Redundancy

The proposed Andritz system consists of a single process train without redundancy incorporated into any major process component. As demonstrated in Table 10-1, the proposed drying facility is designed to operate on a 24/5 schedule, typically operating only on weekdays. Routine maintenance would be carried out as needed during the 2 consecutive days in which the facility is not in operation. This approach substantially reduces the capital cost associated with the thermal drying facility; however, if more intensive maintenance is required, the facility as proposed would be unable to treat dewatered biosolids until such work is completed. To address this lack of direct redundancy, additional features are included in the proposed design to allow for continued plant operation in the event of extended outage periods. During such an extended outage, NEWRF cake would not be received. Cake from the W.B. Casey WRRF centrifuges would be directed to a dewatered cake loadout pipe rather than being fed to the cake mixer. This allows for temporary discharge to a receiving trailer for hauling and disposal until the system can be brought back into service.

11. Polymer Storage and Feed

11.1 Introduction

Entirely new polymer systems are included to aid the operation of the proposed Biosolids Management Facilities. These systems provide polymer feed to the following facilities:

- Primary Sludge Thickening
- Dewatering (Centrifuges)
- Cake Receiving Discharge to Thermal Drying (Lubrication Aid)

The PST polymer system is housed within a standalone fiberglass reinforced plastic building, similar in configuration to the polymer system at the existing WAS Thickening Facility, except that tank storage is used instead of totes. This building houses storage tanks and blending units needed to convey polymer solution to the feed side of each PS thickening train where it is introduced via an injection ring.

The dewatering polymer system is housed in the proposed Dewatering/Thermal Drying Facility. The storage tanks and blending units are situated on the first floor at the end of the building immediately adjacent to the proposed dewatering equipment. This positioning supports simplified chemical deliveries and minimizes the length of required polymer feed piping. Blended polymer is conveyed to two injection points for each centrifuge, one immediately upstream of the static mixer and the other immediately upstream of the centrifuge.

Additionally, polymer may be added to dewatered cake as a lubricant aid to convey cake from the piston pump to the proposed Dewatering/Thermal Drying Facility. Whether to use polymer or water for pipeline lubrication will be evaluated during detailed design and depends on conveyance distance and number of bends. If its determined that polymer is required, it will be supplied from the dewatering polymer system. For preliminary storage tank sizing, it is assumed that lubrication aid polymer is 10 percent of dewatering polymer flows.

11.2 Process Description

Polymer emulsion is delivered to the site via chemical delivery truck and transferred to separate bulk storage tanks provided at the PST and Dewatering/Thermal Drying Facilities. Each facility has a dedicated truck unloading station. To optimize activation and dose response, polymer goes through two-stage mixing and two-stage dilution in the package blending units. First-stage dilution is achieved using backflow prevented potable water, while second-stage dilution uses plant water. Pumps included in the package blending units convey the diluted polymer to the various feed points associated with each system, as detailed in Table 11-1.

Each storage tank is equipped with level sensors and alarms to support delivery scheduling, prevent overfilling, and track usage rates. Each tank has a mixer to prevent stratification. The proposed storage tanks and blending units are located in a containment area to contain minor leaks and major spills from tank failure. Sumps are provided in each containment to enable chemical removal in the event of a spill and to allow for thorough drainage after washdowns are performed.

The design criteria for the polymer feed systems are summarized in Table 11-1.

Table 11-1. Polymer Feed System Design Criteria

W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Polymer Properties, PST, Dewatering, Cake Pumping	
Type	Cationic, Emulsion
Polymer Active Fraction	40%
Polymer Density	9.2 lb/gallon
Polymer Feed, PST (Based on Maximum Week Requirement)	
Number of Feed Points	4
Number of Blending Units	4 (3 Duty + Standby)
Polymer Dose	12 active lb/dry ton
Polymer Feed Rate	550 active lb/d
Polymer Feed Rate (Neat)	1,376 lb/d
Polymer Feed Rate (Neat)	6.2 gph
Final Polymer Solution Concentration	0.10%
Polymer Solution Feed rate	83 gpm
Polymer Storage, PST (Based on Maximum Month Requirement)	
Required Volume	3,602 gallons
Tank Quantity	2
Type	Vertical, HDPE
Storage Quantity, Each	3,000 gallons
Storage Quantity, Total	6,000 gallons
Polymer Feed, Dewatering and Cake Pumping (Based on Maximum Month Requirement)	
Number of Feed Points	5 (2 per Centrifuge + Cake)
Number of Blending Units	4 (3 Duty, 1 Standby)
Polymer Dose	25 active lb/dry ton
Polymer Feed Rate	550 active lb/d
Polymer Feed Rate (Neat)	2,827 lb/d
Polymer Feed Rate (Neat)	12.8 gph
Final Polymer Solution Concentration	0.10%
Polymer Solution Feed rate	171 gpm
Polymer Storage, Dewatering and Cake Pumping (Based on Maximum Month Requirement)	
Required Volume	6,599 gallons
Tank Quantity	2
Type	Vertical, HDPE
Storage Quantity, Each	5,000 gallons

Table 11-1. Polymer Feed System Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Storage Quantity, Total	10,000 gallons

gph = gallons per hour
HDPE = high-density polyethylene

11.3 Functional Description

Process flow diagrams of the PST polymer system Drawing 100-N-023) and the dewatering and cake receiving polymer system (Drawing 100-N-024) are provided in Appendix A.

Polymer feed for PST and dewatering is automatically flow paced based on sludge flow. Polymer feed for cake conveyance is controlled using pipeline pressure. Polymer dose and dilution rate are adjusted by the operator. Blending unit dilution water rates and pump speeds are automatically controlled via PLC on the blend unit skid to provide polymer solution at the selected concentration and dose based for each application point.

Tank level is monitored by level sensors, and alarm conditions notify operators of low level and overflow conditions. The containment sump is equipped with floats to alert operators to chemical spills.

11.4 Reliability and Redundancy

The following design features are included for reliability and redundancy:

- Sufficient storage for 30 days for each facility at maximum month conditions.
- Two storage tanks at each facility
- Standby polymer blending unit at each facility
- Provisions for adding polymer to the cake pumping

12. Odor Control

12.1 Introduction

Design of the proposed Biosolids Management Facilities will integrate odor control. The design will implement best practices in odor control and seek the highest practicable standards of odor control while minimizing associated capital costs and operations and maintenance (O&M) burden. To these ends, the following goals are set out for the odor control concept:

1. Meet quantitative design criteria with respect to odor impacts beyond the plant fence line.
2. Maximize worker health and comfort with respect to indoor air quality.
3. Provide technologies and equipment compatible with owner culture and preferences.
4. Minimize odor control costs while meeting goals 1, 2, and 3.

Odorous air sources at the Biosolids Management Facilities are:

- PST
- Thickened Sludge Screening
- Cake Receiving
- Dewatering
- Thermal Drying

12.2 Design Criteria

Odor concentration is expressed as dilution to threshold (D/T), which is the ratio of clean air to odorous air required so that the odor is detectable by an average person. Amidst background odors (cut grass, car exhaust, household odors, etc.), a low but perceivable odor impact tends to be missed by the typical person. Infrequent, short-duration odor impacts tend to be overlooked by the public even when concentrations are noticeable. This dynamic is illustrated on Figure 12-1.

Hours Exceedence per Year	D/T Ratio				
	2	7	20	50	100
0 -10	Acceptable	Acceptable	Acceptable	Acceptable	Not Acceptable
10 - 100	Acceptable	Acceptable	Acceptable	Not Acceptable	Not Acceptable
100 - 200	Acceptable	Acceptable	Not Acceptable	Not Acceptable	Not Acceptable
200 +	Acceptable	Not Acceptable	Not Acceptable	Not Acceptable	Not Acceptable

Figure 12-1. Odor Concentration versus Frequency Dynamic Affecting Public Perception
W.B. Casey WRRF Draft Preliminary Engineering Report

Based on Jacobs' experience in similar applications, the recommended design criteria for offsite odor impacts are odor concentrations exceeding a D/T of 4 for no more than 0.1 percent of the time using 1-hour averaging. These criteria are anticipated to seldom cause odor complaints near the W.B. Casey WRRF.

12.3 Sources, Loading, and Technology Selection

12.3.1 Preliminary Air Loads

Odor sources include any unit process with an interface between an odorous material and either air headspace or the ambient air. Odorous unit processes will be covered tightly with open penetrations minimized. The exception is cake receiving, for which a separate approach is discussed. Each covered headspace will be ventilated with the resultant foul air stream conveyed to an odor treatment device to remove odorous compounds before releasing the air to the atmosphere. The foul air load associated with each unit process is potentially governed by three factors:

- Air Displacement
- NFPA Guidance
- Air Capture

The first factor involves air driven out of a headspace by rising water levels or other air headspace volume changes. All of the proposed unit processes requiring odor control will have steady headspace volumes, and air displacement will not affect air loads. (The Dewatering Feed Tanks have variable headspace volume, but their headspace is connected to the digester gas system.)

NFPA guidance pertains to electrically-classified spaces that require certain headspace air exchange rates. These air exchange rates contribute to the foul air stream and must be accommodated by the odor control equipment. With the exception of sludge screenings storage and the cake receiving bin, odorous unit process headspaces will be fully enclosed and separated from the building air spaces in which they are located. That is, the odor control ventilation system will be separate and independent from the building heating, ventilation, and air conditioning (HVAC) system, and the covered headspaces will be maintained under vacuum relative to the building air space. This allows for classified building air spaces with push/pull ventilation while the covered, odorous headspaces are unclassified. This strategy results in the best possible indoor air quality and minimizes foul air loads and associated odor control costs. Sludge screenings storage will require an NFPA-driven air exchange rate, which will be considered in design of odor control for the Thickened Sludge Screening facility.

The third factor, air capture, governs air loads for each unit process. A sufficient ventilation rate will be pulled from each covered odor source such that ambient air tends to rush into openings and penetrations. An industry standard air capture rate of 200 feet per minute across all openings and penetrations to a covered headspace will be applied to arrive at design air loads. Design air loads will be determined early during detailed design when process configurations are determined, and it becomes possible to estimate the open area of cracks and penetrations to each unit process. Until then, provisional air load estimates have been developed.

12.3.2 Loading of Odorous Compounds

Sources associated with PS thickening and dewatering are typically far more odorous than those of WAS or mixed PS and WAS. WAS contains few compounds with reduced oxidation states (odorous compounds are usually in this category); rather, WAS contains nitrified compounds that oxidize odorous compounds as they are generated. Based on sampling at similar facilities, odorous compounds associated with the PS handling processes (thickening and screening) are expected to include moderately high H_2S concentrations of between 40 and 80 parts per million by volume (ppmv) plus a range of reduced organic sulfur compounds such as methyl mercaptan, dimethyl sulfide, and dimethyl disulfide in concentrations of up to 1.0 ppmv.

Dewatered cake handling processes, provided they do not involve storage for longer than 1 day, tend to have somewhat lower H_2S concentrations, but higher reduced sulfur organic concentrations. Based on sampling at other locations, H_2S concentrations are expected to range from 20 to 40 ppmv on average, and concentrations of organic reduced sulfur compounds are expected to be up to 10 ppmv (sum of reduced sulfur organics). Ammonia is also likely emitted from the solids processes in concentrations that may or may not be odorous.

Odor loads will be refined as specific process configurations are developed. However, this assessment is sufficient for technology selection.

12.3.3 Odor Control Technology Survey

The preferred vapor phase treatment technology depends on such factors as odor removal performance, O&M burden, and life cycle cost. Each class of vapor phase treatment technology is surveyed below including advantages, disadvantages, and applicability for this project.

Thermal treatment includes incinerators, flares, and recuperative or regenerative thermal oxidizers. Thermal treatment burns the odor compounds in foul air before releasing to the atmosphere. Advantages for this treatment approach is that thermal treatment is an effective form of odor control for a wide range of odorous compounds, including VOCs. However, it is usually only appropriate where an incineration process is already in place for some other reason. Otherwise, this option is prohibitively expensive. Thermal treatment is not recommended for odor control, although an RTO is proposed for emissions control from the drying facility.

Dry media scrubbers are the simplest of the vapor-phase treatment technologies. They pass the foul air stream through a bed of dry activated carbon or other engineered media. Odorous constituents diffuse into the media pore spaces, adsorb onto the media, and are thereby removed from the air stream.

Many types of media are designed for removal of different compounds; a single media type or a mixture of different media can be used. Dry media scrubbers have a small footprint compared to other technologies and can be configured with single, dual, horizontal, or radial flow beds in locations where footprint must be minimized.

Carbon scrubbers have excellent removal efficiency for a range of compounds, but the media must be replaced periodically. The expense and frequency of media replacement can be prohibitive for applications where odor loads are high, as is the case for PST and dewatering. For this reason, carbon scrubbers are not recommended for those processes; however, they are recommended for the Cake Receiving Facility.

Wet chemical scrubbers pass the foul air stream through a bed of inert media that is continuously irrigated. Chemicals are added to the irrigation water to absorb and oxidize odorous compounds. Chemical scrubbers can be designed using several different configurations with separate stages using different chemistries. Some scrubbers include a high-pH stage with caustic soda to facilitate dissolution of H_2S into solution. Most scrubbers oxidize odorous reduced compounds with sodium hypochlorite. Other chemistries can be used to remove compounds such as ammonia that are less amenable to dissolution in a high-pH solution. Chemical scrubbers offer flexible configurations with a relatively small footprint. They are effective for removing high H_2S concentrations and are adaptable to varying odor loads. Chemical scrubbers have the disadvantage that the cost to operate is proportional to the H_2S loading; thus, significant H_2S loads can result in large operating costs. Compared to other technologies, chemical scrubbers are more complex to operate and maintain, and require chemical handling and storage. For these reasons chemical scrubbers are not recommended for the W.B. Casey WRRF.

Oxidant gas reactors use strong oxidant gases to oxidize odorous compounds. These devices generate ozone gas and/or a range of other oxidized radical or singlet oxygen compounds. Oxidant gas reactors are relatively new in the odor control industry and have a limited track record. However, the mechanism is legitimate, and several devices in this category may emerge as industry standards for certain applications. Scale-ability is often a limitation for this category of device. Oxidant gases pose a health hazard and are problematic in locations that are noncompliant with respect to ambient ozone, including much of metropolitan Atlanta. In practice, ozone is generated as a byproduct of the production of oxidant gases. Some devices use a post scrubber to remove residual ozone before release to the ambient atmosphere. Oxidant gas reactors often use ultraviolet light (UV) bulbs to generate gases and may use a catalytic surface to facilitate the reaction. Operating costs for technologies that use UV bulbs are typically high due to the requirement for bulb replacement. This category of technology is not recommended for the W.B. Casey WRRF as it is not considered comparable with the other technologies in terms of track-record.

Biofilters send the foul air stream through a bed of media on which a population of microbes has been acclimated to consume odorous compounds. Odorous compounds diffuse into the media where they are oxidized by the microbes, thereby removing these compounds from the air stream. Biofilter media is often composed of organic material such as ground wood products, soil, or compost. Supplemental nutrients are supplied by the media, which breaks down over time and requires periodic replacement. Media replacement frequency depends on the loading and the type of media, and usually ranges from 2 years for highly loaded organic media to up to 10 years for engineered media or longer with soil media.

Often, biofilters include two layers; the first layer acts as a roughing stage to remove H_2S, and the second layer acts as a polishing stage. Biofilters require intermittent irrigation and may require pre-humidification of the foul air stream. They require acclimation and once acclimated, must remain in function with a continuous foul air stream. Biofilters have the advantage that the cost to operate does not depend on the inlet H_2S concentration. However, they require longer contact times than other technologies, which results in larger equipment and footprint. Biofilters are able to achieve excellent removal of both H_2S and a range of organic odorous compounds. Based on expected H_2S and organics loadings for the PS and dewatered cake processes, biofilters would be highly appropriate and are recommended for these sources. Depending on the finalized design air loads, it may be possible to use the existing solids treatment biofilter as part of the odor control system.

Biotowers are similar to biofilters in that they use a biologically active media bed to absorb and oxidize odorous compounds from a foul air stream. Unlike biofilters, biotowers use inert media on which a biofilm is attached. Nutrients must be added to the irrigation water, and media can last 20 years or longer. Irrigation fluid is either continuously recirculated from a sump (for bioscrubbers) or sprayed intermittently over the top and wasted to a drain without recirculation (for biotrickling filters). Biotowers depend on odorous compounds dissolving into the wet film where they become available to microbes. As such, biotowers are most effective at removing relatively soluble compounds such as H_2S. Biotowers, where applicable, have the advantage over biofilters of requiring much less contact time and may be more heavily loaded without media degradation. Biotower operating costs are independent of H_2S loads. Biotowers have a limited ability to remove less soluble organic compounds. For this reason, biotowers would be less preferable to biofilters and are not recommended for the W.B. Casey WRRF.

12.3.4 Odor Control Technology Selection

Each category of vapor phase technology was reviewed for applicability to treat the odors generated by the proposed Biosolids Management Facilities. In general, H_2S loads are expected to be moderate to high, and organic reduced sulfur loads are expected to be moderate for PS thickening and screening and high for cake receiving, dewatering, and drying. Biofilters are most appropriate to this loading and are the recommended technology for all odor sources for the proposed improvements with the exception of the Cake Receiving Facility.

The Cake Receiving Facility involves trucks entering the building, tipping dewatered cake into a bin, and then exiting the building. Tipping events release bursts of odor emissions, with the cake bin releasing lower emissions of odors continuously. It is proposed that the building ventilation air stream be directed to a radial bed carbon scrubber to treat a dilute foul air stream with occasional bursts of increased odor loading during truck tipping events. The configuration would include a large hood located over the tipping location to capture foul air from tipping events. Make-up air would be introduced near floor level so that fresh air enters low, near the worker breathing zone, and sweeps up to the hood. This configuration will maximize indoor air quality. Radial bed scrubbers are able to handle large air streams for a relatively small capital cost compared to other technologies. The dilute air stream would allow for up to 4 years between media changes.

Odor control processes are typically not capable of achieving perfect odor removal. At best, biofilters release a slightly odorous (musty, aerated odor) in the range of 200 to 300 D/T. Likewise, carbon scrubbers can typically achieve concentrations down to 100 to 200 D/T. For these reasons, some amount of dilution by atmospheric dispersion is needed to meet the offsite impact criteria. Atmospheric dispersion is enhanced by such factors as stack height and vertical velocity at the release point. Stack dispersion and recommended stack heights will be assessed using atmospheric dispersion modeling as part of detailed design.

12.4 Process Functional Description

The odor control systems will consist, at minimum, of the following components:

- Covers on odor sources
- Ductwork for conveyance of foul air to treatment devices
- Fans to move foul air
- Biofilter or carbon scrubber in which foul air is passed through a bed of media and odors are adsorbed (carbon scrubber) or oxidized (biofilter) within the media
- Controls

The proposed technologies are relatively easy to operate with minimum number of wear components and a modest amount of regular maintenance. Controls include Local/Hand/Off/Auto switches and alarms for the fan(s). The fan status is indicated in SCADA. Biofilter irrigation is controlled on a timer, and the timer is set to achieve optimal pH of the blow-down liquid (more frequent irrigations increases blow-down pH). A potable water supply is needed for biofilter irrigation. The recommended biofilter configuration is single stage with engineered media, possibly in package configuration depending on the final design air load.

Several process parameters need to be measured periodically as part of routine operation. These include blow-down pH, media pressure drop, air flow rate, and H_2S inlet and outlet concentrations. It is recommended that portable rather than online instrumentation be used wherever possible. Portable instruments are less expensive and easier to maintain and calibrate.

12.5 Siting, Layout and Air Conveyance

The odorous sources are grouped in two separate locations at opposite ends of the Biosolids Management Facilities. For this reason, foul air conveyance to a central odor control facility would not be favorable. Instead, two separate biofilter installations are proposed, one to serve proposed thickening and screening and another to serve the Dewatering/Thermal Drying facility. The Cake Receiving facility will include a radial bed carbon scrubber adjacent to that building. This configuration will minimize foul air conveyance ductwork. Appendix B shows the proposed site layout, including location of proposed odor control facilities.

12.6 Reliability and Redundancy

Odor control is not a critical process, does not support critical processes, and is not associated with an air quality permit. Therefore, no redundancy will be provided in the odor control systems or components. With respect to the radial bed scrubber media replacement, the design includes provision for sampling at multiple points across the media bed. This allows for anticipation of odor breakthrough so that media replacement can be scheduled before breakthrough occurs. Upon delivery of the new media, the media replacement procedure can be completed within 1 day, thereby minimizing downtime.

12.7 Loading and Technology Selection Summary

Provisional loadings were developed for each unit process along with sizing for each recommended odor treatment device. The summary is provided in Table 12-1.

Table 12-1. Biosolids Management Facilities Odor Control
W.B. Casey WRRF Draft Preliminary Engineering Report

Location	Odor Control Approach	Estimated Air load (cfm)	Air Load Subtotal (cfm)	H_2S Loading (ppmv)	Sum of organic sulfur loading (ppmv)
Primary Sludge Thickening (Facility not Enclosed)					
Flocculation Tanks	Biofilter	2500		48	1
RDTs	Biofilter	1000		48	1
Sludge Pumping Equipment	Biofilter	500		48	1
Thickening Filtrate	None				
PST Biofilter			**4,000**	**48**	**1**
Sludge Screening					
Screening Equipment	Biofilter	TBD			
Sludge Pumping Equipment	Biofilter	TBD			
Screenings	Biofilter	TBD			
Sludge Screening Biofilter			**TBD**		
Anaerobic Digestion and Dewatering Feed Tanks					
Biogas	Flare				
Boiler Offgas	None				
Cake Receiving					
Storage Bin	Biofilter	2500		4	13
Screw Conveyors	None				
Sludge Pumping Equipment	None				
Building	Roof Stack Ventilation				
Transient Dumping Events	Radial Bed Activated Carbon	30,000		<1	<1
Cake Receiving Radial Bed Carbon Scrubber			**30,000**	**Light**	**Light**
Dewatering					
Centrifuge	None				
Centrate Deaerator	Biofilter	500		25	0.8
Thermal Drying					
Wet Cake Screw Conveyors	Biofilter	0			
Wet Cake Bin	Biofilter	500		4	13
Wet Cake & Recycled Material Mixer	Biofilter	500		4	13
Product Screw Conveyors	None				
Product Solids Separator	None				

Table 12-1. Biosolids Management Facilities Odor Control

W.B. Casey WRRF Draft Preliminary Engineering Report

Location	Odor Control Approach	Estimated Air load (cfm)	Air Load Subtotal (cfm)	H_2S Loading (ppmv)	Sum of organic sulfur loading (ppmv)
Product Screener	None				
Product Crusher	None				
Dryer Offgas (after Particle Separation)	RTO				
Cake Receiving, Dewatering, Drying Biofilter			**4,000**	**7**	**11**
Dewatering/Drying Facility					
Building	Roof Stack Ventilation				
Pellet Storage					
Pellet	None				

cfm = cubic feet per minute

13. Electrical Distribution

13.1 Existing Distribution System

The existing electrical distribution system for the W.B. Casey WRRF includes a single utility source that distributes power to the plant through a single utility transformer. The transformer steps the incoming voltage down from 25 kilovolts (KV) to 12.47KV and distributes it to the main 12.47KV switchgear. Two 2000-kilowatt (KW), 12.47KV standby generators are also connected to the main 12.47KV switchgear to provide back-up power to the plant in the event of a loss of normal utility power.

The 12.47KV switchgear distributes power to the various load centers throughout the plant via a 12.47KV loop that is distributed around the project site. Most load centers include two transformers (one duty, one redundant) and the associated double-ended switchgear or motor control centers (MCCs).

The existing Pelletizing Facility is served via a single unit substation style transformer (Unit Substation 1); however, the primary on the unit substation transformer can be powered from two sources of power.

13.2 Preliminary Design Overview

The proposed Biosolids Management Facilities will increase the connected load of the plant. The proposed dryer and centrifuge loads exceed the existing dewatering and drying loads in the existing Pelletizing Facility. In addition, the existing loads will need to remain in service until the proposed facility is operational. Therefore, new loads centers are required to power the proposed Dewatering/Thermal Drying Facility and the Anaerobic Digester Building. Each load center will sub-feed the following processes:

- Dewatering/Thermal Drying Facility Electrical Room
  - Cake Receiving
  - Dewatering
  - Thermal Drying
  - Biofilter
  - Activated Carbon Scrubber
  - Polymer
- Digester Building Electrical Room
  - Anaerobic Digestors and Ancillary Equipment
  - Dewatering Feed Tanks and Ancillary Equipment
  - Sub-feed PST and Thickened Sludge Screening electrical room

A more detailed evaluation of loads at the W.B. Casey RSPS may allow PST and Thickened Sludge Screening to be sub-fed from the W.B. Casey RSPS Electrical Building instead of the proposed Digester Building electrical room. This would only be feasible if the old Lab Administration Building can be demolished prior to construction of the proposed PST and Thickened Sludge Screening Facilities.

Preliminary calculations based on connected load suggest that the existing medium voltage loop is marginally able to handle the new loads. At most wastewater treatment plants, the voltage loops are designed so that actual peak load is well under the connected load. A more detailed investigation of existing plant peak loads will be required during detailed design to determine the extent of upgrades required for the medium voltage loop to accommodate the new loads. Installing a separate electrical feed to the dewatering / thermal drying facility can also be evaluated during the design phase.

14. Site Civil

14.1 Introduction

This section of the report was developed to summarize the preliminary site development plans for the proposed W.B. Casey WRRF Biosolids Management Facilities.

14.2 Applicable Codes, Standards, and Design Criteria

The following codes will apply to construction of the proposed W.B. Casey WRRF Biosolids Management Facilities:

- Clayton County Land Disturbance and Right-of-Way Construction Guidelines, latest edition
- Georgia Department of Transportation Standard Specifications, latest edition
- *Manual for Erosion and Sediment Control in Georgia* (Georgia Soil and Water Conservation Commission, 2016)
- Georgia Stormwater Management Manual "Blue Book," latest edition
- Clayton County Municipal Separate Storm System Permit from Georgia Environmental Protection Division
- American Association of State Highway and Transportation Officials Policy on the Geometric Design of Highways and Streets

14.3 Site Description

14.3.1 Existing Site

Multiple upgrades and modifications to the facilities on this property span more than 60 years. As shown on Figure 14-1, the W.B. Casey WRRF is broken into two main areas consisting of the Upper Site and the Lower Site.

The Upper Site consists of the following main facilities: Administration/Lab Building, Preliminary Treatment, Chemical Storage, Primary Clarification, Main Electrical Building and Generators, Odor Control, Biological Reactor Basins, Secondary Clarifiers, W3 Pump Station, Secondary Effluent Splitter Box and Flow Control Vault, Phosphorus Polishing, UV Disinfection, and the Cascade Aerator.

The scope of the Biosolids Management Facilities project will be strictly focused on the Lower Site, which currently consists of the following facilities: W.B. Casey RSPS, W.B. Casey RSPS Electrical Building and odor control, former Administration Building, WAS Thickening Facility and associated odor control and polymer storage and feed facilities, Lab Building, Raw Waste Pump Station (abandoned), Sludge Blending Tank and biofilter, Anaerobic Digester (abandoned), and Pelletizing Facility. An overall site plan is included in Appendix B.

Figure 14-1. Existing Site
W.B. Casey WRRF Draft Preliminary Engineering Report

14.3.2 Proposed Site

Section 3 of this report lists the proposed Biosolids Management Facilities. The Overall Site Plan in Appendix B shows the layout of these facilities. To accommodate the proposed facilities at the Lower Site, several existing facilities may be demolished including:

- Administration Building
- Anaerobic Digester and Control Building (optional)
- Pelletizing Facility (optional)
- Lab Building (optional)
- Raw Waste Pump Station
- Sludge Blending Tank (optional)

Demolition cost were not included in the capital cost estimates but these cost are expected to be accounted for with the 30% contingency markup.

14.3.2.1 Access Roads and Walkways

The existing asphalt paved roads at the Lower Site vary in width between 11 and 20 feet. By the time construction is complete on the Biosolids Management Facilities, the existing roads will have been damaged by construction equipment, and they are not adequately sized or positioned to meet the needs of the proposed facilities. Therefore, all the proposed and existing facilities to remain will be accessed with new roads and sidewalks.

The new access roads are sized at 24 feet wide with 60-foot turning radii. This turning radius allows a WB-65 design vehicle to traverse the site. Roadway widths and turning radii required for the design vehicle also meet requirements for fire truck access. Concrete curb and gutter may be provided depending on CCWA preference and stormwater requirements.

Access roads are constructed of asphalt concrete pavement designed for HS-20 loading. Portland cement concrete may be used in high traffic truck areas and turn arounds and will be assessed as an alternative during detailed design. Sidewalks are provided for access from parking areas to facilities and between facilities. Sidewalk widths vary from 5 feet near facilities to 10 feet between facilities.

All widths, access, and design elements of the road system will be verified with CCWA during the detailed design. Access roadway profiles do not exceed 6 percent slope and have a minimum cross slope of 2 percent. Short segments of driveways should not exceed 10 percent slope.

14.3.2.2 Fences, Gates, and Site Security

Minor modifications to the existing fence line may be required on the western side of the Lower Site along the access road and proposed stormwater best management practices (BMPs). No new gates or site security measures are proposed; however, any modifications will be confirmed with CCWA during detailed design.

14.3.2.3 Grading and Stormwater Drainage

The existing Lower Site is not subject to large variation in elevation, and the site generally slopes downward from east to west. There is a large area (approximately 3.5 acres) that has been utilized by previous construction projects for soil disposal. A portion of this area will be utilized for construction of the Biosolids Management Facilities. It may be necessary to over-excavate the previously filled areas to provide proper foundation bearing subgrade surfaces. The proposed facility finished floor elevations will likely follow the natural drainage pattern with lower elevations being located on the western side of the site.

The site is bounded on the west by the Flint River and to the north by a tributary to the Flint River. The Federal Emergency Management Agency's (FEMA) 100-Year Flood Plain elevation for these rivers vary in elevation across the site. Figure 14-2 shows the flood plain information for the W.B. Casey WRRF.

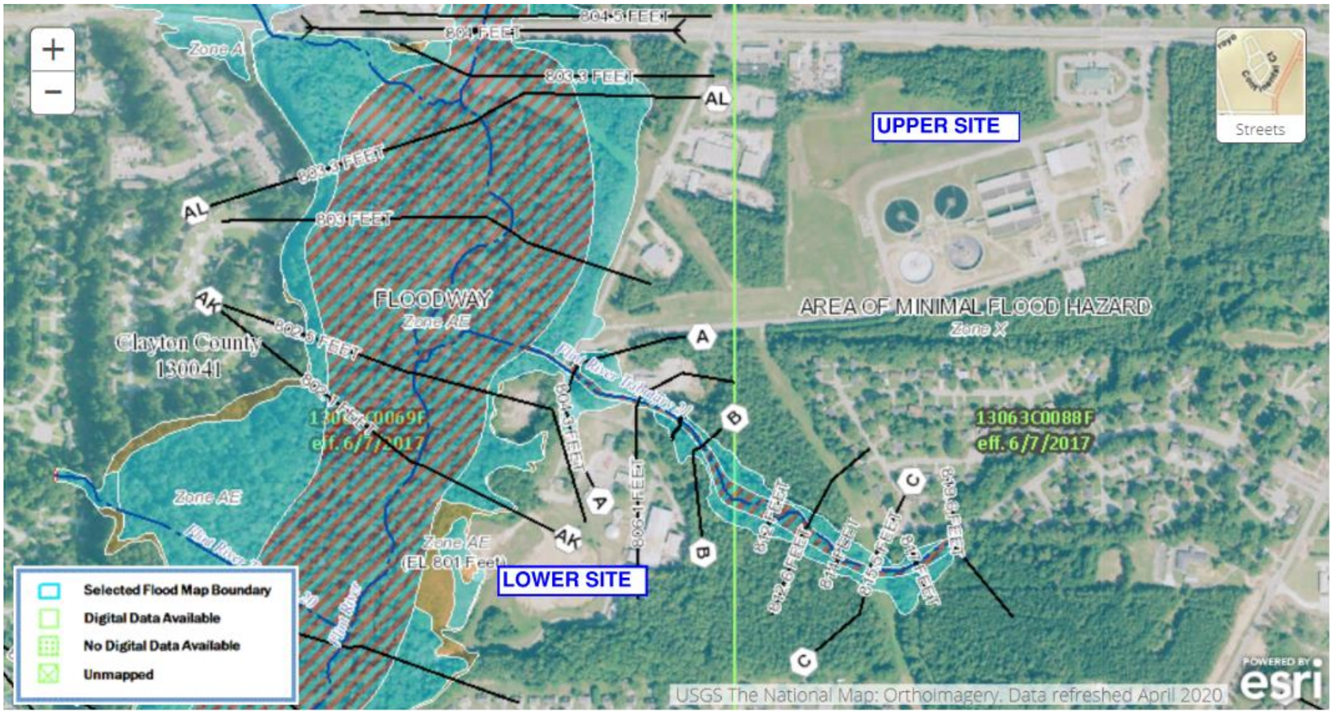


Figure 14-2. Flood Plain Map

W.B. Casey WRRF Draft Preliminary Engineering Report

No existing BMPs are present in the Lower Site to provide water quality treatment of stormwater runoff. The Municipal Separate Storm Sewer System NPDES Permit No. GAS000107 states that any redevelopment that creates 5,000 square feet or greater of impervious area must abide by the Georgia Stormwater Management Manual performance standards for stormwater runoff conveyance and water quality treatment. Beginning December 10, 2020, all sites must also be designed to retain the first 1.0 inch of rainfall on site. Further explanation of this requirement is given in the county permit.

The proposed site developments include stormwater BMPs that provide adequate retention and treatment and meet discharge requirements. The overall site plan in Appendix B provides preliminary locations for stormwater BMPs. These BMPs may include curb cuts, bioretention ponds, enhanced swales, filtration strips, and extended dry detention basins. These will be combined with the more typical conveyance methods of grassed swales, downspout disconnects, yard inlets, stormwater gravity piping, and headwalls with outlet protection to provide for a complete stormwater design for the site. Final stormwater BMP selection and locations will be included in detailed design.

The stormwater requirements for site development of the Lower Site may provide an opportunity for CCWA to implement representative or educational stormwater green infrastructure (GI) post-construction runoff features. It is suggested that a landscape architect be consulted during detailed design of this project should CCWA desire to include more public access to the site for purposes of viewing the new GI/Low Impact Development structures.

Grading and stormwater design criteria are shown in Table 14-1.

Table 14-1. Grading and Stormwater Design Criteria

W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Cut/Fill Slopes	3:1 Maximum, 10:1 Minimum, 6:1 Normal

Table 14-1. Grading and Stormwater Design Criteria
W.B. Casey WRRF Draft Preliminary Engineering Report

Parameter	Value
Gravity Pipe Slope	0.5% Minimum
Gravity Pipe Design Storm	25-year, 24-hour Event
Water Quality Runoff Reduction Volume	1.0 inch
Water Quality Treatment Volume	1.2 inch
Channel Protection	1-year, 24-hour Event
Overbank Flood Protection	25-year, 24-hour Event
Extreme Flood Protection	100-year, 24-hour Event

14.4 Erosion Control

The project site is located within the Northern Piedmont geologic region. Soils within the Piedmont region are classified as Residual Soils and are considered to have developed from in-place weathering of underlying bedrock. These soils can be classified as eroded; therefore, it will be necessary to design and implement temporary erosion and sediment controls before and during construction along with permanent measures that are required when construction has been completed.

As stated in the General NPDES Permit GAR 100001, the detailed design phase Erosion Control Plans will include BMPs that are consistent with, and no less stringent than, those practices contained in the *Manual for Erosion and Sediment Control in Georgia* (Georgia Soil and Water Conservation Commission, 2016). Each Plan will include a description of appropriate controls that will be implemented at the construction site including:

- Initial sediment storage requirements and perimeter control BMPs
- Intermediate grading and drainage
- Final BMPs

The primary permittee (General Contractor) will be responsible for the timeline of when the previous erosion control phase has been completed and the subsequent phase is to begin.

14.5 Existing Utilities and Yard Piping

There are numerous abandoned pipes within the proposed footprint of the proposed Biosolids Management Facilities and site access roads. Depending on the final excavation requirements and piping corridors of the Lower Site, some of the abandoned pipes will need to be demolished during construction. As accurate as-builts for these pipes are not available, it will be highly dependent on contract field verification to determine the extents of the subgrade utility demolition.

The most critical existing pipe to consider for the Biosolids Management Facilities site development is the 60-inch diameter plant effluent (PLE) pipe and adjacent electrical duct bank that run parallel to one another passing south and then turning southwest through the proposed site. No modifications are proposed to the existing alignment. All proposed facilities are located at least 10 feet from the pipeline. Pipes crossing the 60-inch PLE pipe are located with at least 1-foot vertical separation between outer pipe diameters.

Numerous process pipes will run between the proposed Biosolids Management Facilities. The preliminary site plan shown in Appendix B does not provide process piping routes. The design of the piping corridors will be completed during detailed design. However, no large diameter (greater than 24-inch) pipes are required to run below grade between any of the proposed facilities. All sanitary drains for the proposed facilities are routed to the W.B. Casey RSPS via a network of sanitary sewer manholes and gravity pipelines.

15. Construction Cost

As described in the Task 6 TM, construction cost estimates were developed for alternatives 3a, 3b, 3c, 4a, 4b, and 5. These cost estimates are Class IV (+50%/-30%), as defined by the Association for AACE International. For the initially selected alternative (3b), estimated capital cost was $75.7 million.

Subsequent concept development led to inclusion of a cake receiving facility. After the Task 6 TM was issued, the estimated cost of the drying facility was increased to account for revised biosolids production predicted by the calibrated process model. Table 15-1 presents estimated construction costs that include the markups described in the Task 6 TM, listed as Alternative 3b revised. As with previous cost estimates, these estimates are Class IV (+50%/-30%). For the final selected alternative (3b-2) described in this Preliminary Engineering Report, estimated construction cost is $91.1 million.

Table 15-1. Construction Cost of Alternatives 3b (original), 3b (revised), and 3b-2
*W.B. Casey WRRF Draft P**reliminary Engineering Report***

Facility	Alternative 3b original	Alternative 3b revised	Alternative 3b-2
Primary Sludge Thickening (including Polymer Storage and Feed)	$5.0 million	$5.0 million	$5.0 million
Thickened Sludge Screening	$7.2 million	$7.2 million	$7.2 million
Anaerobic Digestion	$27.9 million	$27.9 million	$27.9 million
Dewatering Feed Storage	$2.2 million	$2.2 million	$2.2 million
Dewatering (Including Polymer Storage and Feed)	$8.4 million	$8.4 million	$8.4 million
Thermal Drying	$25.1 million	$34.7 million	$34.7 million
Cake Receiving	---	---	$5.7 million
Total	$75.7 million	$85.4 million	$91.1 million

Note: Values may not total exactly as shown due to rounding.

16. References

Georgia Soil and Water Conservation Commission, 2016. *Manual for Erosion and Sediment Control in Georgia*.

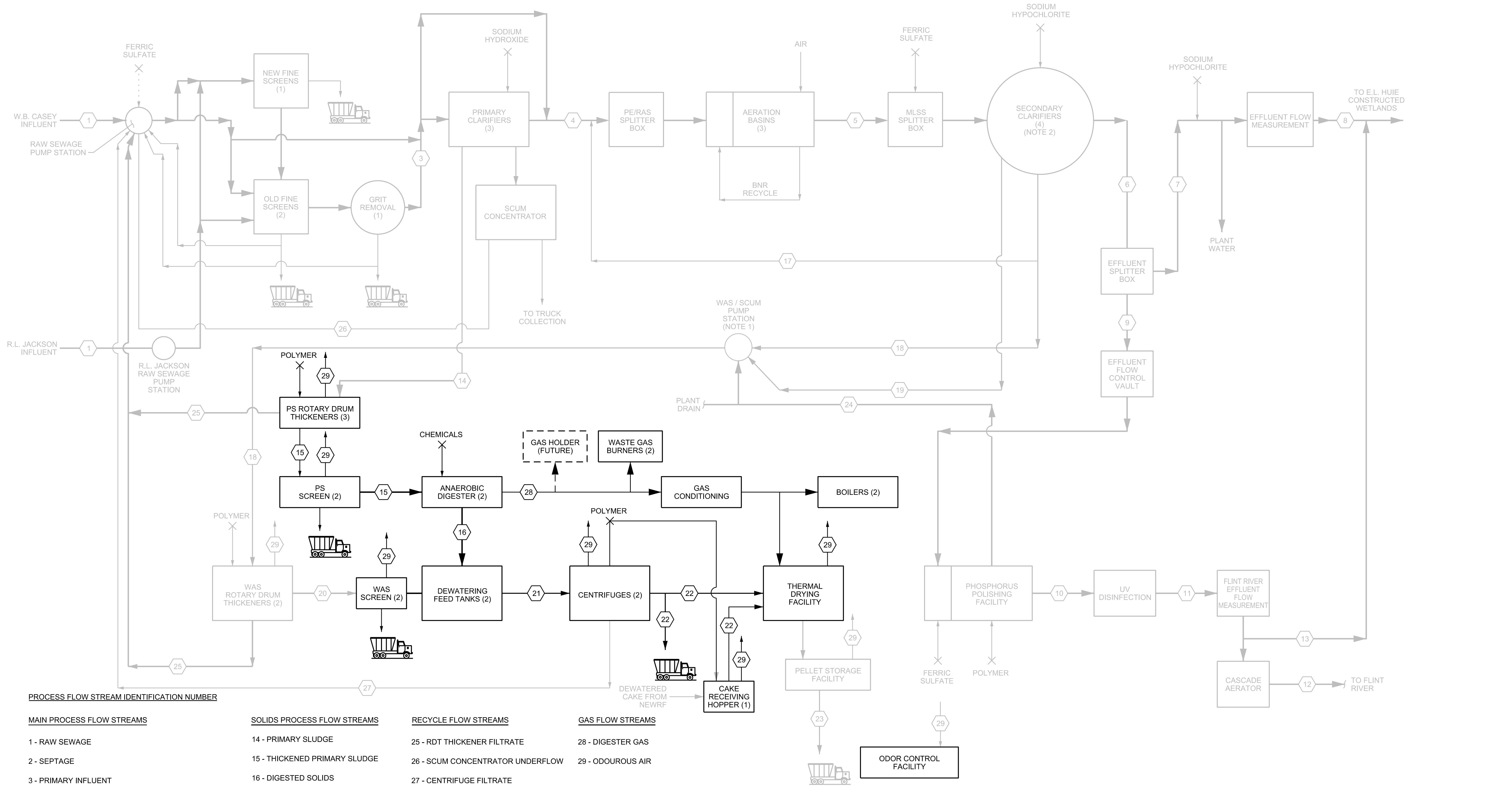
Jacobs Engineering Group Inc. (Jacobs), 2019. *Task 6 TM, Part 1 – W.B. Casey WRRF Biosolids Alternatives Evaluation*. September 27.

Jacobs Engineering Group Inc. (Jacobs), 2020a. *Task 1 TM – W.B. Casey WRRF Design Basis*. February 3.

Jacobs Engineering Group Inc. (Jacobs), 2020b. *Task 3 TM – W.B. Casey WRRF Process Model Calibration and Plant Capacity Analysis*. April 17,

Jacobs Engineering Group Inc. (Jacobs). 2020c. Executive Summary for Memorandums for Tasks 1,3,5 and 6. June 22.

Appendix A
Process Flow Diagrams



PROCESS FLOW STREAM IDENTIFICATION NUMBER

MAIN PROCESS FLOW STREAMS

1 - RAW SEWAGE
2 - SEPTAGE
3 - PRIMARY INFLUENT
4 - PRIMARY EFFLUENT
5 - MIXED LIQUOR SUSPENDED SOLIDS (MLSS)
6 - SECONDARY EFFLUENT
7 - SECONDARY EFFLUENT TO WETLANDS
8 - DISINFECTED EFFLUENT TO WETLANDS
9 - SECONDARY EFFLUENT TO PHOSPHORUS POLISHING
10 - PHOSPHORUS POLISHING EFFLUENT
11 - UV-DISINFECTED EFFLUENT
12 - EFFLUENT TO FLINT RIVER
13 - EFFLUENT BYPASS

SOLIDS PROCESS FLOW STREAMS

14 - PRIMARY SLUDGE
15 - THICKENED PRIMARY SLUDGE
16 - DIGESTED SOLIDS
17 - RETURN ACTIVATED SLUDGE (RAS)
18 - WASTE ACTIVATED SLUDGE (WAS)
19 - SECONDARY SCUM
20 - THICKENED WAS
21 - BLENDED SLUDGE
22 - DEWATERED SLUDGE
23 - PELLETS TO CUSTOMERS
24 - PHOSPHORUS SLUDGE BLOWDOWN

RECYCLE FLOW STREAMS

25 - RDT THICKENER FILTRATE
26 - SCUM CONCENTRATOR UNDERFLOW
27 - CENTRIFUGE FILTRATE

GAS FLOW STREAMS

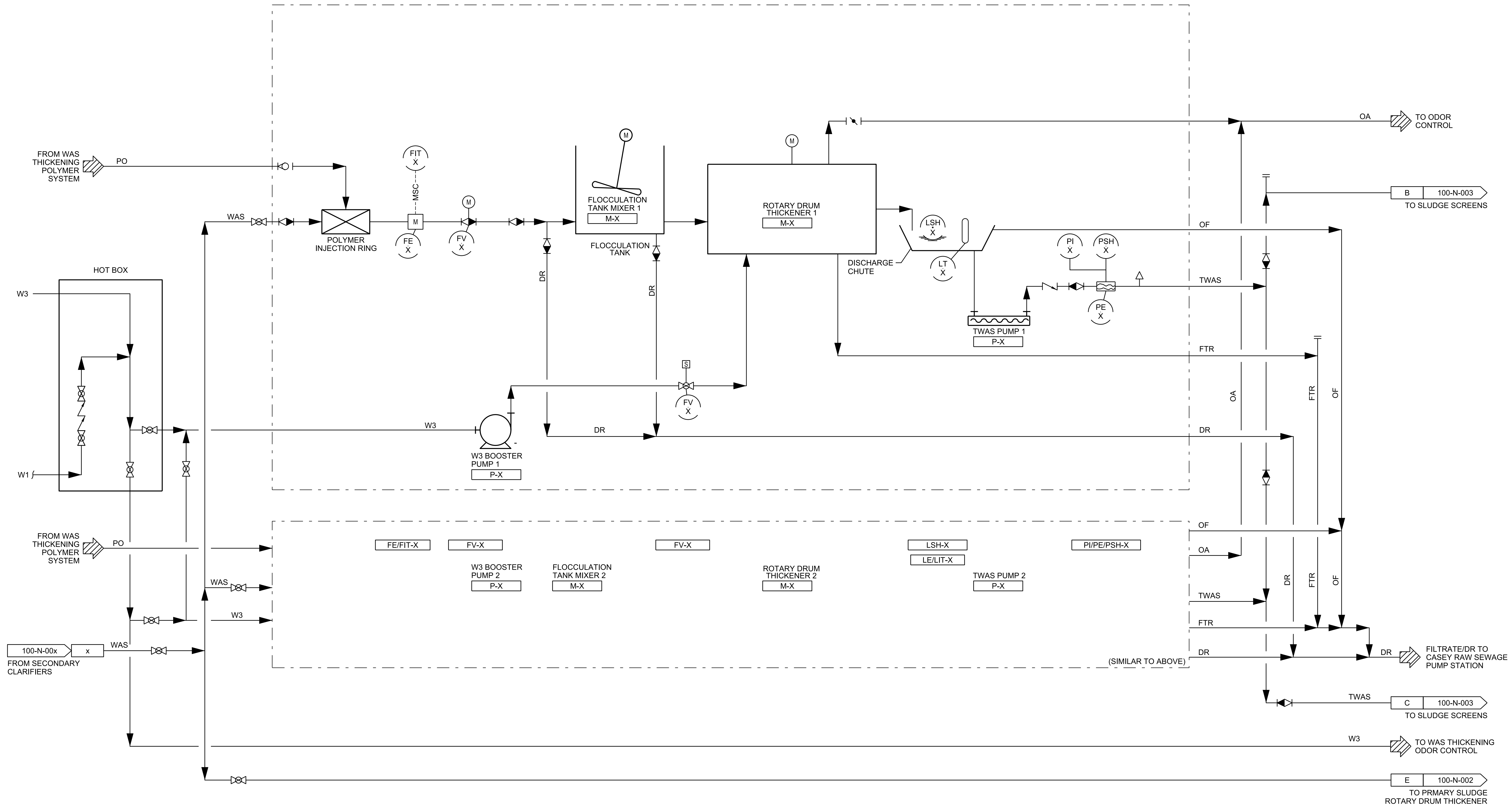
28 - DIGESTER GAS
29 - ODOUROUS AIR

LEGEND

PROCESS FLOW STREAM (X) = IDENTIFICATION NUMBER
PRIMARY CHEMICAL ADDITION POINTS
ALTERNATE CHEMICAL ADDITION POINTS
EXISTING PROCESS AND FACILITES
PROPOSED PROCESS AND FACILITIES
FUTURE PROCCES AND FACILITIES

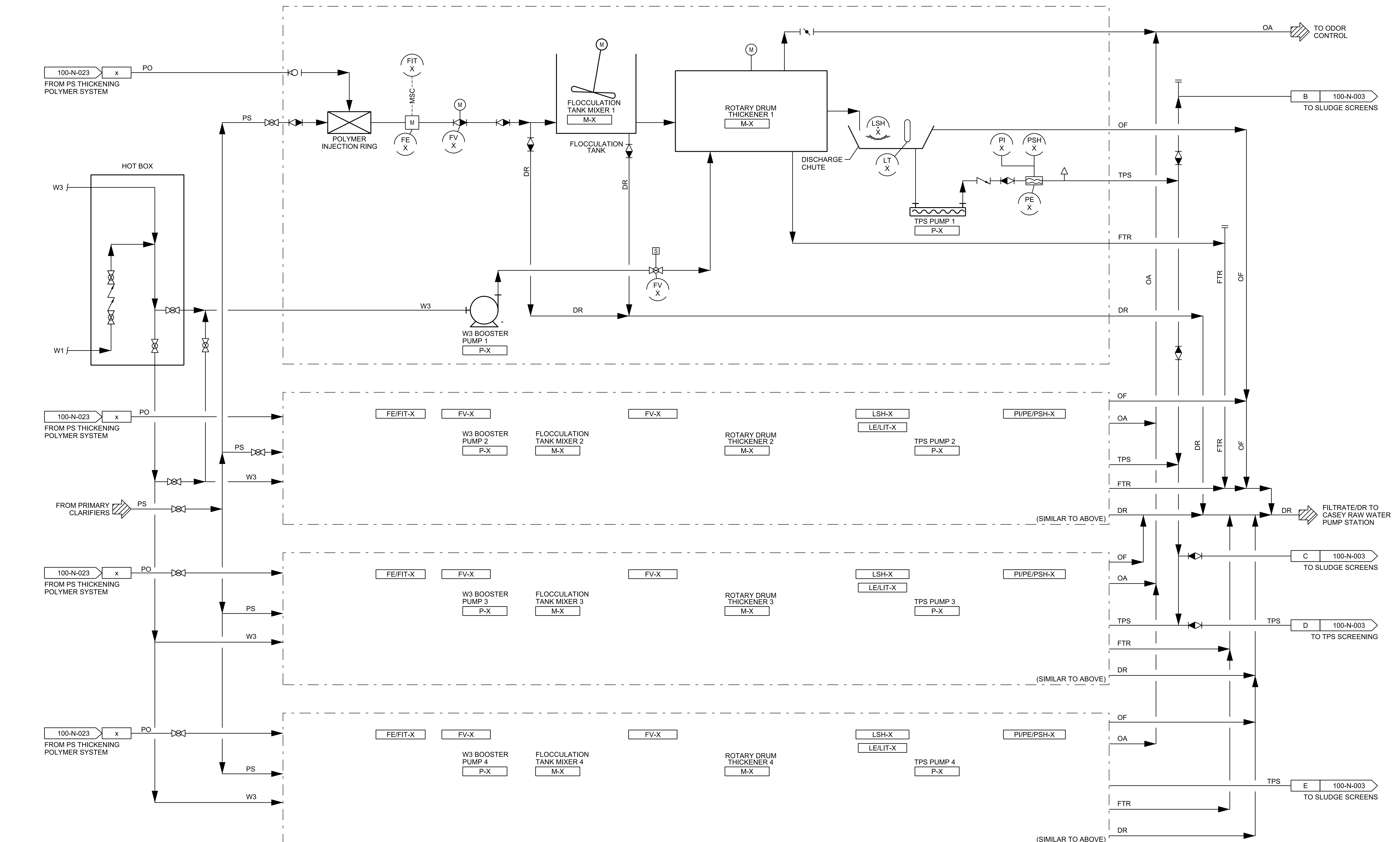
001-G-001
GENERAL
PROCESS FLOW DIAGRAM

Jacobs



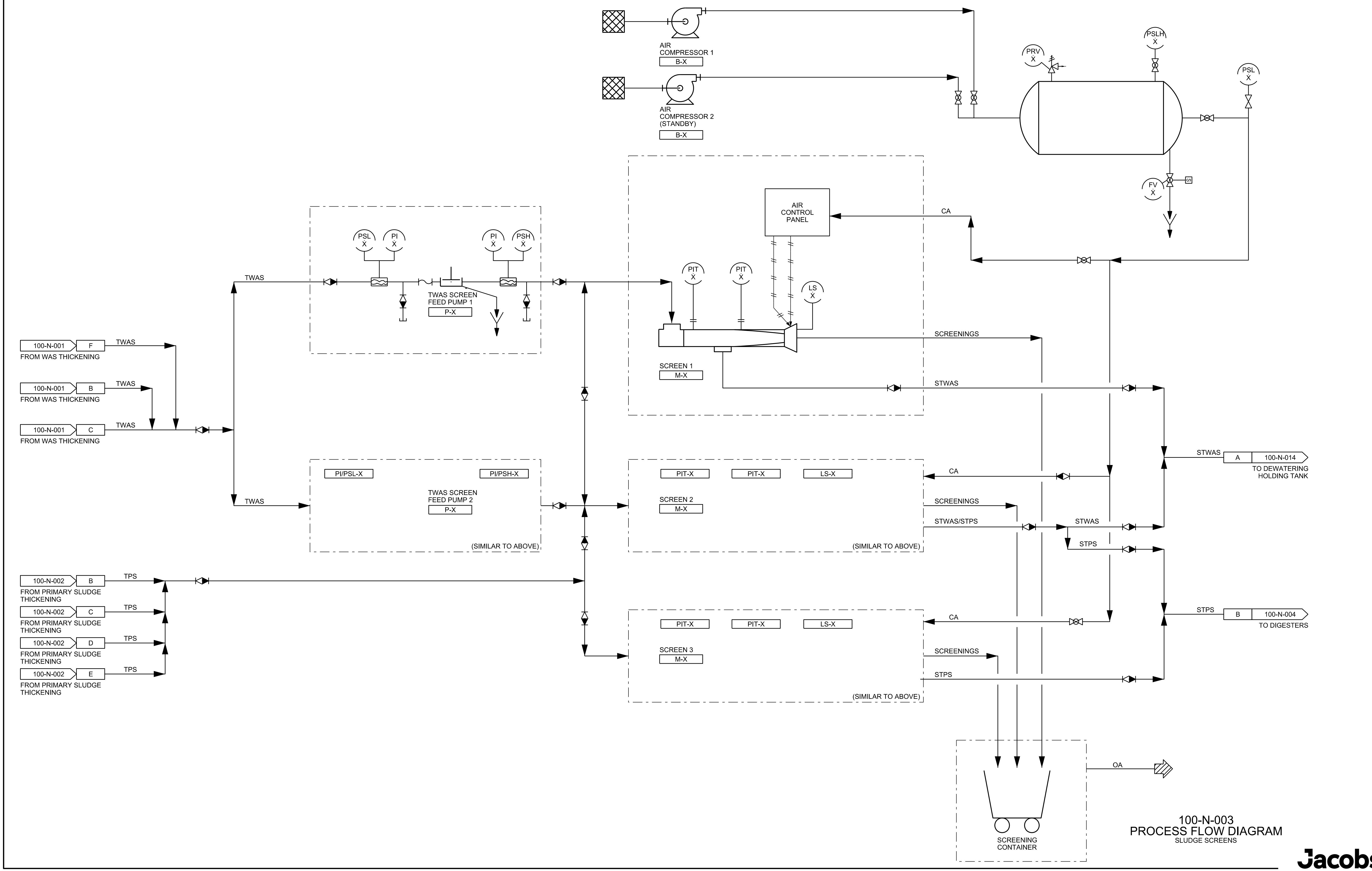
100-N-001
PROCESS FLOW DIAGRAM
WASTE ACTIVATED SLUDGE
ROTARY DRUM THICKENERS

Jacobs



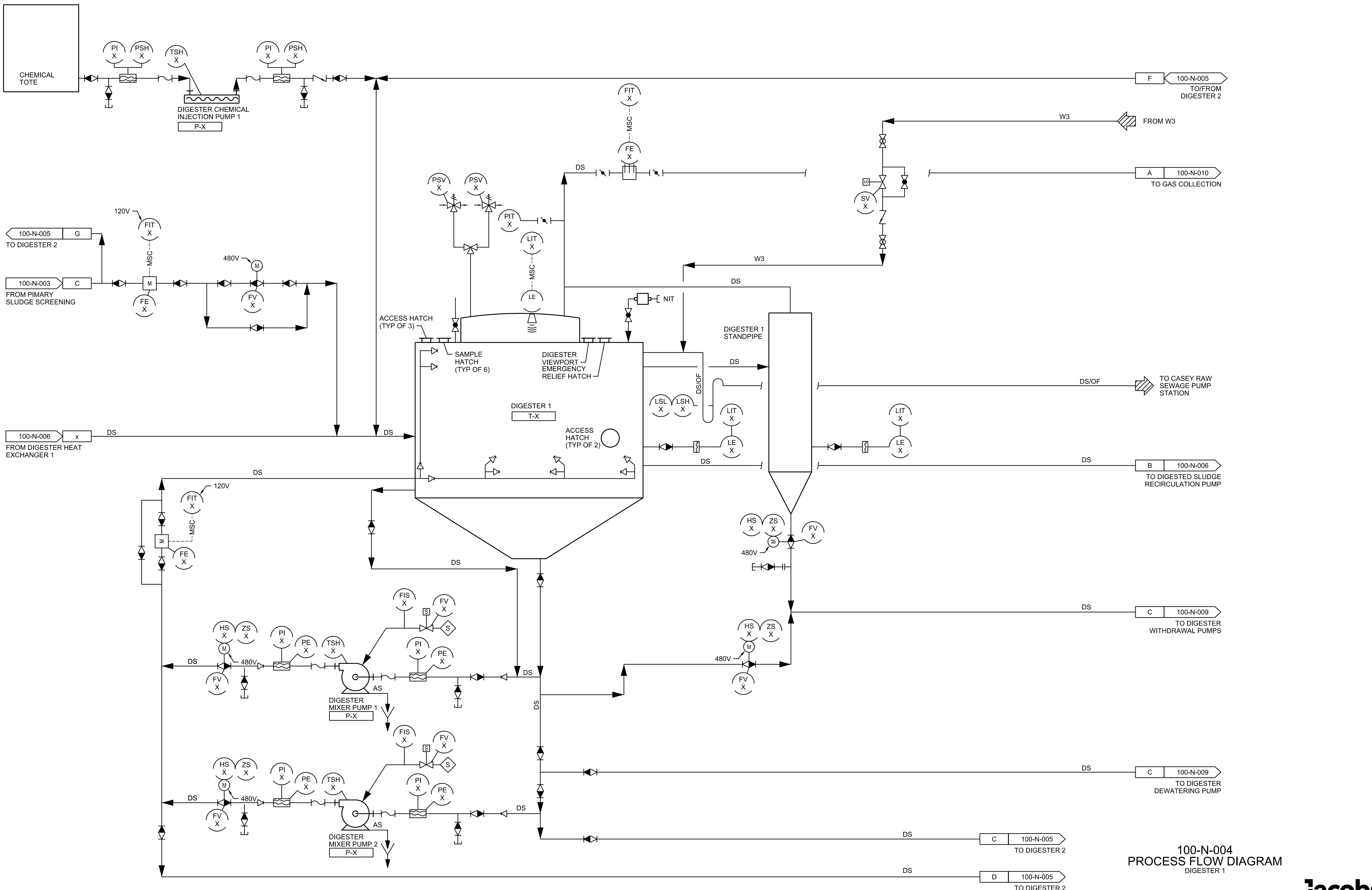
100-N-002
PROCESS FLOW DIAGRAM
PRIMARY SLUDGE
ROTARY DRUM THICKENERS

Jacobs



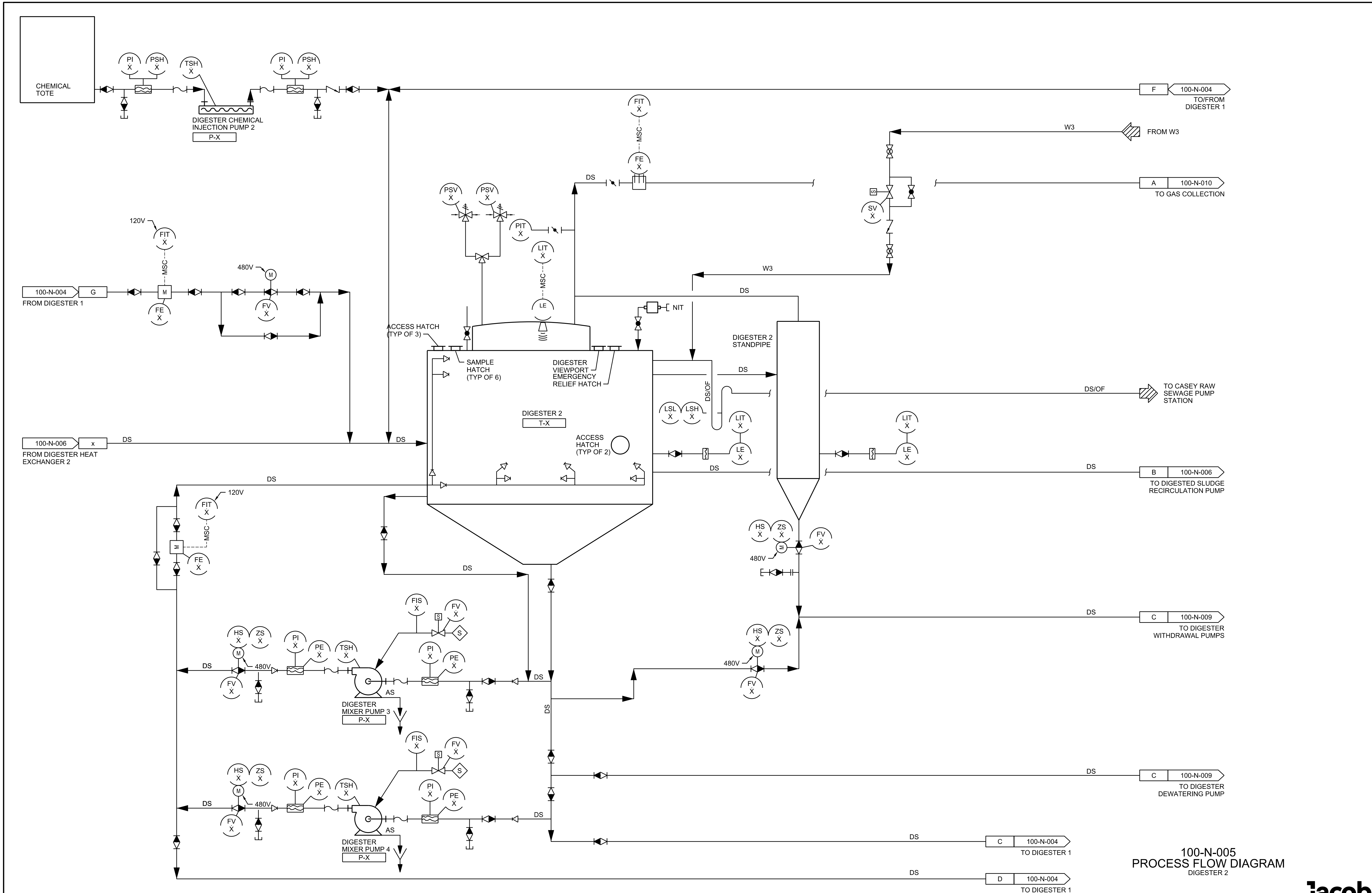
100-N-003
PROCESS FLOW DIAGRAM
SLUDGE SCREENS

Jacobs



100-N-004
PROCESS FLOW DIAGRAM
DIGESTER 1

Jacobs



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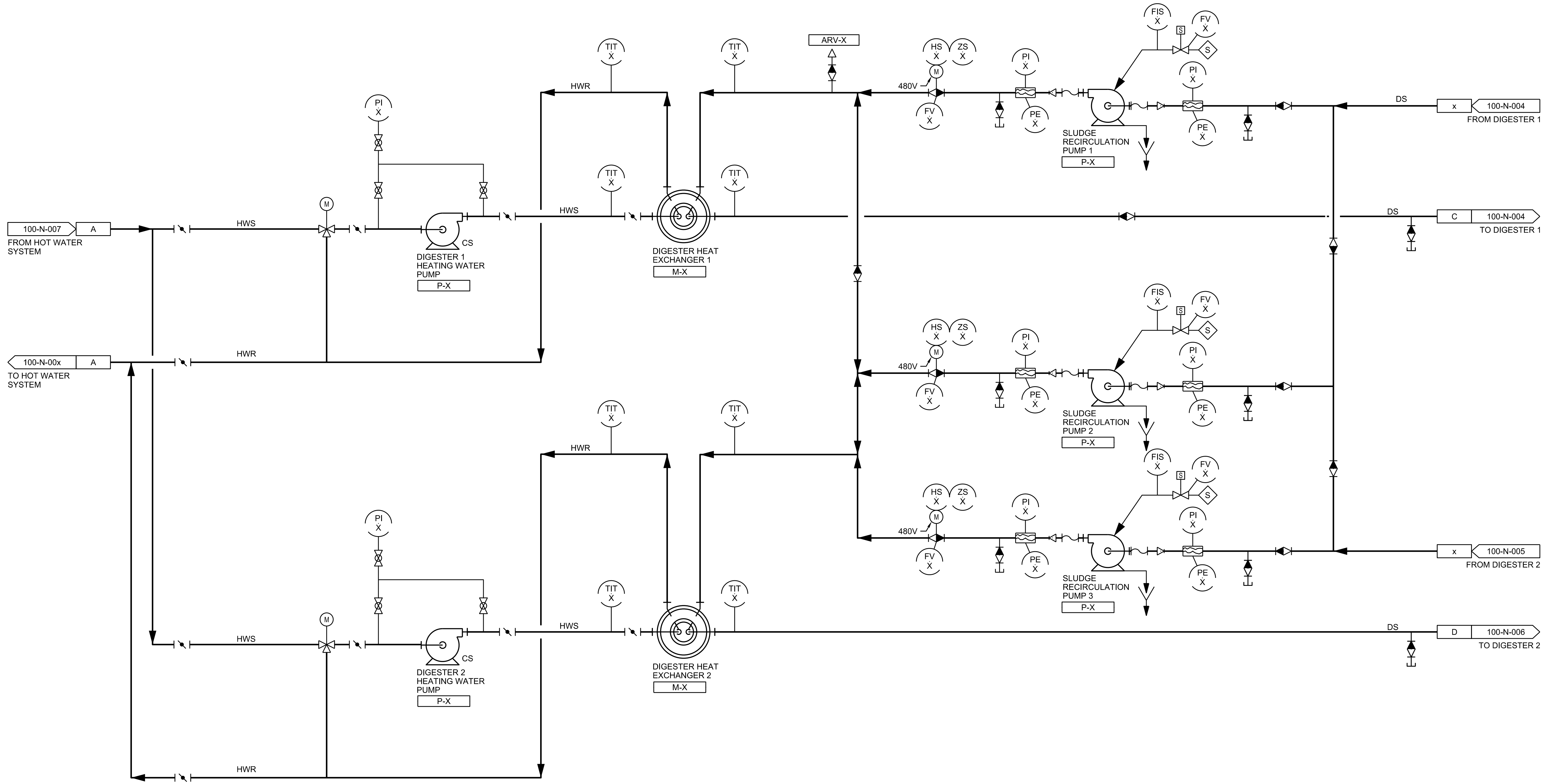
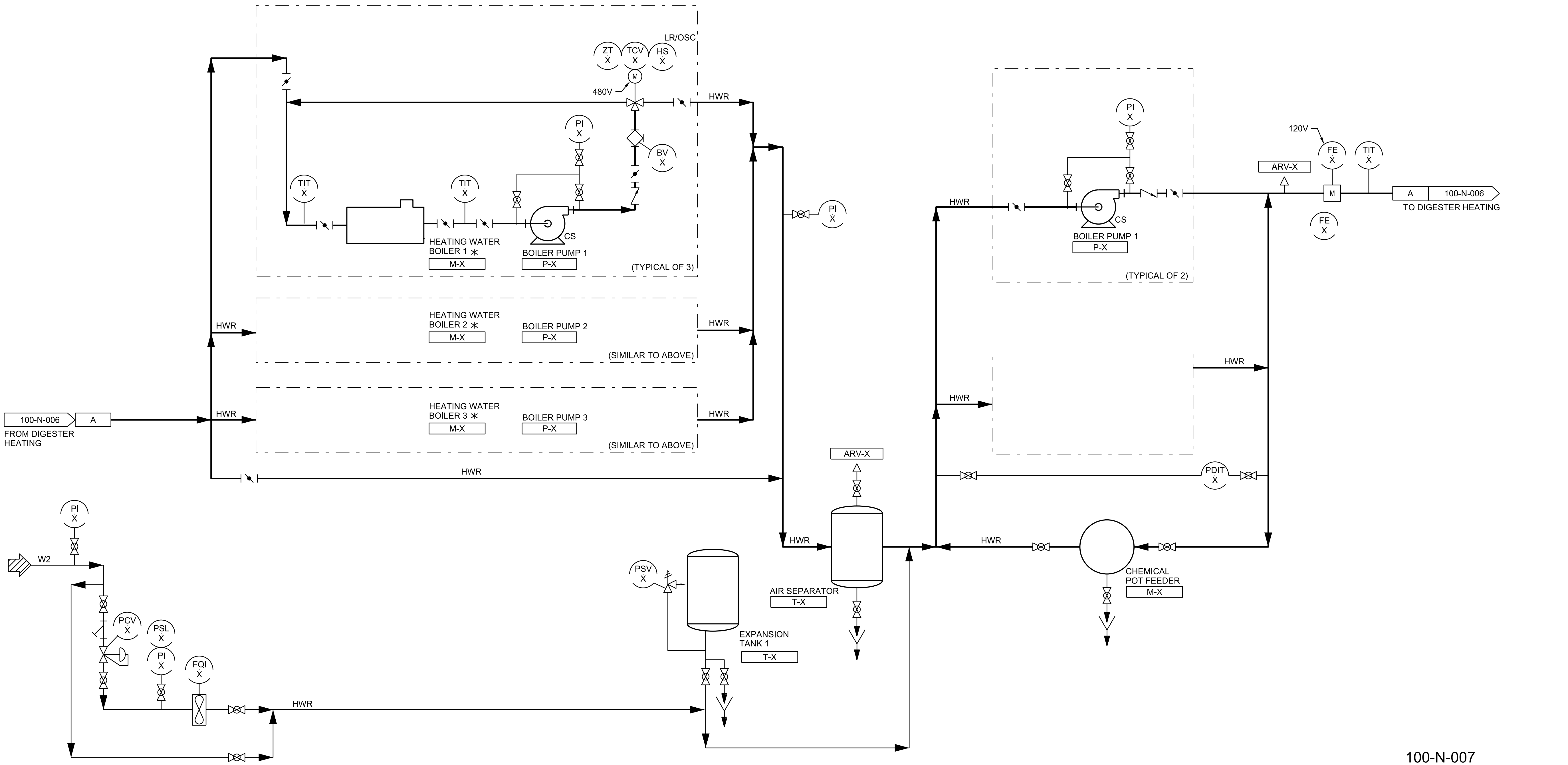


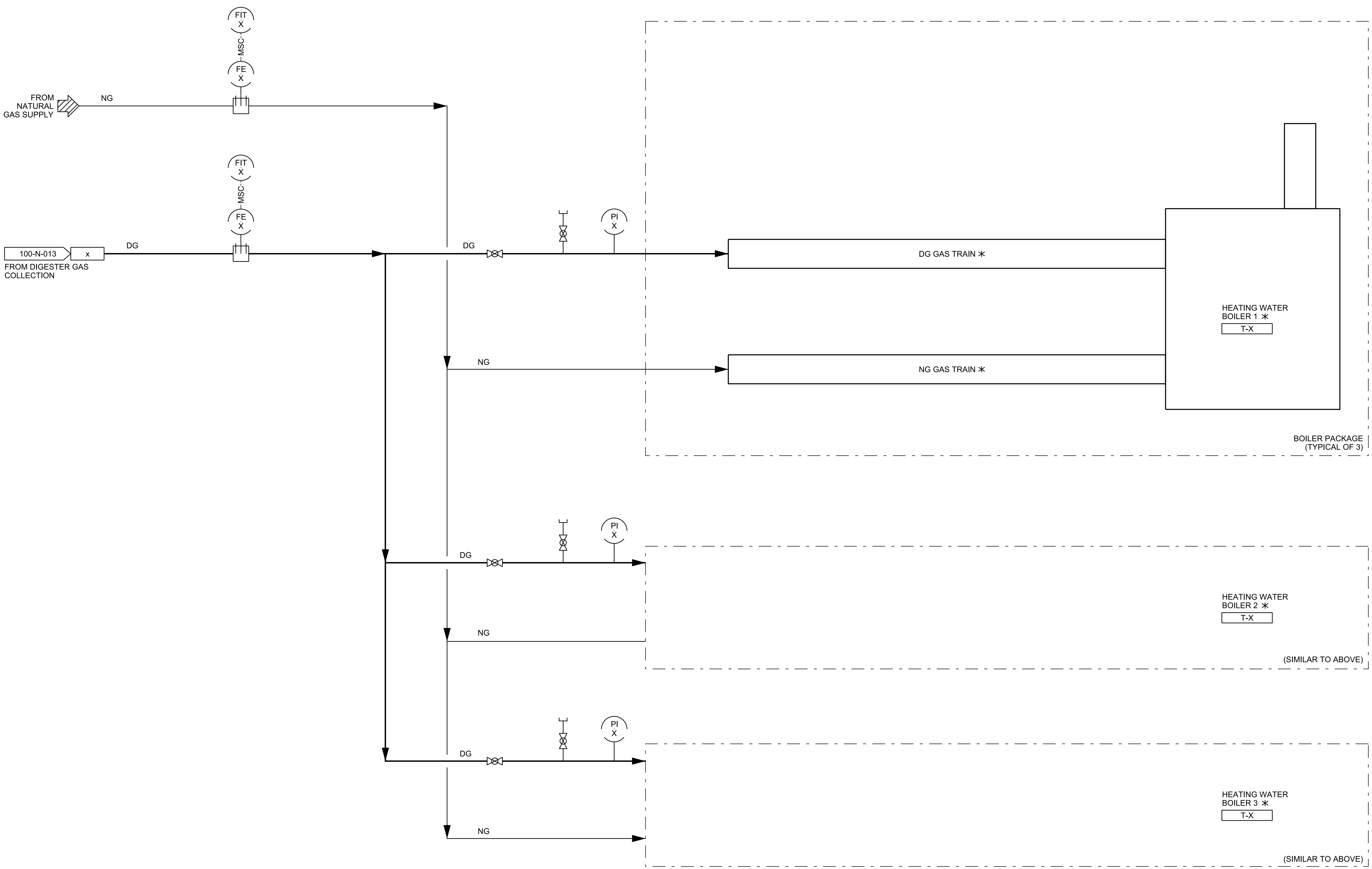
100-N-006
PROCESS FLOW DIAGRAM
DIGESTER HEATING SYSTEM

Jacobs



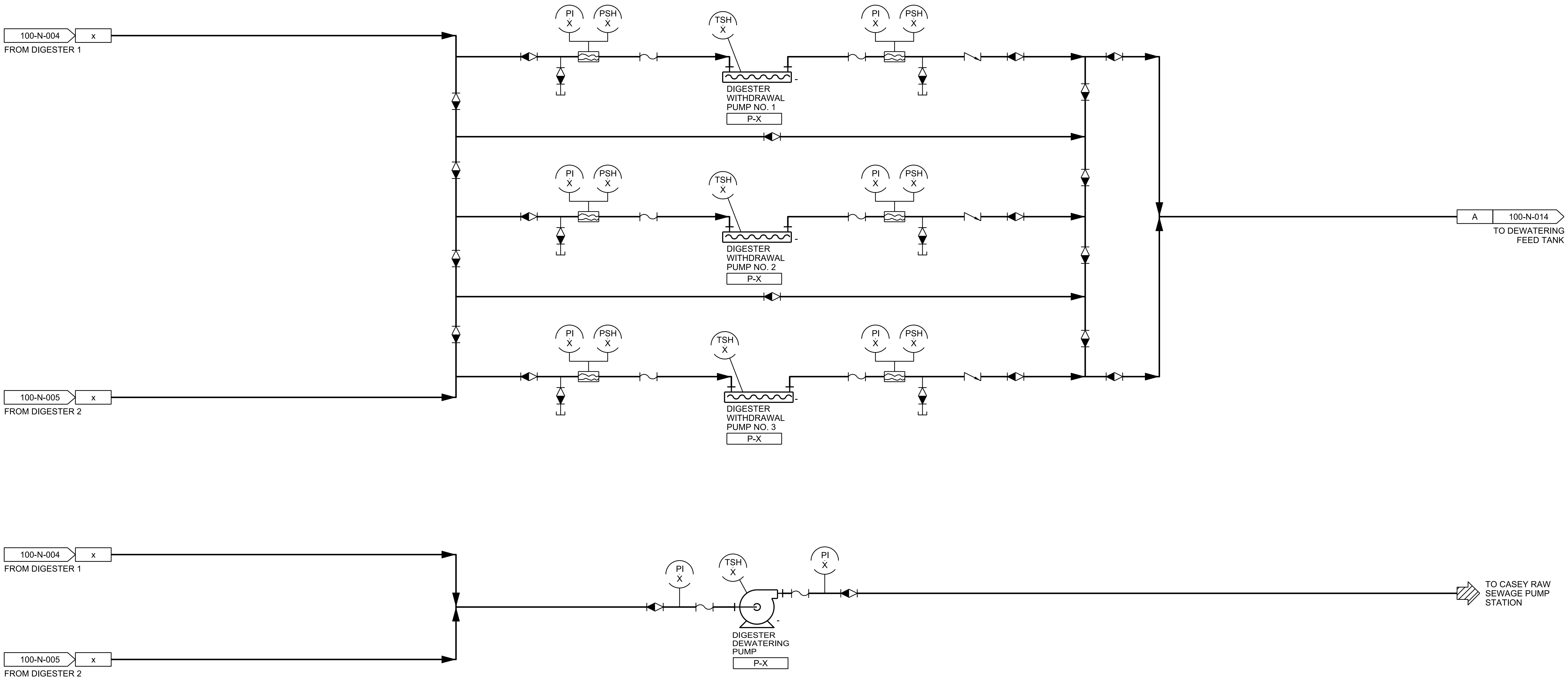
100-N-007
PROCESS FLOW DIAGRAM
HOT WATER SYSTEM

Jacobs



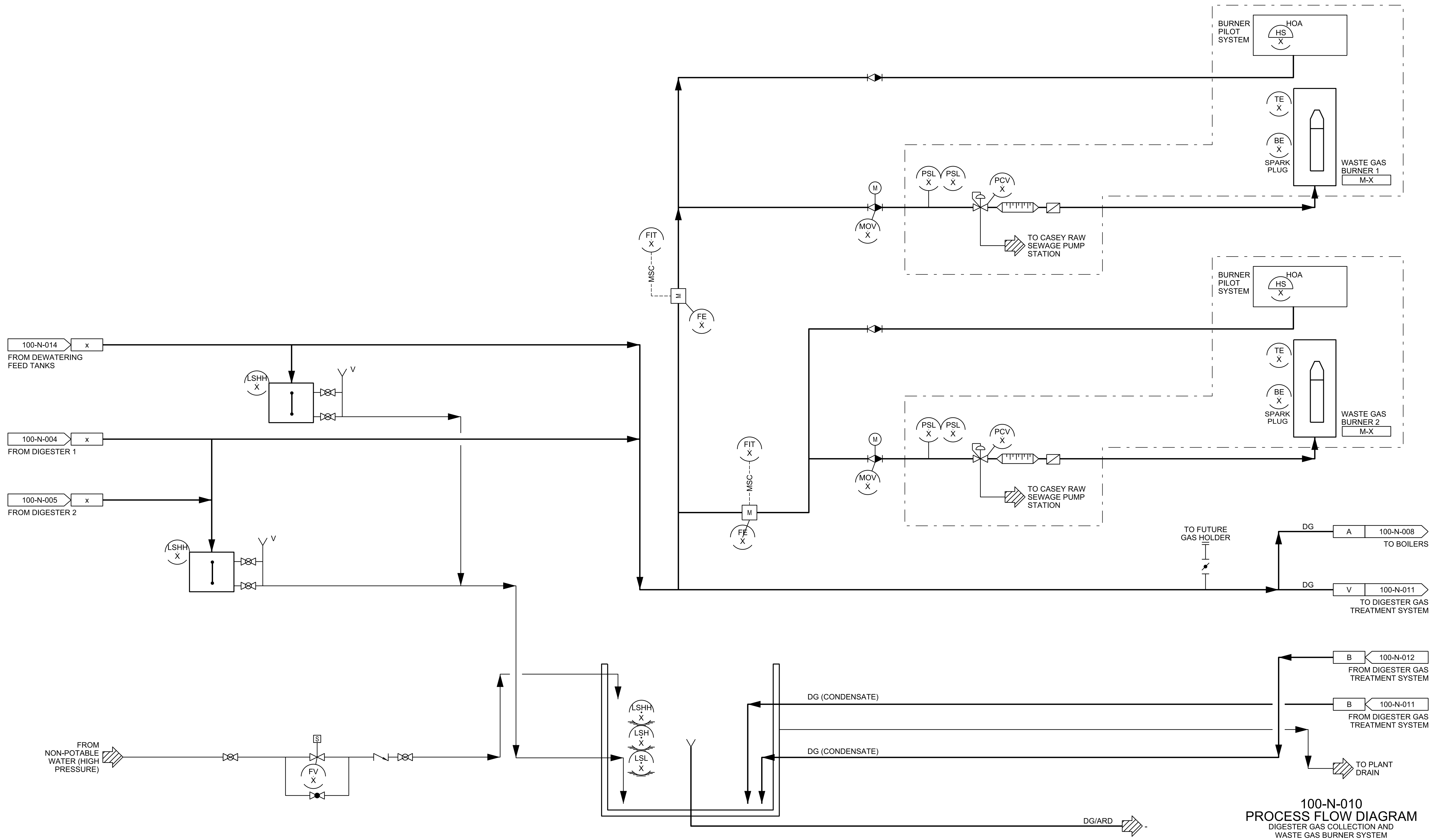
100-N-008
PROCESS FLOW DIAGRAM
BOILERS

Jacobs



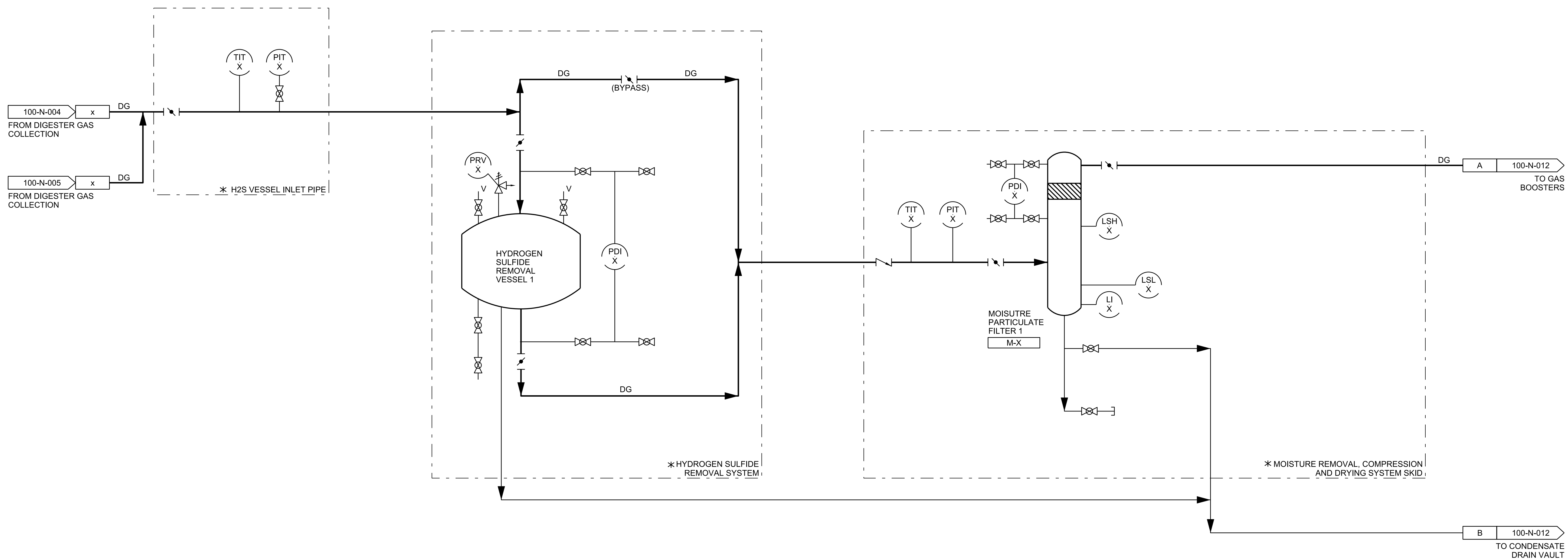
100-N-009
PROCESS FLOW DIAGRAM
DIGESTER WITHDRAWAL SYSTEM

Jacobs



100-N-010
PROCESS FLOW DIAGRAM
DIGESTER GAS COLLECTION AND WASTE GAS BURNER SYSTEM

Jacobs



100-N-011
PROCESS FLOW DIAGRAM
DIGESTER GAS TREATMENT SYSTEM 1

Jacobs

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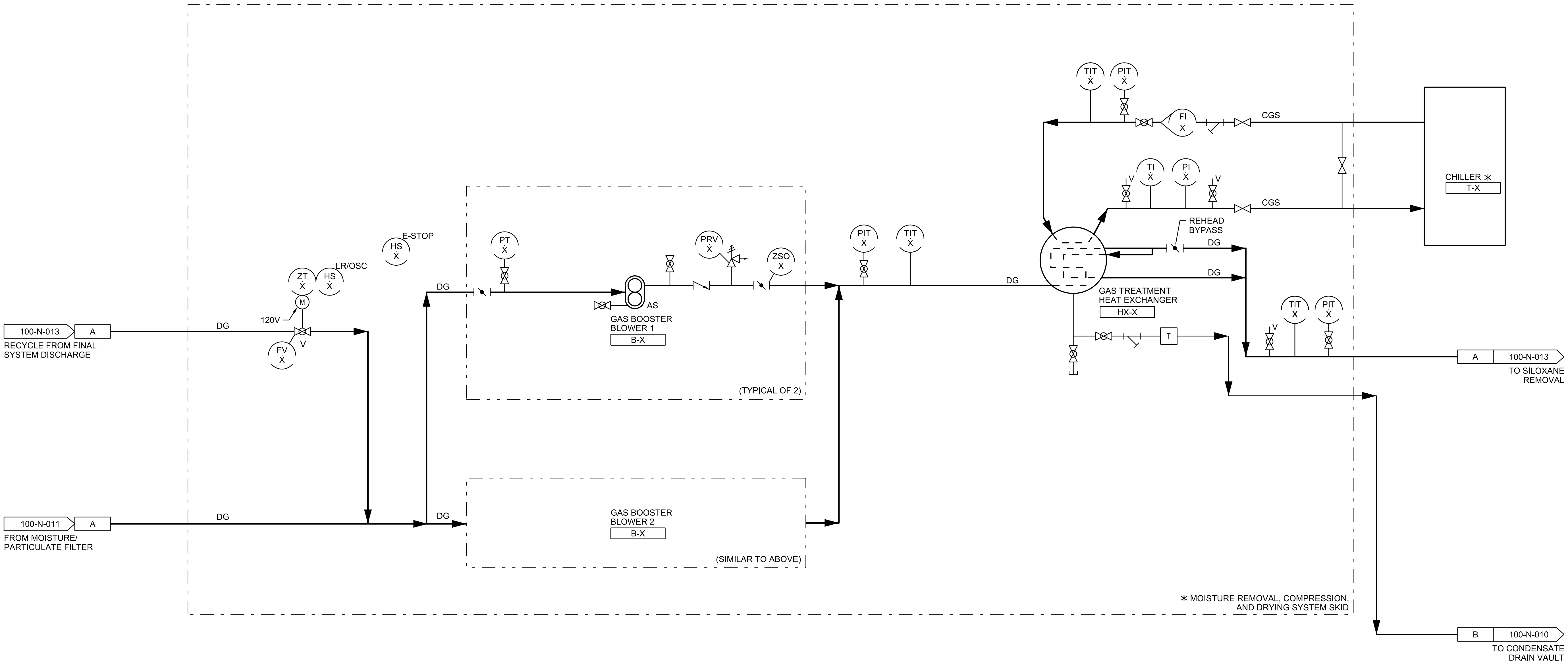

100-N-012
PROCESS FLOW DIAGRAM
DIGESTER GAS TREATMENT SYSTEM 2

Jacobs

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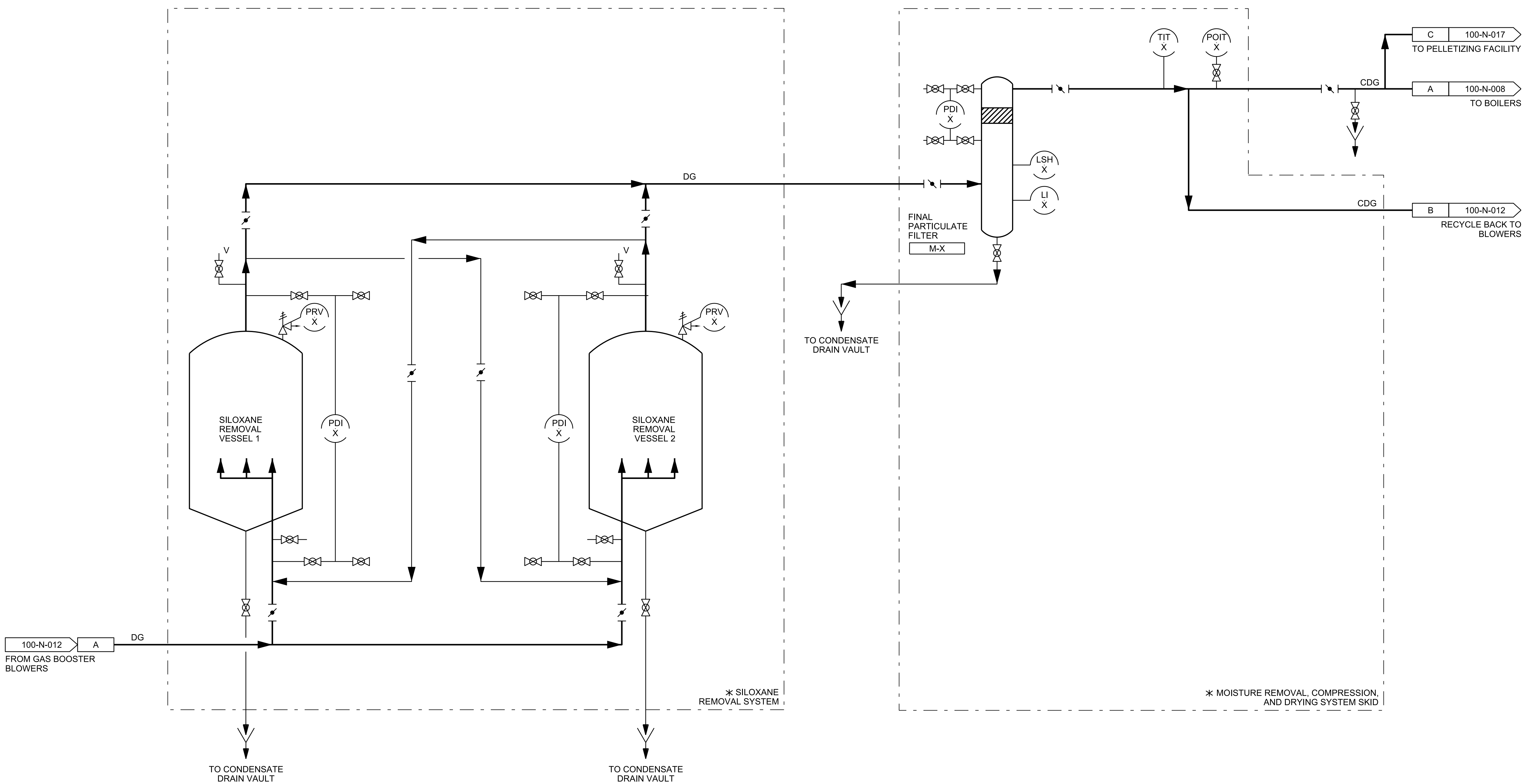

100-N-013
PROCESS FLOW DIAGRAM
DIGESTER GAS TREATMENT SYSTEM 3

Jacobs

pw:\projectwise:DEN001\Documents\674010 - CCWA CASEY-(CAD-2020-07-PER BIOSOLIDS)

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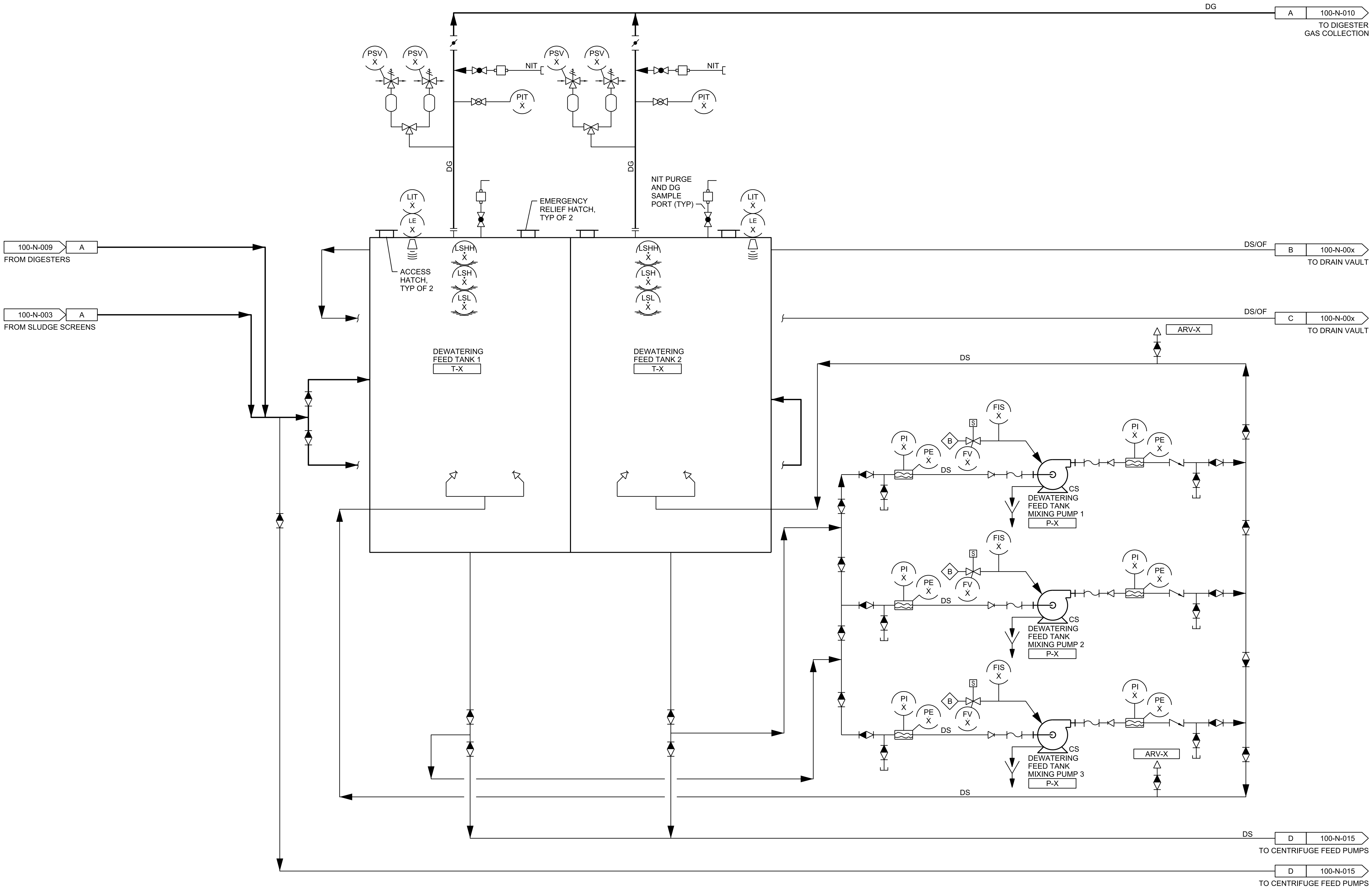

100-N-014
PROCESS FLOW DIAGRAM
DEWATERING FEED TANKS

Jacobs

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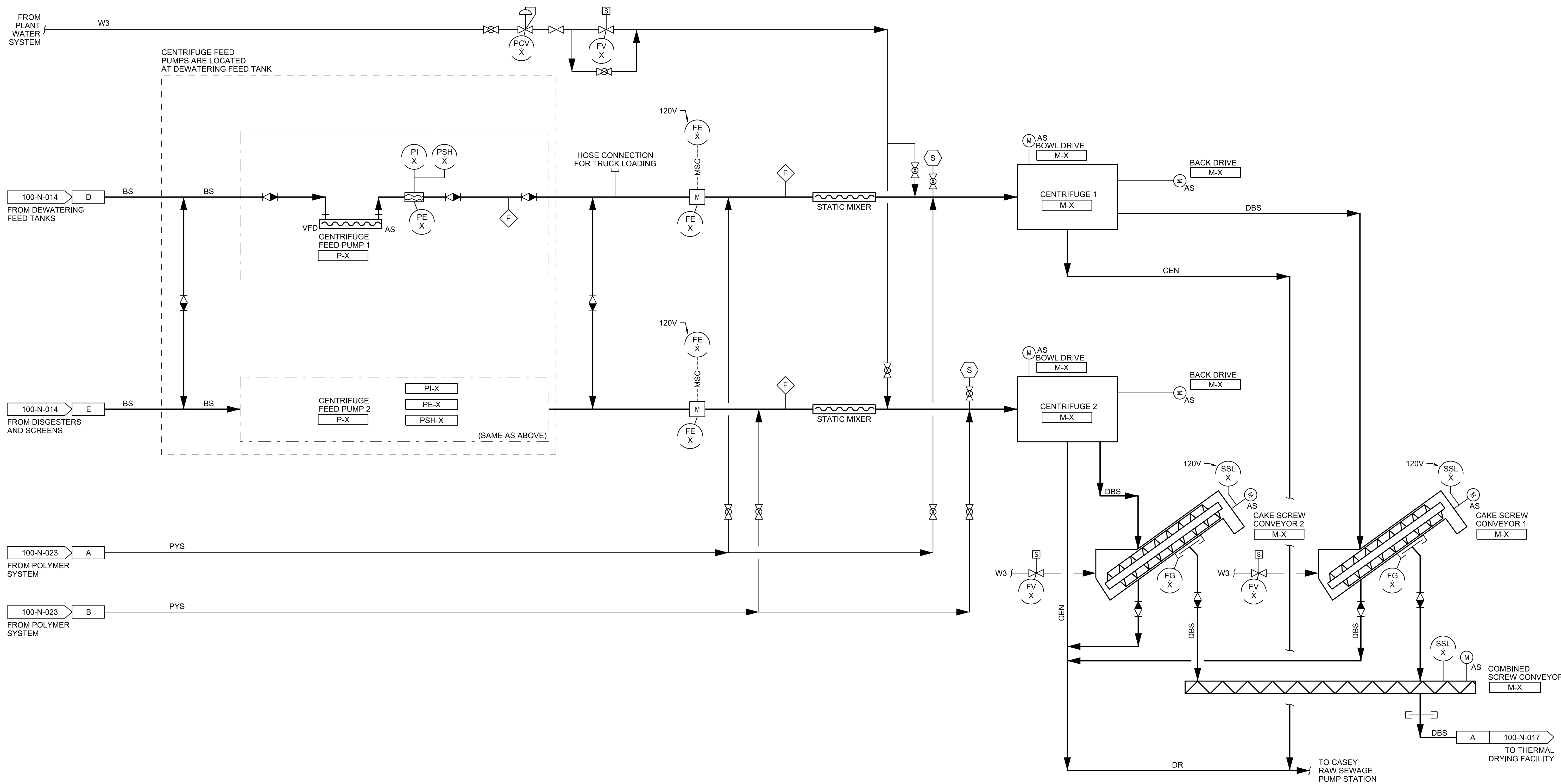
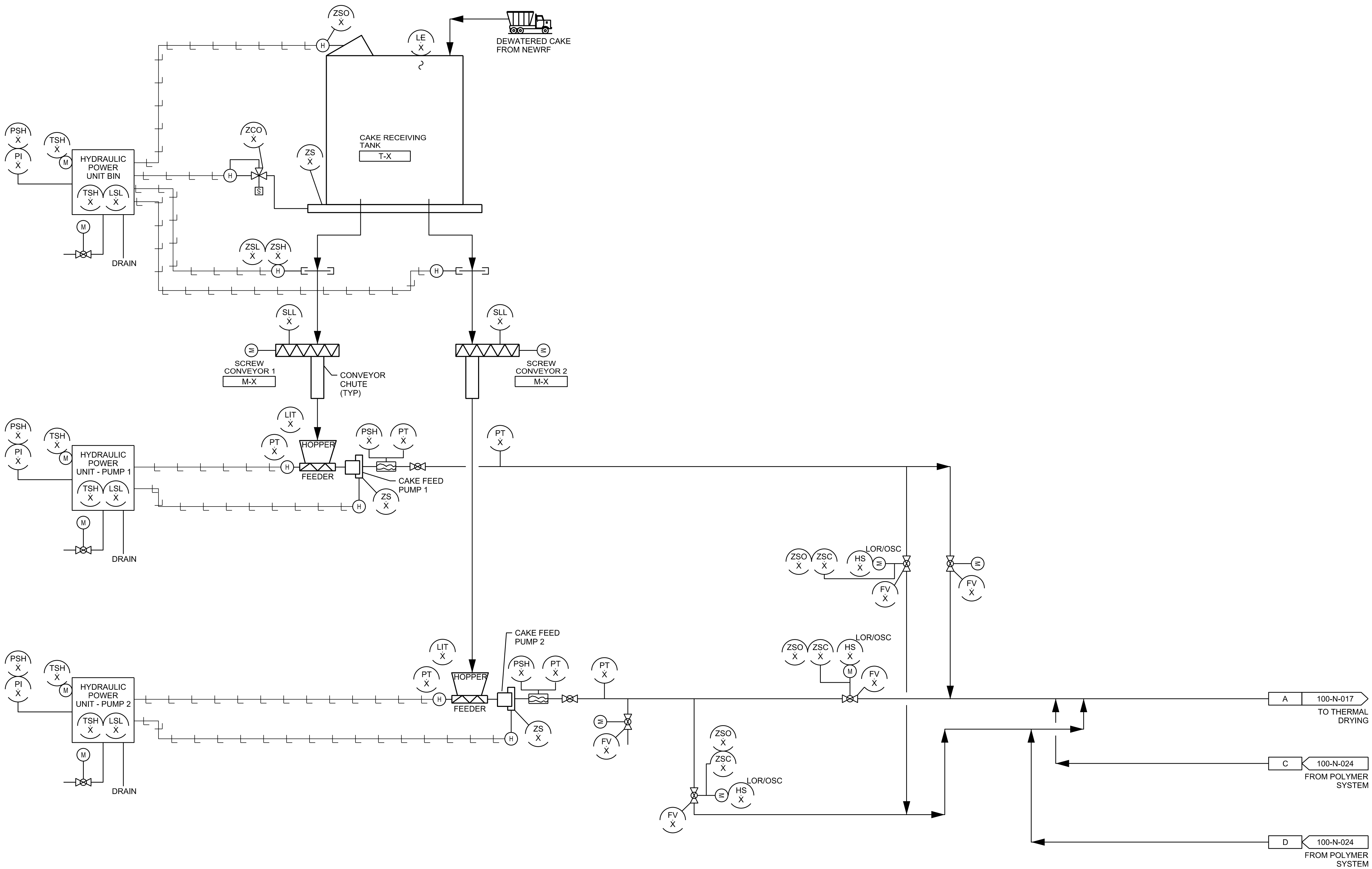


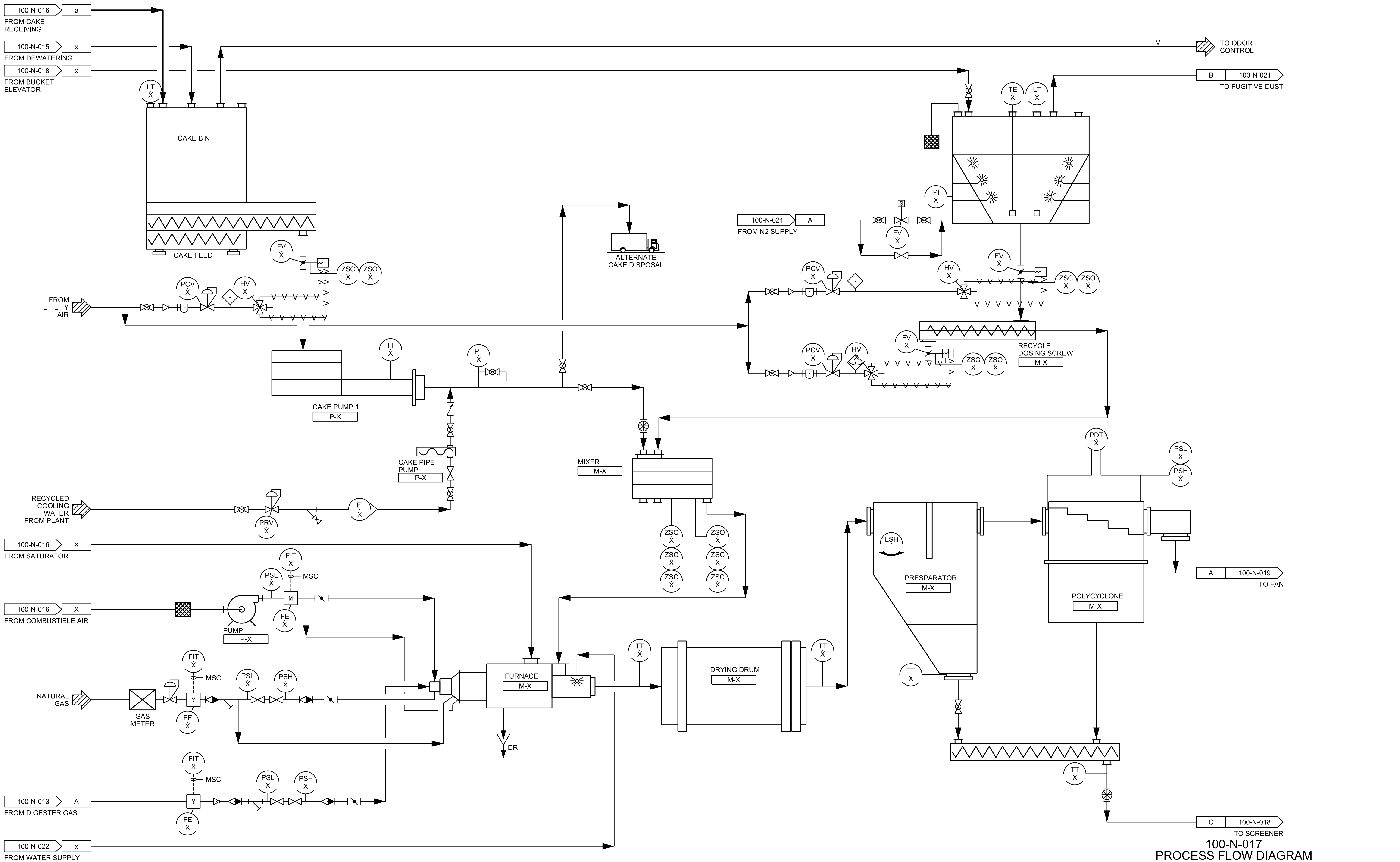
100-N-015
PROCESS FLOW DIAGRAM
CENTRIFUGE DEWATERING

Jacobs



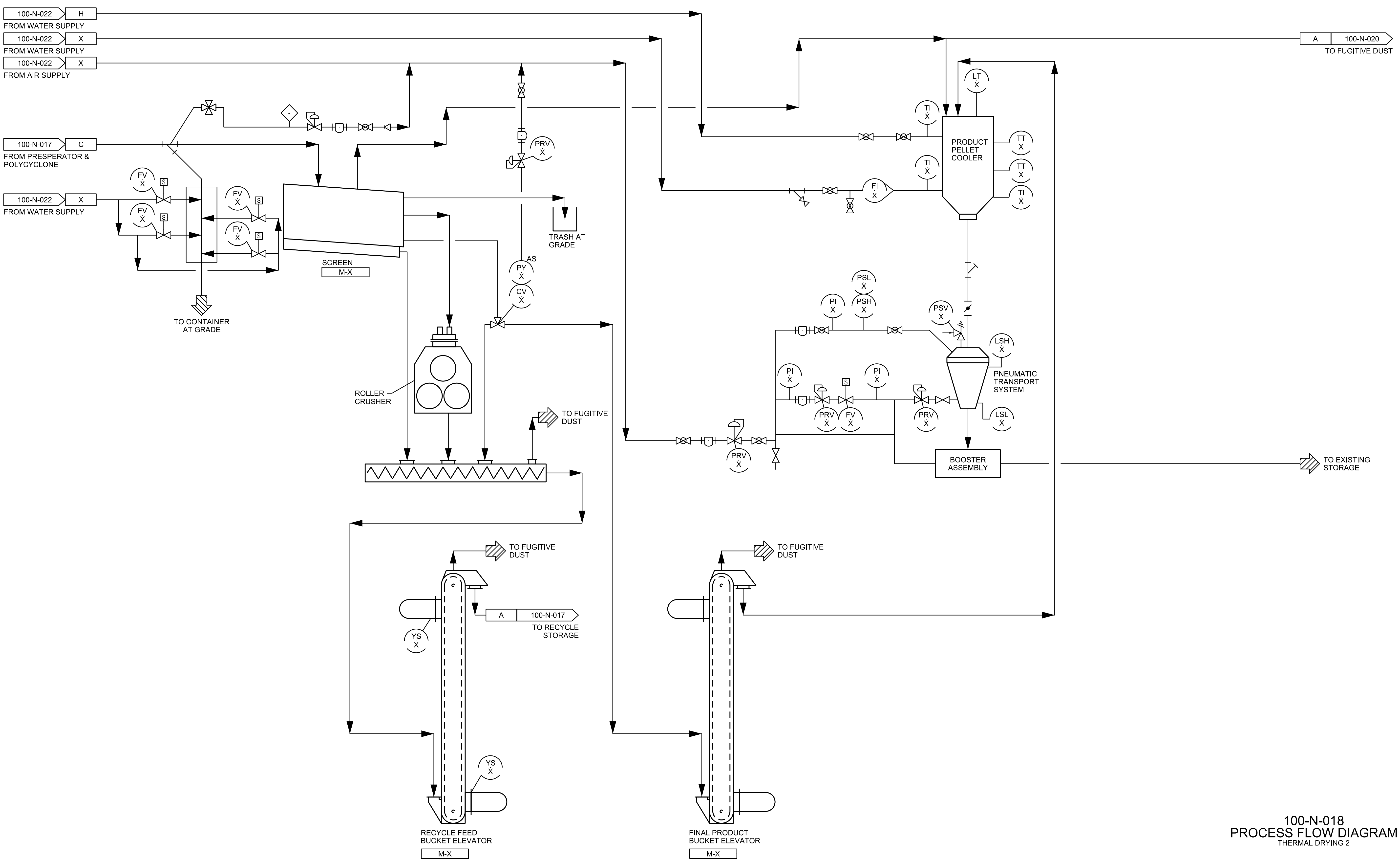
100-N-016
PROCESS FLOW DIAGRAM
CAKE RECEIVING STATION

Jacobs



100-N-017
PROCESS FLOW DIAGRAM
THERMAL DRYING 1

Jacobs

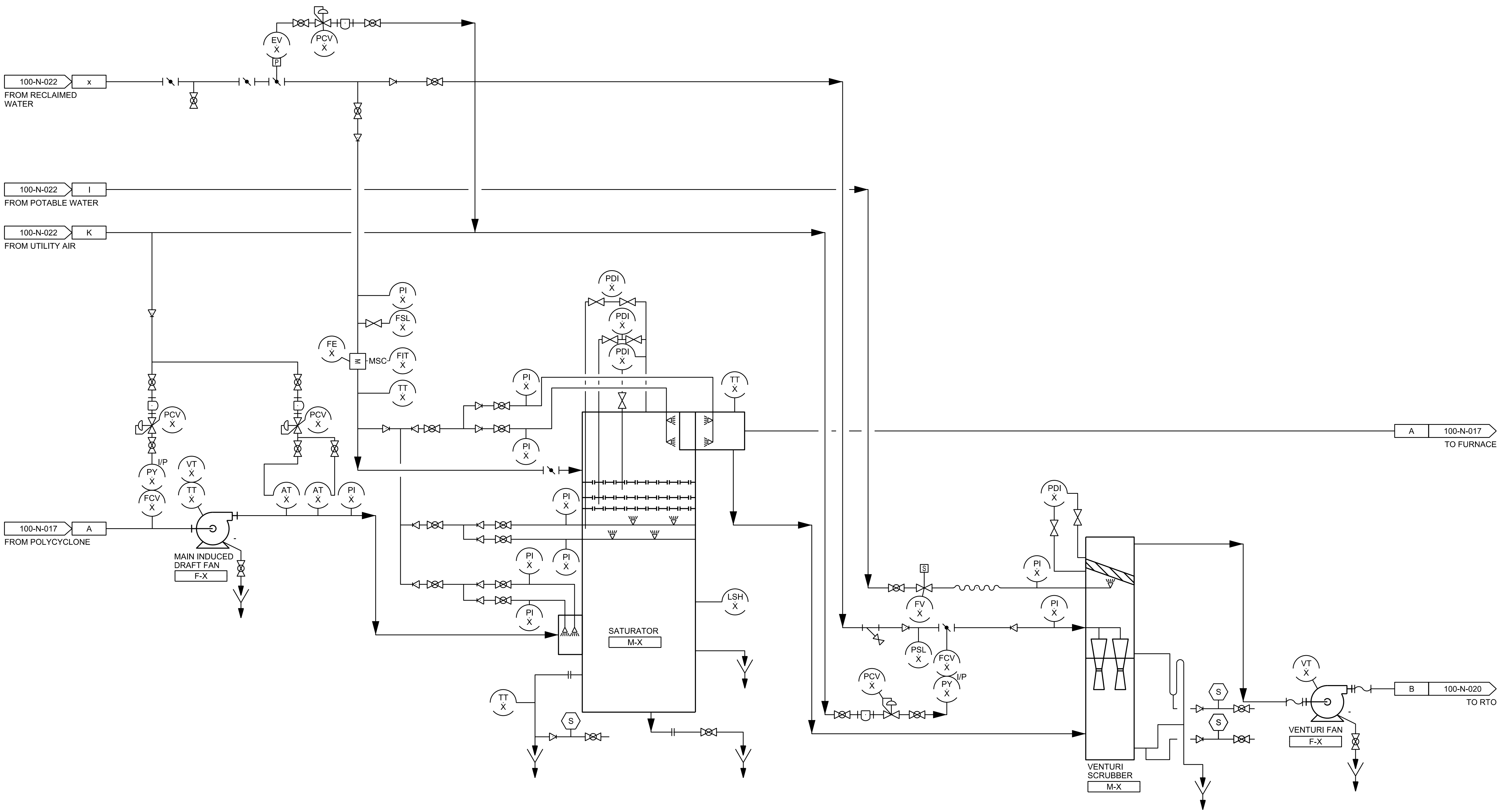


100-N-018

PROCESS FLOW DIAGRAM

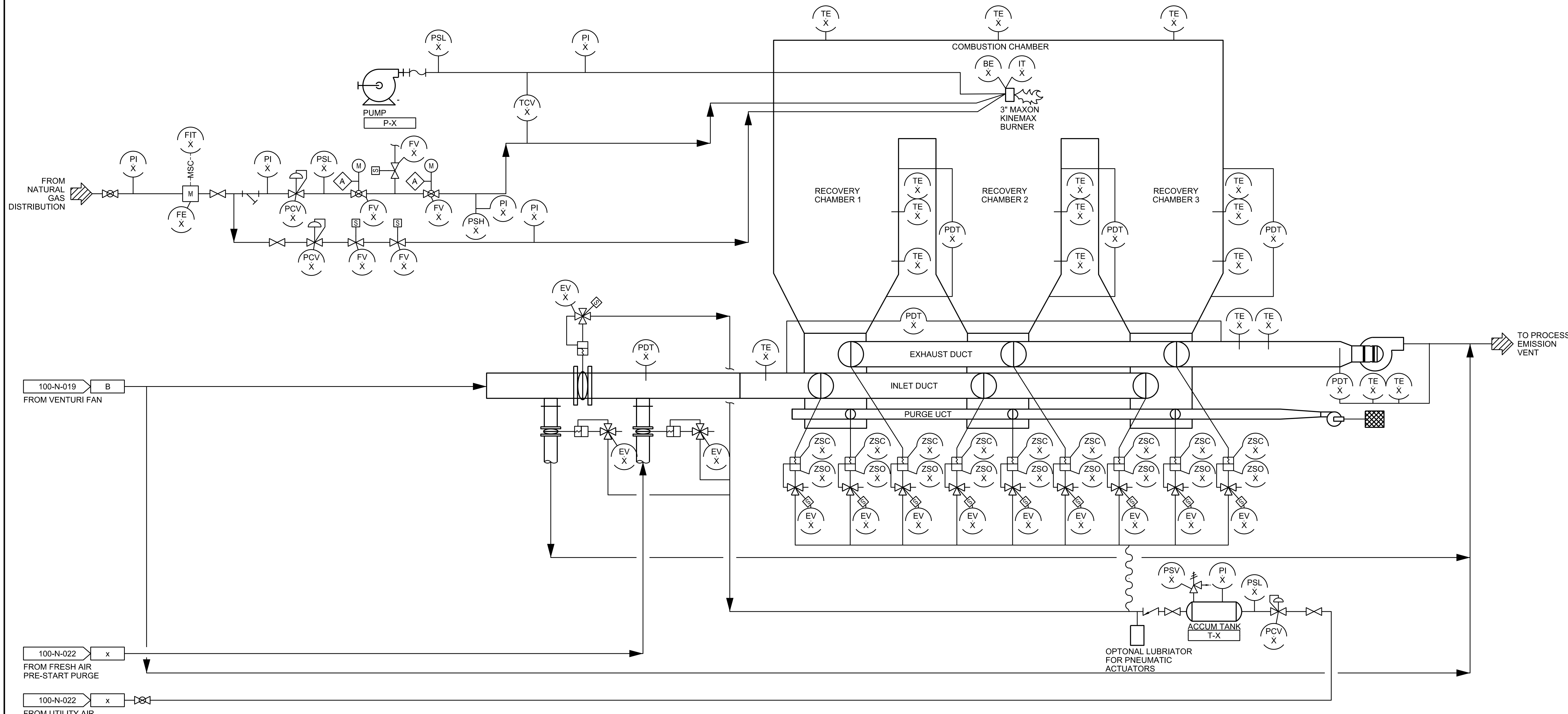
THERMAL DRYING 2

Jacobs



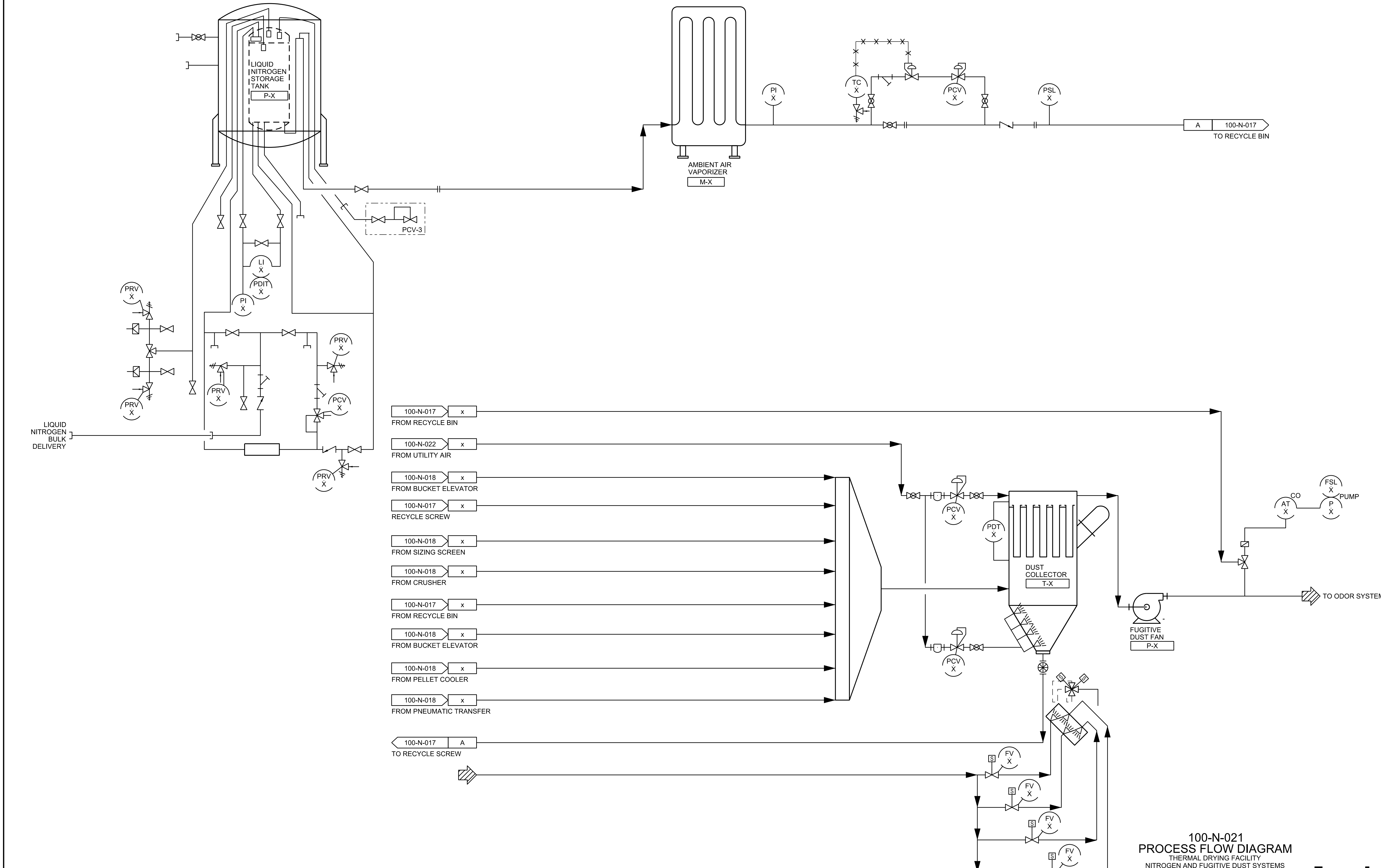
100-N-019
PROCESS FLOW DIAGRAM
THERMAL DRYING 3

Jacobs



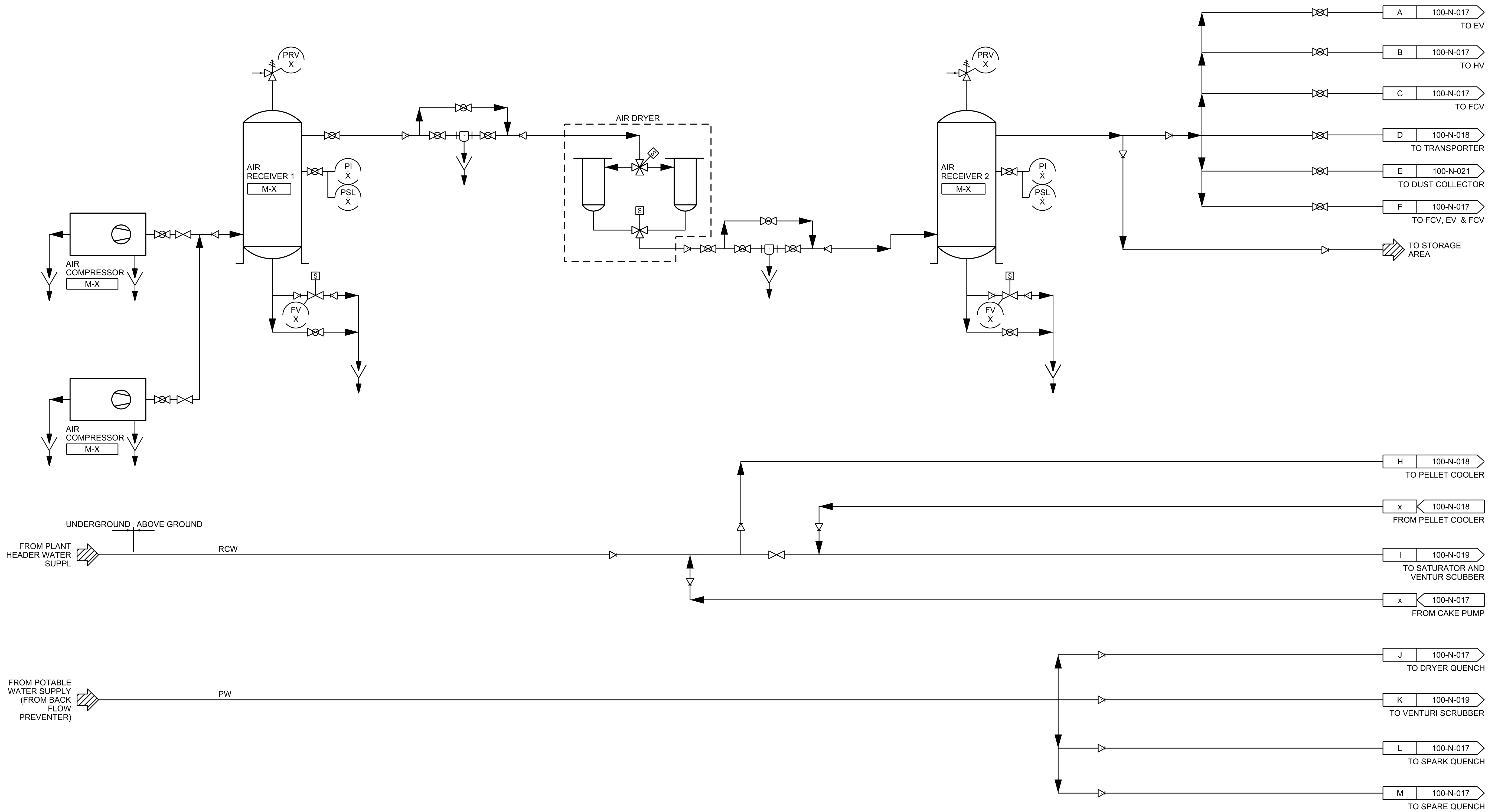
100-N-020
PROCESS FLOW DIAGRAM
THERMAL DRYING FACILITY
REGENERATIVE THERMAL OXIDIZER

Jacobs



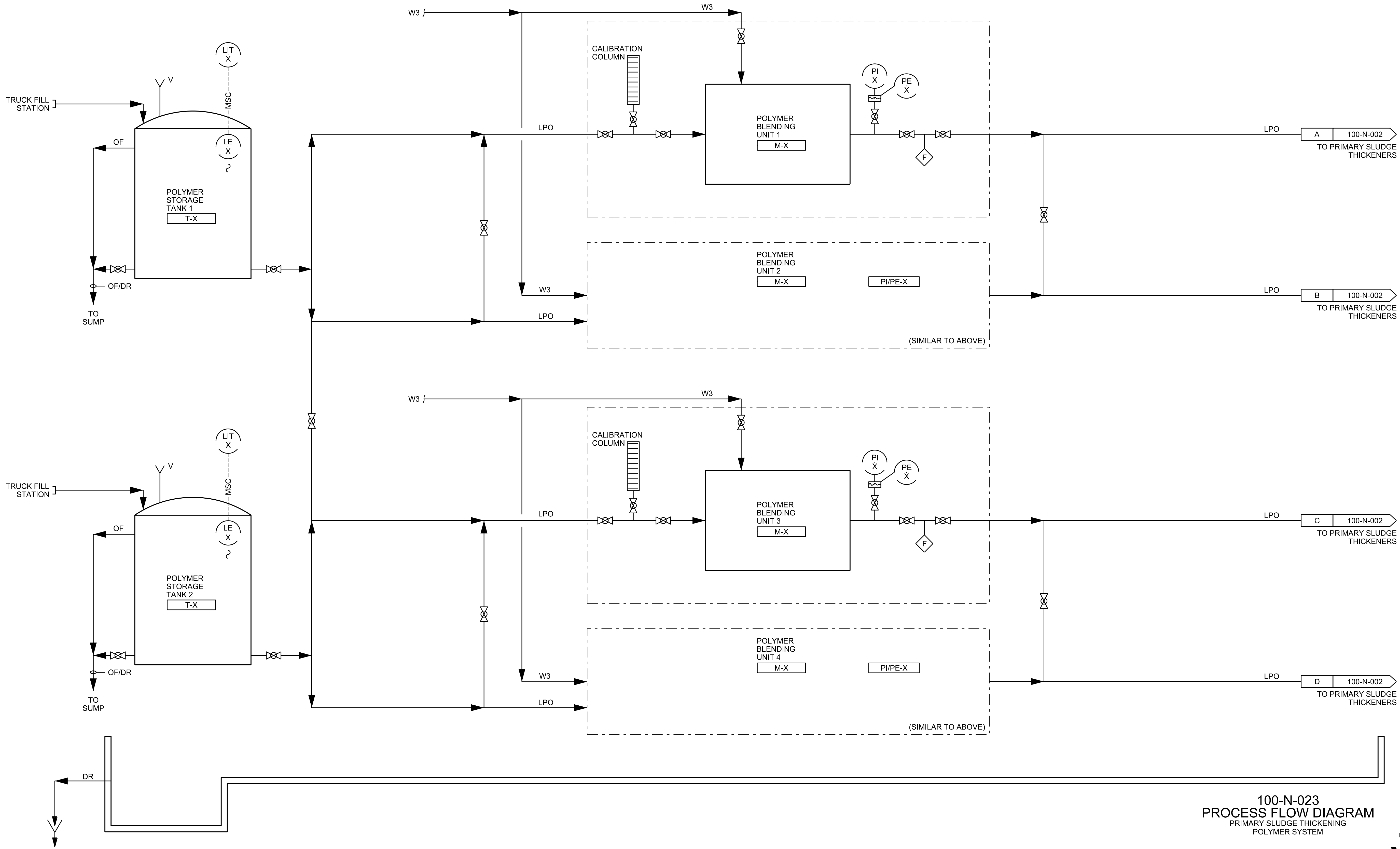
100-N-021
PROCESS FLOW DIAGRAM
THERMAL DRYING FACILITY
NITROGEN AND FUGITIVE DUST SYSTEMS

Jacobs



100-N-022
PROCESS FLOW DIAGRAM
THERMAL DRYING FACILITY
AIR AND WATER SUPPLY

Jacobs



100-N-023
PROCESS FLOW DIAGRAM
PRIMARY SLUDGE THICKENING
POLYMER SYSTEM

Jacobs

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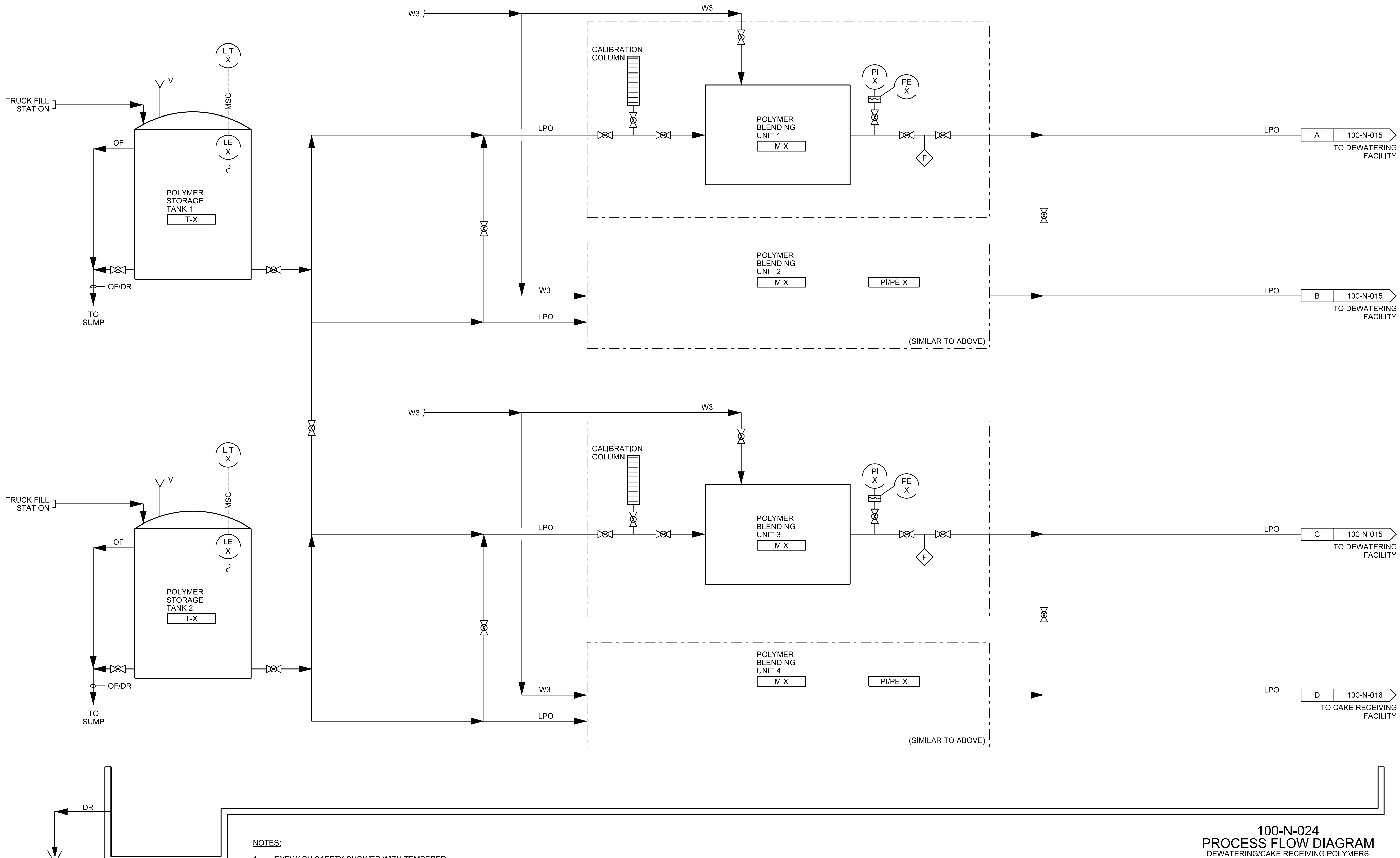


NOTES:

1. EYEWASH SAFETY SHOWER WITH TEMPERED WATER SUPPLY.

100-N-024
PROCESS FLOW DIAGRAM
DEWATERING/CAKE RECEIVING POLYMERS

Jacobs

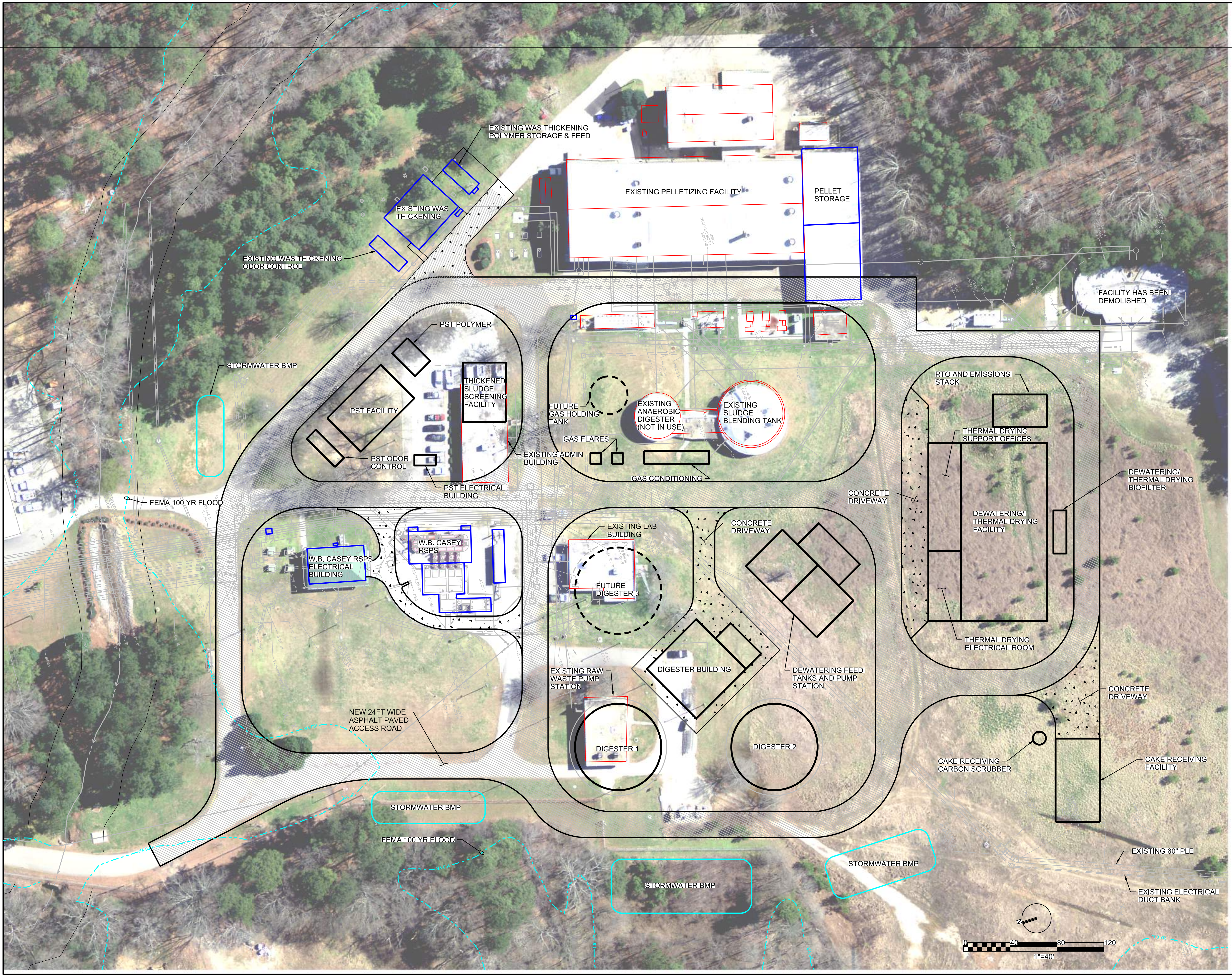
pw:\projectwise:DEN001\Documents\674010 - CCWA CASEY-(CAD-2020-07-PER BIOSOLIDS)

FILENAME: 100-N-024.dgn

PLOT DATE: 2020\08\19

PLOT TIME: 12:49:21 PM

Appendix B
Overall Site Plan



BIOSOLIDS MANAGEMENT FACILITIES

EXISTING FACILITIES TO REMAIN:
- PELLET STORAGE
- WAS THICKENING FACILITY
- RSPS
- RSPS ELECTRICAL BUILDING

EXISTING FACILITIES TO BE DEMOLISHED:
- ADMINISTRATIVE BUILDING
- ANAEROBIC DIGESTER (OPTIONAL)
- LAB BUILDING (OPTIONAL)
- PELLETIZING FACILITY (OPTIONAL)
- RAW WASTE PUMP STATION
- SLUDGE BLENDING TANK (OPTIONAL)

PROPOSED FACILITIES:
- PST FACILITY
- THICKENED SLUDGE SCREENING FACILITY
- DIGESTER 1
- DIGESTER 2
- DIGESTER BUILDING
- DEWATERING FEED TANKS AND PUMP STATION
- DEWATERING / THERMAL DRYING FACILITY
- CAKE RECEIVING FACILITY

FACILITIES NOT SHOWN ON FIGURE:
- WAS/SCUM PUMP STATION

005-C-001
OVERALL SITE PLAN
APPENDIX B
W.B. CASEY WRRF BIOSOLIDS PER

Jacobs