Memorandum

To: *Cheri Cousens, P.E.*
Richard Weare

From: *Benjamin Mosher, P.E., BCEE*
Vincent Apa, P.E., BCEE

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Subject: *Greater Lawrence Sanitary District Organics to Energy Program*
Co-Digestion Pilot Program Monitoring Data Summary

1.0 General

As part of the above referenced project development, the Greater Lawrence Sanitary District (GLSD or District) undertook a source separated organics co-digestion pilot program during the construction but prior to full-scale commissioning of the associated facility improvements. The objectives of this pilot study were to:

1. Assess the logistical issues associated with receiving and processing the material.
2. Determine the increase in gas production resulting from acceptance of PSSO, as well as typical operating parameters (temperature, volatile solids feed and reduction, alkalinity, pH, etc.).
3. Determine the impact of PSSO material on dewatering and thermal drying operations, including impacts to pellet product quality.
4. Determine the impacts of dewatering centrate on secondary wastewater treatment.

2.0 Pilot Program Logistics

2.1 Sourcing and Delivery

In accordance with an agreement between the GLSD and Waste Management (WM), the source separated material for this pilot program was pre-processed offsite before being delivered to the GLSD facility for digestion. WM sourced pre- and post-consumer food waste materials from around the greater metro-Boston region and hauled it to a recently constructed facility located in Charlestown, MA. WM collected the waste from supermarkets, education facilities, industrial food manufacturers and similar suppliers. Once received at the Charlestown facility, the material was processed through the proprietary WM CORe® process to produce an Engineered Bioslurry (EBS®) product (also referred to as Source Separated Organics (SSO) in this document) which complied with the technical requirements stipulated in the supply contract. The final slurry was then delivered to the GLSD treatment facility in North Andover, MA via tanker trucks.

Figure 1: Engineered Bioslurry

2.2 Receiving and Conveyance

At the GLSD facility, the tanker trucks offload into underground storage tanks. Due to the schedule for construction of the facility upgrades, the initial portion of the pilot program utilized an existing and repurposed 33,000 gallon sludge tank located adjacent to the existing sludge blend tank. This existing tank was recently cleaned and coated with a corrosion resistant lining system and retrofitted with a submersible propeller-style mixer in preparation for this program.

Figure 2: SSO Delivery into Pilot Tank

On February 14, 2018, construction was completed on the new SSO storage tanks, located adjacent to the new CHP building; and receipt of the material was transferred to that location. The two tanks provide a total storage capacity of ~240,000 gallons, though only a single tank was used during the later part of the pilot program. The new tanks utilize a pumped jet mix style mixing system with the mix pumps located in the existing Tunnel V.

Transfer of material from both locations (pilot and full-scale SSO tanks) to the blend tank was accomplished utilizing rotary lobe-style pumps. There was a single pump installed to serve the pilot tank while there are a total of four (two per tank) installed to serve the full-scale SSO tanks. Though the pumps were able to convey the materials to the blend tank as designed, there has been concern over jamming and premature wear of the lobes thought to be caused by abrasives in the EBS (grit, glass, metal chards, etc), creating the need to clean out the pumps and replace lobes more frequently than anticipated.

2.3 Ramp-up Trends and Selection of Data for Comparison

2.3.1 Pilot Program Schedule and Data Analysis

Planning for the GLSD co-digestion pilot program began in 2016. As noted in the PSSO Feed Schedule and Monitoring Program memorandum dated September 6, 2016, there were a host of parameters to be monitored during a pre-pilot “baseline” period as well as throughout the anticipated 6 ± month pilot program. The baseline monitoring began in February of 2016 and lasted for approximately 12 months prior to start of SSO feed to the digesters on February 4, 2017. The schedule of samples to be collected during the baseline and pilot periods are shown in the Table included within Attachment A of this memorandum. It should also be noted that operations data collected at the facility is presented in many of the charts attached to this memorandum.

For the purpose of this memorandum and associated analysis, data was reviewed in two ways. First, the entire data set for each parameter was charted during the ramp up period and reviewed for any trends associated with the addition of SSO to the digesters. In addition, discrete “pre vs. post” data were compared on a numerical basis to analyze the percent change for each parameter. For this comparison, the “pre” was considered to be an average of the data over the 12-month baseline period between February 4, 2016 and February 4, 2017. The “post” data set used was the average of the three most recent months of co-digestion conditions which included data from February 14, 2018 through May 14, 2018.

In general, the charts of the data trends are included in attachments to this memorandum while tables showing the pre vs. post comparisons are included in the body of the text. Data within the tables has been extracted from the WIMS data provided by the District and typically rounded to three significant digits. As noted in later sections of this memorandum, in cases where findings are based on a limited data set (i.e. 1 or 2 samples for a given parameter in a period), the results have been excluded from the respective summary tables as the conclusions are not currently considered to be statistically significant.

2.3.2 SSO Ramp-Up

SSO feed to the digesters was ramped up in a step-wise manner starting in February of 2017 to allow for acclimatization of the digestion process and associated microbiology to this new substrate. In addition, this ramp-up period allowed for WM to build their supplier customer base and ramp-up operations at their Charlestown facility. Decisions to adjust the feed rates were based on a weekly data review and calls to discuss operating parameters between the District, WM and CDM Smith staff. Figure 3 shows the trend of SSO feed ramp-up to the digesters between February 2017 and May 2018 (15 months). It should be noted that, though a daily target was set during each of the weekly calls, the actual feed to the digesters often varied due to a number of circumstances including facility operations, SSO/EBS availability and equipment maintenance (i.e. pumps, flow meters, etc). For comparison purposes and to frame the data presented in later sections, it should be noted that this SSO feed rate equates to between 0-percent (baseline) and 15-percent (recent 3-months) of total digester feed on a volumetric basis. On a total volatile solids mass basis, the SSO feed accounts for 31-percent of the total during recent co-digestion flows.

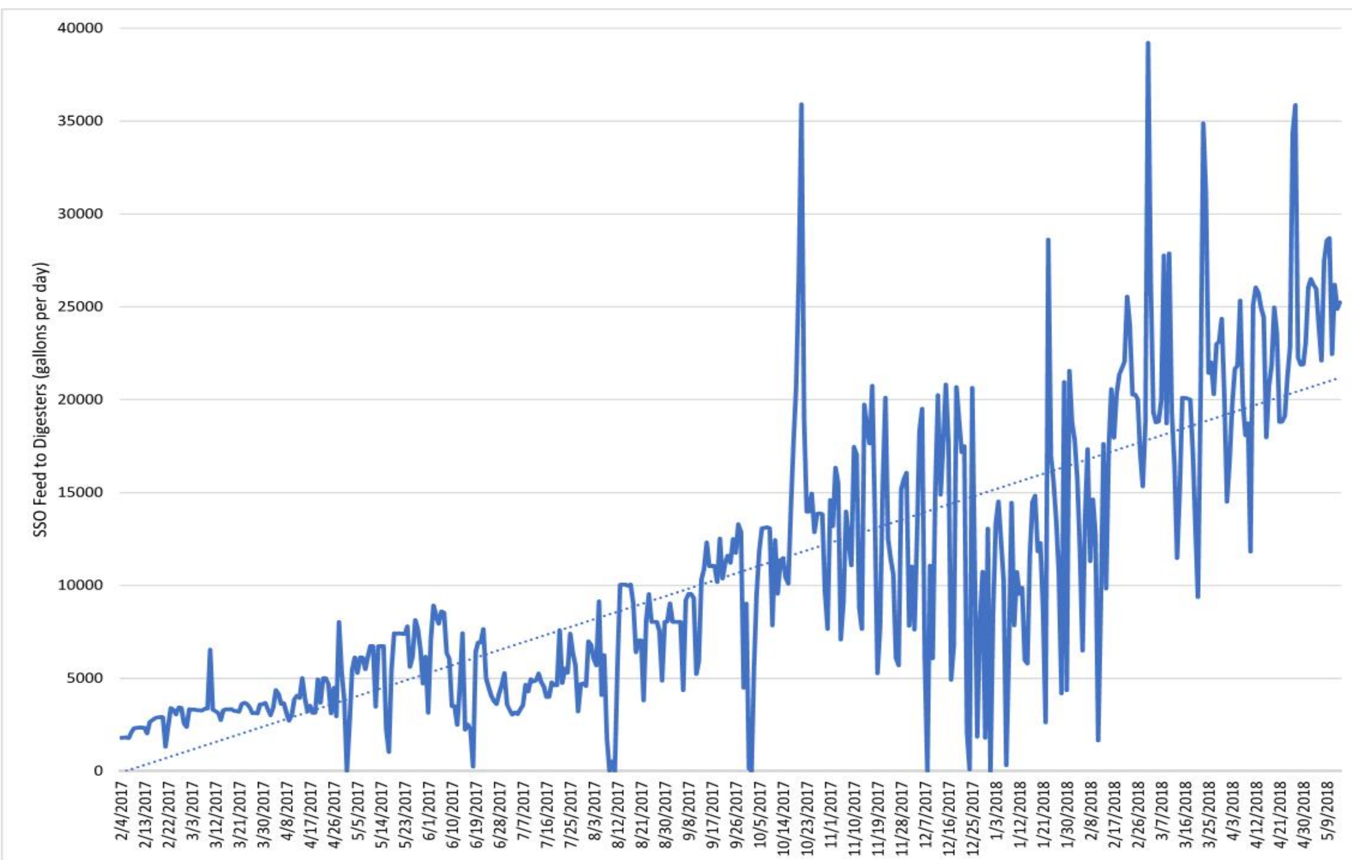


Figure 3: Pilot Program Daily SSO Feed

3.0 Digester Feed

This section provides a summary of data related to the feed of sludge into the digestion system. Charts of the data trends have been included within Attachment B while the pre and post data are summarized below.

3.1 Primary Sludge

As shown in Table 1, the thickened primary sludge (TPS) (gravity thickener effluent) flow was monitored for a variety of parameters. The most notable change in the data is the significant (20%) increase in solids concentration which translated to an apparent 16% increase in volatile solids loading from primary sludge. This presumably corresponds to improved operations of the gravity thickeners, though is likely impacted by operations staff seeking to maintain a Hydraulic Residence Time (HRT) of between 18 and 22 days (addition of SSO volume would translate to less volume and higher concentrations of TPS). Though limited samples were collected for phosphorous, ammonia and COD in the primary sludge, it is difficult to draw any conclusions based on the limited data set.

Table 1: Thickened Primary Sludge Feed

Parameter	Baseline 2/4/16 - 2/4/17	Pilot 2/14/18 - 5/14/18	% Change
Flow to Blend Tank (gpd)	86,400	82,000	-5%
pH (SU)	5.59	5.92	6%
Total Solids (%)	4.36	5.24	20%
Total Solids (lb/day)	31,400	35,800	14%
Volatile Solids (%)	80.7	82.4	2%
Volatile Solids (lb/day)	25,300	29,500	16%
Alkalinity (mg/L)	479	379	-21%
Volatile Acid (mg/L)	1070	680	-36%

3.2 Waste Activated Sludge

Waste activated sludge (Gravity Belt Thickener (GBT) feed) and Thickened Waste Activated Sludge (TWS) data is presented in Table 2. The most notable issue with this data is the need to calculate the TWAS flow rate which is based on subtracting the TPS and SSO flow data from the total digesters feed values. If this data is reliable, this would represent a reduction in total TWAS flow which would correspond to the significant increase in TWAS solids concentration. Similar to the primary sludge, this data suggests an improvement in GBT operations/efficiency and/or a change to maintain HRTs between the baseline and pilot period. Similar to the primary sludge, limited grab samples of GBT filtrate ammonia and phosphorous levels were collected and analyzed, but additional sampling would be required to ascertain any trends related to co-digestion operations.

Table 2: Waste Activated Sludge Feed

Parameter	Baseline 2/4/16 - 2/4/17	Pilot 2/14/18 - 5/14/18	% Change
Feed to GBT (gpd)	1,250,000	1,120,000	-11%
Polymer Use Total (lbs)	197	183	-7%
TWAS Flow to Blend Tank (gpd)*	78,500	47,200	-40%
TWAS Total Solids (%)	4.36	6.69	54%
TWAS Total Solids (lbs/day)**	28,500	26,400	-8%
TWAS Volatile Solids (%)	80.3	85.1	6%
TWAS Volatile Solids (lb/day)**	22,900	22,400	-2%
GBT Filtrate TSS (mg/l)	38.2	68.6	80%

* Calculated by reducing total feed by TPS and SSO rates
** Based on calculated TWAS flow rates

3.3 Source Separated Organic (SSO) Slurry

As discussed in section 2.3.2, the SSO/EBS slurry was supplied to the District by WM via tanker truck deliveries. This product was sampled at a variety of locations including the WM facility, the truck upon delivery, and the pilot storage tank. Table 3 includes a summary of the collected EBS/SSO data for the selected “Pilot” period. The soluble COD concentration as passed through a 1.5 micron filter was approximately 77,000 mg/L or 20% of the total. Cellulose or other high molecular weight organics may register as COD but may not be available to the microorganisms in a 20 day SRT anaerobic mesophilic digester and therefore lead to lower biogas yields.

3.4 Blended Digester Feed

As previously noted, the thickened primary sludge, thickened waste activated sludge and the source separated organic(SSO/EBS) slurry are currently combined within a blend tank at the facility prior to being pumped into the digesters. This blending process is intended to ensure that a consistent mixture is sent to the digesters and has also been shown to improve the hydraulics of the digester feed piping at the facility (based on experience prior to exclusive of SSO addition). As shown in Table 4, the total feed to the digesters decreased in volume between the baseline and pilot conditions due to the thicker TPS and TWAS produced during the pilot. However, the total solids loading and total volatile solids loading increased due to both an increase in solids loading from the WWTP (5-percent increase) and the addition of the SSO material (total of WWTP and SSO equating to a 49-percent total solids loading increase and 59-percent volatile solids increase). Though only a limited data set exists for this parameter to-date, it was also noted that the pH of the blend tank appears to have decreased expectedly due to the addition of the acidic SSO material. It should be noted that the data from the pilot tank sampling within the selected baseline period is not considered as reliable as the samples from the individual feed sources (TPS, TWAS and SSO). As a result, many of the total digester feed parameters were derived using a weighted average of the feed source sampling data.

Table 3: Source Separated Organic (SSO) Slurry Monitoring Data

Parameter	Pilot 2/14/18 - 5/14/18
Flow to Blend Tank (gpd)	21,900
COD (mg/l)	284,000
pH	4.34
Total Solids (%)	14.1
Total Solids (lb/day)	25,800
Total Suspended Solids (Pilot Tank) (%)	7.5
Total Suspended Solids (Pilot Tank) (lb/day)	13,700
Total Dissolved Solids (%)	6.6
Total Dissolved Solids (lb/day)	12,100
Volatile Solids (%)	91.8
Volatile Solids (lb/day)	23,700
Volatile Acids (Pilot Tank) (mg/l)	15,000
Phosphorus (T-PO4) (Pilot Tank) (mg/l)	525
Ammonia (NH3) (Pilot Tank) (mg/l)	1.63

Table 4: Digester Feed Data

Parameter	Baseline 2/4/16 - 2/4/17	Pilot 2/14/18 - 5/14/18	% Change
Feed to Digesters (K gals)	165,000*	151,000*	-8%
Total Solids (%)	4.29	6.98	63%
Total Solids (lb/day)	59,000	88,000	49%
Volatile Solids (%)	80.3	84.6	5%
Volatile Solids (lb/day)	47,400	74,400	57%

* Note that concern has been expressed regarding the accuracy of these flow meters and investigations into the issue are ongoing.

4.0 Digestion and Gas Production Data

4.1 Digestion Process Performance

Regular sampling and analysis of the digester contents occurred throughout the pilot program. Data presented in Table 5 represents an average of the values for the samples taken from the two on-line digesters. Many of the trends shown in the data are consistent with the previously discussed waste source data where an increase in total solids concentration and COD mass were observed. The TSS concentration actually dropped, likely because of the high dissolved solids fraction of PSSO. Alkalinity increased by almost 30% while volatile acids decreased by 3%. There was also a substantial decrease in foam height during the pilot period.

It should also be noted that, though the historical ideal digester volatile solids loading range has been considered to be between 0.12 to 0.16 lb VS/cf of digester capacity/day for a traditional municipal digester, recent studies have shown that co-digestion of SSO with biosolids is stable at loadings in excess of 0.2 lb VS/cf/day. As shown in Table 4 and Figure 4, the loading rate for the GLSD digestors during the pilot program approached this amount with little impact on the digester process thus far.

The Specific Energy Loading Rate (SELR) as defined by total COD loading (lb/d),divided by VSS mass in digester (lb) shows an increase from 0.22 to 0.51 lb COD/lb VSS/d. This may be attributed to the large increase in COD from the PSSO compared to smaller change in VSS.

Table 5: Digestion (Inside Reactor) Sampling Data

Parameter	Baseline 2/4/16 - 2/4/17	Pilot 2/14/18 - 5/14/18	% Change
pH (SU)	7.22	7.34	2%
Total Solids (%)	2.17	2.52	16%
Total Suspended Solids (mg/l)	20,700	19,400	-6%
COD Total (mg/l)*	24,800	27,200	10%
COD Soluble (mg/l)*	888	1,580	78%
Total Volatile Solids (%)	69.5	67.3	-3%
Alkalinity (mg/L)	3,900	5,050	30%
Volatile Acid (mg/L)	430	417	-3%
VA/Alk Ratio	0.11	0.08	-25%
Total Volatile Suspended Solids (%)	69.5	67.3	-3%
Hydraulic Retention Time (days)	18.4	20.1	9%
Volatile Solids Loading (Lbs/cu ft of digestion capacity)	0.12	0.19	59%
Specific Energy Loading Rate (lb CODt/lb VSS/d)**	0.22	0.51	132%
Daily Foam Level (ft)	2.33	0.67	-71%

*Based on limited (<5) samples

** Based on current SSO COD data which, as noted in Table 3, required additional testing and verification

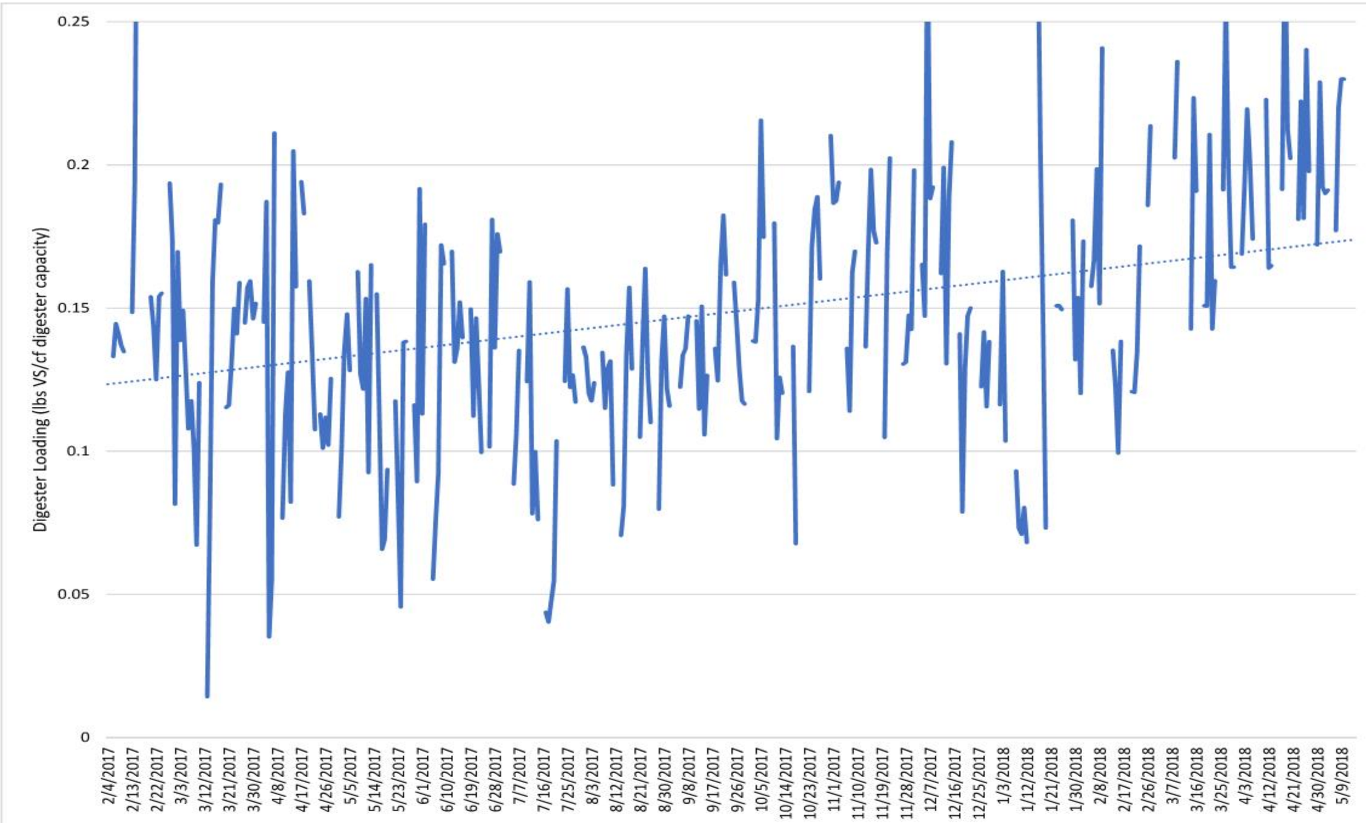


Figure 4: Digester Volatile Solids Loading

4.2 Biogas Production Impacts

In addition to providing a regional solution for beneficial reuse of food waste product, the primary goal of this project is to recover the energy from the co-digestion of this material in the form of biogas. The quantity and quality of the biogas was monitored on a regular basis and the associated results are shown in Table 6 below. As anticipated, the volume of gas during the pilot program increased substantially due the additional volatile solids which were added to and converted in the digestion process.

Sampling and analysis for biogas quality parameters was also completed as part of this pilot program. Based on initial indications from the current data, the quality and energy content of the gas appears to have remained relatively stable with the exception of siloxanes, which decreased substantially. It is surmised that this reduction is due to dilution of the municipal waste stream (containing siloxane forming compounds) with the food waste stream (theoretically absent of siloxane forming compounds). It is recommended that sampling for these parameters continue to be performed and further conclusions drawn following receipt of additional co-digestion operations data.

Table 6: Biogas Quantity and Quality Data

Parameter	Baseline 2/4/16 - 2/4/17	Pilot 2/14/18 - 5/14/18	% Change
Gas Flare (K cu ft)	63,100	322,000	410%
Gas Boiler (K cu ft)	152,000	222,000	46%
Gas Dryer (K cu ft)	226,000	245,000	8%
Total Gas Production (cf/day)	441,000	789,000	79%

4.3 Biogas Unit Production Calculations

As previously noted, one item of particular interest in this review is to determine the impact that SSO material has on gas production under co-digestion conditions at the GLSD facility. The first step in determining this is to evaluate the volatile solids reduction and gas production rate of the biosolids produced by the GLSD wastewater treatment process ("WWTP" noted in Table 7) under the baseline conditions. With this data, one can then remove the WWTP influence from the co-digestion flow and gas production to determine the portion of the combined biogas which can be attributed to the SSO component of the digester feed.

As shown in Table 7, the municipal ("WWTP") component of the digester feed stream yielded volatile solids reduction (VSR) of approximately 64-percent and biogas production of approximately 14.5 cubic feet of biogas per pound of VSR. These numbers are typical of traditional mesophilic digestion and in-line with historical values observed at the GLSD facility. Following the addition of SSO to the digester feed, the system yielded a 79-percent increase in gas production (see Table 6) with 59-percent increase in total volatile solids loading. This net co-digestion biogas production calculates out to a production rate of 14 cubic feet of biogas per pound of VSR.

When the WWTP influence in the biogas production is removed from the total "pilot" data based on the above factors, it was determined that the net influence of the SSO on biogas production is likely on the order of 14 cubic feet of biogas per pound of VSR. This value is very close to the assumed mi-range estimate of prior projections completed during design (see Table 2-4 from Preliminary Design Report dated April 2015). It should also be noted that, based on the GLSD sampling and data collection, <u>the biogas production per gallon of SSO is approximately five times higher than that of the municipal biosolids flow under present conditions</u>.

Table 7: Biogas Production Analysis

		Baseline 2/4/16 - 2/4/17	Pilot 2/14/18 - 5/14/18	% Change
WWTP FEED	Volume (gal/day)	165,000	129,000	-22%
	Percent Solids (%)	4.3%	5.8%	35%
	Dry Weight (lb/day)	59,000	62,200	5%
	VSS (%)	80.3%	83.3%	4%
	VSS Dry Weight (lb/day)	47,400	51,800	9%
	VSS Reduced (using baseline VSR)	30,500	33,300	9%
SSO FEED	Volume (gal/day)	-	21,900	-
	Percent Solids (%)	-	14.1%	-
	Dry Weight (lb/day)	-	25,800	-
	VSS (%)	-	91.8%	-
	VSS Dry Weight (lb/day)	-	23,700	-
	SSO VSR (lbs)	-	22,000	-
	SSO VSR (%)	-	93%	-
TOTAL FEED	Volume (gal/day)	165,000	151,000	-8%
	Dry Weight (lb/day)	59,000	88,000	49%
	VSS Dry Weight (lb/day)	47,400	75,500	59%
DIGESTATE	Total Solids (%)*	2.08%	3.03%	46%
	Dry Weight (lb/day)*	28,500	32,600	14%
	VSS (%)	69.7%	67.3%	-3%
	VSS Dry Weight (lbs/day)	19,900	22,000	11%
TOTAL PRODUCTION	VSS Reduced (lb/day)	30,500	55,300	81%
	VSS Reduction (%)	64.3%	73.3%	14%
	Overall Solids Reduction (%)	48.3%	52.5%	9%
	VSS Loading (lbs VSS/cf/day)	0.12	0.19	58%
	Detention Time (days)	18.4	20.1	9%
	Total Biogas Production (cf/day)	441,000	789,000	79%
	Total Biogas Production (cf/lb VSR)	14.5	14.3	-1%
UNIT PRODUCTION	WWTP Biogas (Using baseline production rate)	441,000	482,000	9%
	WWTP Biogas production rate (cf/lb VSR)	**14.5**	**14.5**	0%
	WWTP Biogas production rate (cf/gal)	2.68	3.73	39%
	SSO Biogas	-	307,000	-
	SSO Biogas production rate (cf/lb VSR)	**-**	**13.9**	-
	SSO Biogas production rate (cf/gal)	-	14	-

* Back-calculated from centrifuge cake and centrate solids data as data was inconsistent between digester contents and centrifuge feed

5.0 Downstream Process Monitoring

5.1 Dewatering, Centrate Quality and Thermal Drying

Table 8 includes a summary of dewatering and centrate data from the selected baseline and pilot period while Attachment D includes charts of the entire dataset.

Table 8: Dewatering and Centrate Sampling Results

	Parameter	Baseline 2/4/16 - 2/4/17	Pilot 2/14/18 - 5/14/18	% Change
Feed	Dewatering Feed (KGal)	176	164	-7%
	Dewatering Feed Sludge (%)	2.03	2.43	20%
	Dewatering Feed Solids from WWTP (DT/day)***	14.3	14.4	1%
	Dewatering Feed Solids from SSO (DT/day)***	0.00	1.89	-
	Total Dewatering Feed Solids (DT/day)	14.3	16.3	14%
Operations and Discharge	Dewatering Polymer Total (lbs)	440	424	-4%
	Dewatering Run Time (Hours)	84,400	93,100	10%
	Dewatering Discharge % Solids (%)	24.7	26.3	6%
	Dewatering Discharge (Wet Tons/day)	55.0	59.0	7%
	Dewatering Discharge (Dry Tons/day)	13.6	15.5	14%
Centrate	Centrate TSS (mg/l)	994	1,250	25%
	Centrate Ammonia (NH3) (mg/l)*	888	1,150	30%
	Centrate Phosphorus (T-PO4) (mg/l)*	105	108	3%
	Centrate TKN (mg/l)*	981	1,300	32%
	Centrate Calcium (mg/l)**	61.9	30.4	-51%
	Centrate Magnesium (mg/l)**	22.4	8.4	-63%
	Centrate Phosphorus-T (mg/l)**	69.3	47.3	-32%
	Centrate Potassium (mg/l)**	127	267	110%
	Centrate Sodium (mg/l)**	149	311	108%
	Centrate Chloride (mg/l)**	385	745	93%
	Centrate Sulfate (mg/l)**	16.2	6.2	-62%
	Centrate Manganese (mg/l)**	120.6	0.2	-100%
	Centrate Iron (mg/l)**	15.0	0.3	-98%

* Based on limited data set
** Centrate baseline data sampling began September 2017
*** Division of dewatering solids sources based on volatile solids reduction calculations and assumptions noted in Table 7

Though many of the dewatering-related parameters are based on limited data and definitive patterns difficult to discern, it is important to note that the solids processed increased approximately 14% between baseline and the pilot period. The current data suggests a slight improvement in dewatering (6% increase in cake solids concentration), but these results would require additional data prior to forming conclusion regarding the impact of co-digestion on this portion of the solids process. However, it should be noted that recent research completed at Bucknell University has shown improved dewaterability of co-digested solids when compared to traditional biosolids which is in line with the trend displayed by the current GLSD data.

The centrate quality in terms of TSS concentration increased by 25%, but is still within a reasonable value for return strength and should not adversely impact the liquid train processes. Centrate ammonia and phosphorus data was also collected, but the limited current data set on these parameters are not statistically significant. Due to the interest in these two parameters as it pertains to impacts to the liquid treatment process at the facility and any potential future nutrient discharge limits.

Data as to the quality of the thermal drying pellet quality also continues to be collected. However, initial indications are that there have been no significant changes to the overall pellet quality (apart from the previously discussed impacts on total dry tons processed). However, it has been noted by the present operator of that facility that the density of the pellets has decreased slightly (38-40 lb/cf previously - now 35-37 lb/cf), though it remains to be determined whether this is an impact of co-digestion or other factors.

6.0 Summary

Overall, as noted in the above referenced data, the Organics to Energy pilot program has shown that co-digestion at the GLSD facility is both viable and has the ability to recover significant energy in the form of biogas. As of the date of this memorandum, the SSO flow to the digestion system accounts for approximately 15-percent of the total flow and approximately 30-percent of the total solids loading to the digestion system. As a result of this added loading, the biogas production is 179% over baseline conditions while the total dry tons of cake sent to pelletizing has increased by 14-percent. The biogas production rate (14 cf/lb. VSR) for the SSO calculated based on this data set is very close to the basis of design for the full-scale project and represents a significant increase in gas production over that produced from a similar volume of WWTP solids (5X gas production from SSO on a per gallon basis).

In terms of overall process considerations, the digestion system has remained stable and shown no adverse process impacts resulting from the introduction of SSO material. Similarly, biosolids processing systems have shown no adverse impacts from the introduction of SSO material to the solids processing train. Based on the results of the program, it is expected that the digestion process will remain stable as the District proceeds with the planned increase in SSO loading to the system and that actual biogas production rates will be similar to the biogas production rates used as the basis of design for biogas conveyance and treatment systems.

However, despite the promising results represented in the initial data set, it is important to note that the "pilot" data is based on a 3-month period selected where SSO feed rates were generally equal or greater than 20,000 gallons per day. Further, the results for many of the parameters during this period are based on a limited number of data points and some meters containing potential error (e.g. digester feed flow values as noted in Table 4) which creates the potential for premature or inaccurate conclusions to be drawn from the present data. As a result, it is recommended that the current robust sampling and analysis program currently being completed by GLSD continue and that the data be reexamined at a later date when SSO flows are a greater percentage of the total digestion feed and when a larger data set is available for analysis.

Attachment A

Pilot Program Sampling Schedule

Revised 5/24/16

Proposed PSSO Monitoring

Yellow Highlight Indicates Baseline Testing (4 weeks) prior to any PSSO acceptance.

	Pilot Frequency	Longterm Frequency
1.) Testing of actual PSSO (at generation site)		
Supplier: pH, % Solids, % VS, TSS, COD, screened <8 mm	ea. Load	weekly
Supplier: AOS/503 parameters, TON(TKN-NH3), Phosphorus(T-PO4), Potassium and Local Limits	prior to 1st delivery	monthly
Testing of actual PSSO Received (each delivery)		
GLSD: Each load to be sampled by GLSD receiving Operator Check and Verification of C.O.A. on-site	ea. Load	ea. Load

2.) Process Control Testing - Agreed number of samples/week

Daily first 4 weeks; then 4 days/wk a single composite of both. And 1 day/wk both individually. (applies to Digester 1 and Digester 2)

Location→ / Parameter↓	Trucked PSSO Material	PSSO Waste Pilot Tank	Blend Tank/ Digester Feed	Digester 1	Digester 2	Digester Composite	Centrifuge Feed	Centrate	4 weeks Total # Samples	Duration Total # Samples
% Solids (TS)	7	7	7	7	7	4	2	2	39	31
TSS (diluted)	7	7	7	7	7	4	2	2	39	31
%VS	7	7	7	7	7	4	2	2	39	31
VA	7	7	7	7	7	4			35	27
Alkalinity	7	7	7	7	7	4			35	27
pH	7	7	7	7	7	4			35	27
COD, Total	2	5	5	2	2		2	2	20	18
COD,Soluble	2	2	2	2	2				10	10
Ammonia(NH3)		1	1	2	2		2	2	10	10
TKN*								2	2	2
SO4*	1								1	1
H2S*				2	2				4	4
Phosphorus (T-PO4)		1	1				2	2	6	6
Ion Chrom.							1		1	1
								SUBTOTAL:	276	226

Green- GLSD to explore digestion procedure for NH3

* Subcontracted

2.) **Process Control Testing - Agreed** ***CONTINUED***

number of samples/week

Location→ / Parameter↓	Influent Comp	Primary Effluent	One A.T. "B" Zone	WAS/RAS	TPS	GBT Filtrate	NEFCO Return	Total # Samples
Phosphorus (T-PO4)	1	1	1	1	1	1	1	7
Ammonia(NH3)	1	1	1	1	1	1	1	7
NO3/NO2 *	1	1						2
COD, Total	1	1		1	1			4
TVSS	1							1
Filament I.D.				1				1
Ortho Phosphate			1					1
TSS						5		5
TKN*	1	1	1					3
							SUBTOTAL:	**31**

* subcontracted

Green GLSD to explore digestion procedure for NH3

Baseline Total: **137**

GRANDTOTAL: first 4 wks. 307

next 5 mo.'s 257

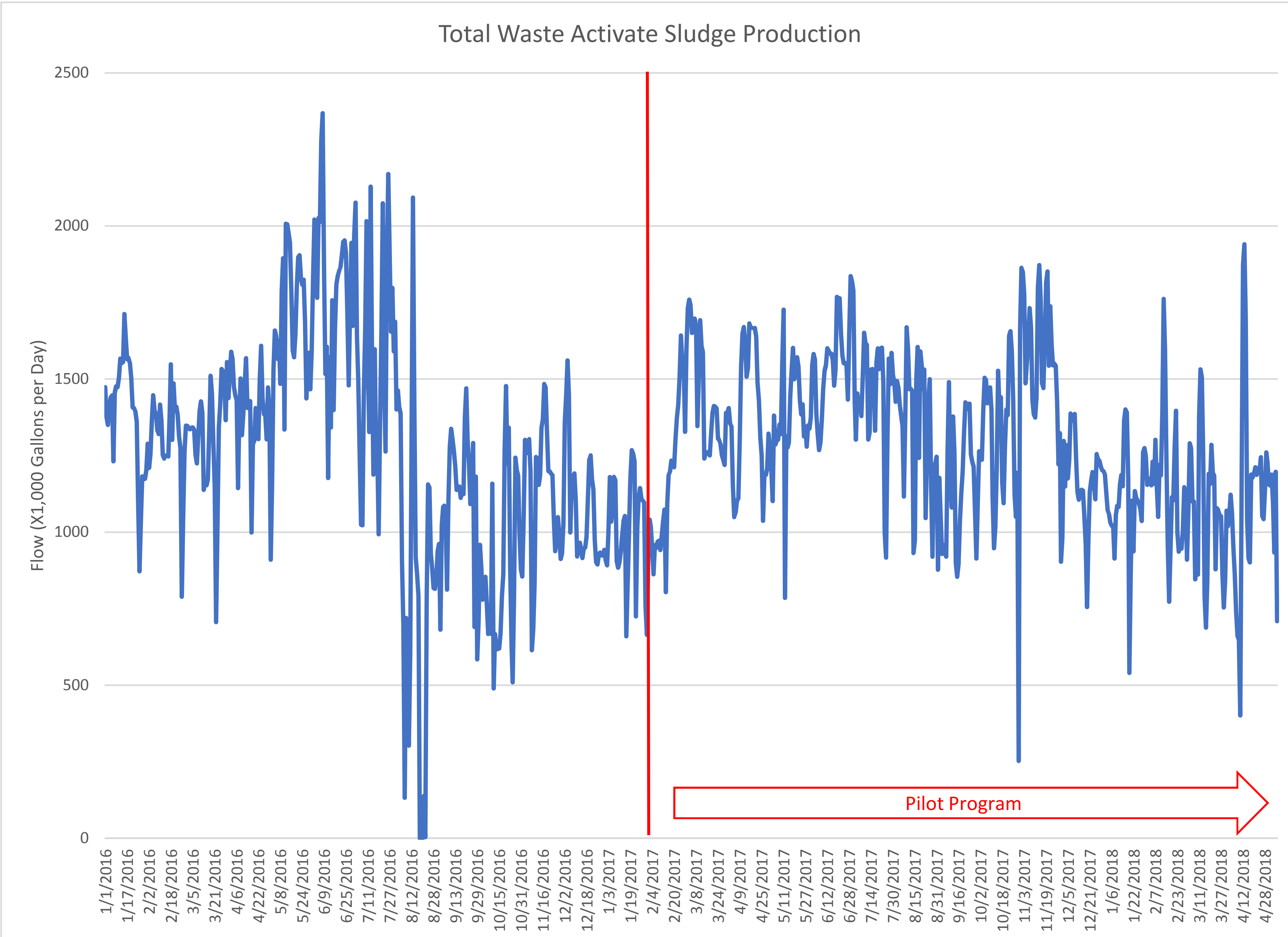
3.) **Digester Gas Testing:**

H2S, Natural Gases, Siloxanes via tedlar bag - Now for Baseline. Again if new sample tap installed. Then 6 weeks into Pilot Program

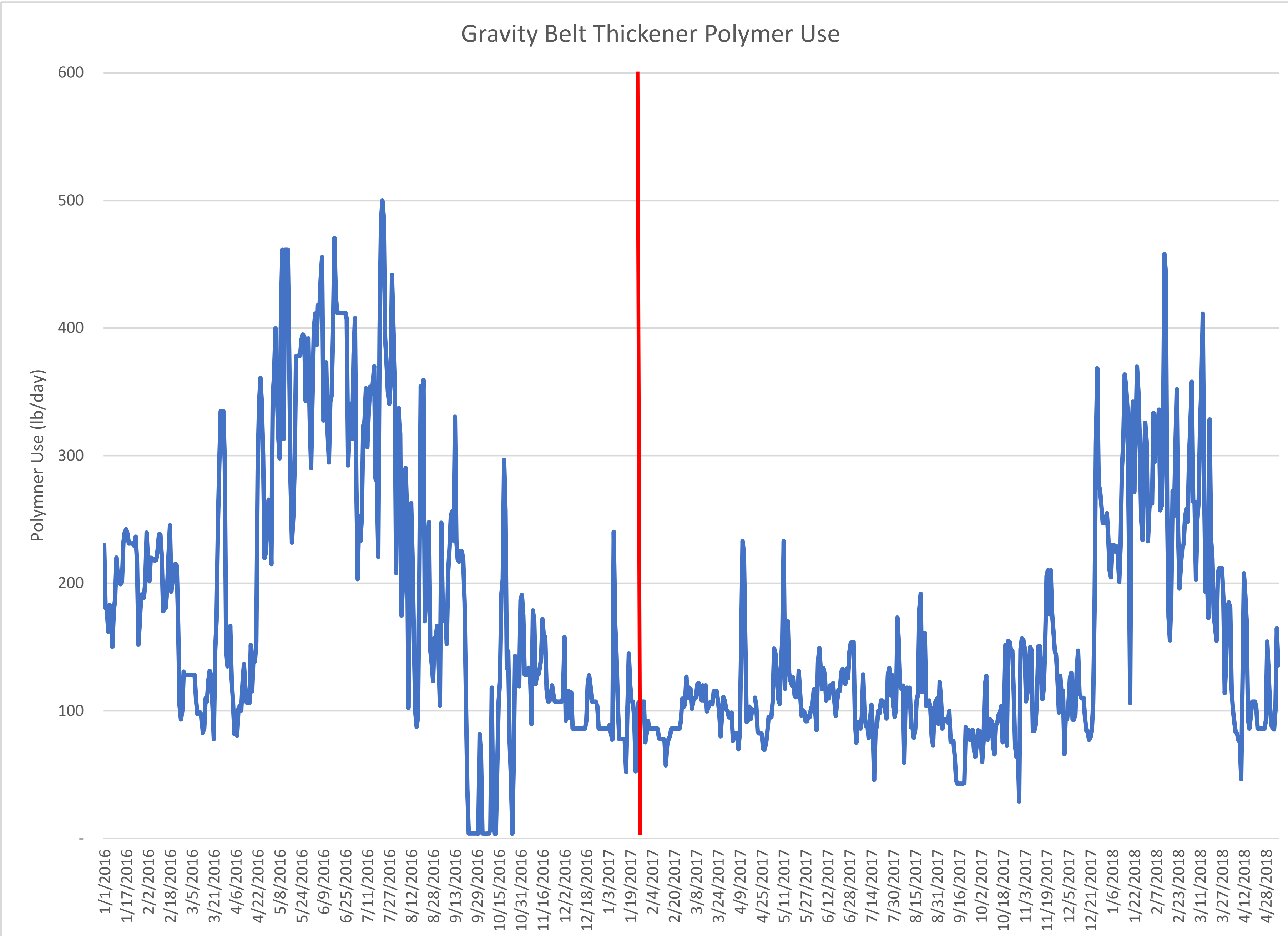
GLSD to purchase a portable gas meter for Methane, H2S, CO2

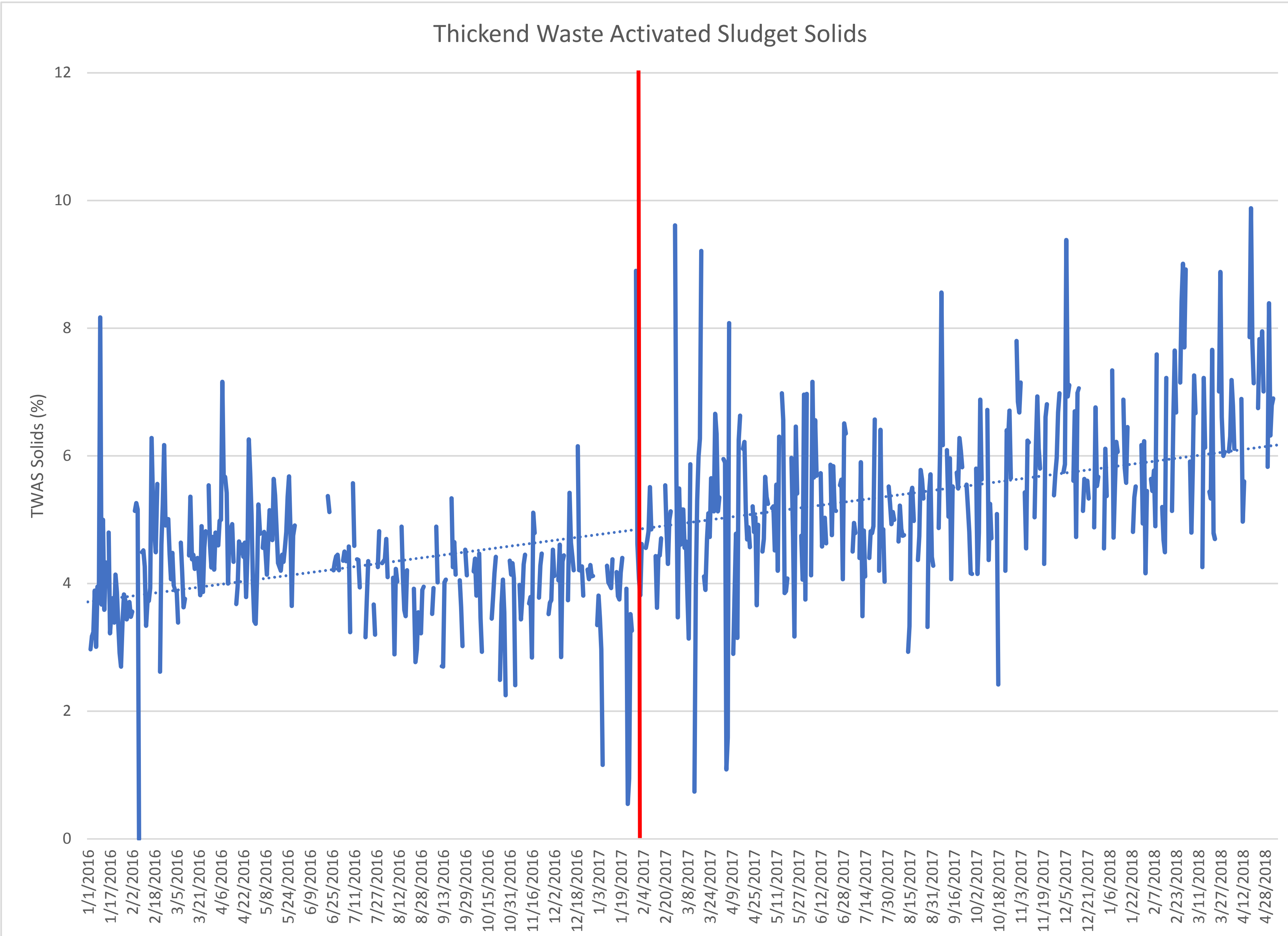
Attachment B

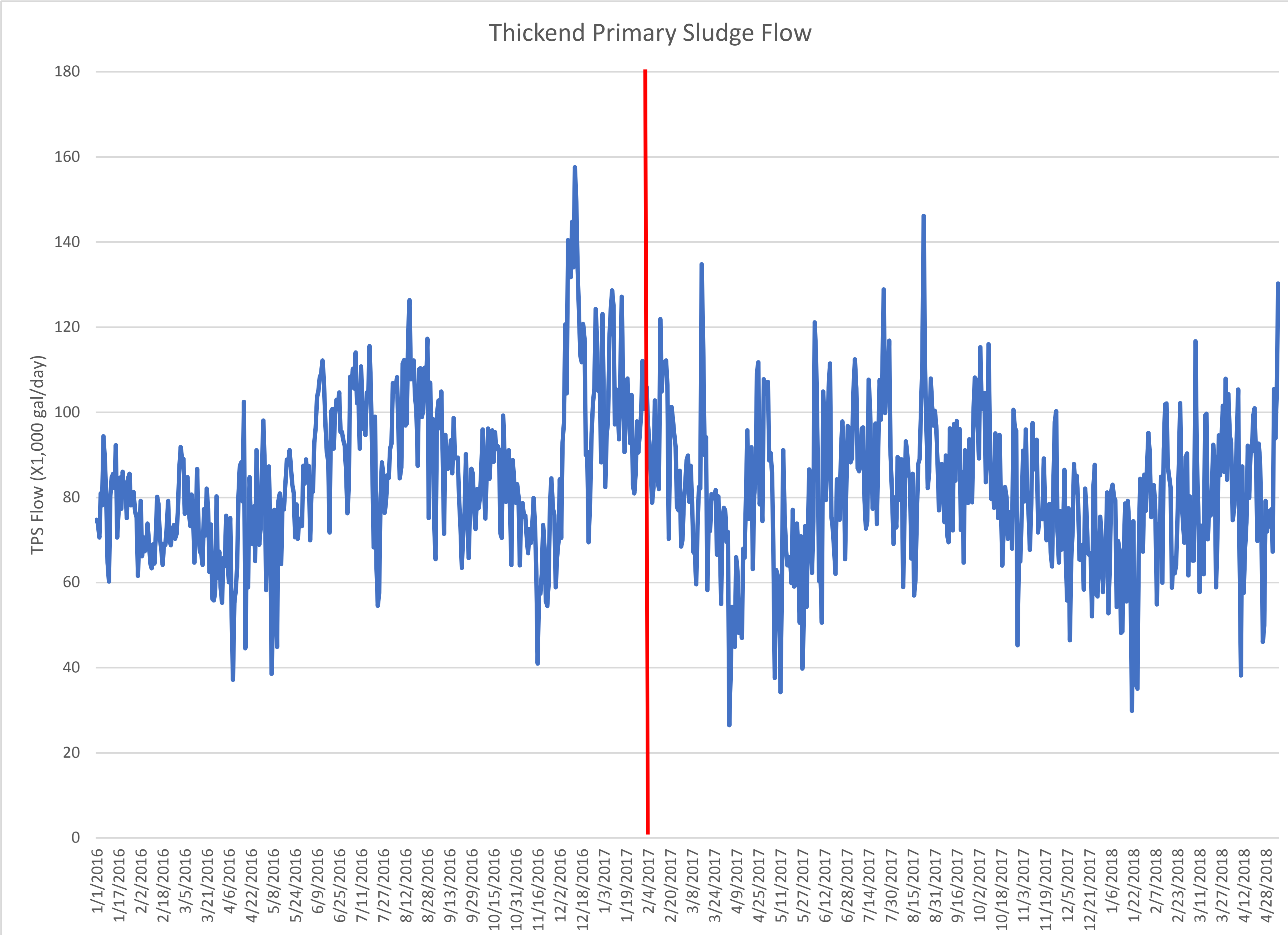
Digester Feed Data

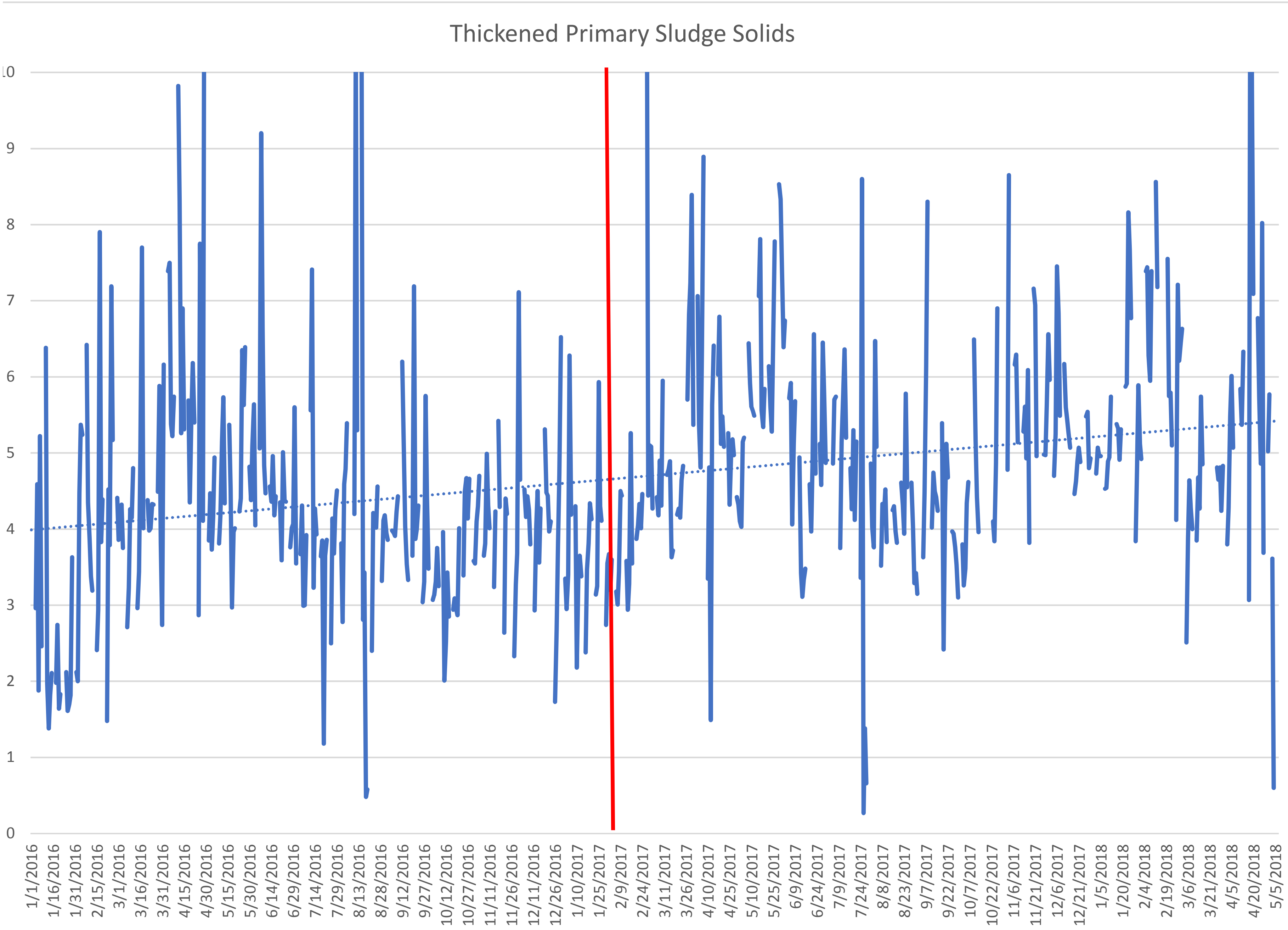


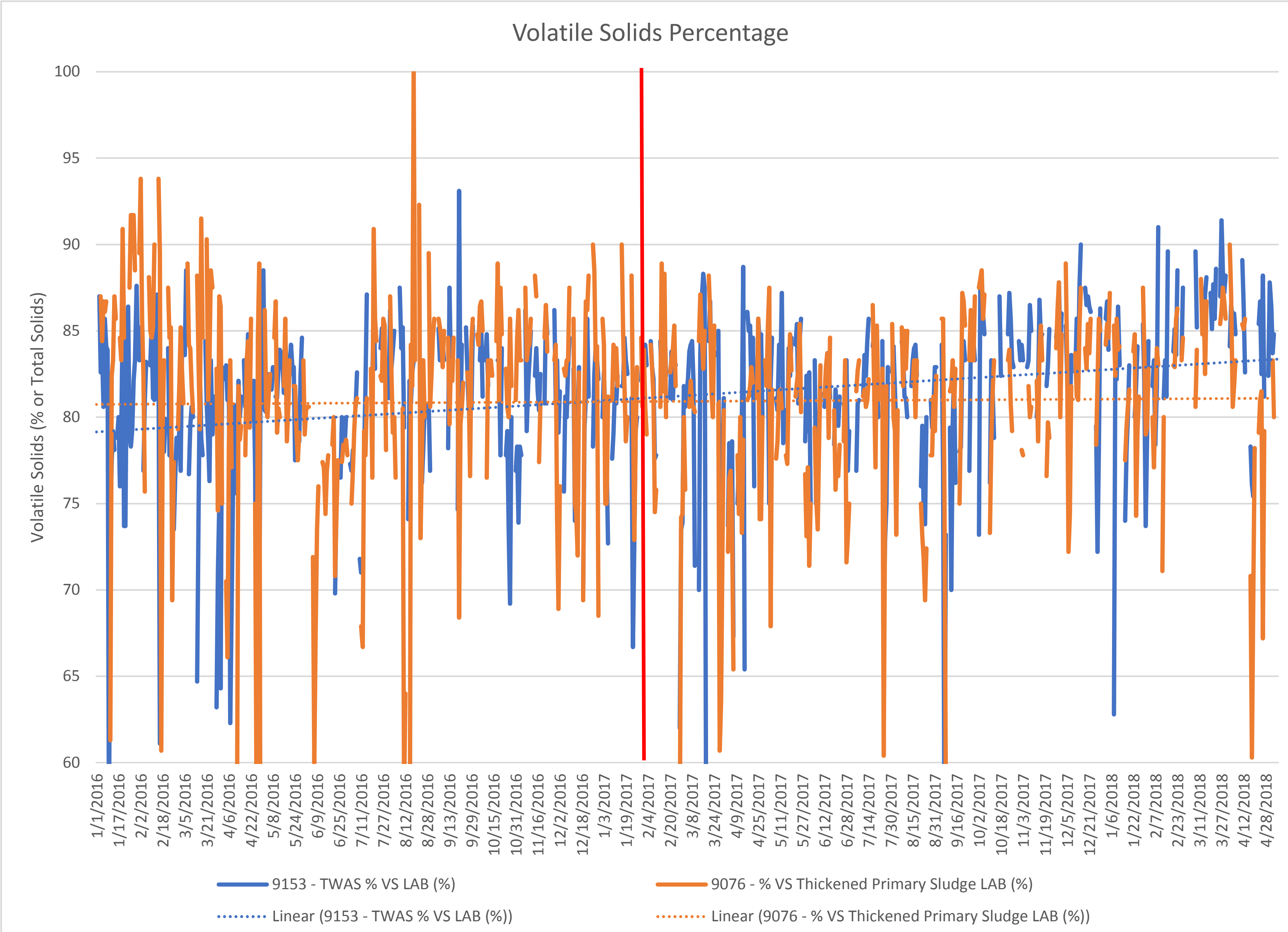
Total Waste Activate Sludge Production
Flow (X1,000 Gallons per Day)
2500
2000
1500
1000
500
0
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018
Pilot Program


Gravity Belt Thickener Polymer Use
Polymner Use (lb/day)
600
500
400
300
200
100
-
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018

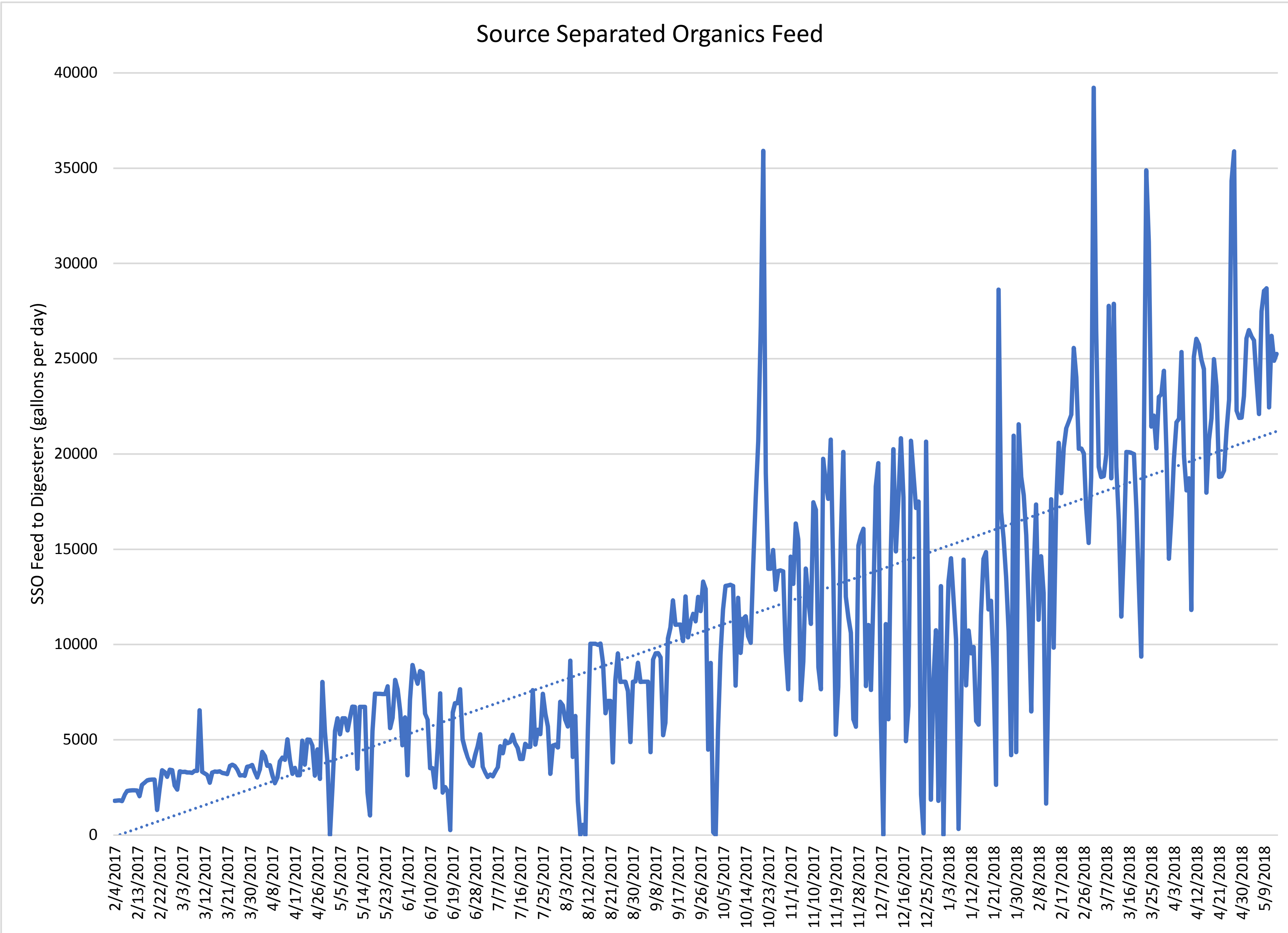

Thickend Waste Activated Sludget Solids
TWAS Solids (%)
0
2
4
6
8
10
12
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018


Thickend Primary Sludge Flow
TPS Flow (X1,000 gal/day)
180
160
140
120
100
80
60
40
20
0
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018

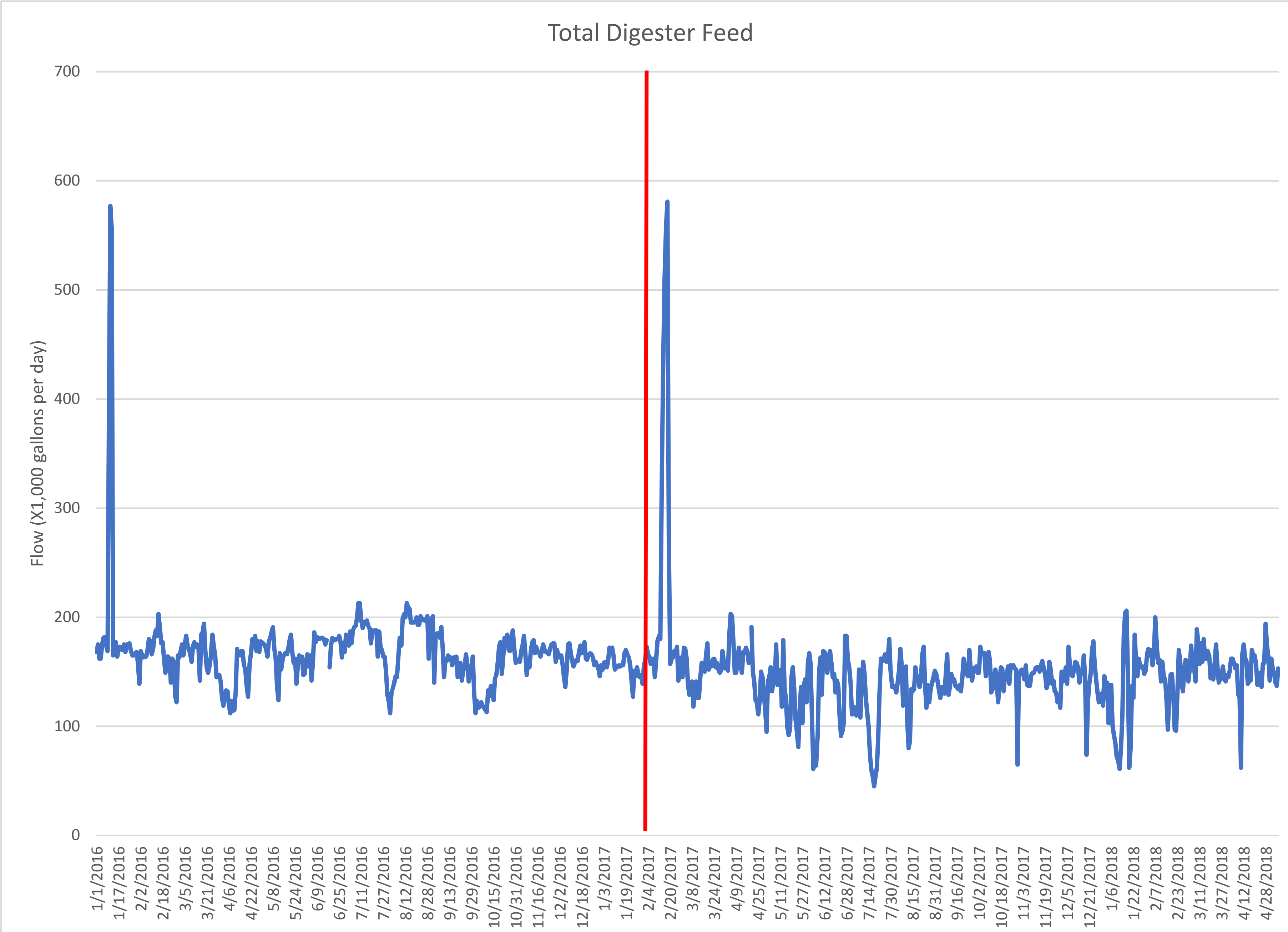

Thickened Primary Sludge Solids
10
9
8
7
6
5
4
3
2
1
0
1/1/2016
1/16/2016
1/31/2016
2/15/2016
3/1/2016
3/16/2016
3/31/2016
4/15/2016
4/30/2016
5/15/2016
5/30/2016
6/14/2016
6/29/2016
7/14/2016
7/29/2016
8/13/2016
8/28/2016
9/12/2016
9/27/2016
10/12/2016
10/27/2016
11/11/2016
11/26/2016
12/11/2016
12/26/2016
1/10/2017
1/25/2017
2/9/2017
2/24/2017
3/11/2017
3/26/2017
4/10/2017
4/25/2017
5/10/2017
5/25/2017
6/9/2017
6/24/2017
7/9/2017
7/24/2017
8/8/2017
8/23/2017
9/7/2017
9/22/2017
10/7/2017
10/22/2017
11/6/2017
11/21/2017
12/6/2017
12/21/2017
1/5/2018
1/20/2018
2/4/2018
2/19/2018
3/6/2018
3/21/2018
4/5/2018
4/20/2018
5/5/2018

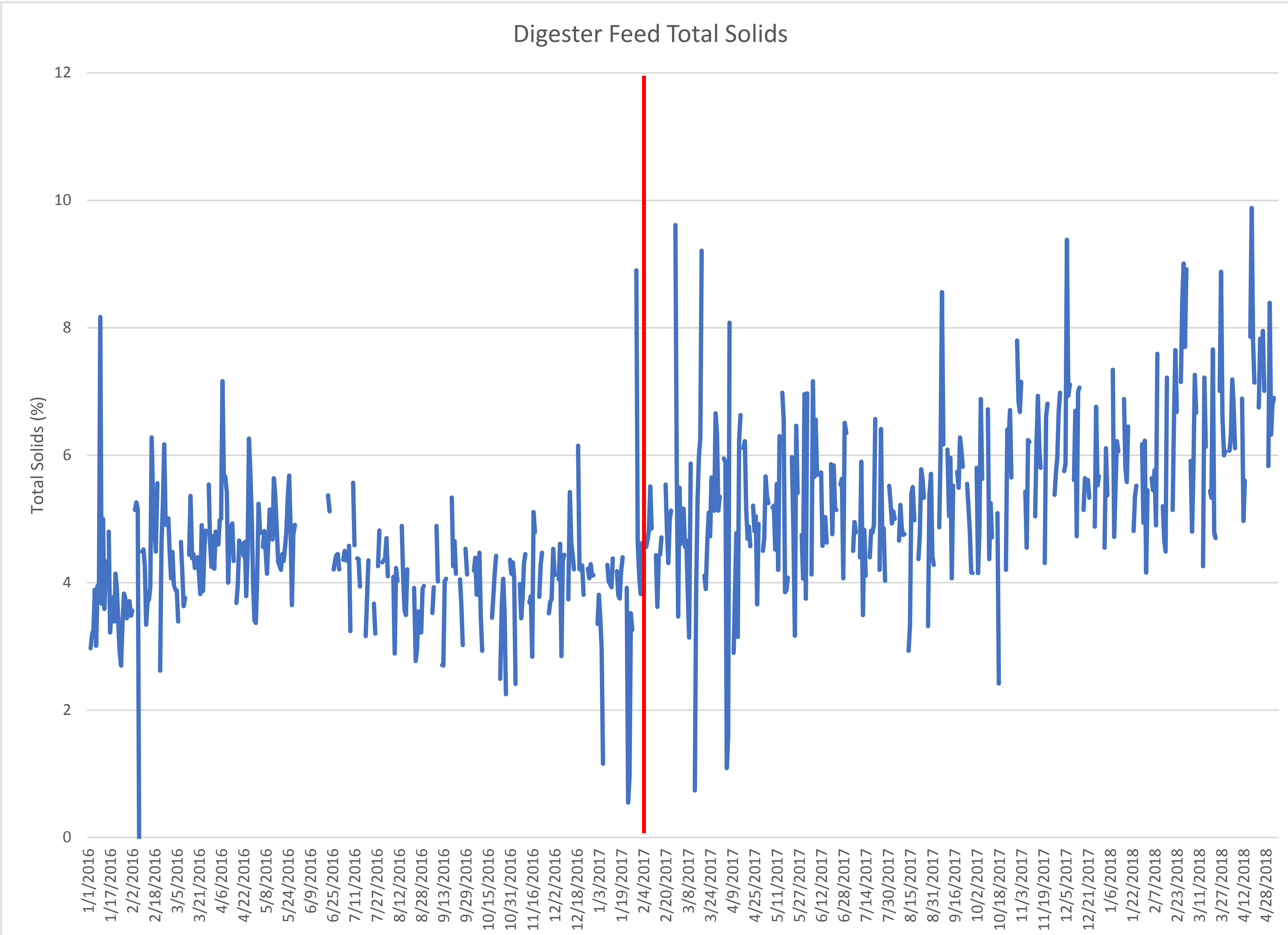


Volatile Solids Percentage
Volatile Solids (% or Total Solids)
100
95
90
85
80
75
70
65
60
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018
9153 - TWAS % VS LAB (%)
9076 - % VS Thickened Primary Sludge LAB (%)
Linear (9153 - TWAS % VS LAB (%))
Linear (9076 - % VS Thickened Primary Sludge LAB (%))

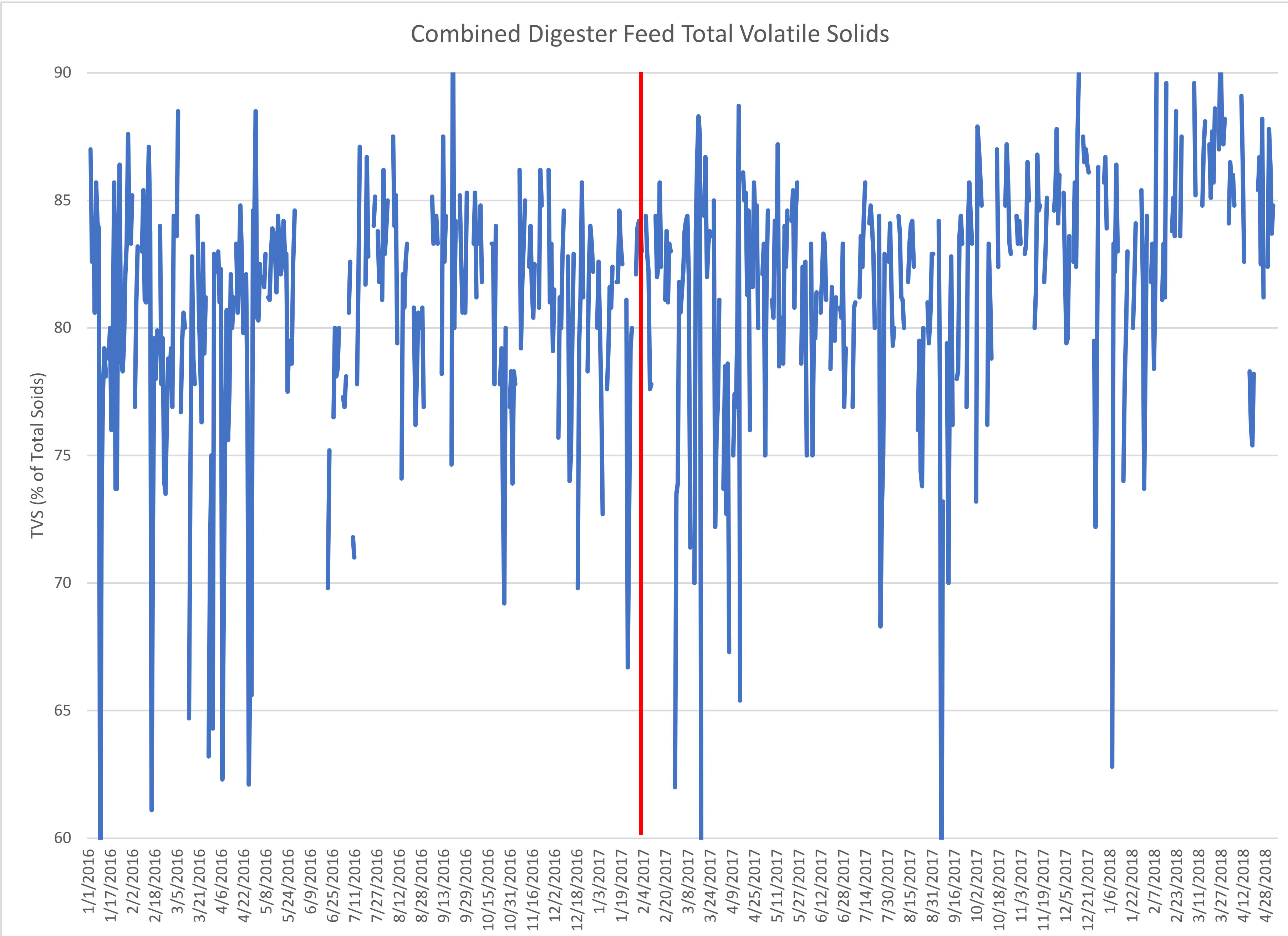


Source Separated Organics Feed
SSO Feed to Digesters (gallons per day)
40000
35000
30000
25000
20000
15000
10000
5000
0
2/4/2017
2/13/2017
2/22/2017
3/3/2017
3/12/2017
3/21/2017
3/30/2017
4/8/2017
4/17/2017
4/26/2017
5/5/2017
5/14/2017
5/23/2017
6/1/2017
6/10/2017
6/19/2017
6/28/2017
7/7/2017
7/16/2017
7/25/2017
8/3/2017
8/12/2017
8/21/2017
8/30/2017
9/8/2017
9/17/2017
9/26/2017
10/5/2017
10/14/2017
10/23/2017
11/1/2017
11/10/2017
11/19/2017
11/28/2017
12/7/2017
12/16/2017
12/25/2017
1/3/2018
1/12/2018
1/21/2018
1/30/2018
2/8/2018
2/17/2018
2/26/2018
3/7/2018
3/16/2018
3/25/2018
4/3/2018
4/12/2018
4/21/2018
4/30/2018
5/9/2018


Total Digester Feed
Flow (X1,000 gallons per day)
700
600
500
400
300
200
100
0
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018



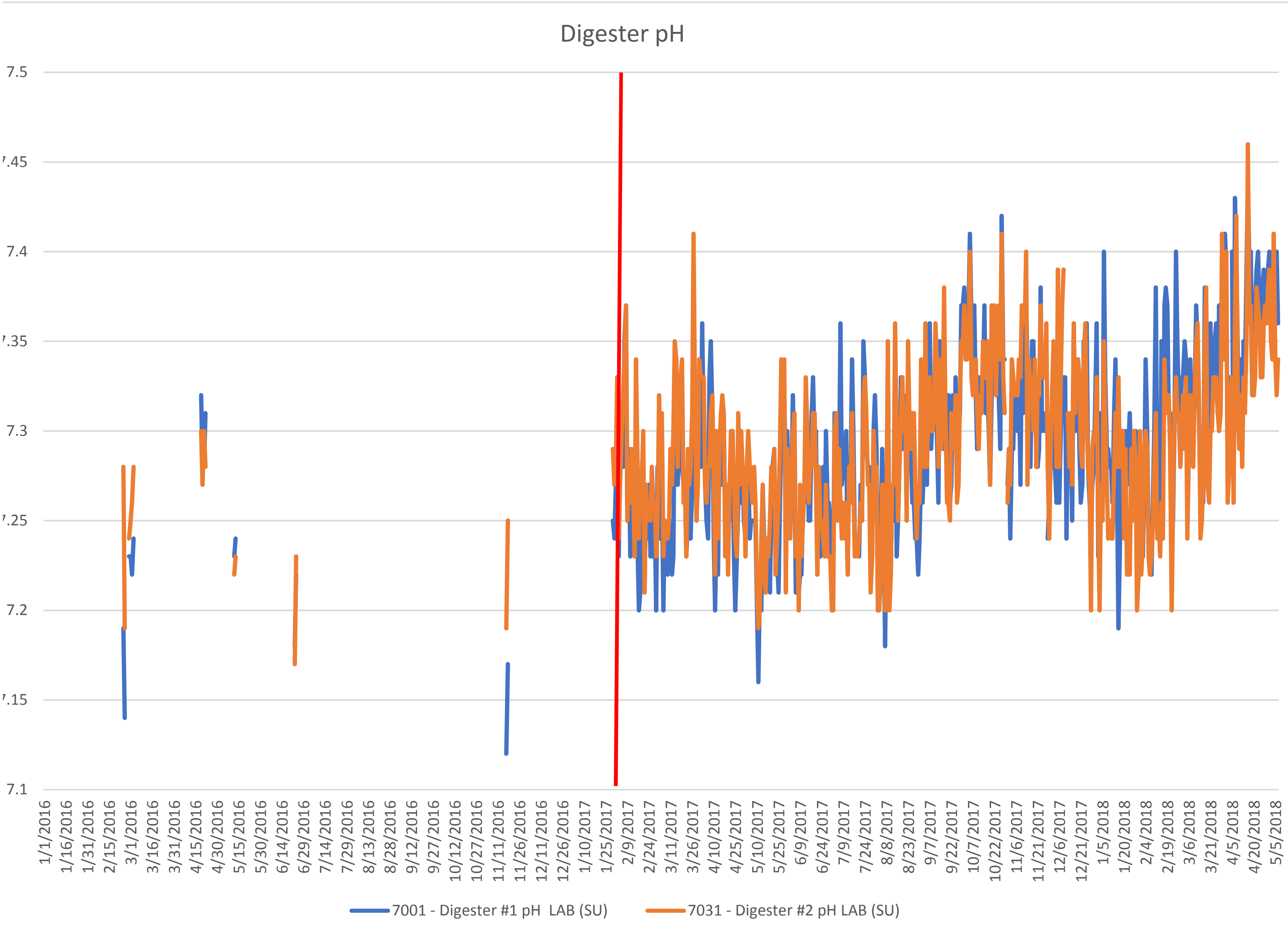
Digester Feed Total Solids
Total Solids (%)
0
2
4
6
8
10
12
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018



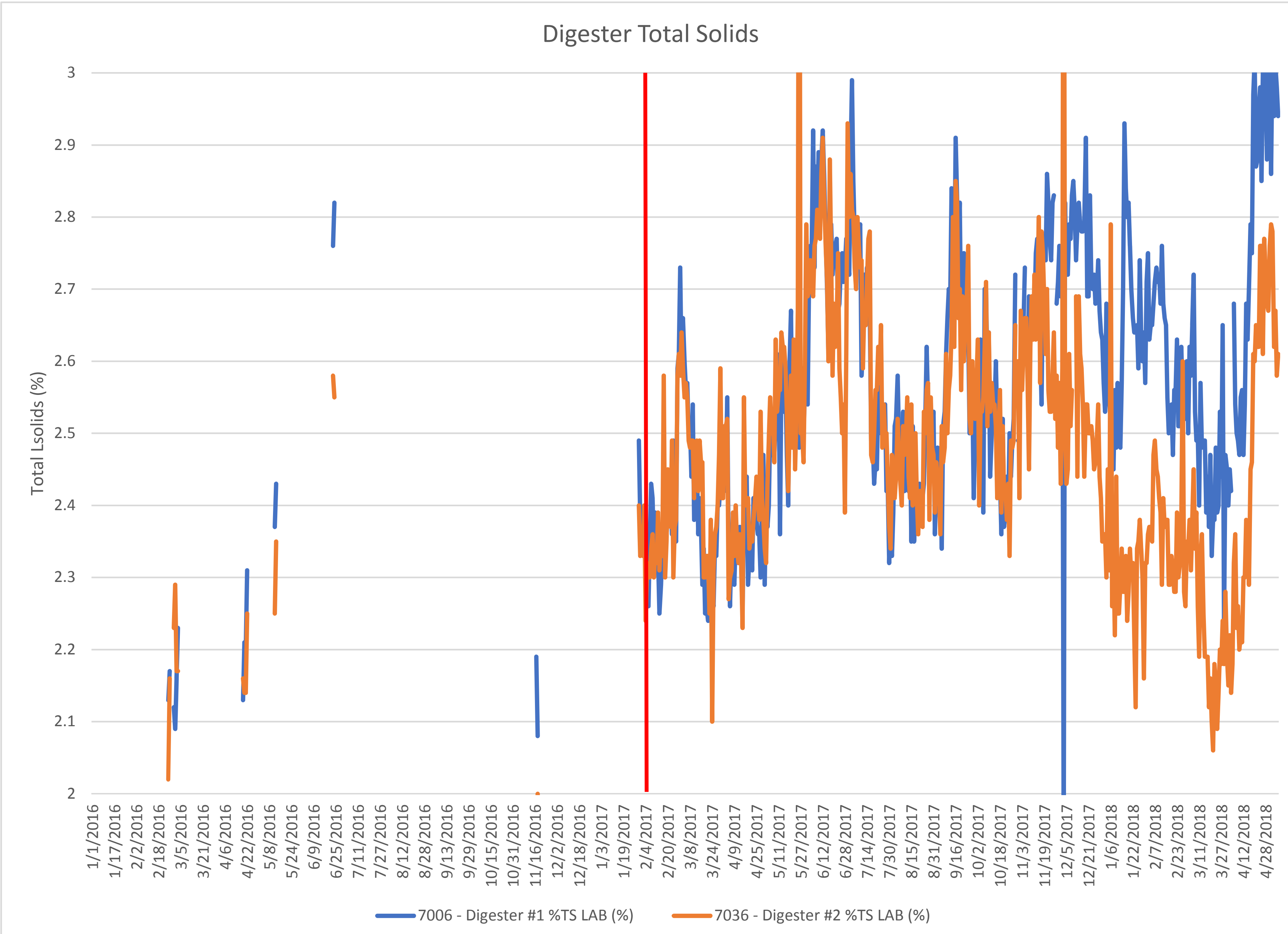
Combined Digester Feed Total Volatile Solids
TVS (% of Total Solids)
90
85
80
75
70
65
60
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018

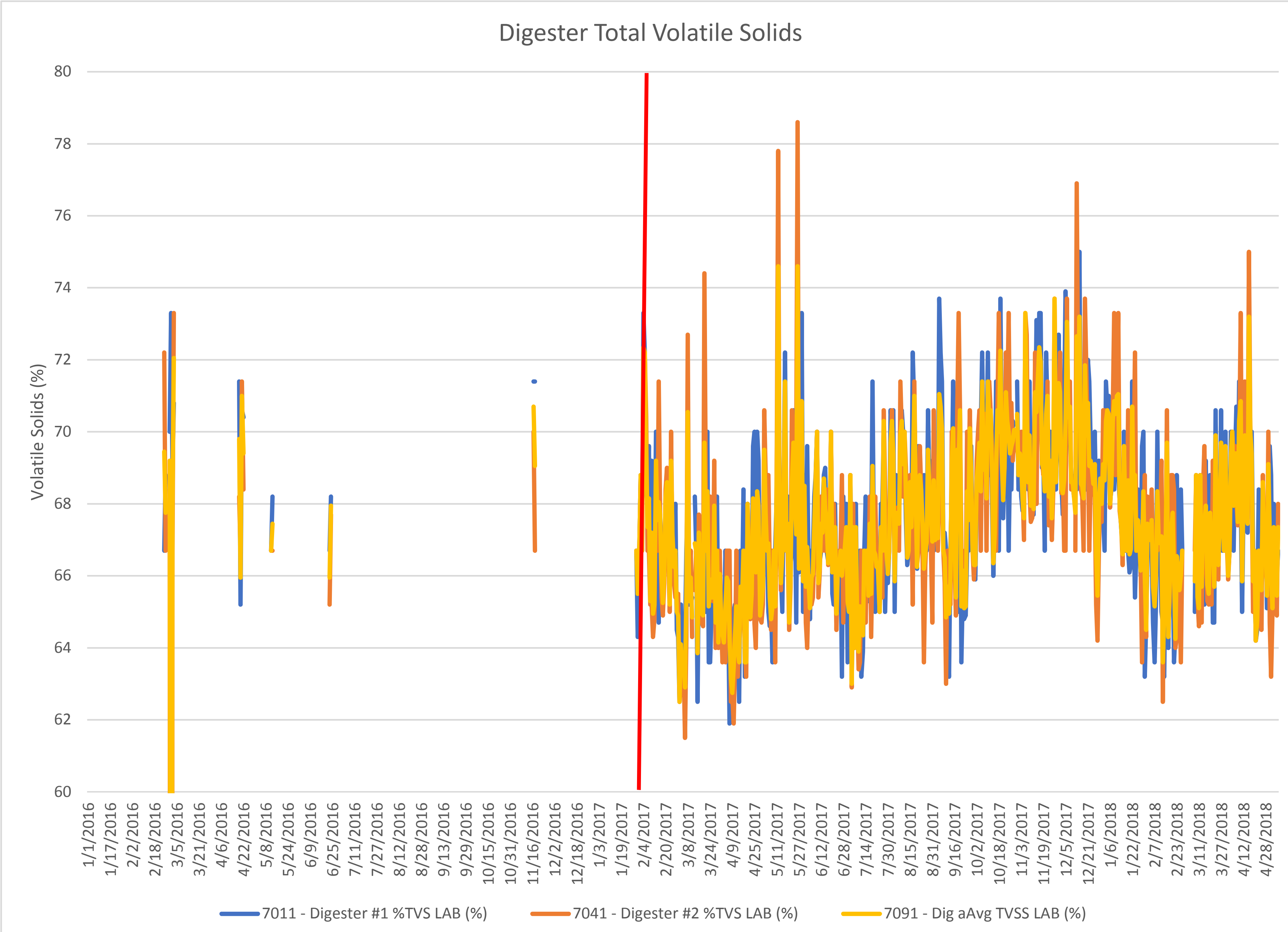
Attachment C

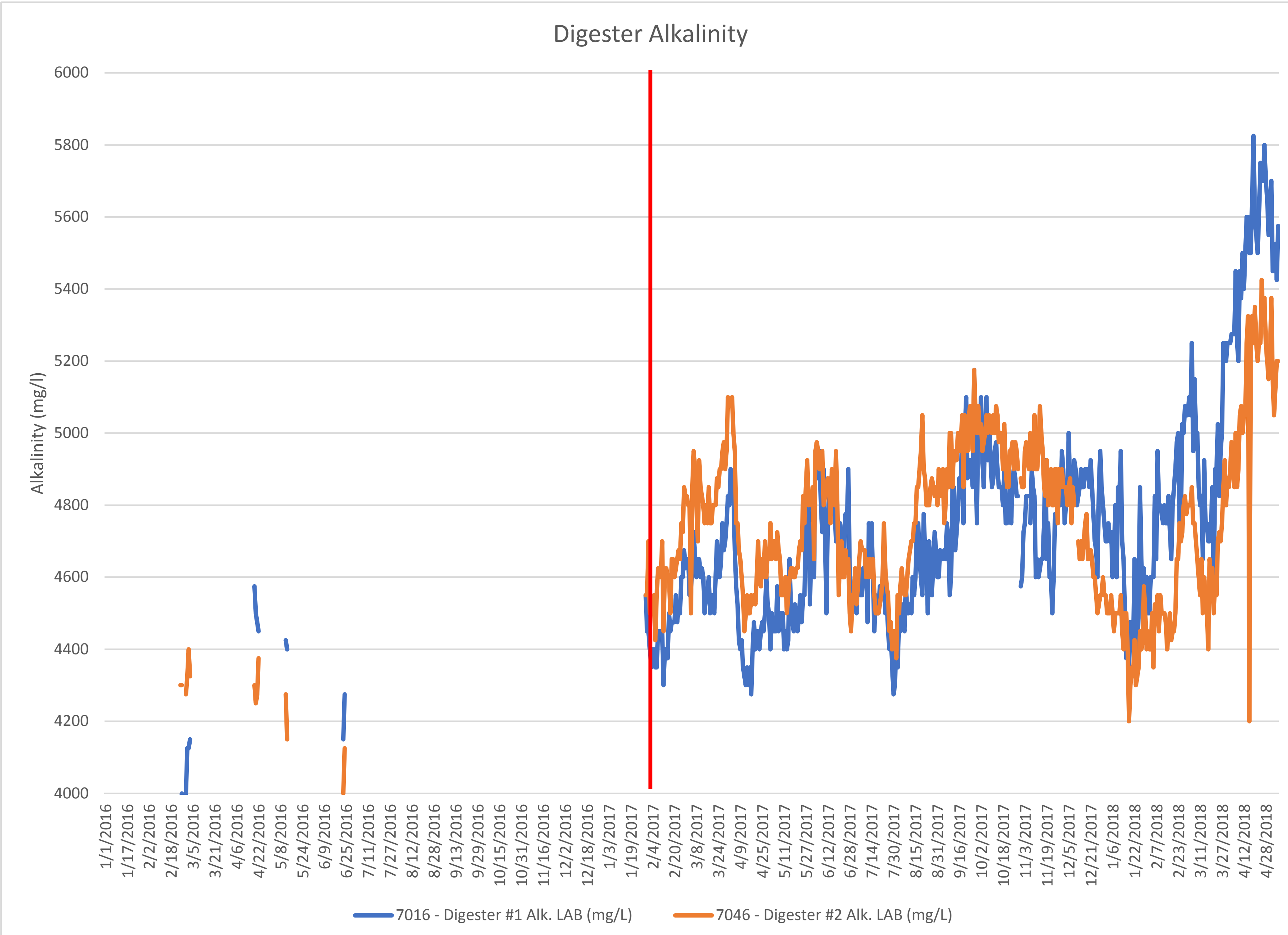
Digestion and Gas Production Data



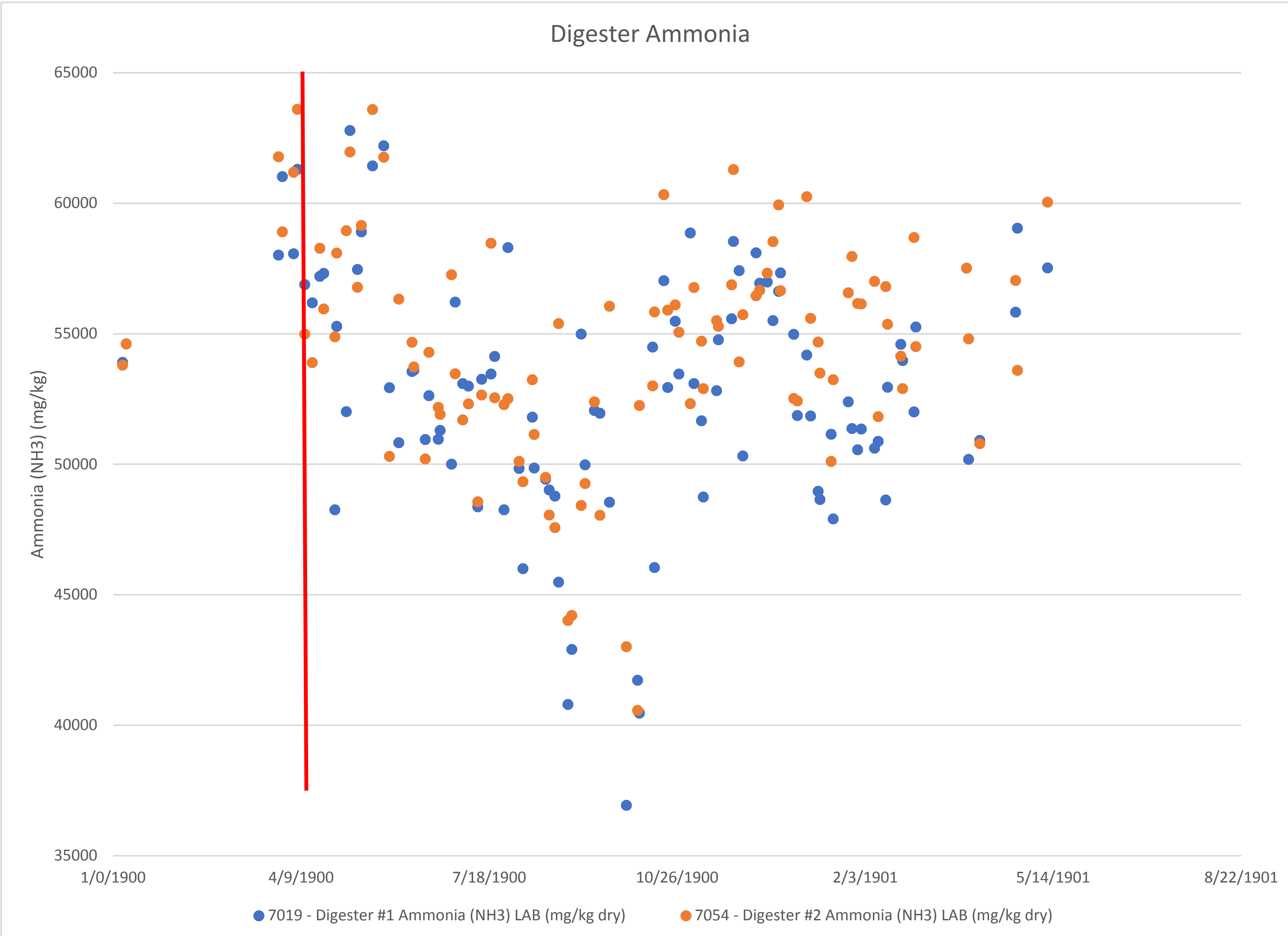
Digester pH
7.5
7.45
7.4
7.35
7.3
7.25
7.2
7.15
7.1
1/1/2016
1/16/2016
1/31/2016
2/15/2016
3/1/2016
3/16/2016
3/31/2016
4/15/2016
4/30/2016
5/15/2016
5/30/2016
6/14/2016
6/29/2016
7/14/2016
7/29/2016
8/13/2016
8/28/2016
9/12/2016
9/27/2016
10/12/2016
10/27/2016
11/11/2016
11/26/2016
12/11/2016
12/26/2016
1/10/2017
1/25/2017
2/9/2017
2/24/2017
3/11/2017
3/26/2017
4/10/2017
4/25/2017
5/10/2017
5/25/2017
6/9/2017
6/24/2017
7/9/2017
7/24/2017
8/8/2017
8/23/2017
9/7/2017
9/22/2017
10/7/2017
10/22/2017
11/6/2017
11/21/2017
12/6/2017
12/21/2017
1/5/2018
1/20/2018
2/4/2018
2/19/2018
3/6/2018
3/21/2018
4/5/2018
4/20/2018
5/5/2018
7001 - Digester #1 pH LAB (SU)
7031 - Digester #2 pH LAB (SU)

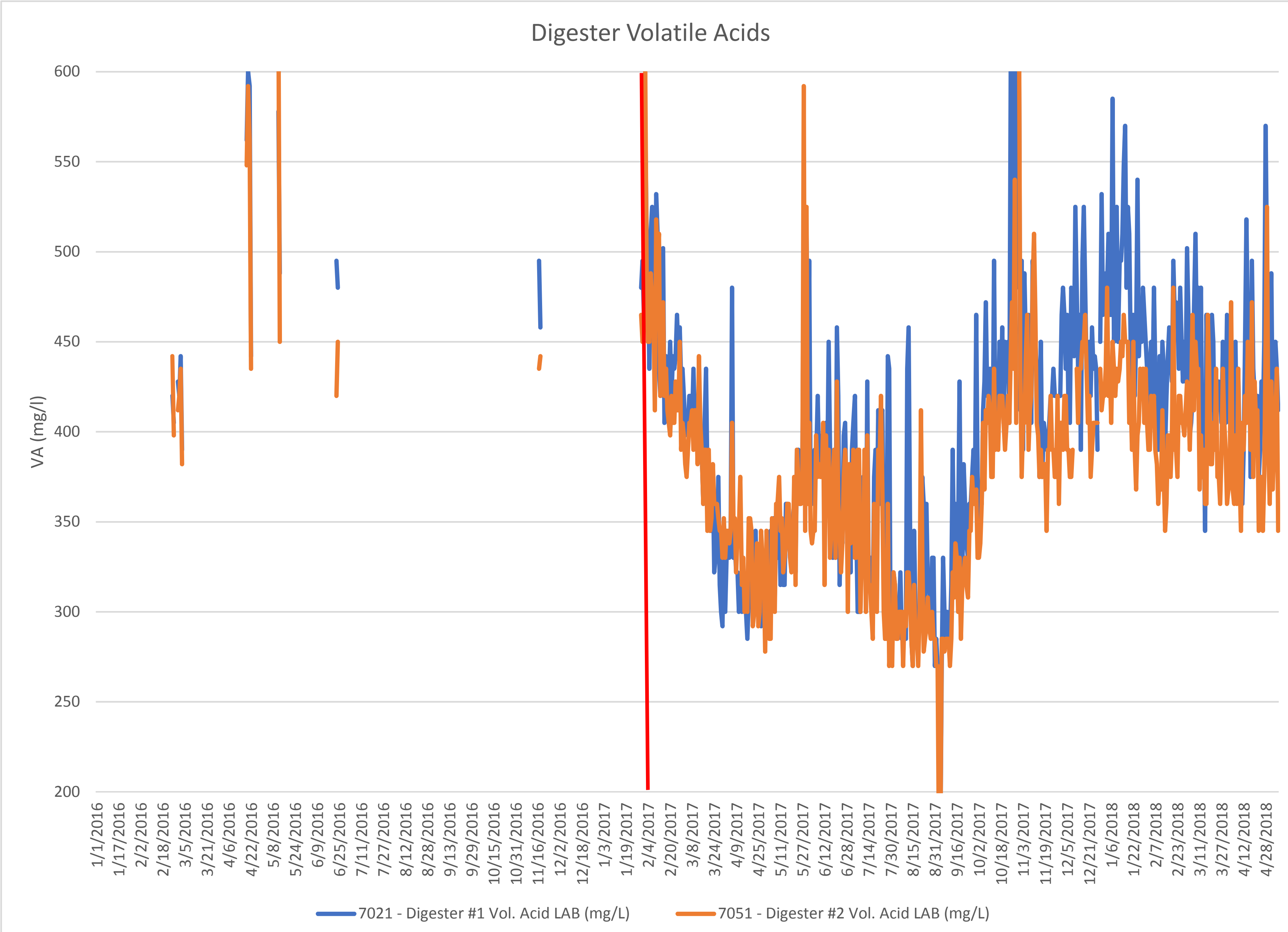

Digester Total Solids
Total Lsolids (%)
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018
7006 - Digester #1 %TS LAB (%)
7036 - Digester #2 %TS LAB (%)


Digester Total Volatile Solids
Volatile Solids (%)
80
78
76
74
72
70
68
66
64
62
60
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018
7011 - Digester #1 %TVS LAB (%)
7041 - Digester #2 %TVS LAB (%)
7091 - Dig aAvg TVSS LAB (%)

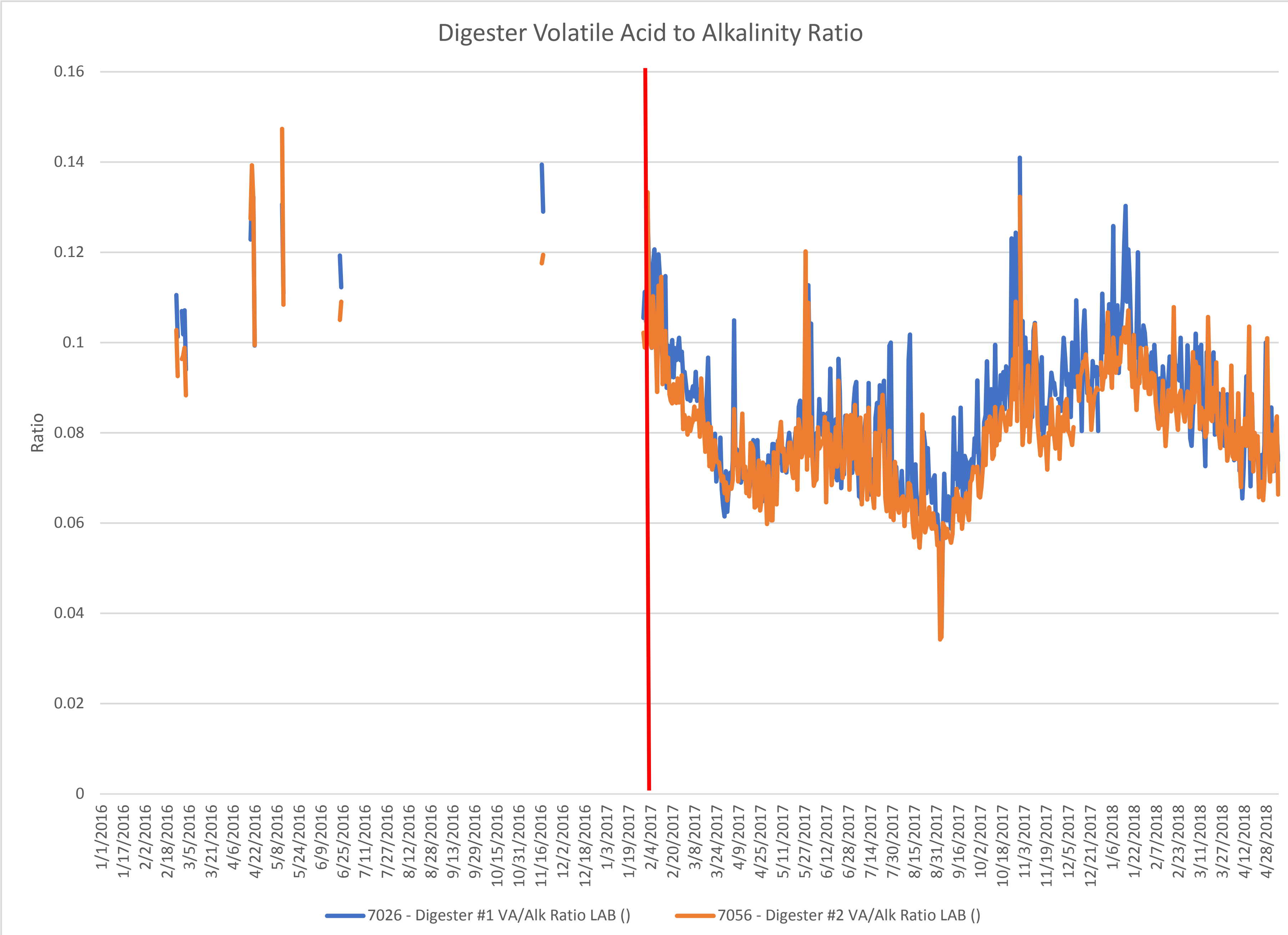


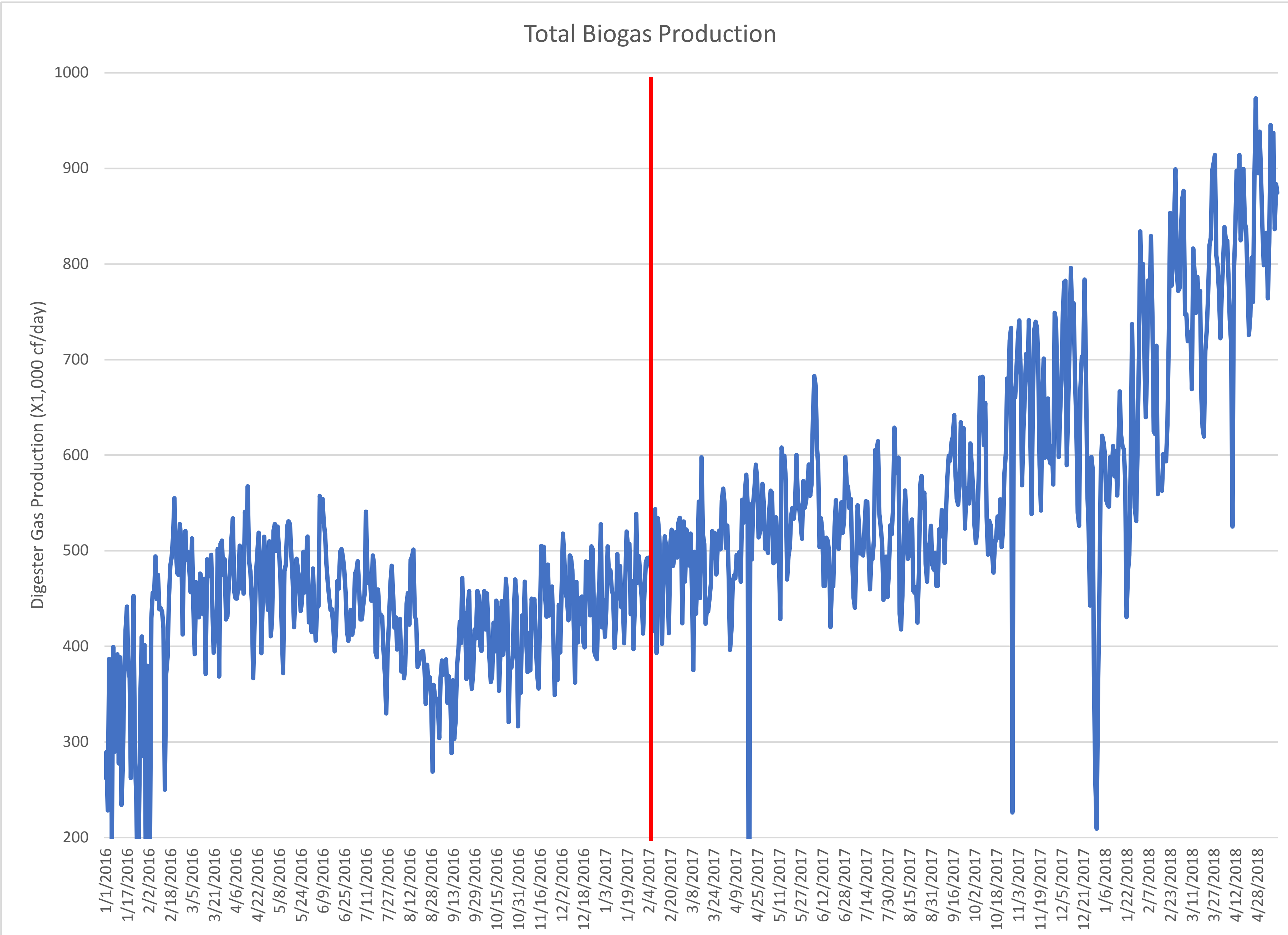
Digester Alkalinity
Alkalinity (mg/l)
6000
5800
5600
5400
5200
5000
4800
4600
4400
4200
4000
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018
7016 - Digester #1 Alk. LAB (mg/L)
7046 - Digester #2 Alk. LAB (mg/L)


Digester Ammonia
65000
60000
55000
50000
45000
40000
35000
Ammonia (NH3) (mg/kg)
1/0/1900
4/9/1900
7/18/1900
10/26/1900
2/3/1901
5/14/1901
8/22/1901
7019 - Digester #1 Ammonia (NH3) LAB (mg/kg dry)
7054 - Digester #2 Ammonia (NH3) LAB (mg/kg dry)



Digester Volatile Acids
VA (mg/l)
600
550
500
450
400
350
300
250
200
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018
7021 - Digester #1 Vol. Acid LAB (mg/L)
7051 - Digester #2 Vol. Acid LAB (mg/L)

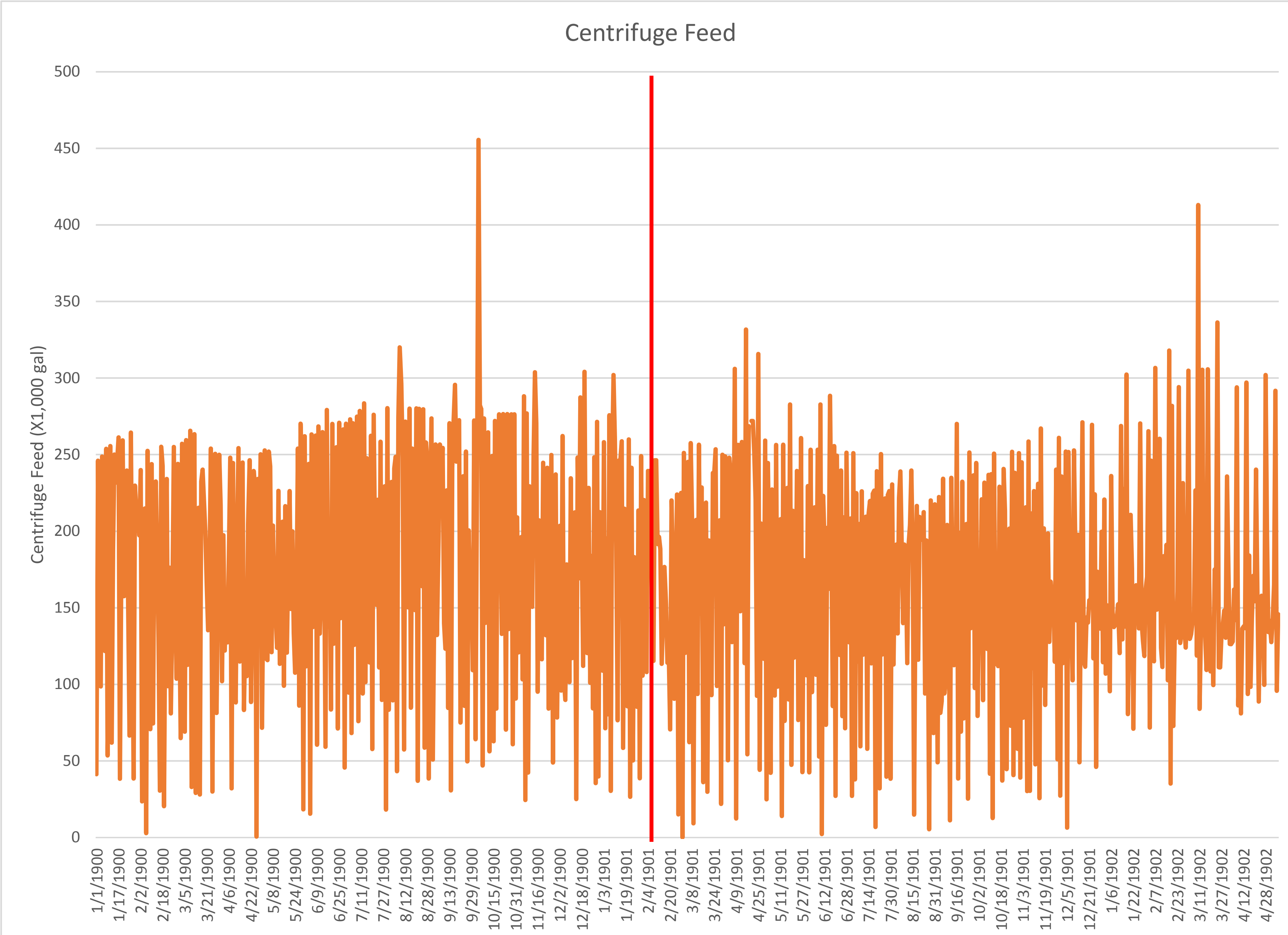

Digester Volatile Acid to Alkalinity Ratio
Ratio
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018
7026 - Digester #1 VA/Alk Ratio LAB ()
7056 - Digester #2 VA/Alk Ratio LAB ()

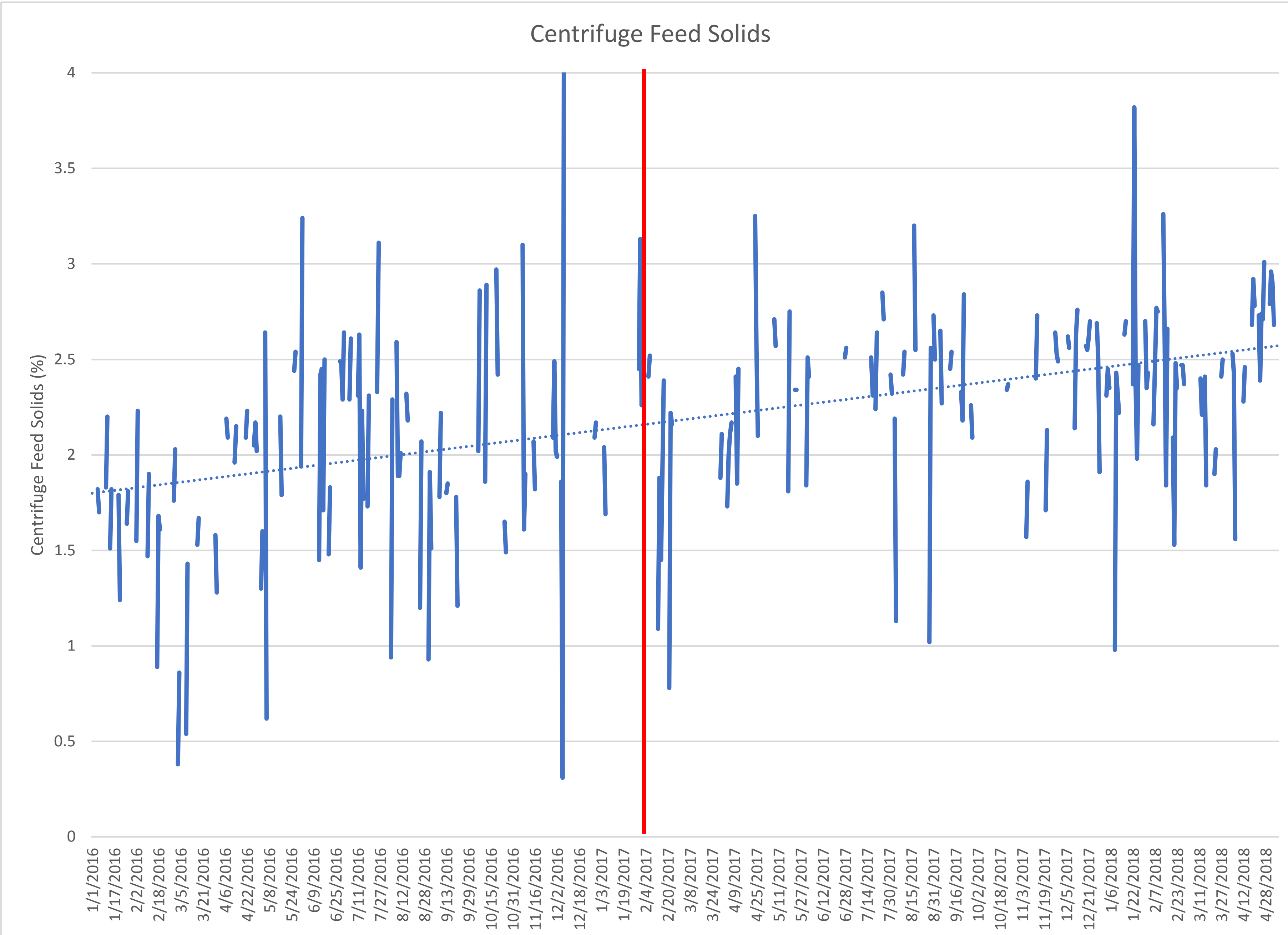


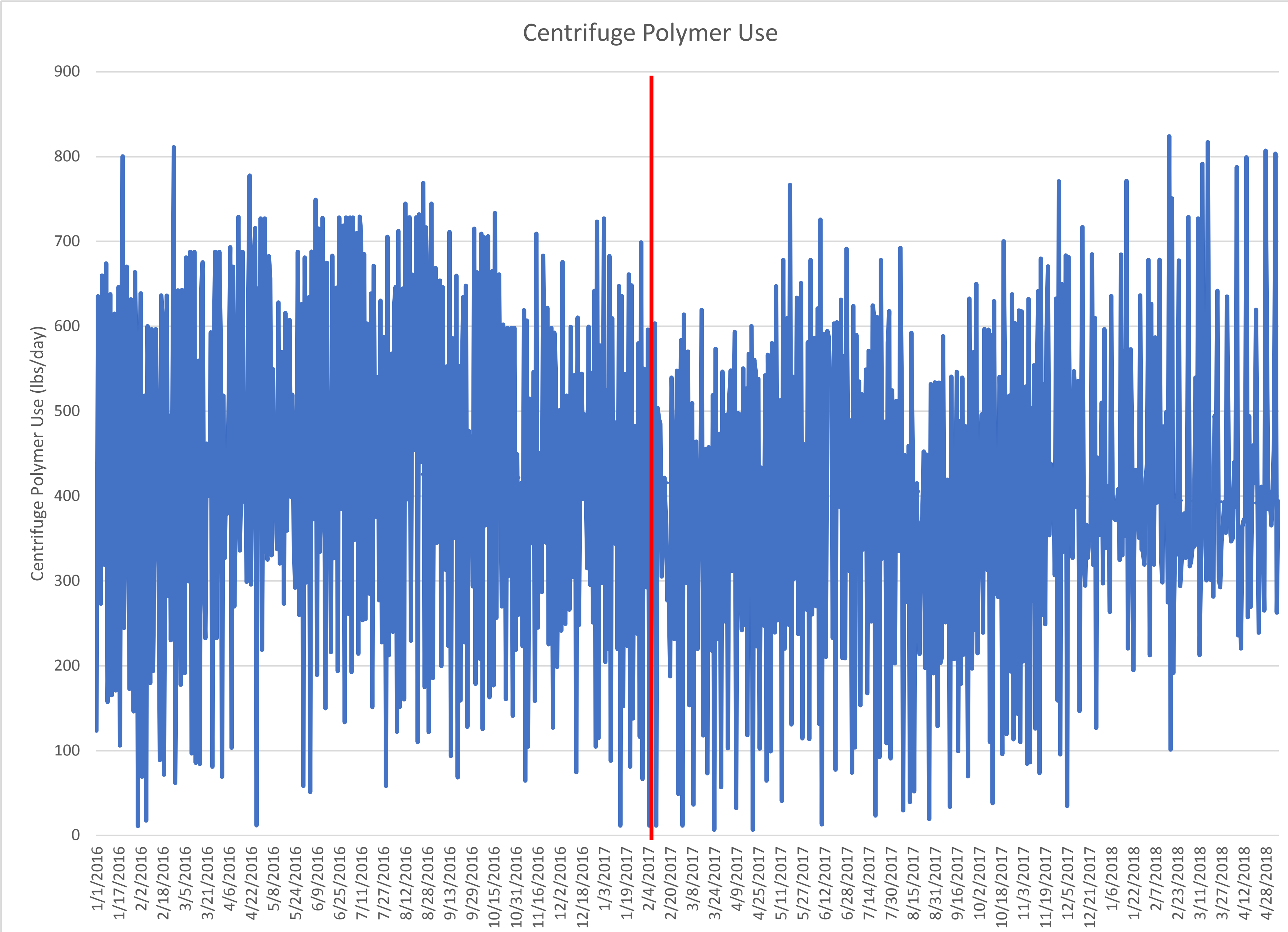
Total Biogas Production
Digester Gas Production (X1,000 cf/day)
1000
900
800
700
600
500
400
300
200
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018

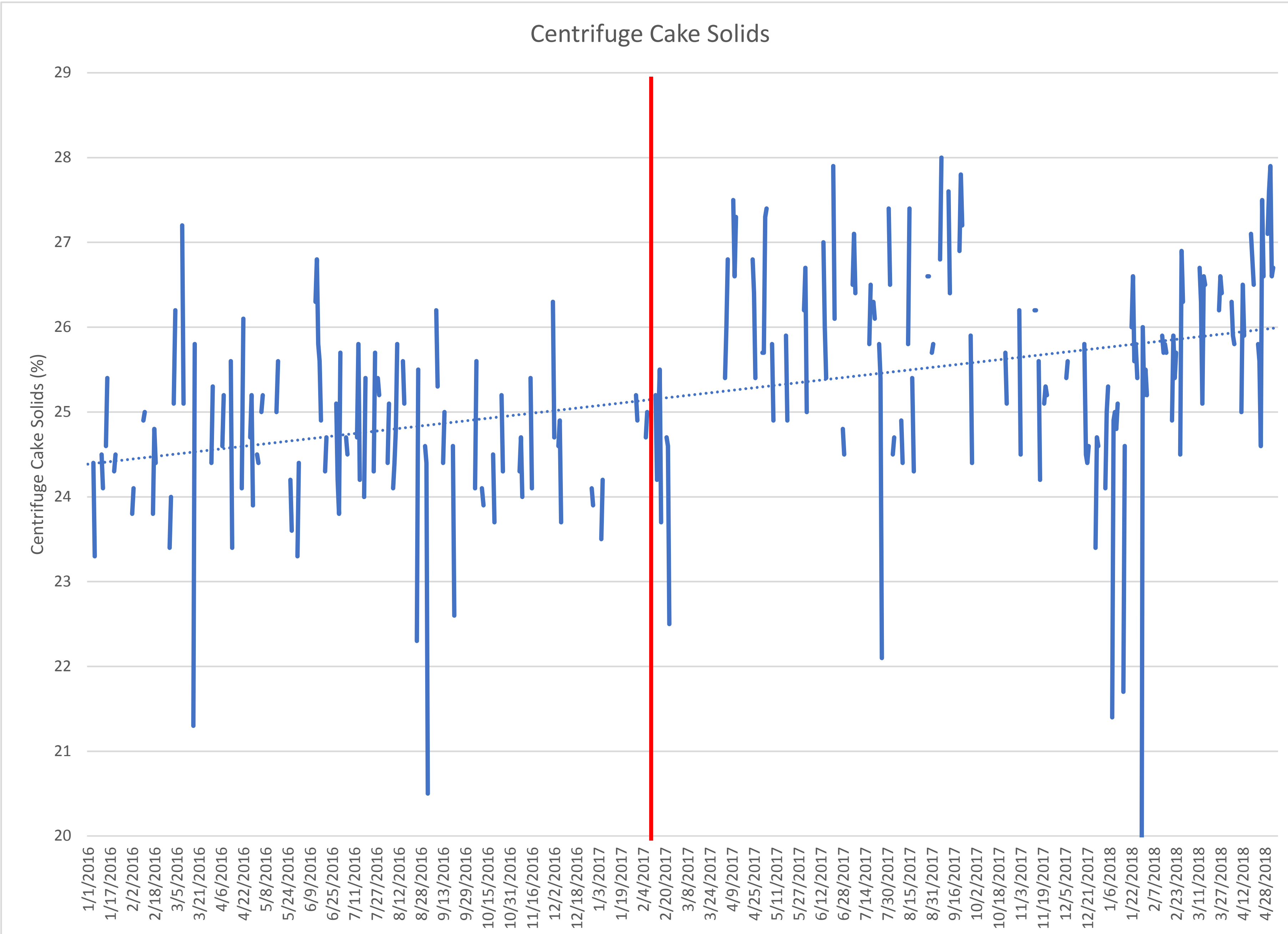
Attachment D

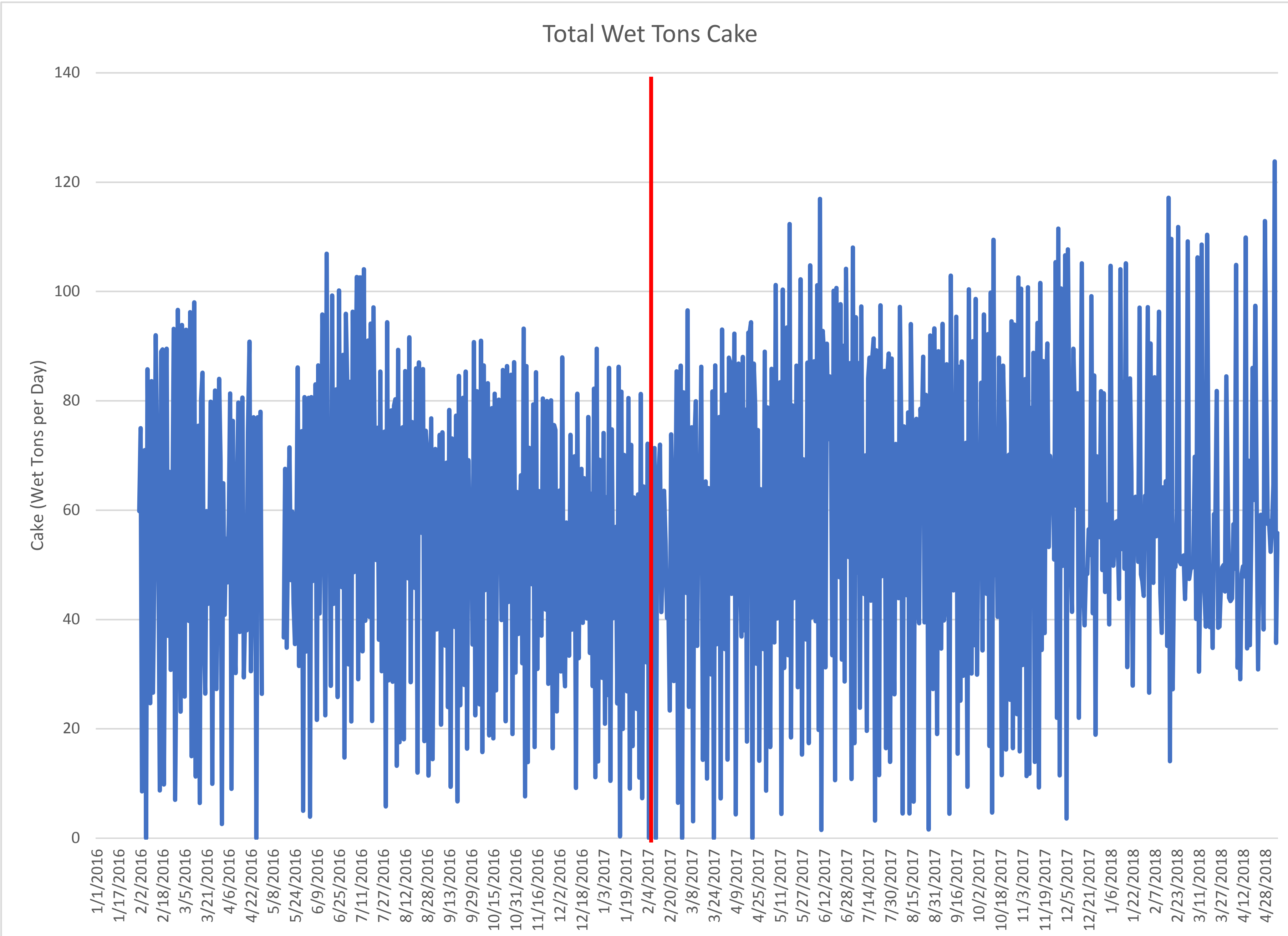
Downstream Process Monitoring Data


Centrifuge Feed
Centrifuge Feed (X1,000 gal)
500
450
400
350
300
250
200
150
100
50
0
1/1/1900
1/17/1900
2/2/1900
2/18/1900
3/5/1900
3/21/1900
4/6/1900
4/22/1900
5/8/1900
5/24/1900
6/9/1900
6/25/1900
7/11/1900
7/27/1900
8/12/1900
8/28/1900
9/13/1900
9/29/1900
10/15/1900
10/31/1900
11/16/1900
12/2/1900
12/18/1900
1/3/1901
1/19/1901
2/4/1901
2/20/1901
3/8/1901
3/24/1901
4/9/1901
4/25/1901
5/11/1901
5/27/1901
6/12/1901
6/28/1901
7/14/1901
7/30/1901
8/15/1901
8/31/1901
9/16/1901
10/2/1901
10/18/1901
11/3/1901
11/19/1901
12/5/1901
12/21/1901
1/6/1902
1/22/1902
2/7/1902
2/23/1902
3/11/1902
3/27/1902
4/12/1902
4/28/1902


Centrifuge Feed Solids
Centrifuge Feed Solids (%)
4
3.5
3
2.5
2
1.5
1
0.5
0
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018


Centrifuge Polymer Use
Centrifuge Polymer Use (lbs/day)
900
800
700
600
500
400
300
200
100
0
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018


Centrifuge Cake Solids
Centrifuge Cake Solids (%)
29
28
27
26
25
24
23
22
21
20
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018



Total Wet Tons Cake
Cake (Wet Tons per Day)
140
120
100
80
60
40
20
0
1/1/2016
1/17/2016
2/2/2016
2/18/2016
3/5/2016
3/21/2016
4/6/2016
4/22/2016
5/8/2016
5/24/2016
6/9/2016
6/25/2016
7/11/2016
7/27/2016
8/12/2016
8/28/2016
9/13/2016
9/29/2016
10/15/2016
10/31/2016
11/16/2016
12/2/2016
12/18/2016
1/3/2017
1/19/2017
2/4/2017
2/20/2017
3/8/2017
3/24/2017
4/9/2017
4/25/2017
5/11/2017
5/27/2017
6/12/2017
6/28/2017
7/14/2017
7/30/2017
8/15/2017
8/31/2017
9/16/2017
10/2/2017
10/18/2017
11/3/2017
11/19/2017
12/5/2017
12/21/2017
1/6/2018
1/22/2018
2/7/2018
2/23/2018
3/11/2018
3/27/2018
4/12/2018
4/28/2018