Appendix 2-3. Future Solids Production

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1.1 FUTURE SOLIDS PRODUCTION

The future solids projections are comprised of historical influent data, known changes (e.g. Northern Star pretreatment program), historical process performance data, and population projections to determine the rate of increase into the future. An existing BioWin process model was provided by Metropolitan Council as a method to develop future solids production projections. The process model incorporates all of the above in terms of historical performance and influent characteristics.

Special sampling was not performed to update the influent characterization, but historical influent data and treatment process performance was a part of the evaluation. Based on the historical data review Table 1.1 summarizes the BioWin influent parameters which were used for the evaluation, these values are compared to previous values and typical domestic wastewater characteristics.

Table 1.1: Summary of BioWin Influent Parameters

FRACTION	DESCRIPTION	BIOWIN DEFAULT	PRIOR VALUE	VALUE USED[1]	NOTES
Fbs	Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.16	0.3	0.3	
Fac	Acetate [gCOD/g of readily biodegradable COD]	0.15	0.352	0.352	
Fxsp	Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.75	0.75	0.80	Adjusted ratio to match influent VSS and TSS
Fus	Unbiodegradable soluble [gCOD/g of total COD]	0.05	0.032	0.032	
XCOD/VSS particulate substrate	Ratio of particulate COD to volatile suspended solids	1.6327	1.41	1.22	Adjusted ratio to match influent VSS and TSS; resultant solids VSS/TSS
XICOD/VSS	Ratio of particulate inert COD to volatile suspended solids	1.600	1.41	1.60	Adjusted ratio to match influent VSS and TSS; resultant solids VSS/TSS

[1]Note parameters used for modeling efforts are to match historical data only, influent characteristics are anticipated to change (See Section 2.3.2).

The previous influent characterization developed was altered to adjust influent solids loadings (TSS and VSS) to match historical plant data. Influent TSS and resulting VSS are based on influent COD loadings. If the ratio of COD/VSS changes over time, corrections can be made to account for the influent solids loading.

In addition to minor changes to the influent characterization the model incorporated changes to the primary sludge stream and caustic addition to the digesters. Figure 1.1 provides a visual indication (red arrows) of the flow streams that were altered.

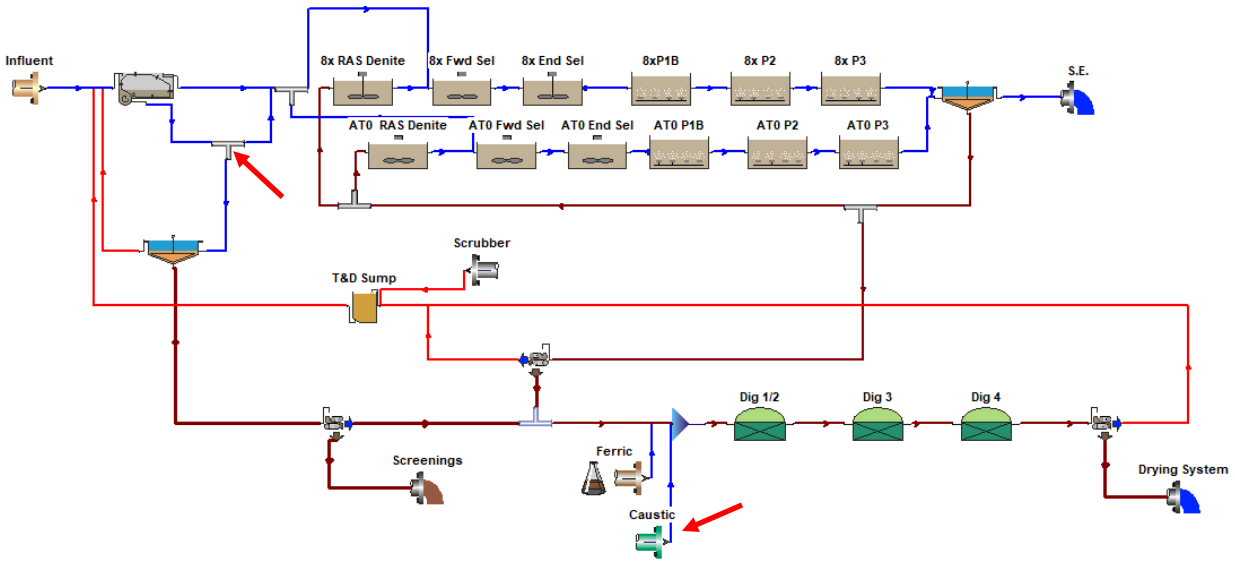

Figure 1.1: BioWin process model structural changes for solids production validation and projection.

The primary sludge flow was previously split to direct a portion of the primary solids to the secondary treatment system with the remaining directed to primary thickening. While the primary clarifier solids removal matches historical plant data (71-74% TSS removal) this effectively reduced the primary clarifier performance. Primary clarifier performance was set to match historical plant data and the splitter to direct all primary sludge to the thickener, these changes agree closely with primary effluent and primary sludge production historical data. The second change removed caustic addition to anaerobic digestion, this was previously incorporated to maintain stable operation within the digestion operation (pH balance). However, the model has been converted to the new BioWin 6 version which has a more stable digestion model and doesn't require caustic addition.

The BioWin model was then used against historical data to validate treatment process performance. Historical data from 2015-2018 was combined as annual average solids values and model simulations were performed, Table 1.2 provides the summary results.

Table 1.2: Mass Balance Results

FLOW STREAM	PARAMETER	MONITORING DATA [1]	MODELING RESULTS	PERCENT DIFFERENCE	COMMENTS
Influent	TSS	60,956 lb TSS/d	60,910 lb TSS/d	<1%	
Influent	COD	120,980 lb COD/d	121,194 lb BOD/d	<1%	
Primary Effluent	TSS	16,366 lb TSS/d	20,410 lb TSS/d	25%	Effluent TSS performance was variable throughout; effluent COD near historical.
Primary Effluent	COD	75,636 lb COD/d	75,409 lb BOD/d	<1%	
Primary Sludge	TSS	45,580 lb TSS/d	44,590 lb TSS/d	2%	
MLSS	TSS	3,057 mg TSS/L	2,214 mg TSS/L	28%	MLSS and WAS flows vary slightly, MLSS time of day and location of historical measurement can have a significant impact with the operation of the RAS denitrification zone.
WAS	TSS	30,295 lb TSS/d	26,437 lb TSS/d	13%	
Thickened WAS	TSS	See Note 2	25,379 lb TSS/d	--	
Feed to Digester	TSS	75,875 lb TSS/d	69,523 lb TSS/d	8%	See Note 3
Digested Sludge	TSS	45,106 lb TSS/d	43,398 lb TSS/d	4%	
Dewatered Cake	TSS	46,033 lb TSS/d	42,964 lb TSS/d	7%	
NEFCO Pellets	TSS	42,712 lb TSS/d	42,964 lb TSS/d	1%	Total hauled solids by NEFCO are considered very reliable. Fewer variables are involved with measurement methodology.

Notes:

1. Monitoring data is average from January 2015 through December 2018.
2. Flow stream is a calculation of the difference between anaerobic digestion feed and thickened primary sludge. Resulting value is 27% greater than historical WAS data over that same period.
3. Historical anaerobic digestion feed based on the sum of WAS and thickened primary sludge, historical data also has direct measurement of digestion feed which was 10% higher than the sum of the two flow streams.

The BioWin model calibration closely matches the hauled solids data produced by NEFCO and matches within 5% of most historical facility parameters. Generally projecting all solids flow streams within 10% of historical data is difficult due to the number of variables involved with developing historical data values. As part of the evaluation potential sources of inaccuracies and causes were investigated.

Table 1.3: Potential sources of measurement inaccuracies and field verification approaches.

VARIABLE	TYPICAL SOURCES OF INACCURACY	BLACK AND VEATCH FIELD VERIFICATIONS
Flow	Flow meter accuracy decreases compared to liquids stream accuracies. Sum of flows carries inaccuracies further into other processes if flow is not measured separately.	Pump curves and flow meter data were compared during typical operation. Generally, pump curves and flow monitoring data agreed.
Concentration	Grab samples capture only a moment in time. Start of pumping cycles vs. end of pumping cycles will have progressively decreasing concentrations. Aeration basin and WAS concentrations can vary over the course of a day with influent loading, RAS denitrification can also impact concentrations through aeration basins and clarifier loading.	Where autosamplers or longer periods of data collection were available these results were treated with a high degree of certainty. Those include: - Influent - Primary effluent - NEFCO hauled solids - Plant effluent
Capture Efficiency	Thickening and dewatering capturing efficiency.	Generally flow streams are not regularly sampled, reviewed available data to confirm modeled accuracy.