25% Cake and 95% Capture, or Lowest Total Cost? "Optimizing" Dewatering

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Clean Water Services

Peter LaMontange, The Centrifuge Guy

Agenda

- Solids Treatment at the Rock Creek AWWTF
- Historical Performance
- The Situation
- The Tools
- Making it Happen

Clean Water Services

- Established in 1970
- Sanitary sewer and Surface Water Management provider
- Serves over 530,000 customers and industries in urban Washington County, Oregon
- 4 wastewater treatment facilities
- 1,000 miles sanitary and storm sewers and 43 pump stations

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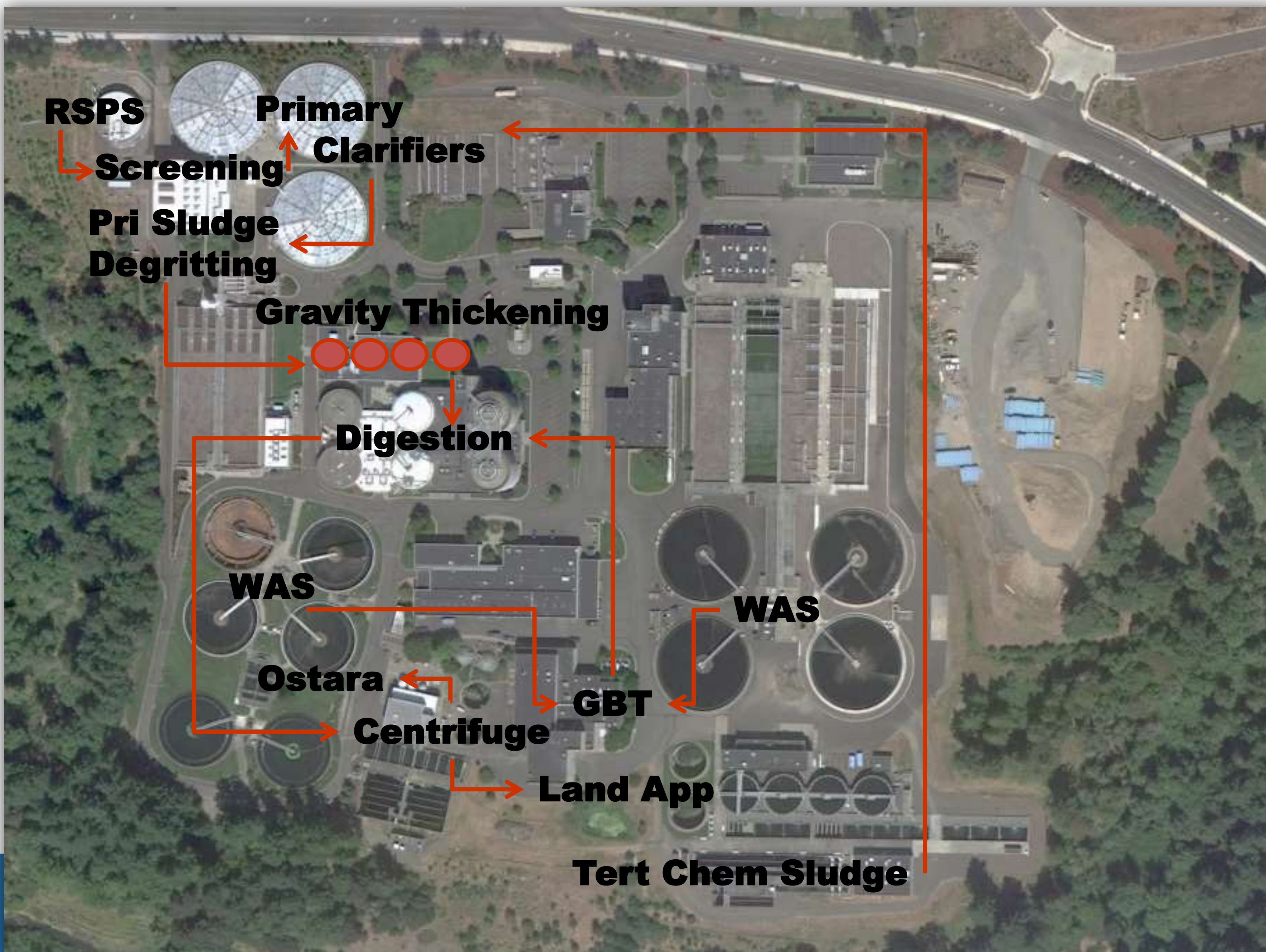
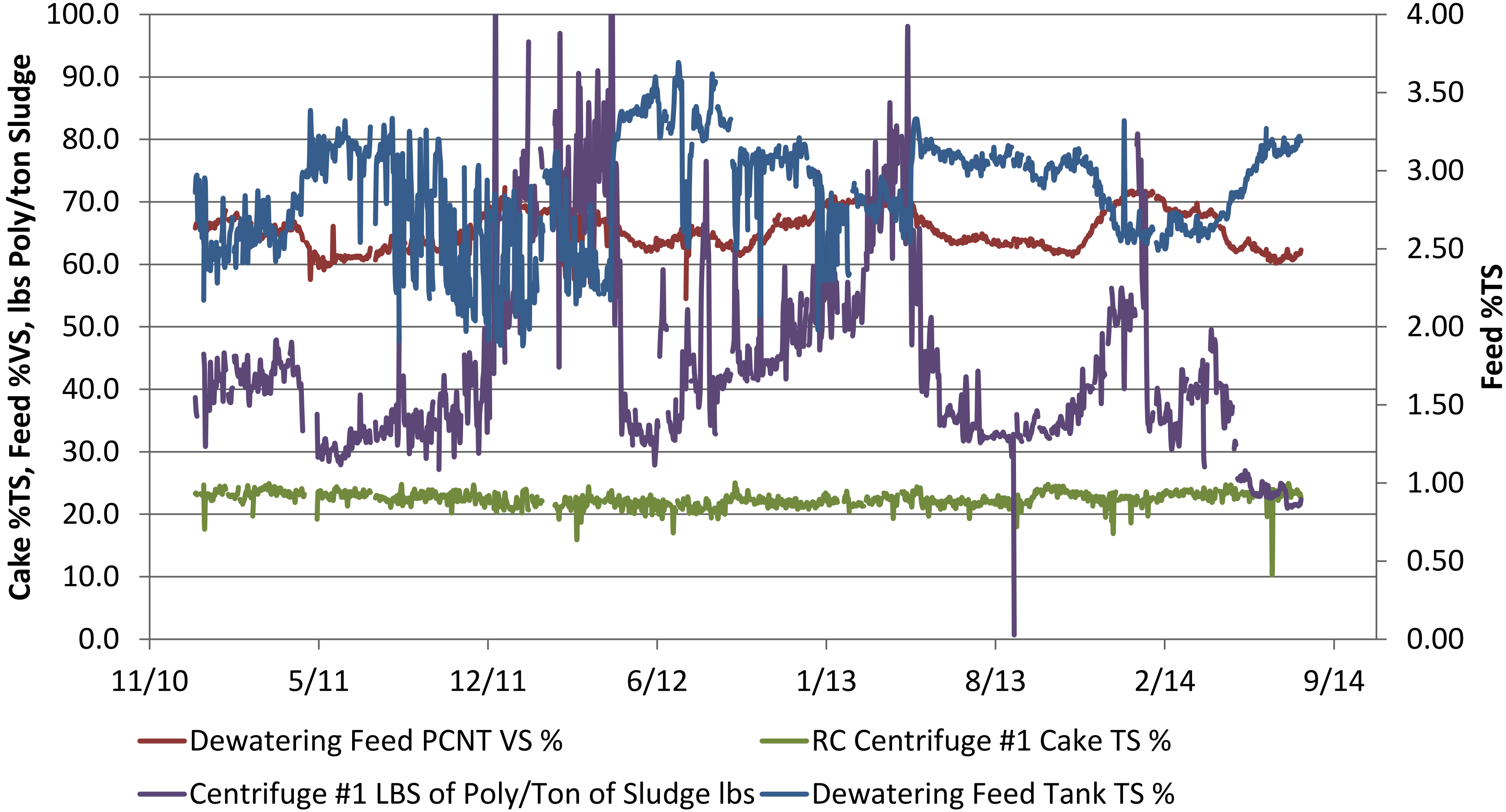

RSPS
Screening
Primary
Clarifiers
Pri Sludge
Degritting
Gravity Thickening
Digestion
WAS
WAS
Ostara
GBT
Centrifuge
Land App
Tert Chem Sludge

Sludge Characteristics

- Seasonal Effluent Phosphorus limits
  - Summer Sludge contains significant amount of alum sludge
    - Higher %TS
    - Lower % VS content
    - Sludge may be conditioned by charge neutralization
  - Winter Sludge is less dewaterable

Historical Performance



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The Situation

Management Sez	Ops Sez	Ops Response	Result	Consequence
The hauling costs are out of hand	We need to dry out the cake	Increase the poly	Slightly drier cake	Higher poly cost
The poly costs are out of hand	We need to use less poly	Decrease the poly	Slightly wetter cake	Higher haul cost
The hauling costs are out of hand	We need to dry out the cake	Increase the poly	Slightly drier cake	Higher poly cost
And on and on…				

The Question

- **“What is the definition of a good job?”**

  - Peter LaMontange

Ops Division Chief
-Under Budget

Ops Analyst
-The Chief is Happy

Process Engineer
-25% Cake, 95% Capture

Solids Operator
-Centrate looks Clean

What is a good job of dewatering?

Hauler
-It doesn't slop out of the truck

Ostara Process Analyst
-Centrate IS Clean

Plant Engineer
-Manufacturers Spec

Maintenance
-Its Turning, right?

Disposal or Beneficial Reuse?

- If we pay to have material hauled off site, then to us it is disposal
- The goal then should be to minimize the cost of disposal, while satisfying all the customers
- The costs of biosolids disposal
  - Haul/Application Cost
    - Varies by distance hauled and app site
  - Polymer Cost
  - Recycle Cost
    - Hardest to set - $0.20/lb ?

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Balancing Costs

- Assume optimized centrifuge:
  - Buy down your recycle cost with polymer
  - Buy down your polymer cost with recycle
  - Buy down your haul cost with throughput
  - Can you buy down your haul cost with polymer?
  - Can you buy down your polymer cost by hauling more?
- The Centrifuge Guy says: Polymer is for capture, Torque is for dryness

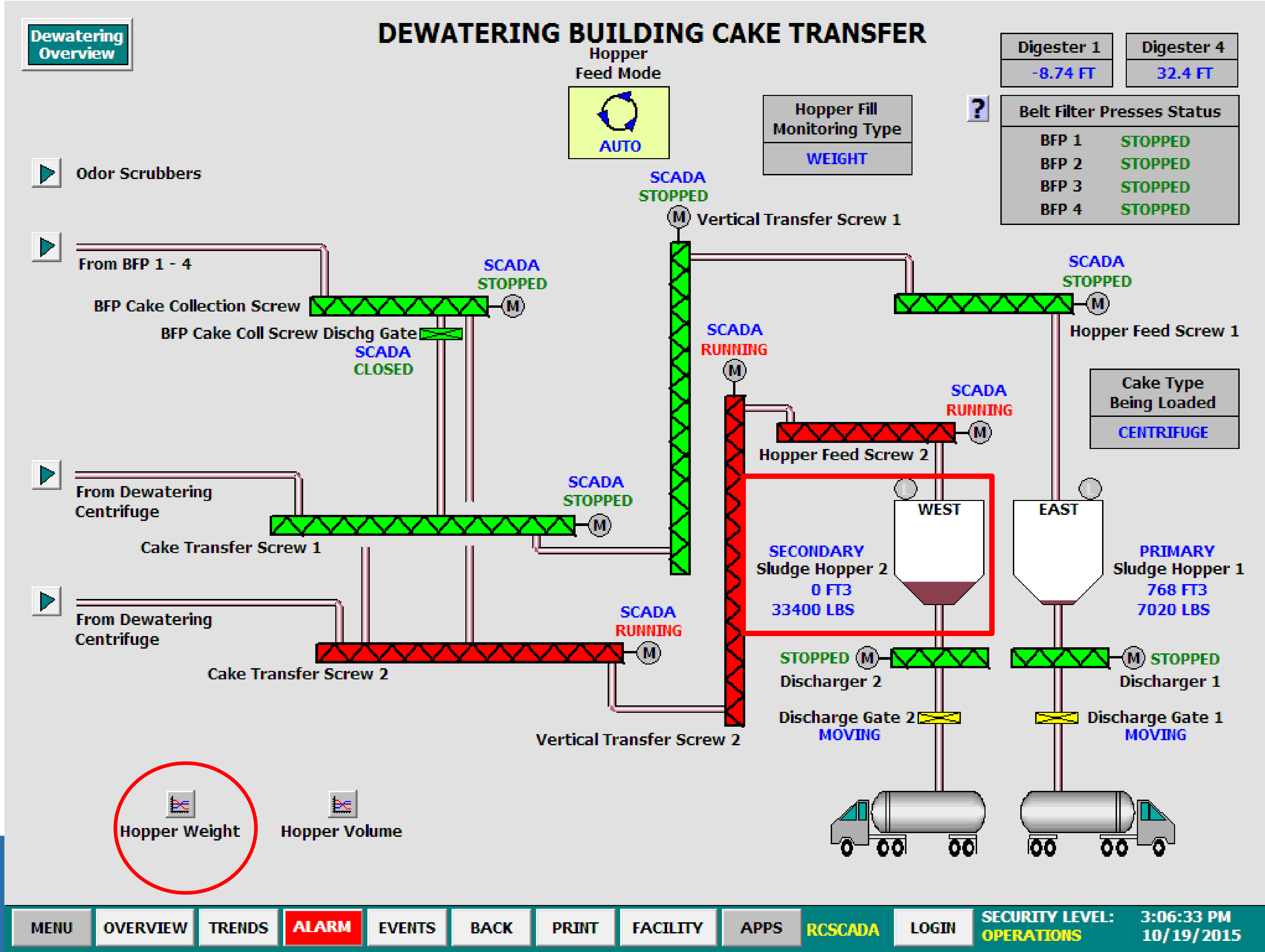
Date	23-Jan	25-Jan	28-Jan	31-Jan	19-Feb
Feed % TS	2.57	2.58	2.58	2.59	2.55
Feed Rate, gpm	140	140	140	140	150
Poly Conc. %	0.30	0.30	0.20	0.18	0.18
Poly Rate, gpm	40	31	38	27	30
Cake % TS	22.0	22.3	22.6	19.7	23.4
Centrate %TS	0.27	0.19	0.29	0.32	0.21
Feed Tons/hour	0.90	0.90	0.90	0.91	0.96
Poly Pounds/hour	60.05	46.54	38.03	24.32	27.02
Wet Tons/hour	3.71	3.79	3.60	4.10	3.79
Dry Tons/hour	0.82	0.84	0.81	0.81	0.89
Recycle Tons/hour	0.08	0.06	0.09	0.10	0.07
Capture	91%	93%	90%	89%	93%
Disposal Cost, $/Dry Ton	134.18	136.50	129.62	147.34	136.05
Poly Cost, $/Dry Ton	156.75	121.01	98.89	63.00	69.99
Recycle Cost, $/Dry Ton	37.58	26.27	40.35	43.63	31.09
Total Cost, $/Dry Ton	328.51	283.79	268.86	253.97	237.14

Real-Time Costs

- Operators making adjustments based on moisture analysis of cake and visual observation of the centrate
- Only get the capture, and therefore the total cost, after lab data comes in the next day
- If we can get some measure of cost in the moment we can make adjustments based on total cost

What to estimate?

- $\frac{k\%(f\% - c\%)}{f\%(k\% - c\%)}$ *** 100 = Capture**
- f% (Feed % solids) stable over the short term
  - Use daily lab data
- k% (Cake % solids)
  - By Ohaus moisture analyzer, results in 30 min
- c% (Centrate % solids)
  - Difficult to measure accurately by any other than TSS

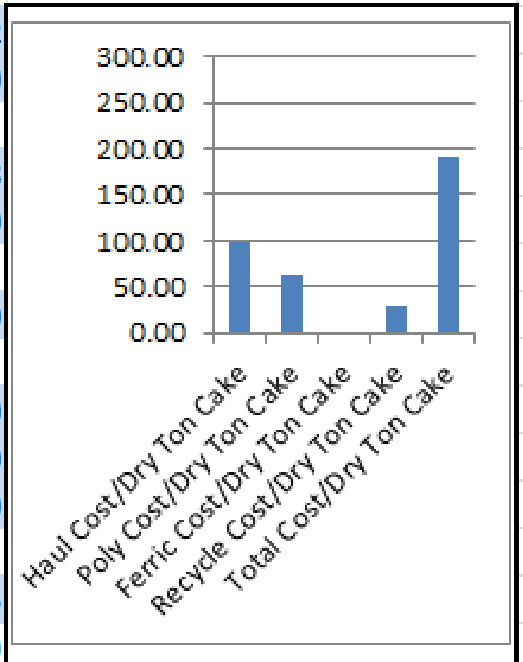

Dewatering Overview
DEWATERING BUILDING CAKE TRANSFER
Hopper Feed Mode
AUTO
Hopper Fill Monitoring Type
WEIGHT
Digester 1
-8.74 FT
Digester 4
32.4 FT
?
Belt Filter Presses Status
BFP 1 STOPPED
BFP 2 STOPPED
BFP 3 STOPPED
BFP 4 STOPPED
Odor Scrubbers
From BFP 1 - 4
SCADA
STOPPED
M
Vertical Transfer Screw 1
BFP Cake Collection Screw
SCADA
STOPPED
BFP Cake Coll Screw Dischg Gate
SCADA
CLOSED
SCADA
STOPPED
Hopper Feed Screw 1
SCADA
RUNNING
SCADA
RUNNING
Hopper Feed Screw 2
Cake Type Being Loaded
CENTRIFUGE
From Dewatering Centrifuge
SCADA
STOPPED
Cake Transfer Screw 1
WEST
EAST
SECONDARY
Sludge Hopper 2
0 FT3
33400 LBS
PRIMARY
Sludge Hopper 1
768 FT3
7020 LBS
From Dewatering Centrifuge
SCADA
RUNNING
Cake Transfer Screw 2
STOPPED
Discharger 2
STOPPED
Discharger 1
Discharge Gate 2
MOVING
Discharge Gate 1
MOVING
Vertical Transfer Screw 2
Hopper Weight
Hopper Volume
MENU
OVERVIEW
TRENDS
ALARM
EVENTS
BACK
PRINT
FACILITY
APPS
RCSCADA
LOGIN
SECURITY LEVEL:
OPERATIONS
3:06:33 PM
10/19/2015

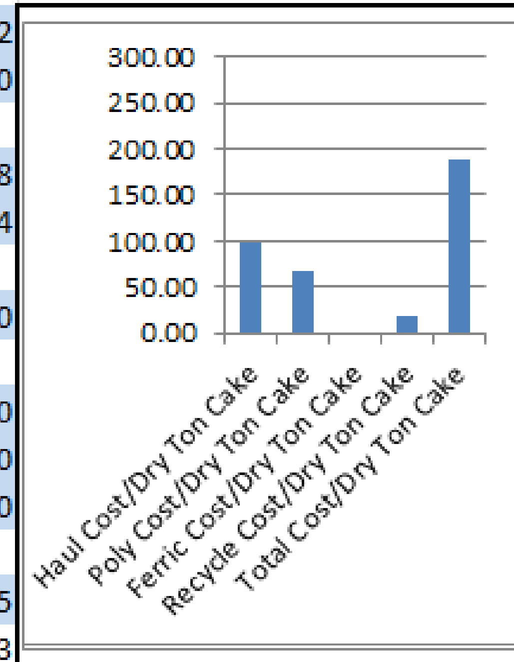
Use the Wet Ton Production Rate

- Biosolids storage hoppers are on load cells, so we know wet tons/hour, therefore haul cost/hour
- Wet tons * k% = Dry tons
- Feed tons – Dry tons = Centrate tons
- Now we have a recycle cost/hour
- All costs are known

Real Time Optimization

	A	B	C	D	E	F	G
1	***Enter values in Blue***						
2							
3	Haul Cost $/wet ton	23.59			23.59		
4	Poly Cost $/pound active	2.186			2.186		
5	Ferric Cost $/dry pound	0.366			0.366		
6	Recycle Cost $/ton	400			400		
7							
8							
9	Feed % TS	2.72			2.72		
10	Feed Rate	150			150		
11							
12	Poly Conc.	0.18			0.18		
13	Poly Rate, gpm	30			34		
14							
15	Ferric Rate, gpm	0			0		
16							
17	Silo Wet Pounds Initial	0			0		
18	Silo Wet Pounds Final	8000			8200		
19	Run Time, minutes	60			60		
20							
21	Cake % TS	23.75			23.75		
22	Centrate %TS	0.19			0.13		





Obstacles and Operation

- Institutional Attitudes
  - Get the Operators to think proactively
- Antiquated/complex control strategy
- 24/7 operation
  - Requires daily seal and optimization

Operate like you own it

Perception	Reality
The centrifuge appears to be running well, why mess with it.	The poly feed rate has most likely been increased over time to an overdose.
If I make an adjustment, and the cake or centrate suffer, it will be a whole shift of fighting to get it back.	The short retention time in a centrifuge means you should be able to reoptimize in an hour.
The only control I have is more polymer.	Many tools at the knowledgeable operators disposal.

Control Variables (Tools)

Variable	Affects	Higher	Lower	Guideline
Poly conc	Activation, dispersion into sludge	Less "unwound"?	Easier dispersion	.2 +/- .03 %
Poly dose	Capture	More capture	Less capture	95% Capture
Poly feed point	Reaction Time, Floc Stability	Greater Capture, weaker Floc	Less capture, Stonger Floc	Who Knows? Check Often
Sludge feed	Retention Time	Drier	Wetter	150 GPM
Dam	Pond Depth, Compression	(Deeper) Drier	(Shallower) Wetter	
Torque	Cake Dryness	Drier	Wetter	85-110+ Bar?
Differential Speed	Retention Time	Wetter	Drier	1.2-2.0

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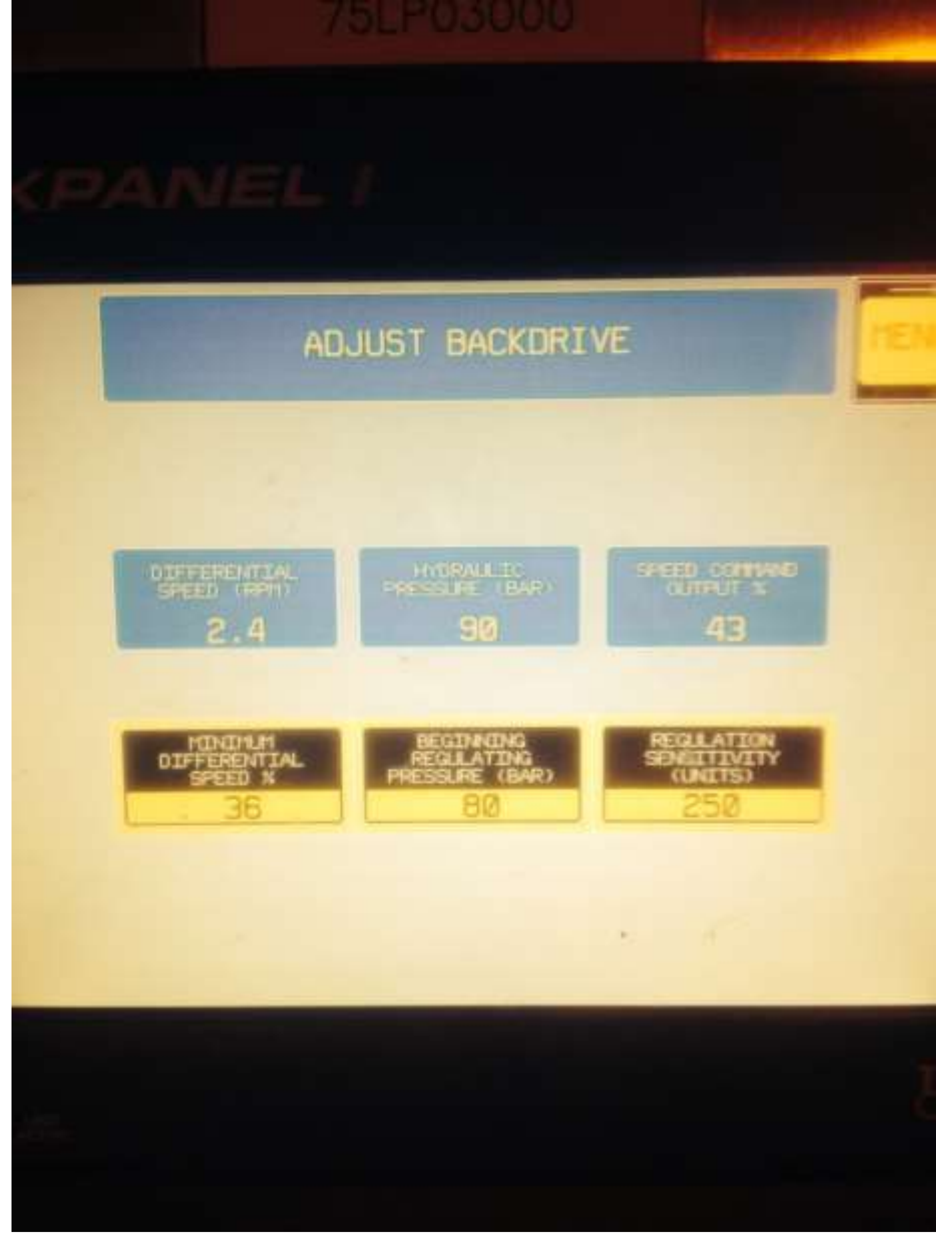
Control

- **Two adjustments can be made**
  - **“Beginning Regulating Pressure” – Torque – Measured as BAR**
  - **Minimum Differential Speed %**



Control

- Both Torque setpoint and Differential Speed Setpoint can be adjusted at the same time
    - "Wider is drier, closer is cleaner"
- It becomes unclear which is controlling
- From the SOP-
    - "The Minimum Differential Speed and Beginning Regulating Pressure have opposite effects on the pressure. An increase of 2% Minimum Differential Speed will have about the same effect as a decrease of about 5% in the Beginning Regulating Pressure.
- Try to train a new operator on that!

Desired Control

- Differential Speed Control
  - Enter a Differential Speed RPM Setpoint
    - Ramp to setpoint

- Torque control
  - Enter a torque setpoint and let the backdrive modulate to achieve the setpoint

Here's How We Do It

- Ensure a solid seal (plug)
  - Run the centrifuge to minimum differential RPM
  - Wait for the BAR to peak, wait for 10-15 minutes
  - This will be the driest cake, and dirtiest centrate
  - If the peak BAR trends down, this is the signal to try more polymer

Here's How We Do It

- **Clean up the centrate**
  - Slowly increase the differential speed from the minimum differential (0.5 RPM)
  - Smaller RPM adjustments as the centrate gets cleaner
  - When the centrate appears acceptable, let the BAR stabilize (15-20 minutes)
  - Run a burn on the cake and put the optimization tools to use

Hach WIMS Multi User v7.4.0 - MAHERC @ "Rock Creek WWTP" on SQL64PROD.OPSRC

File Data Manager Report Pac Graph Pac Design System Setup Modeling Preferences Utilities Help

Home Back Refresh Print

Rock Creek WWTP

Monday, October 19, 2015

Dewatering Dashboard

Key Performance Indicators 09/04/2015 thru 10/19/2015	Last	Min	Max	Avg
Dewatering Feed Tank TS {%}	2.78	2.67	3.09	2.80
Dewatering Feed Tank TVS {%}	1.8	1.7	2.0	1.8
Dewatering Feed PCNT VS {%}	66.2	64.2	66.4	65.4
Centrifuge #1 Flow avg gpm {gpm}	150.00	6.46	165.02	139.70
Feed Tons/Hour	104.33	4.43	115.98	97.34
Poly avg GPM	32.01	1.53	33.93	28.40
RC Centrifuge #1 Cake TS {%}	22.3	19.6	23.0	22.3
Centrifuge #1 Centrate TS {%}	0.177	0.145	0.260	0.181
Centrifuge #1 Centrate Capture {%}	94.38	91.41	95.58	94.24
Centrifuge #1 Centrate OPO4 {mg/l}	108.00	1.74	114.00	71.76
Biosolids Haul Cost $/dt {$/dt}	105.78	102.57	120.36	106.10
Centrifuge #1 Polymer $/Ton {}	63.96	52.60	72.36	61.06
Recycle Cost $/dt	24.58	19.49	637.86	41.70
Centrifuge Biosolids Total Cost $/dt {$/dt}	194.33	178.18	812.78	208.86
Centrifuge #1 Tons Recycled solids {tons}	1.45	1.14	2.14	1.49
Centrifuge #1 LBS of Poly/Ton of Sludge	29.26	24.06	33.10	27.93
Centrifuge #1 Feed Sludge Tons Per Day	25.04	1.06	27.83	23.36
Centrifuge Cake Tons per Day {WT/day}	105.97	4.34	118.03	99.09
Centrifuge #1 Flow {GPD}	215,997	9,306	237,622	201,165

Conclusions

- **The**

Here's How We Do It

- Assess the cake dryness, the centrate quality, sludge rate, poly dose and injection point
- Just because the cake is dry and the centrate is good doesn't mean we cannot reduce poly feed rate
- We typically have not been able to dose poly <23GPM so we will use that for our baseline
- If the poly feed rate has slowly been increased over time or vibrations increase then the centrifuge needs a detergent flush.
- Start optimization by reducing poly to 23GPM
- Allow the BAR's to drop and centrate to darken, if both happen then you are at a good starting point.
- If the BAR's stay in the 80's then the backdrive can be adjusted to clean up the centrate, to achieve this simply move the Minimum Differential closer to the Beginning Regulating pressure, if the BAR's drop to far then this is where poly will need to be increased in 0.5GPM increments.
- Backdrive adjustment are seen fairly quickly in the centrate while poly adjustments take about 30 minutes

Next Steps

- **The**