Planning for An Uncertain Future: Biosolids Disposal in a Bold New World

NEWEA
WORKING FOR WATER QUALITY

January 28, 2015

VEOLIA WATER

HAZEN AND SAWYER
Environmental Engineers & Scientists

Presentation Outline

1. Introduction/Background
2. Study Phase
3. Implementation Phase
4. Conclusions

Introduction/Background

Acknowledgements

- City of Leominster
  - Mayor Mazzarella
  - Raymond Racine, DPW Director
  - Roger Brooks, General Business Manager
- Massachusetts Clean Water Trust
- MassDEP
- CDM-Smith
  - Lee Storrs
- Veolia Operations
  - Bob Chalifoux

Leominster, MA
Water Pollution Control Facility

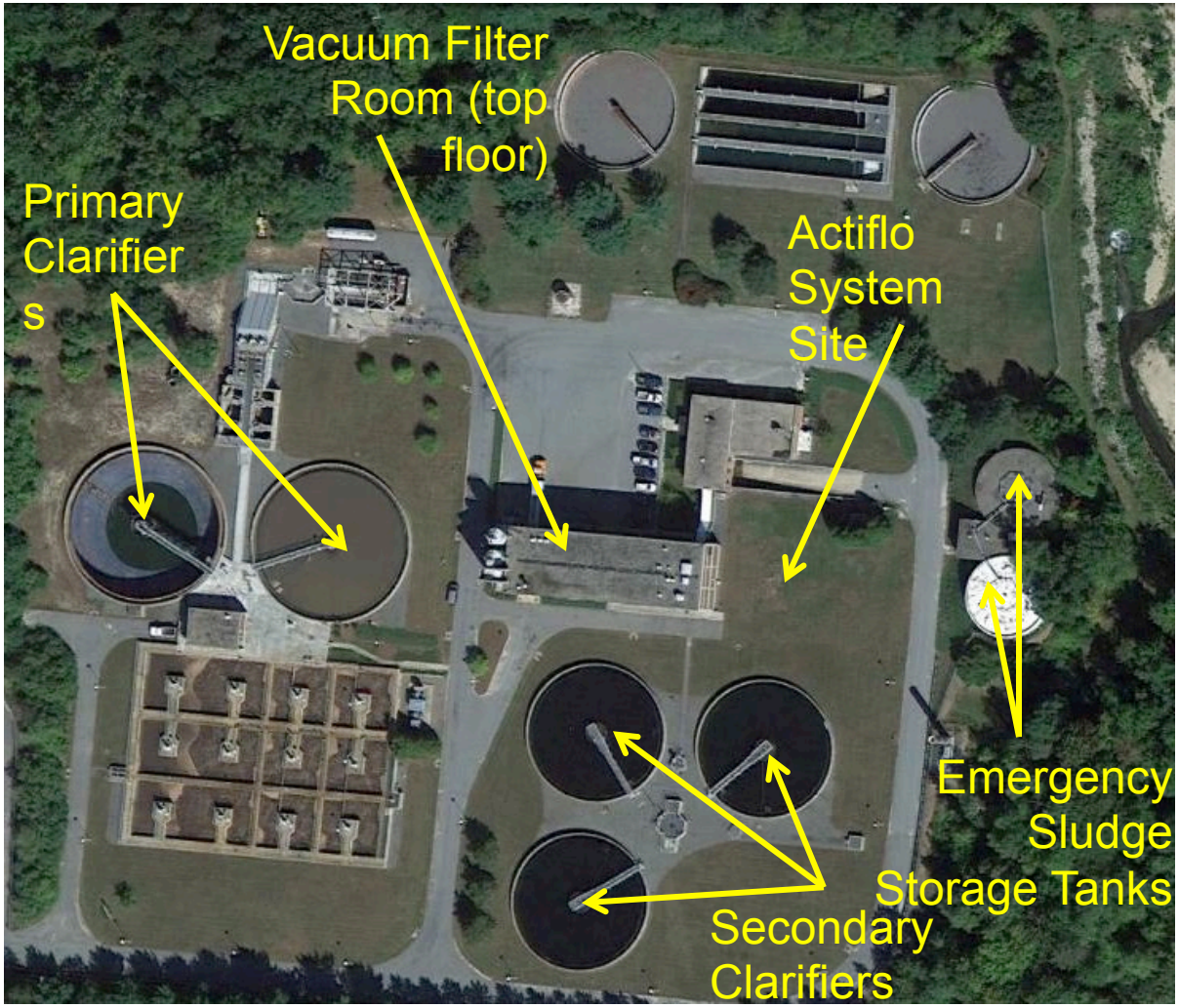
- Average flow = 6.0 MGD
- Design flow = 9.3 MGD
- Online in 1983 with no major upgrades until 2008
- 2010 - advanced tertiary treatment plant
  - Phosphorous removal through the tertiary treatment system (ACTIFLO system).
- 2012 - Upgraded Headworks

Background

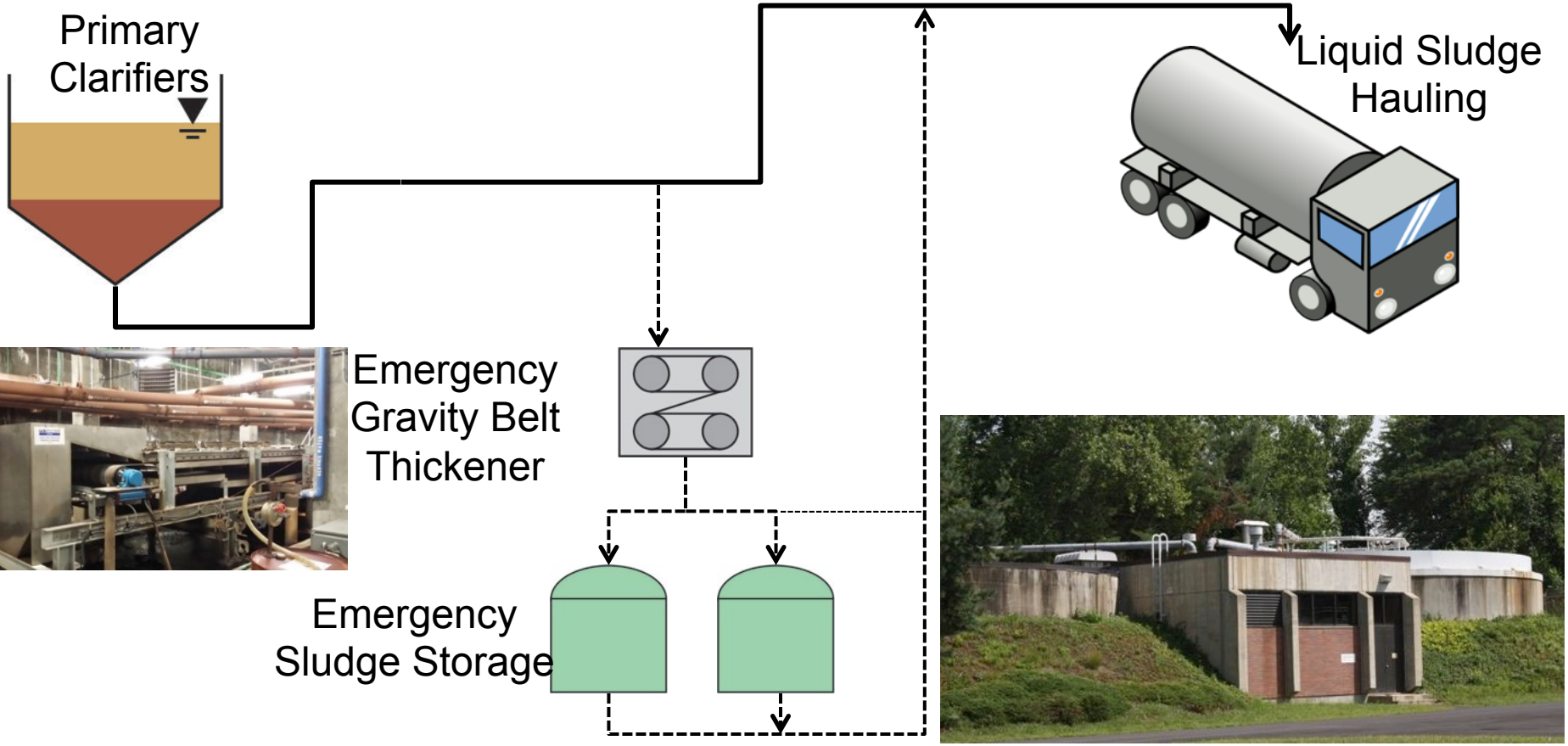
- Intermunicipal Agreement in place between Leominster and Fitchburg for merchant sludge disposal
- City of Fitchburg issued a moratorium on receiving merchant sludge effective October 1, 2012
- Leominster was faced with an opportunity to optimize biosolids disposal.
- Engineering RFP issued for a study phase to prepare and analyze alternatives to thicken, dewater, dry, or digest biosolids

Study Phase

Solids Handling Site Overview



Existing Conditions



Sludge Estimates

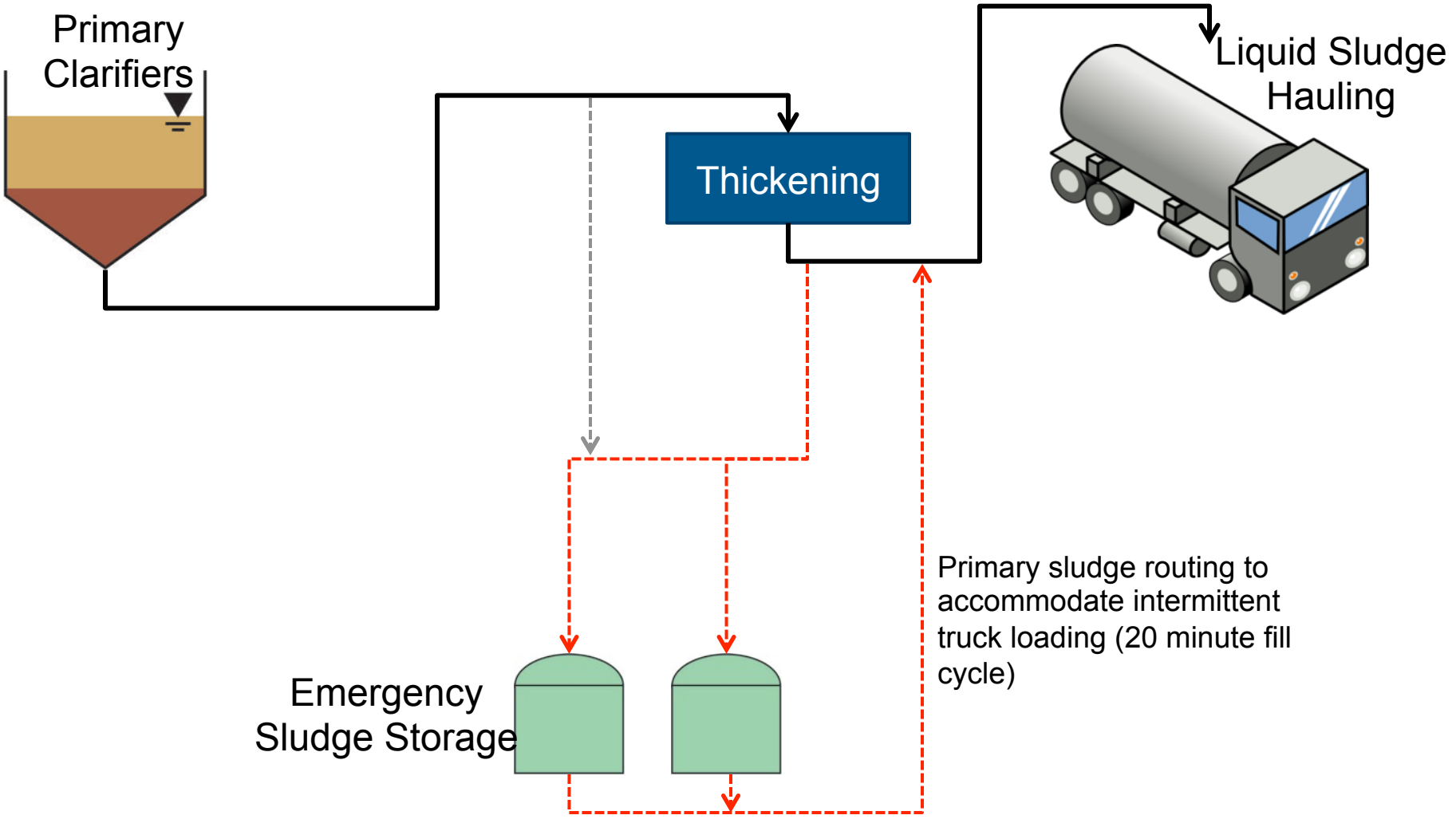
Sludge Production Values for 20-Year Flow Projections (6.58 MGD, 7 day basis)

	Average Annual (AVG365)	Maximum Month (MAX30)	Maximum Week (MAX7)	Maximum Day (MAX1)
Total without Actiflo	10,340 lb/day	14,170 lb/day	17,680 lb/day	22,130 lb/day
Total with Actiflo	10,550 lb/day	14,450 lb/day	18,040 lb/day	22,570 lb/day

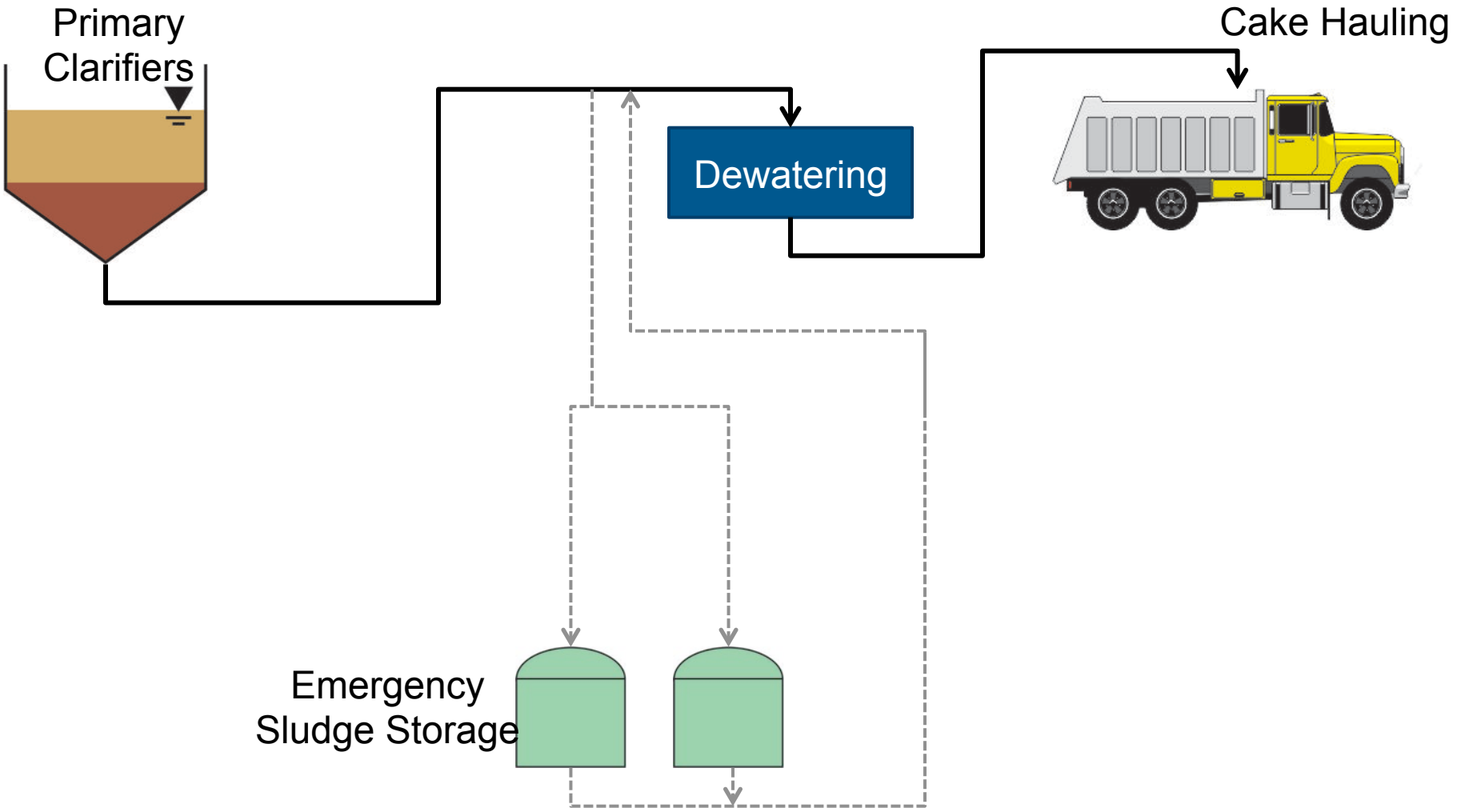
Sludge Production Values for 20-Year Flow Projections (6.58 MGD, 5 day basis)

	Average Annual (AVG260)	Maximum Month (MAX30)	Maximum Week (MAX7)	Maximum Day (MAX1)
Total without Actiflo	14,480 lb/day	19,840 lb/day	24,760 lb/day	30,990 lb/day
Total with Actiflo	14,770 lb/day	20,230 lb/day	25,260 lb/day	31,600 lb/day

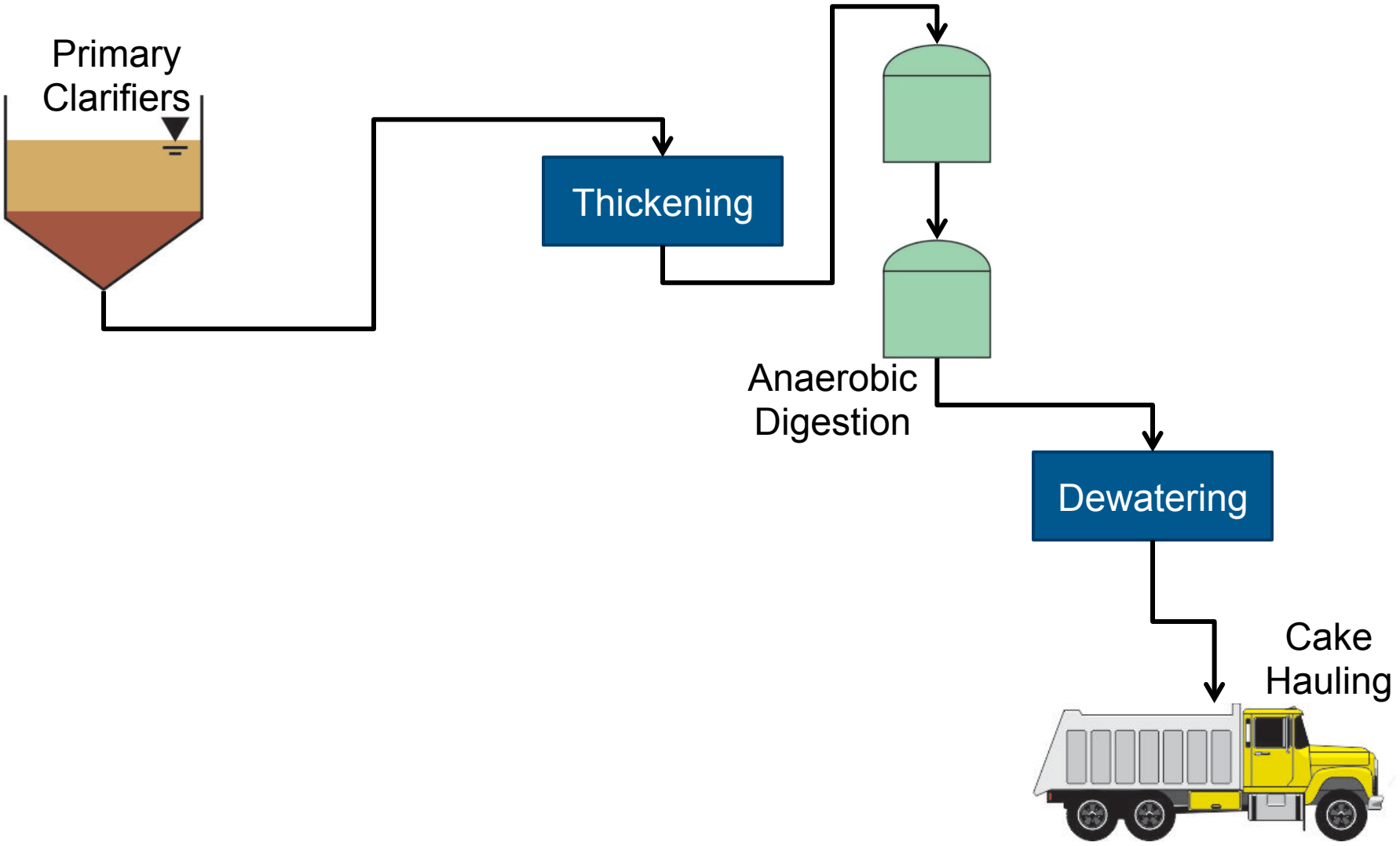
Alternative 1 – Thicken and Haul



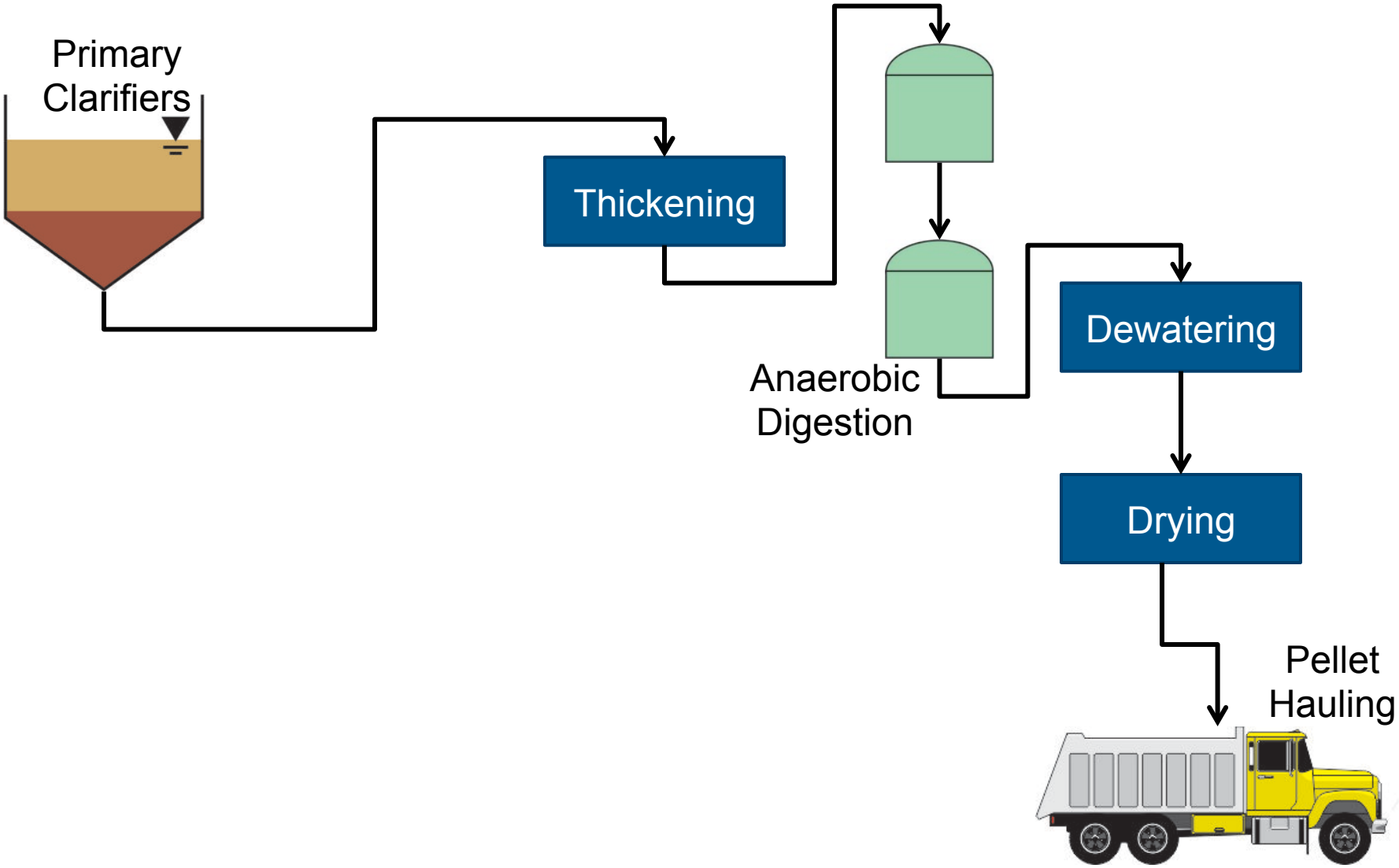
Alternative 2 – Dewater and Haul



Alternative 3 – Digest and Haul



Alternative 4 – Thermal Drying



Disposal Options

Disposal Options Vary Between Alternatives

	Landfill Disposal	Incineration	Composting at 22% TS	Composting at 28% TS	Beneficial Use
Alt 1 – Thicken and Haul		✓			
Alt 2 – Dewater and Haul	✓	✓	✓	✓	
Alt 3 – Thicken, Digest, Dewater and Haul	✓	✓	✓	✓	✓
Alt 4 – Thicken, Digest, Dewater, Dry and Haul	✓				✓

For land application sewage sludge must meet certain requirements

- Non-Hazardous
- Criteria Pollutants
- Pathogen Content
- Vector Attraction Reduction

Disposal Option Considerations

- How is flexibility and reliability defined?
- How important is flexibility in disposal options?
- Is cost the primary consideration?

Disposal Cost Assumptions

Based on information provided by VNA

	Landfill Disposal	Incineration	Composting at 22% TS	Composting at 28% TS	Beneficial Use
Unit Costs ($/ dry ton)	$250	$453 – liquid $515 – undigested cake $545 – digested cake	$496	$323	$0 - pellets

No current information available at this time. Can be modified in the future if additional information becomes available

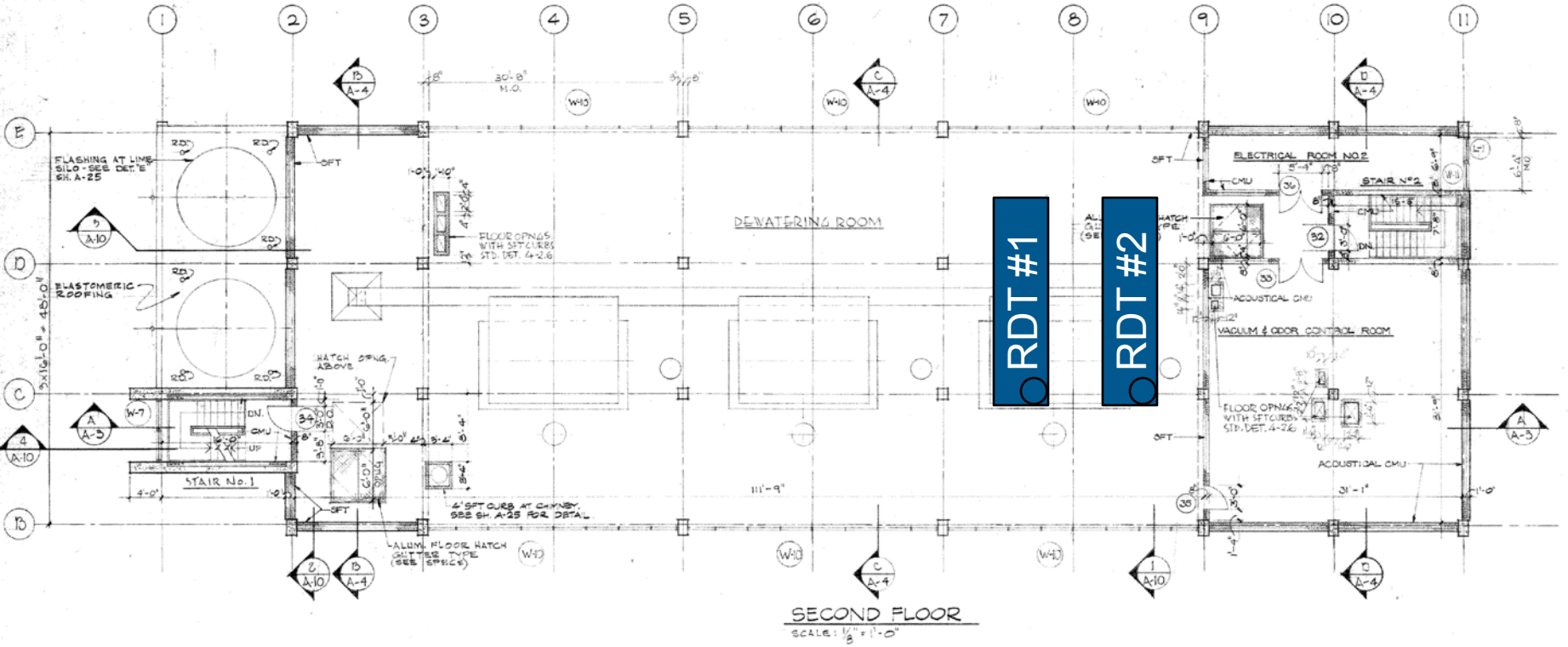
Major Equipment Options

Thickening Equipment

	RDT	Centrifuge
Potential Suppliers	Parkson Ashbrook Huber BDP	Centrisys Andritz Alfa-Laval Flotwegg Westfalia
Number of Duty Units Required	1	1
Number of Standby Units Required	1	1
Budget Equipment Supply Cost, per unit	$200,000	$395,000
Max Hydraulic Loading Rate, gallons/minute (each)	200	400
Max Solids Loading Rate, lbs(dry)/hour (each)	3,300	Not indicated
Connected Horsepower, HP	8.5	70
Polymer Dose, lbs(active)/dry ton	5 to 10	0
Anticipated Thickened Solids Concentration, %TS	5% to 10%	~6%

Conceptual Rotary Drum Thickener Layout

Process Building - Second Floor - Dewatering Room

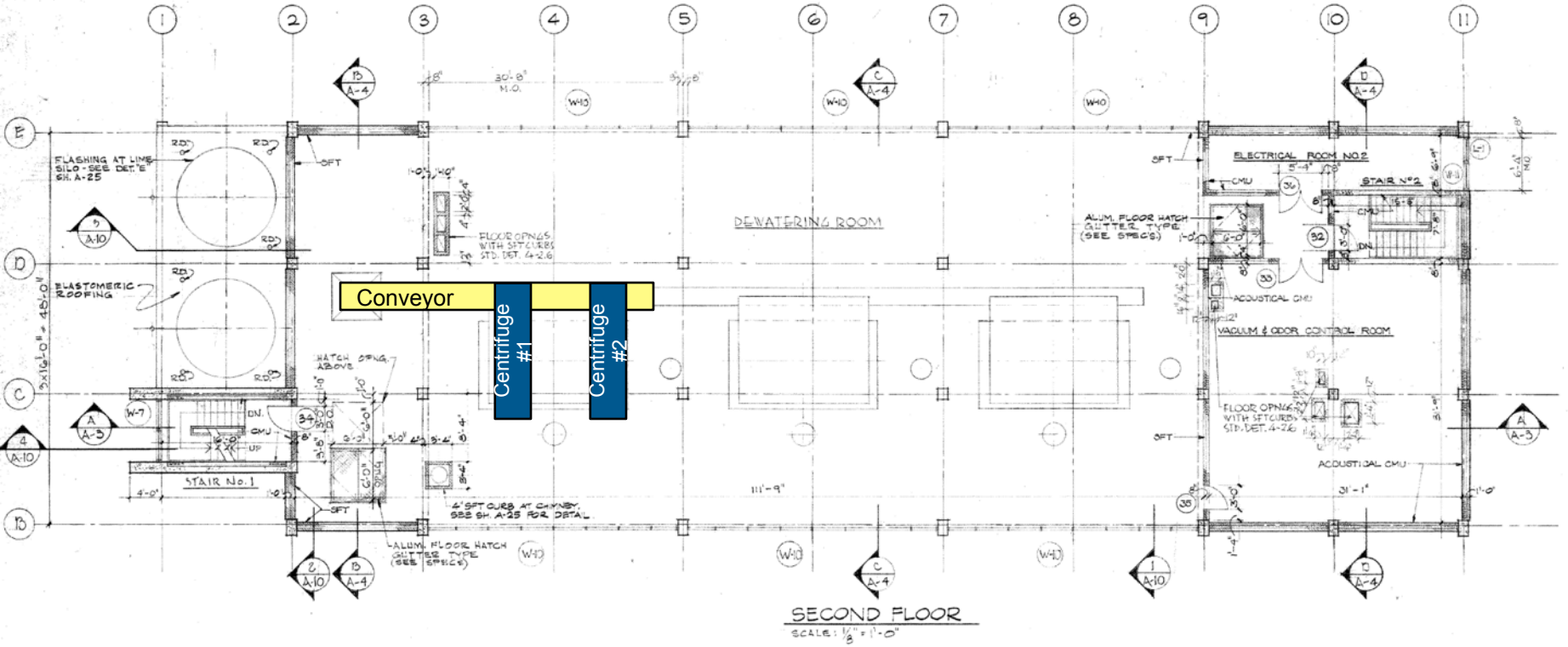


Dewatering Equipment

	Screw Press	Rotary Press	Centrifuge
Potential Suppliers	Huber, FKC, BDP, Schwing	Fournier	Centrysis, Andritz, Alfa-Laval, Flottwegg, Westfalia
Number of Duty Units Required	4	2	1
Number of Standby Units Required	1	1	1
Budget Equipment Supply Cost, per unit	$365,000	$325,000	$360,000
Hydraulic Loading Rate, gallons/minute (each)	52	Not available	140
Solids Loading Rate, lbs(dry)/hour (each)	850	1,500 dry lb/hr/ unit	2,430
Connected Horsepower, HP per unit	5	24	75
Polymer Dose, lbs(active)/dry ton	24 (max)	5 - 15	18 - 22
Anticipated Dewatered Cake Concentration, %TS	19% (average)	24 - 28%	20 - 25%

Conceptual Centrifuge Dewatering Layout

Process Building - Second Floor - Dewatering Room

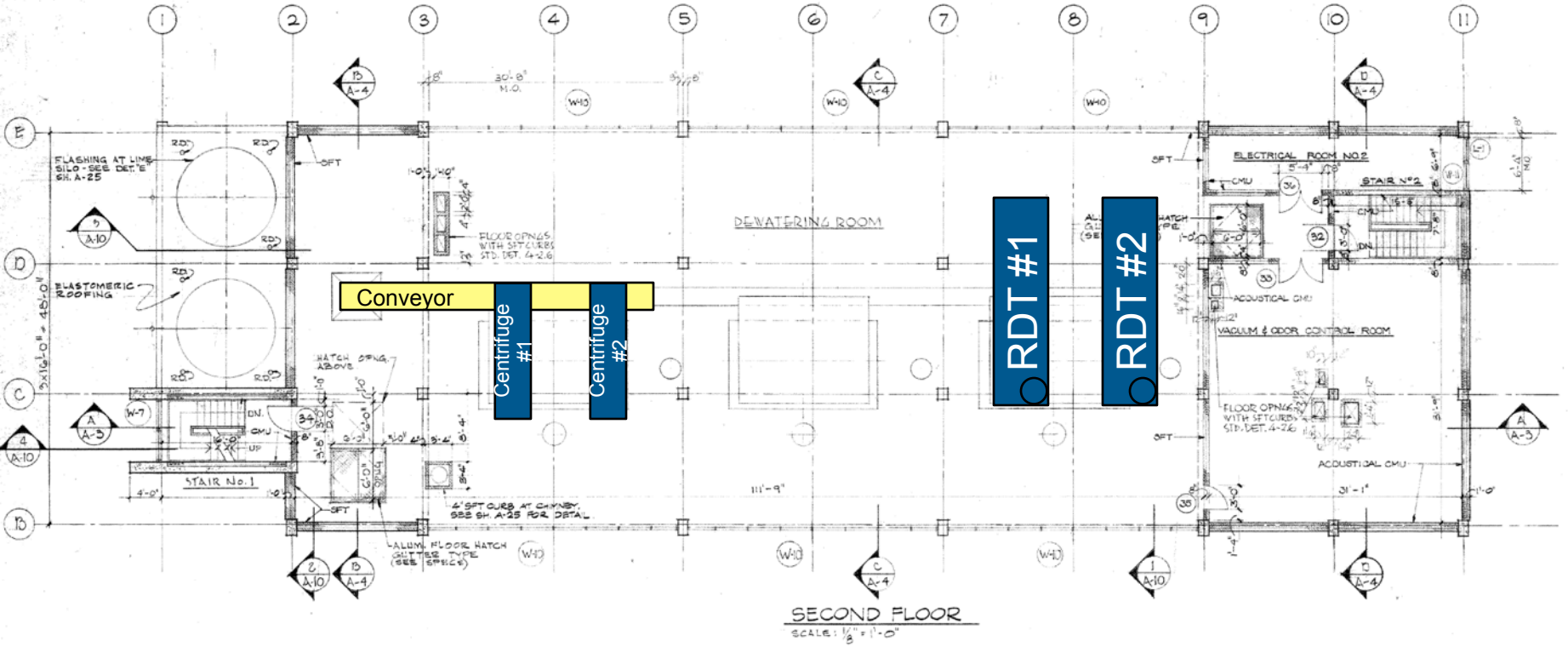


Anaerobic Digester Rehabilitation Components

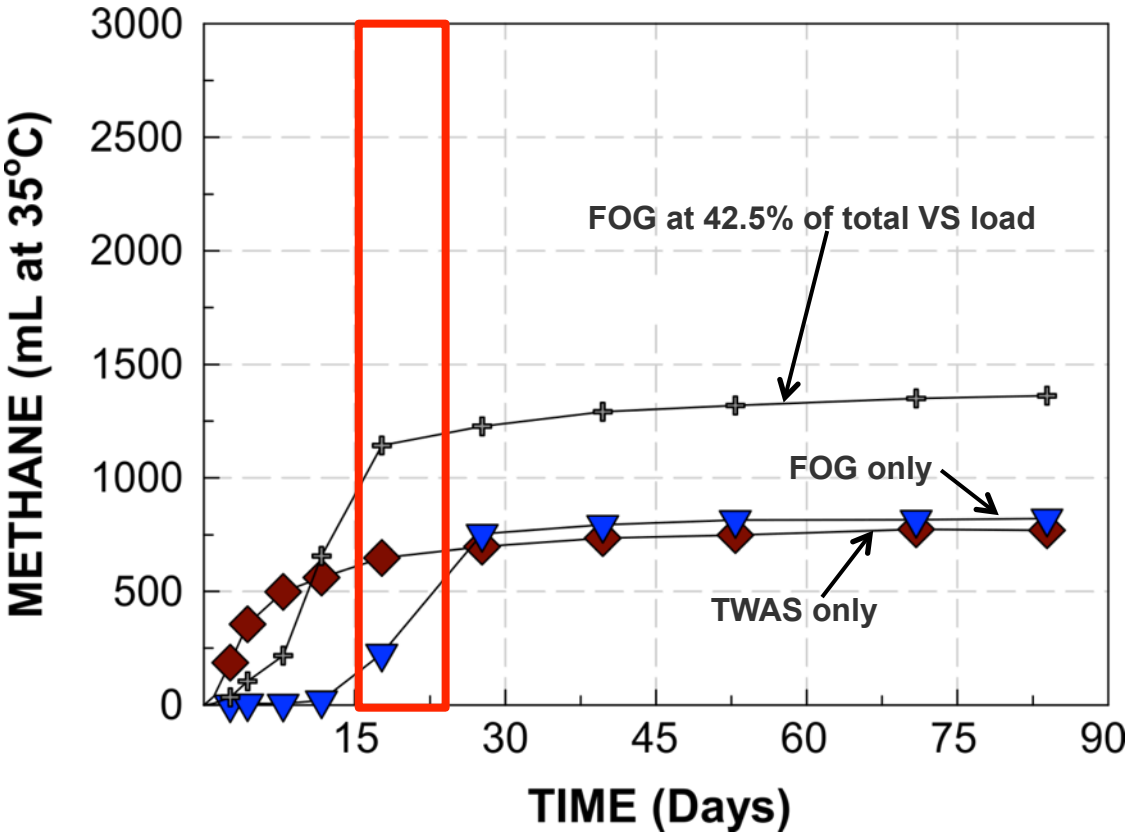
- Structural rehab
- Mixing
- Boiler
- Heat exchangers
- Covers
- Flare
- Gas safety
- Transfer pumps
- NFPA 820 compliance
- Gas monitoring
- Electrical upgrades
- Instrumentation
- Gas utilization
- Piping
- Demo of existing equip.
- HVAC

Conceptual Digester Pre/Post Handling Layout

Process Building - Second Floor - Dewatering Room



Imported Organic Material May Provide Additional Benefits



Considerations for Use of Additional Digester Capacity for Imported Organic Material

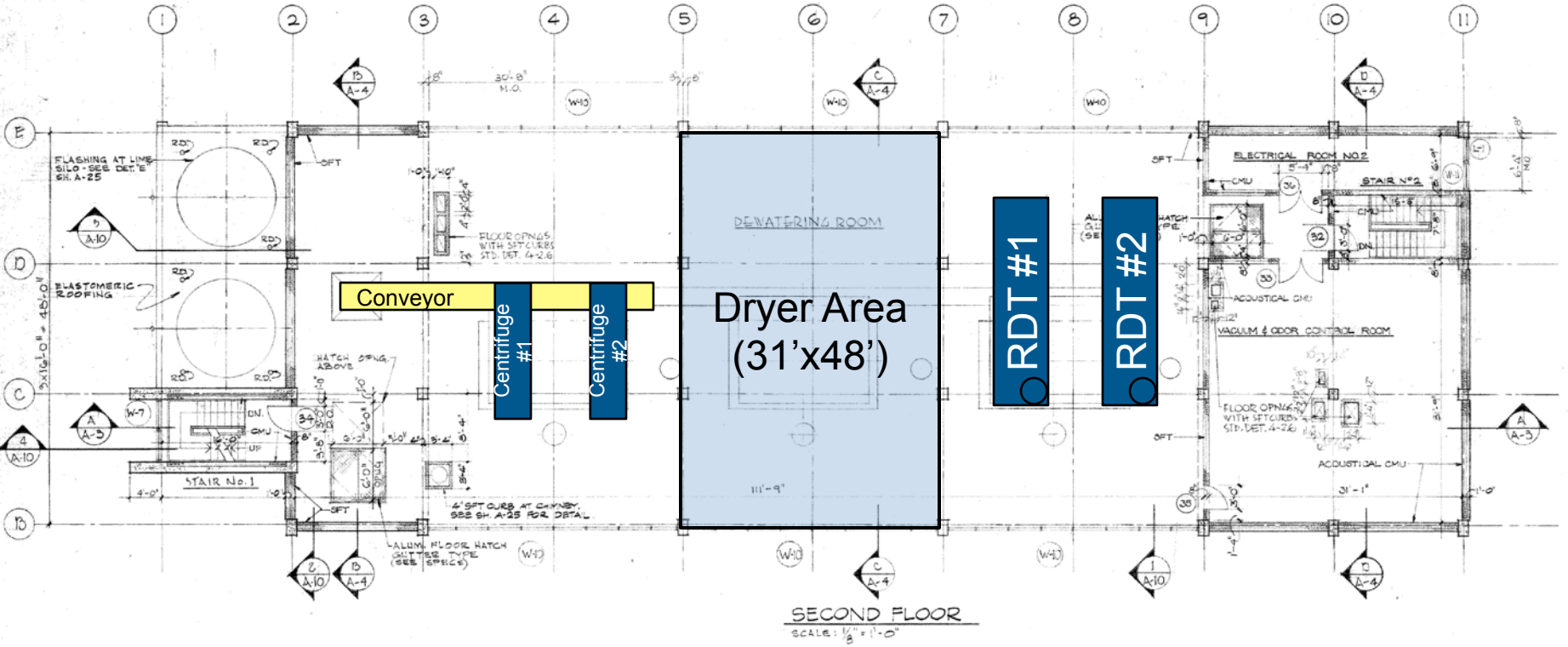
- Unknown cost risk for required structural rehabilitation of tanks
- Not 100% digestible, results in additional solids for final handling
- Additional investment for processing facilities
- No guarantee of market sustainability or tipping fee stability
- Benefits can only be realized with properly sized (i.e. larger) gas utilization equipment
- Not clear if additional investment can be recouped through grant funding and tipping fee income (Mass CEC Grants approx. $100k-$200k)

Dryer Comparison

	Rotary Drum Dryer	Paddle Dryer	Belt Dryer	Fluid Bed
Potential Suppliers	Andritz NEFCO Berlie	GMF-Gouda Komline-Sanderson ThermaFlite	Kruger Andritz Huber Siemens	Andritz Schwing-Bioset
Supplier Used for Evaluation	Not Considered	GMF/ Andritz	Kruger	Not Considered
Model Used for Evaluation		10W65	DR3025	
Approximate Budget Equipment Supply Cost		$3.0 M	$3.2 M	
Evaporative Capacity, lb H_2O/hour		2,400 lb H_2O/hr	2,400 lb H_2O/hr	
Anticipated Dried Solids Concentration, %TS		92%	90%	

Conceptual Thermal Drying Layout

Process Building - Second Floor - Dewatering Room



Evaluation of Alternatives

Economic Criteria

Capital costs

- Equipment
- Mechanical components
- Electrical allowance
- Instrumentation allowance
- General requirements
- Contractor OH&P
- Mobilization/demobilization
- Insurance and bonds
- Design/construction inspection
- Construction management

Recurring costs

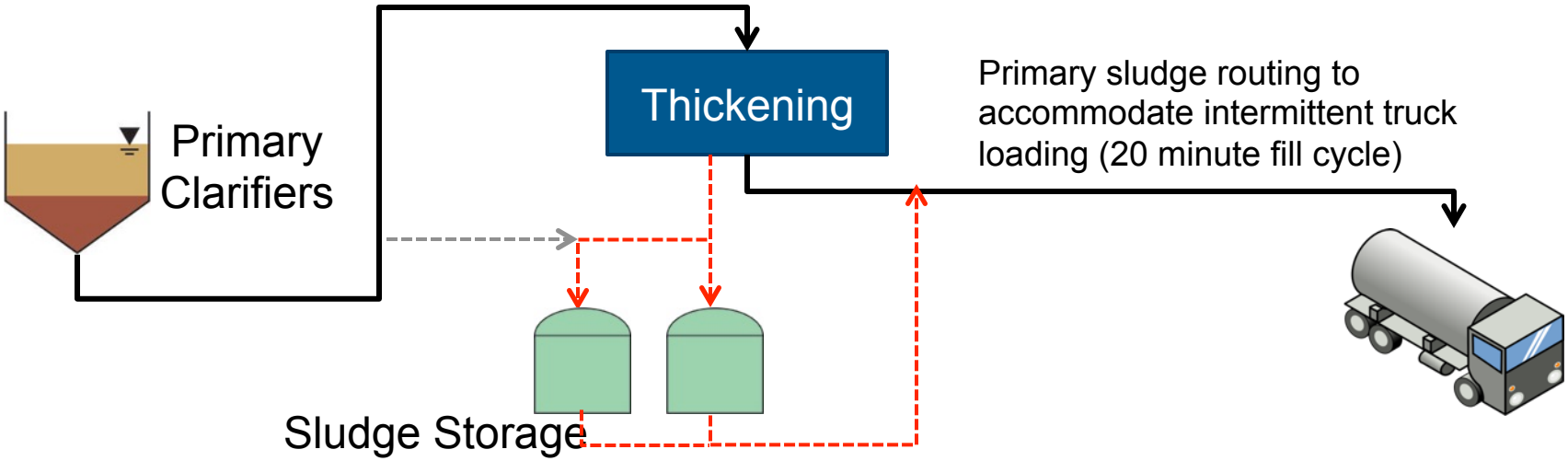
- Electricity
- Supplemental fuel
- Operations labor
- Maintenance labor
- Polymer
- Disposal
- Interest payments

Non-Economic Criteria

- Operator and process safety
- Process reliability
- Process redundancy
- Process flexibility
- Process operability
- Process maintainability
- Odor generation potential and mitigation

Alternative 1 – Thicken and Haul Liquid Sludge

- Install Rotary Drum Thickeners (RDTs)
- Draw sludge from PCs and thicken to 6%
- Operating Hours = 35 hrs/wk
- Thickened sludge or raw sludge sent to sludge storage tanks
- Disposal Site = Liquid Incineration (Upper Blackstone)

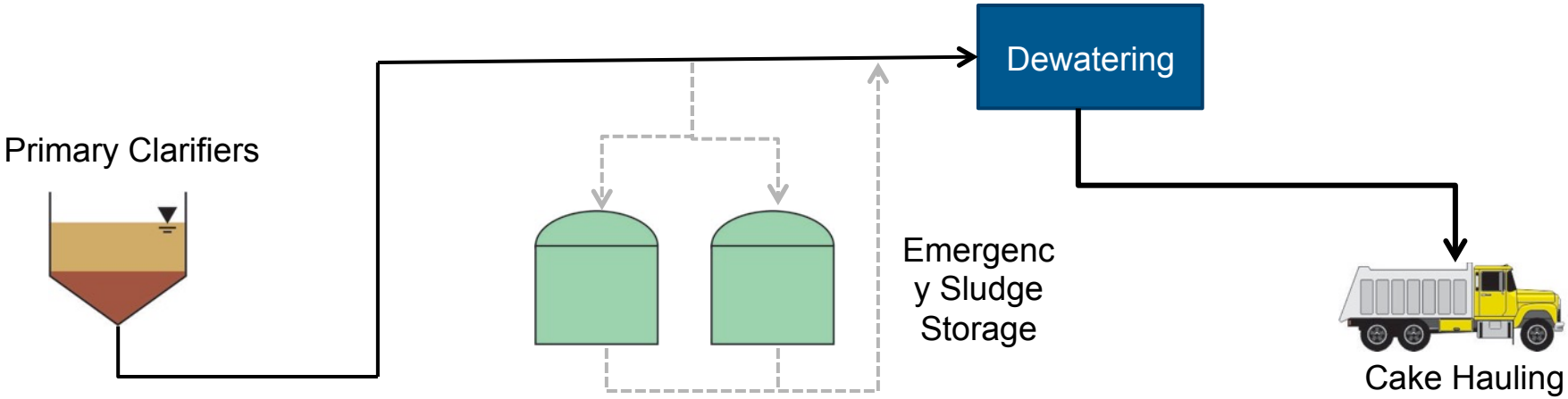


Other Evaluations

- Structural
  - Equipment loading
  - Equipment location
  - Installation and maintenance
- Electrical
  - Replacement of MCC-3 and MCC-6
  - VFDs, wire and conduit
  - Standby generator
- I&C
- HVAC and Odor Control

Alternative 2 – Dewater and Haul Cake Sludge

- Install Centrifuges
- Draw sludge from PCs and dewater to 20-25%
- Operating Hours = 35 hrs/wk
- Dewatered cake discharged to roll-off containers or dump trucks
- Disposal Site Options
  - Landfill
  - Incineration
  - Composting



Other Evaluations

Similar to Alt. 1

Structural

- Centrifuge Vibrations

I&C

- More I/Os required

Electrical

- Higher HP VFDs recommend stand alone construction

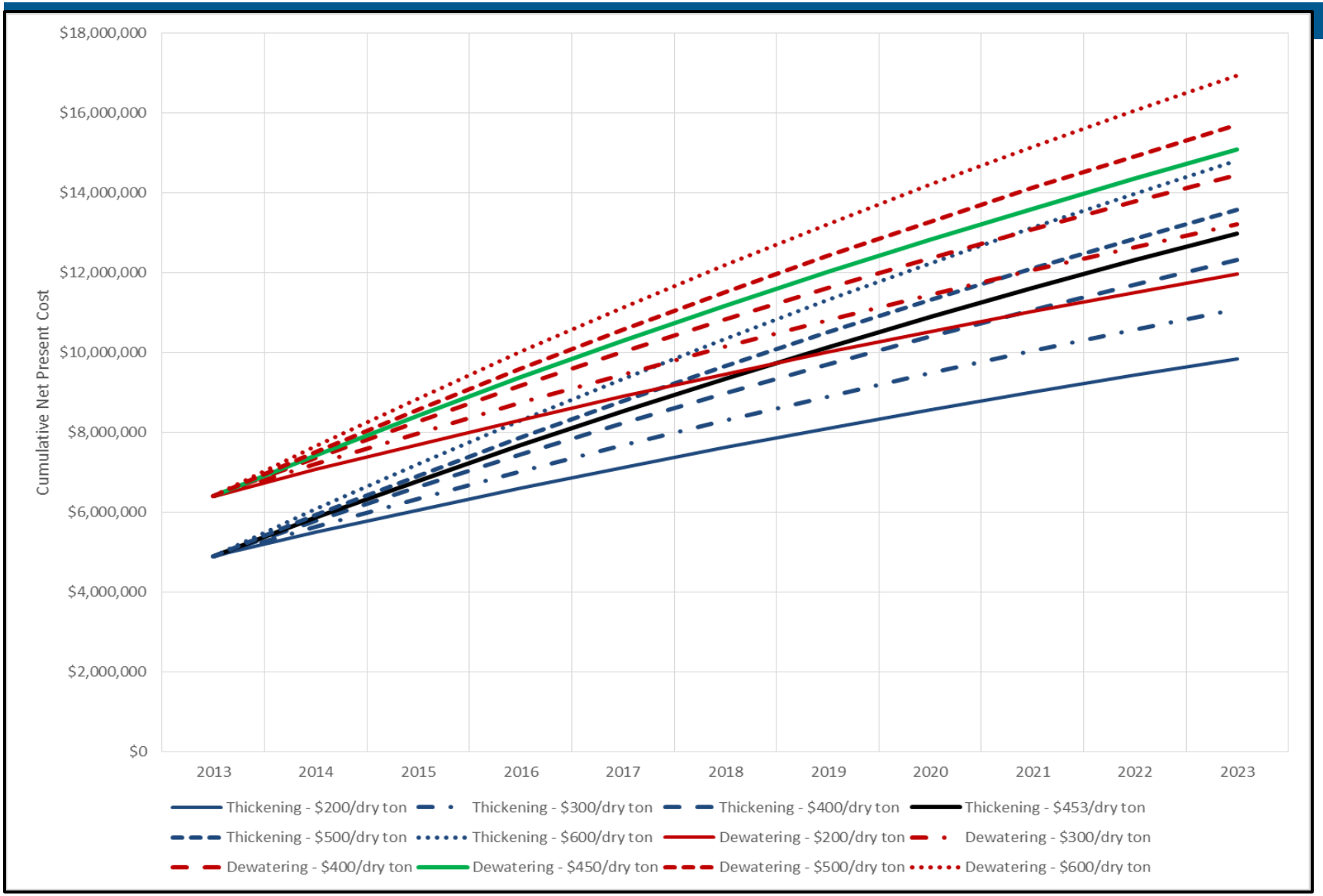
Capital Cost Comparison

Alternative	Est. Project Cost
Alternative 1 Thicken and Haul	$4,900,000
Alternative 2 Dewater and Haul	$6,400,000

Net Present Cost Sensitivity Analysis

- Dependent on final solids disposal
- Alternative 1: Thickening and Haul
  - To sludge incineration
  - Baseline transportation and disposal costs of $453/dt
- Alternative 2: Dewater and Haul
  - To cake composting
  - Baseline transportation and disposal costs of $450/dt
  - Tipping fee of $55/wet ton
  - Hauling distance approx. 100 miles roundtrip

Cumulative Net Present Cost Sensitivity Analysis over 10 years



Conclusions

Alternative 1: Thicken and Haul

- Equipment reduced O&M costs due to lower energy consumption and slower rotational speed
- More viable economic alternative over a 10-year analysis period based on current disposal costs
- Confined to single outlet for disposal
- SSI Regulatory impacts

Implementation Phase

Implementation

- Remove vacuum filters and install 2 RDTs
- Replace primary and stored sludge pumps
- Add storage tank mixing and thickened sludge equipment
- Install polymer mix/feed equipment
- Install odor control system

- Pre-purchase RDTs
  - Site Visits
  - Competitive bidding
  - Expedite schedule
  - 2 dual 4x10 BDP RDTs
- Contractor mobilized 1/26/15

Conclusions

Long Term Recommendation

- Dependent on future economics of digestion
  - Grant contributions
  - Other incentives to rehabilitate digesters

- Three options:
  - Continue with thickening
  - Add centrifuges for dewatering and haul cake
  - Implement anaerobic digestion (with thickening) to produce Class B material

Conclusions

- While the alternatives are similar for other facilities various factors influence decision:
  - Capital expenditures
  - Hauling distances
  - Long term reliability
  - Wastewater sludge characteristics
- While today's Biosolids processing and disposal options offer a larger variety of choices, costs (10-year assessment) still driver.

THANK YOU…

- Roger Brooks *City of Leominster* RBrooks@dpw.LEOMINSTER-MA.GOV
- Hans Tuneblom, P.E. *Veolia North America* hans.Tuneblom@Veolia.com
- Deborah Mahoney, *Hazen and Sawyer* dmahoney@hazenandsawyer.com
- Matthew Van Horne, P.E. *Hazen and Sawyer* mvanhorne@hazenandsawyer.com

NEWEA
WORKING FOR WATER QUALITY

VEOLIA
WATER

HAZEN AND SAWYER
Environmental Engineers & Scientists

Bullpen

Equipment Categories

- **Sludge pumps**
- **Thickening**
- **Dewatering**
- Polymer systems
- Digester covers
- Heat exchangers
- Boilers
- Cake conveyors

Equipment Categories

- Sludge pumps
- Thickening
- Dewatering
- **Polymer systems – assumed dry feeders**
- **Digester covers – assumed floating gas holder**
- **Heat exchangers – assumed spiral**
- **Boilers – assumed DG/NG capable**
- **Cake conveyors – could be shafted or shaftless**

Potential Pump Alternatives

Hose Pump

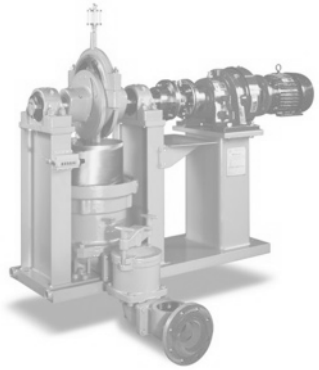
Progressive Cavity Pump

Double Disc Pump

Rotary Lobe Pump

Recessed Impeller Pump

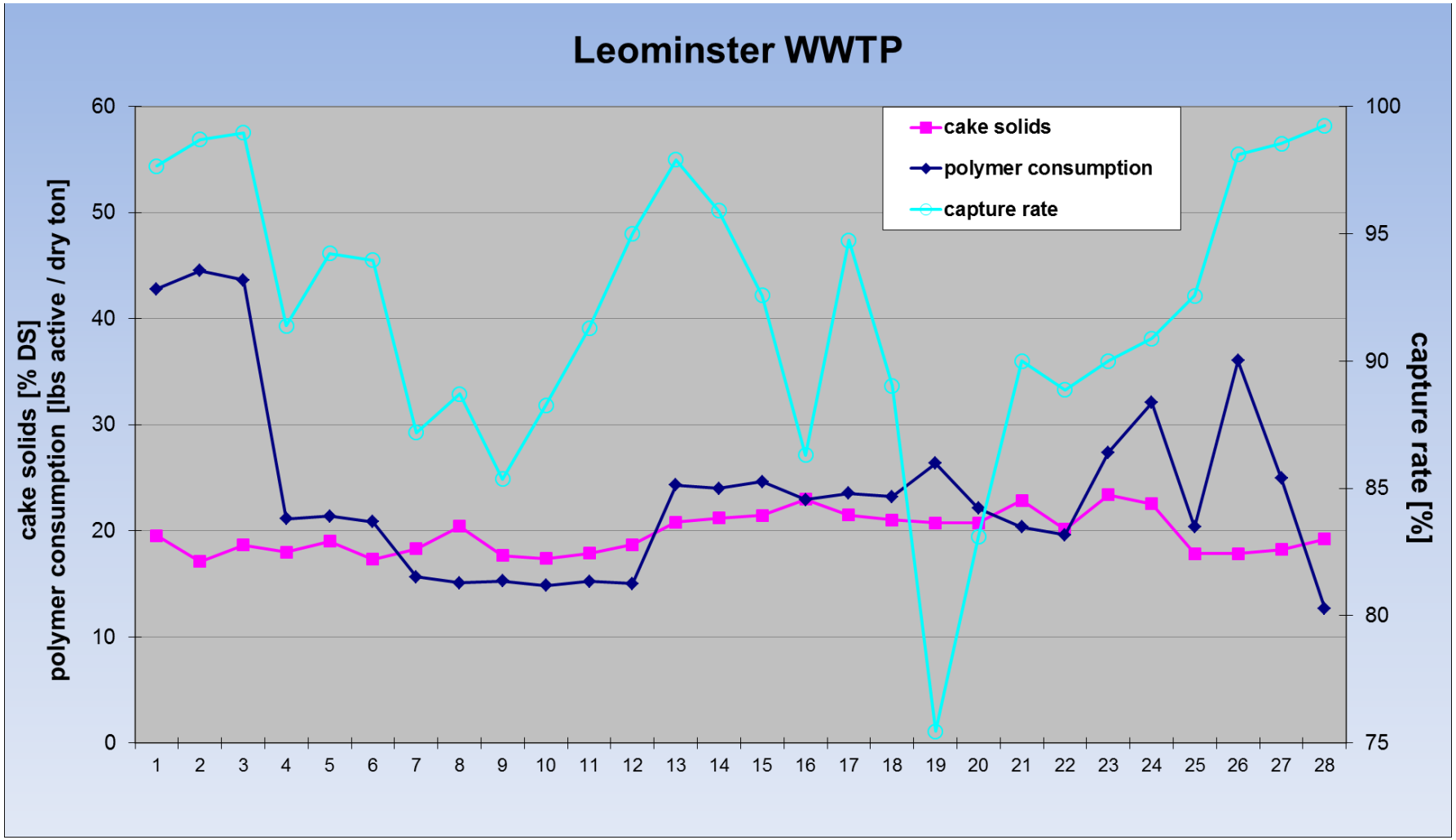
Plunger Pump



Thickening Equipment Recommendation

- Rotary Drum Thickener
  - Available in horizontal or inclined configurations
  - Attractive capital cost and low operating costs

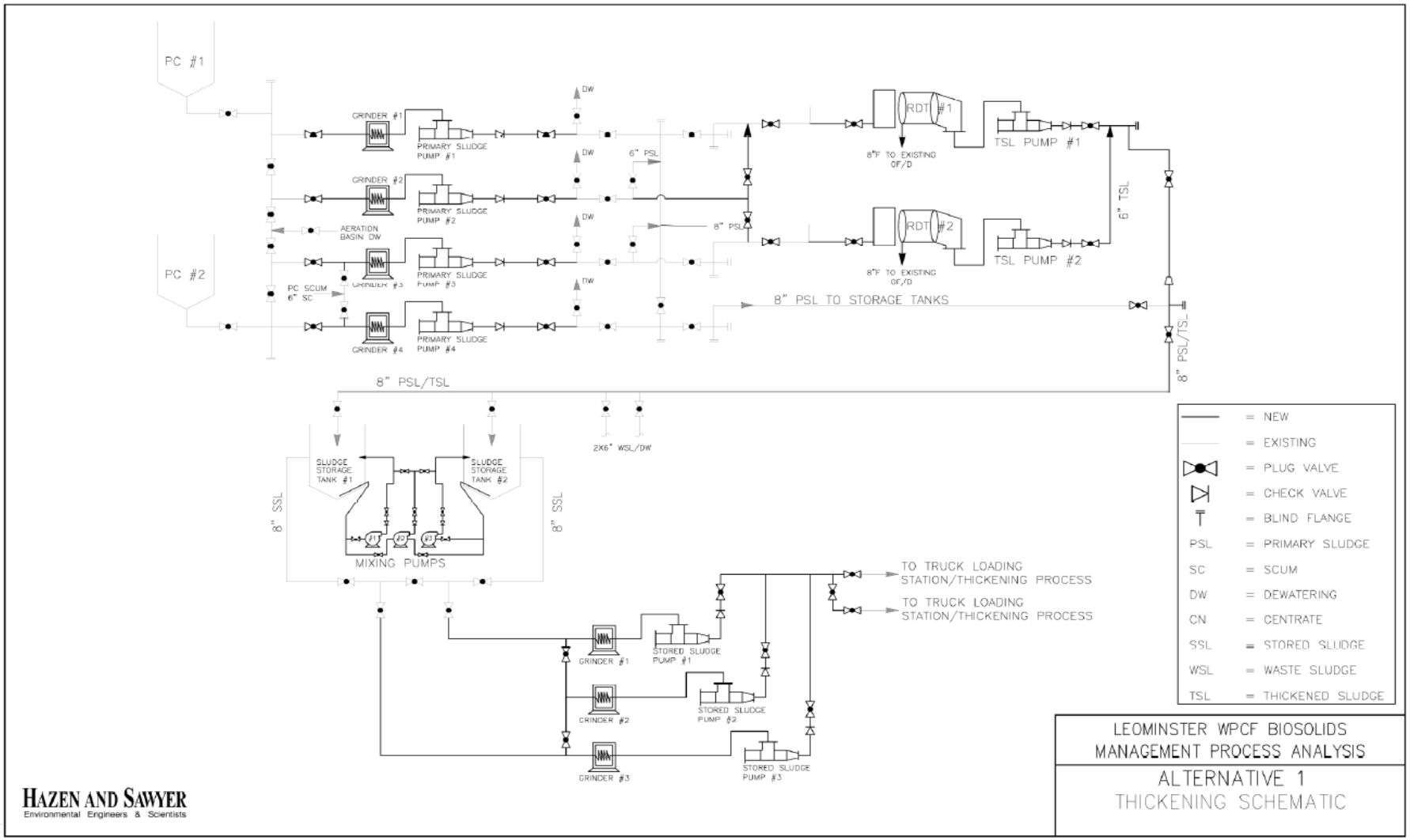
Screw Press Pilot Testing



Mechanical Review

- Two RDTs
- Piping and valve configuration
- Primary sludge pumps (4) with grinders
  - Progressive cavity
- Sludge storage mixing
  - Chopper pumps (3) each and nozzles
- Stored sludge pumps (3) with grinders
  - Progressive cavity or rotary lobe
- Thickened sludge pumps (2)
- Polymer systems (2)
  - Dry polymer, Acrison type
- 5-Ton bridge crane
- Odor control
  - Activated carbon
- HVAC

Schematic of Alternative 1



Structural Review

- Preliminary review of equipment loading
  - No increase in vertical loads and lateral loads
  - May require localized strengthening for concentrated loads
- Equipment location = no interferences
- Continuous support wall under each skid (2/unit)
- 5-ton bridge crane
  - Further review required, but generally appears to be feasible

Mechanical Review

Two Centrifuges

Inclined screw conveyor

Distributing screw conveyor

Primary sludge pumps (4) with grinders

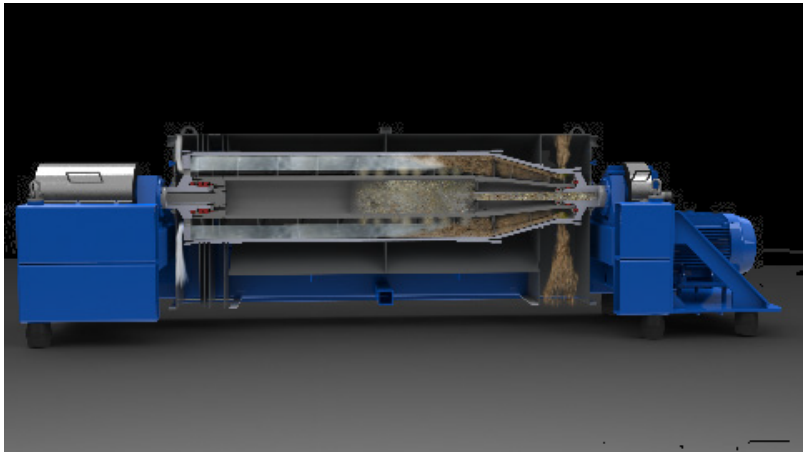
- Progressive cavity

Sludge storage mixing

- Chopper pumps (3) each and nozzles

Thickened sludge pumps (2)

- Stored sludge pumps (3)
- Polymer system
  - Dry polymer - Acrison type
- 5-ton bridge crane
- Odor control system
  - Activated carbon
- HVAC
- Piping and valve configuration



Total Project Capital Cost Summary

Category	Alternative 1 – Thickening	Alternative 2 – Dewatering
General	$272,000	$272,000
Equipment	$1,320,000	$2,083,000
Mechanical	$237,000	$243,000
Electrical	$490,000	$510,000
Instrumentation	$84,000	$97,000
Subtotal	*$2,403,000*	*$3,205,000*
Contractor Costs/Insurances and Bonds/ Engineering Inspections	$481,000	$641,000
Subtotal	*$2,884,000*	*$3,846,000*
General Requirements (5%)	$145,000	$193,000
Mobilization/Demobilization (2%)	$58,000	$65,000
Subtotal	$3,087,000	$4,104,000
Contractor Overhead and Profit (10%)	$309,000	$411,000
Subtotal	$3,396,000	$4,515,000
Escalation to Mid Point of Construction	$180,000	$240,000
Subtotal	$3,576,000	$4,755,000
Insurance and Bonds (3%)	$108,000	$143,000
Subtotal	***$3,700,000***	***$4,900,000***
Design/Construction Inspection (20%)	$800,000	$1,000,000
Construction Management (10%)	$400,000	$500,000
TOTAL PROJECT CAPITAL COSTS	***$4,900,000***	***$6,400,000***

Digestion Design Criteria

- Meet Class B stabilization (15 days at 95^{o}F)
- Provide suitable reliability

	Average 365	Maximum Month
Volume per existing tank	420,000 gallons	
Configuration	1 duty + 1 out of service	
Target SRT	20 days	15 days
Feed Solids	6% TS	
Feed Volume (7 day basis)	20,100 gpd	27,400 gpd
Actual SRT	21 days	15 days
Reliable Additional Feed Volume Available	7,300 gpd	0 gpd
Total Additional Feed Volume Available	34,700 gpd	27,400 gpd