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A Practical Solution to Eliminate Lime Scale Build-up in Slurry Lines

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Broad Creek II WTP

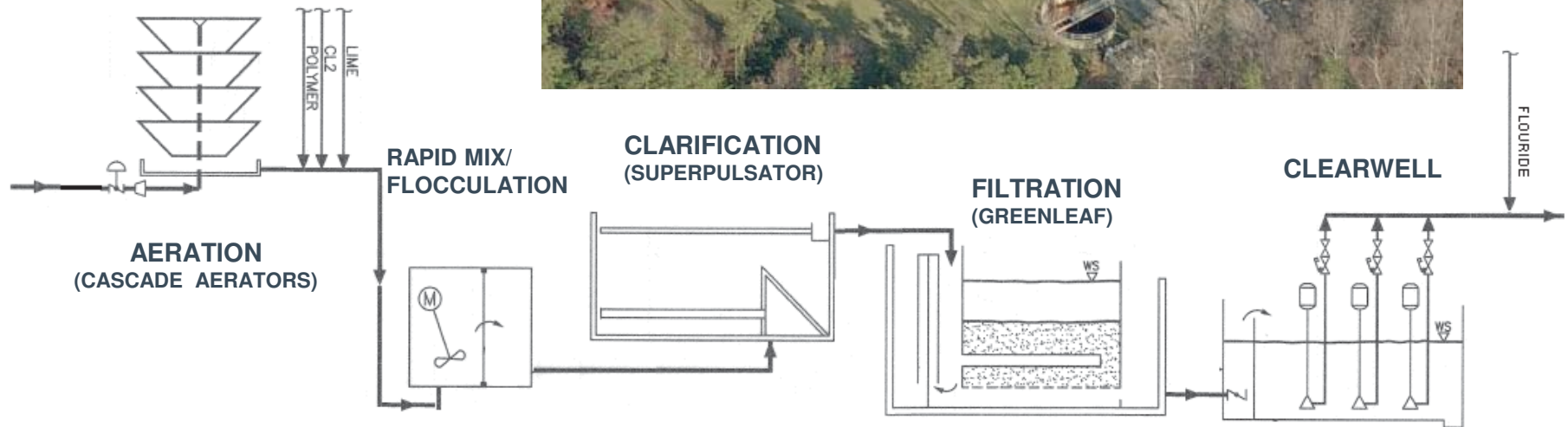
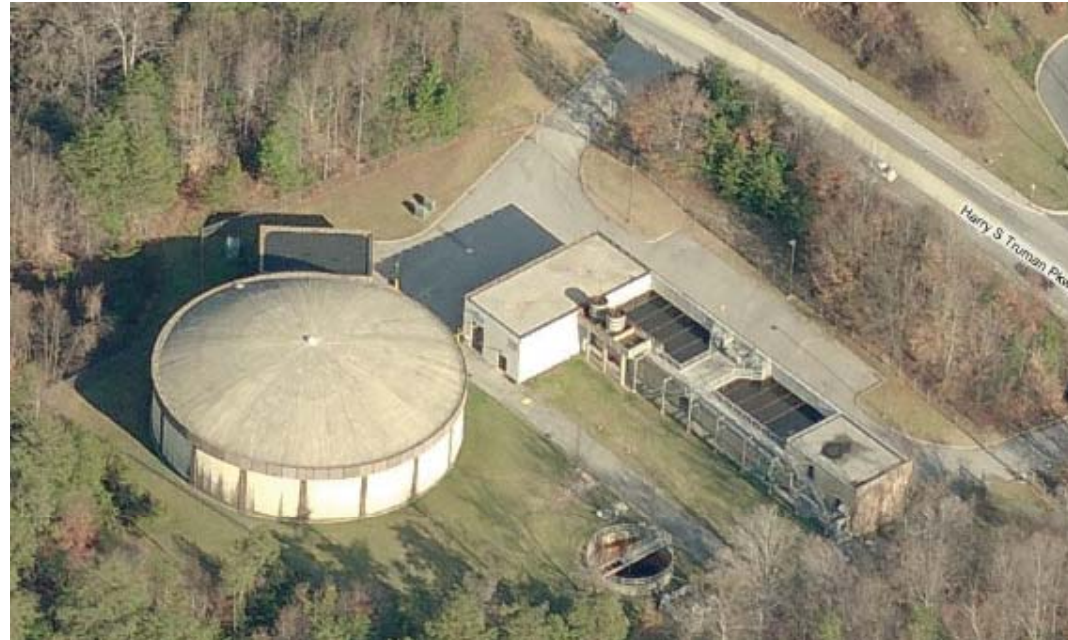


Plan Design Enable

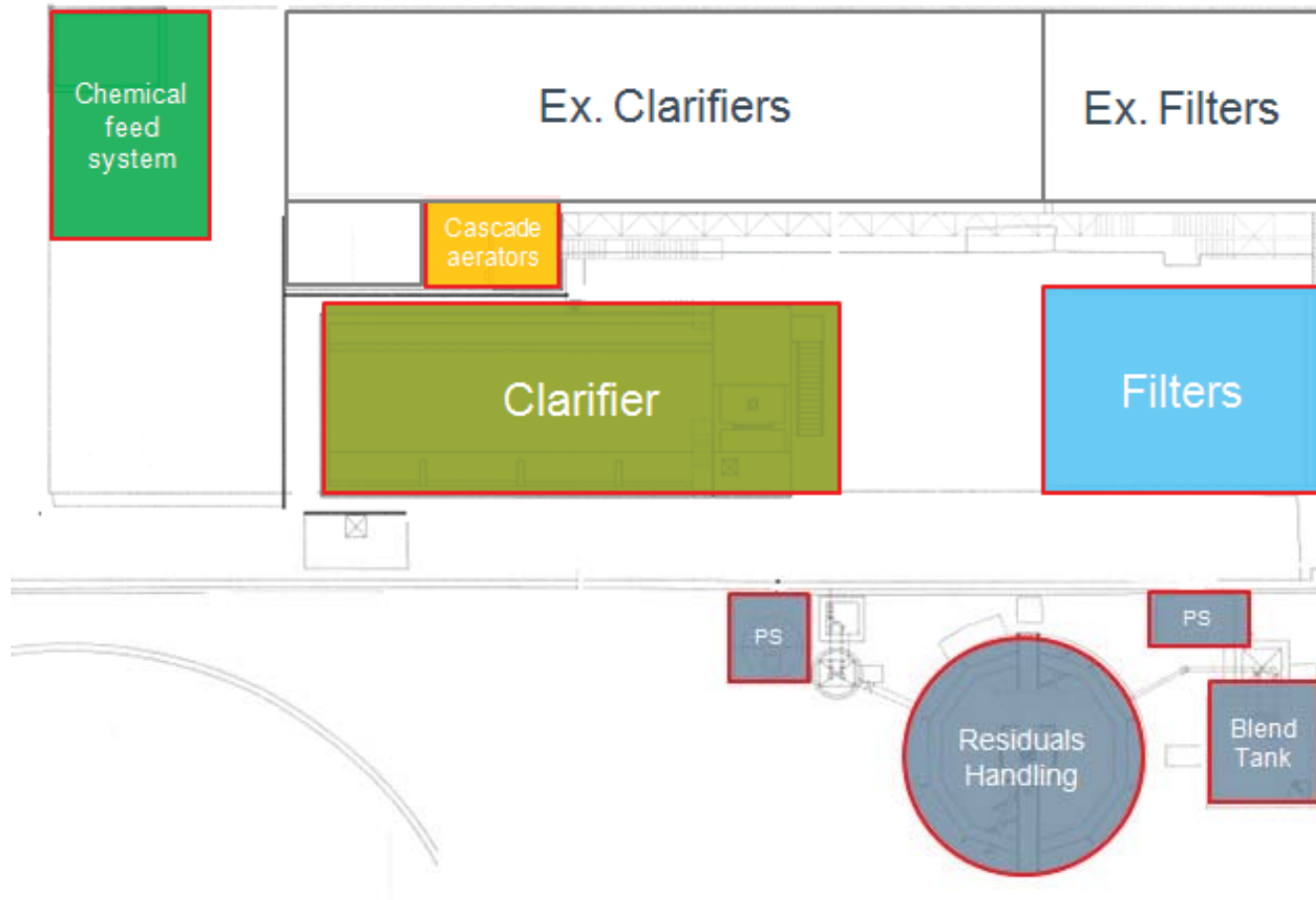
Agenda

- Broad Creek II WTP-Overview
- Existing hydrated lime system
- Issues with the existing system
- Alternatives for lime system improvements
- High Density lime specifics
- Proposed solution
- Maintenance of plant operations during construction

Broad Creek II WTP-Overview

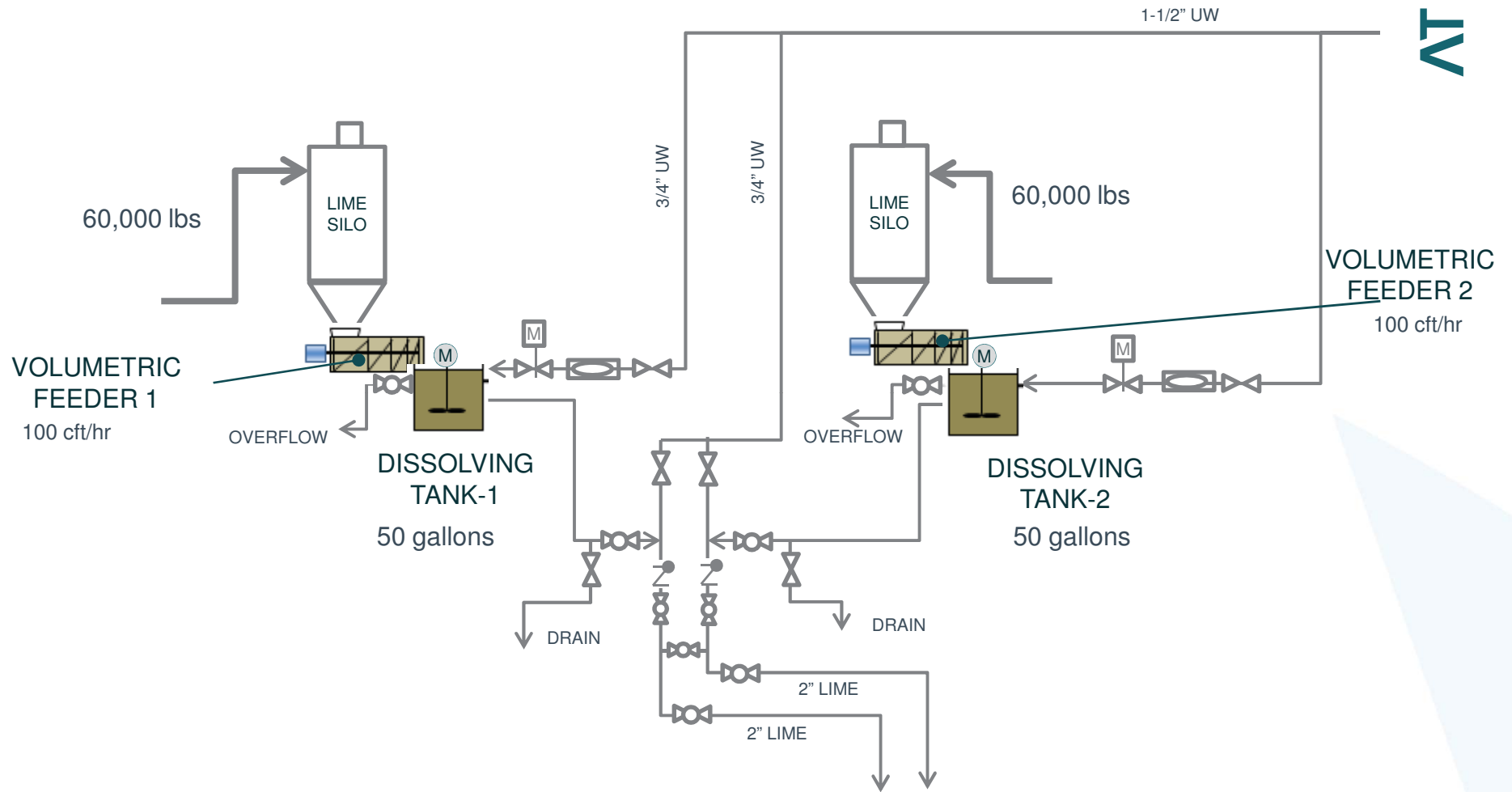


Expansion Project Layout



- 4-8 mgd
- New treatment train
- Lime feed and polymer feed improvements
- New residuals handling

Existing system (<10% lime)



Bin activator and volumetric feeder



hammer marks

Eductor system

Small dissolving tank

Feed lines and acid cleaning system



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Issues with the existing system

- Scaling
 - Acid-cleaning system installed, parallel lines provided
 - Increase Chemical (acid) cleaning
 - Backup lime slurry line
- Need redundant train/system for peak demands
- Better control on lime dosage

Alternatives – new feed point (8 mgd)

- Alternative 1: Retrofit Existing
 - Two (2) larger dissolving tanks
 - Upsize the piping
 - Two (2) new jet pumps
 - Continue using acid cleaning system
 - No modifications to silo



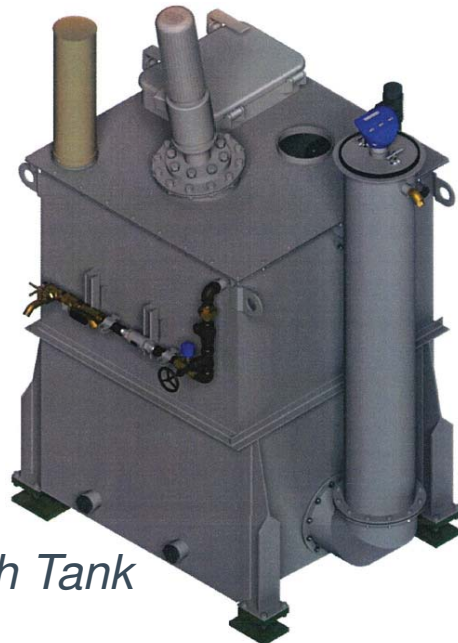
Volumetric Feeder and Dissolving Tank

Alternatives – new feed point (4-8 mgd)

- Alternative 2: New High Density Lime System (30%)
 - Two (2) new bin activators
 - Two (2) inclined conveyors
 - Two (2) weigh-batch systems
 - Two (2) transfer pumps
 - One (1) day tank
 - Three (3) metering pumps
 - No modifications to silo



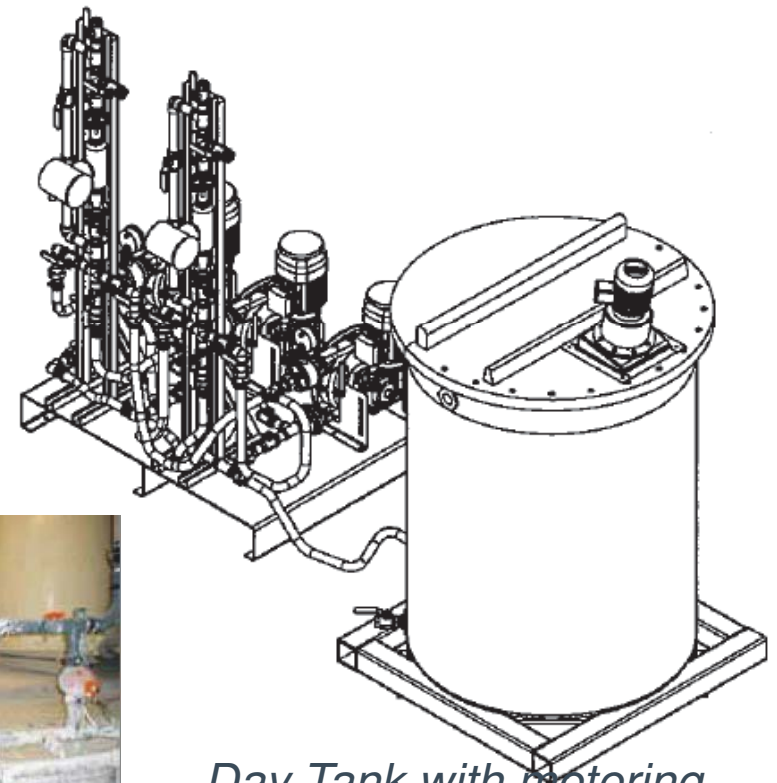
Bin Activator



Weigh Batch Tank



Transfer Pump



Day Tank with metering pumps

Alternative evaluation criteria

- Eliminate lime scale build –up in the slurry lines
- Improve the method of lime dispensing
- Eliminate the acid washing system
- Reuse of existing equipment where possible
- Provide redundancy
- Be cost (capital + O&M) effective

Advantages

Alternative 1 (Retrofit)

- Less capital cost (about half the cost of high density system)
- Reuse of existing equipment
- Acid cleaning may minimize scaling
- Familiarity with the system

Alternative 2 (High Density Lime)

- Reduces operational costs by about 10%
- Reduce scaling without acid cleaning
- Redundancy
- Better method of lime dispersion and calibration with mass flow/density flow meters
- Improved reliability of the system

High/Low Density Lime Comparison

Mixer for batch tank:

Mixer for batch tank only runs when batching and then every say 6 hrs for 30 minutes.

The HDLS system will have 2 ½ times more lime in suspension and does not require continuous operation as stated above.

Mixer for the holding/aging tanks:

Runs 30 minutes every 6 hours or after say 2-3 batches have been transferred from mix tank

Pumping to Treatment Trains:

Requires two (2) metering pumps for a two (2) train system and can be stopped for several hours without flushing the system

Metering pumps are metering to the treatment trains either one train or two trains. High Density systems can be shut down for up to 3-4 days without flushing the lines.

Note: Not recommend but it can be done. The combined hp for two (2) high density slurry pumps will always be less than a recirculation loop slurry pump and in many installations one train may be shut down for several months during the fall and winter.

Mixer for batch tank:

Mixer for batch tank must run continuous if slurry is in tank.

Mixer for the holding/aging tanks:

Must run continuous 24/7

Pumping to Treatment Trains:

Must pump enough slurry to feed the treatment trains plus enough slurry to always maintain the return slurry loop at 2.5'/sec

The low density system must continue to pump at the maximum rate even if one train is shut down. These systems if being shut down for any period of time must be flushed.

Evaluation summary

Criteria	Retrofit Alternative 1	New HD Lime System Alternative 2
Eliminate lime scale build –up in the slurry lines	2	5
Improve lime dispensing	3	4
Eliminate the acid washing system	1	5
Reuse of existing equipment	4	2
Redundancy	1	5
Cost	4	3
Total	15	24

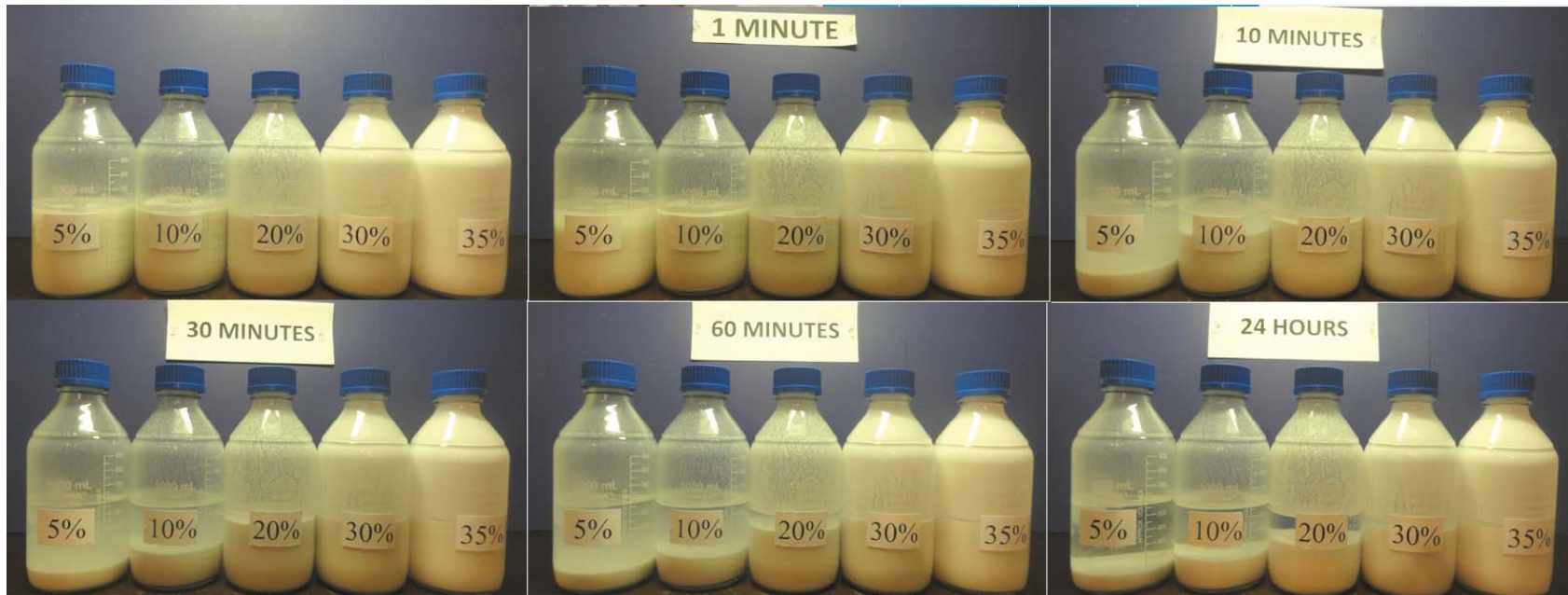
Note: 5 highest 1 lowest

Specifics - High density lime (35%)

- 35% slurry acts as a pseudo plastic and will not settle or scale pipelines
- 35% slurry has a viscosity of 200 cps . Tomato juice is 180 cps
- Size metering pumps with a 30:1 turn-down.
- Size slurry piping with a min velocity of 2 fps and max of 4 fps.
- Low grade hydrated lime contains higher silica causing pump and meter wear.
- Less water required (compared to 18%) to produce a high density slurry.
- No heat of reaction in the hydration process (safety)

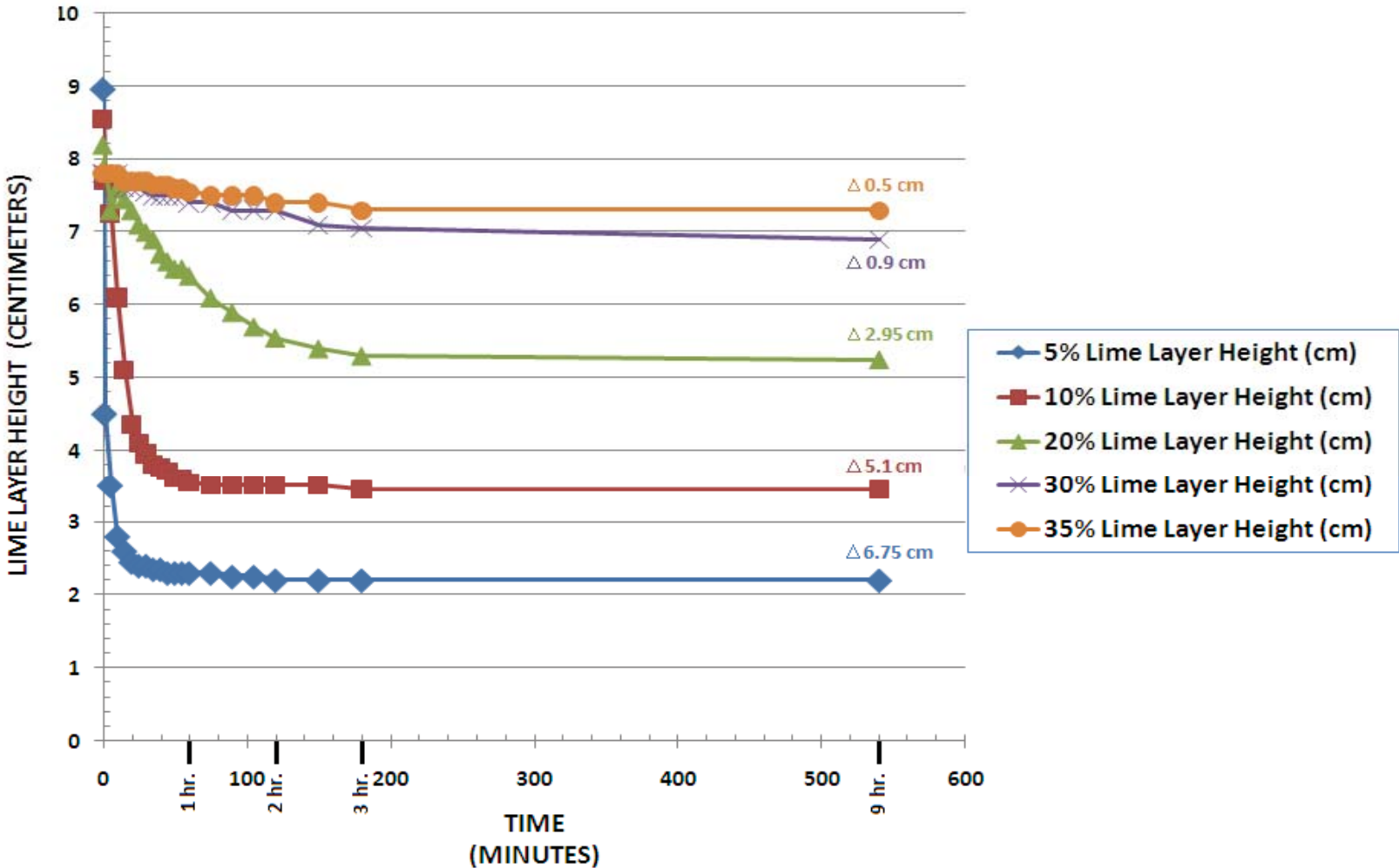


No settling at concentrations $>20\%$



Courtesy – Merrick Industries, Inc.

LIME SETTLING OVER TIME



Courtesy – Merrick Industries, Inc.

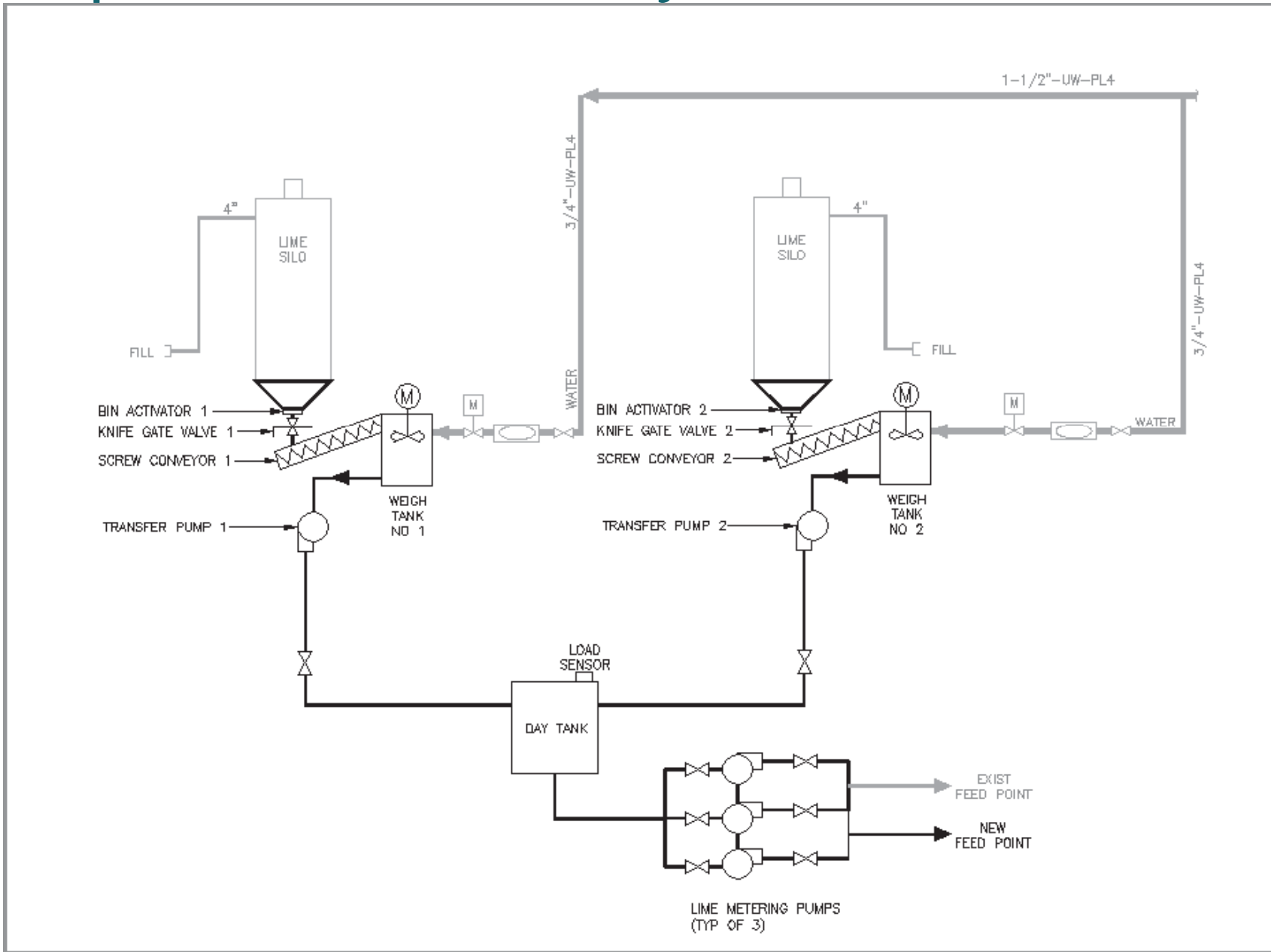
High Density System Advantages

- Cost effective and reduced downtime
- Better calibration with mass flow/density flow meters
- Minimized scaling
- Equipment size reduction
- Energy efficient
- Lower water use
- Consistent slurry density
- Elimination of acid cleaning of slurry lines
- Low maintenance
- Reliable

High Density Lime System Installations

- East Peoria, IL – WTP, (Installed 2007)
- Oklahoma City – Draper WTP (Installed 2004)
- West Chicago, IL – WTP, (Installed in 2004)
- Frito Lay Plant, York, PA:
- Fort Collins WTP, Fort Collins, CO:

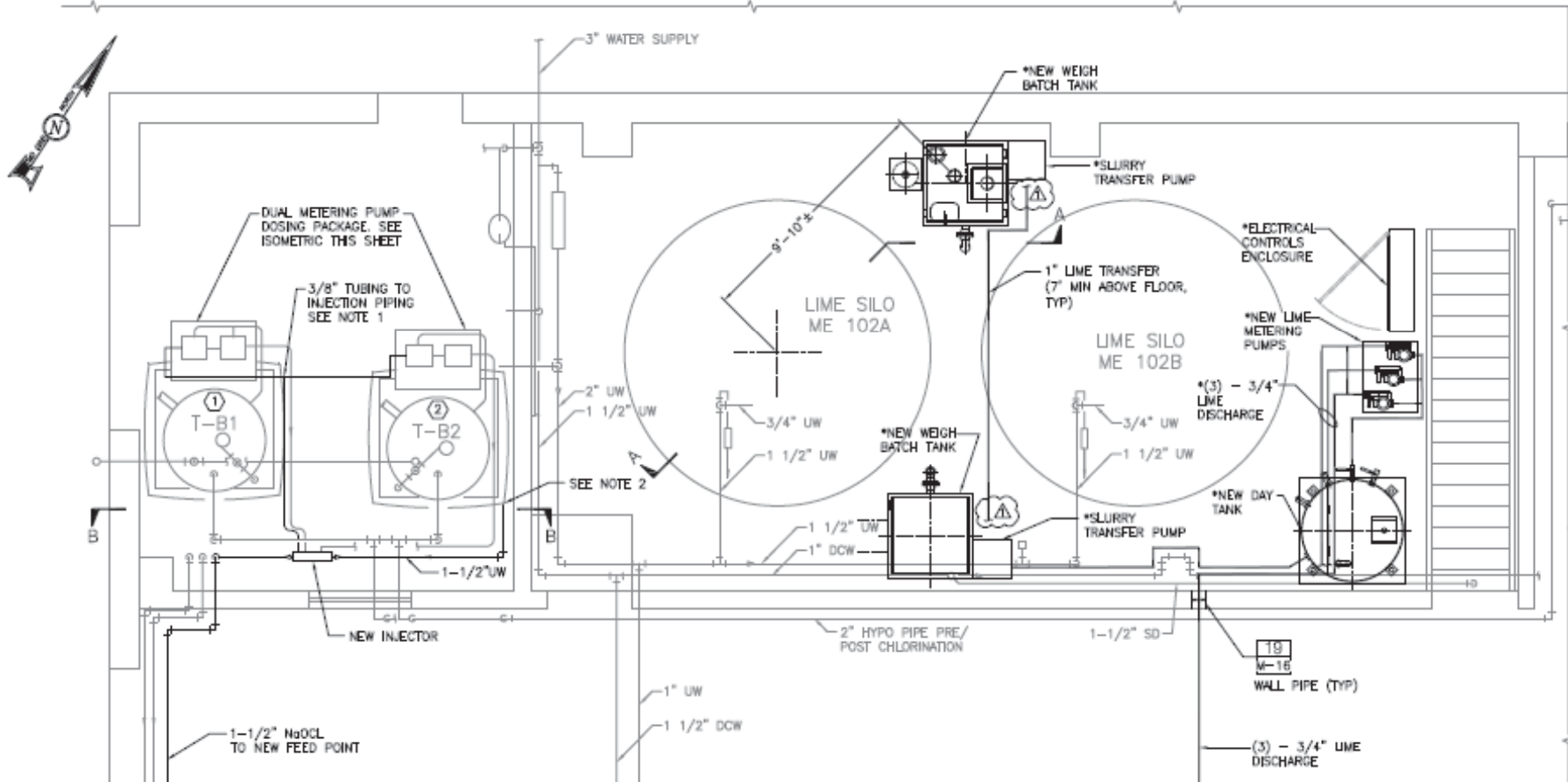
Proposed HD Lime System



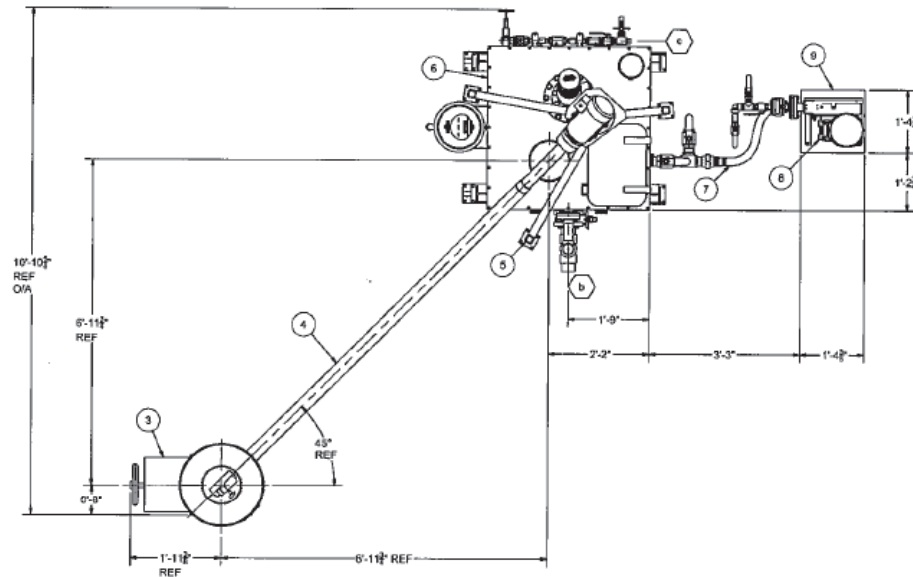
Proposed System Design Criteria

- Lime: 37.5 percent
- Maximum dry density: 35 lbs/cu ft
- Transfer pump rate from batch tanks to day tank: 720 gph
- Volume of each batch tank: 250 gallons
- Volume of day tank: 330 gallons
- Maximum feed rate of metering pumps: 60 gph

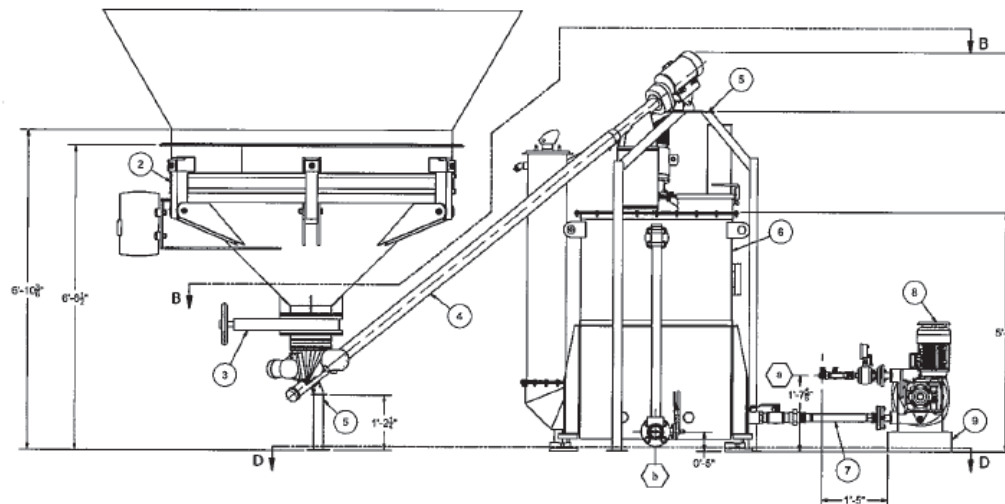
Proposed layout



Conveyor and Batch Tank



VIEW B-B
SCALE 1/16



ID100727 GA SILO RETROFIT HIGH DENSITY LIME	
ITEM	EQUIPMENT
2	8' O.D. BIN ACTIVATOR, 10" DIA. STD. ANSI 150W FLANGED OUTLET, CARBON STEEL CONSTRUCTION FACTORY PAINTED, 3 HP 230-460/3/60 VAC VIBRATOR MOTOR TENV. BLACK NEOPRENE NYLON REINFORCED FLEXIBLE SLEEVE WITH STAINLESS STEEL CLAMPS.
3	10" KNIFE GATE VALVE, MANUAL, HAND WHEEL W/ SS CONTACT PARTS
4	INCLINED SCREW CONVEYOR CARBON STEEL CONSTRUCTION W/ 10" DIA INLET, BALANCED KNIFE EDGE SPIRAL W/ ELECTRO-MECHANICAL AGITATION
5	CONVEYOR SUPPORT STAND, CARBON STEEL CONSTRUCTION EPOXY PAINTED
6	250 GALLON SLURRY BATCH TANK ASSEMBLY W/ ELECTRIC MIXER W/ 6" BREATHER BAG W/ OVERFLOW AND DRAIN ASSEMBLY. STILL WELL ASSEMBLY W/ ULTRASONIC LEVEL CONTROL AND QTY (4) LOAD CELLS FOR WEIGHT CONTROL
7	1" NOMINAL BATCH TANK TO TRANSFER PUMP PIPING ASSEMBLY W/ BALL VALVE AND FLEXIBLE HOSE SECTION
8	DURA 35 PERISTALTIC METERING PUMP, 2 HP TEFC PREMIUM EFFICIENT MOTOR, 44 RPM MAX FOR 7.5 GPM @90 PSI MAX, 230-460/3/60 VAC
9	PUMP SUPPORT PEDESTAL, CARBON STEEL CONSTRUCTION AND EPOXY PAINTED

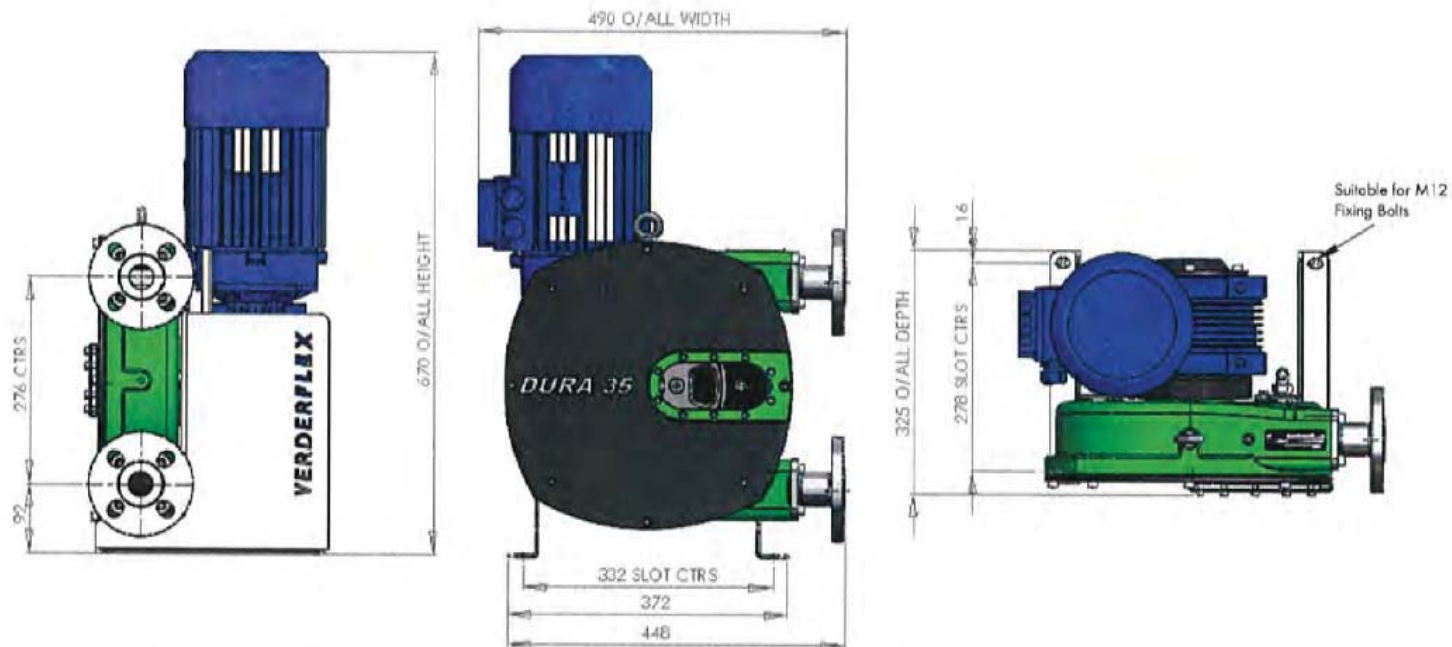
PIPING CONNECTIONS

- a. 1.00" NPT LIME TRANSFER LINE
- b. 4.00" OVER FLOW/DRAIN OUTLET
- c. 1.00" NPT SUPPLY WATER

Hose Pumps – Verderflex Dura

- Slurry Transfer Pumps
- Metering Pumps

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Batch Tank

Tank Application

The 250 Gallon Tank High Density Slurry Tank is specifically designed for mixing CaOH Calcium Hydroxide with water.

Theory of Operation

The slurry batching system will produce a slurry of 30%-40% by weight (calcium hydroxide) that will not scale and will for all practical purposes, be a stable suspension making pipe line settling velocity a mute point. With Properly sized dry feed equipment the system will produce a 30%-40% by weight calcium hydroxide slurry at up to 25,000 dry Lbs/24 hr. day with an accuracy on a batch to batch basis of plus or minus ½ of 1% by weight.

NOTE: The maximum capacity stated above is based on producing a 250 gallon finished batch of 35% by weight calcium hydroxide slurry. Clean water must be supplied to the inlet water header at 50 to 55 PSIG and a flow rate of 40 GPM.

Materials of Construction

- .18 Plate Tank Complete with Inlet, Outlet, Drain Connections
- Epoxy Painted Carbon Steel w/ Special easy release coating inside of tank
- Double Sloped Bottom
- Reinforced Exterior Leg Support
- .25" Plate Cover w/ mixer mount
- Also Available in SS3316

Mechanical Mixer

- Low Speed Impeller 350 max RPM
- 316 Stainless Steel Shaft and Impeller
- 1.50 HP 1750 RPM 230/460/3/60 Motor

Breather Bag

- 6.00" Breather Bag
- Flannel Bag
- SS clamps



Drop Pipes

- Provided on Water Inlet and Overflow
- PVC Pipe

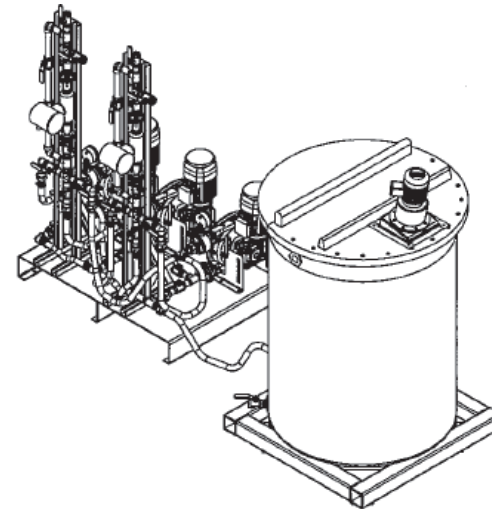
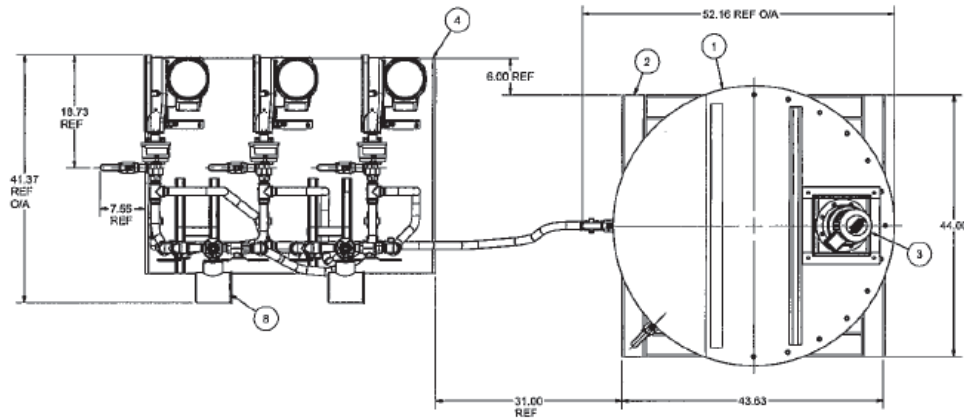
Water Control

- Flow meter/transmitter
- Check Valve
- Y Type Strainer
- Ball Valve
- Flush Connection

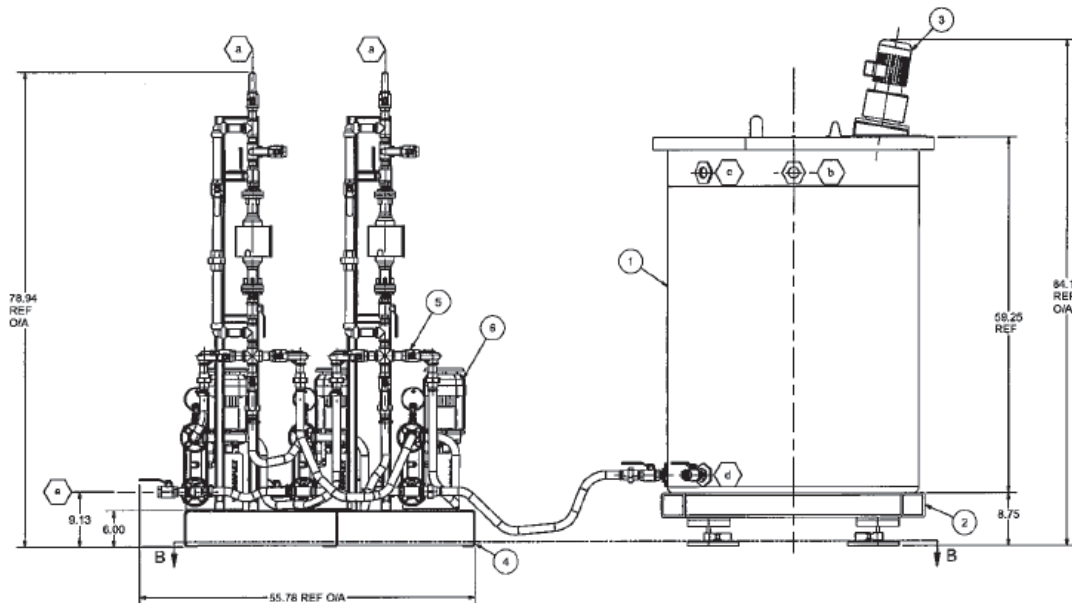
Level Sensor

- Ultrasonic Level Sensor
- Stilling Well (to reduce error in level due to tank roll caused by mixer)

Day Tank and Metering System



ISO VIEW



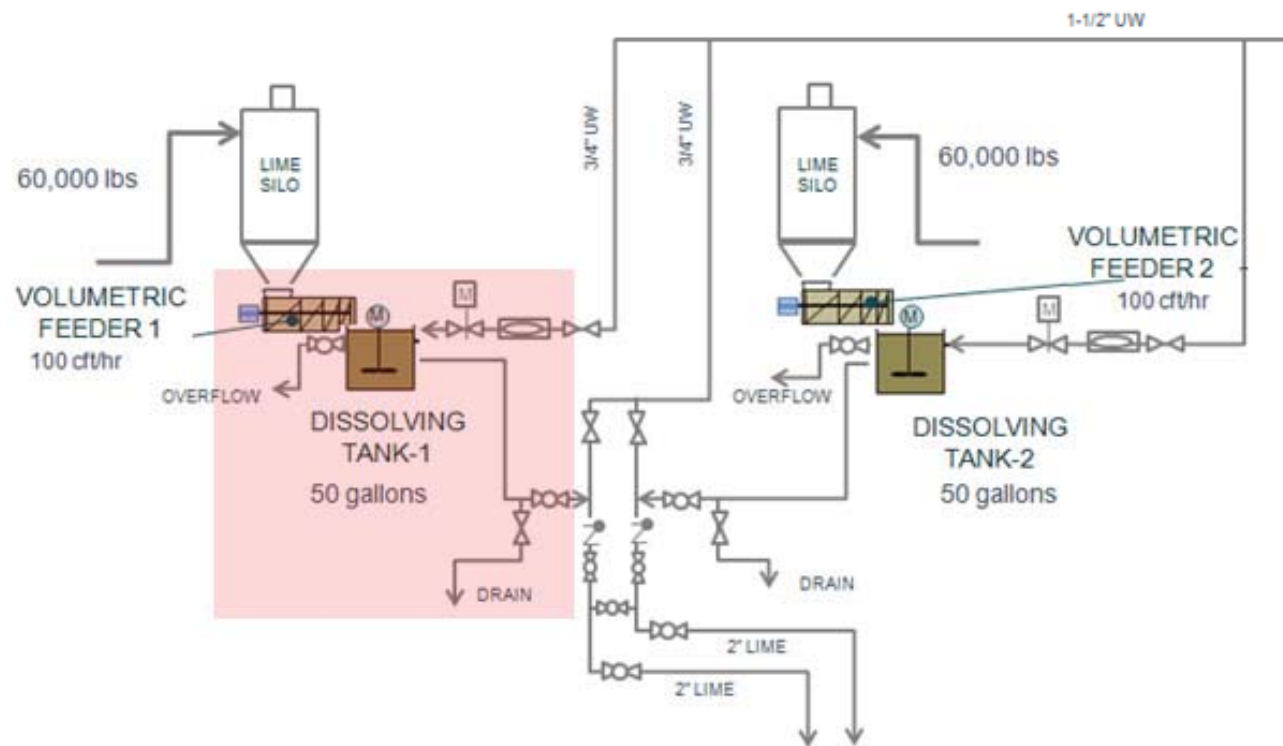
ID100728-1 GA DAY TANK WITH PUMP SKID	
ITEM	EQUIPMENT
1	300 GALLON DAY TANK, LINEAR HIGH-DENSITY POLYETHYLENE W/ REINFORCED AND BOLTED COVER
2	DAY TANK PLATFORM, CARBON STEEL CONSTRUCTION W/ QTY (3) LOAD CELLS
3	350 RPM MIXER W/ 1 HP TEFC MOTOR, SS316 SHAFT AND 12" IMPELLER
4	PUMP SKID WELDMENT, CARBON STEEL CONSTRUCTION
5	DISCHARGE INSTRUMENTATION MANIFOLD W/ SS304 PIPING, BRASS BALL VALVES, QTY (2) COREOLIS TYPE MASS FLOW DENSITY METERS AND QTY(3) PRESSURE SWITCH SENSORS W/ ISOLATION VALVE AND GAUGE
6	DURA 25 PERISTALTIC METERING PUMP, 1.5 HP TEFC PREMIUM EFFICIENT MOTOR, 44 RPM MAX FOR 3.38 GPM @90 PSI MAX, 230-460/3/60 VAC

PIPING CONNECTIONS

- a. 0.75" NPT SLURRY DISCHARGE QTY (2) LINES
- b. 1.00" NPT SLURRY INLET
- c. 1.50" NPT DAY TANK OVERFLOW
- d. 1.50" NPT DAY TANK DRAIN
- e. 1.00" NPT PUMP FLUSH WATER QTY (3) LINES

Maintenance of plant operations during construction

- No shutdowns
- One lime feed system may be out of service at a time
- Lime silo must be emptied before existing bin activators can be removed
- After new treatment train is operational-remove existing lime feed point from service-connect new lime slurry pipe to existing feed point



Acknowledgements

- Anne Arundel County
 - Ben Thompson– Broad Creek II WTP Plant Manager
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Questions???