INNOVATIVE BIOSOLIDS MANAGEMENT

LITTLE PATUXENT WATER RECLAMATION PLANT
HOWARD COUNTY, MD

County Engineers Association of Maryland – Spring 2022 Conference

Joshua Gliptis - April 14, 2022

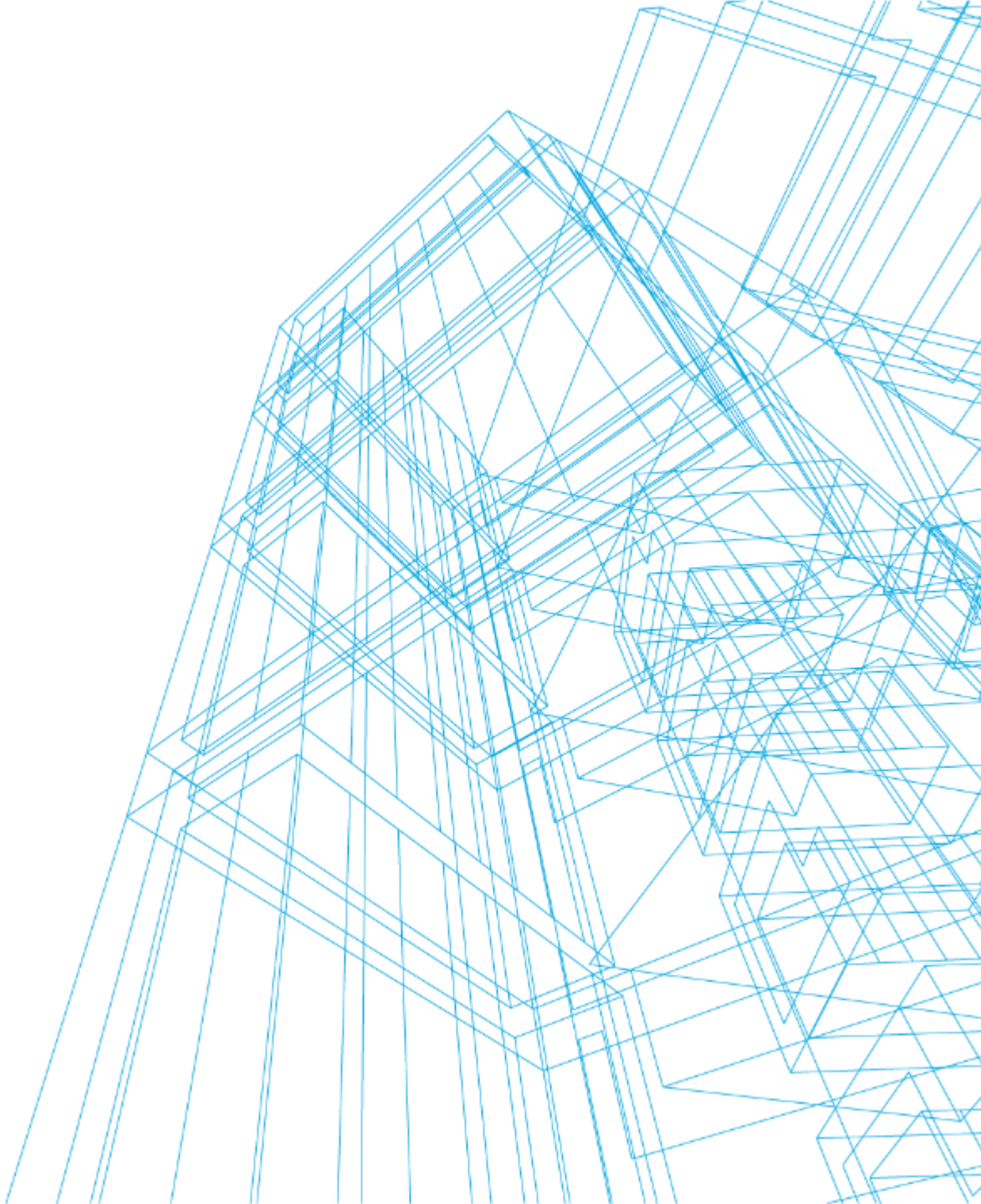
BIOGRAPHY – JOSHUA GLIPTIS, P.E.

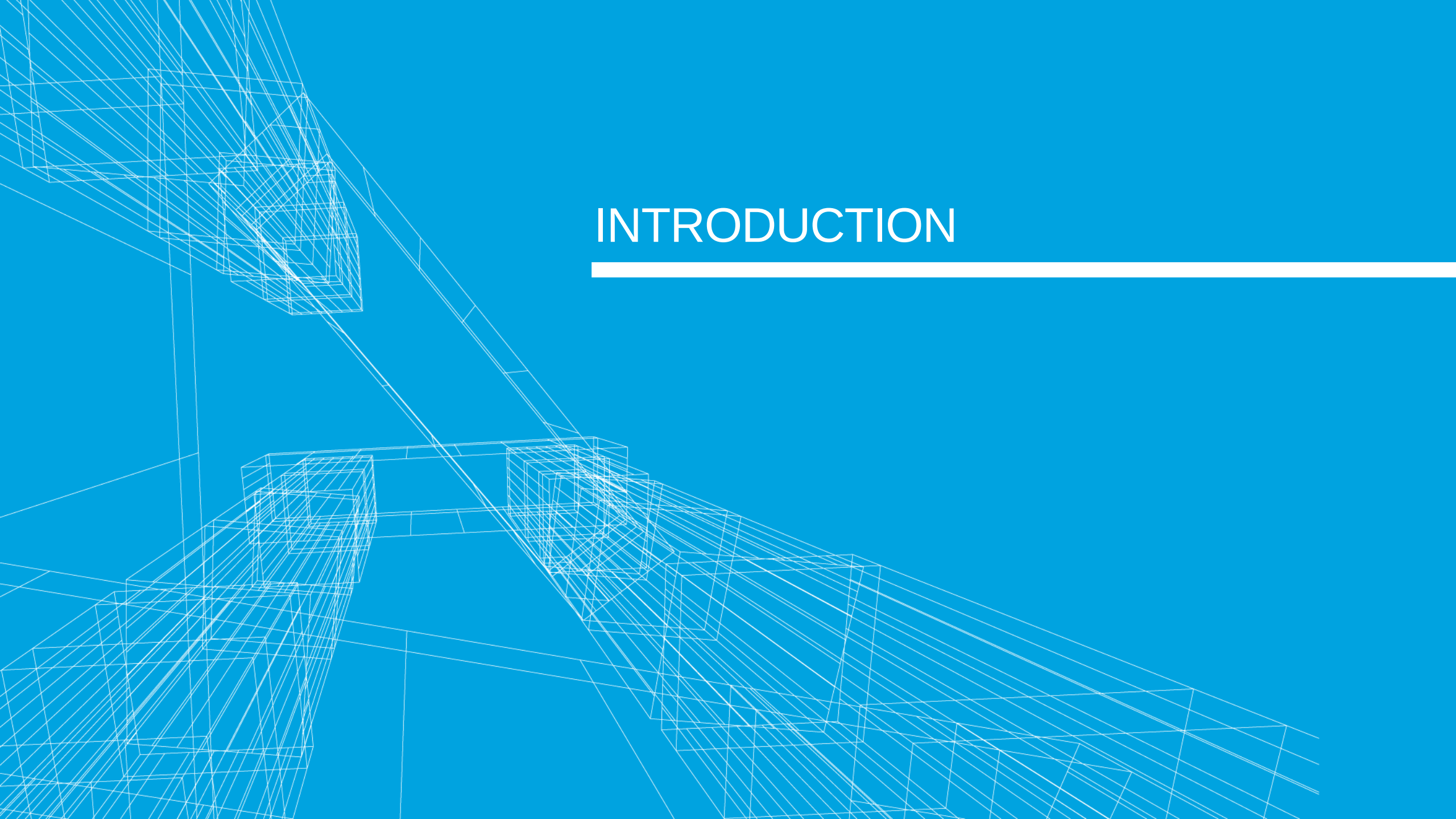
- License Maryland Professional Engineer, #36570
- Licensed Water/Wastewater Operator, #1413
- Over 22 years of experience in the water sector
  - 8.5 years with equipment manufacturer and manufacturer's representative
  - 5.5 years with design consultants
- Bachelor of Science in Geo-Environmental Engineering, Penn State University
- Employed at Howard County Department of Public Works, Bureau of Utilities, Technical Services Division since May 2013
- Principal responsibilities are capital project management and technical support for the Operations and Maintenance Divisions overseeing the water distribution system, sewer collection system and water reclamation facilities.

AGENDA

PDH Value – 1.0 Hour

- Introduction
- Planning
  - Intentional, proactive, focused approach to “The Mission”
  - “Starting with the end in mind”
- Preconstruction and Design
  - CMAR delivery approach and procurement of services
  - Innovative design and process selection
- Construction Progress and Challenges
  - Adaptive, nimble, expedient, collaborative
- Commissioning and Start-up
  - Systematic, performance-based QA/QC
  - COVID impacts
- Closing
  - Lessons Learned and Summary





INTRODUCTION

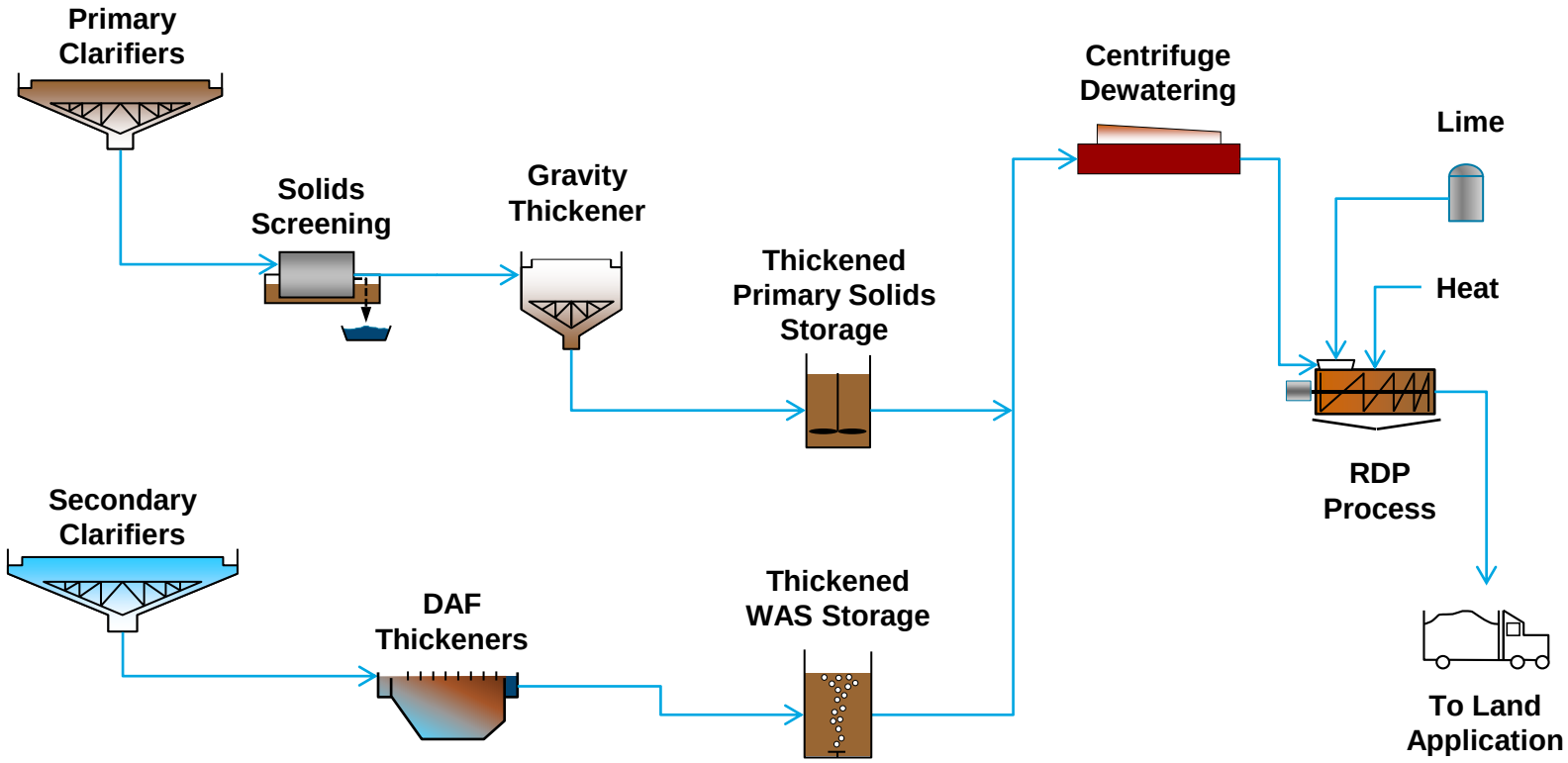
INITIAL CONDITIONS AT START OF PROJECT

- Name: Little Patuxent Water Reclamation Plant (LPWRP)
- Location: Howard County, Savage, Maryland
- Average Daily Flow of 20 mgd and Permitted Capacity of 29 mgd
- Enhanced Nutrient Removal (ENR) process via Modified Bardenpho Process with Denitrification Filters and Biological Phosphorous Removal
- RDP EnVessel Pasteurization for Class A, EQ Solids
- Biosolids production: 50,000 wet tons/year; 7 trucks per day
- Backup Class B Lime Stabilization or Landfill
- Synagro provides contract operations of RDP, distribution and land application

Existing Little Patuxent WRP

EXISTING LPWRP SOLIDS PROCESS

- RDP advanced alkaline stabilization process for Class A EQ biosolids (dewatered cake)



Project Objective:

Design and construct a reliable, cost-effective, and socially responsible treatment facility resulting in beneficial use of LPWRP biosolids in Maryland, for a changing and unpredictable regulatory environment.

Bureau of Utilities

LITTLE PATUXENT WATER RECLAMATION PLANT

Little Patuxent WRP Mission Statement:

Provide environmentally responsible, reliable and cost effective water reclamation services to Howard County.

BUDGET AND TIMELINE

- 2013 Master Plan
  - Approximately $100,000
  - Used on-call engineer HDR Engineering
- 2014 Preliminary Engineering Report
  - Approximately $400,000
  - Continued working with HDR Engineering
- 2015 Est. Capital Project and Procure Engineering Services
  - Initially Fund at $84M: $12M - Planning & Engineering, $70M - Construction, $2M - Administration
  - Qualifications Based Solicitation issued, awarded to HDR Engineering for about $7M
  - Began Design in July
  - Immediately started drafting QBS for CMAR, advertised in November

BUDGET AND TIMELINE (CONT.)

- 2016 Procure Construction Manager at Risk (CMAR) for Preconstruction Services
  - Award to Clark Construction
  - Develop Dryer Supplier Solicitation, Clark Advertises in July
  - Phase 1 Design Complete in November, HDR transitions to construction phase services (~$8.5M)
  - Clark solicits for subcontractors and suppliers
- 2017 Begin Construction
  - January Guaranteed Maximum Price (GMP) awarded for approx. $65.5M including Dryer Package ($8M)
  - Construction for all Phase 1 facilities starts in February
  - Team progresses Phase 2 design now with Dryer supplier, first dryer design workshop in Dec.
- 2018 Progress Phase 1 Construction – Complete Phase 2 Design, Start Building
  - Design of Phase 2 Complete in January
  - Clark solicits for subcontractors and suppliers, GMP2 early start package issued May 2018
  - Final GMP issued July 2018 – Total now $92.5M for Construction
  - Anaerobic digesters started in November (major milestone met)

BUDGET AND TIMELINE (CONT.)

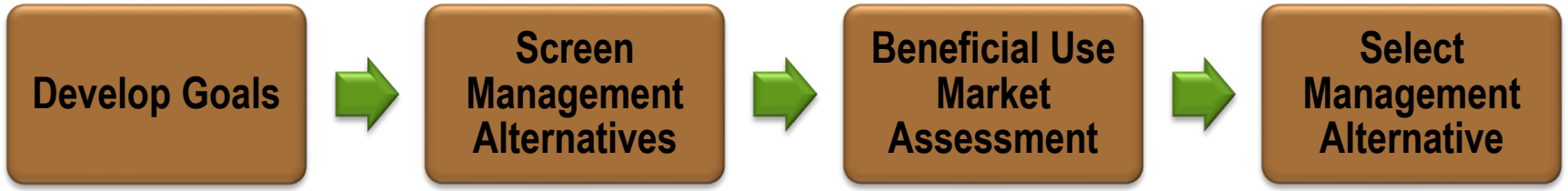
- 2019 Finish Phase1 Construction – Progress Phase 2 Construction
  - Punchlist and warranty issues with Phase 1
  - Phase 2 building completion and construction of dryer facilities/processes
- 2020 Phase 2 Commissioning & Startup
  - Progressed despite COVID challenges, but contract was extended due to some delays in commissioning and final construction
  - Dry checkout, wet checkout, and performance testing
- 2021 Phase 2 Completion
  - Final commissioning, punchlist and warranty items
  - Substantial Completion issued December 2020
  - Final Completion issued August 2021

PLANNING

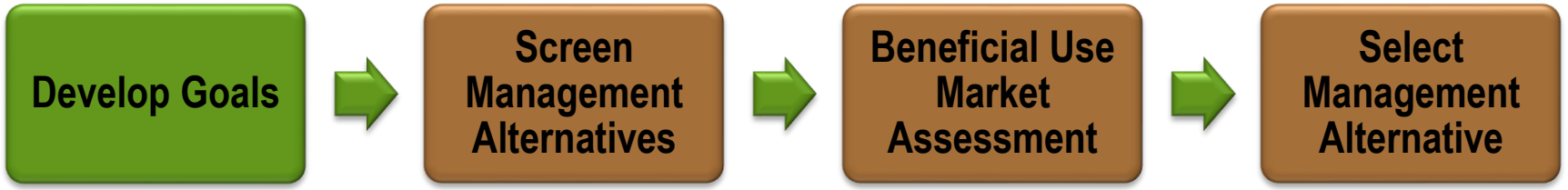
2013 Biosolids Master Planning

Develop a Biosolids Master Plan that provides a framework for reliable, cost-effective, and socially responsible treatment and beneficial use of LPWRP biosolids in a changing and unpredictable regulatory environment.

- Drivers:
  - Evolving regulations for agricultural land application
  - Winter land application ban
  - Phosphorus Management Tool
- Poor workplace environment with lime dust
- High operating cost
- Poor system reliability

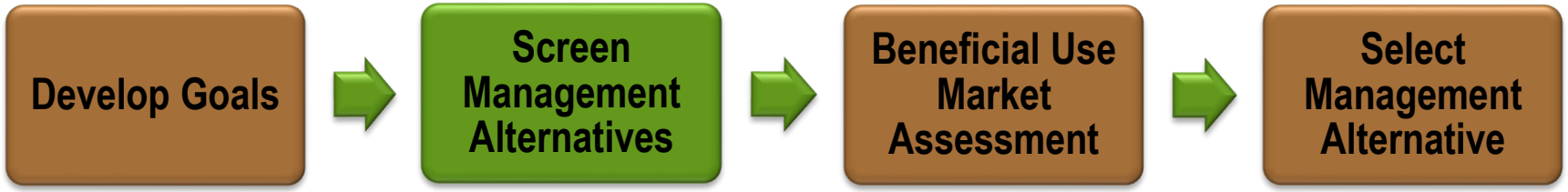


2013 Biosolids Master Planning



- Goals:
  - More versatile biosolids product (i.e., useable in various markets)
  - Biosolids volume reduction
  - Improved workplace environment (i.e., no corrosive lime dust)
  - Improved ease of operations and system reliability
  - Reduced operating cost and chemical demands

2013 Biosolids Master Planning

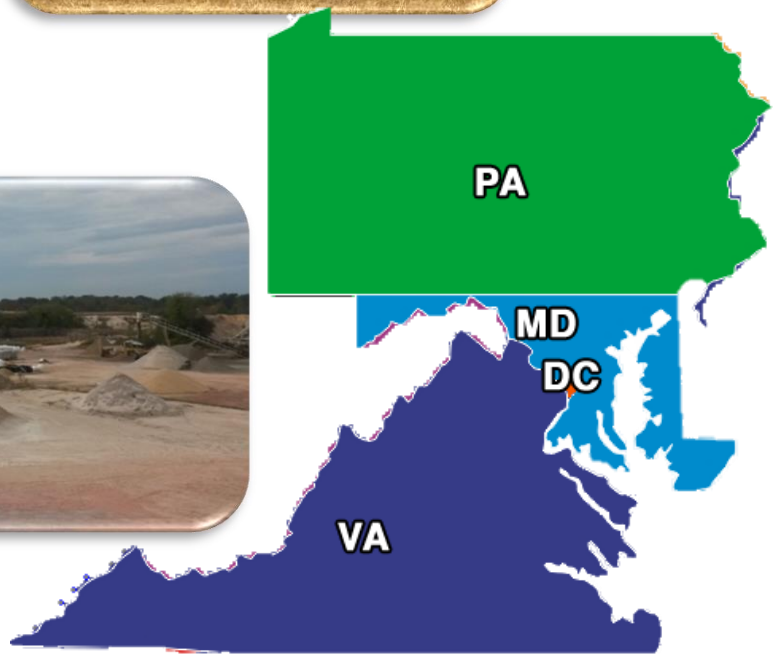


No.	Anaerobic Digestion	Dewatering	Added Stabilization	Energy Recovery	Product	Beneficial Use
1	None	Centrifuge	RDP	NA	EQ cake	Bulk agricultural
2	None	Centrifuge	Drying	NA	EQ granule	Bulk agricultural
5	Mesophilic	Centrifuge	RDP	CHP	EQ cake	Bulk agricultural
7	Mesophilic	Centrifuge	Drying	Dryer fuel	EQ granule	Specialty fertilizer, turf, soil blending
10	THP/ Mesophilic	Centrifuge /BFP	None	THP, CHP	EQ cake	Bulk agricultural
13	THP/ Mesophilic	Centrifuge	Drying/ Screening	THP, Dryer	EQ granule	Specialty fertilizer, turf, soil blending

2013 Biosolids Master Planning

Develop Goals → Screen Management Alternatives → Beneficial Use Market Assessment → Select Management Alternative

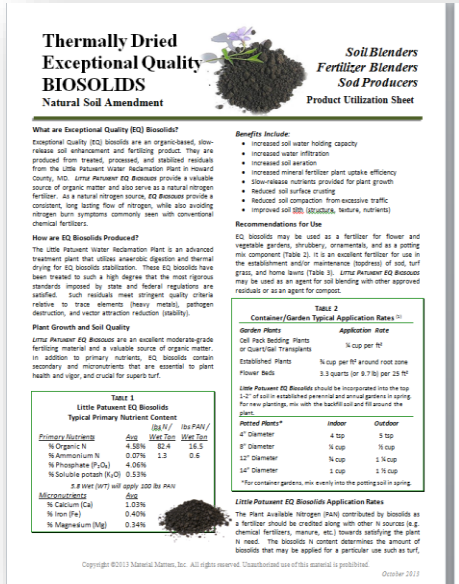
- Understand local markets available
- Preferred/required customer product characteristics
- Market capacity
- Storage needed
- Seasonality



2013 Biosolids Master Planning

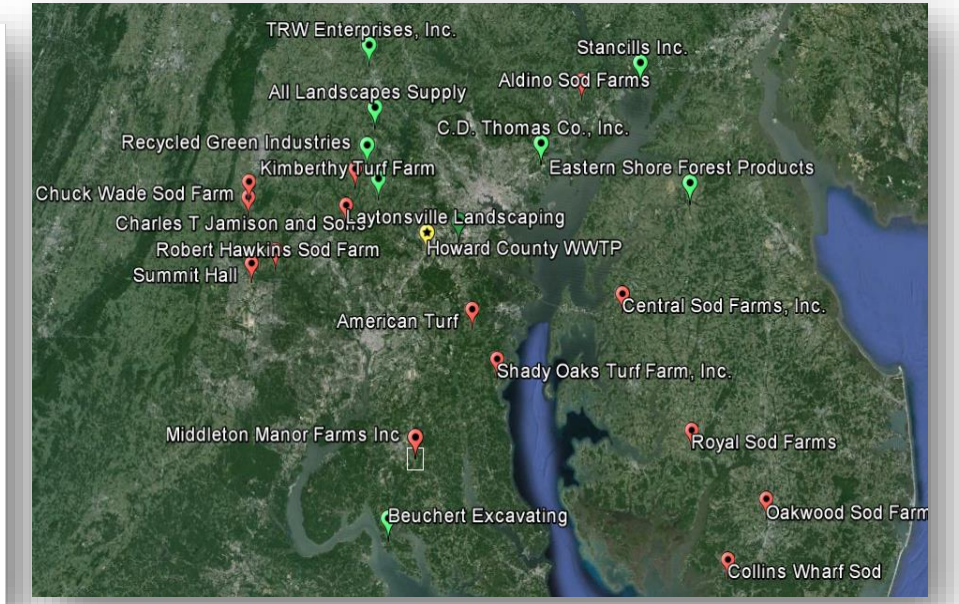
Develop Goals → **Screen Management Alternatives** → **Beneficial Use Market Assessment** → **Select Management Alternative**

- Define target markets
- Assess product
- Assess regulatory environment
- Identify local customers
- Phone surveys/site visits

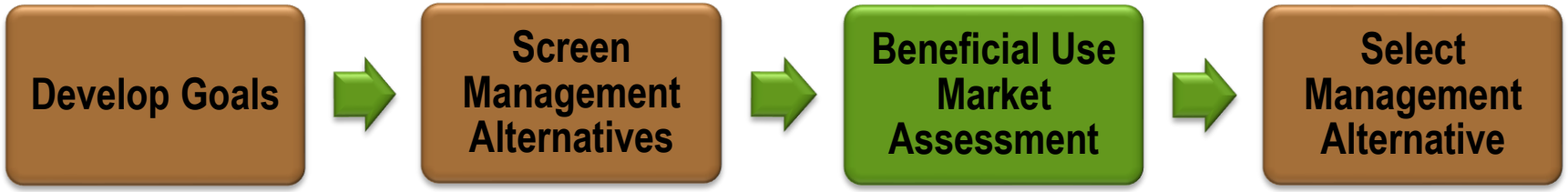


Thermally Dried Exceptional Quality BIOSOLIDS
Natural Soil Amendment

Soil Blenders
Fertilizer Blenders
Sod Producers
Product Utilization Sheet



2013 Biosolids Master Planning

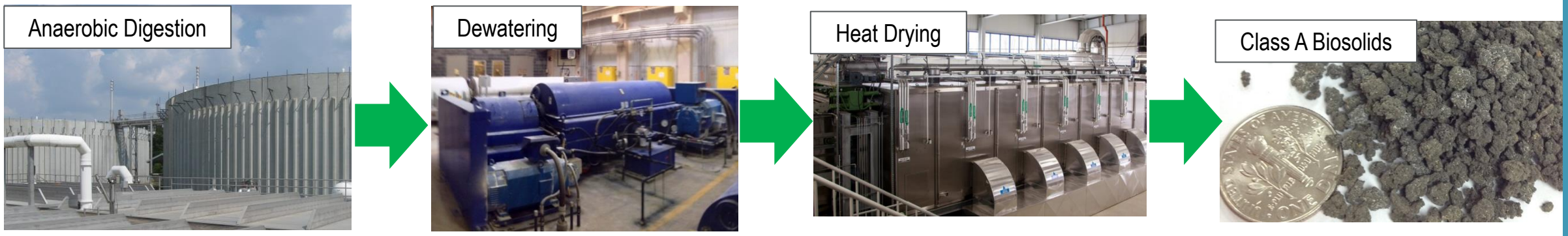


- Survey Results

Bulk Agriculture	Specialty Markets (turf, soil blending, fertilizer blending)
Established market	Novel market
Low marketing effort required	Marketing effort required
Low value	Higher Value
MD options likely limited in long term	Local markets available in long term
One market option	Multiple markets
Wide range of characteristics accepted	Narrow range of characteristics

Master Planning Recommendation

- Replace RDP with anaerobic digestion and heat drying



- Versatile Class A EQ product, multiple end-use potentials
- Volume reduction – from 7 trucks/day to just one
- Local beneficial use outlets exist
- Improved reliability
- Manageable process complexity
- Greatly improved work environment
- Reduced chemical costs (no lime!)

Management Alternative	Biosolids Product tons/year	Project Cost $million	Annual O&M $million	Present Worth[1] $million
Alt 1: RDP Lime Stabilization	48,800	$7.1	$4.3	$77.3
Alt 2: Heat Drying	11,800	$31.5	$3.1	$82.6
Alt 5: Anaerobic Digestion + RDP Lime Stabilization	33,100	$31.1	$3.0	$81.1
Alt 7: Anaerobic Digestion + Heat Drying	6,800	$49.3	$2.5	$89.8
Alt 10: THP + Anaerobic Digestion	16,900	$40.2	$1.9	$71.7
Alt 13: THP + Anaerobic Digestion + Heat Drying	5,600	$58.7	$2.3	$95.8

[1]Project Cost + Present Worth of 20 years O&M cost at 1.5% annual escalation and 3% discount rate.

PRECONSTRUCTION AND DESIGN

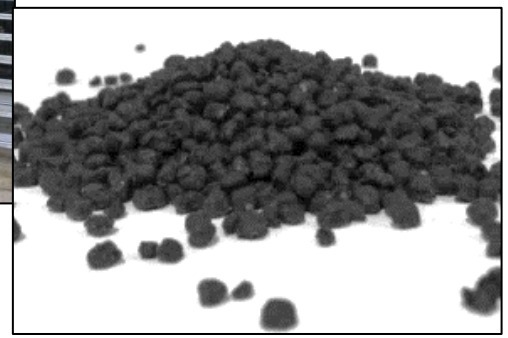
Preliminary Engineering Report

2014 Preliminary Engineering Report

- Summarize Master Plan Finding and Objectives of Project
- Assess Similar Facilities and Market Evaluation
  - Visit other dryer sites
  - Refine biosolids market analysis
- Further define necessary process improvements
  - Thickening, Storage, and Screening
  - Anaerobic digestion and gas handling
  - Nutrient management (P & N)
  - Heat Drying and Building Requirements
  - Odor control
  - Electrical Distribution
- Outline Project Implementation and Path Forward
  - Schedule, Budget, and Permitting Requirements
  - Bridging document for CMAR delivery method

PER - Visit Sites Using Selected Management Alternatives

- Interviewed plant operators
  - Dryer benefits/challenges
  - Manufacturer relations
- Obtained product samples
- Noted dryer configurations, layout, and ancillary processes



Drum Dryer

Belt Dryer

Drum Dryers in Philadelphia and New Jersey

PER – Refine Beneficial Use Markets

- Revisited interviewed customers
- Conducted additional market interviews
  - Detailed and confirmed product preferences

Granule Size?
Dustiness?
Nutrient content?
Consistency?
Odors?

PER – Define necessary process improvements and equipment

- Thickening, Storage, and Screening
- Anaerobic digestion and gas handling
- Nutrient management (P & N)
  - P: Struvite control with chemical addition
  - N: Centrate treatment - Deammonification
  - Risk: relatively new technologies and limited vendors
- Odor control
- Electrical Distribution
- Dryer options – rotary drum or belt
  - Belt dryers selected – less complex, lower operations and maintenance demands
  - Risk: relatively new and nearly unprecedented size of units; Site constraints

PER - Outline Project Implementation and Path Forward

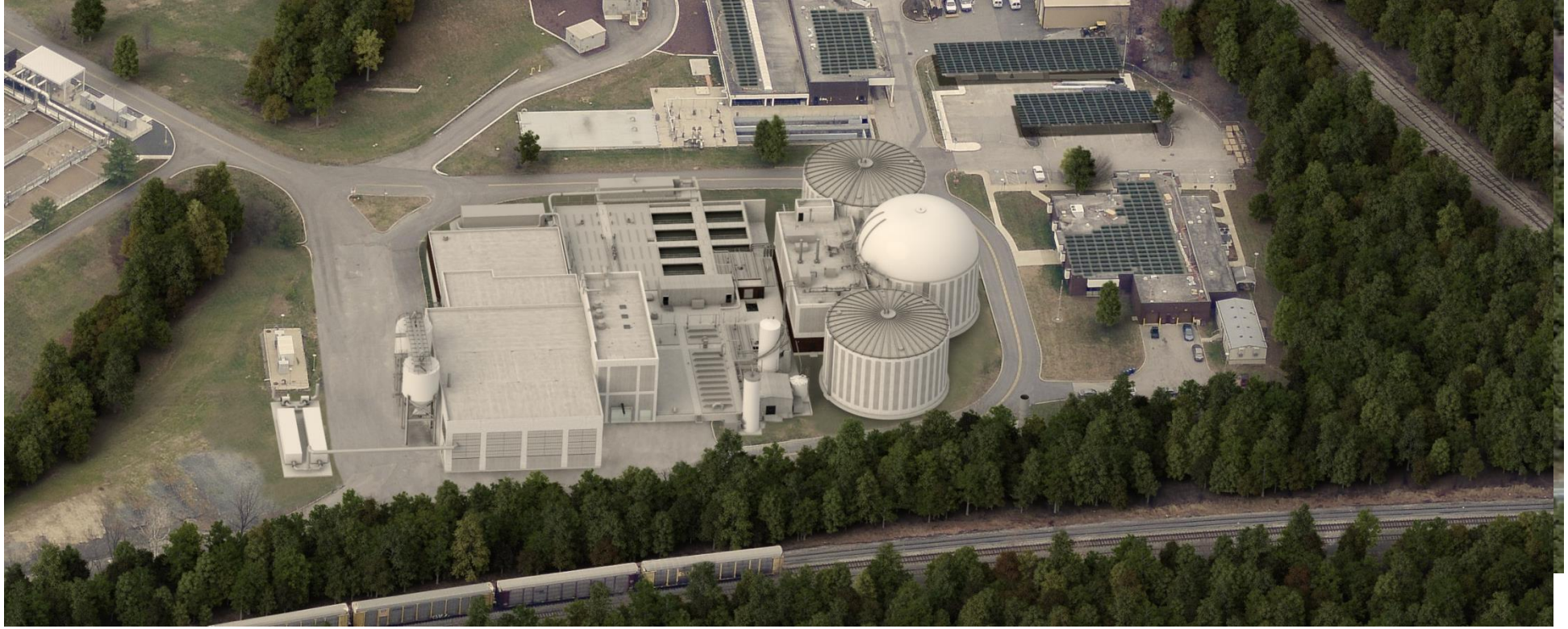
- Present draft schedule and “Opinion of Probable Construction Cost”
- Identify permitting and procurement constraints

Phase 1

- WAS thickening (GBTs)
- Gravity Thickener No 1 & 2 rehabilitation
- Solids storage tank modifications
- Solids screening facilities
- Anaerobic digestion facilities
- Digester gas equipment and treatment facilities
- Centrate treatment process
- Odor control for Phase 1 facilities
- Primary Substation No. 2 replacement
- Phase 1 electrical and instrumentation
- Phase 1 stormwater management
- Plant Control System

Phase 2

- Belt dryer facilities – building and equipment
- Dried biosolids storage
- Dryer odor control
- Centrifuge relocation and feed pump replacement
- Phase 2 electrical and instrumentation
- Phase 2 stormwater management
- Existing biosolids and lime equipment demolition
- Existing biosolids building modifications



Choosing Delivery by Construction Manager at Risk (CMAR)

CMAR Delivery – Why Do It? What are the Benefits?

- Complexity of Project
  - Maintenance of Plant Operations
  - Site Constraints
  - Innovative technology selection and procurement
- Speed in delivery
- Manage Risk
- Eliminate Exhaustive/Defensive Engineering
- Collaboration
  - Selection of most qualified team
  - Selection of equipment and vendors
- Price Certainty
  - Estimates done by Contractor at each milestone
  - Guaranteed Maximum Price established (GMP)
- Schedule Certainty

Engineer and CMAR Solicitations

- Both follow Howard County's Quality Based Selection process
  - Expressions of Interest
  - Technical Proposals (Top 3-4)
  - Interviews
  - Consider Compensation for Proposals and Interviews

- County develops solicitation for Engineer
  - Issued summer 2015
  - Under contract October, 2015
- County and Engineer (acting as Owner's Rep) Develop Solicitation for CMAR
  - Issued late 2015
  - Under contract March 2016
- CMAR Contracts
  - Pre-construction – modeled after County's professional services agreement
  - Construction – modeled after County's construction agreements
  - Incorporated lessons learned from previous CMAR and DB agreements
  - EJCDC and DBIA reference documents as resources

CMAR Involvement and Responsibilities

- Review and comment on Preliminary (30%), Intermediate (60%) , and Final (90%) design submittals
- Other CMAR responsibilities
  - Early procurement of dryer systems and other major equipment items
    - Visited dryer sites together
    - Increased pre-selection list
    - Drafted EOI Solicitation and RFP
  - Value engineering proposals
  - Constructability reviews
  - Development of formal Plans: Site Utilization, Maintenance of Plant Operations (MOPO), Procurement, and Site Specific Safety Plans
  - Schedule
    - Key Milestones
      - » October 2018 Start of Phase I Processes
      - » Working backwards leads to Early and On-Time Delivery of Final Design and GMP1 NTP

GMP Development

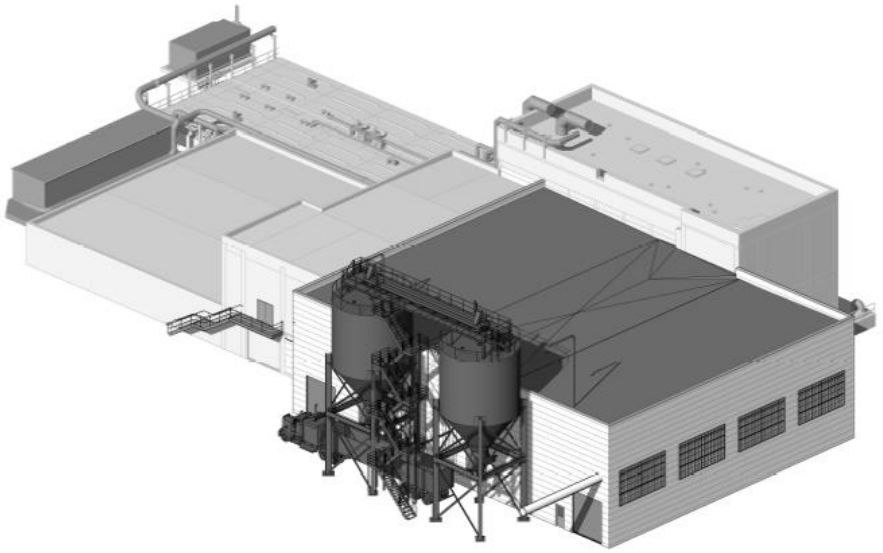
- Estimates completed on each design submittal
  - Final GMP consistent with original 30% estimate
- Competitive bids for each of the major bid packages
- Joint interview and review of bidding companies (Owner, Engineer, CMAR)
  - Risk assessment
  - Scope verification
  - Quality
  - Understanding of delivery process
- Meet to review Owner Allowances and CMAR Contingencies
  - Place risk where it is best controlled
- Negotiated GMP within three weeks of receiving bids
- NTP for Phase 1 – February, 2017

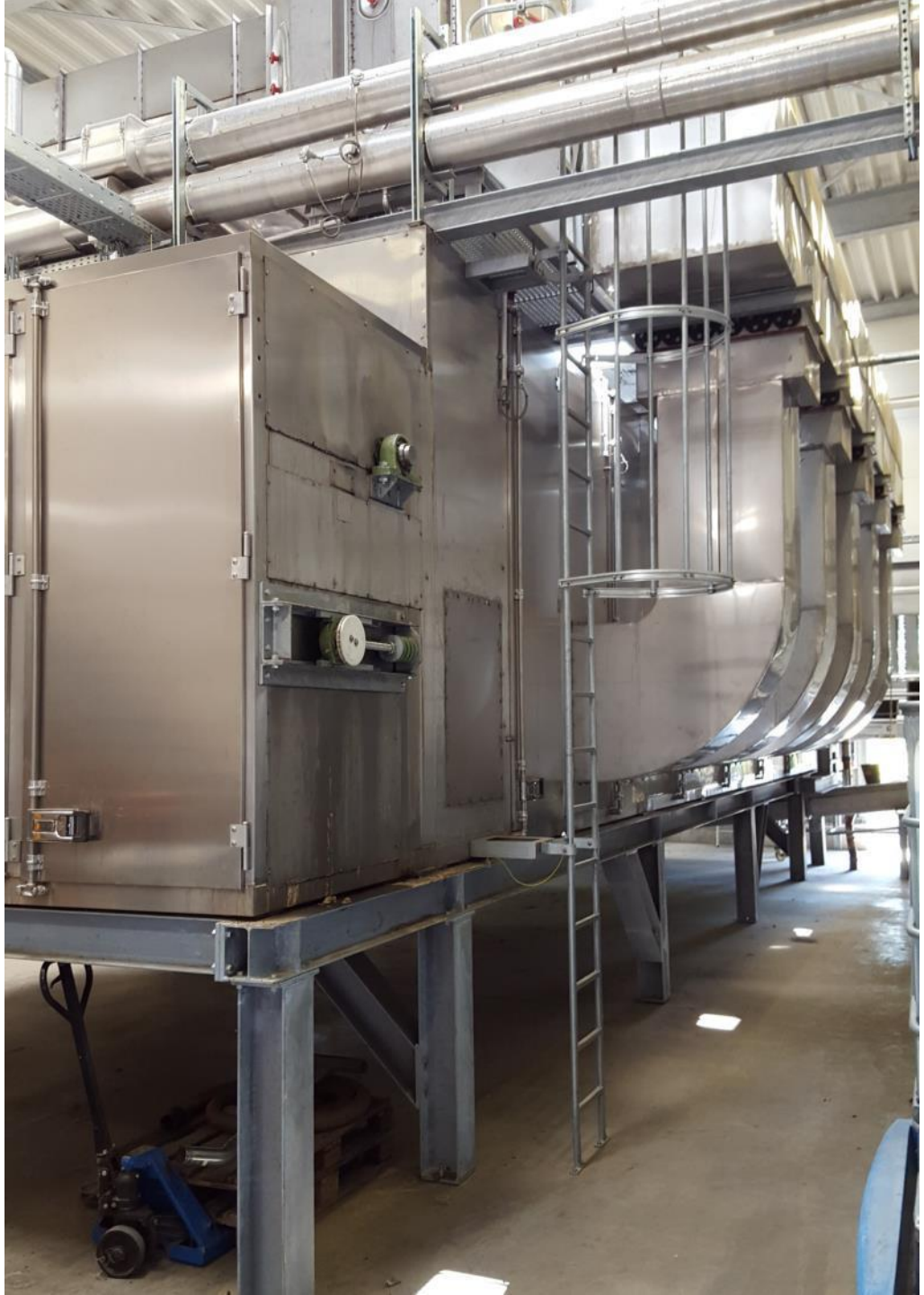
Collaborative Approach…

- Workshops
  - Identifies the key decisions needed
  - Facilitates decisions for the owner
  - Opportunity for top and mid level team members to share ideas
- Partnering
  - Promotes High Level PM Discussions
  - Venue for voicing concerns or highlighting positives
  - Involve key sub-contractors and vendors
- Value Engineering
- BIM
- Outreach
- Envision

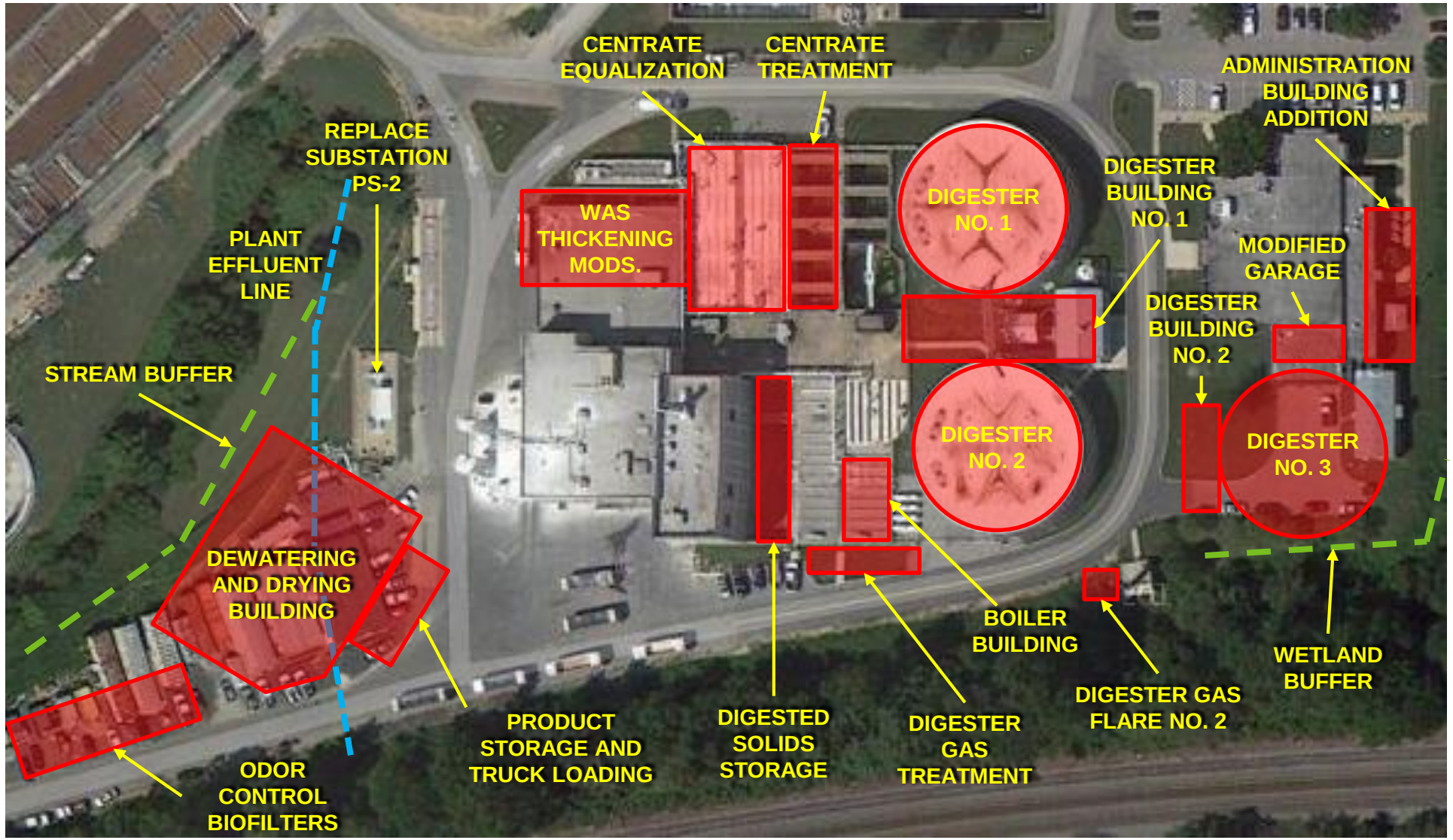
… Leads to Results

- Major scope revisions…
  - Digester configuration and construction methods
  - Dryer package selection
  - Split Substation and MCC locations (PH1 Design Revision)
  - Relocate dryer building
- …leads to improved operations, maintenance, and site utilization.

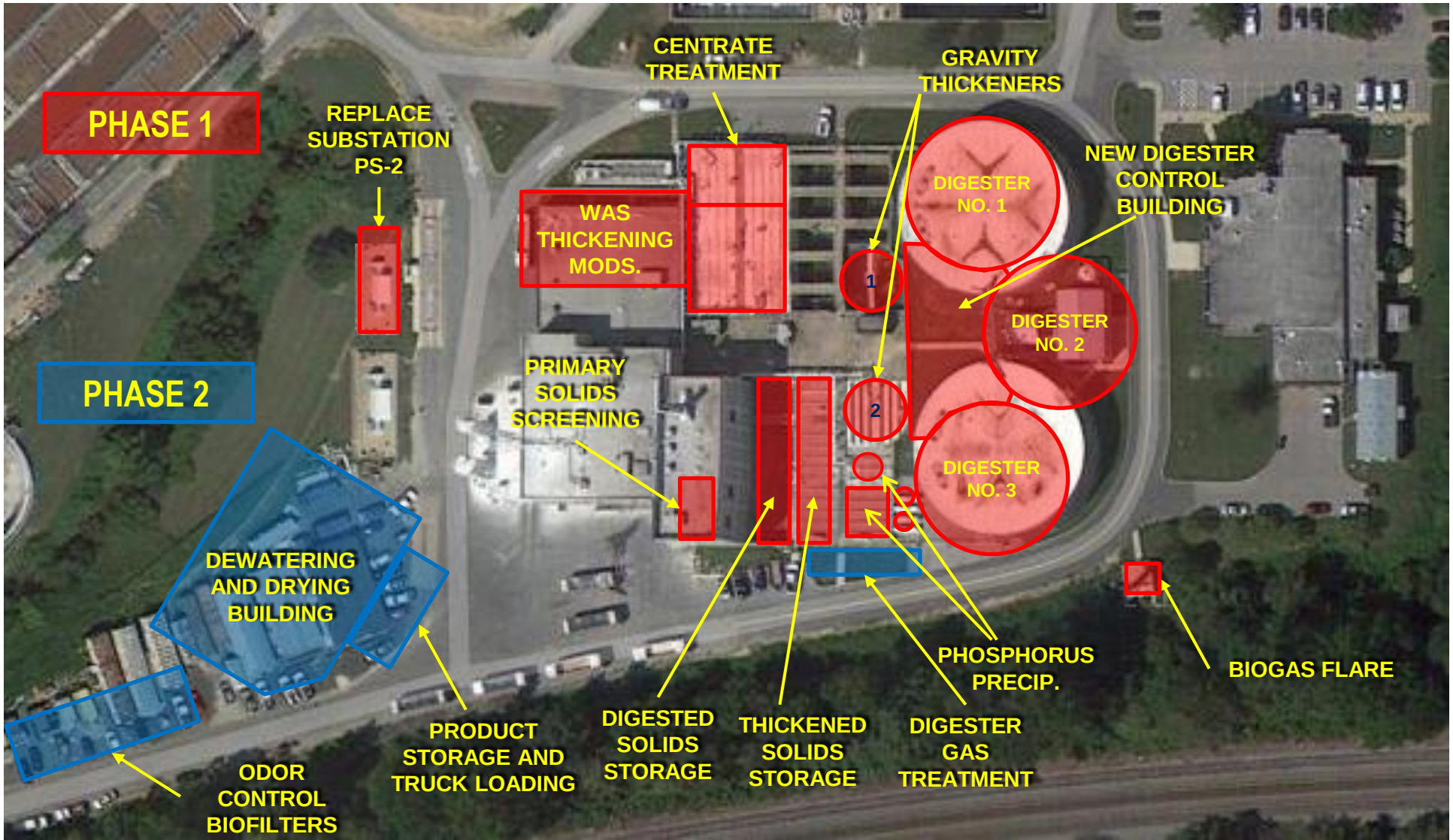




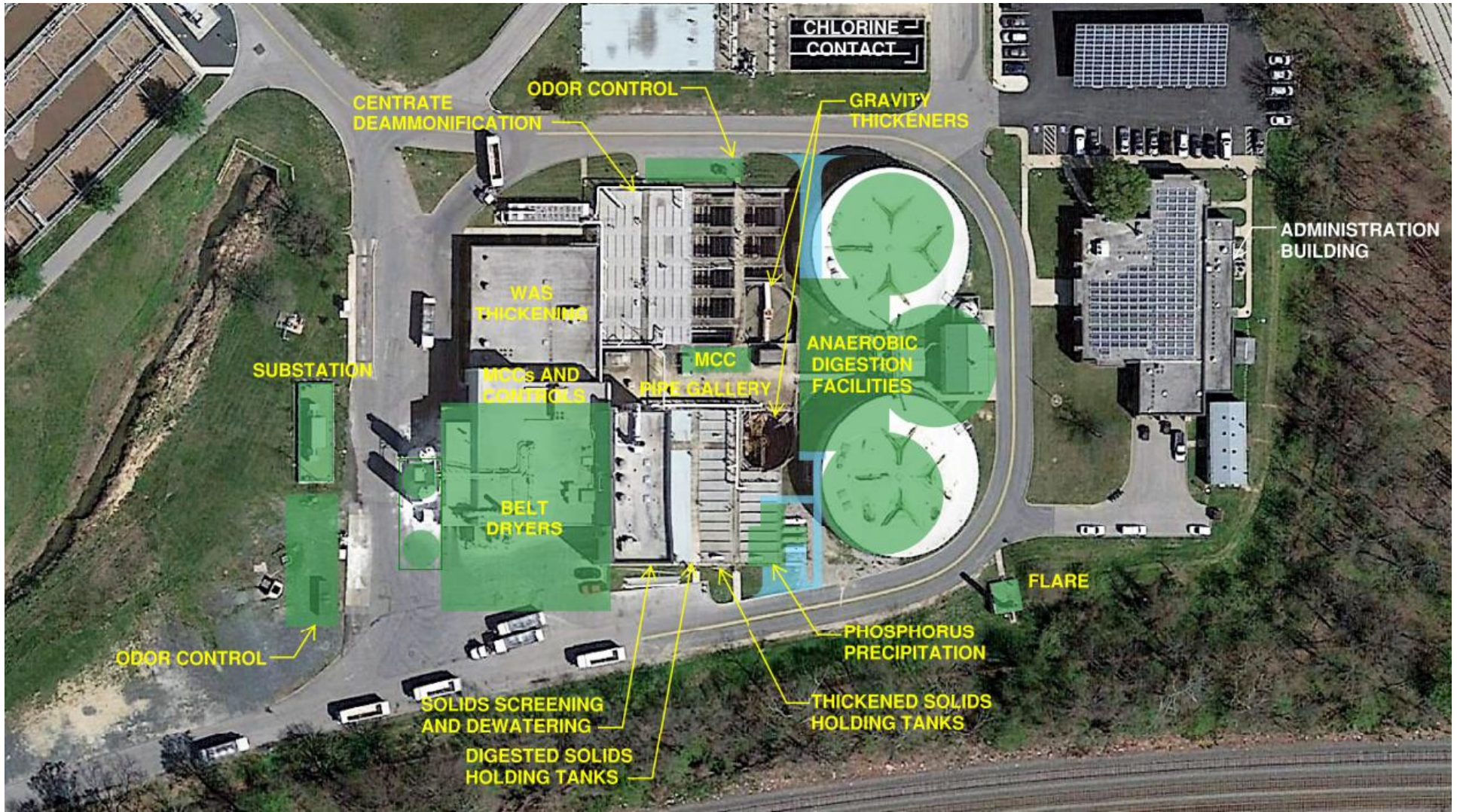
From where we started design…



… through collaboration the process evolved …



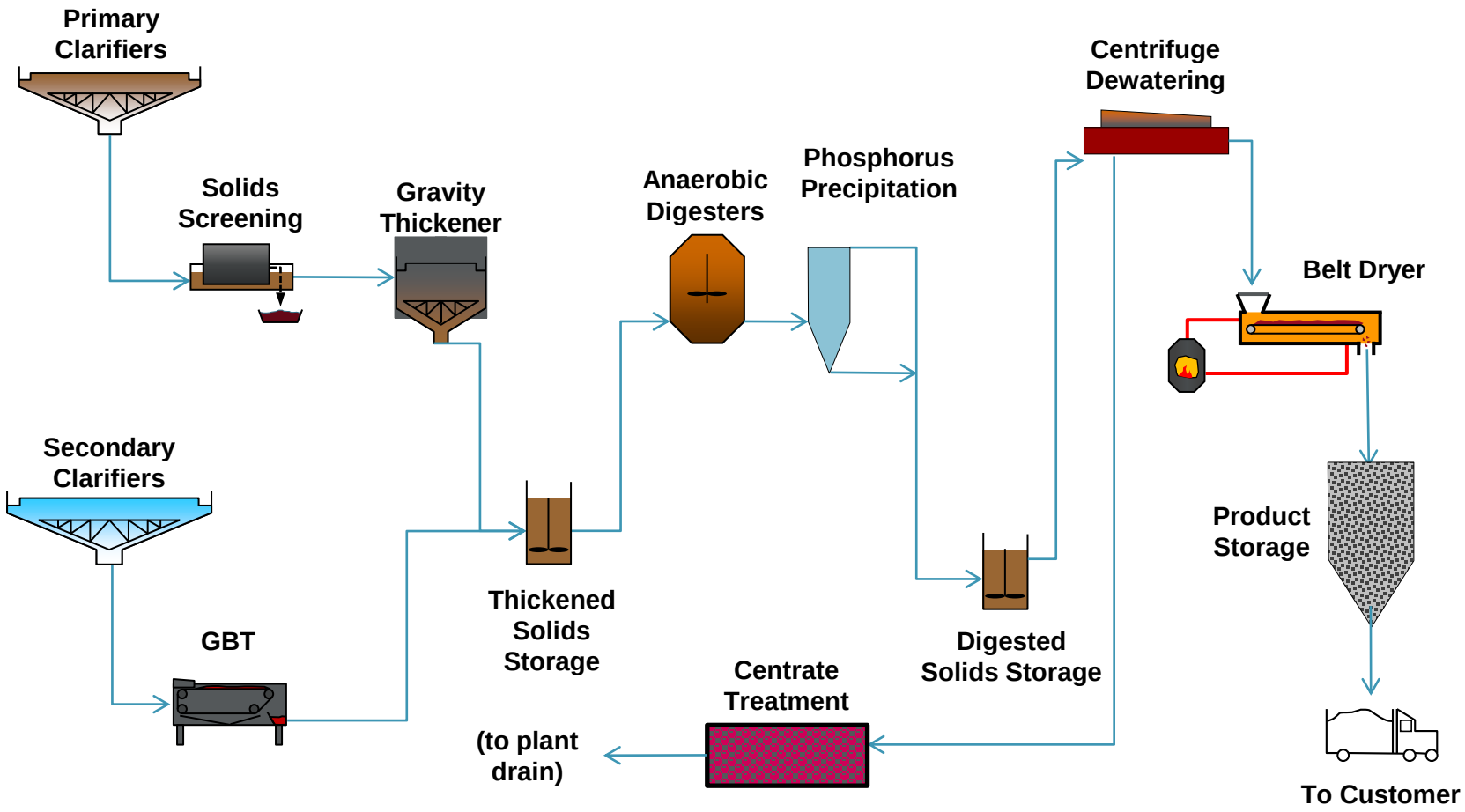
… to where we finally landed



Final Design

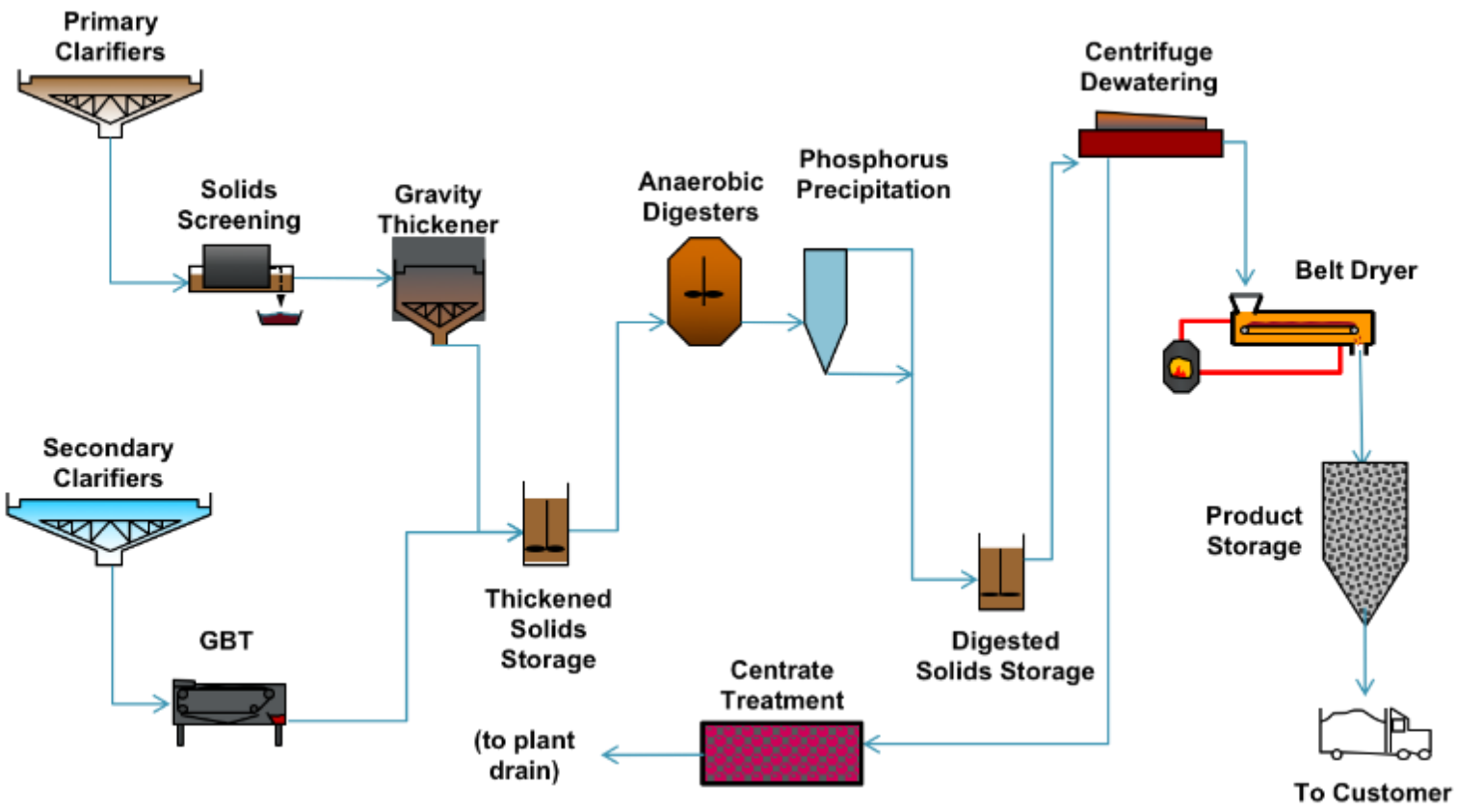
- Three new digesters and single digester building
- Phosphorus precipitation for struvite management
- Deammonification process for control of nitrogen in centrate
- Belt dryer system selected
- Dryer building relocated
- New prefabricated motor control center centrally located
- Spit power distribution with two substations vs. one originally

LPWRP Biosolids Improvements



RESULT AT END OF PHASE 1 (LATE 2016)

- Finalized digester configuration
- Phosphorus precipitation
- MOPO
- Deammonification process selection
- Belt dryer pre-selection

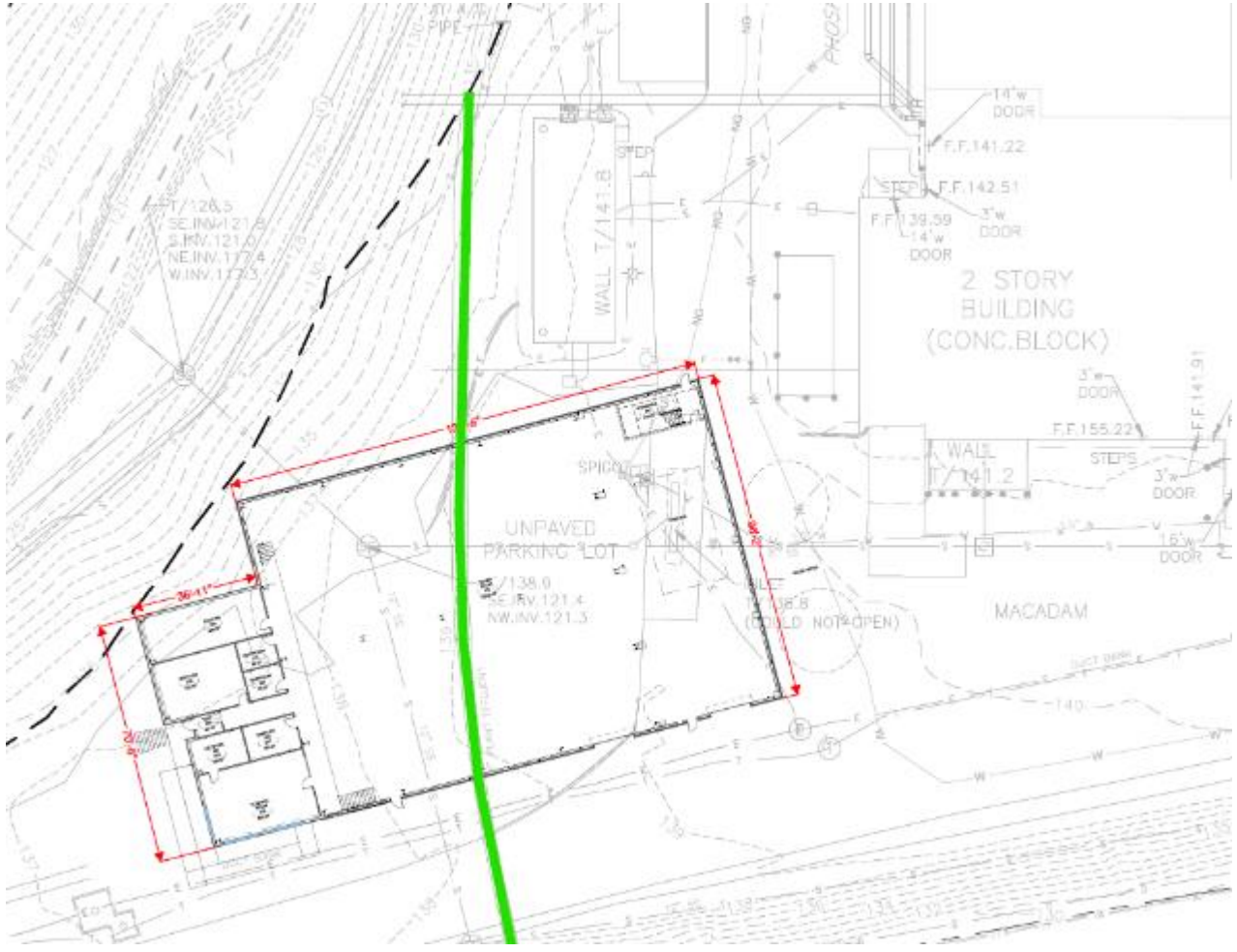


RESULT AT END OF PHASE 1 (LATE 2016)

JANUARY 2017 – PHASE 2 30% DESIGN CHALLENGES

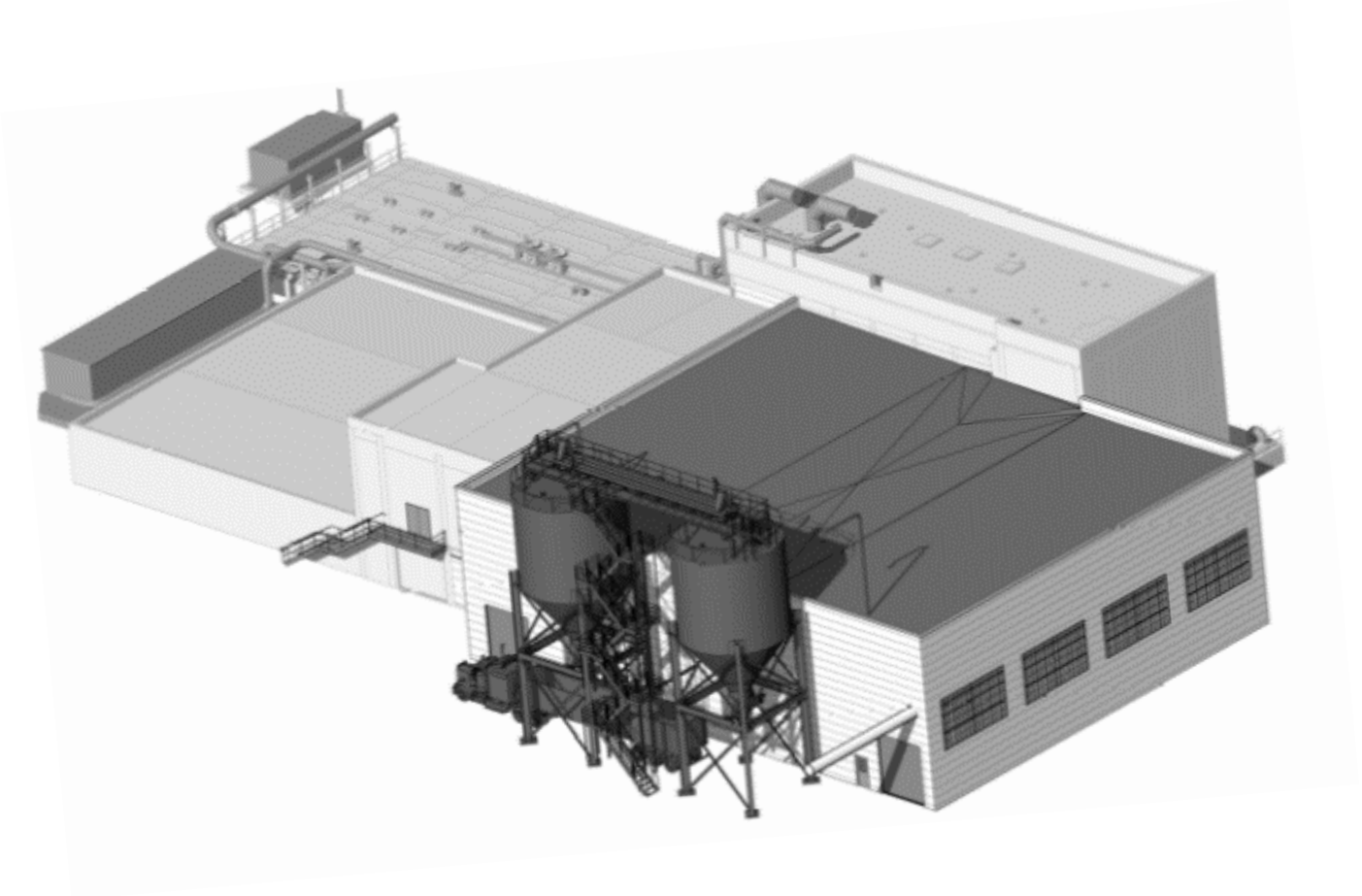
- 54-inch effluent pipe under proposed Dryer Building
- Irregular space
- Encroaching on stream
- Relocate centrifuges
- Multiple facility locations

Challenge: As presented, the current option was not viable. Two weeks to provide three options for Dewatering Building location.

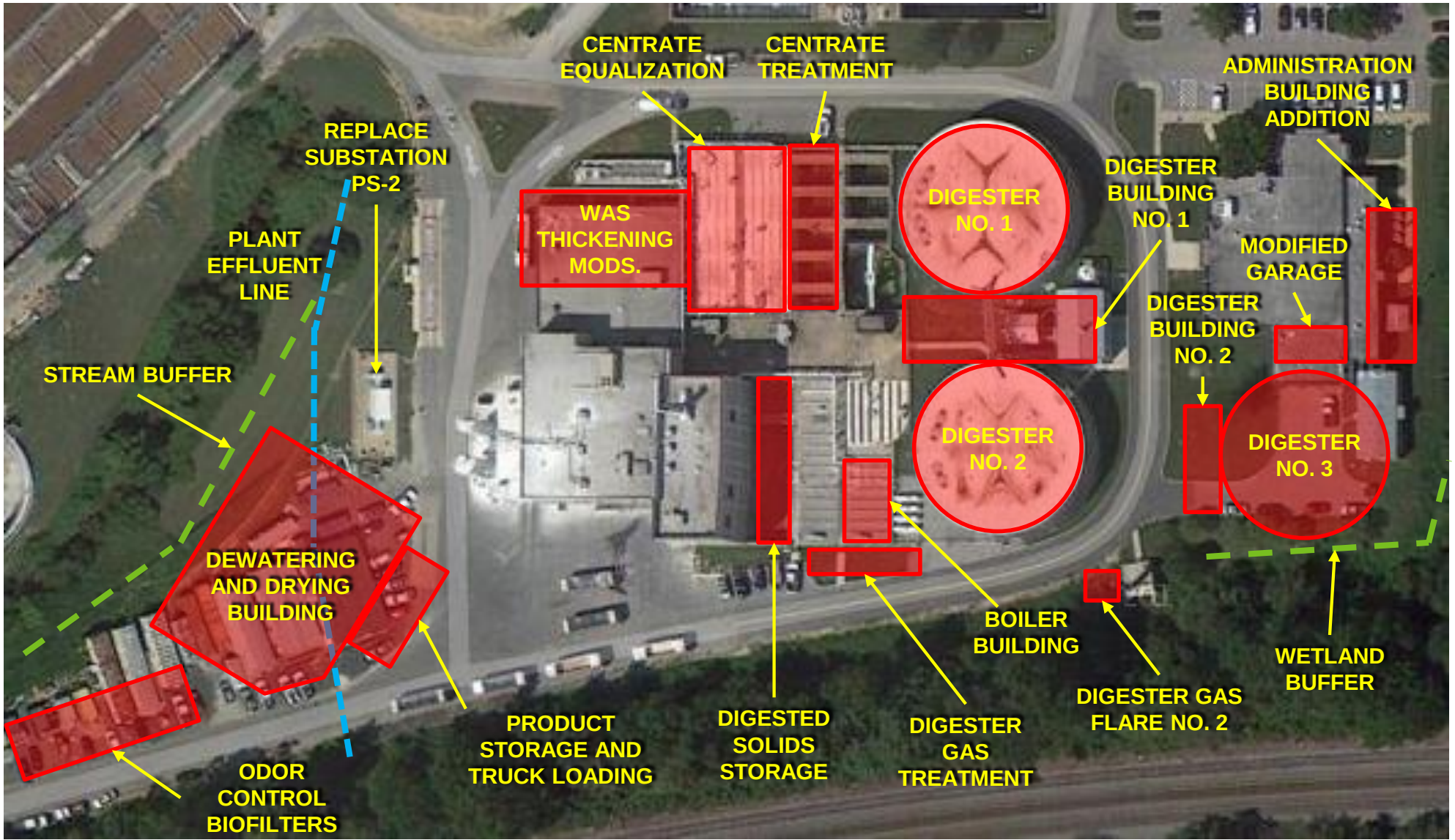


COLLABORATIVE RESULTS

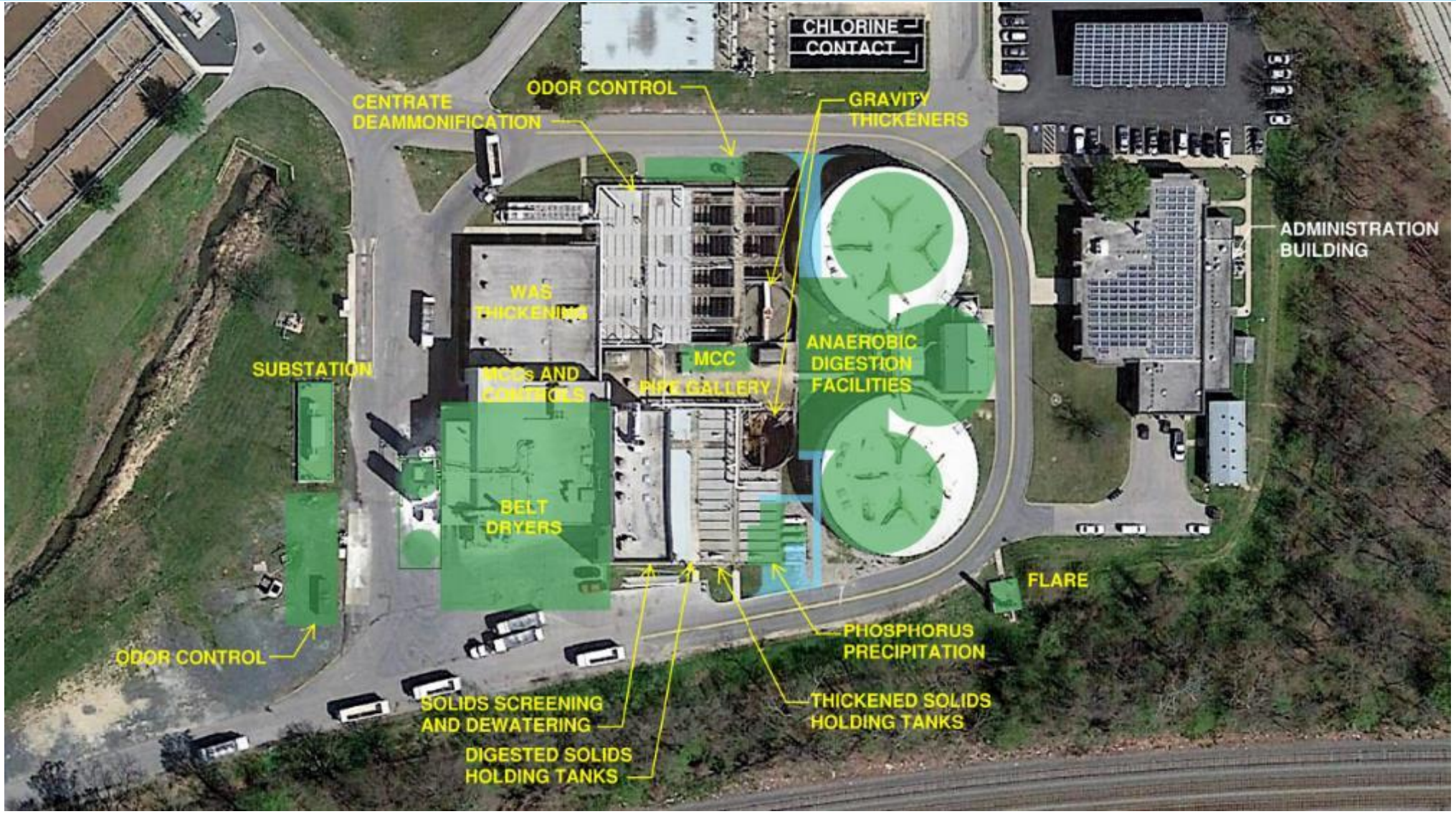
- In those two weeks:
  - Engineering due diligence
  - Decision making tools to review costs and risks
- Collaborative workshop to make decision
- Move forward with retrofit in location of existing building



PLAN FROM PRELIMINARY ENGINEERING



WHERE WE ENDED



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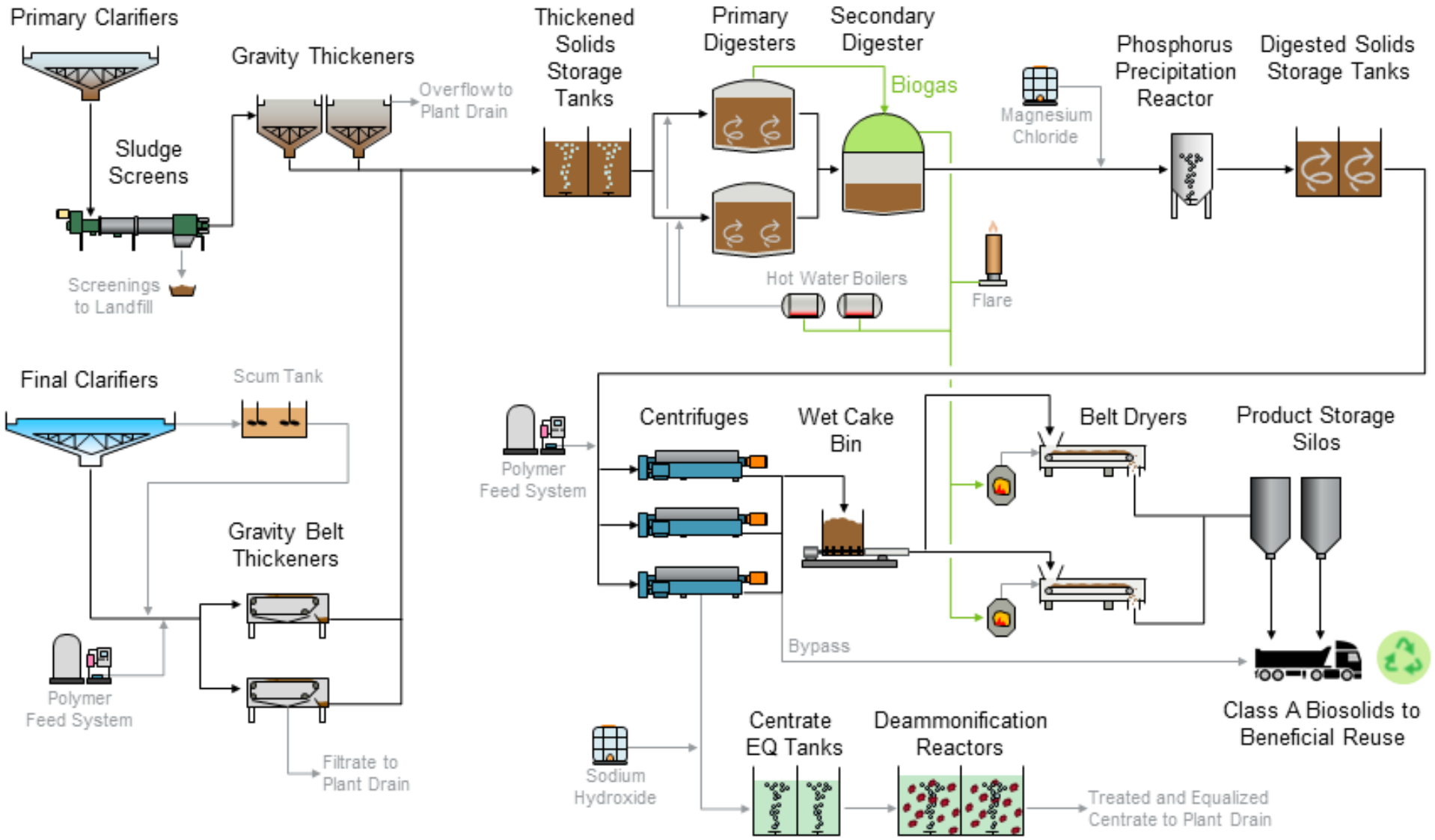


CONSTRUCTION PROGRESS AND CHALLENGES


FEBRUARY 2017
Paul Schneider 2/22/2017 9:11 AM - LPWRP 8th Edition


GROVE

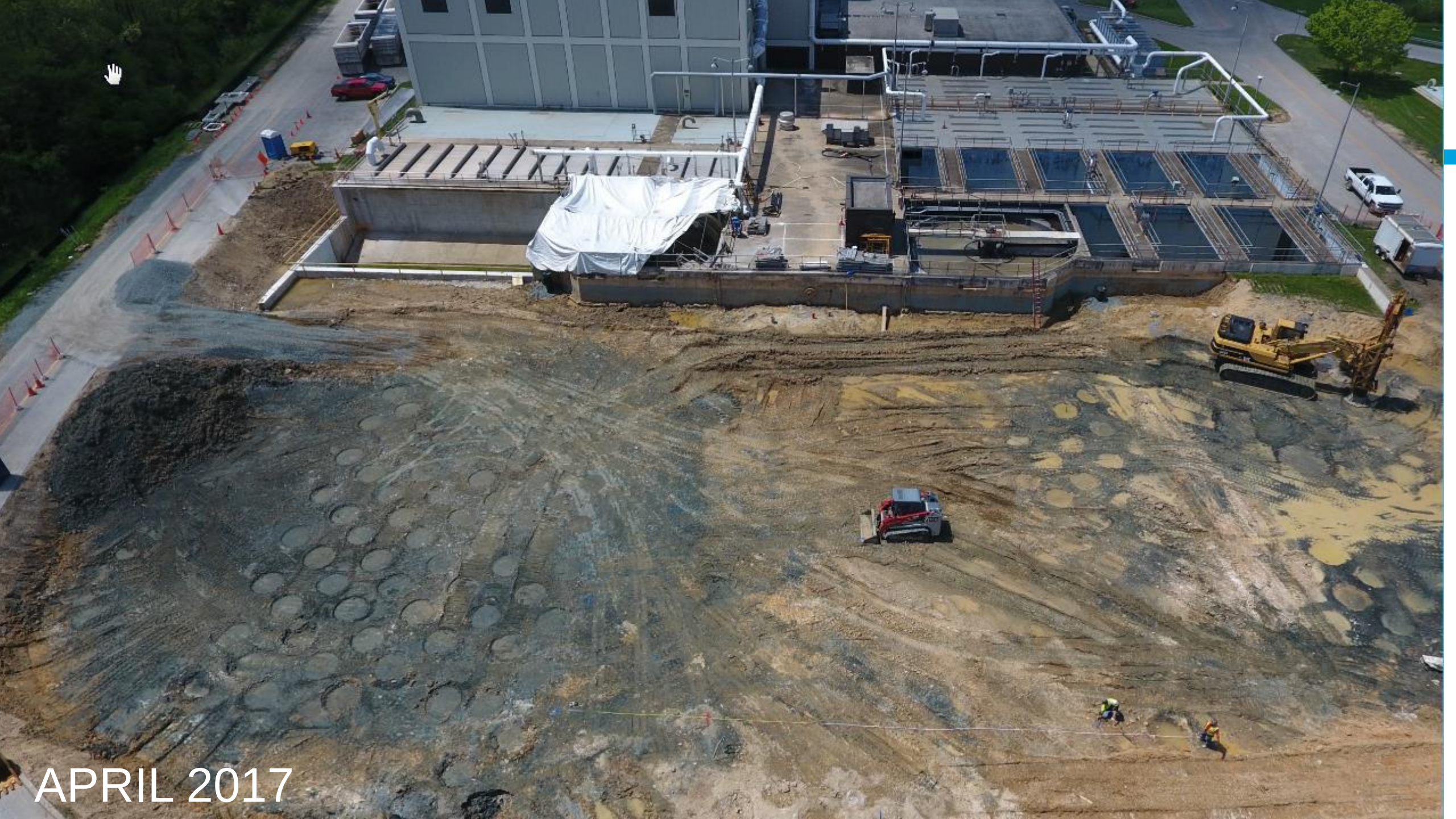

Paul Schneider 2/22/2017 8:47 AM - LPWRP 8th Edition

MARCH 2017

Paul Schneider 3/30/2017 11:03 AM - LPWRP 8th Edition


CAT


CENTRATE DRAIN H.D.P.


APRIL 2017

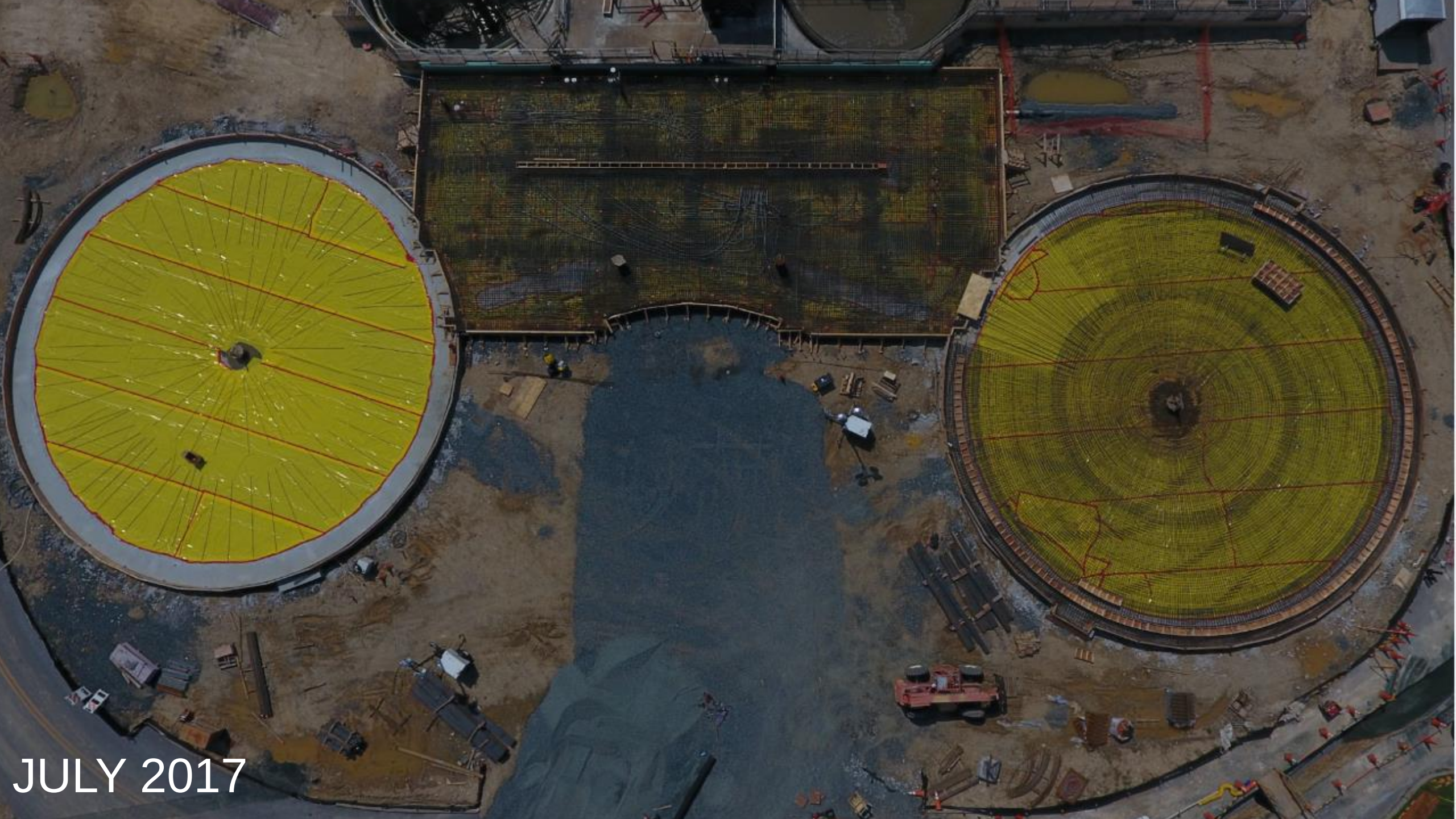

VENT

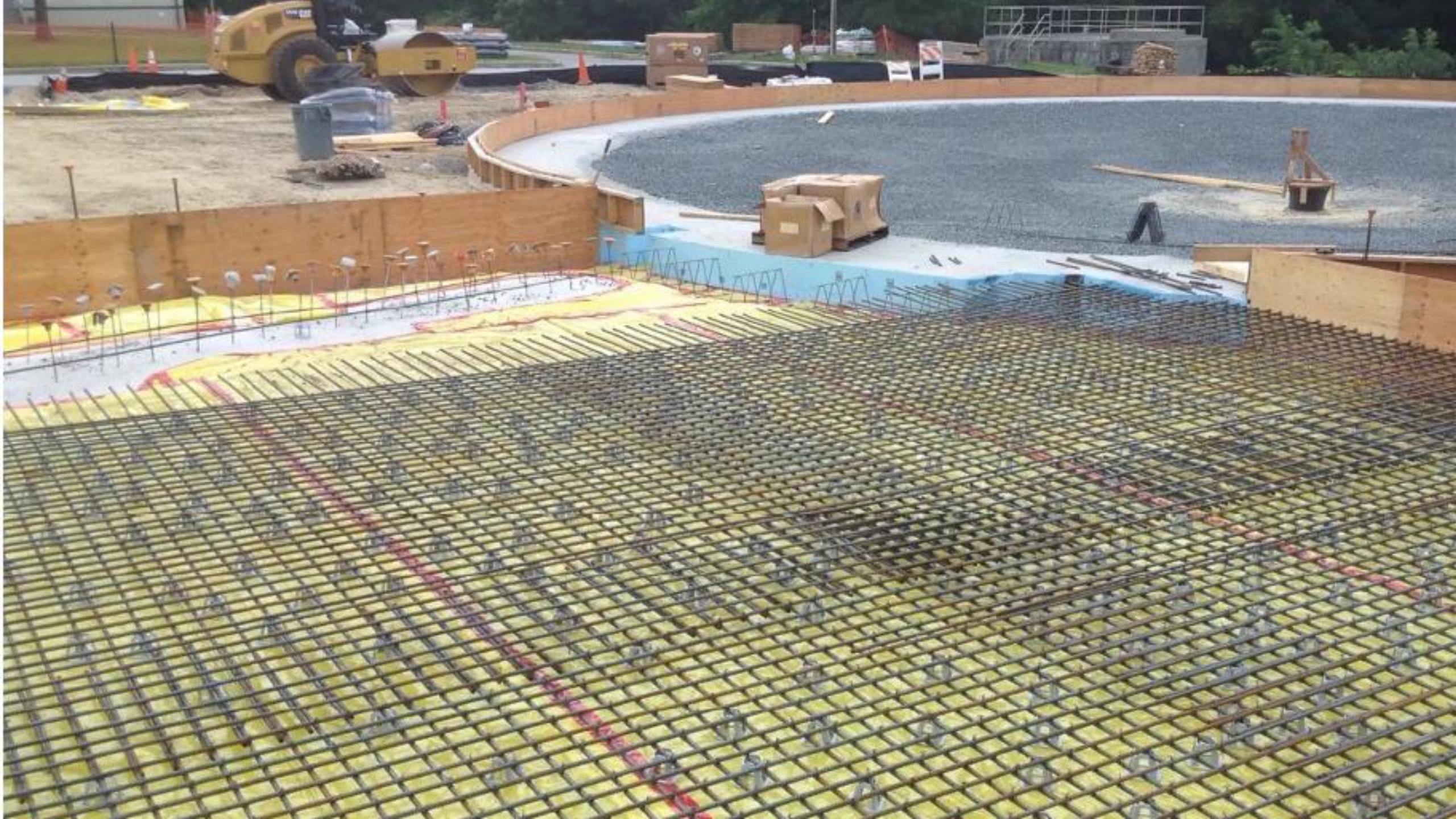

MAY 2017

Paul Schneider 5/22/2017 10:23 AM - LPWRP 8th Addition


JUNE 2017


Paul Schneider 6/29/2017 9:32 AM - LPWRP 8th Addition


JULY 2017

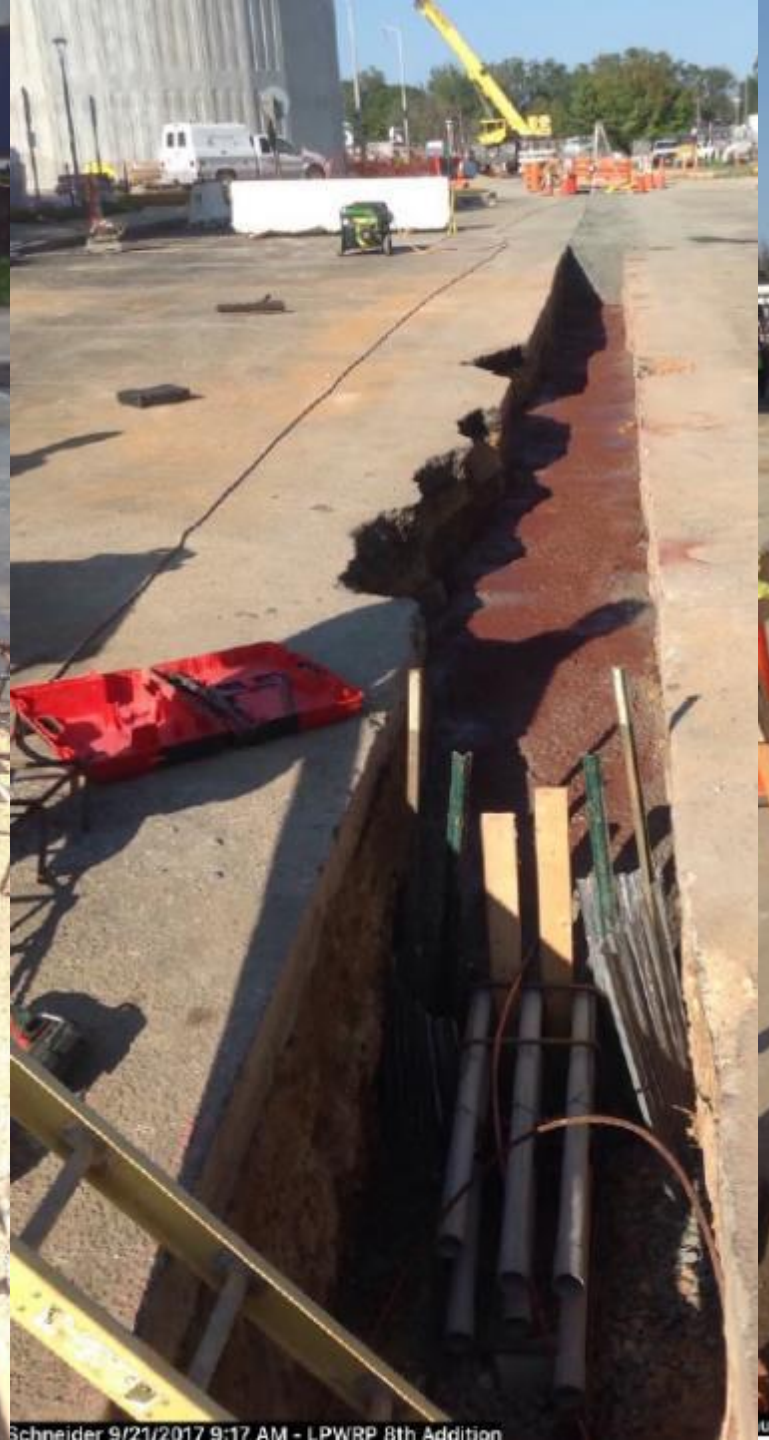



AUGUST 2017

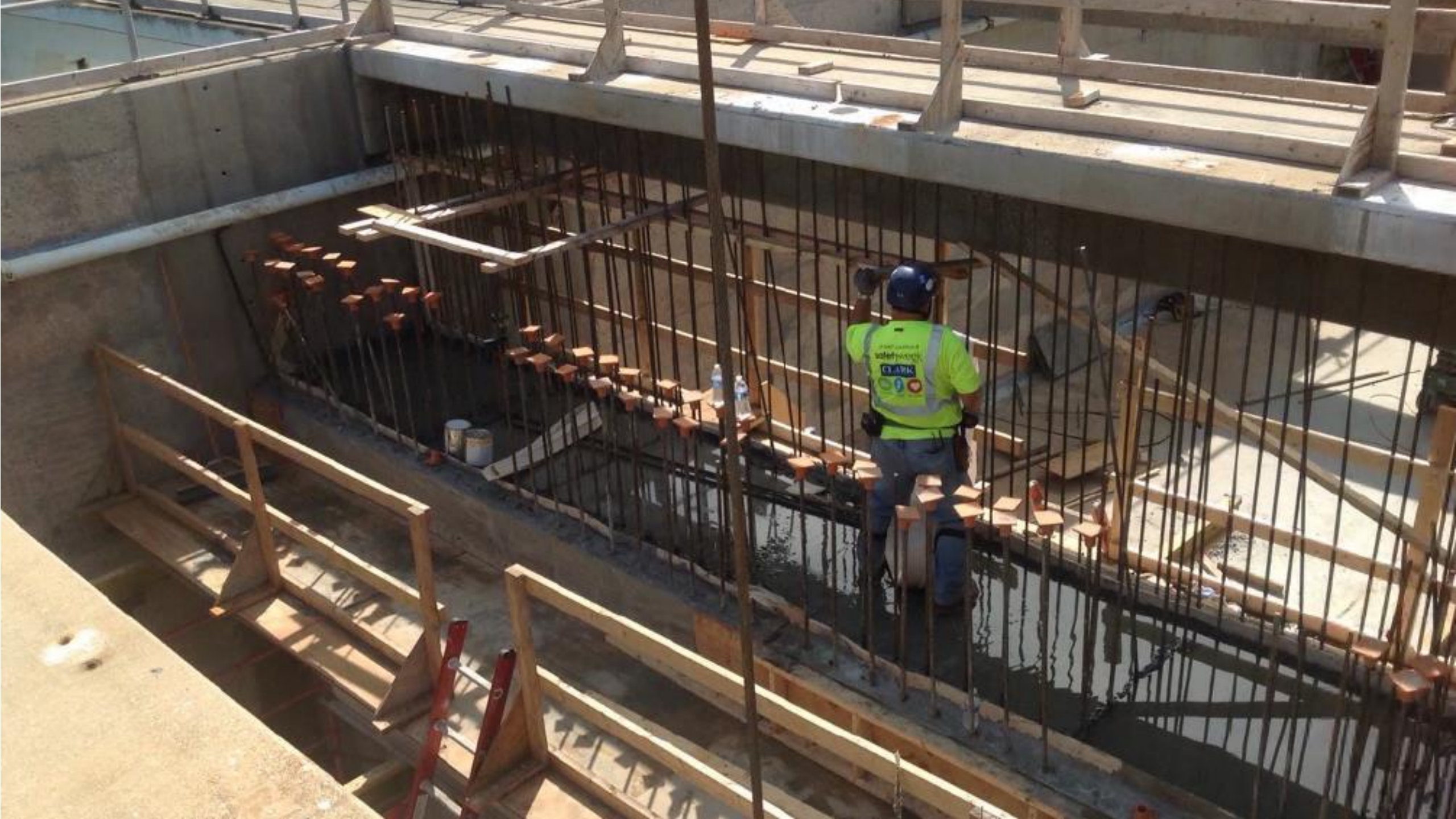

Paul Schneider 8/30/2017 11:55 AM - LPWRP 8th Addition


SEPTEMBER 2017


/2017 9:17 AM - LPWRP 8th Addition


Schneider 9/21/2017 9:17 AM - LPWRP 8th Addition


ul Schneider 9/21/2017 9:17 AM - LPWRP 8th Addition




OCTOBER 2017


ADMINISTRATION BUILDING


NOVEMBER 2017


DECEMBER 2017


CLARK

JANUARY 2018


FEBRUARY 2018

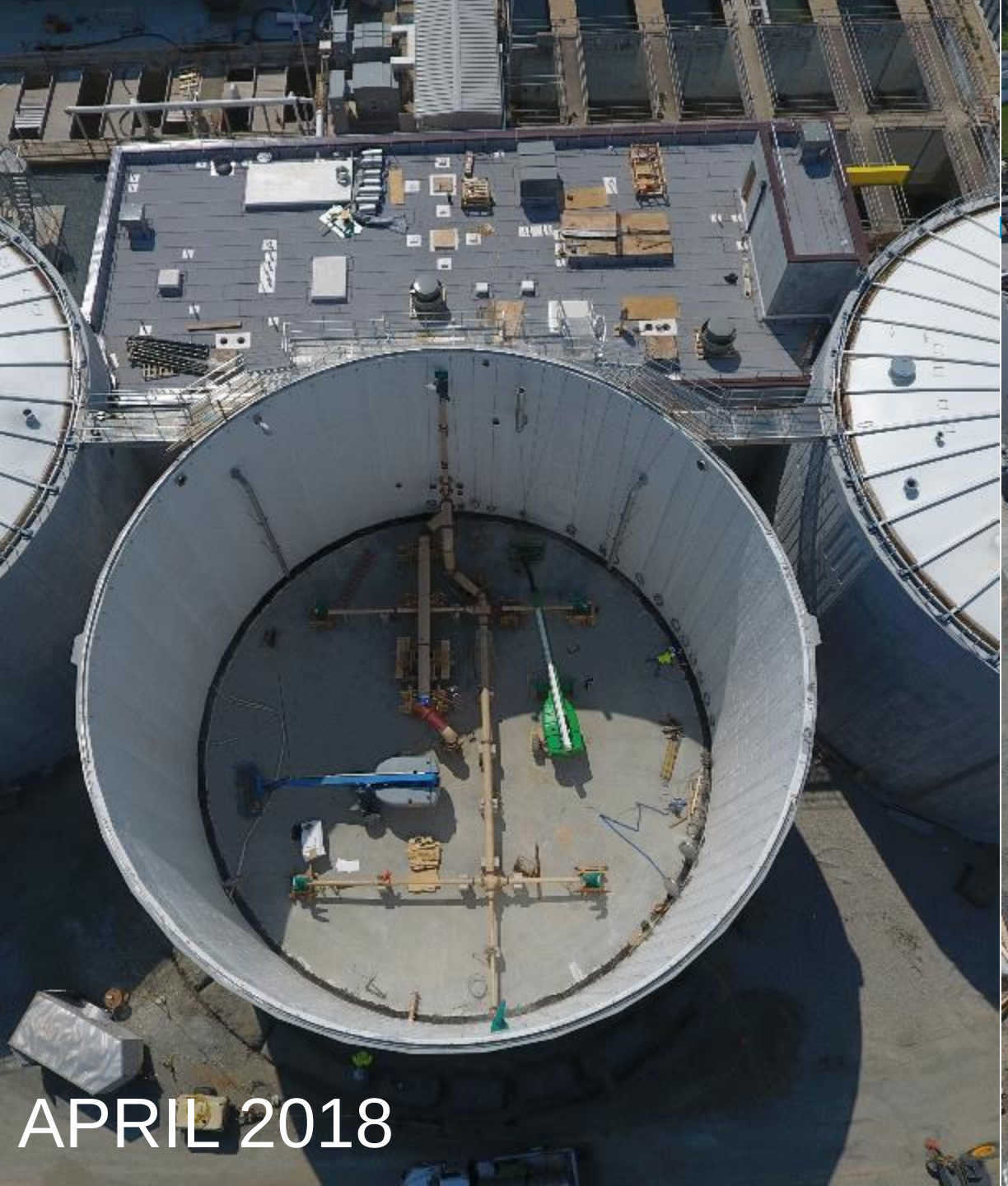

MVA MAIN 1
DANGER


Paul Schneider 2/13/2018 10:35 AM - LPWRP 8th Addition


CAT
CAT
320E
CAUTION
CAUTION
CAUTION
CAUTION


MARCH 2018


:36 AM - LPWRP 8th Addition

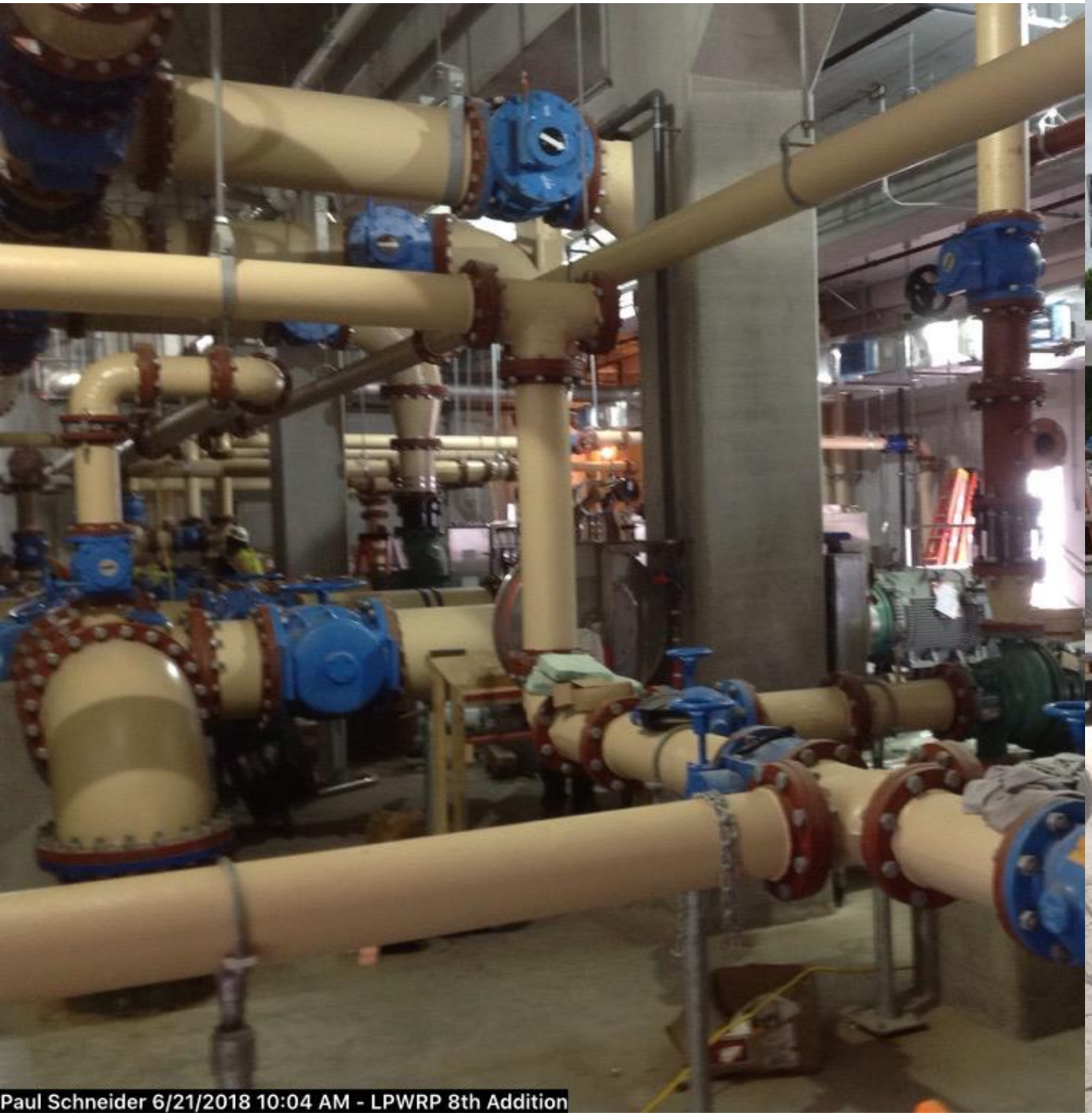


APRIL 2018


Paul Schneider 4/24/2018 9:42 AM - LPWRP 8th Addition


Paul Schneider 4/24/2018 9:42 AM - LPWRP 8th Addition


JUNE 2018


Paul Schneider 6/21/2018 10:04 AM - LPWRP 8th Addition


CAUTION


JULY 2018
Paul Schneider 7/13/2018 9:05 AM - LPWRP 8th Addition


KAESER
Paul Schneider 7/10/2018 11:04 AM - LPWRP 8th Addition


10:24 AM - LPWRP 8th Addition


0:24 AM - LPWRP 8th Addition


Paul Schneider 8/7/2018 10:06 AM - LPWRP 8th Addition


neider 8/2/2018 9:36 AM - LPWRP 8th Addition

SEPTEMBER 2018

OCTOBER 2018

ckey Carr 10/18/2018 8:07 AM - LPWRP 8th Addition

:21 PM - LPWRP 8th Addition


STAMO


SUNBELT RENTALS


CAT


NOVEMBER 2018
Mickey Carr 11/30/2018 11:29 AM - LPWRP 8th Addition


Carr 11/29/2018 8:18 AM - LPWRP 8th Addition

DECEMBER 2018


CAT

JANUARY 2019

FEBRUARY 2019

Mickey Carr 2/28/2019 11:10 AM - LPWRP 8th Addition

MARCH 2019

Mickey Carr 3/19/2019 7:49 AM - LPWRP 8th Addition

APRIL 2019

Mickey Carr 4/25/2019 2:07 PM - LPWRP 8th Addition


238


MAY 2019

JUNE 2019

Mickey Carr 6/12/2019 1:44 PM - LPWRP 8th Addition


JULY 2019


KOBALT


AUGUST 2019

SEPTEMBER 2019


SEPTEMBER 2019
Aaron Rosansky 10/2/2019 4:27 PM
LPWRP 8th Addition

OCTOBER 2019

OCTOBER 2019

OCTOBER 2019

LPWRP 8th Addition


NOVEMBER 2019


NOVEMBER 2019

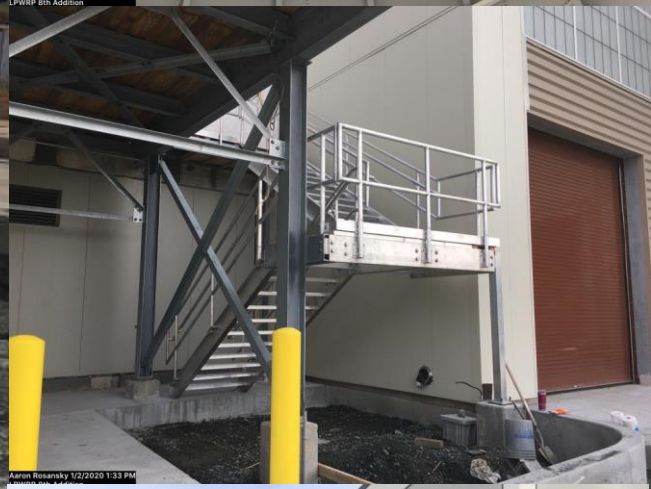
NOVEMBER 2019

NOVEMBER 2019

DECEMBER 2019


Aaron Rosansky 1/2/2020 1:33 PM
LPWRP 8th Addition


Aaron Rosansky 1/2/2020 1:33 PM
LPWRP 8th Addition


Aaron Rosansky 1/2/2020 1:33 PM


Aaron Rosansky 1/2/2020 1:33 PM

JANUARY 2020


Aaron Rosansky 2/6/2020 9:10 AM
LPWRP 8th Addition
/2020 9:10 AM
HILTI
HILTI

FEBRUARY 2020


Aaron Rosansky 3/5/2020 2:14 PM
LPWRP 8th Addition

COMMISSIONING AND STARTUP

COMMISSIONING (PHASE 2)

- Dry and Wet checkout
  - Mechanical Tests
  - Control System Tests
  - Integrated Systems Tests
- Performance Testing
  - Product sieve analysis, 0.5 – 4.0 mm
  - 92-95% dry
  - Bulk Density, 35 lbs./cf
  - Heat energy consumption
  - Evaporation rate
  - 3 - 8hr days run cont. for ea. dryer
- Six (6) months needed for full commissioning and full start-up with performance testing

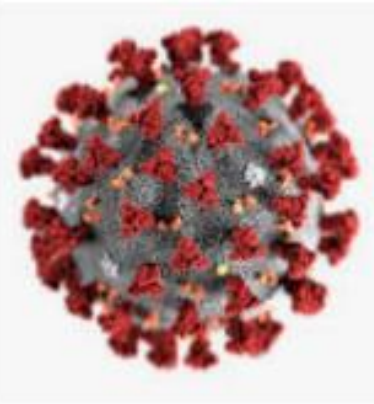
B. The belt dryer shall be designed to operate under the following conditions:

Design / Operating Parameters	**Value(s)**
Number of trains	Two (2). Capacity values listed are for throughput of one (1) Dryer.
Operation / Required run time, each dryer	7 days/week, 24 HRS/day Dryers are not redundant. A total of 10-days of dryer operation per week required to meet solids loading.
Solids processing capacity, each dryer	12.2 dry tons per day (DTPD) (24 HRS/day)
Process feed rate, wet, each dryer	61 Wet tons per day (WTPD) (24 HRS/day)
Cake dryness	20% Total Solids (T.S.) Design Value 18% to 28% Operating Range
Cake dryness variation	2% DS in any one (1) hour, maximum (For purposes of performance testing only)
Final pellet dryness	92% T.S. Average Class A compliant 90% to 94% Range
Estimated dry product rate, each dryer	13.3 TPD at 92% T.S. 1,105 LBS/HR at 92% T.S.
Design evaporative capacity, each dryer	3,961 LBS/HR H_2O
Maximum evaporative capacity, each dryer	4,400 LBS/HR H_2O
Fuel source	Natural gas, LHV of 950 BTU/CF. Biogas , LHV of 450-640 BTU/CF
Heat consumption	1,500 BTU per LB of water evaporation based on LHV
Final product characteristics	95% inclusive 0.5 – 4.0mm Diameter at product silo outlet Bulk density equal to or greater than 35 lbs/cf
Final product temperature	≤100 DegF at dryer outlet or product cooler outlet

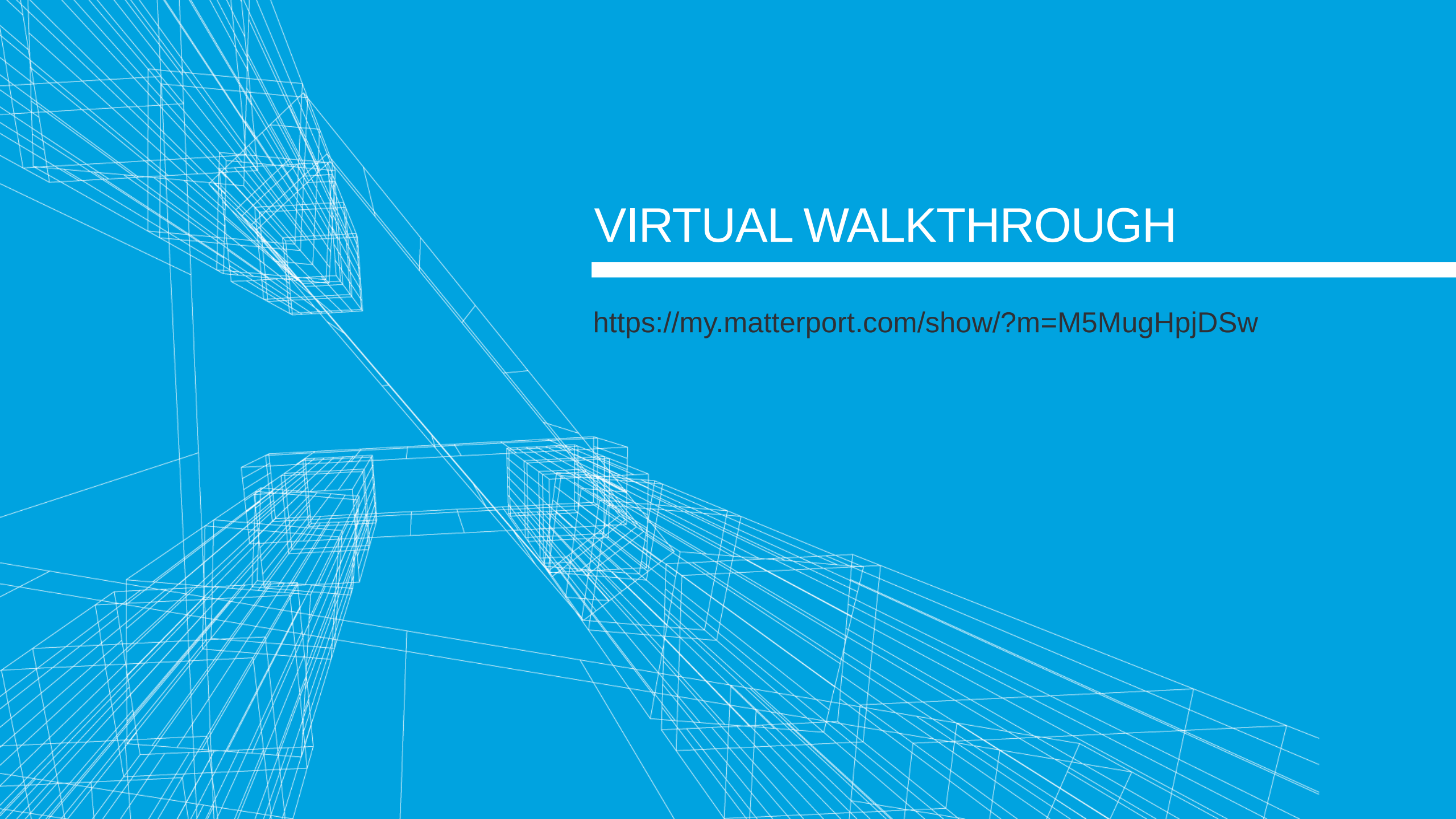
TRAINING

- Training was planned nearly from the beginning and conducted throughout construction
- Training included classroom training as well as field training during commissioning
- A huge investment of County Operations and Maintenance personnel time
  - (ex. Ph1: 56 classroom training sessions Apr'18 – Jul'18)
- Required a tremendous amount of coordination and subcontractor, Passaro Associates was used for this purpose exclusively
  - (ex. Ph2: 38 training plan submittals)
- COVID impacts during Phase 2 required virtual classroom training and contractor did field training for vendors or postponed until vendors could travel.

COVID IMPACTS AND ADJUSTMENTS



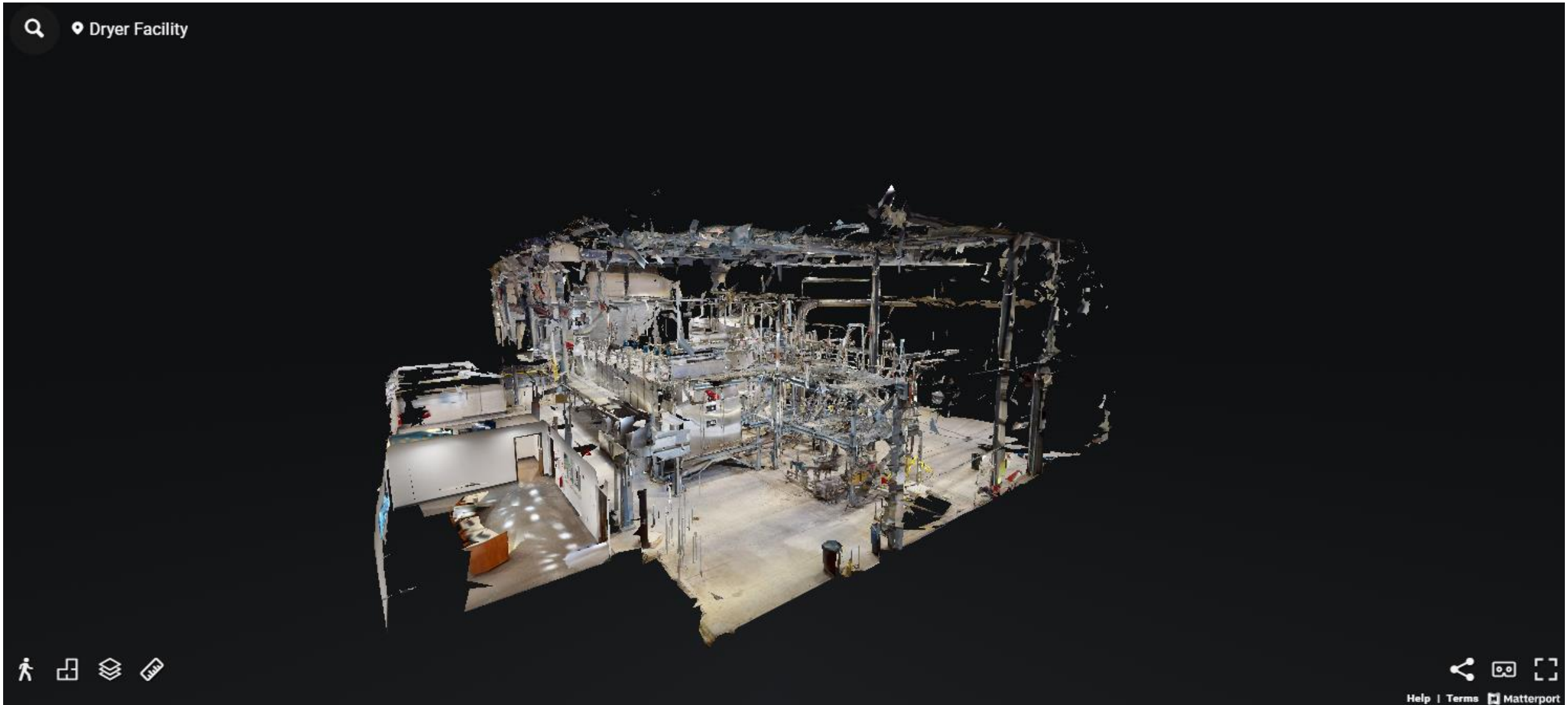
- Project declared “essential” – kept working
- Impacts to productivity – contract extended about 6 monts
- Challenges with deliveries and personnel required to typically be onsite (vendors for checkouts and commissioning)
- Followed CDC Guidelines (face coverings, distancing, hand washing, etc.)
- Added hand washing stations through construction areas
- Added signage regarding safe distancing
- Reduced number of office staff
- Allowed teleworking for all team members including onsite engineers and construction managers
- Virtual meetings and trainings



VIRTUAL WALKTHROUGH

https://my.matterport.com/show/?m=M5MugHpjDSw

VIRTUAL WALKTHROUGH

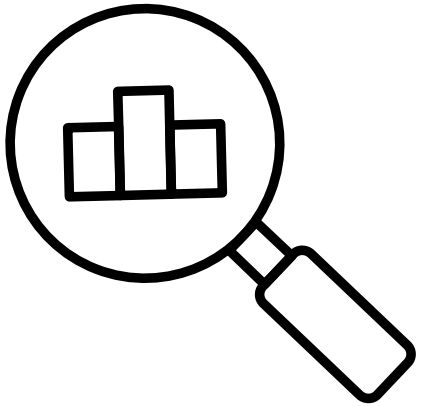


VIRTUAL WALKTHROUGH

CLOSING

BY THE NUMBERS

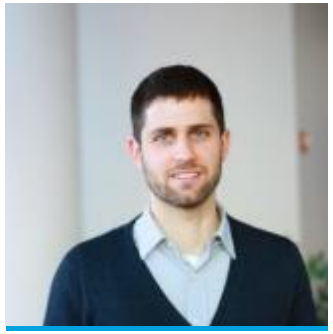
- 14 major plant processes rehabilitated or built new
- $94.3M for Construction, $19.1M for Engineering
- About 9 years from planning to construction final completion
- Construction 4 years, 8 months, 1 day since the start of preconstruction
- 4,079 material supplier invoices paid
- 1,240 subcontractor payment applications
- 38,671 charge entries to the project (875 pages of costs!)
- 74 owner payment applications
- 627 RFIs, 2,125 submittals, 234 changes
- 450,000 construction manhours
- 166 weekly/bi-weekly coordination meetings with HDR and Howard County
- 73 contracts written through the Clark Contracts Management Group
- Envision Silver Certification
- And…….



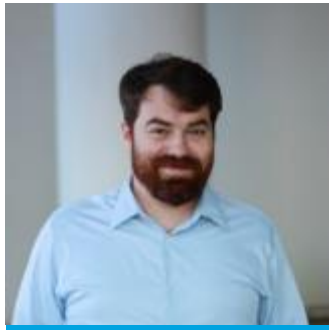
2,140 emails from Josh to Ben (Clark PM)!

KUDOS TO DESIGN TEAM

Larry Hentz, PM and Principal



Chris Moline, Process Engineer



John Maley, Lead Design Engineer and Resident Engineer

Adam Parmenter, Lead Design Engineer (Dryer) and Start-up

And many, many others:

Brian Balchunas, PM
Bill Cunningham
Billy Fox
Chris Alcorn
Chris Easter
Chris Work
Christina Alito
Dave Ogden
David Brearley
Dennis Scannell
Eric Martin
Henry Antshel
Jason Seagle
John Koch
Jonathan Gordon
Kanu Shah
Kathee Smith
Kelsey Kenel
Kirk Dunbar
Luis Hurtado
Meredith Welle
Michael Little
Michael Shumpert
Nadia Shebaro
PJ Daughton
Ron Emons
Sameer Deo
Scott Joslyn
Sebastian Smoot
Steve Brown
Teigan Gulliver
Tom Kochaba
… and ~ 150 more

THANK YOU CLARK TEAM!

- Aaron Rosansky
- Allison Kim
- Andy Alexander
- Ben Miller
- Brian Wright
- Brionna Farney
- Christian Toth
- Dakota Snyder
- Dave Hill
- Emily Jorgenson
- Eva Johnson
- Gabrielle Ferro
- Harrison Collien
- Joe Kinser
- Liz Hiddemen
- Mickey Carr
- Nic Peffer
- Patrick Szarnicki
- Paul Schneider
- Rob Randolph
- Rocky Levee
- Sandy Mitchum
- Sinara Ly
- Will Miller
- Interns
  - Sam Ramsland
  - Ben Voigt
  - Lainey Reed
  - Tanner Carr
  - Kyle Myers (now an asst. superintendent!)
- Foremen
  - Austin, Tommy, Angel, Hector, Maury, Josh, Wayne

Ten promotions, three marriages, three babies (maybe four depending on closeout…), three house purchases, one master electrician, one pilot

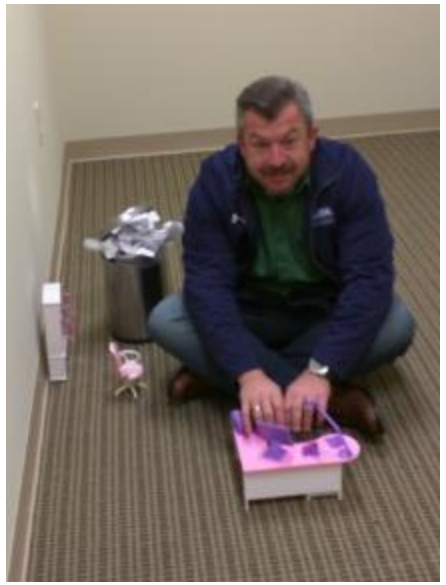
THANK YOU SUBS AND VENDORS!

- A2Z Environmental
- Adtek Engineers
- AEGIS Project Controls
- Allegany Door and Hardware
- Alliance Exterior Construction
- Altoona Pipe & Steel
- Apple Valley Scale
- Architectural Hardware Systems
- Asphalt General
- Aultec
- BA Martin Certified Welding
- Badger Daylighting Corp.
- Bay Ready Mix
- Bay Town Painting
- Biorem Environmental
- **Bowen Engineering**
- Bragunier Masonry
- Cagley & Assocaites
- **CNP/Centrisys**
- Complete Boiler Systems
- Continental Fire Sprinkler Co
- Diversified Safety Services
- DTM Construction
- **Dutchland Inc.**
- Engineered Air
- Fab-Tech
- **Ferguson Enterprises**
- FJ Industrial
- Froehling & Robertson
- Geiger Pump & Equipment
- General Heating & Cooling
- Geoconstructors
- Goel Services
- Gordon Contractors
- **Haarslev, Inc.**
- Havtech
- Heat Tape Solutions
- Horton Mechanical
- Insight
- James Myers
- John Wood Company
- Kimball Construction
- KWS
- **Kruger/Veolia**
- LC Insulations
- **LT Engineering**
- Lady Liberty
- Lloyd Plumbing
- MidAtlantic Photographic
- National Fire Protection
- NEFCO Corporation
- NEFCO Systems
- Nelson Precast
- Nicholson Construction
- Overhead Door of Baltimore
- **Passaro Engineering**
- Potts and Callahan
- ProTAB
- Reading Crane
- Regional Contracting
- Roane's Rigging
- **RPG Surface Prep**
- **Sherwood Logan (x3!)**
- Shirley Underground
- **Singleton Electric**
- SMI Services
- South-Tek Systems
- Sure Shot
- Tekleen
- Velodyne
- Ward Boland
- Westech Engineering

- And all our everyday suppliers…
- HD Supply, Grainger, McMaster, United Rentals, Sunbelt, Herc, Alban, NIN, Freedom Septic, JJ Adams, Metal Supermarkets, Seton, Hilti, Robnet, **MANY** more

- And thanks to Synagro and Plant Staff!

THANK YOU CLARK TEAM!



KUDOS TO COUNTY TEAM

LITTLE PATUXENT WATER RECLAMATION PLANT:

Rob Hindt
Rupa Pandey
Justin Myers
Sonya Williams
Byron Beckham
Chas Heine
Lewis Lockhart
Tim McFarland
Mark Ratliff
Bill Holland (R)
Bruce Taylor
Johnny Good
Keith Hood
Lou Maltese
John Swain (R)
Bob Funk (R)

And many, many others:

Tom Meunier
Art Shapiro
Ross Beschner
Daniel Davis
Tom Butler
Dean Hof
Bob Frances
Don Mock
Jim Hobson
Sidney Garrett
Jim Irvin (R)
Steve Gerwin (R)
Jeff Welty (R)
…and many, many more

(R) - Retired

LESSONS LEARNED

- CMAR method allows for good collaboration and fast delivery
- CMAR method is very beneficial for dealing with a multitude of process improvements happening sequentially and/or simultaneously
- CMAR is helpful for quickly navigating through unforeseen and design changes
- LOTS of skilled personnel are needed to successfully delivery a project of this size and complexity
- Must rely on (and trust) the expertise of each team member to do the part and “stay in their lane”

QUESTIONS

Joshua Gliptis, P.E. – Engineer, Project Manager
jgliptis@howardcountymd.gov