JEA
Building Community®

JEA's Measured Approach to Biosolids Management – Setting a Trend for Large Utilities

State-of-the-Art Thermal Drying

September 14, 2023

carollo®

Buckman Biosolids Capital Conversion Project Team

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Presentation Agenda

- Overview of JEA's Buckman Biosolids Capital Conversion Project
- Sludge Projections and Equipment Sizing
- Review of Design Elements and Layout

01

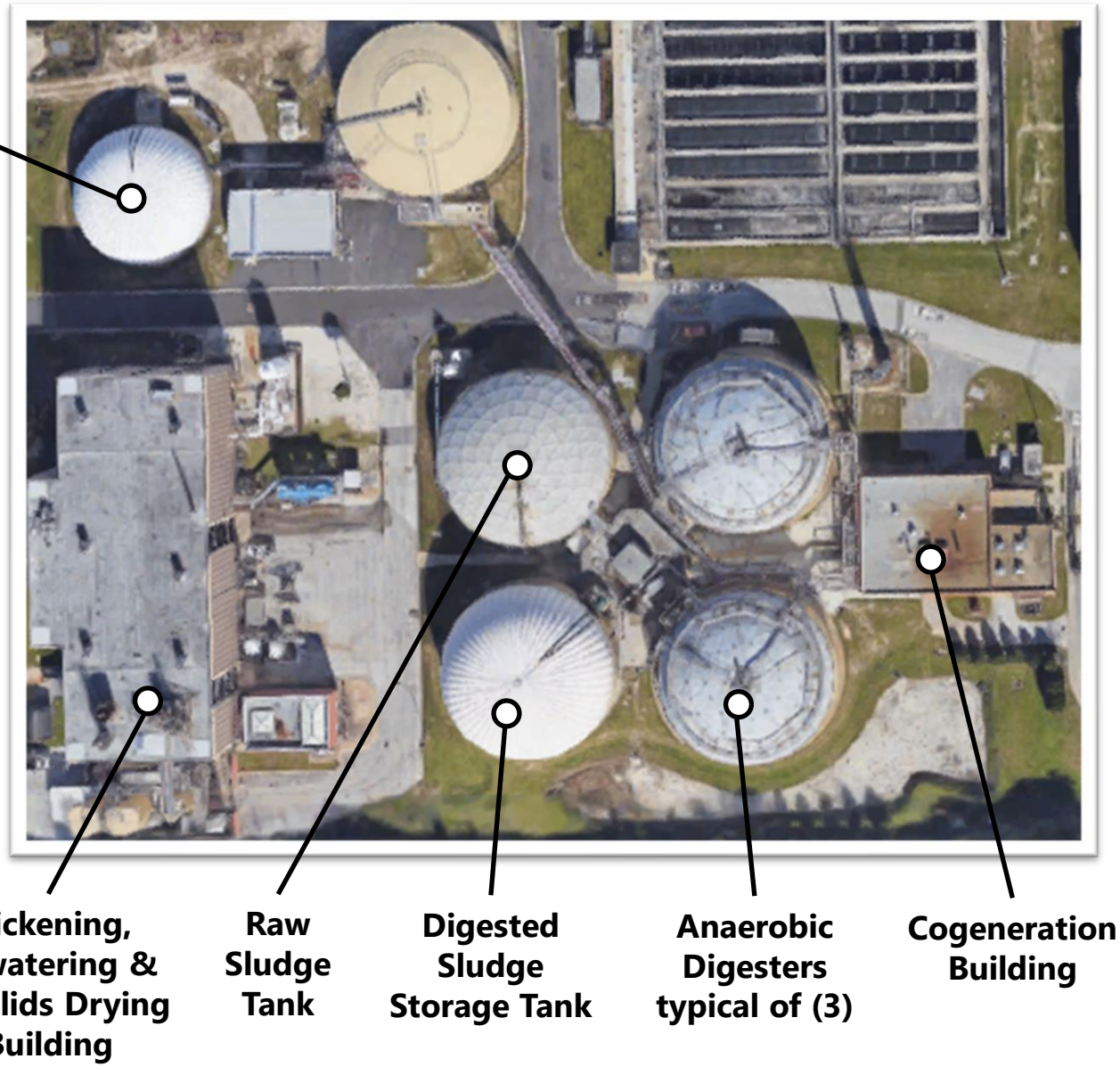
Overview of JEA Buckman Biosolids Capital Conversion Projects (BBCCP)

Background

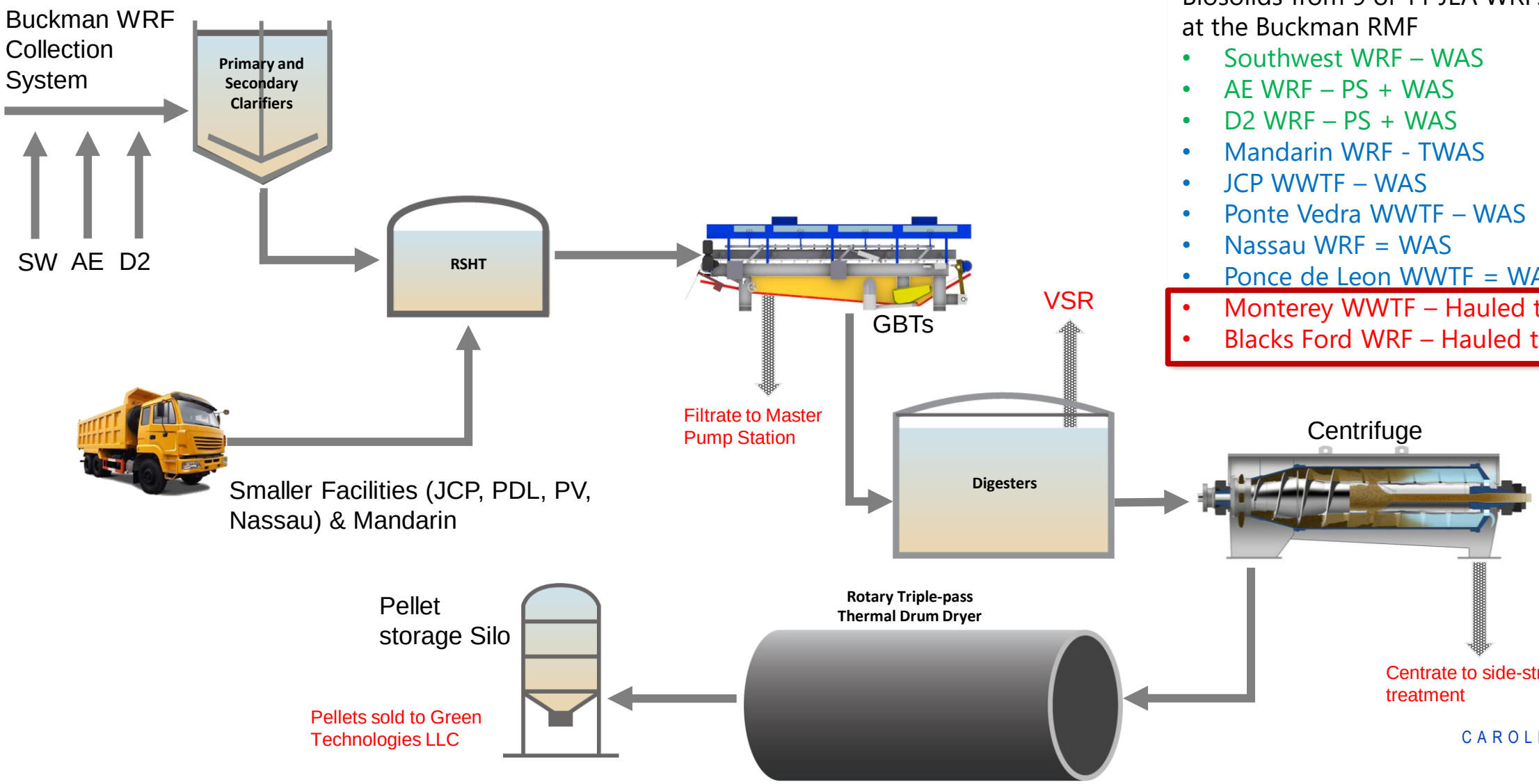
- **JEA** – Owns and operates 11 water reclamation facilities with combined treatment capacity of ~ 128.2 mgd
- **Buckman WRF** – Largest with capacity of 52.5 mgd
- **Buckman WRF** – Houses a Residuals Management Facility (RMF) that processes sludge from 8 WRFs

Background

- Buckman RMF includes
  - » **WAS** and PS **storage tank**
  - » **Thickening** with gravity belt thickeners
  - » **Stabilization** with anaerobic digestion meeting Class B requirements
  - » **Biogas** harnessed and used as fuel for energy production
  - » **Dewatering** of anaerobically digested sludge with centrifuges
  - » **Drying** dewatered sludge to >92% total solids using a thermal dryer (One DDS-70 dryer train by Andritz Separation Inc.)
  - » **Storing** dried biosolids in silos and further processed by 3rd party vendor



Existing Process Flow Diagram of Buckman RMF



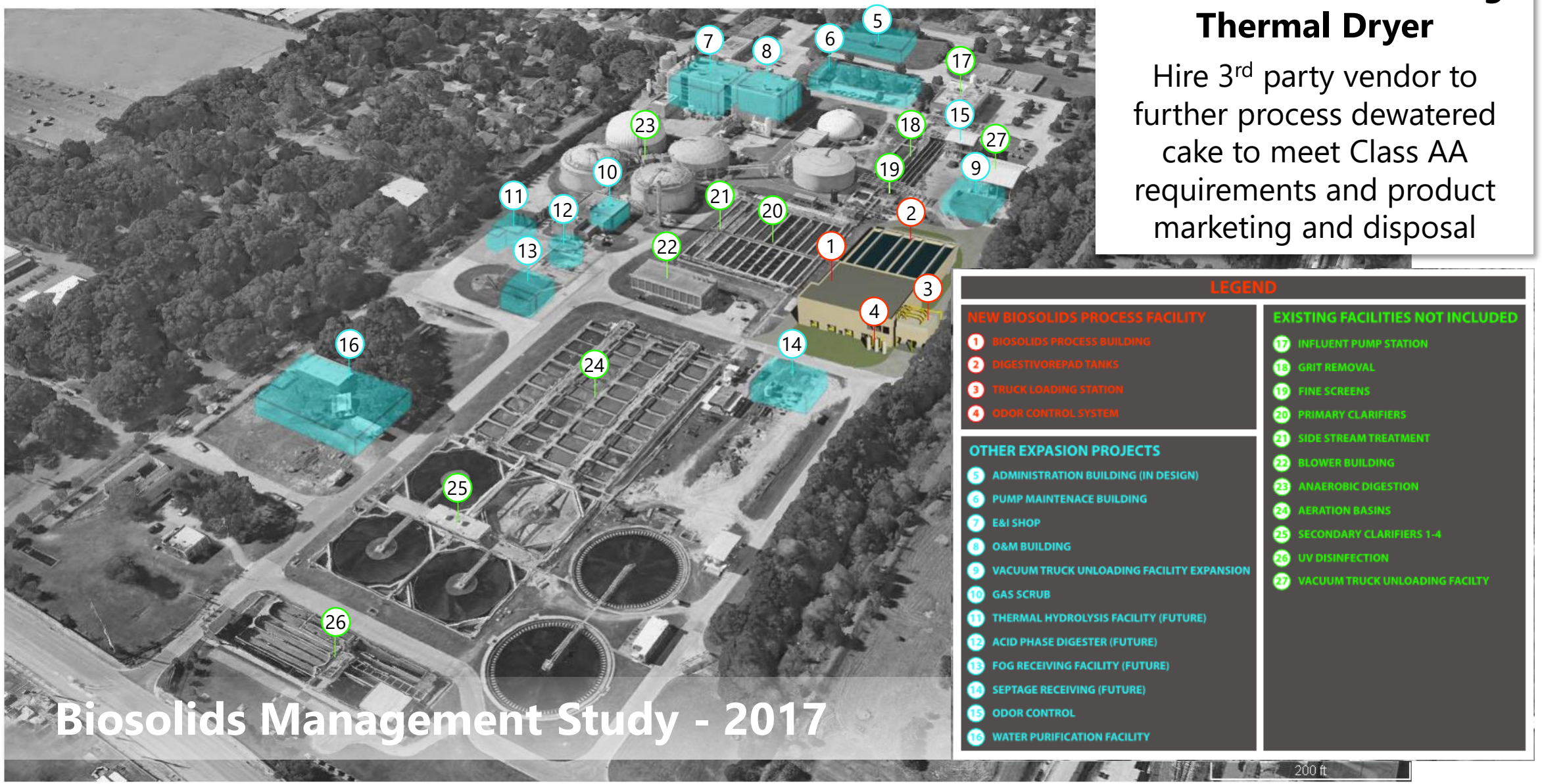
Biosolids from 9 of 11 JEA WRFs is treated at the Buckman RMF

- Southwest WRF – WAS
- AE WRF – PS + WAS
- D2 WRF – PS + WAS
- Mandarin WRF - TWAS
- JCP WWTF – WAS
- Ponte Vedra WWTF – WAS
- Nassau WRF = WAS
- Ponce de Leon WWTF = WAS
- Monterey WWTF – Hauled to Landfill
- Blacks Ford WRF – Hauled to Landfill

BBCCP Scope, Changes & Timeline

Decommission Existing Thermal Dryer

Hire 3rd party vendor to further process dewatered cake to meet Class AA requirements and product marketing and disposal

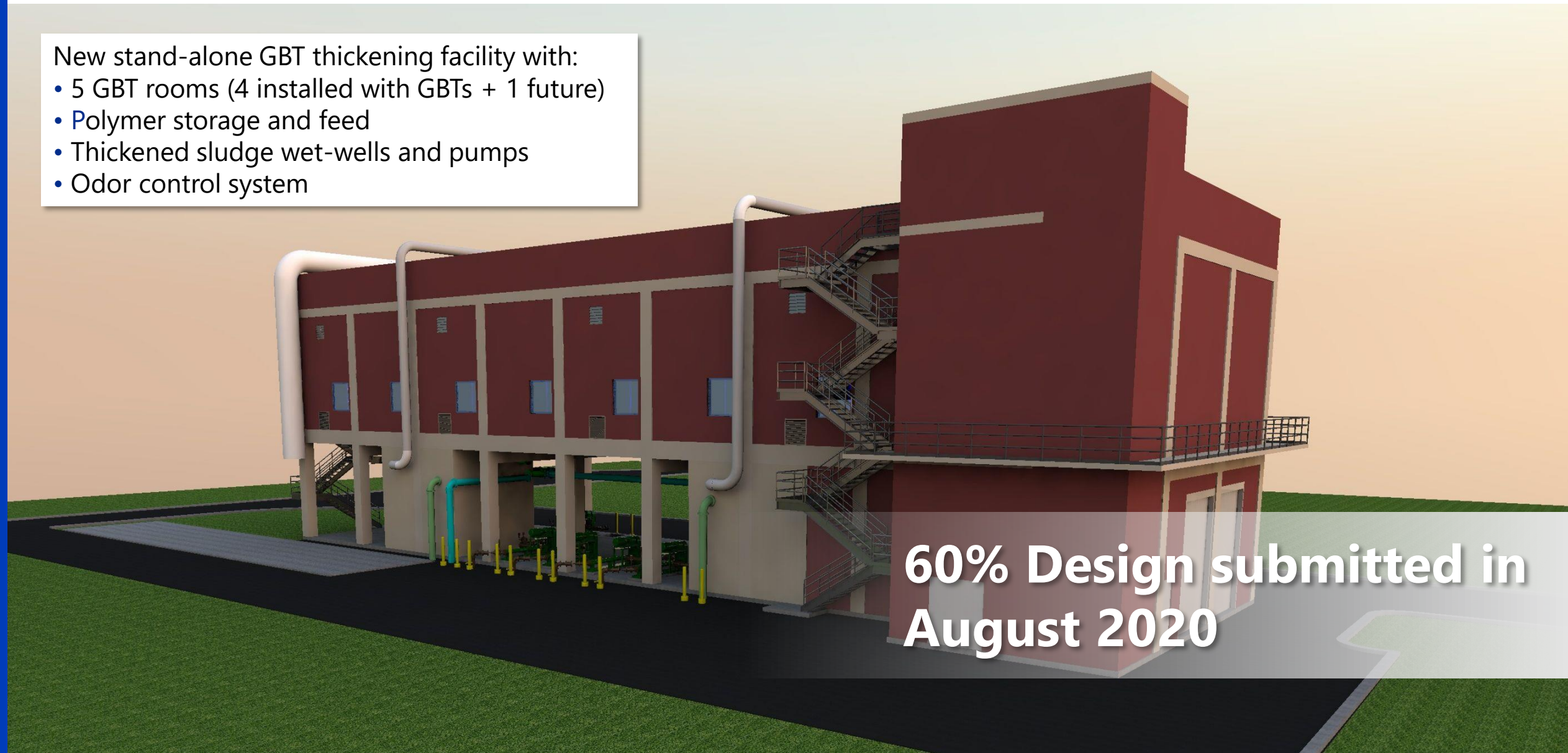


Biosolids Management Study - 2017

BBCCP Scope, Changes & Timeline

BBCCP Scope, Changes & Timeline

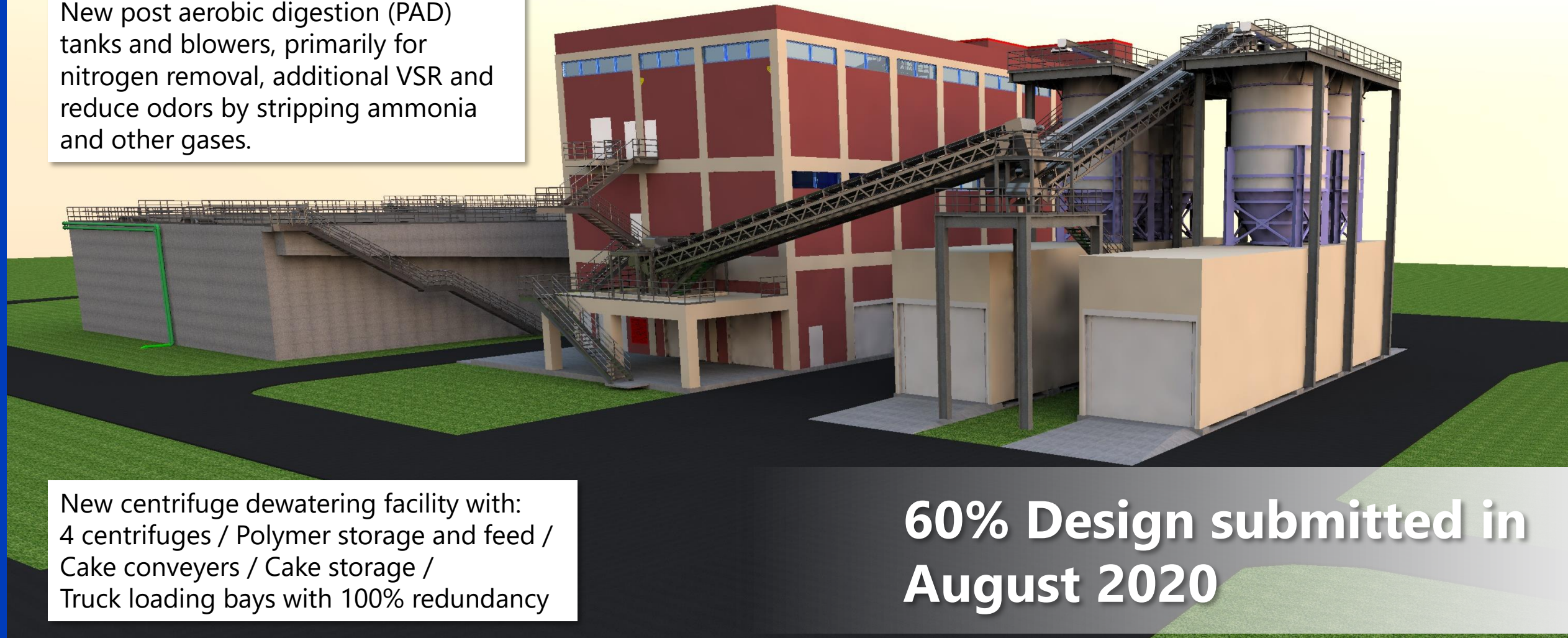
New stand-alone GBT thickening facility with:
- 5 GBT rooms (4 installed with GBTs + 1 future)
- Polymer storage and feed
- Thickened sludge wet-wells and pumps
- Odor control system



60% Design submitted in August 2020

BBCCP Scope, Changes & Timeline

New post aerobic digestion (PAD) tanks and blowers, primarily for nitrogen removal, additional VSR and reduce odors by stripping ammonia and other gases.



New centrifuge dewatering facility with:
4 centrifuges / Polymer storage and feed /
Cake conveyers / Cake storage /
Truck loading bays with 100% redundancy

60% Design submitted in August 2020

BMS, 2020 Goals and Objectives

- JEA hired Carollo for the BMS 2020 update
  - » Revisit short and long term Biosolids Management Options
    - Cost effective solution
    - Ease of end product disposal
    - Maintain reliability and redundancy
    - Reduce risk/offer more control to JEA
  - » Identify and screen treatment alternatives – desktop analysis
  - » Develop evaluation criteria and scoring matrix
  - » Select top two or three ranked options for detailed evaluation

FY 2020 Biosolids Management Costs

Item	FY20 Total Cost (Estimate, $) (1)	Average Monthly Cost ($)	Item Cost per DT Solids ($/DT) (2)
Chemicals	1,281,000	106,700	109.74
Solids Hauling & Disposal	170,000	14,100 (3)	14.53
Utilities	1,117,000	93,200	95.73
Labor/O&M (4)	2,145,000	178,800	183.80
Total	$4,713,000	$392,800	**$404**

Notes:

(1) Estimated from partial billing data for fiscal year 2020.
(2) Based on September 2019 through August 2020.
(3) Includes offset costs from pellets production/sale to Green Technologies.
(4) Assumes 40% of total plant labor, maintenance, etc. is allocated towards the biosolids handling process.

Biosolids Production – Projection Update

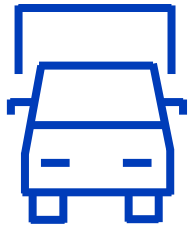
Year	Combined Dry Solids from 3 Satellite Facilities (Blacks Ford, Monterey, & Greenland) (DT/d)	Buckman Dry Solids - (DT/d)	Total Dry Solids to be processed at new Dryer (DT/d)	Total Wet Solids to be processed at new Dryer (WT/d)
2021	4.07	35.54	39.61	198.06
2025	6.17	36.48	42.65	213.27
2030	6.82	38.39	45.21	226.07
2035	7.51	40.08	47.59	237.93
2040	8.14	41.92	50.06	250.30
2045	8.77	44.07	**52.84**	**264.20**

Notes:

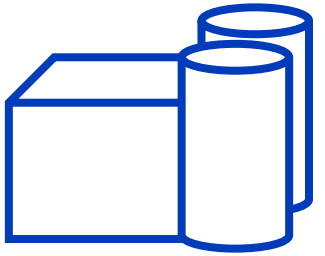
(1) Adapted from **2018 BMS RFP** . Data for 2041 through 2045 extrapolated from earlier projections.
(2) Greenland assumed online in 2023.
(3) Assumes 20% total solids in the dewatered cake.

BMS 2020 Update Alternatives Analysis

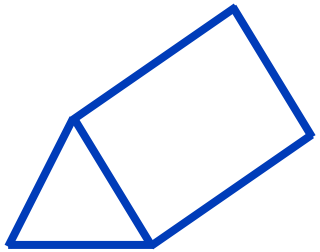
Alkaline Stabilization/ Pasteurization



Hauling



Direct Drying



Composting

DESIGN CONSIDERATIONS

- Increase Sludge Volume
- Establish a Market in North Florida

- Regulations for Land Application
- Landfills not Accepting Biosolids
- High Disposal Costs

- Most Marketable Product
- Significant Volume Reduction
- Familiar with Technology

- Large Land Area Required
- Located Offsite
- Potential Odor Issues

Alternatives Comparison Summary

Alternative	Capital Cost	Net Year 1 O&M Cost	NPV	Net Year 1 O&M Cost ($/DT)	Evaluation Score
Dryer DDS-100 with Digester Gas	$148,800,000	$4,794,000	$220,755,000	$308	1.94
Dryer DDS-100	$147,400,000	$5,577,000	$228,363,000	$358	
Dryer DDS-80	$140,450,000	$5,855,000	$228,919,000	$376	
Bioset – Buckman Only	$79,500,000	$9,825,000	$231,925,000	$648	2.34
Bioset – Buckman & Satellites	$82,425,000	$10,093,000	$237,184,000	$629	
Primary CASP Off-Site	$105,400,000	$8,515,000	$237,193,000	$547	2.48
Primary CASP On-Site	$107,600,000	$7,951,000	$230,603,000	$511	2.34
Full CASP Off-Site	$113,100,000	$7,335,000	$224,016,000	$471	2.18
Full Enclosed CASP Off-Site	$136,200,000	$7,535,000	$245,836,000	$484	2.33
Full In-Vessel Off-Site	$132,230,000	$7,502,000	$241,509,000	$482	2.29
Baseline Landfill	$81,830,000	$11,966,000	$281,255,000	$769	3.37
Baseline Land Application	$81,830,000	$9,015,000	$219,864,000	$579	2.83

FY 2020 processing cost is ~$400/DT

Summary of Cost *and* Non-Cost Factor Evaluation

Criteria	Weight	Dryer Score	Dryer Weighted Score	Bioset Score	Bioset Weighted Score	Primary CASP On-Site Score	Primary CASP On-Site Weighted Score	Primary CASP Off-Site Compost Score	Primary CASP Off-Site Weighted Score	Full CASP Off-Site Score	Full CASP Off-Site Weighted Score	Full Enclosed CASP Off-Site Score	Full Enclosed CASP Off-Site Weighted Score	Full In-Vessel Off-Site Score	Full In-Vessel Off-Site Weighted Score	Baseline Landfill Score	Baseline Landfill Weighted Score	Baseline Land Application Score	Baseline Land Application Weighted Score
Capital Cost	16%	5.0	0.80	1.0	0.16	2.8	0.44	2.6	0.42	3.2	0.51	4.0	0.64	3.9	0.62	1.1	0.18	1.1	0.18
O&M Cost	16%	1.0	0.16	3.9	0.62	2.7	0.43	3.3	0.53	2.5	0.39	3.0	0.48	2.9	0.46	5.0	0.80	3.4	0.54
Risk Exposure	12%	1	0.12	3	0.36	3	0.36	3	0.36	2	0.24	2	0.24	2	0.24	5	0.61	4	0.48
Public Safety, Acceptance, and Neighborhood Friendliness	6%	1	0.06	3	0.18	3	0.18	3	0.18	2	0.12	1	0.06	1	0.06	4	0.24	4	0.24
Ease of Operation and Maintenance	12%	3	0.36	2	0.24	2	0.24	2	0.24	2	0.24	2	0.24	2	0.24	1	0.12	1	0.12
Ease of End Product Disposal	12%	1	0.12	3	0.36	2	0.24	2	0.24	2	0.24	2	0.24	2	0.24	4	0.48	4	0.48
Ease of Permitting	3%	1	0.03	1	0.03	1	0.03	2	0.06	2	0.06	2	0.06	2	0.06	1	0.03	1	0.03
Reliability	9%	1	0.09	1	0.09	1	0.09	1	0.09	1	0.09	1	0.09	1	0.09	5	0.45	4	0.36
Waste-Side Stream Impacts	2%	2	0.03	3	0.05	2	0.03	2	0.03	2	0.03	2	0.03	2	0.03	2	0.03	2	0.03
Beneficial Use	8%	1	0.08	2	0.15	3	0.23	3	0.23	1	0.08	2	0.15	2	0.15	5	0.38	4	0.30
Impacts of Facility Foot Print	5%	2	0.09	2	0.09	4	0.18	2	0.09	2	0.09	2	0.09	2	0.09	1	0.05	1	0.05
Total	100%		**1.94**		**2.34**		**2.46**		**2.48**		**2.18**		**2.33**		**2.29**		**3.37**		**2.83**

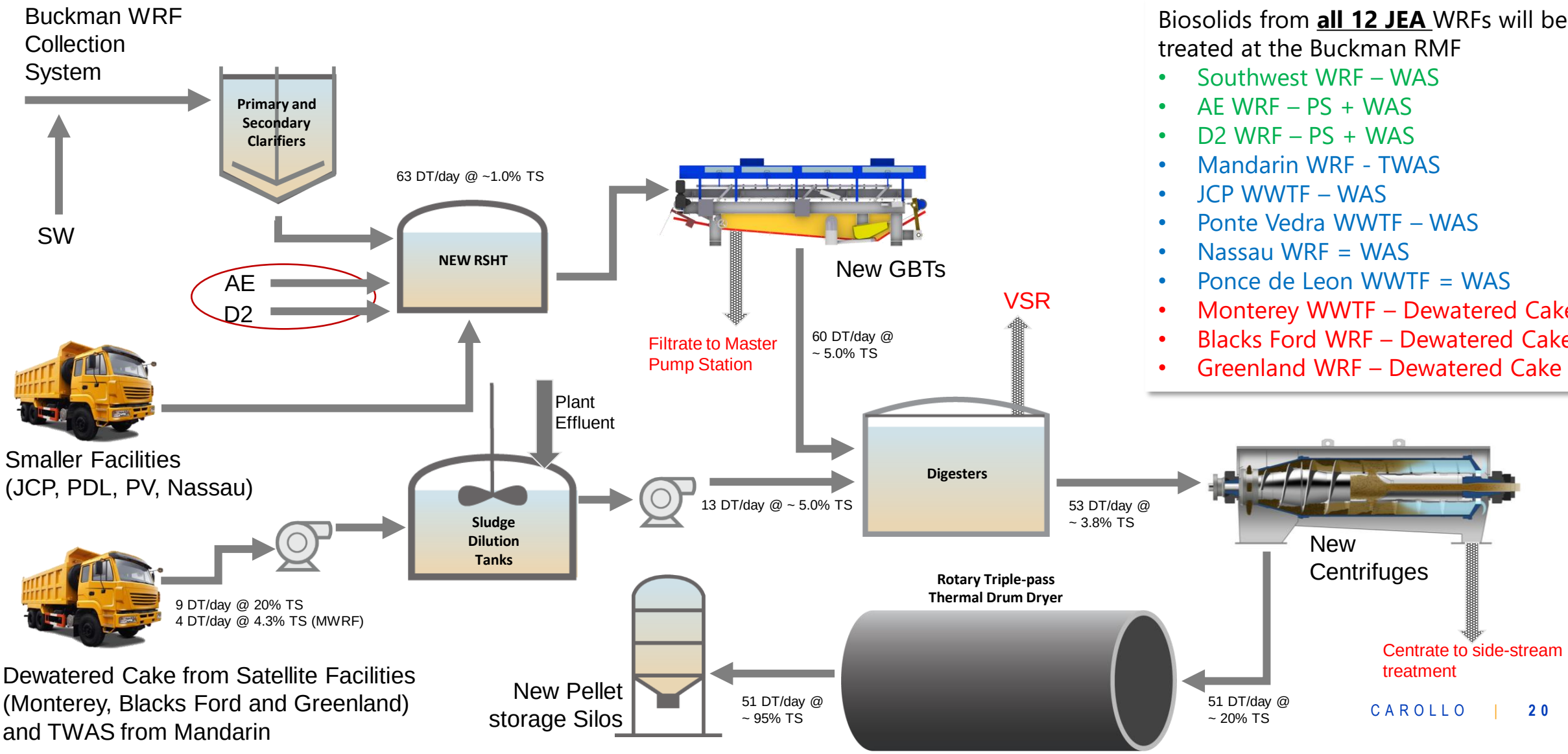
02

Sludge Projections and Equipment Sizing

BBCCP Design Criteria

Parameter	Thickening Process	Anaerobic Digestion Process	Dewatering Process	Thermal-Drying Process
Total solids loading, DT/d				
Year 1, 2026 annual average	51.9	59.2	44.6	42.3
Year 1, 2026 maximum month	63.1	72.0	52.9	50.3
Maximum month peaking factor (5)	1.2	1.2	1.2	1.2
Year 1, 2026 maximum day	89.8	101.3	74.5	70.7
Maximum day peaking factor	1.7	1.7	1.7	1.7
Design year 2045 annual average	62.6	72.1	54.0	51.3
Design year 2045 maximum month	76.2	87.6	64.4	61.2
Maximum month peaking factor (5)	1.2	1.2	1.2	1.2
Design year 2045 maximum day	108.4	123.1	90.5	86.0
Maximum day peaking factor	1.7	1.7	1.7	1.7
Influent solids concentration, % TS	2.0 - 2.5%	4.0 – 5.0%	3.0 - 3.7%	18 - 21%
Operating hours per day	24	24	24	24
Operating days per week	7	7	7	7
Total sludge flow, gpm				
Design year 2045 annual average	465	270	265	NA
Design year 2045 maximum month	565	325	315	NA
Design year 2045 maximum day	805	460	445	NA
Total solids loading, lb/hr				
Design year 2045 annual average	5,2,20	6,000	4,500	4,300
Design year 2045 maximum month	6,350	7,300	5,400	5,100
Design year 2045 maximum day	9,035	10,260	7,550	7,170

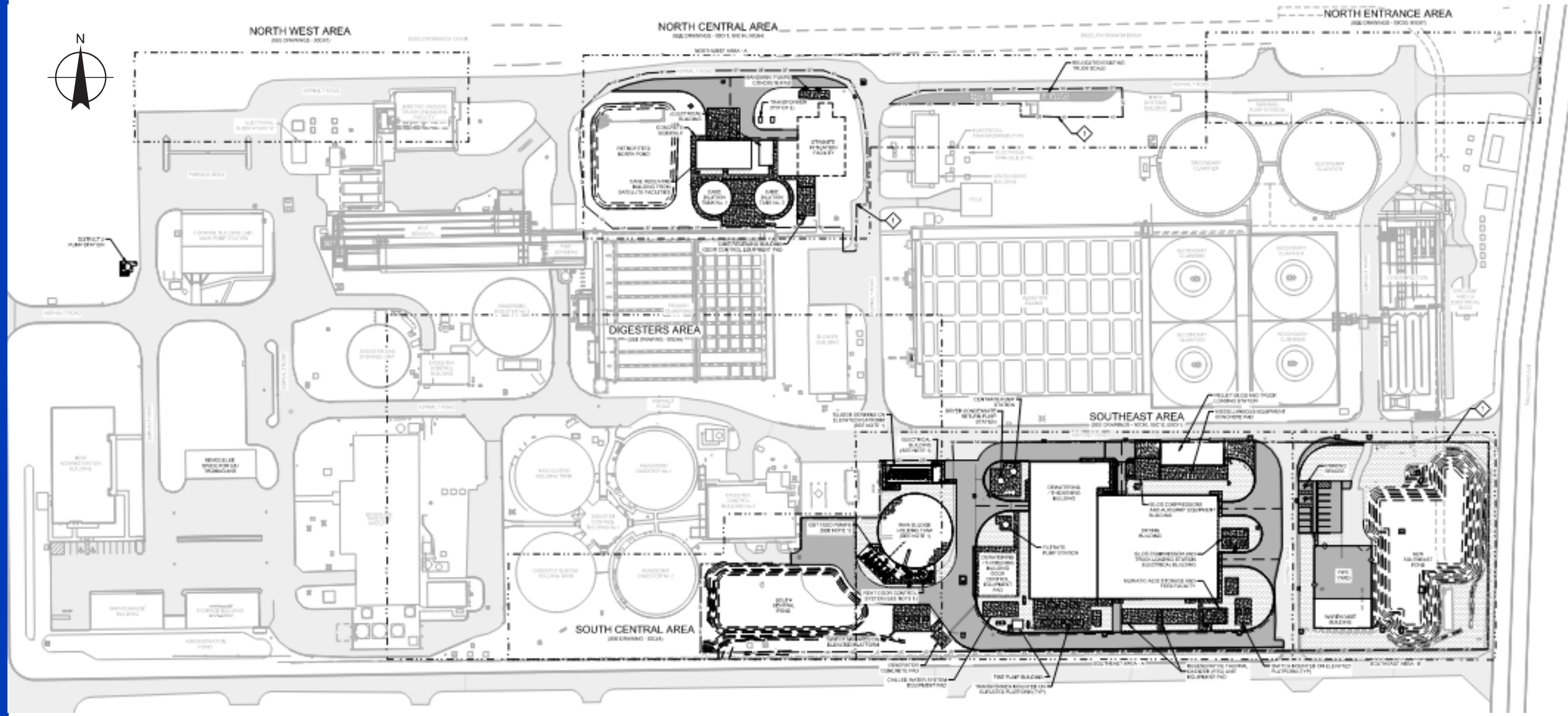
New Process Flow Diagram of Buckman RMF



Biosolids from **all 12 JEA** WRFs will be treated at the Buckman RMF

- Southwest WRF – WAS
- AE WRF – PS + WAS
- D2 WRF – PS + WAS
- Mandarin WRF - TWAS
- JCP WWTF – WAS
- Ponte Vedra WWTF – WAS
- Nassau WRF = WAS
- Ponce de Leon WWTF = WAS
- Monterey WWTF – Dewatered Cake
- Blacks Ford WRF – Dewatered Cake
- Greenland WRF – Dewatered Cake

New BBCCP Site Layout



New Biosolids Processing Facility

Entire design done using Revit® BIM software

Overall Plan View of new BFP

New Biosolids Processing Facility

Biosolids Processing Facility (BPF) is 190-feet wide, 262-feet long and 80-feet tall

New Biosolids Processing Facility

New Biosolids Processing Facility

BFP has a separate pellet storage and truck loading station

New Biosolids Processing Facility

Sludge Projections and Dryer Sizing

Dryer Sizing Requirements

Design Condition	Year 1 - 2027				Design Year - 2045			
	Avg. day	Max. Mon	Max. Wk	Max. Day	Avg. day	Max. Mon	Max. Wk	Max. Day
Sludge Production (DT/d)	41.3	50.2	53.3	70.7	50.3	61.1	64.9	85.9
Sludge Production (lb/d)	82,648	100,447	106,616	141,303	100,569	122,226	129,734	171,794
Design Cake Dryness (% DS)	20%	20%	20%	20%	20%	20%	20%	20%
Dryer Operations (days/week)	7	7	7	7	7	7	7	7
Hours of Operation (hr/d)	24	24	24	24	24	24	24	24
Dryer Cake Feed (wet lbs/hr)	17,218	20,926	22,212	29,438	20,952	25,464	27,028	35,790
Final Product Dryness (%DS)	95%	95%	95%	95%	95%	95%	95%	95%
Final Product (wet lbs/hr)	3,272	3,976	4,220	5,593	3,981	4,838	5,135	6,800
Evaporation Rate (lbs H_2O/hr)	13,947	16,950	17,992	23,845	16,971	20,626	21,893	28,990
No. of Drying Trains (duty/standby)	1/1	1/1	1/1	2/0	1/1	1/1	1/1	2/0
DDS Model	DDS - 100							
Max. Evaporation Rate (lb H_2O/hr)	22,000	22,000	22000	44,000	22,000	22,000	22,000	44,000
Dryer Turndown	63%	77%	82%	108%	77%	94%	100%	132%
No. of Days Both Dryers will be "ON"	0	0	0	7	0	0	0	40

03

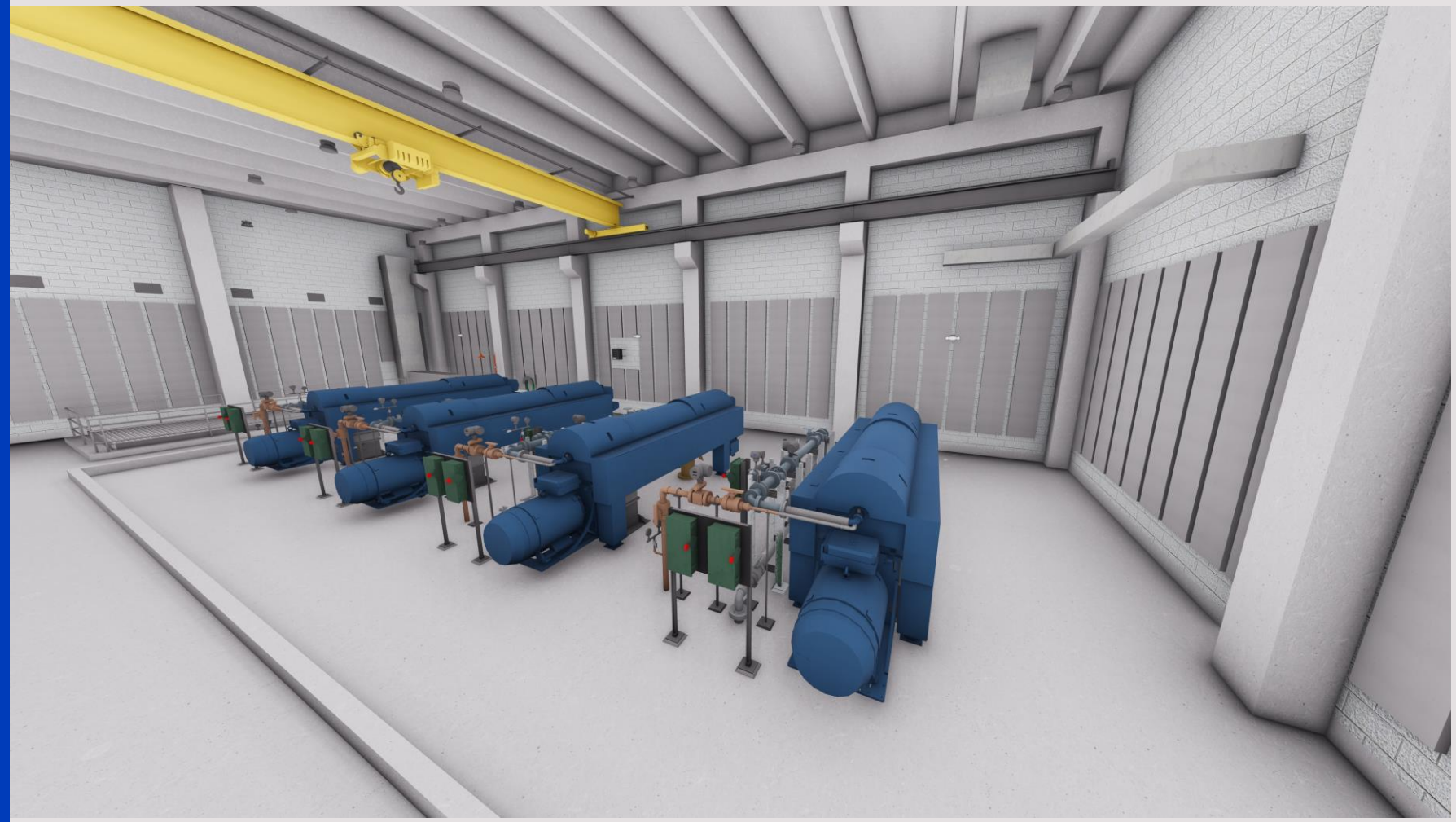
Review of Design and Layout

New Thickening/Dewatering Facilities

New Gravity Belt Thickening

- 5 Gravity Belt Thickeners mounted on the second floor with thickened sludge wetwells beneath
- Each GBT located in a separate room to allow for ease of O&M and repair/rehabilitation
- Thickening Facilities will have biotrickling filters for foul odor treatment

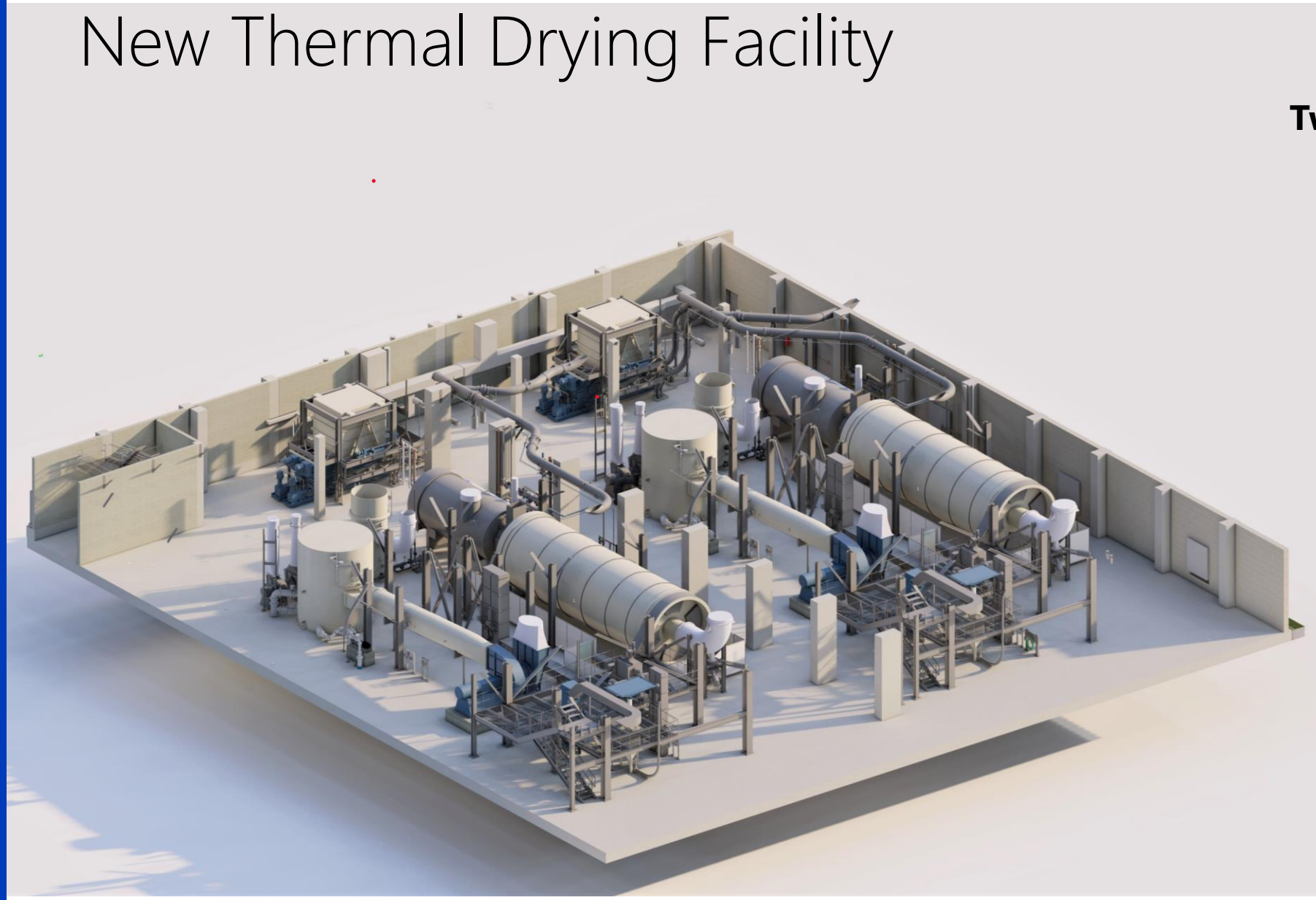
New Thickening/Dewatering Facilities



New Centrifuge Dewatering

- 4 High-speed Centrifuges for dewatering of anaerobically digested biosolids.
- Screw conveyors for conveying dewatered biosolids to the wet-cake bins to feed to new thermal drum dryers

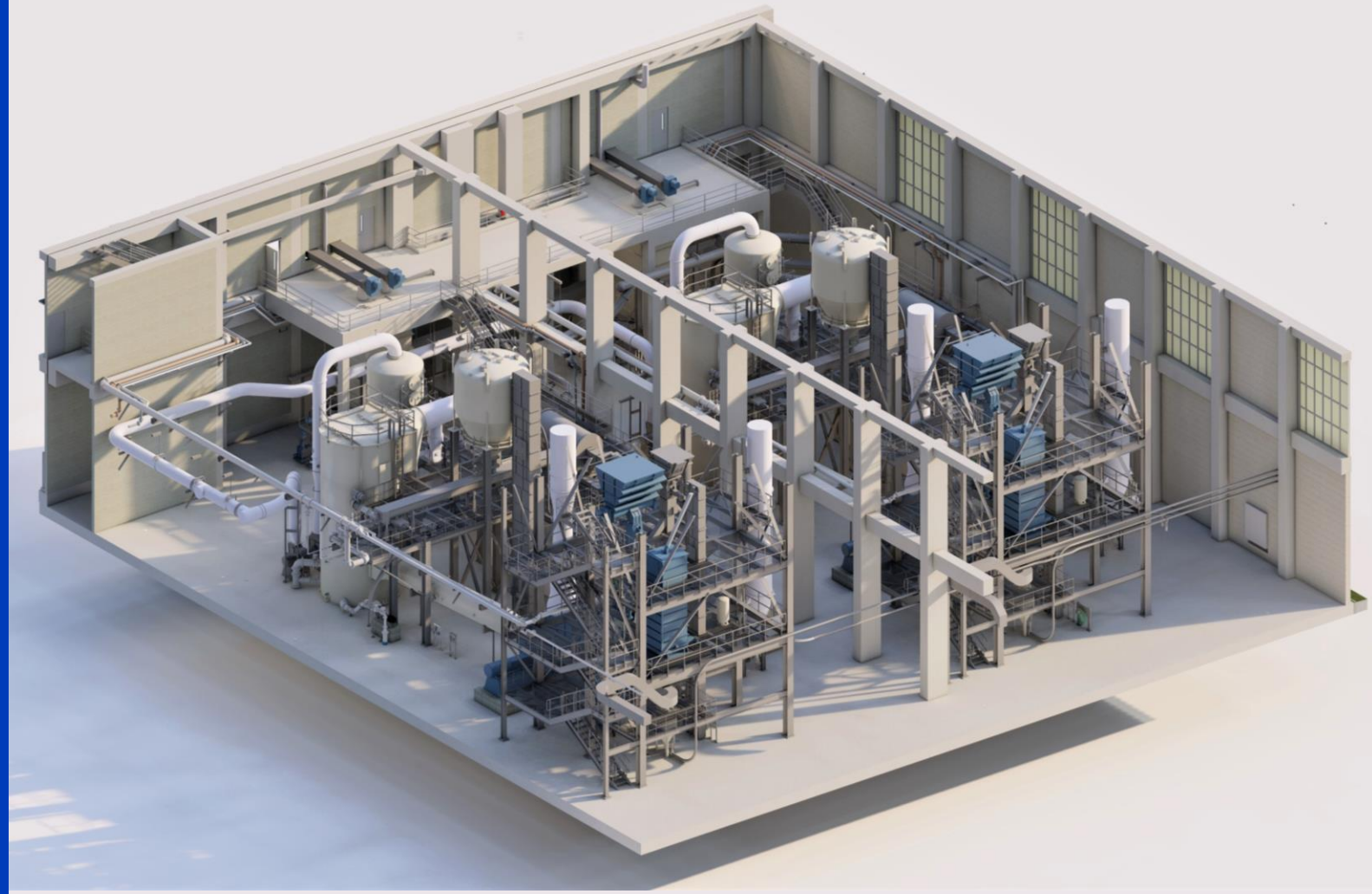
New Thermal Drying Facility



Two DDS-100 Dryer Trains

- One wet-cake storage bin with live bottom hopper
- Wet-cake progressive cavity feed pumps (2)
- Recycle bin with metering screw conveyor and bucket elevator
- Mixer
- Direct-fired dual fuel furnace with flame safety CP
- Direct-heat, concurrent, Triple-pass drum dryer to produce pellets 0.7– 4 mm diameter

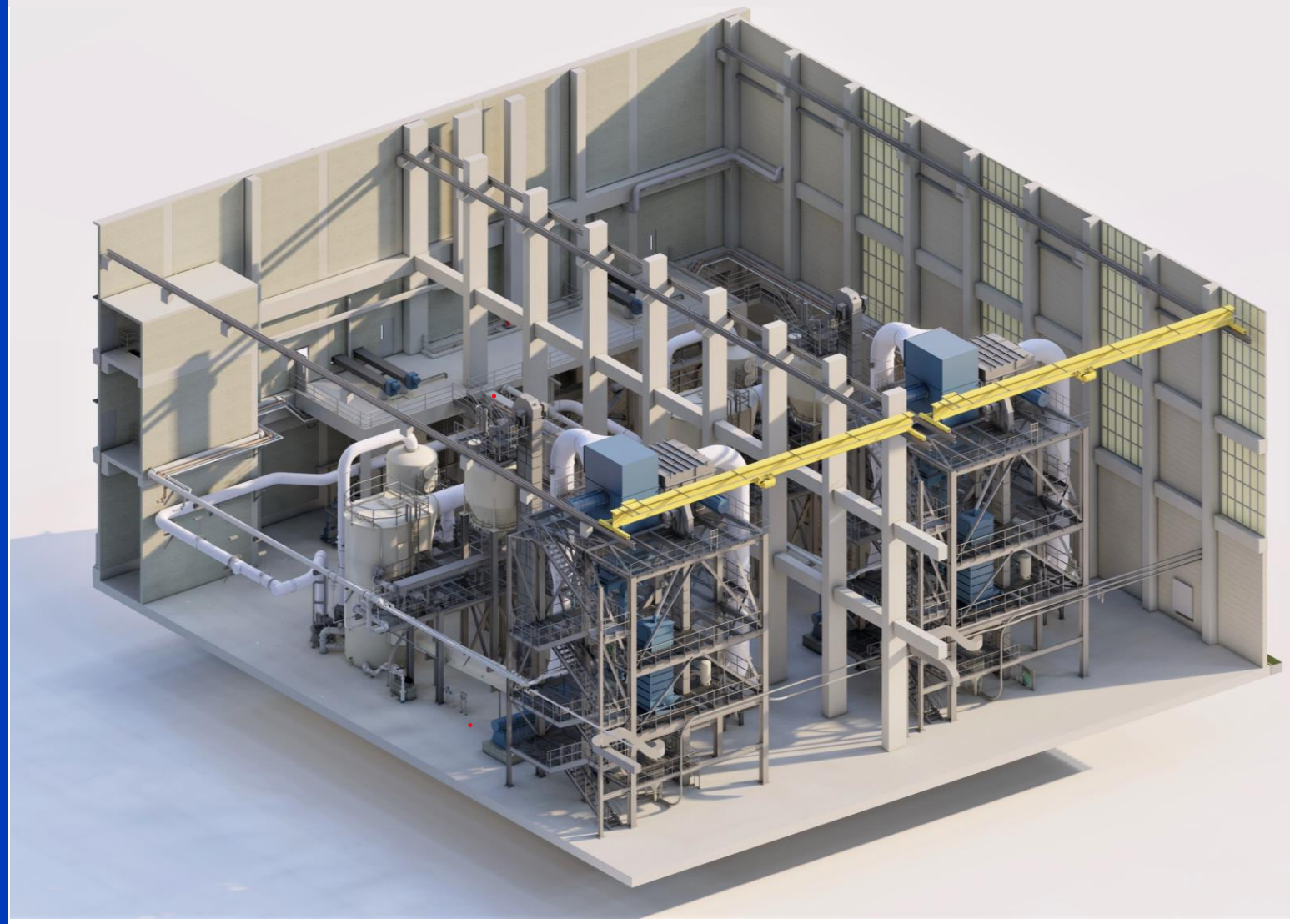
New Thermal Drying Facility



Two DDS-100 Dryer Trains

- Pre-separator and poly-cyclone systems for solids separation from process gas
- Solids classifier with shaker screen, crusher
- Pellet cooler with bucket elevator
- Pneumatic conveyors with air compressors and nitrogen generators
- Main process induced draft fan
- Combustion air supply fan
- Condenser (tray tower scrubber)
- Venturi scrubber with induced draft fan
- Regenerative Thermal Oxidizer (RTO) with exhaust stack
- Dust collection systems
- Platforms, catwalks, and stairwaysa

New Thermal Drying Facility



Revit® BIM software has allowed us to model all systems – process equipment, floor drain locations, ductwork, piping and duct/pipe supports, electrical conduits, instruments and HVAC ducts

- Eliminate conflicts
- Open floor plan for ease of access to all equipment

New Thermal Drying Facility

Heat Recovery System

New Biosolids Processing Facility

- Two 250-ton silos for final product storage
- One 50-ton silo for waste pellet storage
- One 100-ton silo for emergency cake storage
- Three nitrogen generators for generating nitrogen gas from ambient air to use with pellet transport and therefore reduce hot spots within the silos
- Truck loading station is design with a covered roof (intermediate platform) long enough to house the largest truck under any silo for unloading product without any potential impact during rain events
- All silos designed to have 316 SS roof for better corrosion protection
- We are investigating full welded silos in lieu of bolted silo design

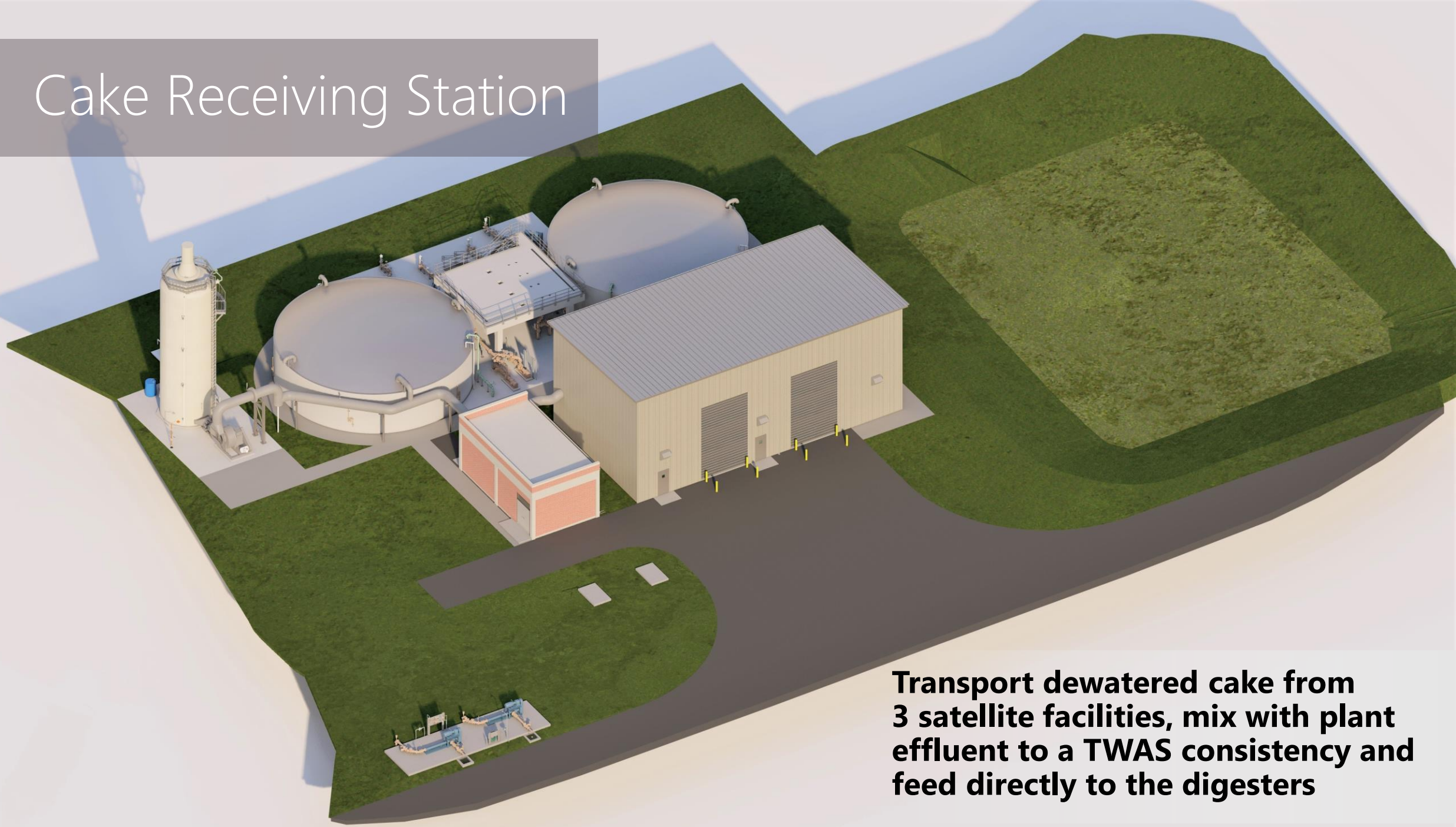
Three-Chamber RTO Design

- RTOs plumbed with valves to allow to operate any train with any RTO providing redundancy
- Low pressure drop Ceramic random packing
- Each RTO chamber has a 4-ft square opening on top for media cleanout

New Biosolids Processing Facility

All electrical rooms, control rooms, offices, conference room, and other occupied spaces served with chilled water air handling units and building Direct Digital Control (DDC) for ease of O&M

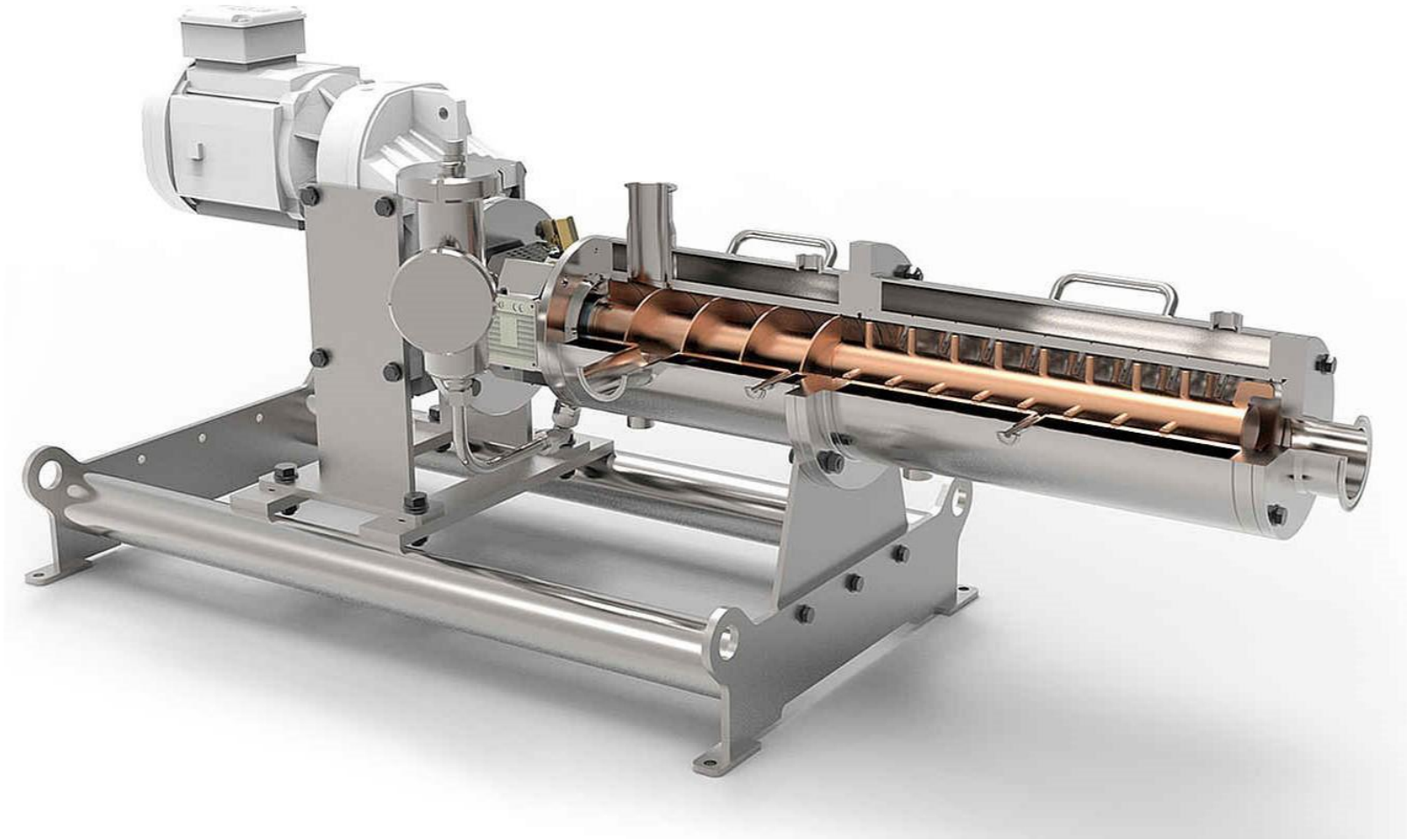
Cake Receiving Station



Transport dewatered cake from 3 satellite facilities, mix with plant effluent to a TWAS consistency and feed directly to the digesters

In-line, High-shear, Dynamic Mixer

- Transport partially stabilized dewatered sludge cake from three satellite facilities to Buckman to reduce costs
- Re-wet cake with plant effluent to a thickened sludge (~5%) consistency for feeding into the digesters
- Achieve a consistent feed cake into the dryer to minimize formation of fines, dust and odors

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Thank you.

Contact us with any questions, comments, or issues.

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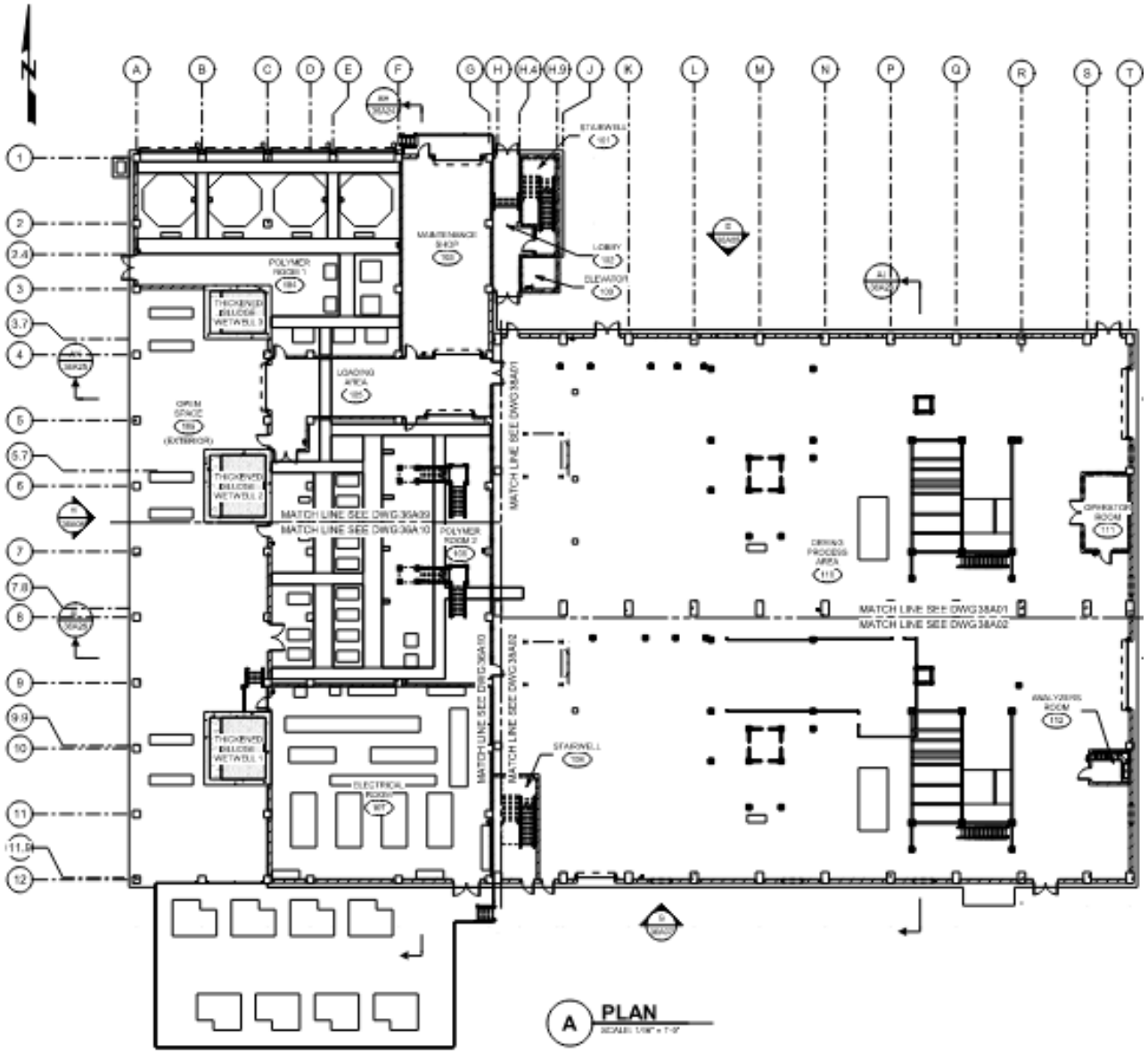
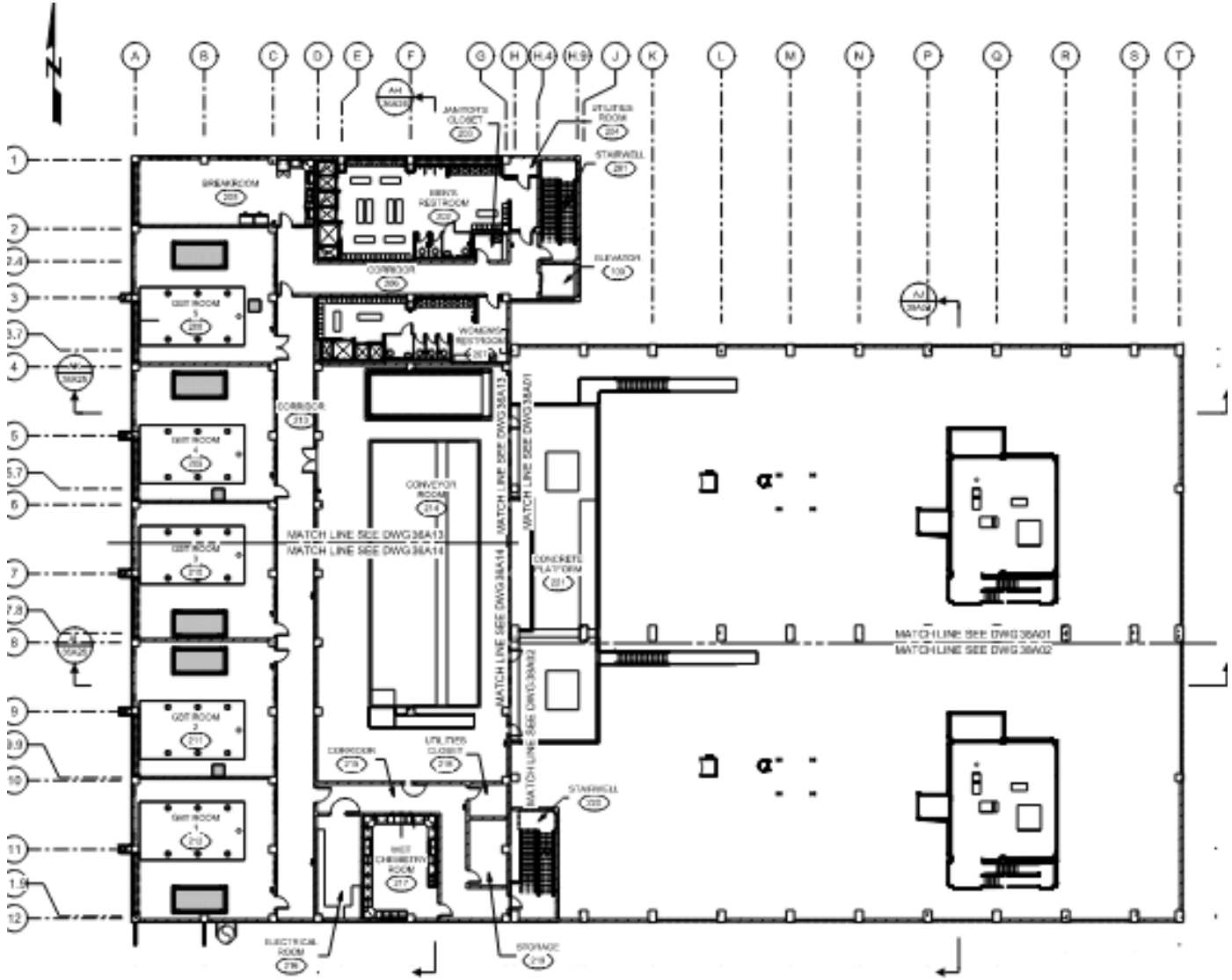
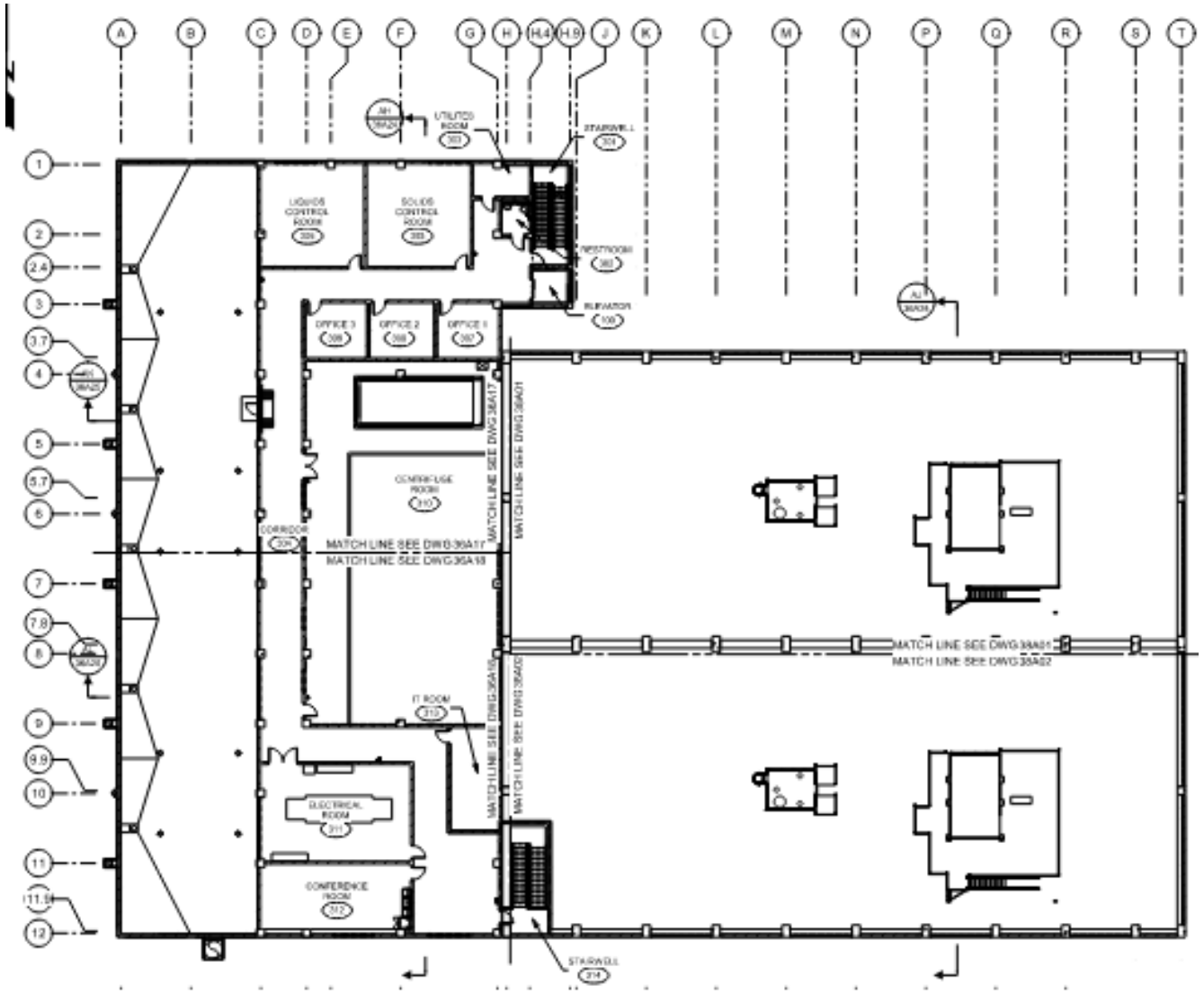
1st Floor Plan



2nd Floor Plan

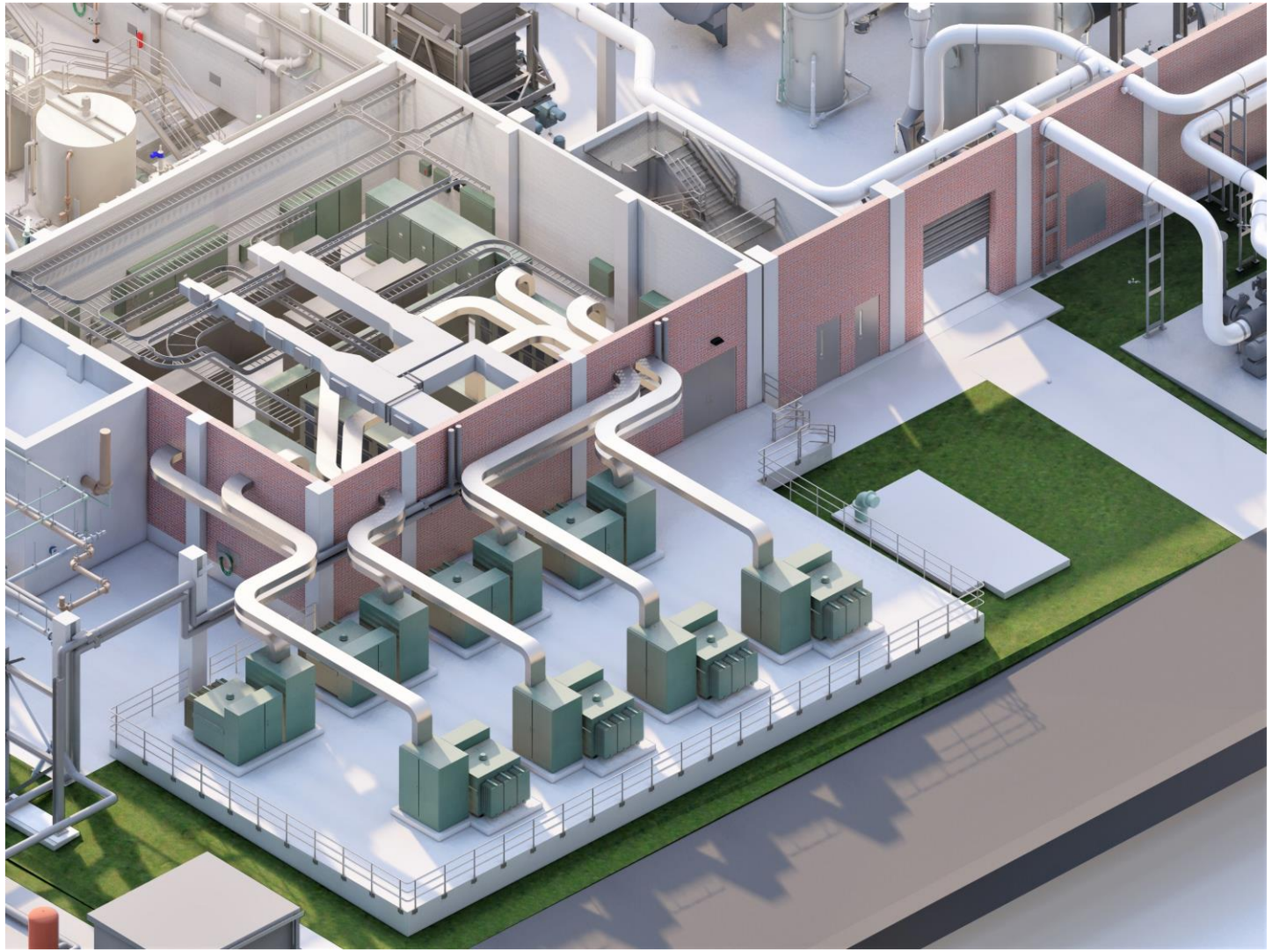


3rd Floor Plan



Electrical Design Features

- There will be eight 2.5 MVA transformers with overhead cable bus to feed to four 3,200 A switchgears
- Electrical room, transformer pad is 2-feet higher than the rest of the building (F.F EL 15) to meet the resiliency requirements



I&C Design Features

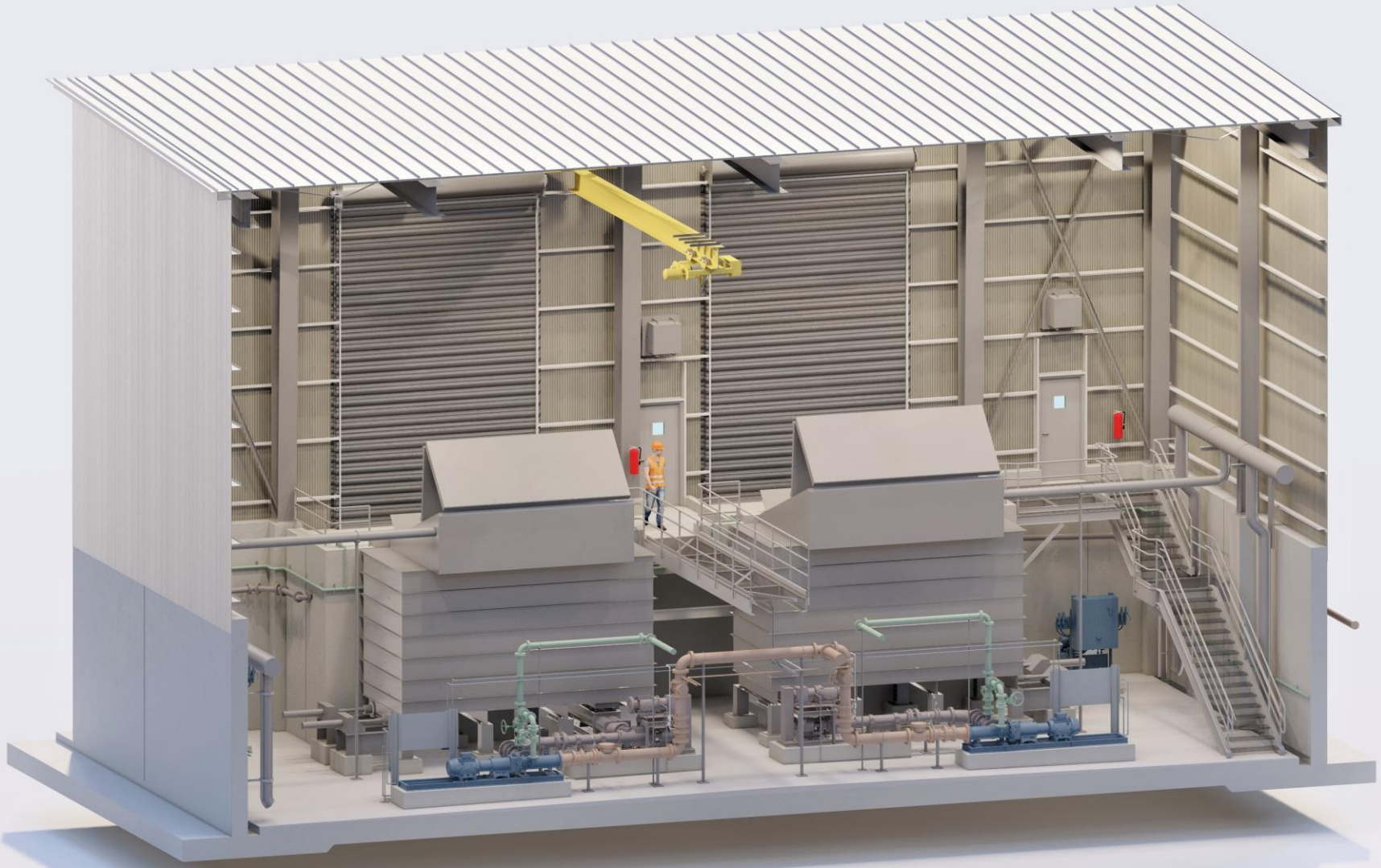
- Control system will be based on Siemens S7-1500 series PLCs using Operator Interface for input for system operation.
- PC based operator control stations
  - Two in the new Control Room (3rd floor),
  - Two in Operator room (1st floor)
  - One in Electrical room (1st floor)
  - One at the RTOs
  - One at truck loading station

- Operator Interface Terminals (OITs) will have - Hope Industrial for widescreen LCD
- HMI/SCADA – GE iFIX. There will be 1 HMI server per train.
- I/O system will be based on Siemens ET-200 MP
- Communications will be Siemens Profinet
- Instruments will have Profibus-DP (to the extent possible)
- Where applicable, all enclosures will be NEMA 4X with 3-point latch and single handle

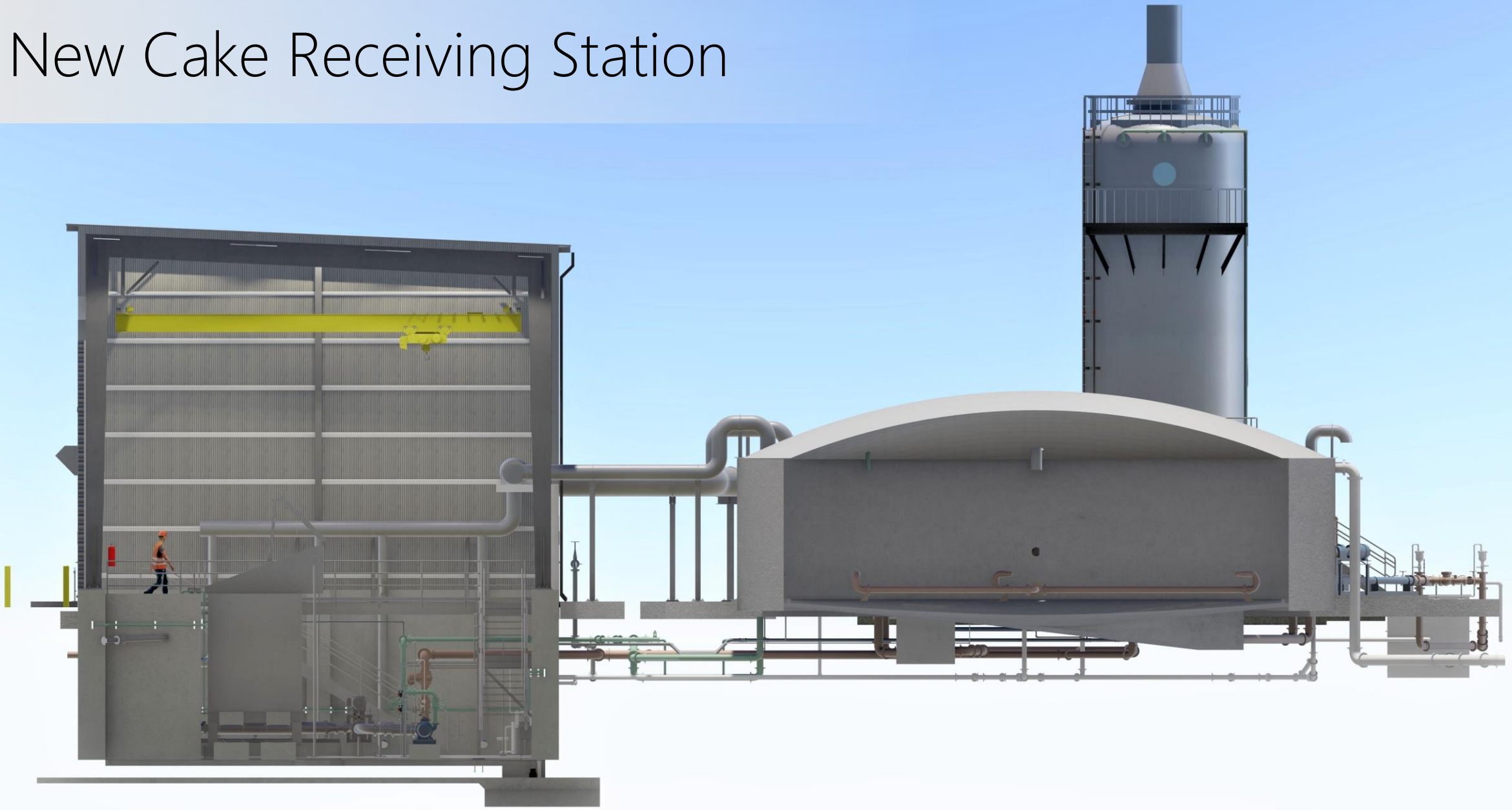
BPF – Water Use and Waste Streams

- Use plant effluent for all non-potable needs
  - » Use 100-micron self-cleaning filters and in-line booster pumps to boost pressure to serve the dryer system and other needs
  - » Polymer make-up
  - » Bio-trickling type odor control system irrigation
  - » Dryer system needs
    - Condenser
    - Venturi scrubber
- Use potable water for hose bibbs, eye washes and potable needs
- Centrate from the centrifuge dewatering process will be routed to an on-site lift station and pumped either to a struvite harvesting type process or sidestream treatment for nitrogen removal
- Filtrate from GBTs will be routed to a separate on-site lift station and pumped either to a struvite harvesting type process or to aeration basins for treatment
- Spent condensate will be routed to a separate on-site lift station and pumped to the aeration basins for treatment
- Drains from restrooms will be diverted to plant sanitary

New Cake Receiving Station



New Cake Receiving Station




carollo