On Campus Digester Manages Food Waste Streams

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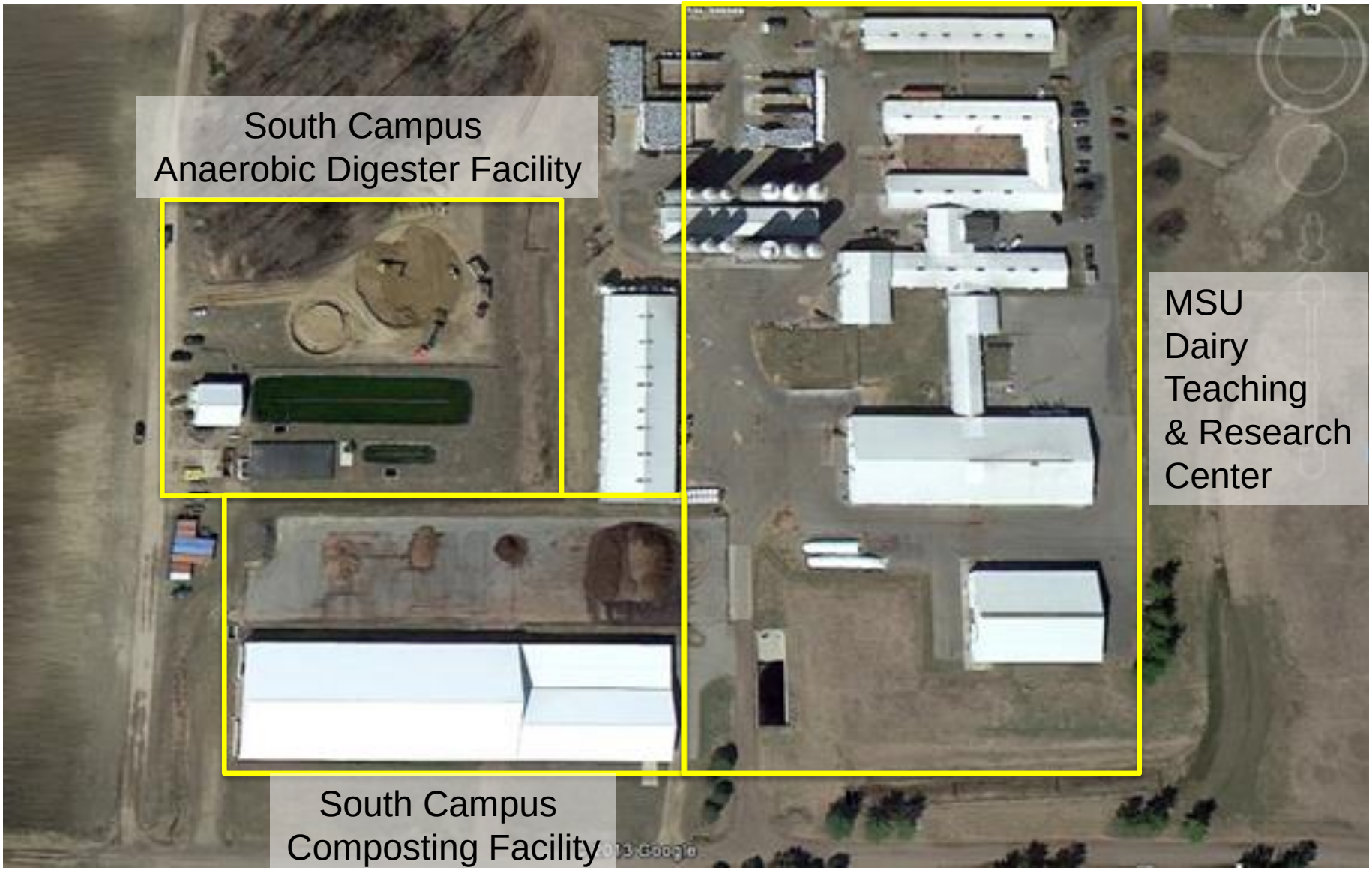
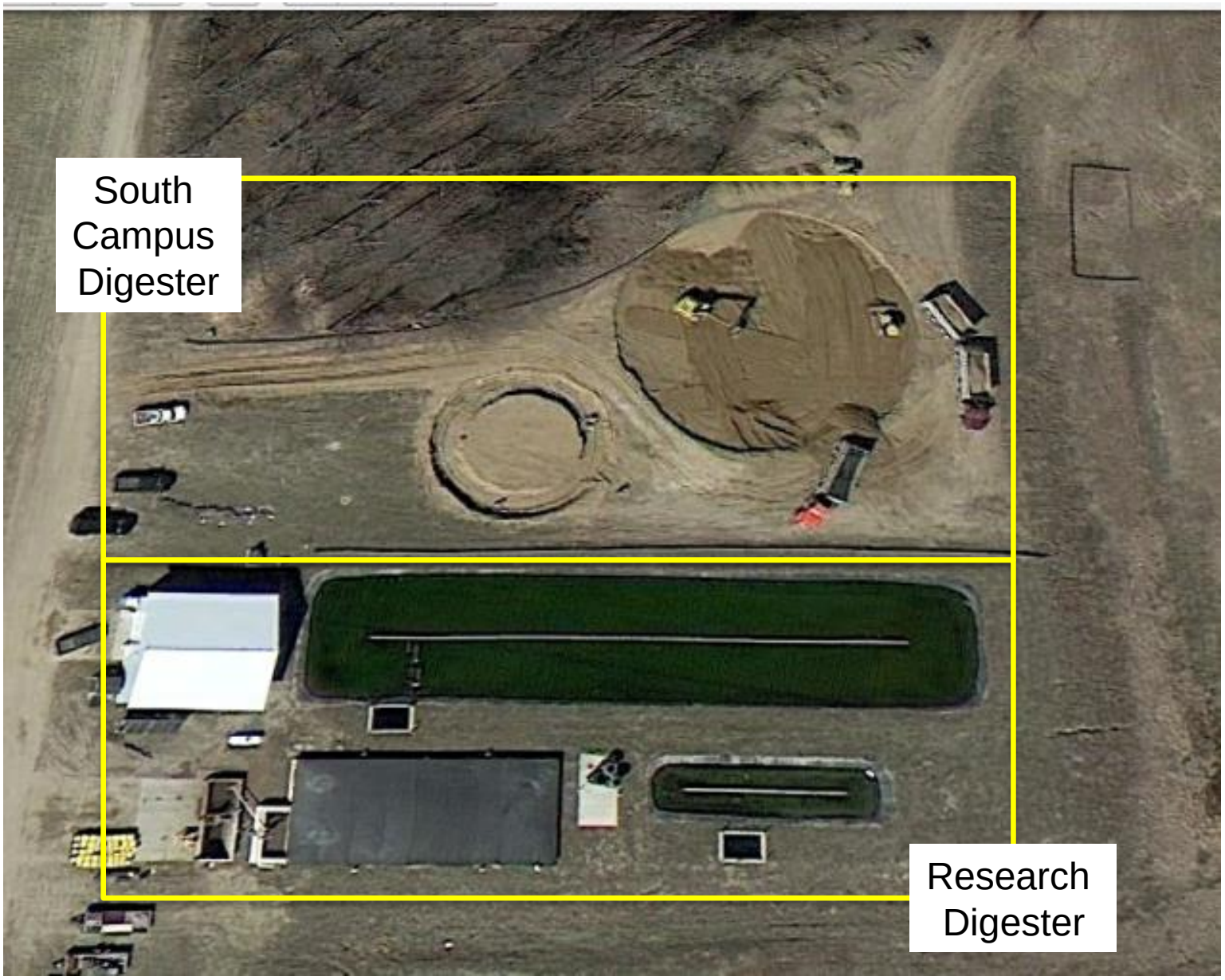
South Campus Anaerobic Digester

South Campus Anaerobic Digester facilities



South Campus Anaerobic Digester Facilities



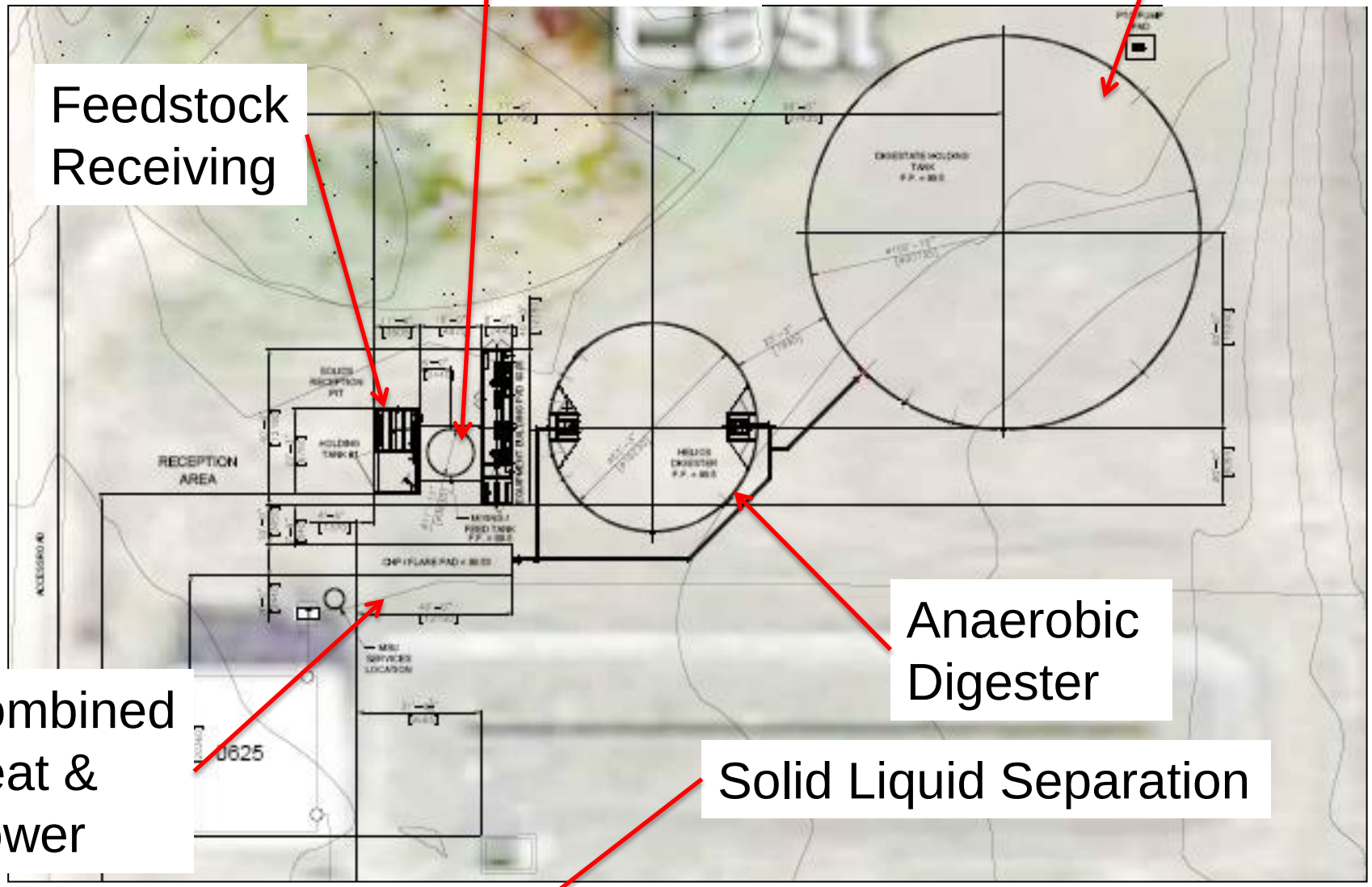
System Specifics

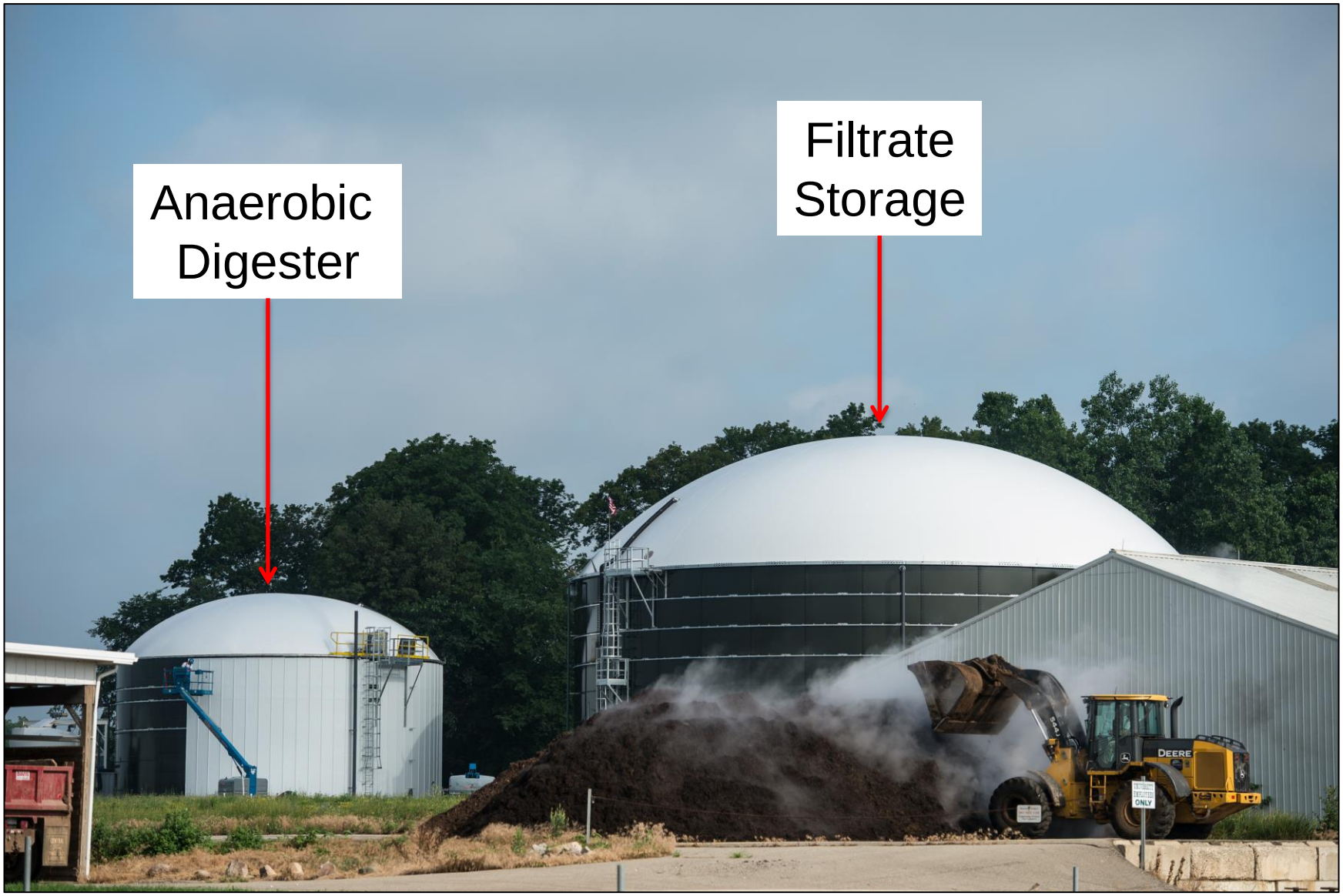
- Digester tank
  - 52’ * 26’ plus cover (450,000 gallons)
  - Mesophilic (101^{o}F)
  - Hydraulic retention time ≈ 26 days
- Digestate storage tank
  - 101’ * 42’ plus cover (2.1 million gallons)
- CHP system
  - 400 kW electrical production & 450 kW of thermal energy recovery
  - Offset power at 8 to 10 south campus facilities
  - Thermal energy used to sustain the process, heat support building and separator area
- Digestate
  - Separated solids to compost
  - Separated liquid to storage and land application

MSU South Campus Digester Feedstock

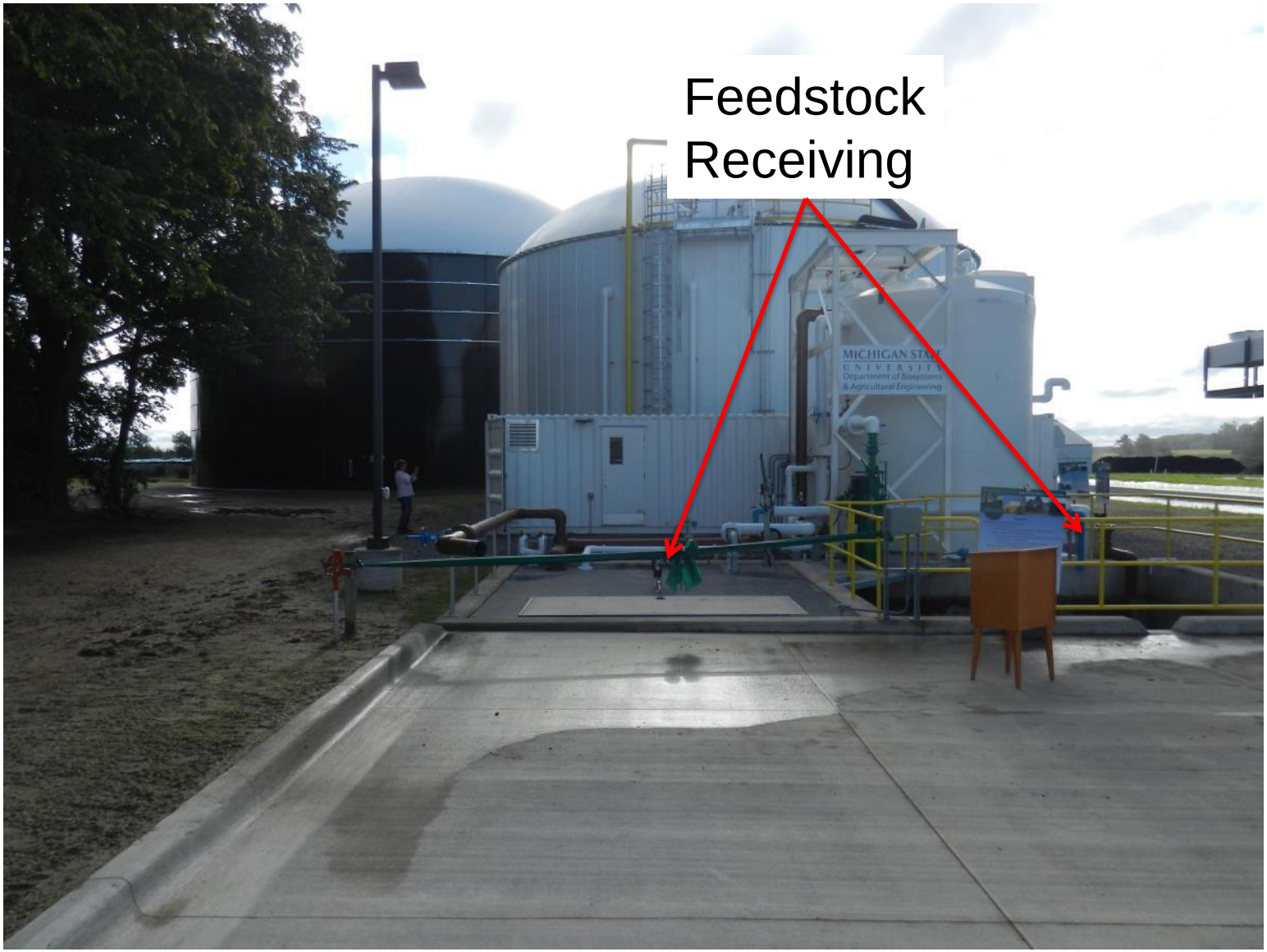
- **Dairy Manure (43%)**
  - Quantity: 7,000 ton/yr
  - Total Solids: 12%
- **Fruit & Vegetable Waste (24%)**
  - Quantity: 3,900 ton/yr
  - Total Solids: 11%
- **Fat, Oil & Grease (FOG) (30%)**
  - Quantity: 5,000 ton/yr
  - Total Solids: 20%
- **Campus Food waste (3%)**
  - Quantity: 500 - 1,000 ton/yr
  - Total solids: 8 – 12%

Site Plan


Feedstock Mixing
Filtrate Storage
Feedstock Receiving
RECEPTION AREA
Anaerobic Digester
Combined Heat & Power
Solid Liquid Separation


Anaerobic Digester
Filtrate Storage
DEERE


Feedstock
Mixing
Combined Heat & Power
2G


Feedstock
Receiving

Solid Liquid Separation
& Compost

Combined Heat & Power

Cafeteria Food Waste

Campus Living

- Roughly 17,000 students live on campus
- Culinary Services serves over 35,000 daily
- 9 dining halls have all access from 7AM to 12AM
- 23 coffee shops/convenience stores/retail foods

RESIDENTIAL AND HOSPITALITY SERVICES

Cafeteria Food Waste

2012 Food waste diversion (pilot program)

- A total of 660,000 pounds utilized in the research digester
- Pulped material: 250,000 pounds (38%)
  - Pulped waste is both pre & post-consumer waste from Brody that has been “chopped up”
  - Delivered twice per week in a roll-off container
- Pre-consumer: 510,000 pounds (62%)
  - Delivered three times per week in curb carts
  - 8 residence halls participating
  - 100,000 lb to SOF

2013 Food waste diversion (as of July 1, 2013)

- 98,040 pounds pulped food waste
- 310,745 pounds pre-consumer (9 residence halls)

Brody Pulped Food Waste (pre & post consumer)

Post Consumer Food Waste

Food Waste in Receiving Pit

Input & Effluent Characteristics

Sample	pH	EC (mS/cm)	TS (mg/L)	VS (mg/L)	TS %	VS %	VS % of TS	sCOD (mg/L)
Mixed feedstock	6.4	13.1	76,945	65,330	7.6	6.5	84%	37,050
Digester effluent	7.7	19.3	35,123	25,554	3.5	2.5	72%	23,336
Average change	-1.3	-6.2	41,822	39,776	4.1	3.9	12%	13,714
			54%	61%				37%
Filtrate								
Separated solids			264,405	209,579	26	21	81	

Digestate (effluent)

	Ammonia-N (mg/L)	TN (mg/L)	TP (mg/L)	TSS (mg/L)	VSS (mg/L)	TC (Est) (mg/L)	C:N
Average	1,926	3,475	1,098	26,010	21,274	12,252	5.3

Contribution to Campus Sustainability

- **Electrical energy: 3,000 MW/yr**
  - 7.3% of the 2015 energy transition goal (based on 08-09)
  - Renewable energy certificates: 3,000 MW/yr
- **Thermal energy: +3,000 MW/yr**
- **Landfill & wastewater diversion (≈10,000 ton/yr)**
- **Recycling of carbon and nutrients**
  - Emission & odor control
  - Pathogen & weed seed reduction
- **Renewable Energy Certificates**
- **Greenhouse gas reduction (carbon credits)**
  - Dairy manure: 400 mton CO_2/yr
  - Cafeteria food waste diversion: ?
  - Food waste & fog: ?
- **Education, outreach & research opportunities**

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Project Budget

- Base bid $4.1 million
  - Feedstock 18%
  - Digester 34%
  - Digestate storage 27%
  - CHP 19%
- Change orders $150,000
- Interconnection $200,000
- Dairy farm improvements $200,000
- Site improvements $150,000

- Approximate total cost $4.8 million

Cash Flow Projections

Income

- Electricity (offset) 55%
- Tipping fees 40%
- REC's 5%
- Carbon credits 0%
- Fertilizer 0%

Expenses

- Debt service 60%
- Labor & benefits 16%
- Digestate management 8%
- CHP maintenance 3%
- Digester maintenance 3%
- Other 10%