Brown AND Caldwell

City of Columbus

Often Overlooked - Lessons from WWTP Non-Potable Water Model

THE CITY OF COLUMBUS
ANDREW J. GINTHER, MAYOR

DEPARTMENT OF PUBLIC UTILITIES

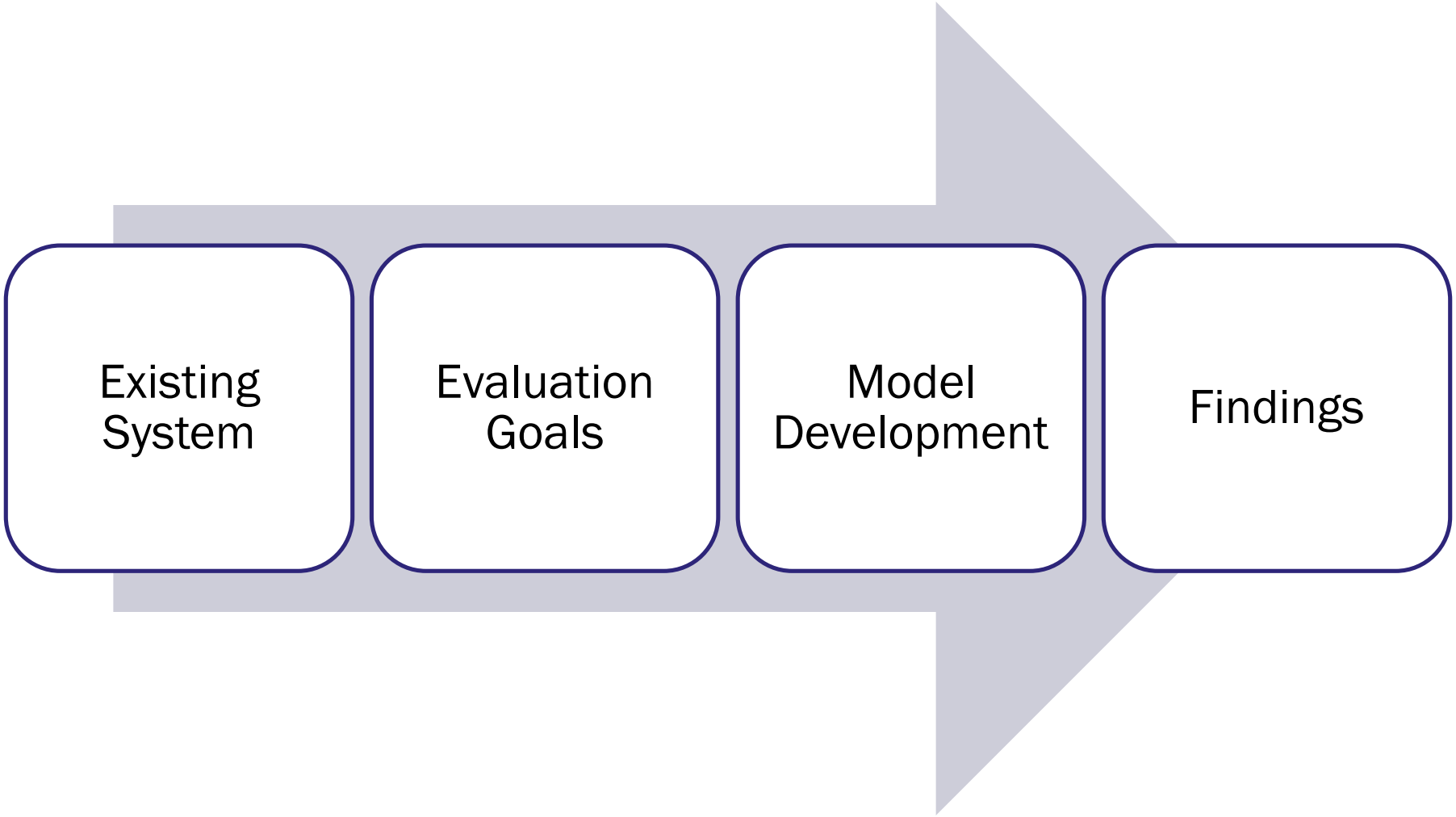
Darin Wise, Columbus SWWTP
Dante Fiorino, Brown and Caldwell
June 26, 2019

Non-Potable Water

- Treated effluent water
- Pumped from Effluent Pump Station
- Used for process demands
- Used for flushing lines and tanks
- Used for sampling, other misc.
- NOT used for drinking

Don’t drink the water!!!

Agenda


Existing System
Evaluation Goals
Model Development
Findings

Existing System

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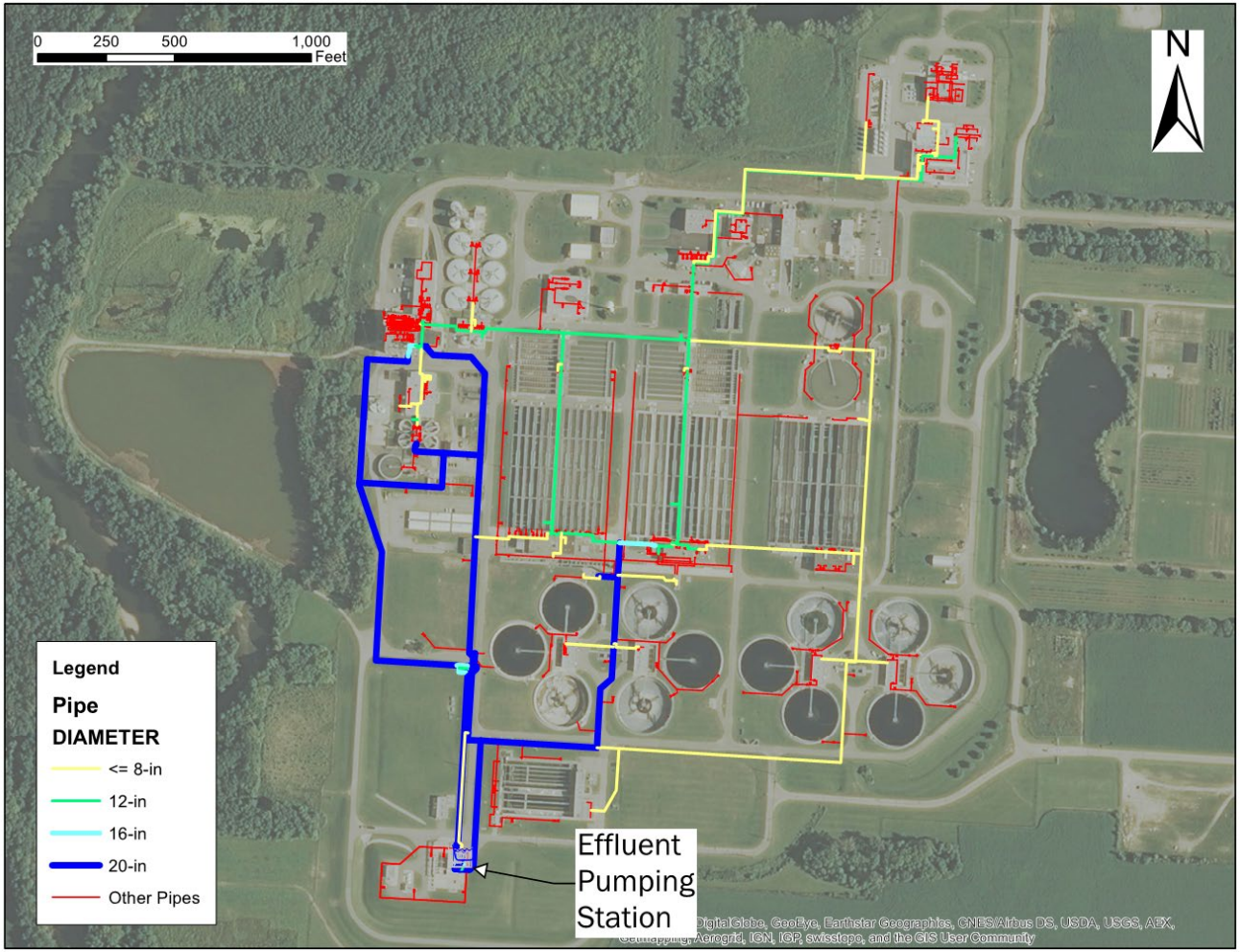
Existing System

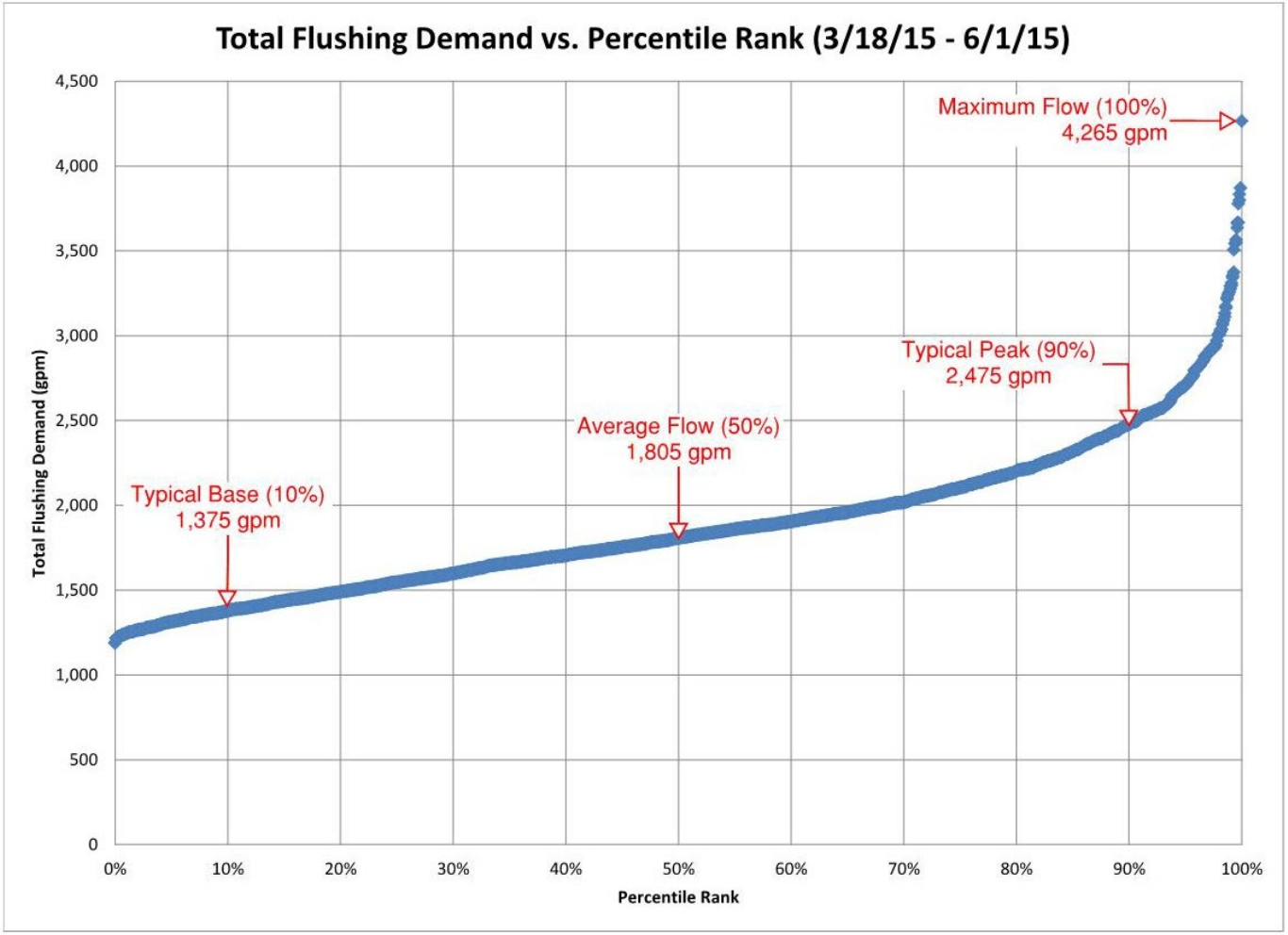


Effluent Pump Station

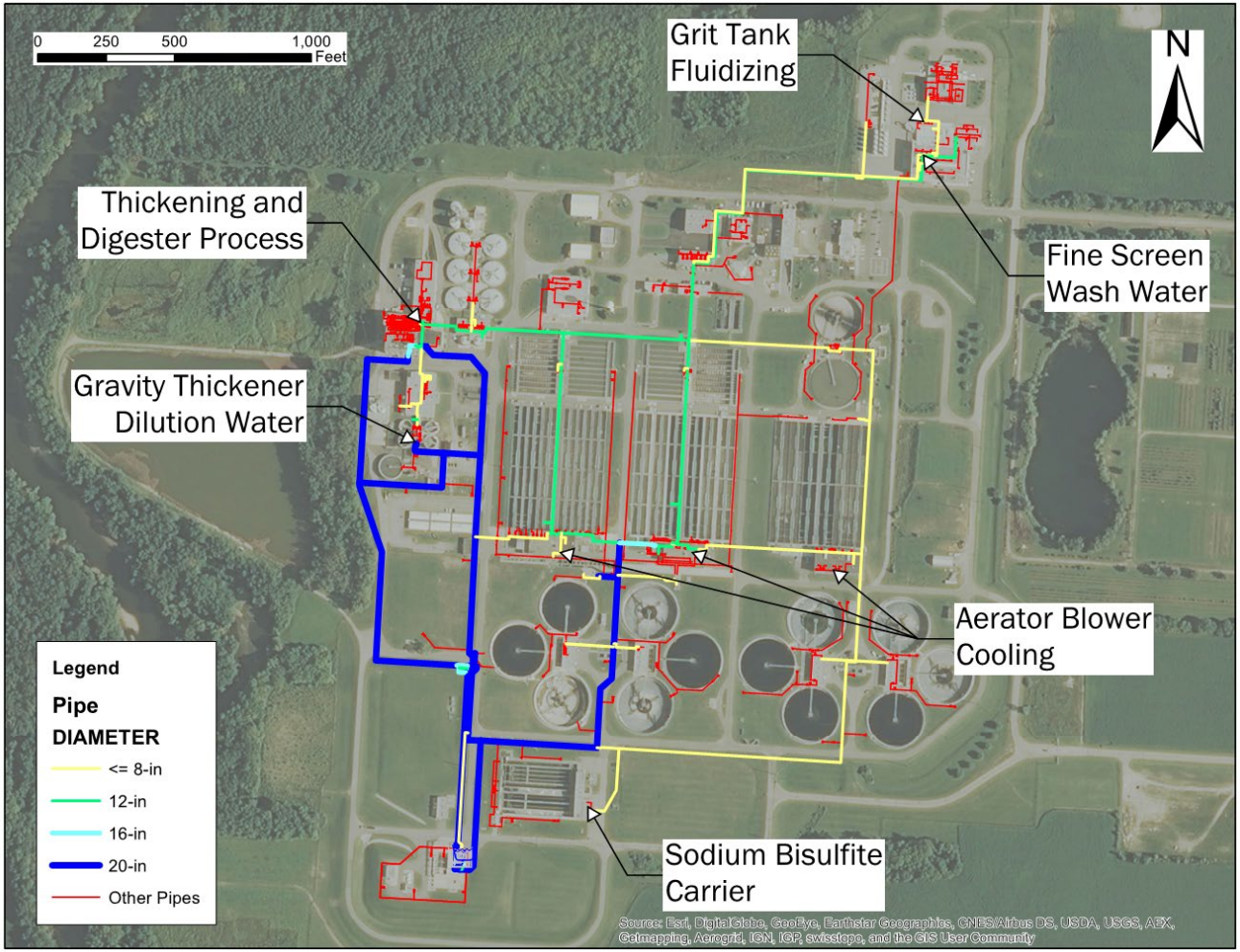
- 4 vertical turbine pumps with 3,250 gpm capacity, 250 hp motor
- Firm capacity of 9,750 gpm (3 in service + 1 redundant)
- Operated at a pressure of 84 psi
- Controlled by a local control panel and driven by an adjustable frequency drive (AFD)
- Minimum speed of 80%

SWWTP Non-Potable Pump

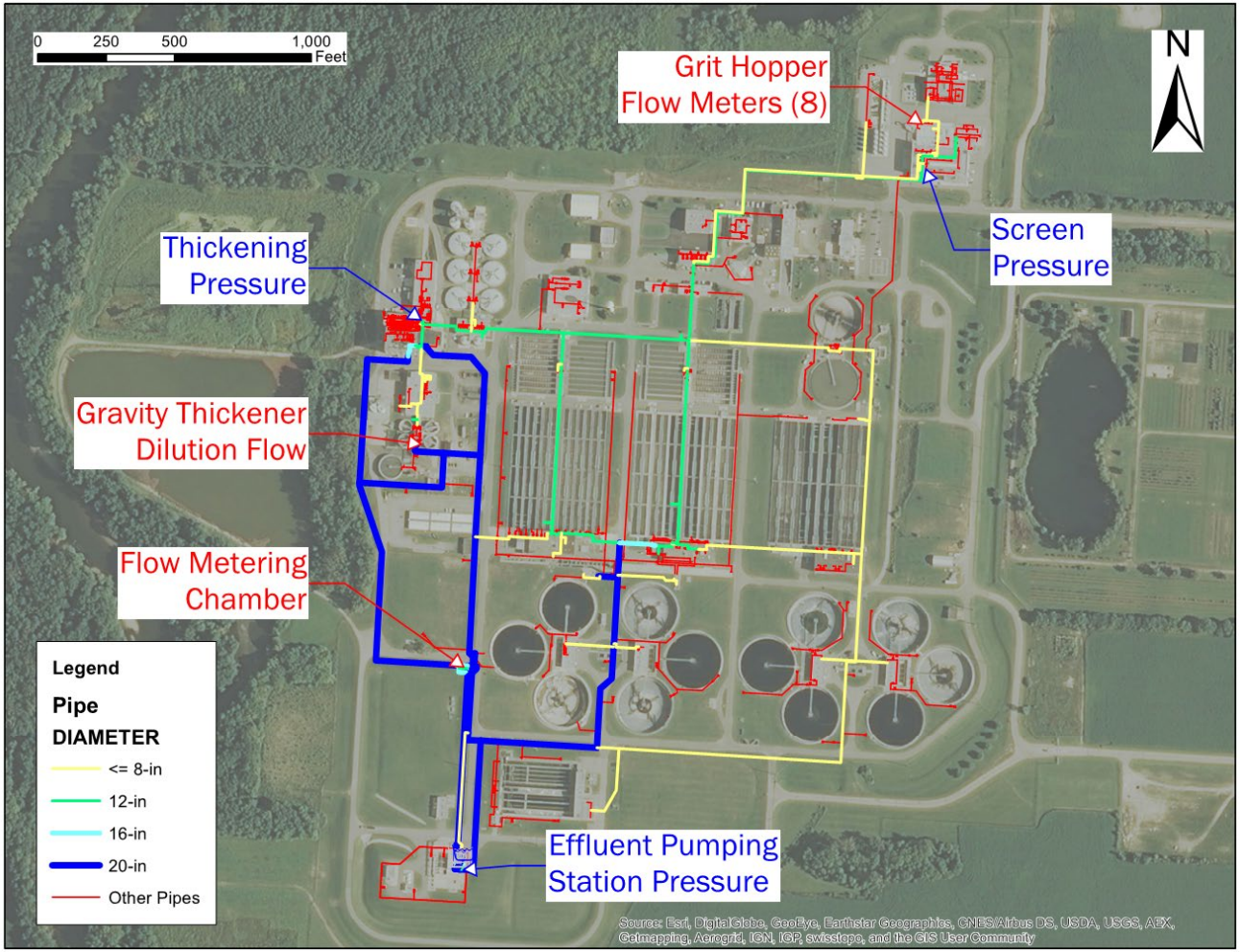
Existing Demand



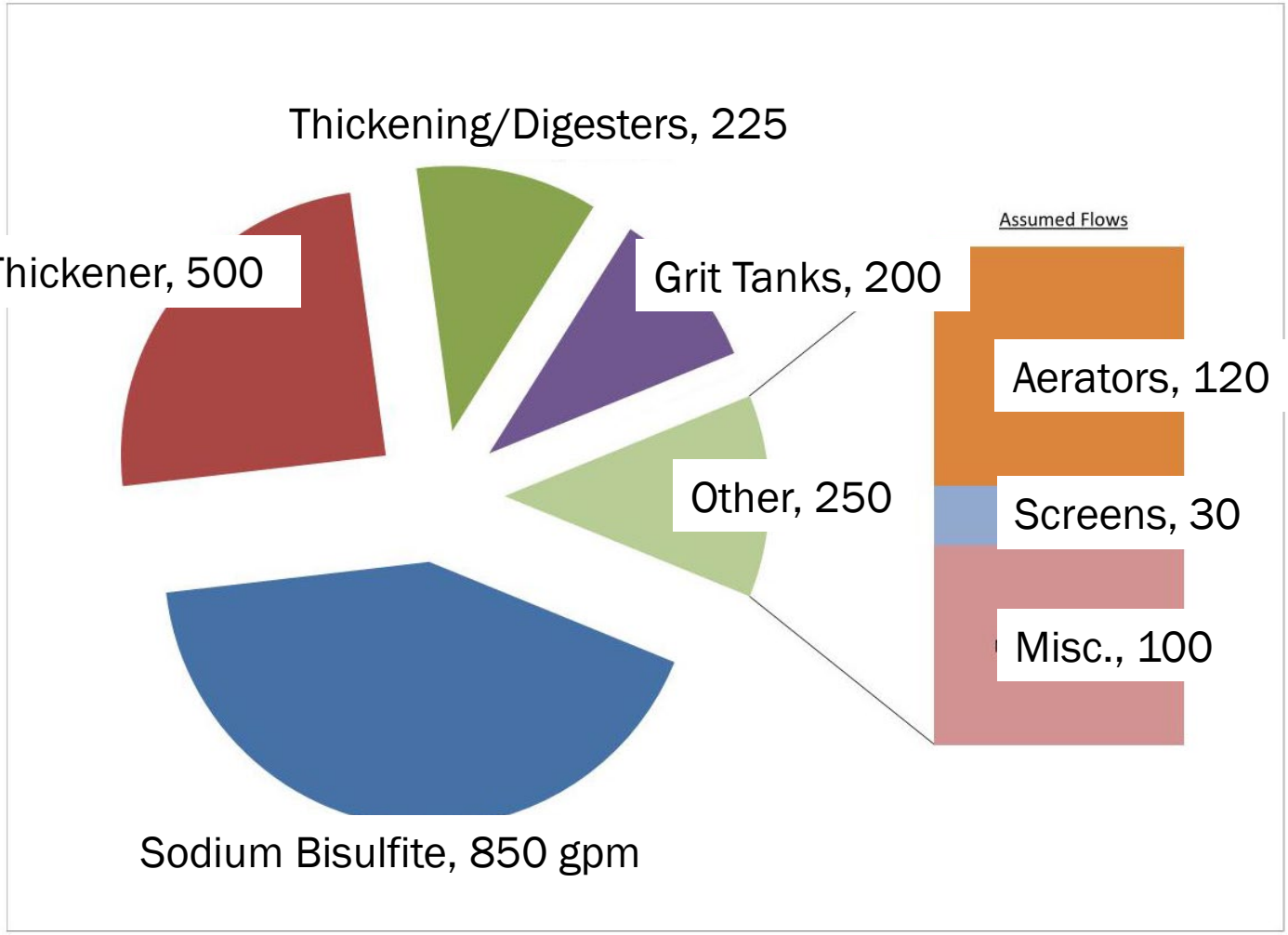
Major Process Demands



SCADA Monitored Locations



Existing Demand Distribution



Evaluation Goals

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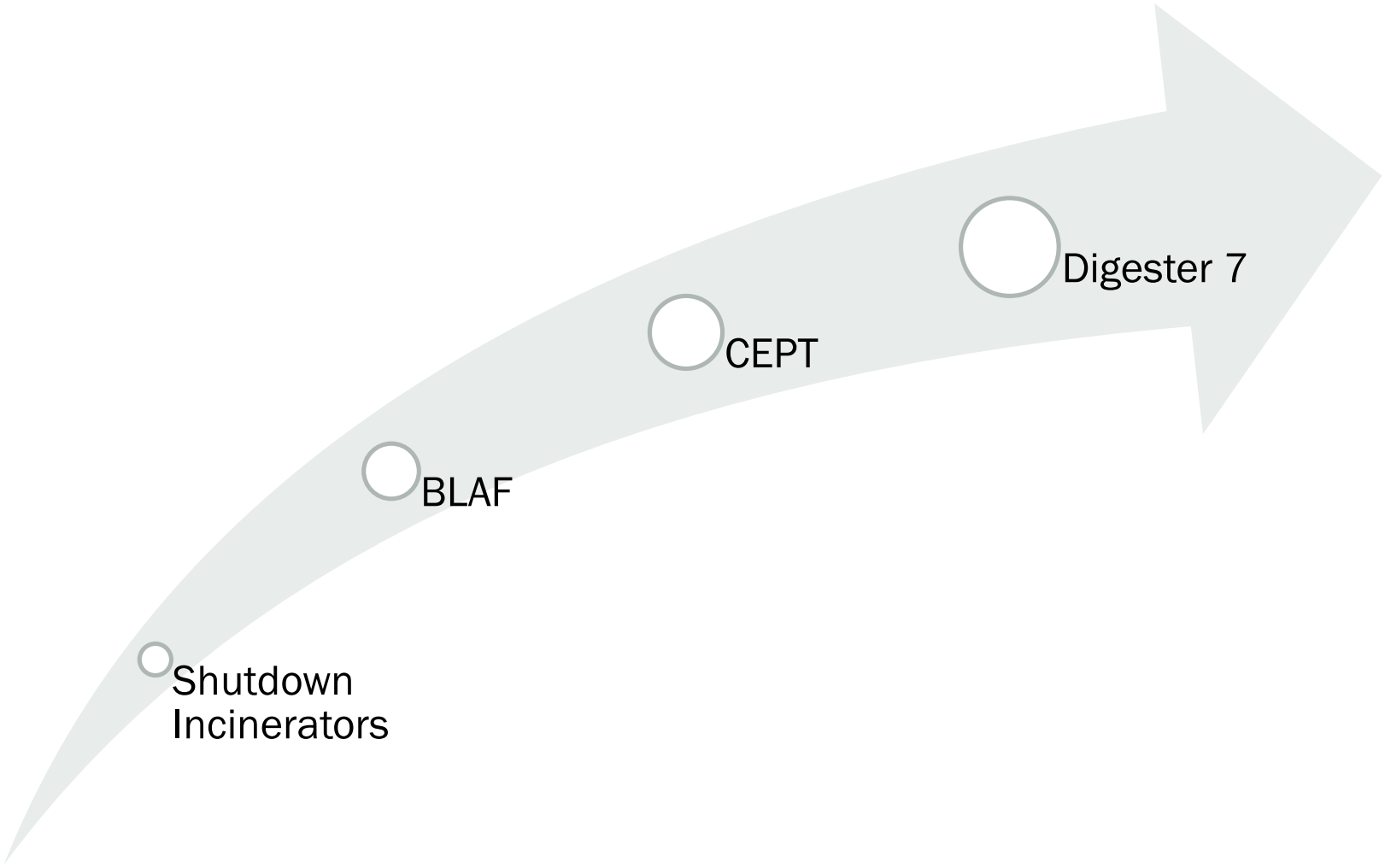
Purpose

- Planned CEPT projects will:
  - ❑ Increase demand on existing processes
  - ❑ Add new demands
  - ❑ Add new mains and hydrants
- A calibrated hydraulic model can:
  - ✓ Analyze existing system
  - ✓ Assess ability to meet future demands
  - ✓ Address existing concerns

Southerly in Transition

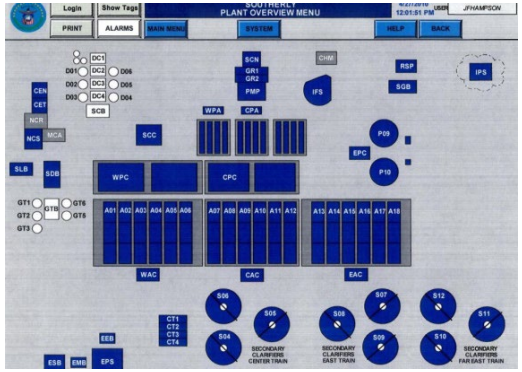


Pump Station Capacity

System Pressure

- Controlled by 84 psi pressure set point
- Based on abandoned incinerator requirements
- Evaluate lowering set point for current demands
- Would save energy and pump maintenance

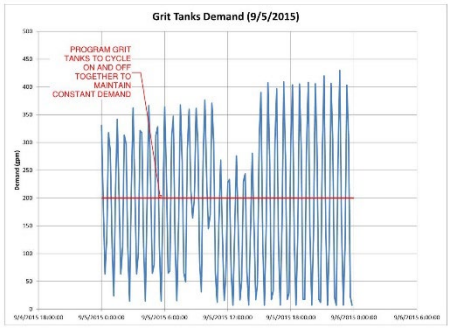
Non-Potable Pressure Gauge



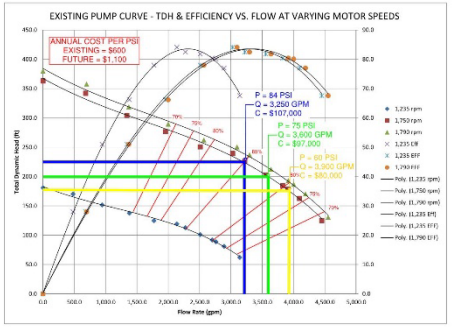
SWWTP NPW SCADA Screen

Pump Cycling

- Pumps frequently cycle on and off
- Operating at low speed on the AFD controlled range
- Undesirable timers built into ‘Pump Director’
- Causes poor operability and increased maintenance



Grit Tank Demand Variation



NPW Pump Curve

Future Planning Impacts

- CEPT / BLAF connections
- New Gravity Thickener Tank
- Sodium Bisulfite Carrier Water
- Digester Process Water

Model Development

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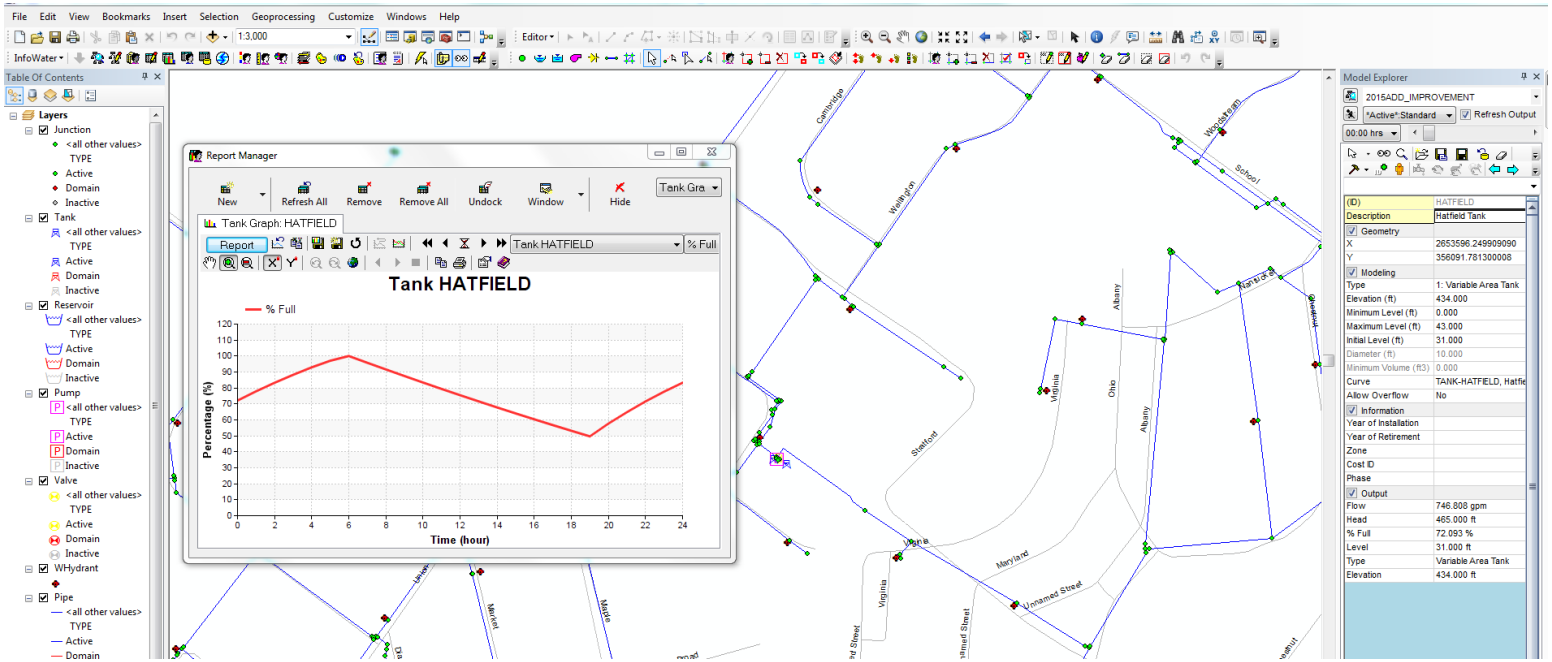
Model Development

- InfoWater hydraulic modeling platform
- GIS water network from CAD drawings
- Process demands where they connect to system



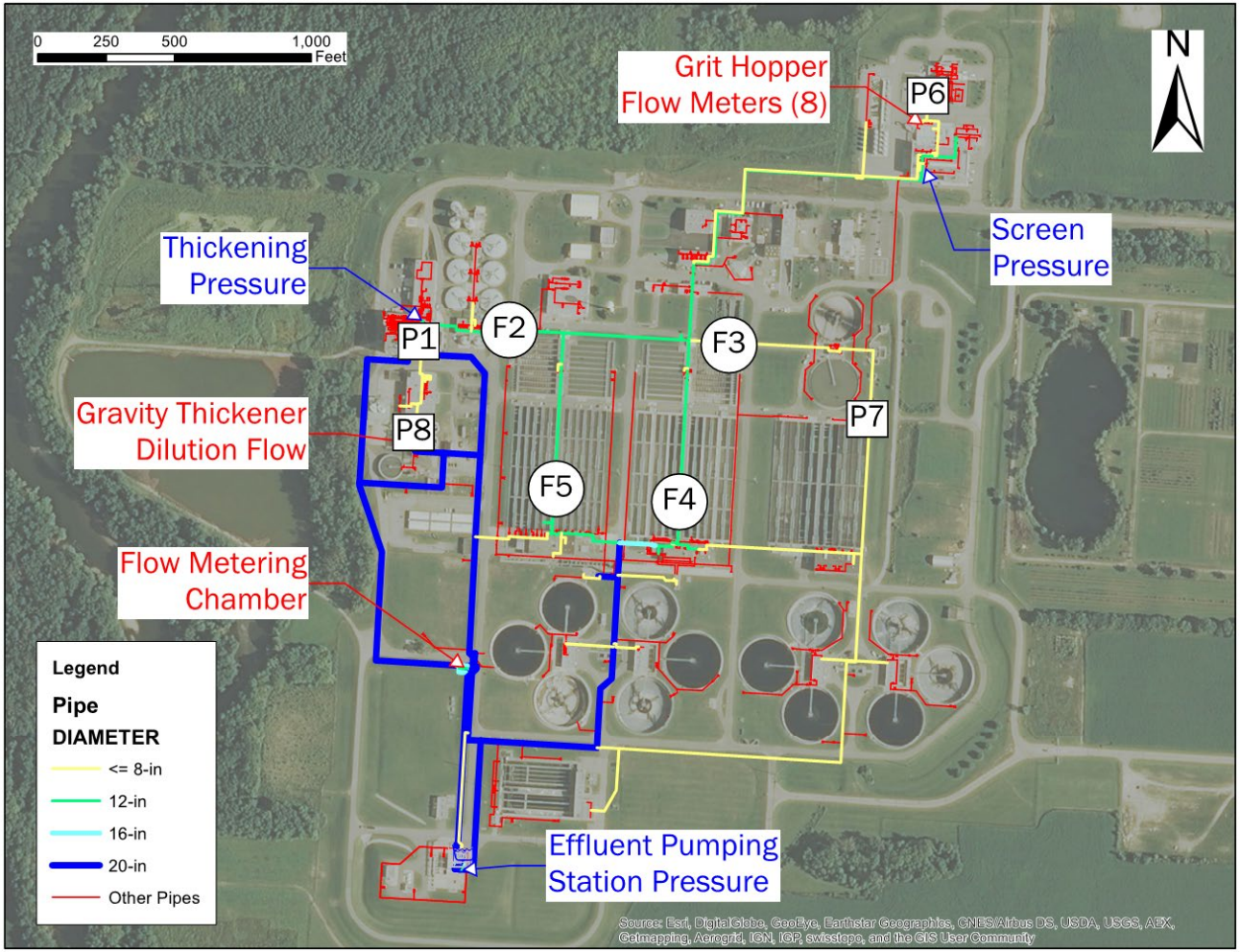
Field Testing

Goal: obtain field data on current system operations for calibration

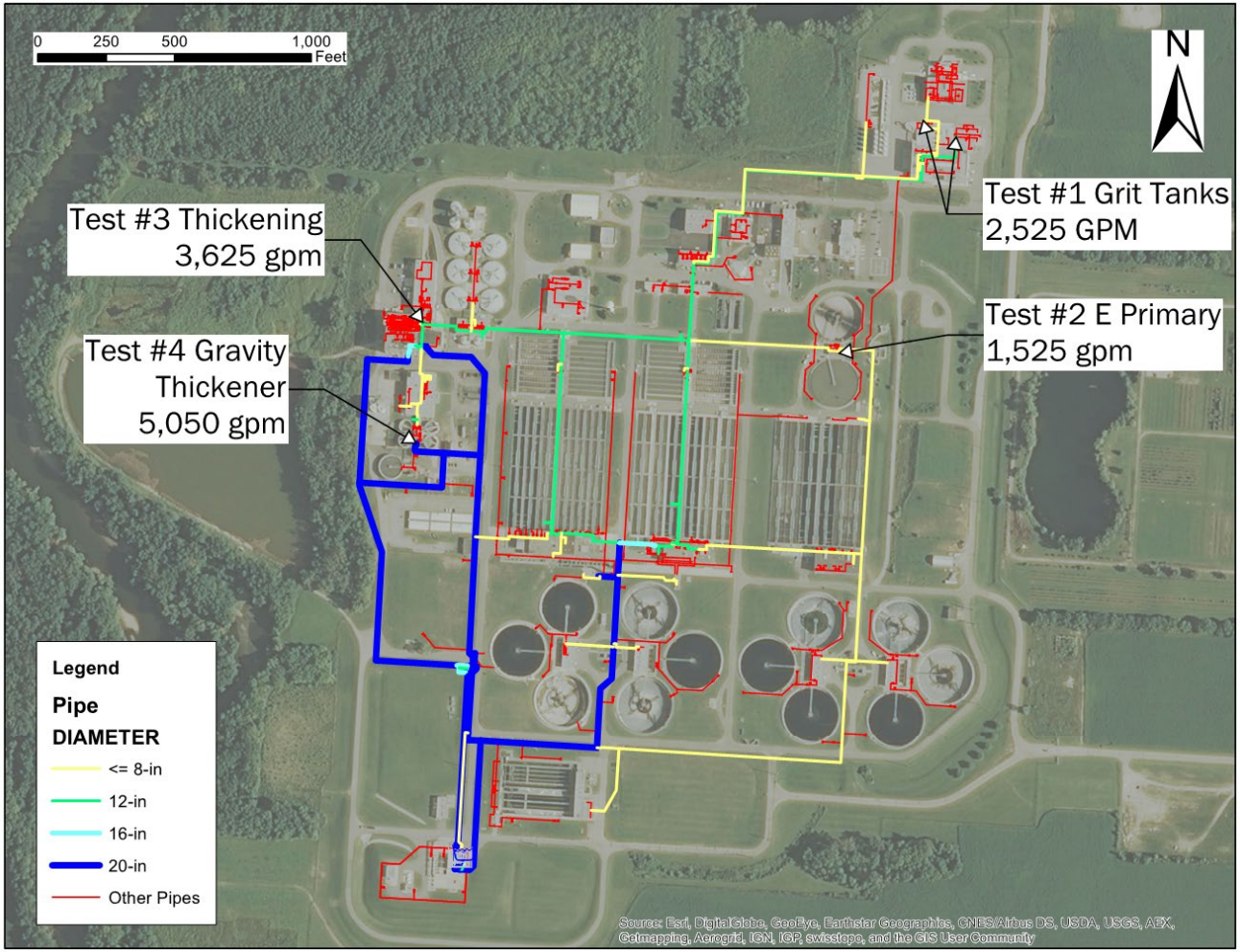
- Typical system operation
  - 8 pressure sensors (4 temp)
  - 5 flow meters (4 temp)
  - 1 week period
- Hydraulic stress test
  - High flow scenario
  - Use yard hydrants
- Pump curve testing

NPW Pump Check Valve

Monitoring Locations



Hydraulic Stress Test



Model Calibration

- Steady-state calibration
  - Adjust assumed C-factors
  - Match pressure observed losses
- Extended period simulation
  - Evaluate pressure and flow trends
  - Identify peak conditions
- Within 2 psi at all monitored locations

Non-Potable Water Strainer

Test Results

Test	Location	Pre Flow (gpm)	Test Flow (gpm)	Demand (gpm)
Test #1	Grit Tanks	1,775	4,300	2,525
Test #2	East Primary	1,525	3,050	1,525
Test #3	Thickening Facility	1,350	5,025	3,675
Test #4	Gravity Thickener	2,000	7,050	4,800

Test	Critical PM	P Drop (psi)	Actual P (psi)	Model P (psi)
Test #1	PM6 – RSP	28.2	64.3	64.3
Test #2	PM7 – EPC	9.3	82.1	81.9
Test #3	PM3 – CPC	10	86.8	88.5
Test #4	PM2 – SCB	13.2	79.3	81.1

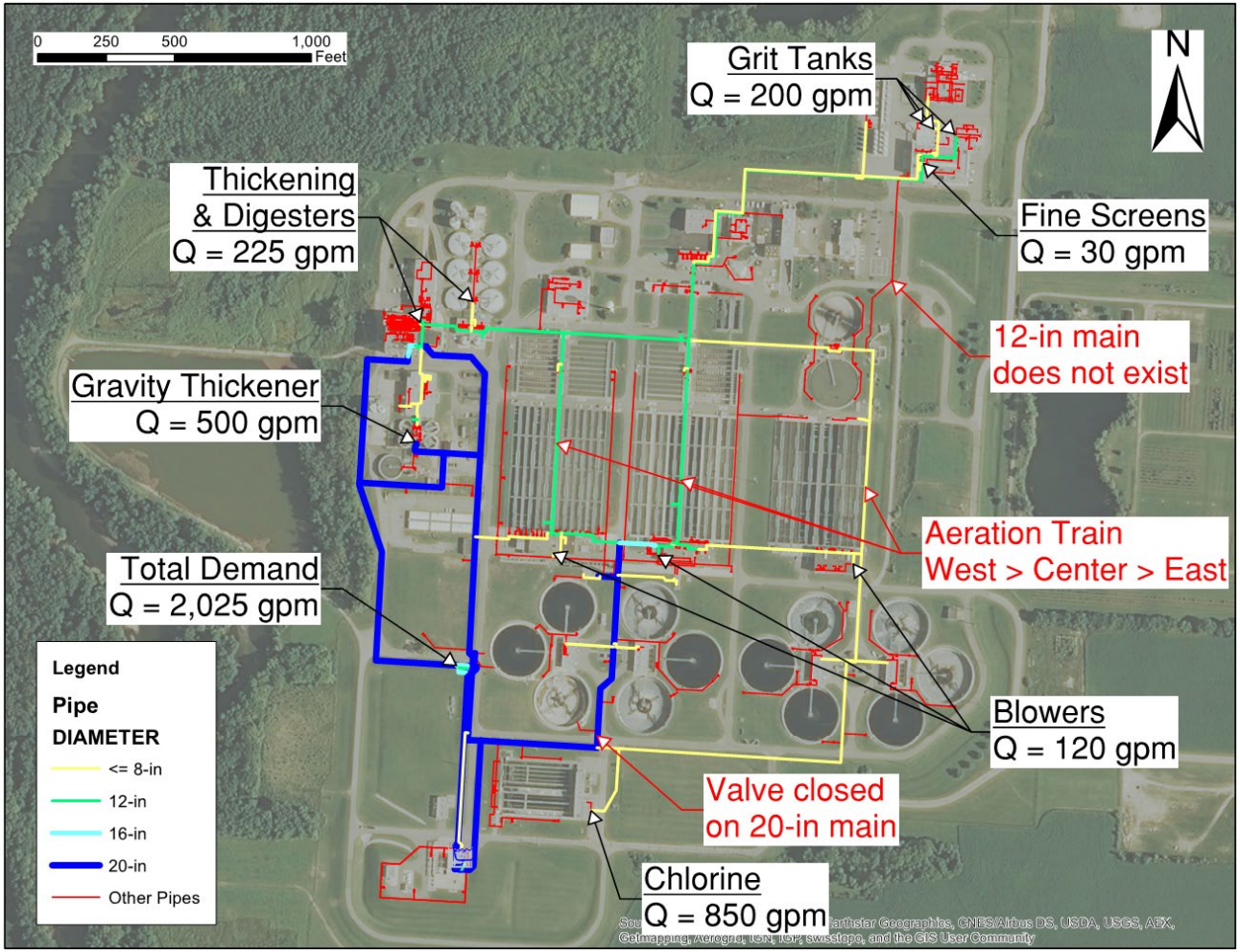
Model Analysis

Once the model is calibrated it was used to review capacity and performance

- System deficiencies in available pressure or flow
- Capacity to support future process demands
- Evaluation of operational or physical changes to mitigate deficiencies

Non-Potable Water Header

Model Determinations



Findings

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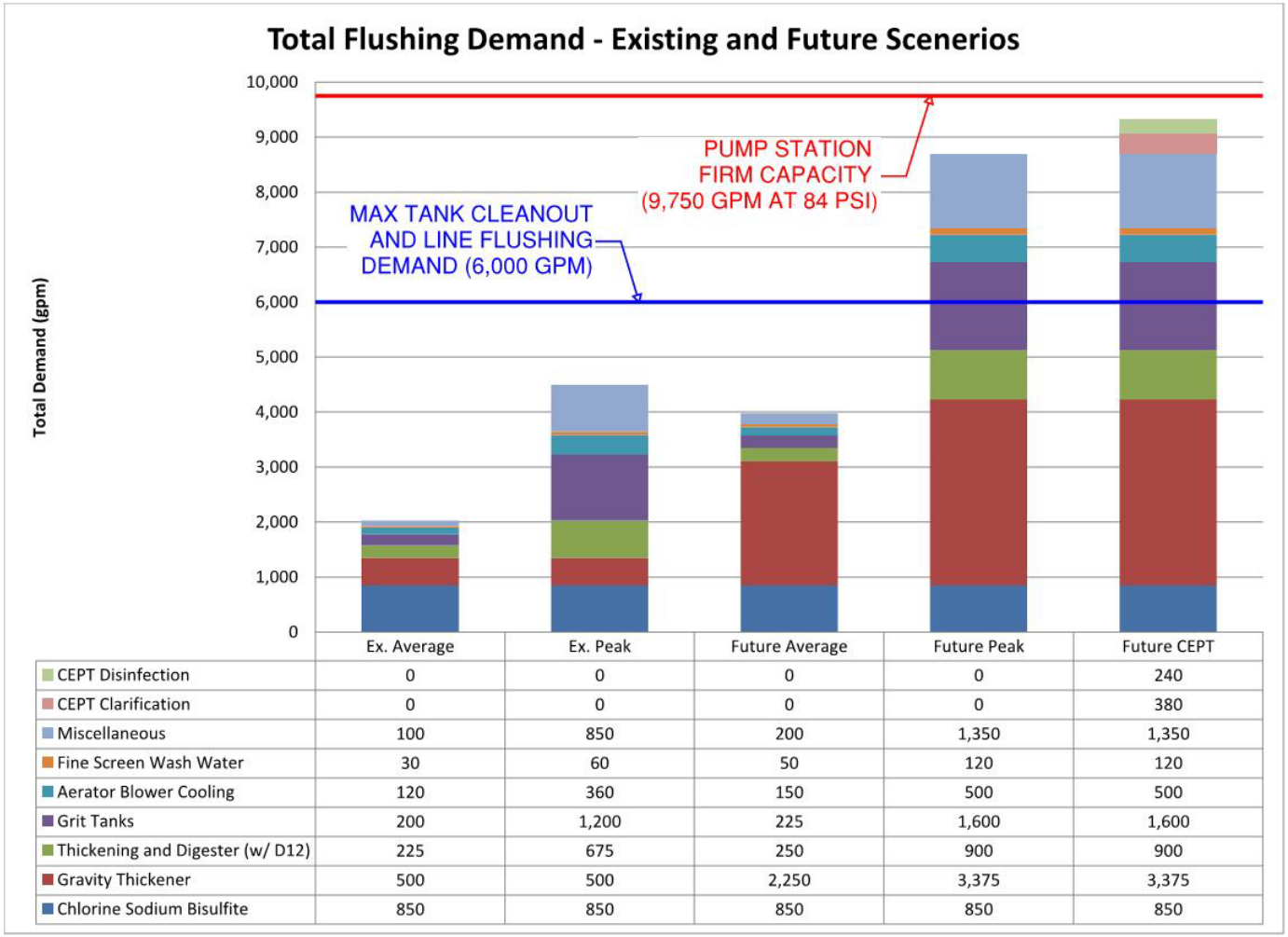
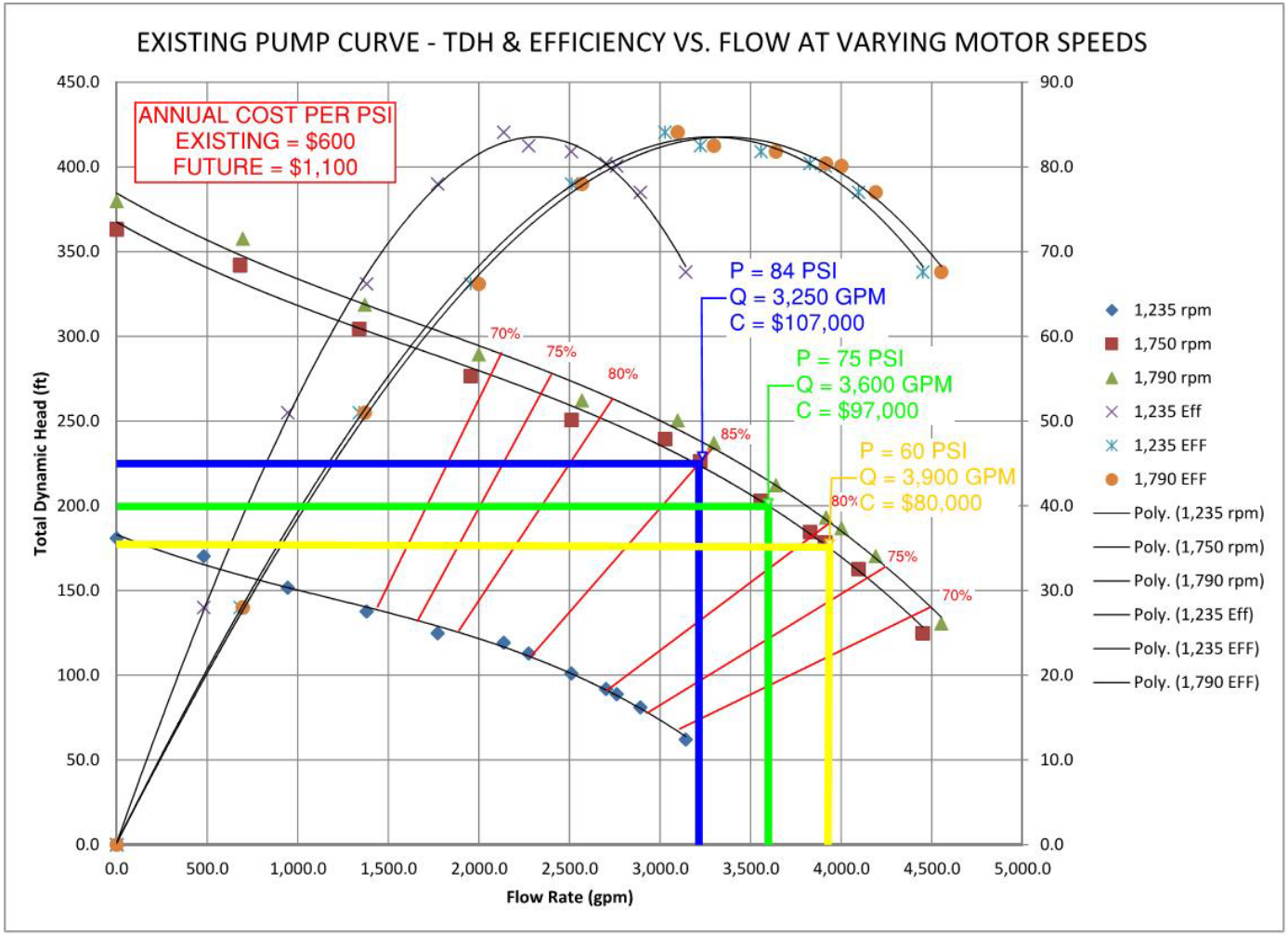
Existing Pump Station Capacity

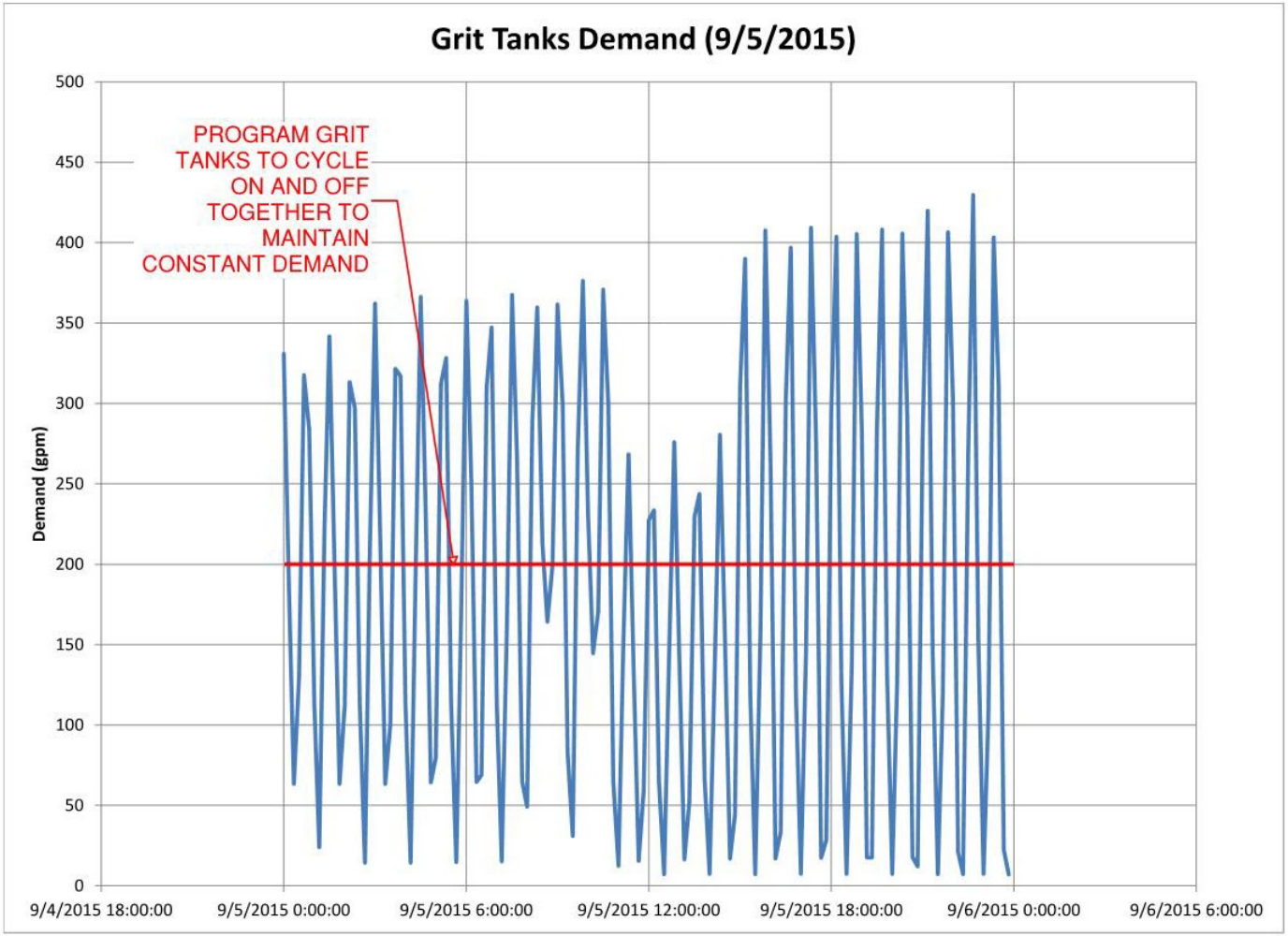


	Ex. Average	Ex. Peak	Future Average	Future Peak	Future CEPT
CEPT Disinfection	0	0	0	0	240
CEPT Clarification	0	0	0	0	380
Miscellaneous	100	850	200	1,350	1,350
Fine Screen Wash Water	30	60	50	120	120
Aerator Blower Cooling	120	360	150	500	500
Grit Tanks	200	1,200	225	1,600	1,600
Thickening and Digester (w/ D12)	225	675	250	900	900
Gravity Thickener	500	500	2,250	3,375	3,375
Chlorine Sodium Bisulfite	850	850	850	850	850

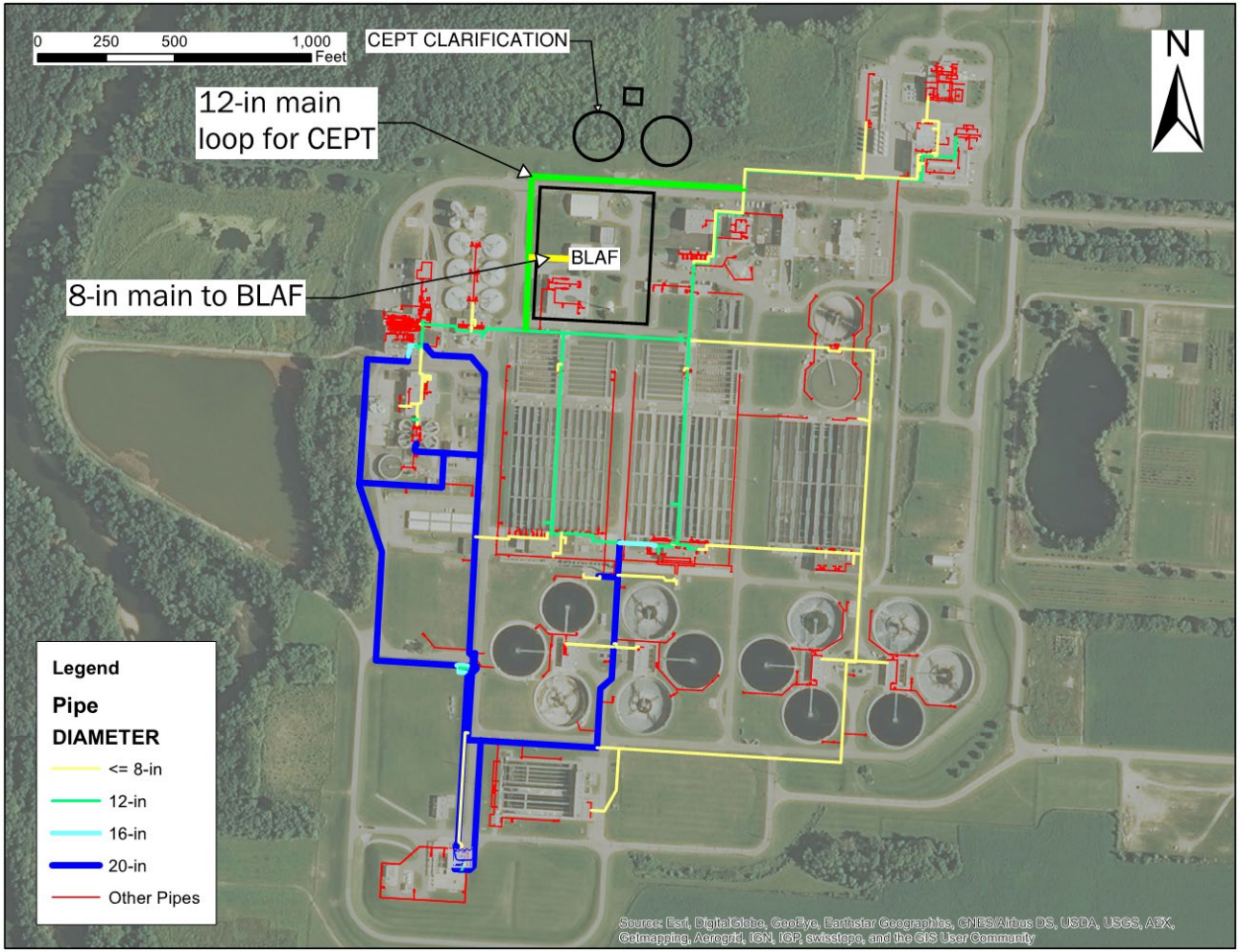
Existing System Pressure



Existing Pump Cycling



Future BLAF / CEPT



Gravity Thickener Dilution

Operating Pressures
- Existing = 90+ psi
- Required = 30 psi

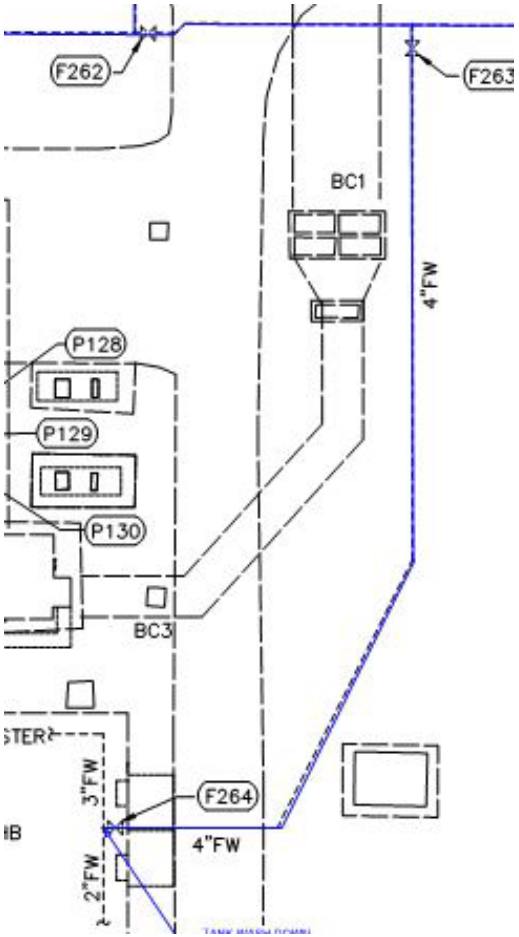
Problems
- Wasted energy
- Demand increasing
- Difficult Q control

Solution
- P reducing valve
- Increased control

Sodium Bisulfite Carrier Water

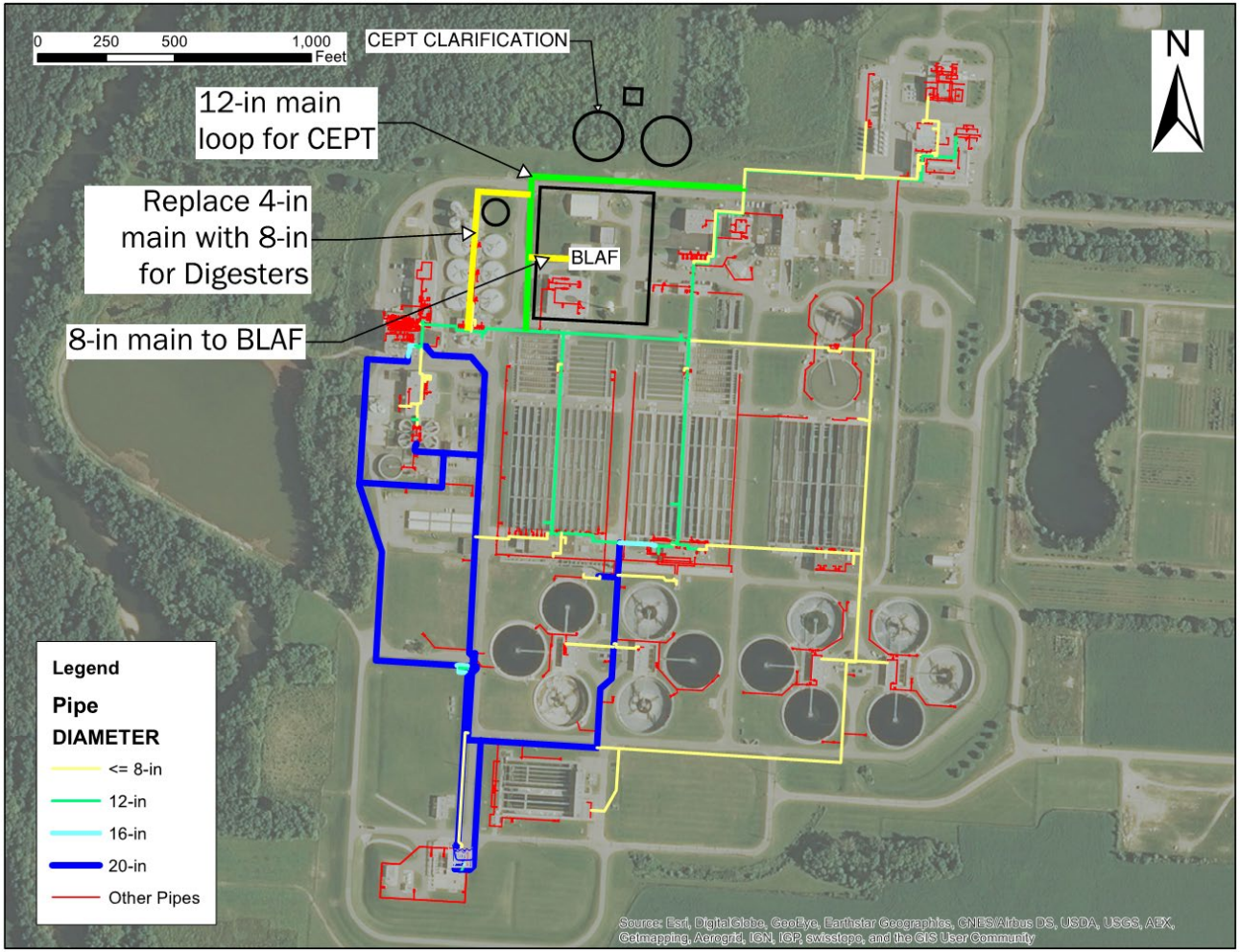
Feeder main undersized, unmetered, largest existing demand

- Valve open in warm weather
- Valve closed in cold weather
- CEPT project to modify feed
- Add SCADA controlled valve
- Increase main from 2-inch to 4-inch



Sodium Bisulfite Carrier Water

Digester Process Water



Non-Potable Water

- Typically least important process for any given project
- Part of every process at SWWTP
- Individual impact is small
- Overall impact is large
- SWWTP took a holistic look
- Improved existing performance
- Better prepared for future demands
- Don’t drink the water!

Don’t drink the water!!!

Acknowledgements

- City of Columbus
  - Stacia Eckenwiler
  - Troy Branson
  - Rick Kent
  - Jeff Hall
  - Jeff Bartoe
- Brown and Caldwell
  - Dave Nitz
  - Christie Patel

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Questions/Discussion