Bi-Furcating a Central Plant for Redundancy and Reliability

Milwaukee Regional Medical Center

Campus Energy 2019
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BOLDT®

SPEAKERS

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INTRODUCTION – What is MRMC?

- Both a location and a company
  - ✓ Location
    - 250 acre Milwaukee Regional Medical Center campus
    - Part of original "Milwaukee County Grounds" which provided a variety of county-delivered services starting in the 1850s
- Among those county-provided services was district heating and district cooling to buildings on the campus

INTRODUCTION – What is MRMC?

- **Both a location and a company**

  ✓ **Company**

  - **Consortium composed of 6 members operating on the campus.**
    - Froedtert Memorial Lutheran Hospital
    - Children's Hospital of Wisconsin
    - The Medical College of Wisconsin
    - Blood Center of Wisconsin
    - Milwaukee County Behavioral Health

- **Provides central planning, shared services, and infrastructure for the member entities**

INTRODUCTION – The Original System

- Campus Thermal Energy Systems
  - Built by County in 1954 as coal-fired steam with steam turbine electric generators
  - Chilled water added in 1974
  - Purchased by Wisconsin Energy Corporation in 1996
- Acquired by MRMC Thermal, a wholly-owned subsidiary of MRMC, in April 2016
  - MRMC and its members had a vision for the thermal energy systems that served the campus

OWNERSHIP – Transferred Assets

- All components of the MCPP including:
  - Nine acre site
  - Chilled water production(chillers, pumps, cooling towers, etc.)
  - Steam production(boilers, water treatment, stacks, etc.)
  - All coal handling and ash reclaiming equipment
  - Plant structures, balance of plant, process controls, etc.
  - Steam & chilled water distribution system

- Easements for access and operation of steam and chilled water distribution systems.
  - Included tunnels, box conduit and direct buried runs.

- What was not transferred:
  - Environmental permits.
  - Plant staff (supervision, operators, maintenance or distribution)

MRMC STATISTICS

Milwaukee Regional Medical Center Thermal

- 7,500,000 square foot of conditioned space
- 22 buildings from 5 customers
- 4 miles of steam and condensate lines
- 4 miles of chilled water piping
- 2,500 feet of steam tunnels
- Peak chilled water demand: 17,100 tons
- Peak steam demand: 217,000 lbs/hr.
- Largest chilled water line: 42” HDPE and 36” PCCP
- Largest steam line: 24” (15 psi) and 12” (135 psi)

PROJECT & DESIGN PHILOSOPHY

Aspirations for a Steam and Chilled Water Future

Redundancy

A second plant to provide continuous supply of critical thermal service with geographic source diversity, on site alternate fuel backup

Reliability

Investment in plant and distribution infrastructure to enhance uninterrupted, consistent source of thermal service

Environmental

Reduce emissions through elimination of coal

Growth

Creating capacity for growth as the campus expands

INTRODUCTION – What is MRMC?

INTRODUCTION – Existing Plant

INTRODUCTION – Existing Plant

MRMC Thermal - Risk Analysis

- **Risk Categories**
  - The identified risks have been placed into four categories:
    - **Internal Utility Failures** - Originating in Thermal's utility assets or operations
    - **External Utility Failures** - External utility service failure
    - **Disasters** - Natural or man-made disasters
    - **Other** – Public Perception

MRMC Thermal - Risk Analysis

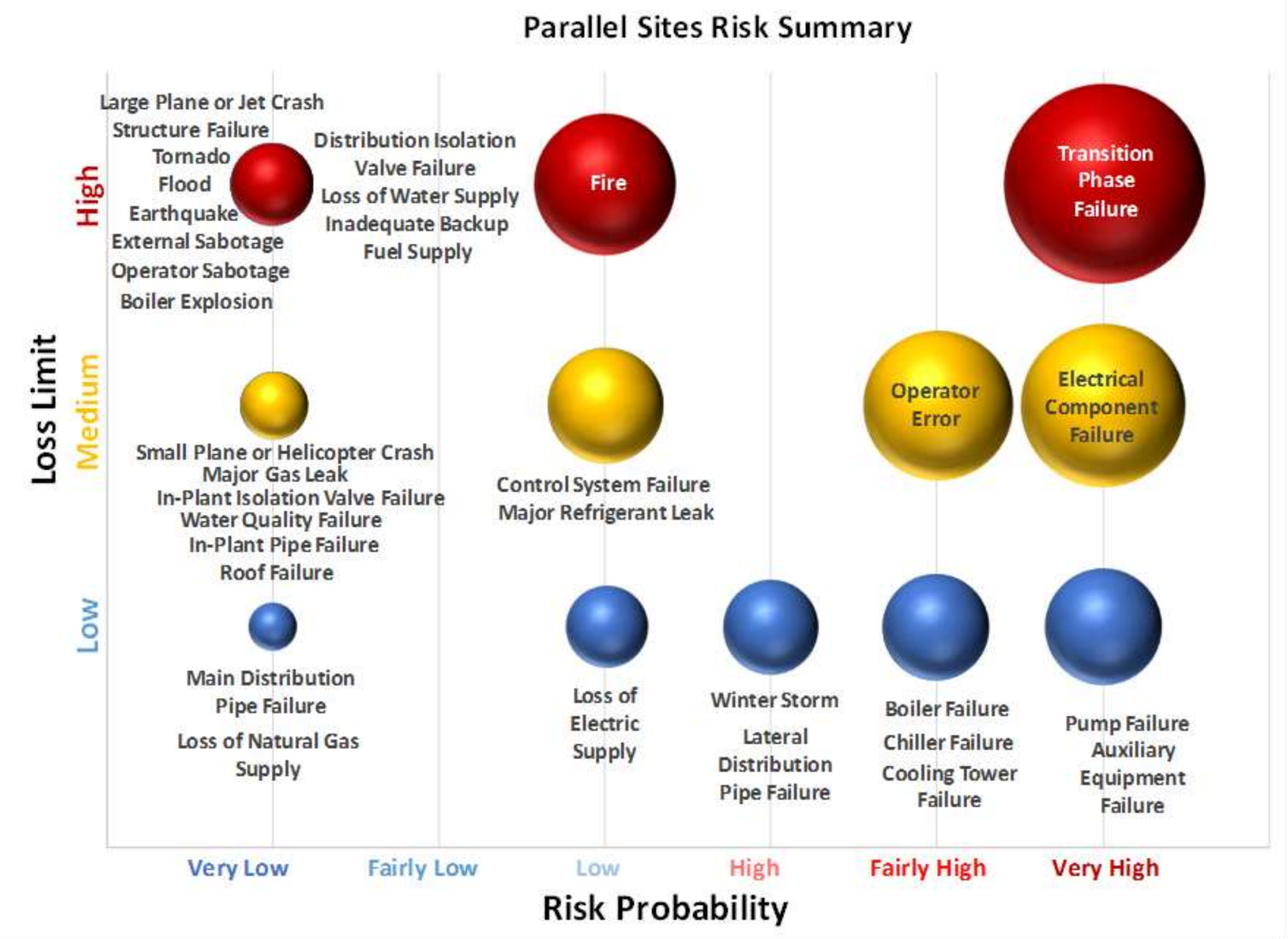
Risk Probability

Very Low	Fairly Low	Low	High	Fairly High	Very High

Loss Limit

Low	Medium	High
< 33% Loss	50% Loss	100% Loss
Minimal Disruption	Manageable Disruption	Significant Disruption

MRMC Thermal - Risk Analysis



INTRODUCTION – Existing Plant

PLANT SITE OVERVIEW - ORIGINAL

A – Emission Controls

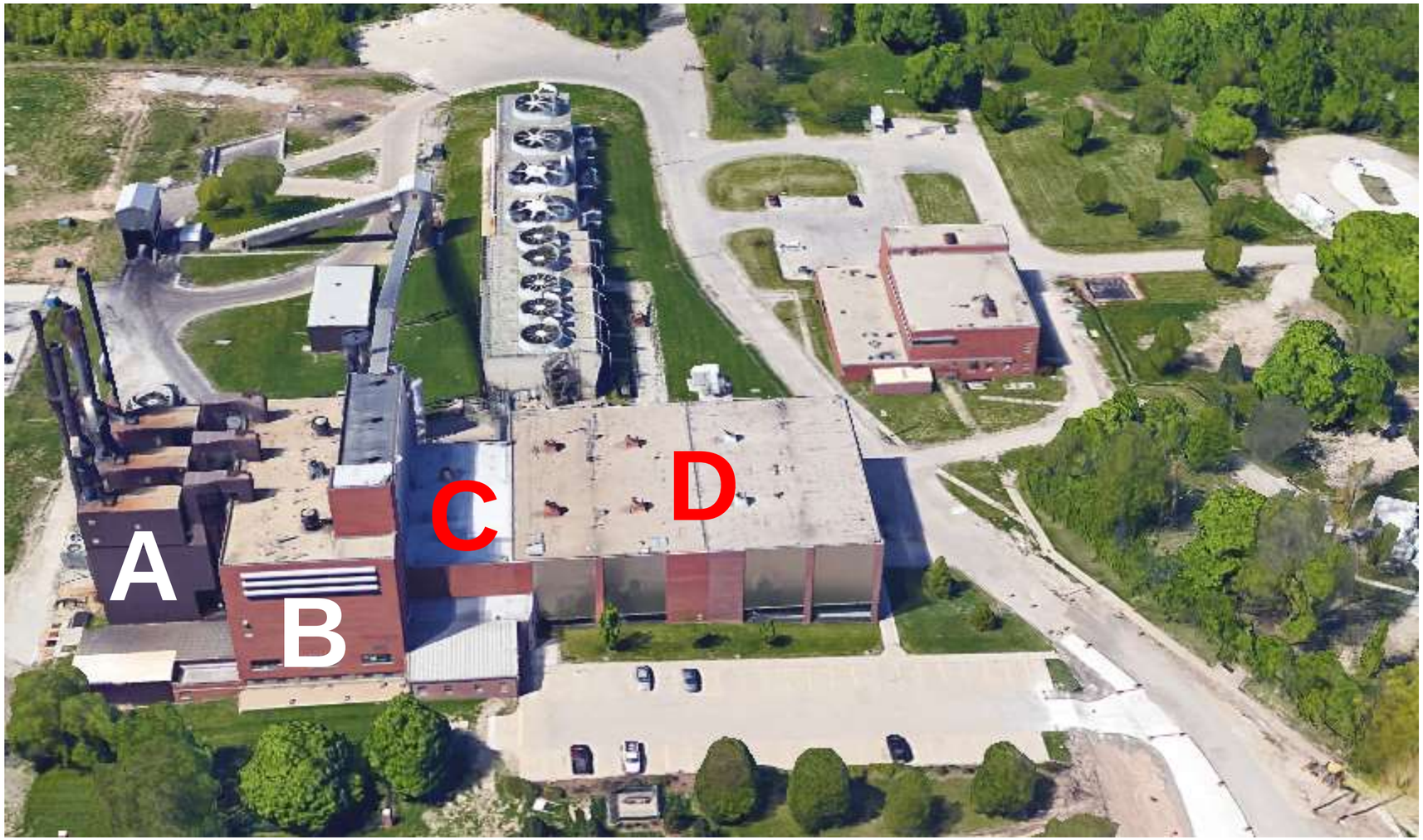
B- Boiler Room
- Steam to Users

C – Turbine Hall

D – Chiller Room
- Steam to Users
- Chilled Water to Users

- No Emergency Generators

- No Fuel Oil



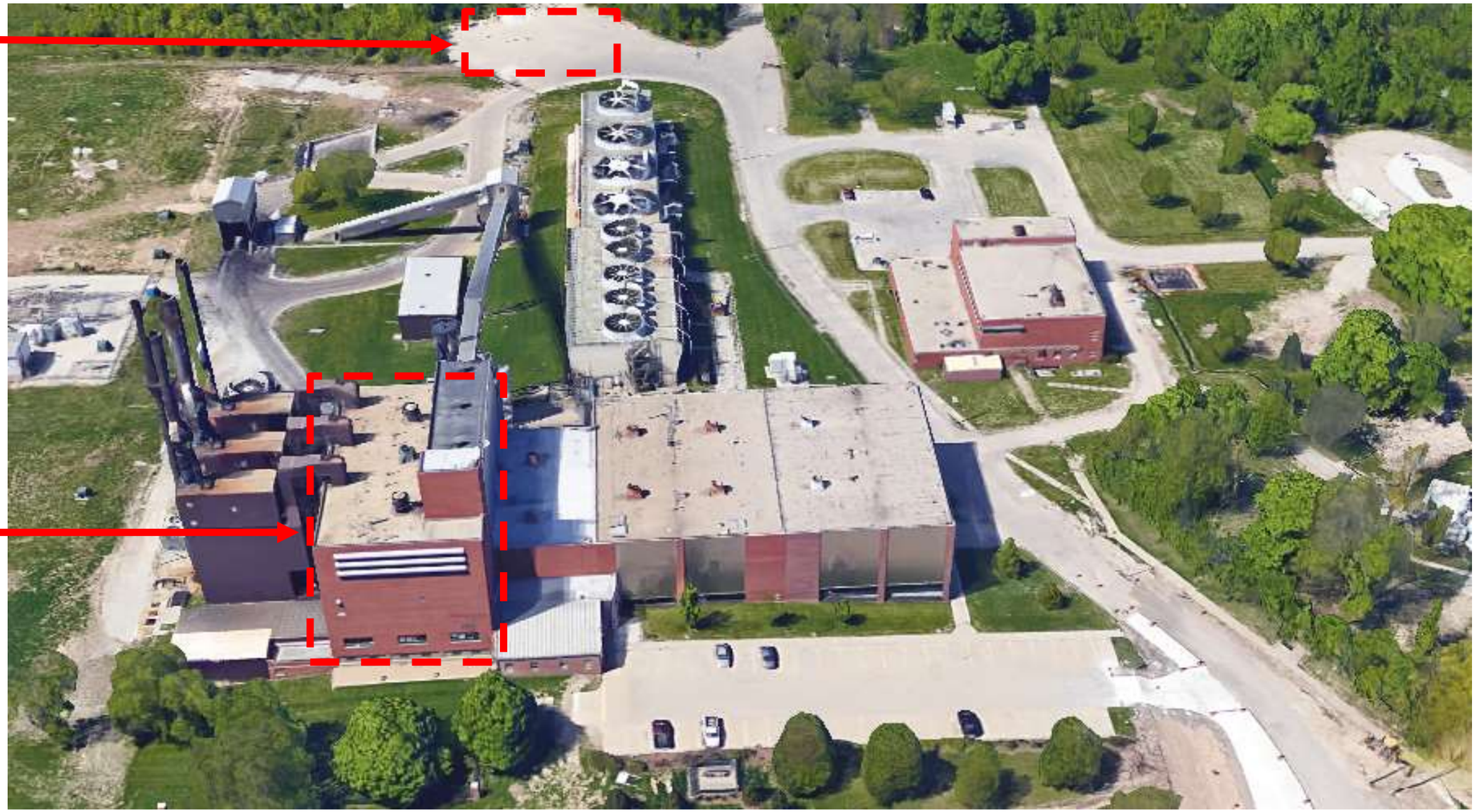
PLANT SITE OVERVIEW

NORTH PLANT

PLANT SITE OVERVIEW

NORTH PLANT

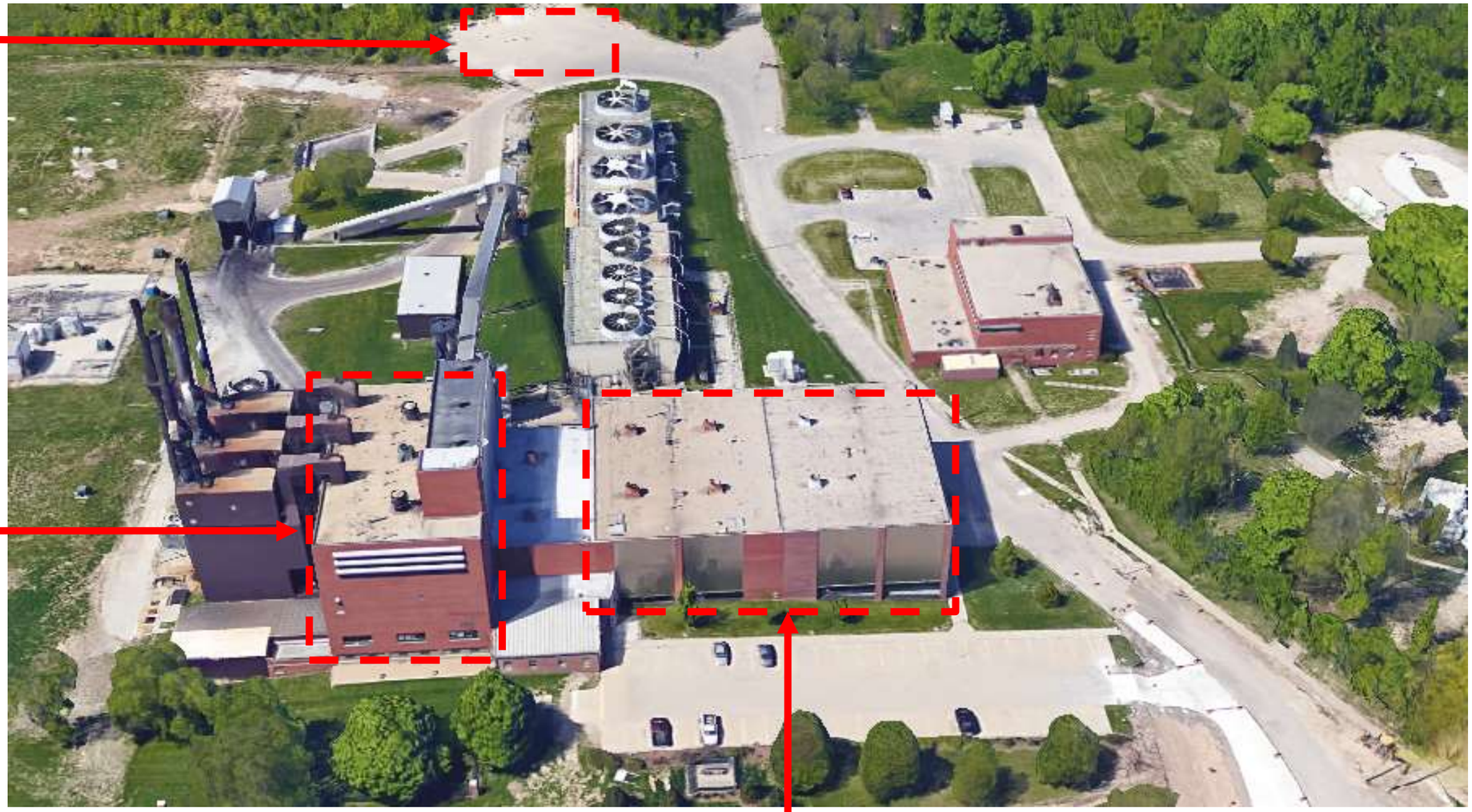
WEST PLANT



PLANT SITE OVERVIEW

NORTH PLANT

WEST PLANT

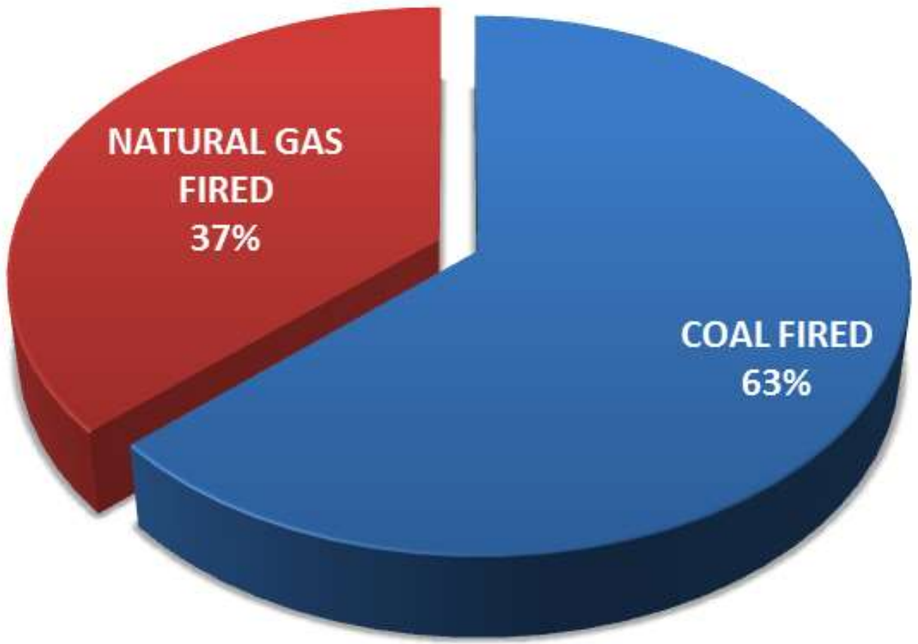


EAST PLANT

STEAM PRE-PROJECT CONDITIONS

- **Boilers 1-3 (1955) – Coal-Fired**
- **Boiler 4 (1970) – Gas-Fired**
  Administratively limited for runtime
- **Boiler 5 (2009) – Gas-Fired**
  Retain for continued use

Capacity	Pct	Age
255,000 lb/hr	63%	~60 yrs
80,000 lb/hr	20%	~45 yrs
67,500 lb/hr	17%	~10 yrs



- **Boiler MACT was looming**
- **NOx compliance is an issue**

STEAM POST-PROJECT CONDITIONS

Capacity	West Plant	North Plant	Total (N+1)
Day 1 (2018)	2 x 70,000 lb/hr Existing: 67,500 lb/hr	2 x 70,000 lb/hr	347,500 lb/hr
Full Build-out Capability	347,500 lb/hr (5 Boilers)	280,000 lb/hr (4 Boilers)	627,500 lb/hr

Following this Phase of Construction:

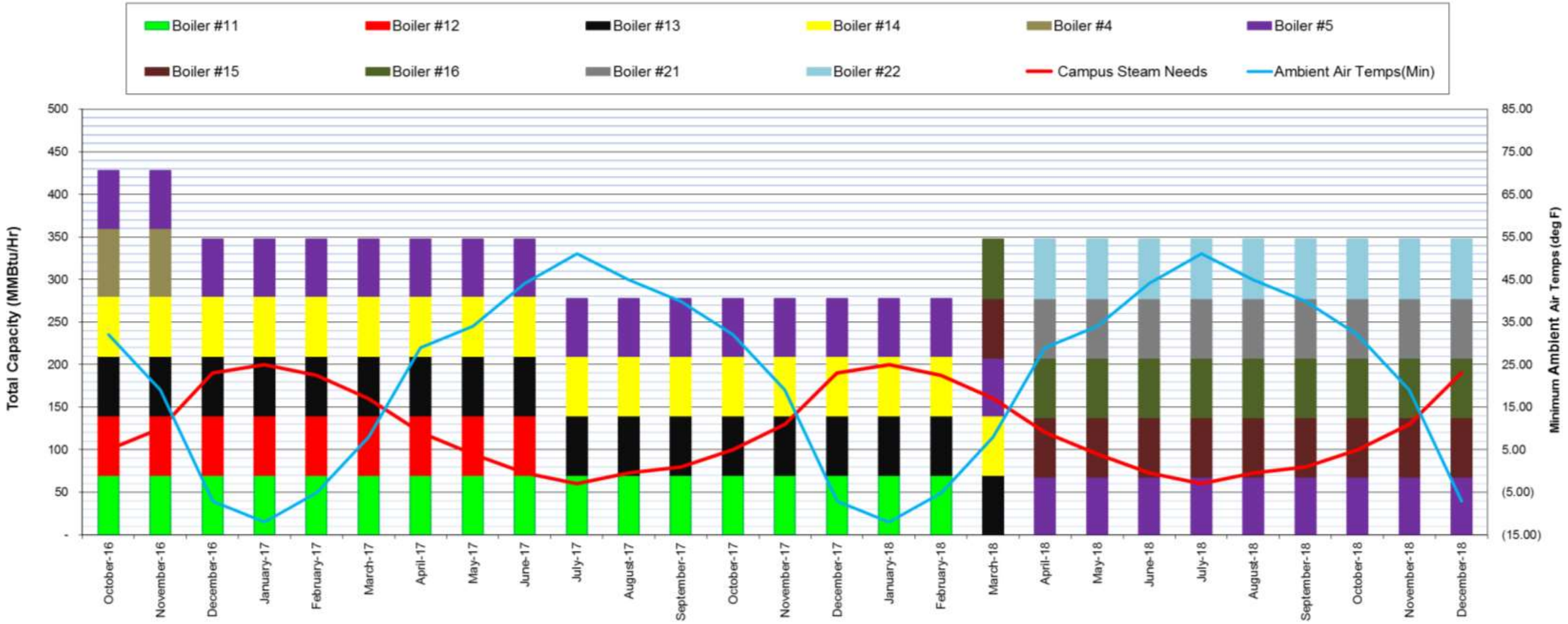
Total Capacity (N+1): 347,500 lb/hr

Firm Capacity: 277,500 lb/hr

Projected Peak Load*: 271,000 lb/hr

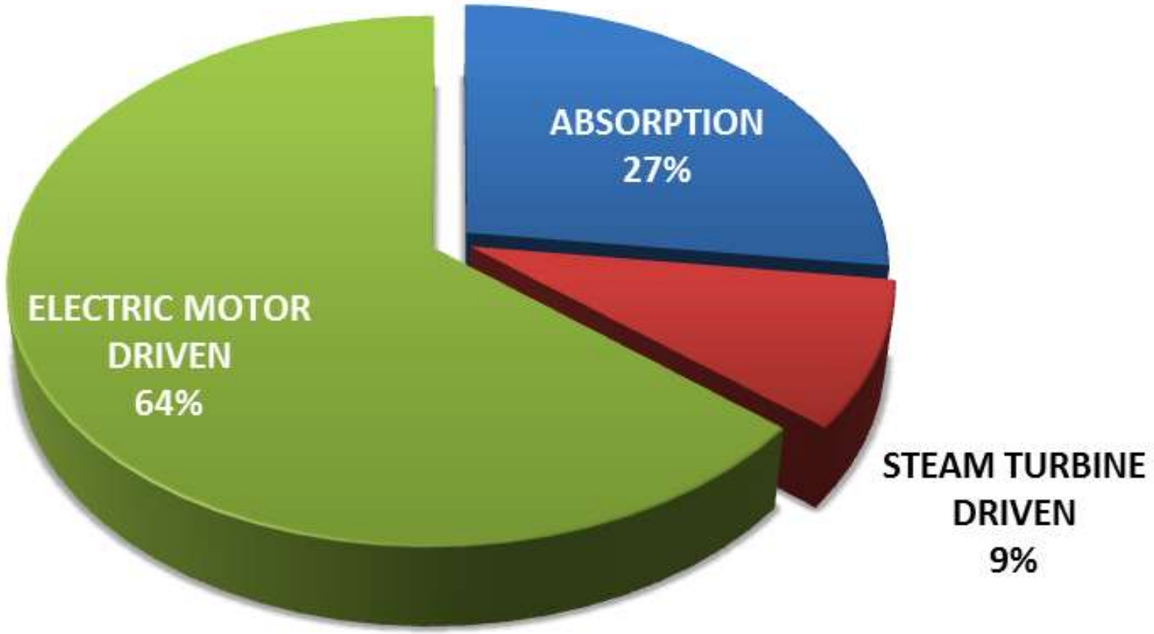
*Within 2023 Planning Horizon

STEAM = N+1 CHART



CHILLED WATER PRE-PROJECT CONDITIONS

Capacity	Pct	Age
3,750 tons	19%	>25 yrs
4,660 tons	23%	20-25 yrs
0 tons	0%	15-20 yrs
4,820 tons	24%	10-15 yrs
6,850 tons	34%	<10 yrs



- Significant age
- Absorption technology inefficient, less reliable

CHILLED WATER POST-PROJECT CONDITIONS

Capacity	East Plant	West Plant	Total (N+1)
Day 1 (2018)	Existing: 16,780 tons	3 x 2,500 tons	24,280 tons
Full Build-out Capability	24,280 tons (13 Chillers)	15,000 tons (6 Chillers)	39,280 tons

Following this Phase of Construction:

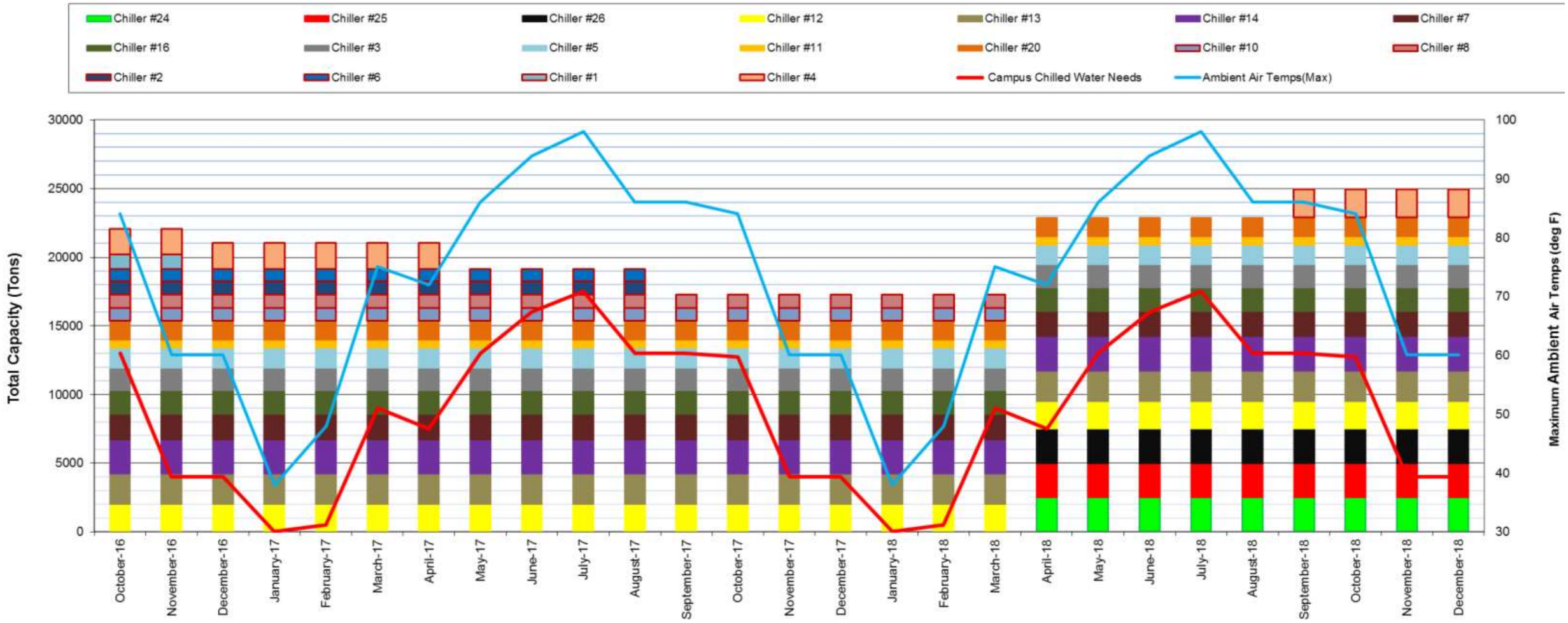
Total Capacity (N+1): 24,280 tons

Firm Capacity: 21,780 tons

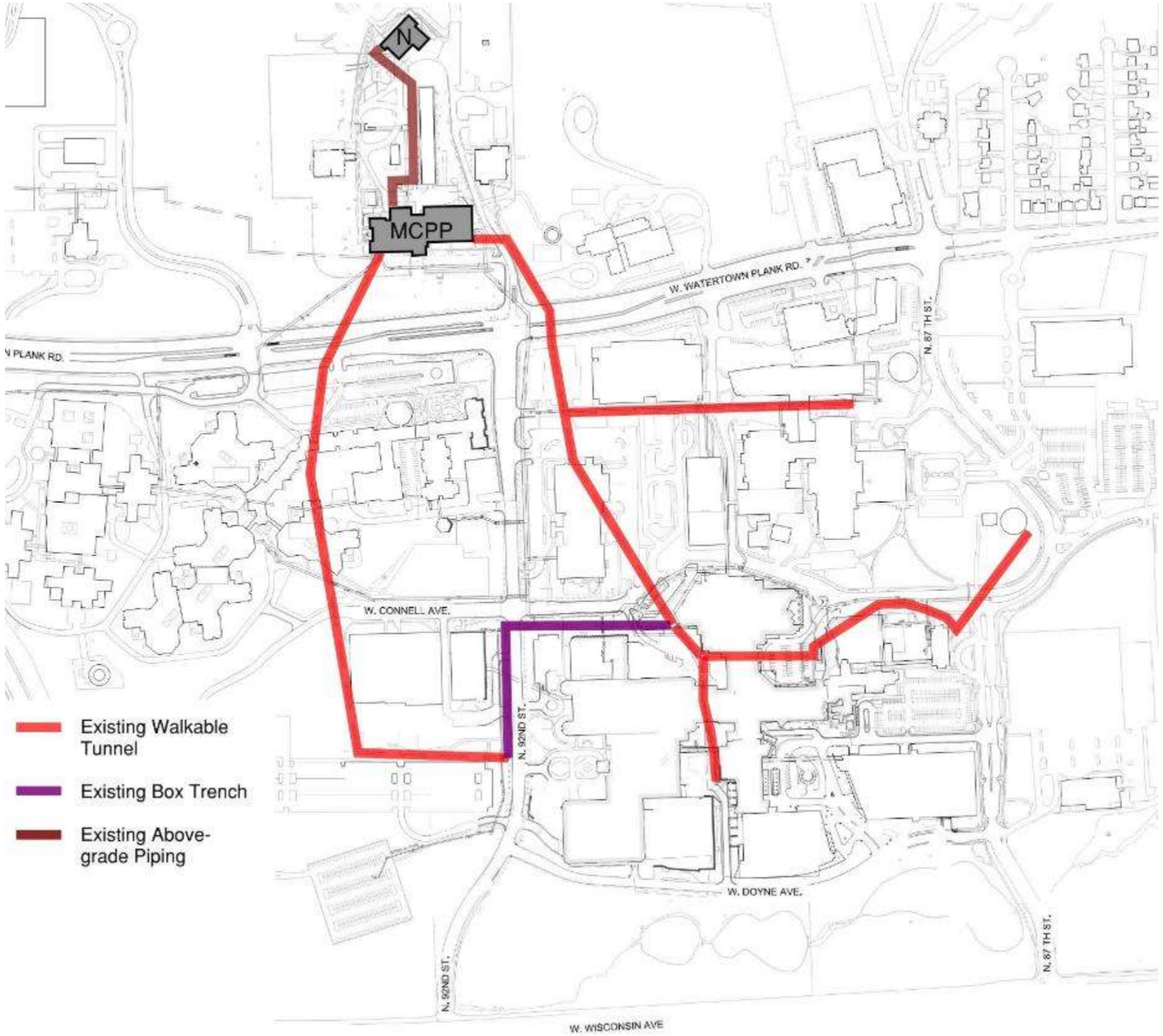
Projected Peak Load*: 21,400 tons

*Within 2023 Planning Horizon

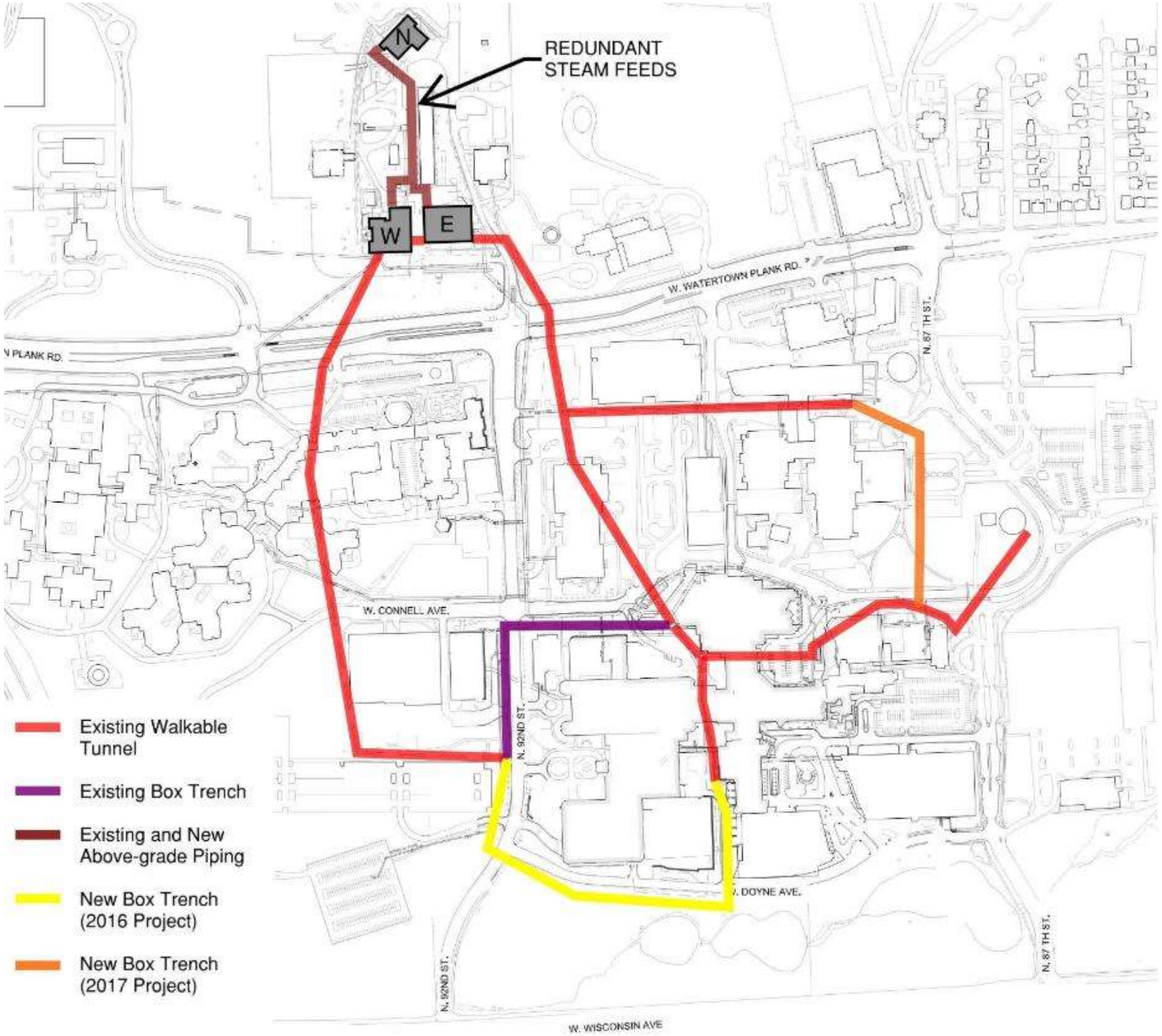
CHILLED WATER = N+1 CHART



STEAM DISTRIBUTION 2016



STEAM DISTRIBUTION 2018



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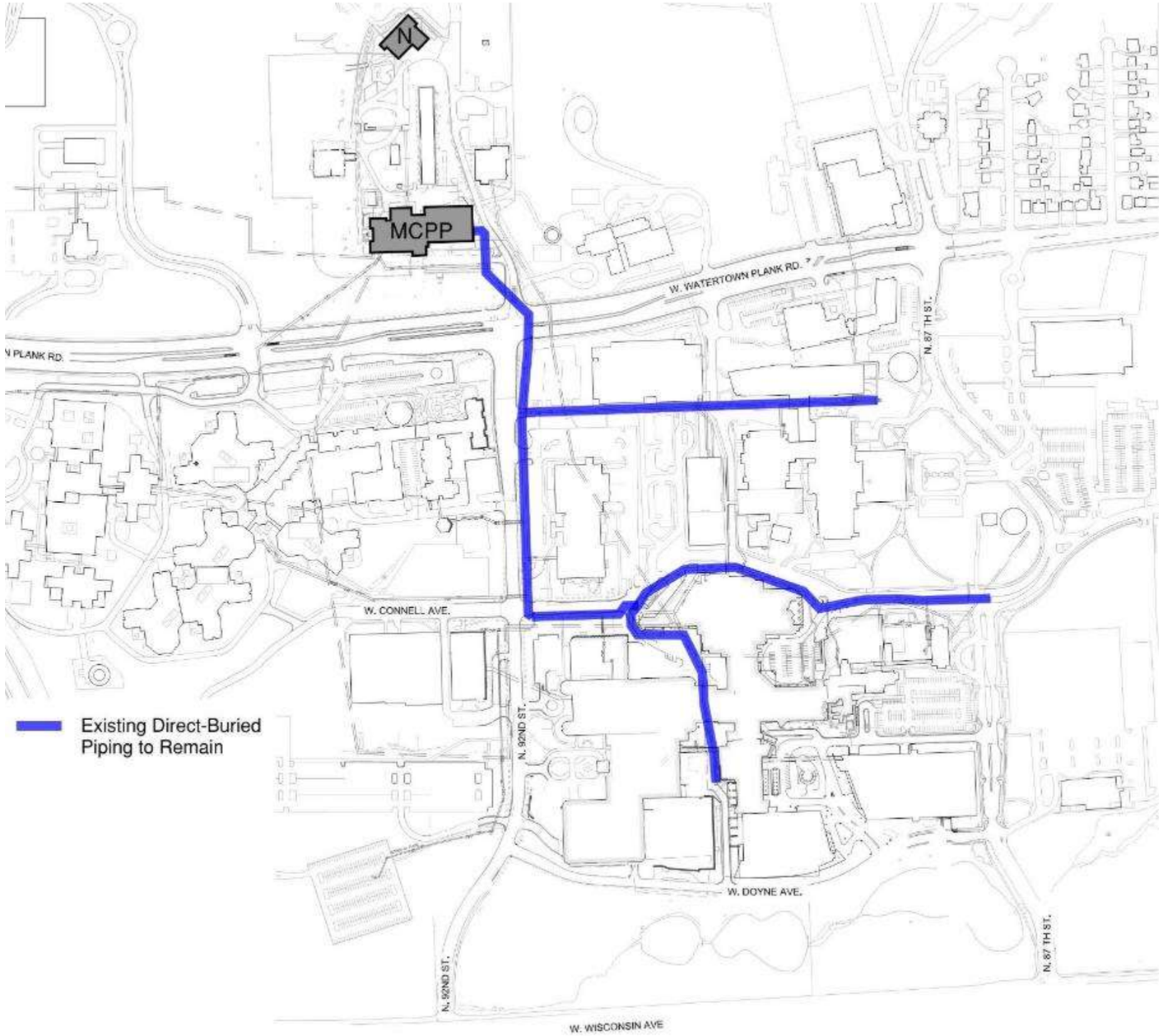
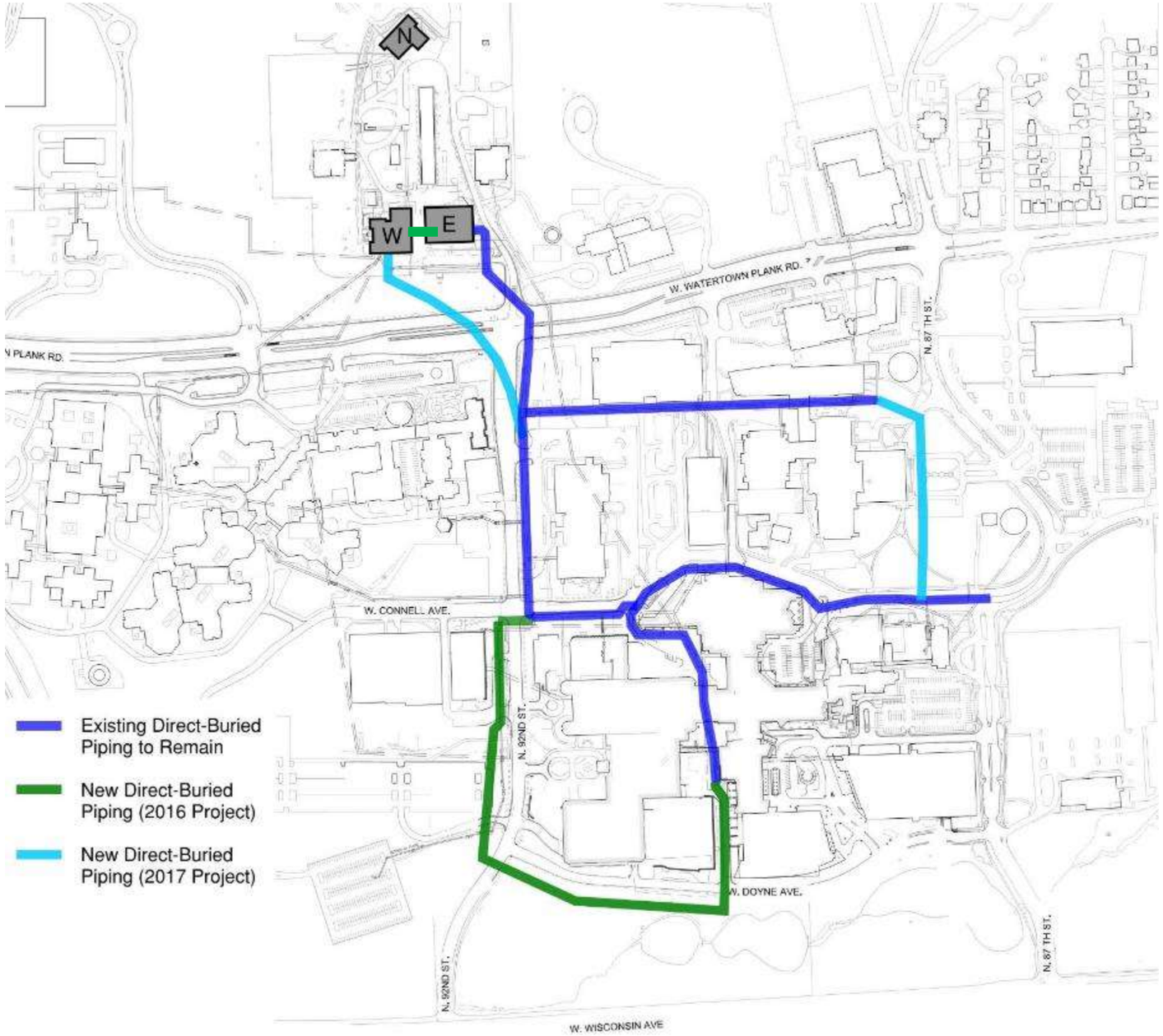


CHILLED WATER DISTRIBUTION 2018



MRMC Thermal – Reliability thru Bi-Furcation

VIA PIPE BRIDGE
- Steam
- Condensate
- Make-up Water
- Fuel Oil

VIA PIPE BRIDGE
- Steam
- Condensate
- Fuel Oil

NORTH PLANT

2 Boilers 140,000 #/hr
Air Compressors
HV Electrical Feed
Natural Gas Feed
Emergency Generator
Fuel Oil Tank
Water Treatment

WEST PLANT

3 Boilers 210,000 #/hr
3 Chillers 7,500 Tons
Air Compressors
Natural Gas Feed
HV Electrical Feed
2 Emergency Generators
3 Fuel Oil Tanks

EAST PLANT

9 Chillers 17,000 Tons
Air Compressors
HV Electrical Feed
Emergency Generator

PLANT CONTROLS

Chilled Water

DISTRIBUTION SYSTEM TO USERS
- Steam
- Condensate
- Chilled Water

DISTRIBUTION SYSTEM TO USERS
- Steam
- Condensate
- Chilled Water

PLANT BI-FURCATION HOW WAS IT DONE?

NEW RENTAL BOILERS STEP 1

NORTH PLANT

NORTH PLANT

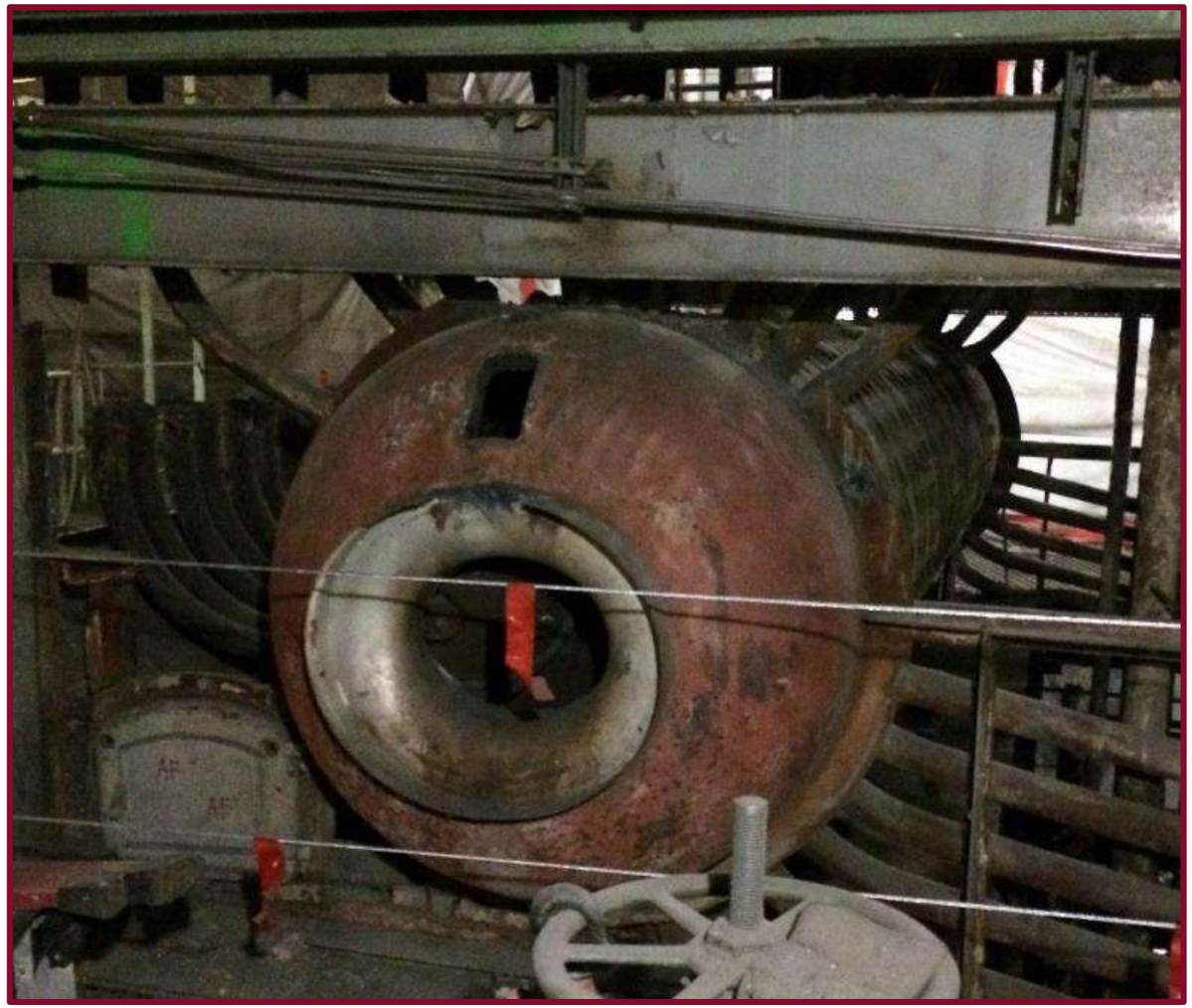

REYNOLDS
RIGGING & CRANE SERVICE
GROVE
wabash
Wabash Power Equipment Company
Wheeling, Illinois
800-704-2002
RENTAL-SALES
24 HR. EMERGENCY STEAM
MOBILE BOILER
4375

NORTH PLANT

NORTH PLANT

NORTH PLANT

DEMO OF COAL BOILERS STEP 2



INSTALLATION OF NEW GAS/OIL PACKAGE BOILERS STEP 3A

INSTALLATION OF NEW GAS/OIL PACKAGE BOILERS STEP 3B

NORTH PLANT

INSTALLATION OF NEW CENTRIFUGAL CHILLERS STEP 4

DEMO OF ABSORPTION CHILLERS STEP 5

DISTRIBUTION HOW WAS IT DONE?

DISTRIBUTION - STEAM HOW WAS IT DONE?

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DISTRIBUTION - CW HOW WAS IT DONE?

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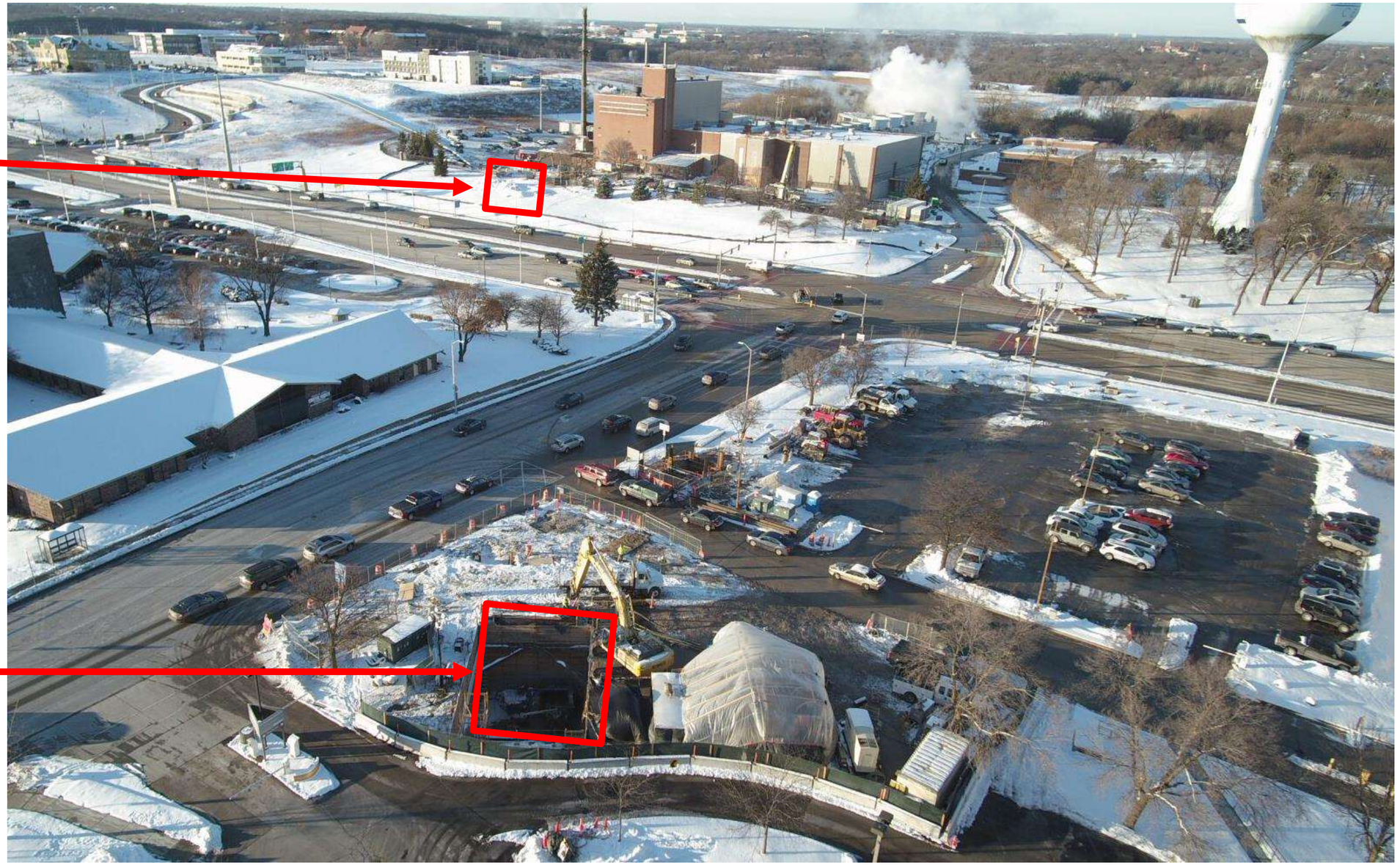
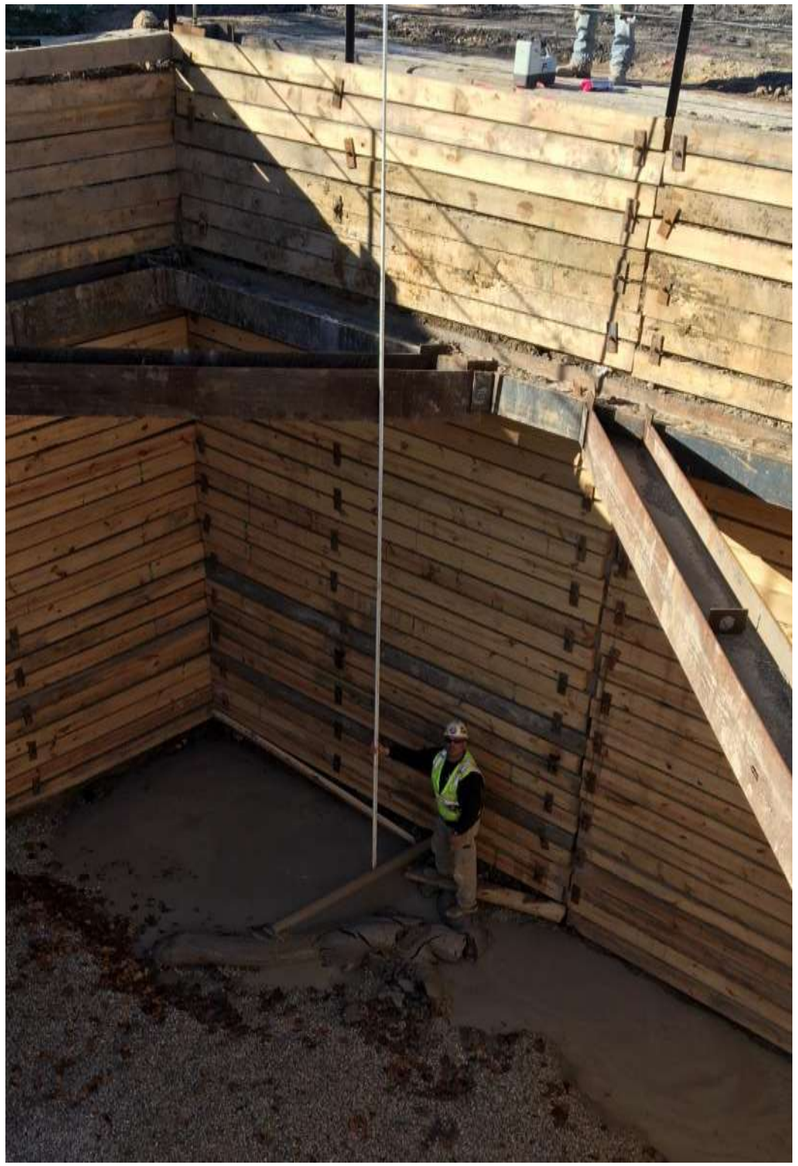
DISTRIBUTION – CW HOW WAS IT DONE?

Boring Pit

Receiving Pit



DISTRIBUTION - CW HOW WAS IT DONE?



DISTRIBUTION - CW HOW WAS IT DONE?

QUESTIONS ? ? ? ? ? ? ?