TCUF
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PROFESSIONALS

The Millennials have landed.

Session: 092806

Date: Wednesday, September 28, 2016

Time: 1:00pm – 2:00pm

Utility Master Planning

and its Role in the Campus Planning Process

Presented by:

- Mark Mikulin, EEA Consulting Engineers
- Thomas Shewan, Texas State University – San Marcos & Round Rock, Texas

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UTILITY MASTER PLANNING

AND ITS ROLE IN THE CAMPUS PLANNING PROCESS

Presenters

- **Mark Mikulin, PE**
  - EEA Consulting Engineers (Austin, TX)
  - Senior Project Manager
- **Thomas Shewan, PE, MBA, CEFP**
  - Texas State University (San Marcos & Round Rock, TX)
  - Associate Vice President of Facilities

Agenda

Utility Master Plan?

Why Plan for Utilities?

The Process

Case Study: Texas State University

Utility Master Plan?

A What?

A consolidated approach to utility generation, distribution, and consumption on campus, documented in a format that is repeatable, referenceable, and readily modified when necessary.

A What?

A consolidated approach to utility generation, distribution, and consumption on campus,
documented in a format that is repeatable, referenceable, and readily modified when necessary.

Possible Included Utilities

Electrical	Combined Heating/Power	Domestic Water	Sanitary Sewer	Storm Water	Chilled Water
Heating Water	Steam	Fire Protection Water	Irrigation Water	Well Water	Natural Gas
Reclaimed Water	Telecom	Emergency Power	Generators	Building Automation	Alternative Energy Sources

Why Plan for Utilities?

Why Plan for Utilities?

To Keep the Lights On.

- Capacity vs. Usage
  - How and where are they used?
  - Current and future
- Utility Source Availability & Reliability
  - Long term stability

Why Plan for Utilities?

To Improve Operations.

- Improve Reliability, Efficiency, Safety, Operating Cost
- Known & Unknown Issues
- Examples:
  - Life Cycle Cost of Sources and Systems (Local vs. Municipal)
  - Efficiency vs. Total Cost vs. Maintainability

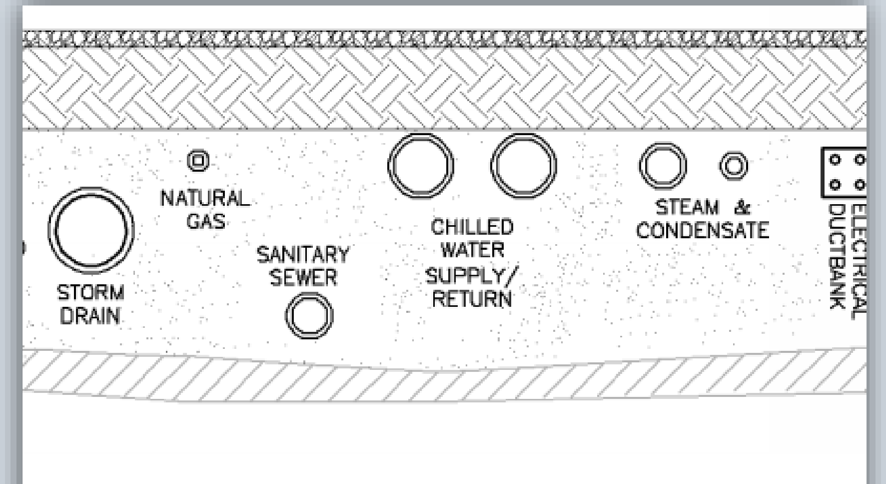

FIGURE 6: TYPICAL UTILITY ALIGNMENT

Why Plan for Utilities?

To Set the Path Forward.

- Develop Guidelines for Campus-Specific Best Practices
  - Campus geography
  - Maintenance ability
  - Don’t Recreate Wheel & Don’t Repeat Mistakes
- Develop Specific Improvements
  - Define the Issues
  - Begin process of addressing them

Why Plan for Utilities?

Risk Management.

- Lack of Planning = Surprises
- Surprises ≠ Stable, Efficient, Safe, Cost Effective

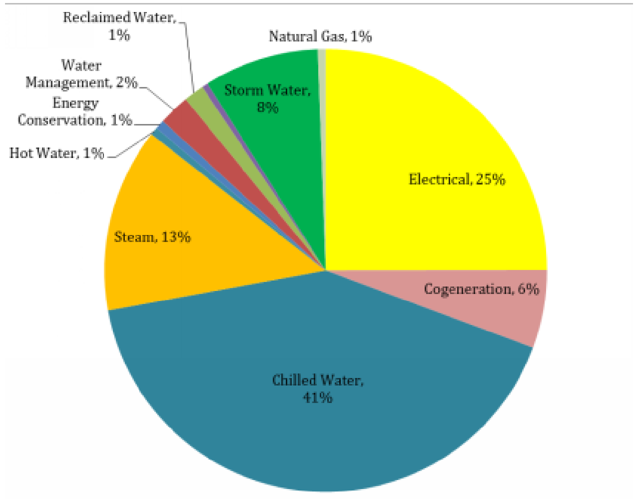

FIGURE 15: 2017-2027 ANTICIPATED CAPITAL COST – PERCENTAGE BY UTILITY

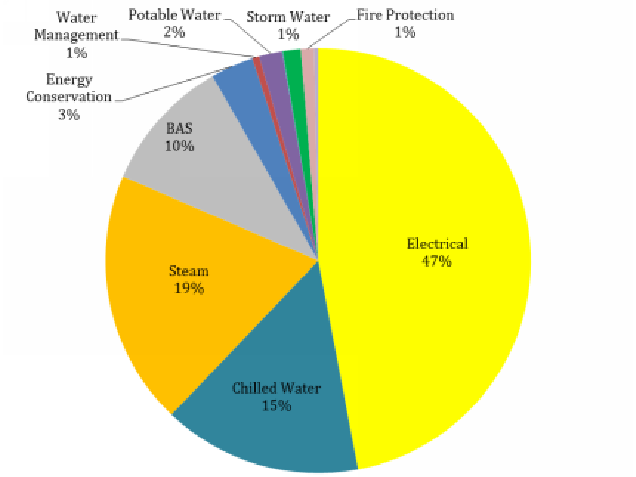

FIGURE 16: 2017-2027 ANTICIPATED RENEWAL COST – PERCENTAGE BY UTILITY

Why Plan for Utilities?

Accountability.

- A comprehensive plan combines all available knowledge into a document that can be **reviewed and vetted by the stakeholders**.
- Having the plan documented gives it legitimacy and **steadies a moving target**.
- It serves as **utility operation business plan** for the support of academic and research activities.

The Process

The Process

Scope Identification

Data Collection

Data Analysis

Options Development and Testing

Documentation

The Process: **Scope Identification**

- What present utilities are of concern?

Electrical	Combined Heating/Power	Domestic Water	Sanitary Sewer	Storm Water	Chilled Water
Heating Water	Steam	Fire Protection Water	Irrigation Water	Well Water	Natural Gas
Reclaimed Water	Telecom	Emergency Power	Generators	Building Automation	Alternative Energy Sources

The Process: **Scope Identification**

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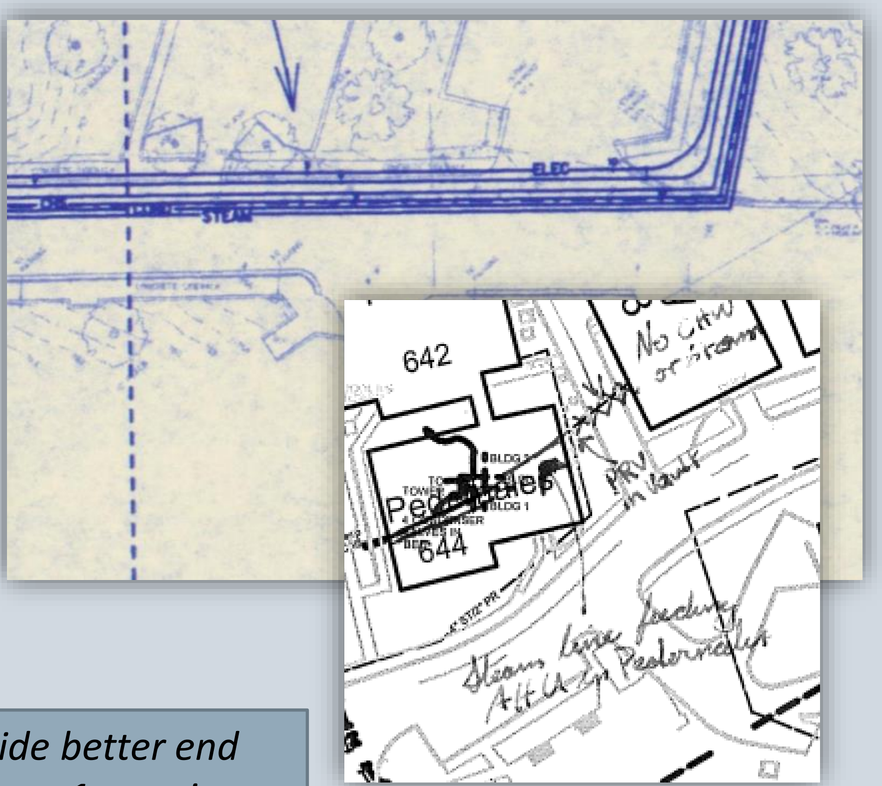
Electrical	Combined Heating/Power	**Domestic Water**	**Sanitary Sewer**	**Storm Water**	**Chilled Water**
Heating Water	Steam	**Fire Protection Water**	Irrigation Water	Well Water	Natural Gas
Reclaimed Water	**Telecom**	Emergency Power	**Generators**	**Building Automation**	**Alternative Energy Sources**

The Process: **Data Collection**

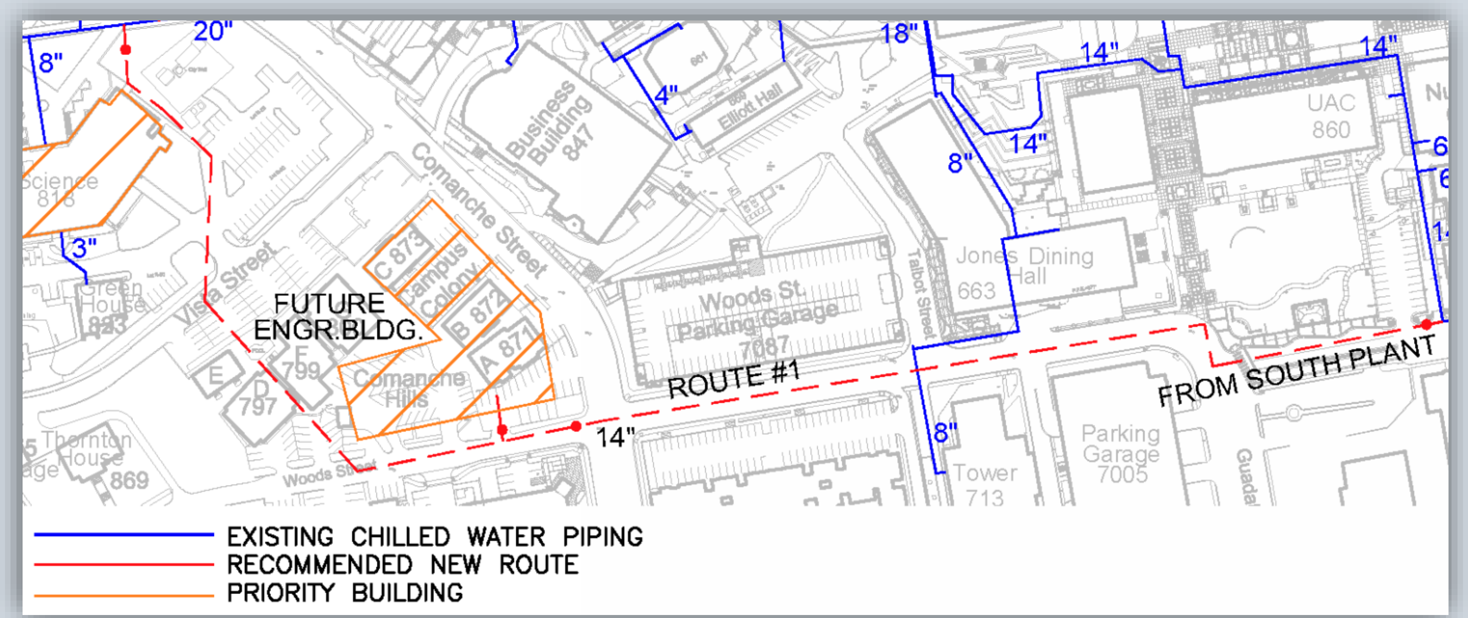
- Existing studies, drawings, record documents review
- Field surveys & inspections
- O & M Costs
- Personnel interviews – “tribal knowledge”
  - *Capture this information while it is available!*
- Log Data
  - Utility Meter
  - Manual Log
  - Building Automation Trends

Having this data available will provide better end results. Consider starting collection ***> 1 year*** *in advance of study.*



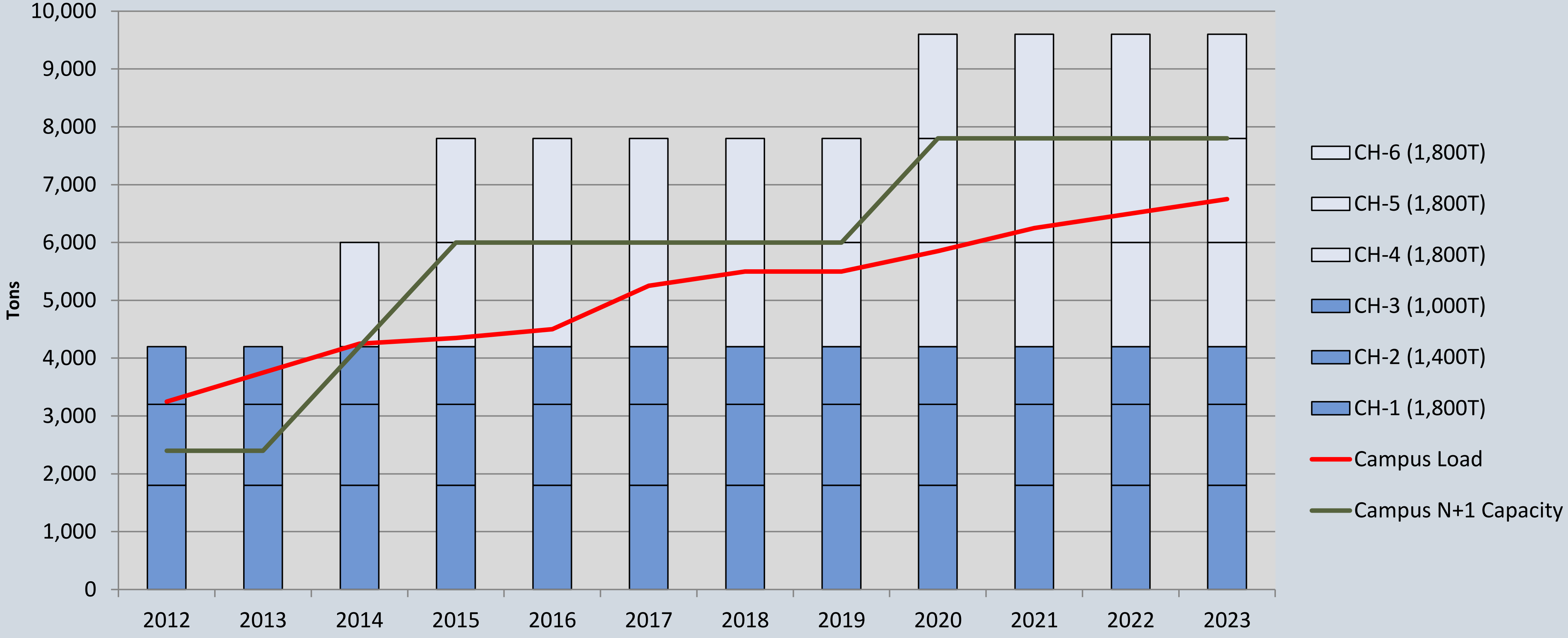
The Process: Data Collection

- Current Campus Master Plan Requirements
  - Renovations
  - Demolitions
  - New Construction
  - Landscaping
  - Infrastructure Upgrades



The Process: **Data Analysis**

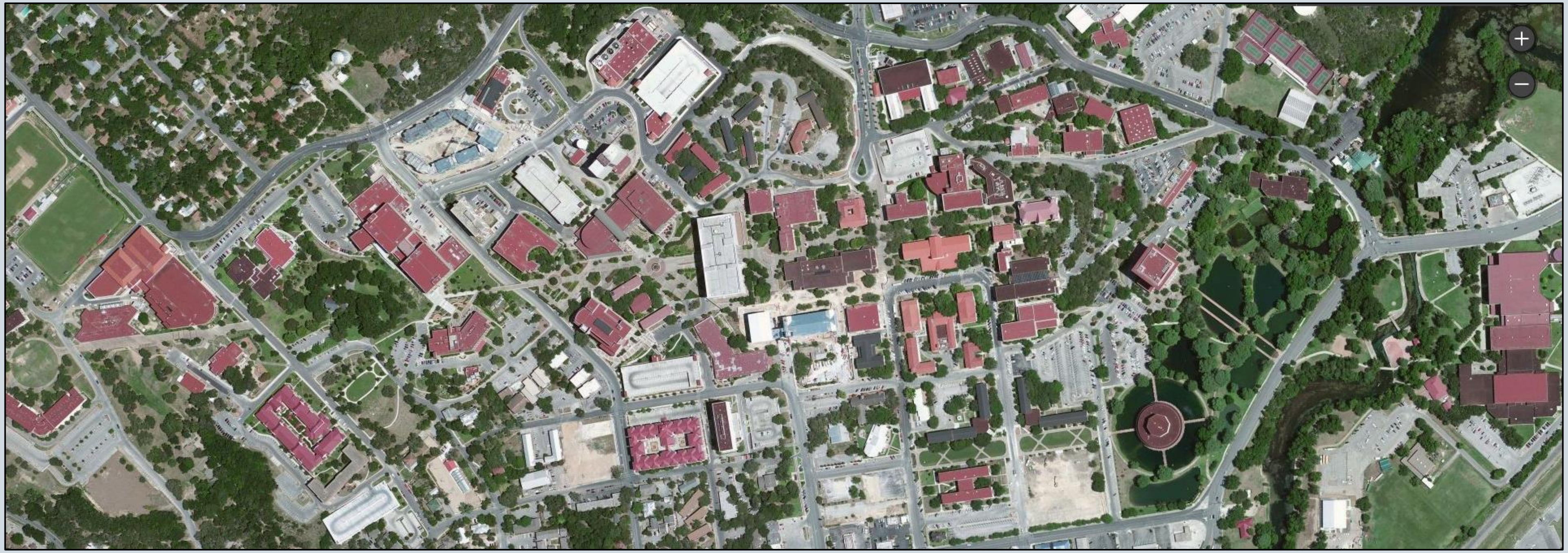
Generating Capacity Assessment *"What do we have vs. what do we need?"*



The Process: **Data Analysis**

Distribution Assessment *"How well are utilities being delivered?"*

- Capacity Assessment: Software models available for fluids and electrical



The Process: **Data Analysis**

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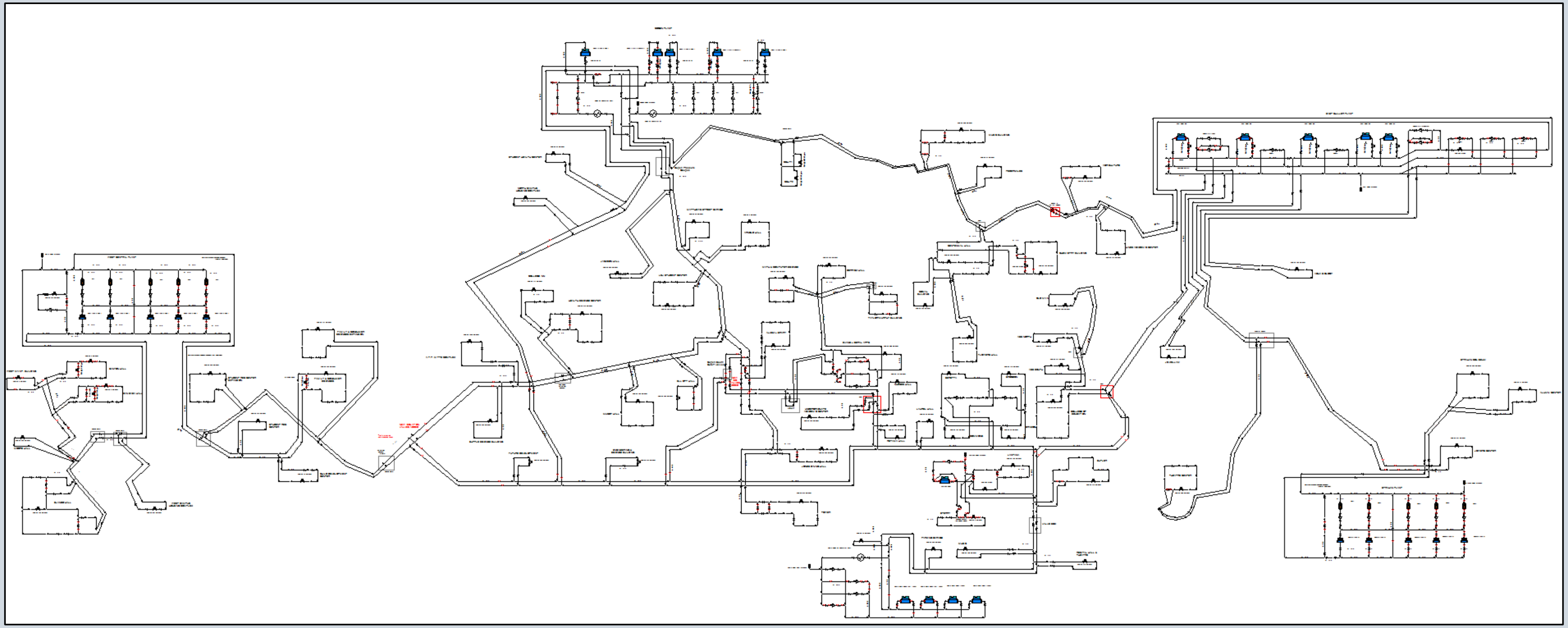
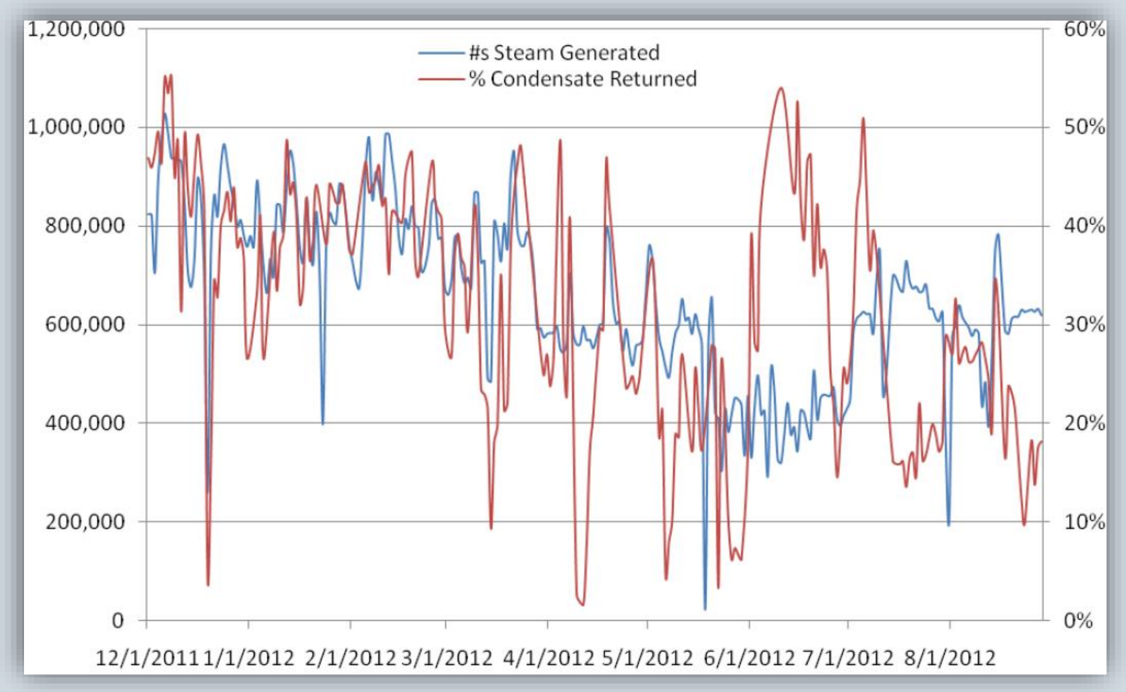


The Process: **Data Analysis**

Distribution Assessment *"How well are utilities being delivered?"*

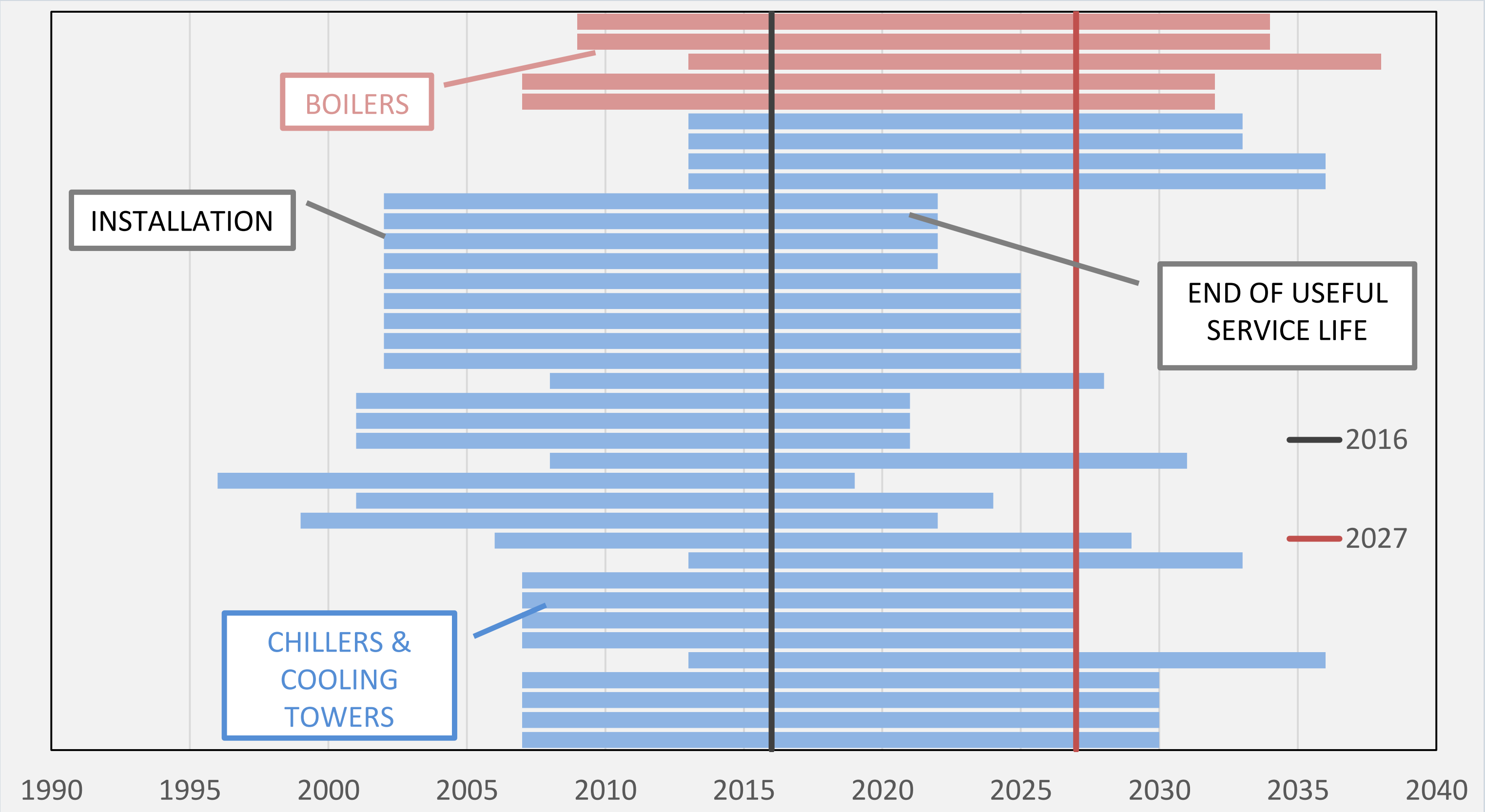
- Efficiency Assessment: *Thermal Energy Distribution Systems*
  - Fuel In vs. Btus at User
  - Includes ALL Losses
- Helpful in LCCAs and for ECMs
- Increasing Efficiency:
  - Reduces operating costs
  - Can defer capital costs



The Process: **Data Analysis**

Condition Assessment *"Where are the weak links?"*

- Examines physical conditions
- Applies to all utilities
- Field inspections and statistical service life expectancies

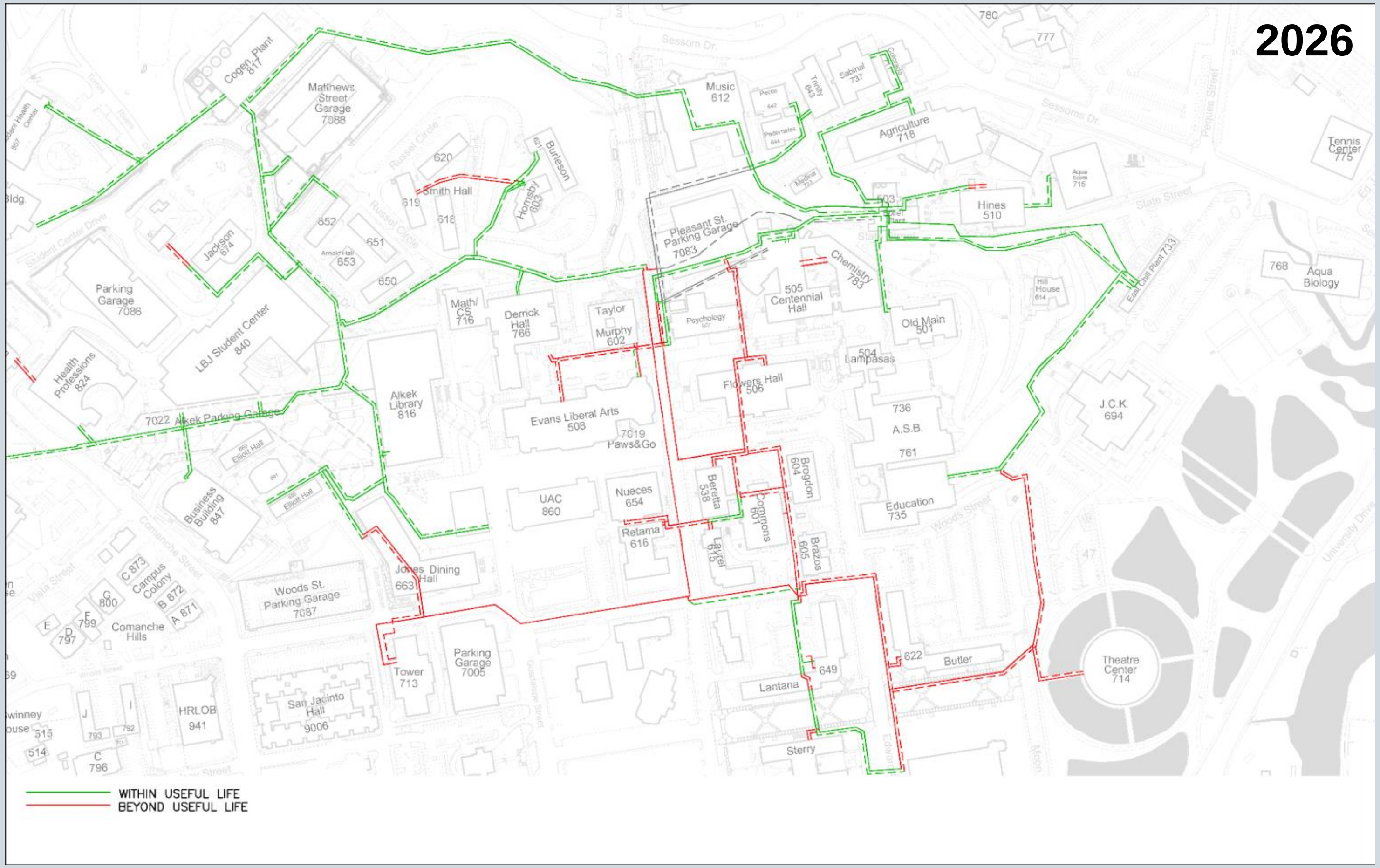


The Process: **Data Analysis**

Condition Assessment *"Where are the weak links?"*

The Process: **Data Analysis**

Condition Assessment *"Where are the weak links?"*



The Process: **Data Analysis**

Condition Assessment *"Where are the weak links?"*

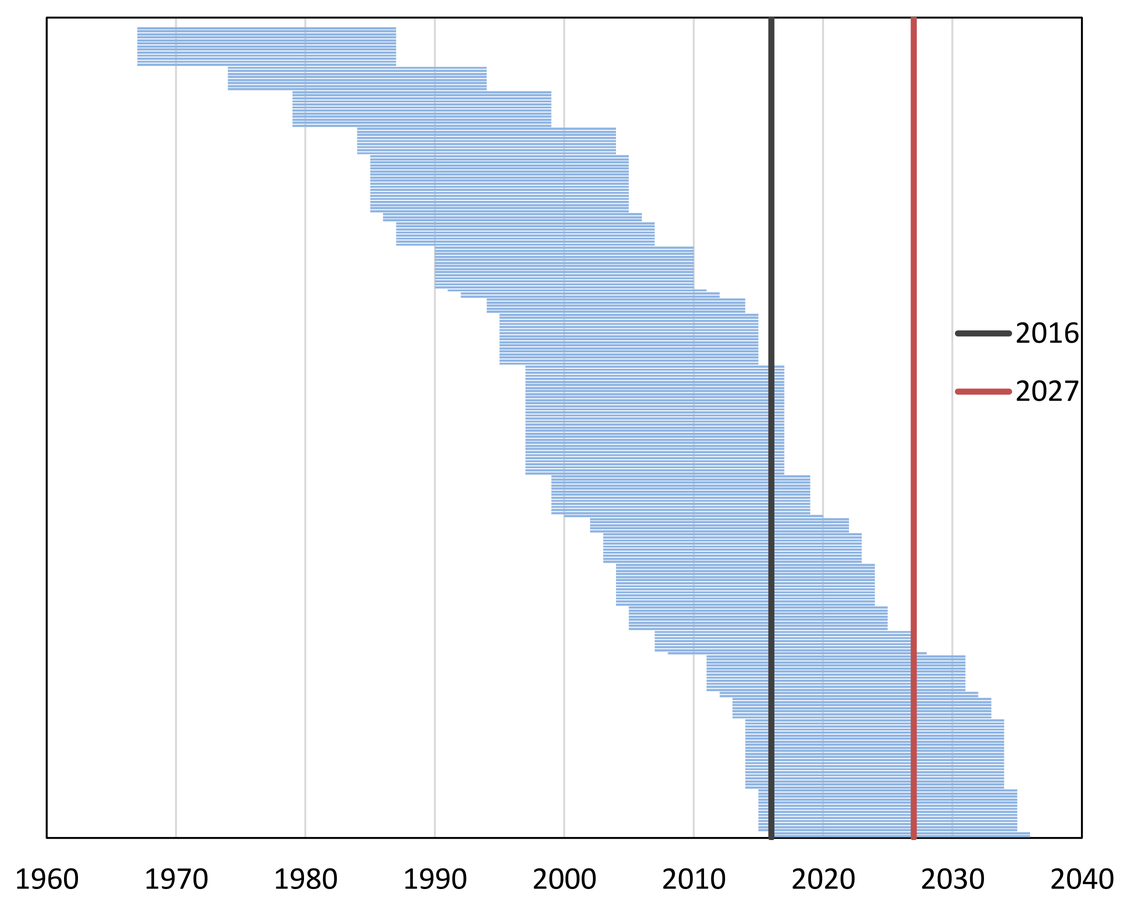
Building HVAC, electrical, telecom, generators, BAS infrastructure also analyzed

BUILDING EQUIPMENT	% OF EXPECTED SERVICE LIFE USED					TOTAL QUANTITY
	0-25	26-50	51-75	75-100	100+	
CHILLED WATER COILS	11%	10%	21%	16%	42%	291

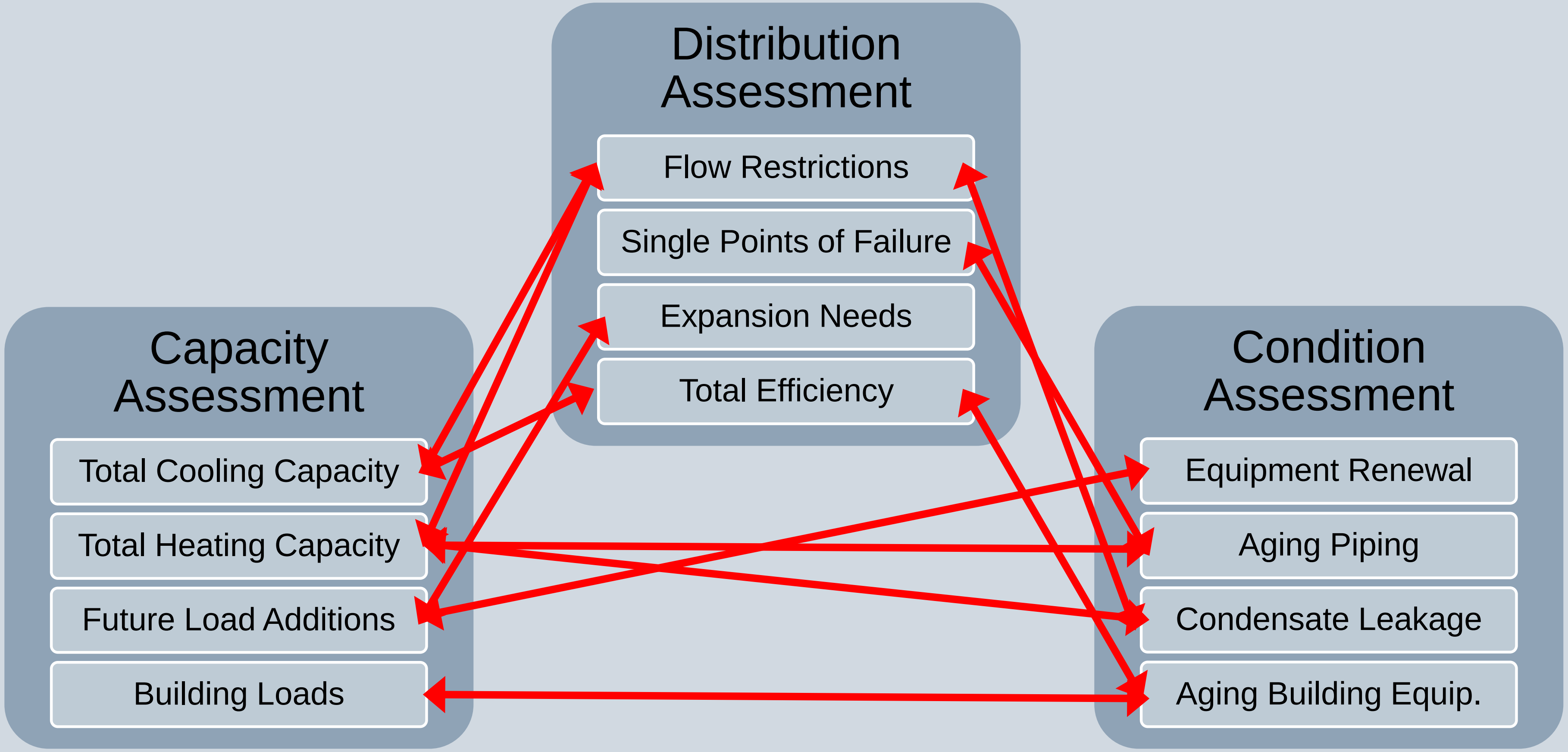
Notes:
1. Chilled water coil expected life of 20 years based on ASHRAE 2011 Applications Handbook, Chapter 37.
2. Units with capacities below 5 tons are not included.

Building Equipment	% of Expected Service Life Used					Total Quantity
	0-25	26-50	51-75	75-100	100+	
Steam Coils	24%	8%	15%	20%	33%	272
Steam to Hot Water Heat Exchangers	25%	15%	8%	5%	47%	87

Notes:
1. Steam coil expected life of 20 years based on ASHRAE 2011 Applications Handbook, Chapter 37.
2. Heat exchanger expected life of 24 years based on ASHRAE 2011 Applications Handbook, Chapter 37.



The Process: **Data Analysis**



The Process: **Options Development & Testing**

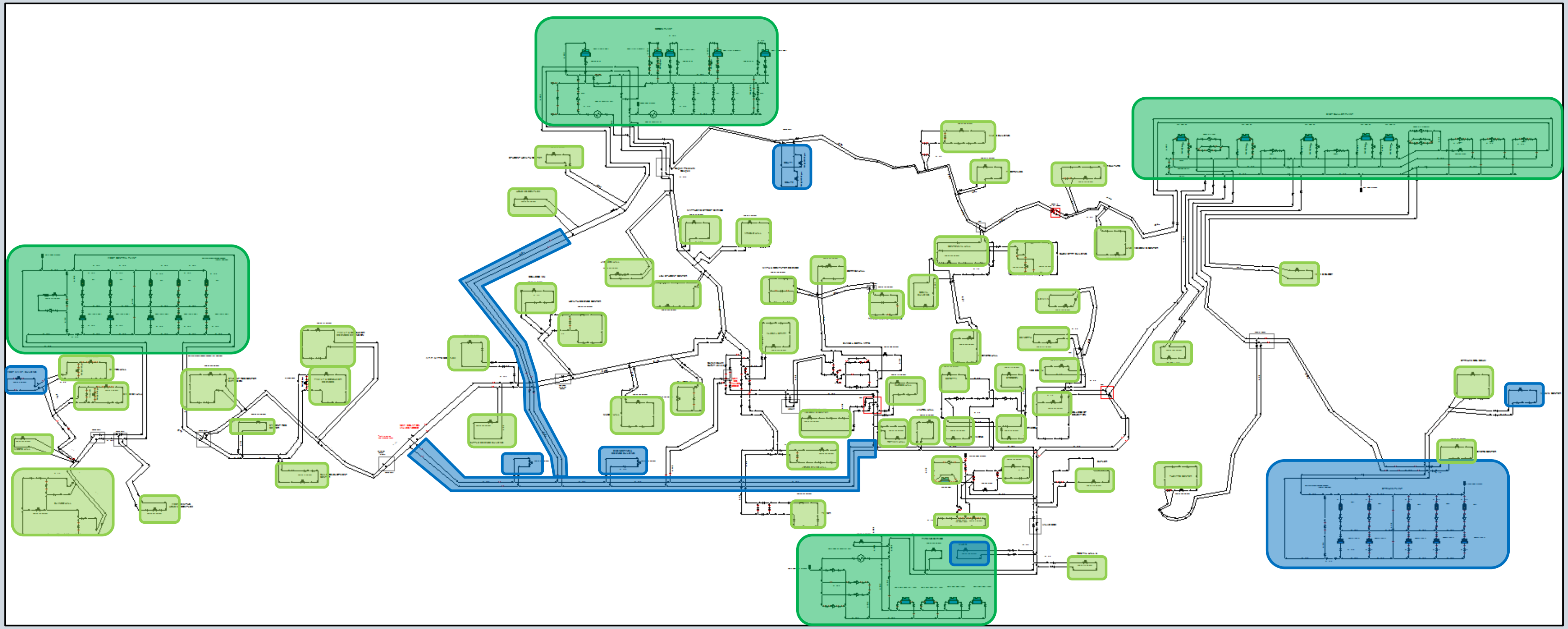
- <u>Options Development</u>
  - Specific Single or Multi-Discipline Utility Projects
  - Correct Existing Issues and serve Future Needs
    - Component Replacements
    - Generation Increases
    - Distribution Increases
    - Source Modifications
    - Methodology Modifications
  - Develop adequate detail for visualization, discussion, testing, and ROM estimates

The Process: **Options Development & Testing**

- Options Testing: Tools
  - Utility Consumption Analyses
    - Electrical & Water Interactions
  - Life Cycle Costs Analyses
    - First, regulatory, energy, operational, maintenance, replacement costs
  - Software Models
    - Hydraulic and Electrical

The Process: **Options Development & Testing**

- Software models used to predict performance of future utility generation and routes



The Process: **Documentation**

- Purpose & Scope Description
- Summary of Existing Conditions
  - Generating Capacity Assessment
  - Distribution Capacity Assessment
  - Existing Condition Assessment
- Data Analysis and Assessment Summaries
- Recommended System Improvements

The Process: **Documentation**

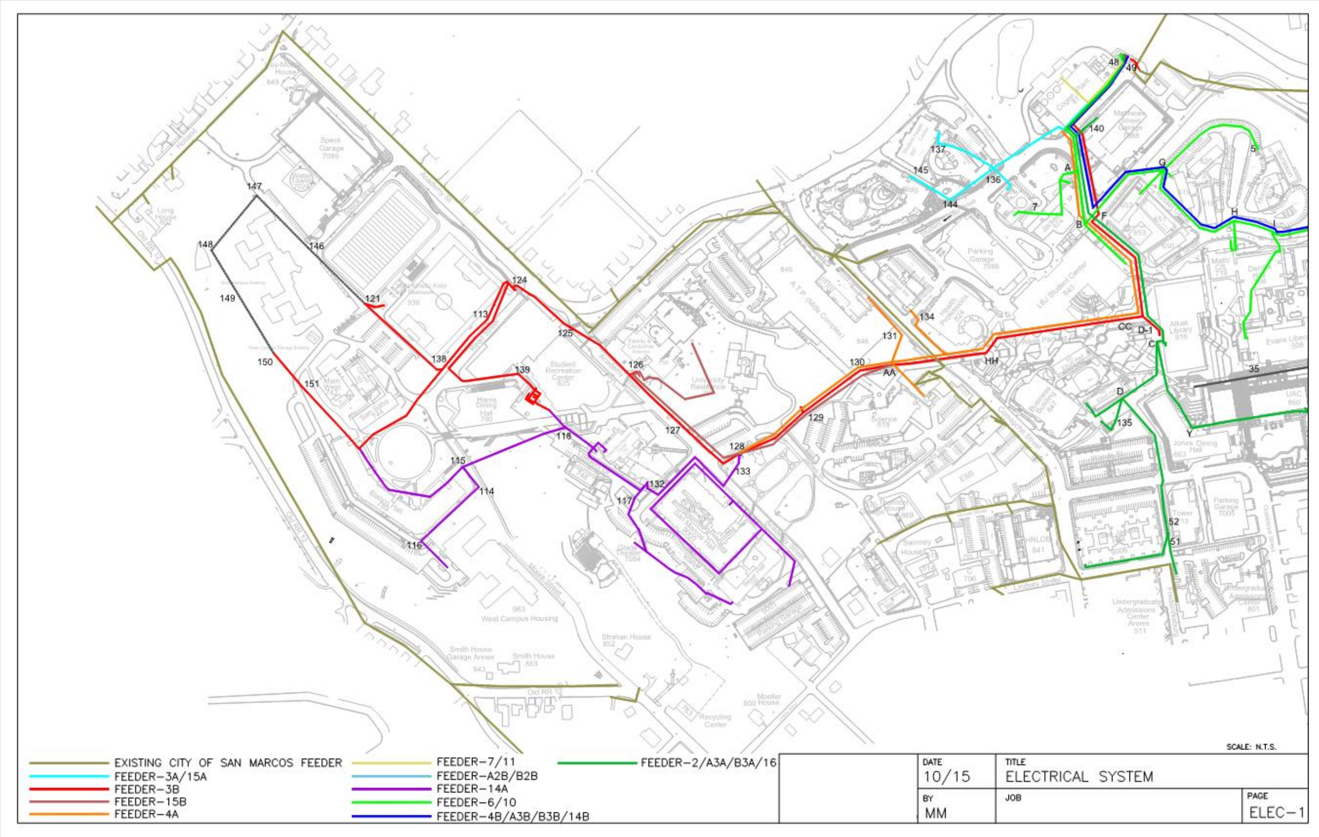
- Purpose & Scope Description

A **consolidated approach** to utility **generation**, **distribution**, and **consumption** on campus, **document**ed in a format that is **repeatable**, **referenceable**, and readily modified when necessary.

Electrical	Combined Heating/Power	Domestic Water	Sanitary Sewer	Storm Water	Chilled Water
Heating Water	Steam	Fire Protection Water	Irrigation Water	Well Water	Natural Gas
Reclaimed Water	Telecom	Emergency Power	Generators	Building Automation	Alternative Energy Sources

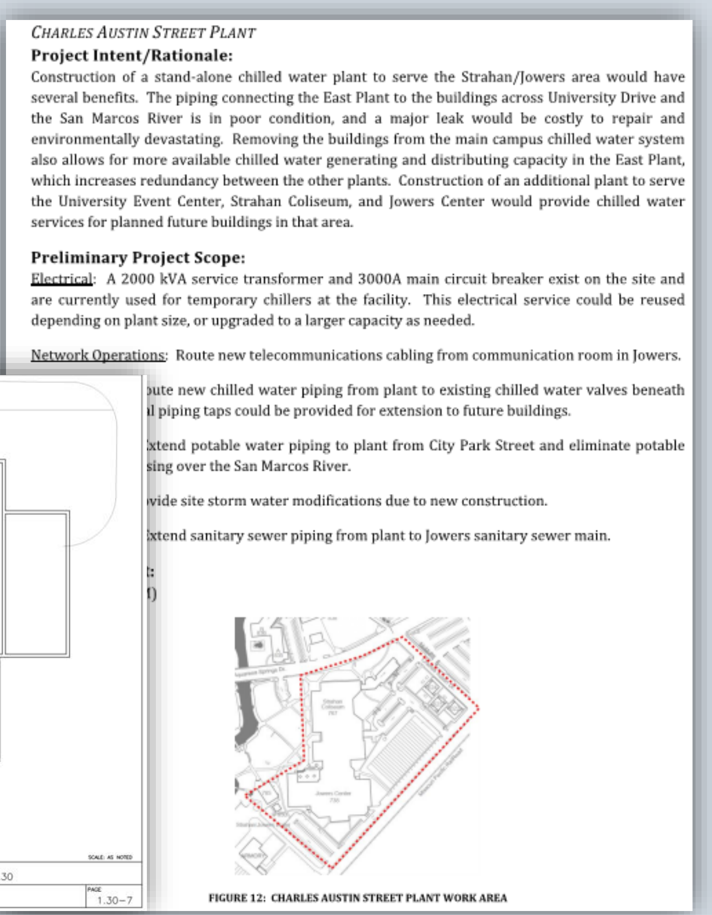
The Process: **Documentation**

- <u>Summary of Existing Conditions</u>
  - Generating Capacity Assessment
  - Distribution Capacity Assessment
  - Existing Condition Assessment
- <u>Data Analysis Summaries</u>
  - Current & Future Issues
  - Options Analyses



The Process: **Documentation**

- <u>Recommended System Improvements</u> *("road map")*
  - Comprehensive List of Specific Projects
  - Narrative Scopes / Conceptual Drawings
  - ROM Costs
  - Implementation Phases for Projects
  - Summary Phase ROM Costs



CHARLES AUSTIN STREET PLANT

Project Intent/Rationale:

Construction of a stand-alone chilled water plant to serve the Strahan/Jowers area would have several benefits. The piping connecting the East Plant to the buildings across University Drive and the San Marcos River is in poor condition, and a major leak would be costly to repair and environmentally devastating. Removing the buildings from the main campus chilled water system also allows for more available chilled water generating and distributing capacity in the East Plant, which increases redundancy between the other plants. Construction of an additional plant to serve the University Event Center, Strahan Coliseum, and Jowers Center would provide chilled water services for planned future buildings in that area.

Preliminary Project Scope:

<u>Electrical</u>: A 2000 kVA service transformer and 3000A main circuit breaker exist on the site and are currently used for temporary chillers at the facility. This electrical service could be reused depending on plant size, or upgraded to a larger capacity as needed.

<u>Network Operations</u>: Route new telecommunications cabling from communication room in Jowers.

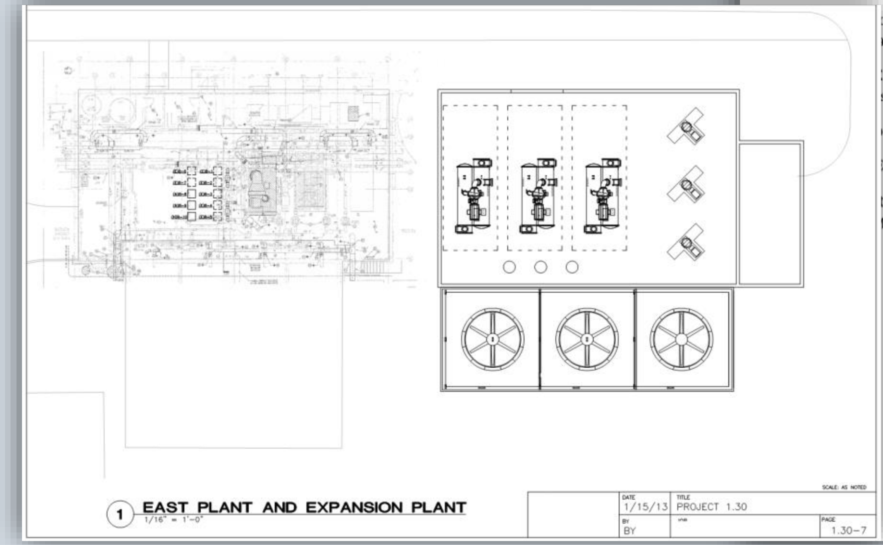
...oute new chilled water piping from plant to existing chilled water valves beneath ...l piping taps could be provided for extension to future buildings.

...xtend potable water piping to plant from City Park Street and eliminate potable ...sing over the San Marcos River.

...vide site storm water modifications due to new construction.

...xtend sanitary sewer piping from plant to Jowers sanitary sewer main.

FIGURE 12: CHARLES AUSTIN STREET PLANT WORK AREA



Utility Master Plan

Concept

- Generation
- Distribution
- Consumption

- Living Document
- Referenceable
- Repeatable

Purpose

- To Keep the Lights On
- To Improve Operations
- To Set the Path Forward
- Risk Management
- Accountability

Method

- Scope Identification
- Data Collection
- Data Analysis
- Options
- Documentation

Case Study:

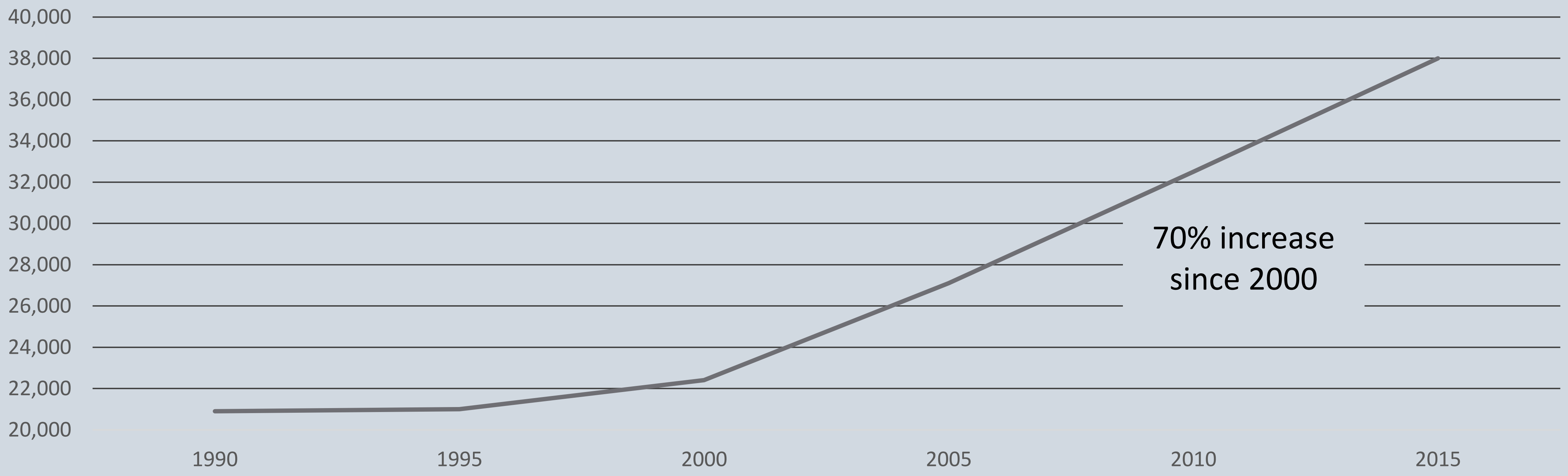
Texas State University

Texas State University: Campus Overview

- San Marcos & Round Rock, Texas
- San Marcos campus – 457 acres, 218 buildings
- Topography:
  - 220’ elevation change
- Water-Oriented:
  - Headwaters of San Marcos River
  - Over Edwards Aquifer recharge zone

Texas State University: Campus Overview

- <u>Enrollment Growth</u>: 2015 was 18th consecutive record year



Texas State University: Utilities Operations

Electrical	Combined Heating/Power	Domestic Water	Sanitary Sewer	Storm Water	Chilled Water
Heating Water	Steam	Fire Protection Water	Irrigation Water	Well Water	Natural Gas
Reclaimed Water	Telecom	Emergency Power	Generators	Building Automation	Alternative Energy Sources

Texas State University: Utilities Operations

- Medium-voltage electrical system
- 15,500 tons of chillers (4 plants)
- 160,000 #/hr of boilers (3 plants)
- 20 miles of thermal distribution piping
- Domestic water generation
- MS4 Storm System

Texas State University: Utility Planning History

<u>2011</u>: Campus Master Plan Update

<u>2011</u>: 1st Utility Infrastructure Master Plan

<u>2014</u>: Individual Utility Studies Completed

<u>2015</u>: Utility Infrastructure Master Plan update begins

<u>2016</u>: Campus Master Plan Update begins

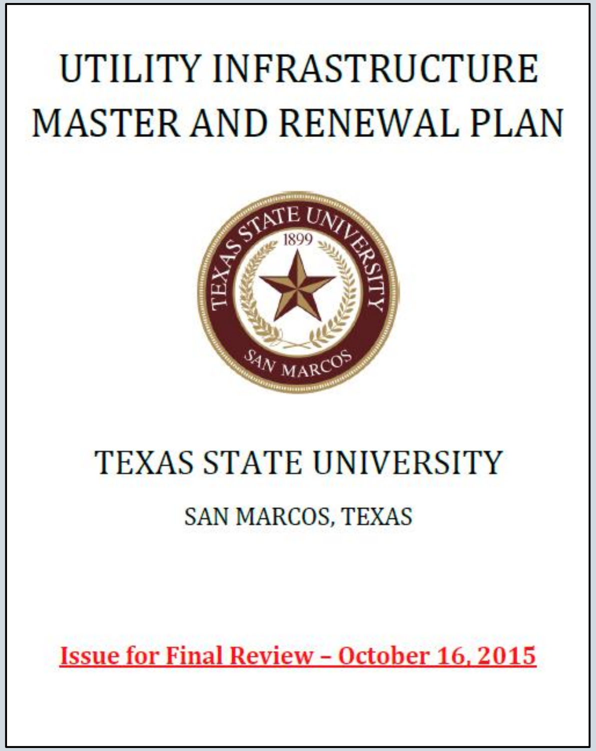
<u>2017</u>: Campus Master Plan Update completed

<u>2017</u>: Utility Infrastructure Master Plan update

Texas State University: Utility Master Plan

- Scope is based on utilities department’s **Statement of Vision** and **Key Characteristics**:

The purpose of the campus utility infrastructure is to provide users with living, learning, and research spaces that are safe, useful, and comfortable. These utility services must be provided while also considering impact on the surrounding natural and human environments and fiscal responsibilities. Condition and operation of the utility infrastructure systems should support the campus’s “Sustainable Stewardship” initiatives and should embody the following key characteristics: ***safety, efficiency, effectiveness, resiliency, redundancy, sustainability, and transparency.***


UTILITY INFRASTRUCTURE
MASTER AND RENEWAL PLAN

TEXAS STATE UNIVERSITY
SAN MARCOS
1899

TEXAS STATE UNIVERSITY

SAN MARCOS, TEXAS

Issue for Final Review – October 16, 2015

Texas State University: Utility Master Plan

- Current plan contains 120+ utility projects
  - Includes 6 “major” multi-discipline projects
    - New utility corridors
    - New thermal plant
    - Major electrical improvements
  - Document references previous studies
  - Summarizes “Guiding Principles” for utility development on campus

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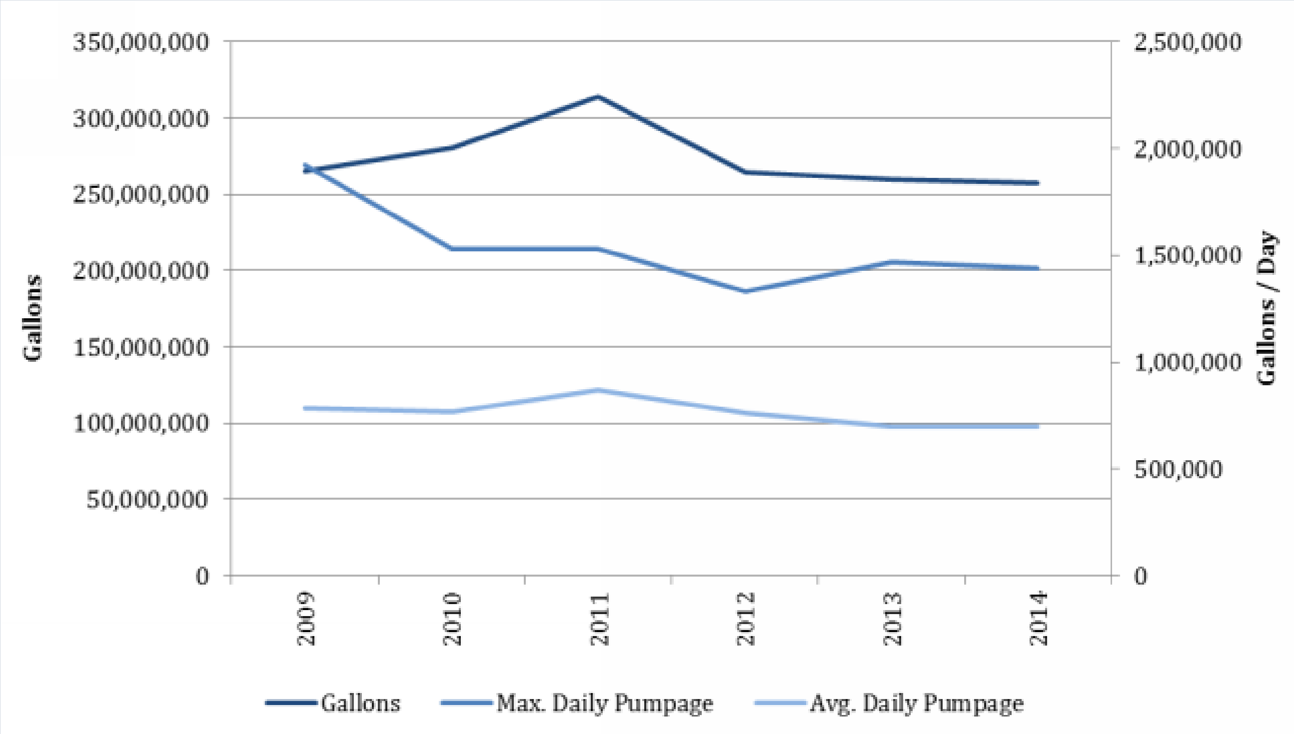


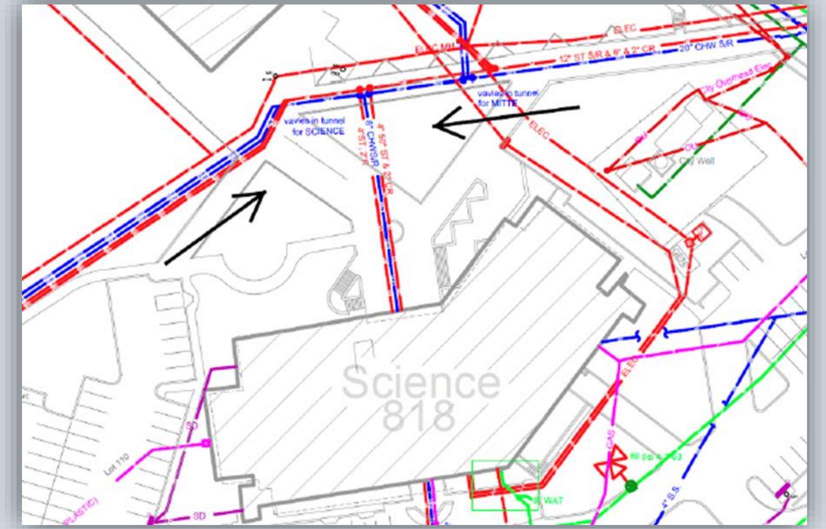
Texas State University: Benefits Realized

5 years of utility planning on campus has shown tangible results:

- Risk Management: Need for additional domestic water source identified
  - Operational Improvement: Conservation efforts have postponed initial timeline

Texas State University: Benefits Realized

- Risk Management: Need for reliability improvements at critical research facilities required
- Operational Improvement: Major electrical improvements justified, planned, designed, and executed
- Operational Improvement: Facilities with 2 chilled water sources increased by 50% through planned bypass installations

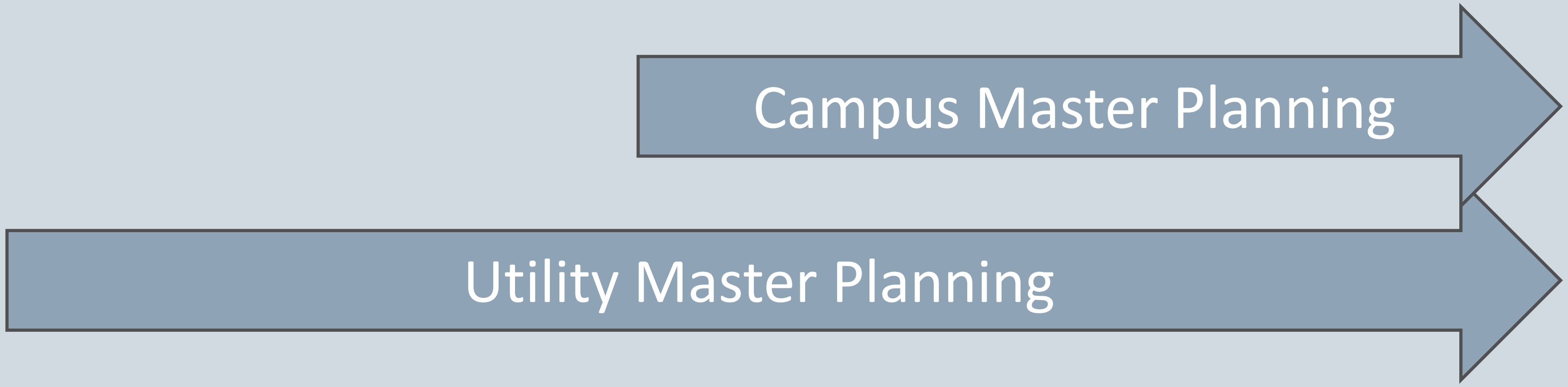


Texas State University: Benefits Realized

- <u>Other Long-Range Planning Successes</u>:
  - Critical new utility corridor now being designed. Capital project construction will be leveraged to share cost.
  - Installation of additional chillers has been deferred due to planned interconnections of plant distribution.
  - 1,000s of feet of chilled water, steam, and condensate piping replaced.

Texas State University: Timing

- Beginning the Utility Planning process in advance of campus planning provided several benefits:
  - Allowed for appropriate focus on utilities-specific issues.
  - Helped to ensure utility issues were included in campus master plan.
  - Magnitude of required improvements may already by understood.
  - Limiting factors on development / triggers for improvements may be known.



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Potable Water: Extend potable water piping to plant from City Park Stre
water piping crossing over the San Marcos River.

Storm Water: Provide site storm water modifications due to new construct

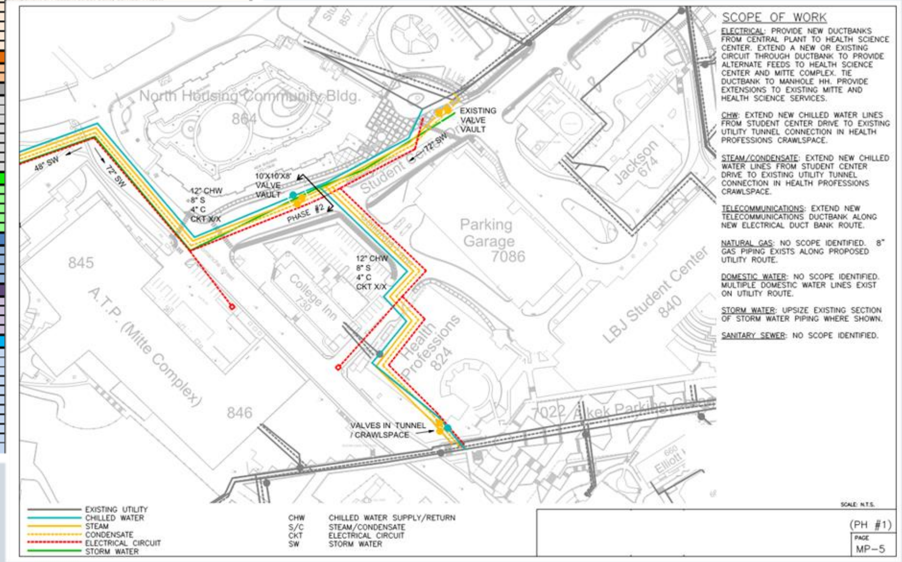
Sanitary Sewer: Extend sanitary sewer piping from plant to Jowers sanitary

Estimated Cost:

- $2M (ROM)

FIGURE 12: CHARLES AUSTIN STREET PLANT WORK AREA

STEAM SYSTEM	Est. Cost	Funding	Years	Start	Complete		Project Reference	Notes
North Commons Steam & Condensate Piping Replacement	$ 400,000	Renewal	1	2018	2019	A	Hydraulic Model & Condition Assessment Update	
South Commons Steam & Condensate Piping Replacement	$ 200,000	Renewal	1	2018	2019	A	Hydraulic Model & Condition Assessment Update	
Steam Trap Survey and Repairs to Increase Condensate Return	$ 175,000	Renewal	1	2020	2021	A	Steam System Study / UIMP: 2012-2022	
Repair Central Plant 2nd DA Tank	$ 75,000	Renewal	1	2020	2021	A	Steam System Study	
Boiler Plant Renovation	$ 150,000	Renewal	1	2020	2021	A	Steam System Study	
Manhole Safety Improvements	$ 200,000	Renewal	5	2017	2022	A	Steam System Study	
General Steam Distribution Piping Repairs	$ 10,000,000	Renewal	10	2017	2027	A	Hydraulic Model & Condition Assessment Update	
Pickard Street Utility Corridor - Steam & Condensate Piping	$ 1,000,000	Capital	1	2018	2019	A	None	Component of Pickard Street Utility Corridor Project
Pleasant Street Utility Corridor - Steam & Condensate Piping	$ 500,000	Capital	1	2021	2022	B	None	Component of Pleasant Street Utility Corridor Project
Woods Street Utility Corridor (West) - Steam & Condensate Piping	$ 1,100,000	Capital	1	2017	2018	A	Hydraulic Model & Condition Assessment Update	
Woods Street Utility Corridor (East) - Steam & Condensate Piping	$ 1,300,000	Capital	1	2020	2021	A	Hydraulic Model & Condition Assessment Update	
Student Center Drive Utility Corridor (Phase 1) - Steam & Condensate Piping	$ 800,000	Capital	2	2022	2024	B	Hydraulic Model & Condition Assessment Update	
Student Center Drive Utility Corridor (Phase 2) - Steam & Condensate Piping	$ 1,200,000	Capital	2	2024	2026	B	Hydraulic Model & Condition Assessment Update	
HOT WATER SYSTEM	**Est. Cost**	**Funding**	**Years**	**Start**	**Complete**		**Project Reference**	
Upgrade Jowers Heating Water System	$ 250,000	Capital	1	2018	2019	A	None	
PLANT & BUILDING AUTOMATION SYSTEMS	**Est. Cost**	**Funding**	**Years**	**Start**	**Complete**		**Project Reference**	
Building Chilled Water & Steam Metering Projects	$ 900,000	Renewal	3	2018	2021	A	Hydraulic Model & Condition Assessment Update	
Cogen Plant Steam/Condensate Metering Project	$ 150,000	Renewal	1	2017	2018	A	Steam System Study	
Distribution Loop Steam/Condensate Metering Project	$ 200,000	Renewal	2	2017	2019	A	Steam System Study	
Update Campus Building Automation System Platform	$ 2,000,000	Renewal	1	2020	2021	A	None	
Upgrade to Industrial Grade Control System at Thermal Utility Plants	$ 1,000,000	Renewal	1	2019	2020	A	None	
Implement Central Plant Optimization Strategies	$ 500,000	Renewal	2	2020	2022	A	None	
Building HVAC DDC Upgrades	$ 1,173,000	Renewal	4	2017	2021	A	Energy Audit Report	
ENERGY CONSERVATION	**Est. Cost**	**Funding**	**Years**	**Start**	**Complete**		**Project Reference**	
UtilVisor and Energy Consumption Dashboard Implementation	$ 300,000	Capital	2	2018	2020	A	None	
HVAC Building Renovations (Energy Conservation Project)	$ 512,000	Renewal	4	2017	2021	A	Energy Audit Report	
Lighting Upgrades	$ 1,327,000	Renewal	5	2017	2022	A	Energy Audit Report	
PC Power Management	$ 52,000	Renewal	1	2018	2019	A	Energy Audit Report	
WATER MANAGEMENT	**Est. Cost**	**Funding**	**Years**	**Start**	**Complete**		**Project Reference**	
Water Metering	$ 300,000	Renewal	3	2018	2021	A	Recovered Water System Analysis	
Plant Water Treatment	$ 1,000,000	Capital	10	2017	2027	A	None	
Low Flow Aerators	$ 5,000	Renewal	2	2018	2020	A	Energy Audit Report	
RECLAIMED WATER SYSTEM	**Est. Cost**	**Funding**	**Years**	**Start**	**Complete**		**Project Reference**	
Install Service Entrance Vault at South Chill Plant	$ 50,000	Capital	1	2017	2018	A	None	
Extend Piping to East Plant	$ 200,000	Capital	1	2017	2018	A	None	
Extend Piping to Central Plant	$ 400,000	Capital	1	2018	2019	A	None	
POTABLE WATER	**Est. Cost**	**Funding**	**Years**	**Start**	**Complete**		**Project Reference**	
Conduct tank inspections for Standpipe	$ 50,000	Renewal	1	2017	2018	A	Potable Water Study	
Complete tank inspections for elevated storage tank	$ 50,000	Renewal	1	2017	2018	A	Potable Water Study	
Develop a Plan for Temporary Removeal of Standpipe and Elevated Storage Tank from Service	$ 50,000	Renewal	1	2017	2018	A	Potable Water Study	
Prepare a contingency plan for treatment of well water using membrane filtration	$ 50,000	Renewal	1	2017	2018	A	Potable Water Study	
Recoat surfaces of the Standpipe	$ 200,000	Renewal	1	2022	2023	B	Potable Water Study	
Recoat surfaces of the Elevated Storage Tank	$ 450,000	Renewal	1	2022	2023	B	Potable Water Study	
Install Additional Transfer Pump	$ 200,000	Capital	1	2022	2023	B	Potable Water Study	
Jackson Well Pump Electrical Repairs	$ 100,000	Renewal	1	2017	2018	A	Potable Water Study	
Jackson Well Pump Security Upgrades	$ 25,000	Renewal	1	2017	2018	A	Potable Water Study	
Existing Water Well Upgrades	$ 47,500	Renewal	3	2018	2021	A	Water Well Report	



QUESTIONS?

EEA CONSULTING ENGINEERS

TEXAS STATE UNIVERSITY

Thank you!

Seminar Evaluation

We hope you enjoyed this session…

Please take a moment to complete the evaluation form.

Thank you!