Pushing Boundaries:
CHW Master Planning at University of Denver

February 10-14, 2020

Lynn Bailey, P.E.
Jeff Easton, P.E.
Agenda:

- Campus Background
- Existing System
- CHW Analysis
- Recommendations
- Putting into Practice
University of Denver (DU)

- Founded in 1864 as Colorado Seminary in the Colorado Territory
- 3.8 million square feet over 125 acres in the City of Denver
- 11,500 students & 3,800 staff/faculty
- Campus is a working Arboretum
- Great Private University dedicated to the Public Good
- 18 of 88 Buildings on Central Plant (Sturm Hall)

University Hall: 1864

Engineering/Computer Science: 2017
Existing CHW Distribution
Existing CHW Production
Future Growth
CHW Analysis:

1. Quantify existing situation
2. Forecast load growth
3. Future Recommendations

Goal: Provide reliable CHW service in the future with minimal campus disruption
CHW Analysis:

1. Quantify existing situation
   a) As-builts
   b) Existing data
   c) Additional metering
CHW Analysis:

PVC Piping

- Performs differently than steel
- Surge pressure calculations
- Sudden shutdown driving case
- Higher velocities possible
- Approach carefully!
CHW Analysis:

2. Forecast load growth

<table>
<thead>
<tr>
<th>Campus Framework Phase</th>
<th>Building Name</th>
<th>GFS</th>
<th>Flow (GPM)</th>
<th>Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1B*</td>
<td>Sturm Renovation</td>
<td>47,718</td>
<td>254</td>
<td>149</td>
</tr>
<tr>
<td></td>
<td>Community Commons</td>
<td>132,000</td>
<td>707</td>
<td>413</td>
</tr>
<tr>
<td></td>
<td>Driscoll South Renovation</td>
<td>4,972</td>
<td>24</td>
<td>16</td>
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<tr>
<td></td>
<td>Mary Reed</td>
<td>77,293</td>
<td>414</td>
<td>414</td>
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<tr>
<td><strong>Phase 1B Subtotal:</strong></td>
<td></td>
<td><strong>261,983</strong></td>
<td><strong>1,399</strong></td>
<td><strong>992</strong></td>
</tr>
<tr>
<td>Phase 2A</td>
<td>Central Campus Academic Facility</td>
<td>130,425</td>
<td>699</td>
<td>408</td>
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<tr>
<td>Phase 3A</td>
<td>Graduate Psychology Clinic</td>
<td>115,200</td>
<td>617</td>
<td>360</td>
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<tr>
<td>Future Buildings</td>
<td>Anderson Academic Commons</td>
<td>142,990</td>
<td>513</td>
<td>299</td>
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<tr>
<td></td>
<td>Shwayder Art Renovation</td>
<td>62,540</td>
<td>335</td>
<td>195</td>
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<td></td>
<td>Frontier Hall</td>
<td>43,920</td>
<td>275</td>
<td>83</td>
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<tr>
<td><strong>Future Buildings Subtotal:</strong></td>
<td></td>
<td><strong>249,450</strong></td>
<td><strong>1,123</strong></td>
<td><strong>577</strong></td>
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<tr>
<td><strong>Total:</strong></td>
<td></td>
<td><strong>757,058</strong></td>
<td><strong>3,838</strong></td>
<td><strong>2,337</strong></td>
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*Near-term buildings are Phase 1B
International District Energy Association

CampusEnergy2020
The Power to Change
February 13-14, 2020, Denver, CO

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Flow Modeling
Recommendations

Chilled Water Capacity (Tons)

Existing Phase 1B Phase 2A Phase 3A Future

CH-1 CH-1 CH-1 CH-1 CH-1

1B CH-1 1B CH-2 1B CH-1 1B CH-2 1B CH-2

2B CH-1 2B CH-2 2B CH-1 2B CH-2 2B CH-2

FUTURE CH-1

CH-3 CH-3 CH-3 CH-3 CH-3

1B CH-2 1B CH-2 1B CH-2 1B CH-2 1B CH-2

2B CH-1 2B CH-1 2B CH-1 2B CH-1 2B CH-1

FUTURE CH-1

CH-2 CH-2 CH-2 CH-2 CH-2

CH-1 CH-1 CH-1 CH-1 CH-1

Future

-500 -1,000 -1,500 -2,000 -2,500 -3,000 -3,500 -4,000 -4,500 -5,000

Chilled Water Capacity (Tons)

Existing Phase 1B Phase 2A Phase 3A Future

CH-1 CH-1 CH-1 CH-1 CH-1

1B CH-2 1B CH-2 1B CH-2 1B CH-2 1B CH-2

2B CH-1 2B CH-1 2B CH-1 2B CH-1 2B CH-1

FUTURE CH-1

CH-3 CH-3 CH-3 CH-3 CH-3

1B CH-2 1B CH-2 1B CH-2 1B CH-2 1B CH-2

2B CH-1 2B CH-1 2B CH-1 2B CH-1 2B CH-1

FUTURE CH-1

CH-2 CH-2 CH-2 CH-2 CH-2

CH-1 CH-1 CH-1 CH-1 CH-1

Future
Recommendations

- Short-term chiller additions
- Distribution and Plant additions installed with long-term growth
- Bi-directional pumping
- South Campus Loop
## Putting into Practice: South Loop Summary

<table>
<thead>
<tr>
<th>BUILDING NAME</th>
<th>GSF</th>
<th>LOAD (TONS)</th>
<th>FLOW (GPM)</th>
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</thead>
<tbody>
<tr>
<td>Boettcher Center</td>
<td>49,296</td>
<td>74</td>
<td>183</td>
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<tr>
<td>Engineering and Computer Science Building</td>
<td>129,600</td>
<td>405</td>
<td>972</td>
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<tr>
<td>Newman Center for the Performing Arts</td>
<td>181,298</td>
<td>567</td>
<td>1,360</td>
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<tr>
<td>Olin Hall</td>
<td>41,000</td>
<td>128</td>
<td>308</td>
</tr>
<tr>
<td>Seeley Mudd Science Building</td>
<td>64,770</td>
<td>202</td>
<td>486</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>465,964</strong></td>
<td><strong>1,376</strong></td>
<td><strong>3,309</strong></td>
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</table>
Putting into Practice:
South Loop Summary
Questions?

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