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U.S. Green Building Council – Missouri Gateway Chapter  
www.usgbc-mogateway.org | 314.577.0854

Missouri Botanical Garden Commerce Bank Education Center

LEED: EXISTING BUILDINGS  
OPERATIONS & MAINTENANCE

Transforming the Built Environment
INTRODUCTIONS

• Who are we?
  – Nick Bristow
    Senior Project Engineer, Forum Studio
    • LEED coordinator on numerous projects
    • WE Team- CBEC
Category Overview | Water Efficiency
Credit X Credit Investigation
Review

Missouri Botanical Garden Commerce Bank Education Center

WATER EFFICIENCY CLASS OVERVIEW

Transforming the Built Environment
WATER EFFICIENCY
CATEGORY OVERVIEW

- Prerequisites
- Credits
- Resources

Transforming the Built Environment
CATEGORY OVERVIEW

IS YOUR BUILDING QUALIFIED?

• Prerequisites
  • WEp1 Minimum Indoor Plumbing Fixture and Fitting Efficiency
IS YOUR BUILDING QUALIFIED?

• **Water Efficiency Credits (WEc)**
  - ✓ **WEc1** Water Performance Measurement
  - ✓ **WEc2** Additional Indoor Plumbing Fixture and Fitting Efficiency
  - ✓ **WEc3** Water Efficient Landscaping
  - ✓ **WEc4.1** Cooling Tower Water Management, Chemical Management
  - × **WEc4.2** Cooling Tower Water Management, Non-Potable Water Sources
• Resources
  Time
  Money
  Teamwork
  LEED

WATER EFFICIENCY CATEGORY OVERVIEW

Transforming the Built Environment
CATEGORY OVERVIEW

RESOURCES. WHAT DID IT REALLY TAKE?

• Time
  – Building Tours
    • Informal interviews with key building personal & Stakeholders, and building walk through
    • Review all drawings, reference guide, LEEDonline, etc.
    • Walk building again with stakeholders and new questions
  – Manual meter readings
RESOURCES. WHAT DID IT REALLY TAKE?

• Money
  – Building already has efficient plumbing fixtures
  – Sub-meter calibration
  – We were able to identify areas for potential improvement
CATEGORY OVERVIEW

RESOURCES. WHAT DID IT REALLY TAKE?

- The Water Efficiency Team
  Admo Ogun
  Rakesh Mora | Scott Schweiger | Nick Bristow

- Team meetings
- The Cloud via Dropbox
- Early Finish

Transforming the Built Environment
RESOURCES. WHAT DID IT REALLY TAKE?

• Key Players & Stakeholders
  – Horticulture Staff
    • Plant identification and planting history
  – Maintenance Staff
    • Tracking down pipes and meters
    • Taking weekly meter readings
Transforming the Built Environment

RESOURCES. WHAT DID IT REALLY TAKE?

• LEED Specific
  – Existing Documents
    • Monsanto Center LEED EB:O&M
    – LEED EB:O&M Reference Guide
    – LEEDUser.com
CATEGORY OVERVIEW

RESOURCES. WHAT DID IT REALLY TAKE?

• LEED Online
  – Log In…
    • Familiarize Yourself Ahead of Time
    • Figure Out THE GOAL
      – not always the same as understanding the goal
    • Work Backwards
  – Required Documentation?
  – Performance Period | YES/NO?
    • A specific timeframe allowed for measurement.
  – Who Signs off on the Documents?

Transforming the Built Environment
LEED ONLINE

Transforming the Built Environment
CREDITX CREDIT

HOW DID WE DO IT? WHAT DID WE DO?

• How did we do it?
  – Credit Analysis
    • Policy
    • Program
    • Plan
  – Scorecard

<table>
<thead>
<tr>
<th>MBG/CBEC LEED EBOM Certification</th>
<th>Points Attempted</th>
<th>Plan</th>
<th>Policy</th>
<th>Program</th>
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<td>3WE c1.0 Water Performance Measurement</td>
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<td>N</td>
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<tr>
<td>3WE c4.2 Cooling Tower Water Management-Non-Potable Water Source Use</td>
<td>0</td>
<td>N</td>
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<td>N</td>
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<tr>
<td>Credit</td>
<td>Points Attempted</td>
<td>Plan</td>
<td>Policy</td>
<td>Program</td>
</tr>
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<td>---------</td>
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<td>Y</td>
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<td></td>
<td>N</td>
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</table>
HOW DID WE DO IT? WHAT DID WE DO?

• How did we do it?
  – Volunteers
  – Teamwork
    • Monthly Meetings
    • A few offsite meetings
    • Plan Writing & Revising
    • Area Takeoff/Calculations

• MBG Monsanto Center Plans & Programs
**How Did We Do It? What Did We Do?**

- **WEp1 Minimum Indoor Plumbing Fixture and Fitting Efficiency**

- **Credit Intent & Requirements**
  - Reduce the burdens on water supply and wastewater systems.
  - Plumbing installed 1994 or later: baseline is 120% of reference codes.
  - Plumbing installed before 1994: baseline is 160% of reference codes.
  - Implement a policy requiring economic assessment of future plumbing renovations.
### WEp1 Minimum Indoor Plumbing Fixture and Fitting Efficiency

<table>
<thead>
<tr>
<th>Fixture</th>
<th>UPC/IPC Standards</th>
<th>EPA WaterSense Standards</th>
<th>Currently Installed</th>
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<tbody>
<tr>
<td>Water Closet</td>
<td>1.6 GPF</td>
<td>1.28 GPF</td>
<td>1.6/0.8 Dual flush</td>
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<tr>
<td>Urinal</td>
<td>1.0 GPF</td>
<td>0.5 GPF</td>
<td>0 GPF</td>
</tr>
<tr>
<td>Public Lavatory Faucet</td>
<td>0.5 GPM</td>
<td></td>
<td>1.5 GPM</td>
</tr>
<tr>
<td>Private Lavatory Faucet</td>
<td>2.2 GPM</td>
<td>1.5 GPM</td>
<td>N/A</td>
</tr>
<tr>
<td>Kitchen/Janitorial Sink</td>
<td>2.2 GPM</td>
<td></td>
<td>2.2 GPM</td>
</tr>
<tr>
<td>Shower</td>
<td>2.5 GPM</td>
<td></td>
<td>2.5 GPM</td>
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</tbody>
</table>
HOW DID WE DO IT? WHAT DID WE DO?

- **WEP1** Minimum Indoor Plumbing Fixture and Fitting Efficiency
  - Assessment of Existing Fixtures
WEp1 Minimum Indoor Plumbing Fixture and Fitting Efficiency

• Policy Development

Transforming the Built Environment
<table>
<thead>
<tr>
<th>Select</th>
<th>Display</th>
<th>Fixture ID¹</th>
<th>Fixture Family</th>
<th>Fixture Type</th>
<th>Total Daily Uses 2</th>
<th>Baseline (GPF)</th>
<th>Installed (GPF)</th>
</tr>
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<tr>
<td>Main Level</td>
<td>Main Level UsWC-1,2</td>
<td>Water Closet</td>
<td>HET, Dual Flush</td>
<td>102</td>
<td>1.6</td>
<td>1.2</td>
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<tr>
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<td>Main Level UsU-1</td>
<td>Urinal</td>
<td>Non-Water</td>
<td>57</td>
<td>1</td>
<td>0</td>
<td></td>
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<tr>
<td>Lower Level</td>
<td>Lower Level UWC-3</td>
<td>Water Closet</td>
<td>IPC/UPC (Conventional)</td>
<td>9</td>
<td>1.6</td>
<td>1.6</td>
<td></td>
</tr>
</tbody>
</table>

- **Total calculated flush fixture water use annual volume, baseline case (kGal):** 58.65
- **Total calculated flush fixture water use annual volume, performance case (kGal):** 34.2
- **Percent reduction of water use in flush fixtures (%):** 41.69
## CREDITX CREDIT

### Process Credits

<table>
<thead>
<tr>
<th>Fixture Groups</th>
<th>Flow Rate (GPM / GPC)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
</tr>
<tr>
<td>Main Level Main Level UsSH-1</td>
<td>2.5</td>
</tr>
<tr>
<td>Lower Level Lower Level USH-1</td>
<td>2.5</td>
</tr>
<tr>
<td>Main Level Main Level UsL-1</td>
<td>0.25</td>
</tr>
<tr>
<td>Lower Level Lower Level UL-1</td>
<td>0.25</td>
</tr>
<tr>
<td>Main Level Main Level UsS-1</td>
<td>2.2</td>
</tr>
<tr>
<td>Lower Level Lower Level US-1</td>
<td>2.2</td>
</tr>
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</table>

### Table

<table>
<thead>
<tr>
<th>Select</th>
<th>Display</th>
<th>Fixture ID</th>
<th>Fixture Family</th>
<th>Fixture Type</th>
<th>Total Daily Uses</th>
<th>Duration (Secs)</th>
<th>Baseline</th>
<th>Installed</th>
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</thead>
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<tr>
<td>Main Level</td>
<td>Main Level UsSH-1</td>
<td>Shower</td>
<td>IPC/UPC (Convention)</td>
<td>4.9</td>
<td>300</td>
<td></td>
<td>2.5</td>
<td>2.5</td>
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<tr>
<td>Lower Level</td>
<td>Lower Level USH-1</td>
<td>Shower</td>
<td>IPC/UPC (Convention)</td>
<td>0.3</td>
<td>300</td>
<td></td>
<td>2.5</td>
<td>2.5</td>
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<tr>
<td>Main Level</td>
<td>Main Level UsL-1</td>
<td>Public Lavatory Faucet</td>
<td>Metering</td>
<td>167</td>
<td>N/A</td>
<td></td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Lower Level</td>
<td>Lower Level UL-1</td>
<td>Public Lavatory Faucet</td>
<td>Metering</td>
<td>9</td>
<td>N/A</td>
<td></td>
<td>0.25</td>
<td>0.25</td>
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<tr>
<td>Main Level</td>
<td>Main Level UsS-1</td>
<td>Kitchen Sink</td>
<td>IPC/UPC (Convention)</td>
<td>49</td>
<td>15</td>
<td></td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Lower Level</td>
<td>Lower Level US-1</td>
<td>Kitchen Sink</td>
<td>IPC/UPC (Convention)</td>
<td>3</td>
<td>15</td>
<td></td>
<td>2.2</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Total calculated flow fixture water use annual volume, baseline case (kGal) = 34.4

Total calculated flow fixture water use annual volume, performance case (kGal) = 34.4

Percent reduction of water use in flow fixtures (%) = 0
### WEp1 Minimum Indoor Plumbing Fixture and Fitting Efficiency

Table WEp1-5. Flush & Flow Summary Statistics

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
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<tbody>
<tr>
<td>IPC/UPC baseline annual water use (kGal)</td>
<td>93.05</td>
</tr>
<tr>
<td>Number of fixtures substantially completed before 1993</td>
<td>0</td>
</tr>
<tr>
<td>Number of fixtures substantially completed in 1993 or later</td>
<td>42</td>
</tr>
<tr>
<td>LEED-EB: O&amp;M baseline multiplier (%)</td>
<td>120</td>
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<tr>
<td>LEED-EB: O&amp;M annual water use, baseline case (kGal)</td>
<td>111.66</td>
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<tr>
<td>Calculated annual water use, performance case (kGal)</td>
<td>68.6</td>
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<tr>
<td>Percent water use reduction in all fixtures (%)</td>
<td>38.56</td>
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</table>
HOW DID WE DO IT? WHAT DID WE DO?

WEp1 Minimum Indoor Plumbing Fixture and Fitting Efficiency

• Lessons Learned, Review, Comments:
  – Issues with lower level users with different fixtures
  – Metering faucet bonus
  – Showerheads identified as easy, effective upgrades
**CREDIT**

HOW DID WE DO IT? WHAT DID WE DO?

**WEc2 Additional Indoor Plumbing Fixture and Fitting Efficiency** {1-5 pts}

- Credit Intent & Requirements
  - Reduce the burdens on water supply and wastewater systems.

<table>
<thead>
<tr>
<th>Use less water than WEp1 baseline:</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% = 1 point</td>
</tr>
<tr>
<td>15% = 2 points</td>
</tr>
<tr>
<td>20% = 3 points</td>
</tr>
<tr>
<td>25% = 4 points</td>
</tr>
<tr>
<td>30% = 5 points</td>
</tr>
<tr>
<td>35% = 1 EP point</td>
</tr>
</tbody>
</table>
CREDITX CREDIT

HOW DID WE DO IT? WHAT DID WE DO?

WEc2 Additional Indoor Plumbing Fixture and Fitting Efficiency {1-5 pts}

• No additional documentation required beyond prerequisite documentation
• Achieved 5 points + 1 EP point

Transforming the Built Environment
HOW DID WE DO IT? WHAT DID WE DO?

WEc1 Water Performance Measurement {1-2 pts}

- Credit Intent & Requirements
  - Measure water use over time to understand patterns and identify opportunities for water savings
  - Option 1: Whole Building Metering {1 pt}
    - Permanently installed water metering that measures the total potable water use for the entire building (utility water meter)
    - Record meter readings at least weekly and compile monthly and annual summaries

Transforming the Built Environment
HOW DID WE DO IT? WHAT DID WE DO?

**WEc1 Water Performance Measurement** {1-2 pts}

- **Credit Intent & Requirements**
  - OR Option 2: Sub-metering {2 pts}
    - Meet requirements of Option 1
    - Sub-metering for 1 or more of the following:
      - Irrigation
      - Indoor plumbing fixtures and fittings
      - Cooling Towers
      - Domestic hot water
      - Other process water
    - Calibrate owned sub-meters at manufacturer’s recommended interval

Transforming the Built Environment
WEc1 Water Performance Measurement

– Building Details
  • 1 Utility meter for whole building
  • 1 Sub-meter installed with renovation
    – Initial thought: irrigation submeter only
  • No automated readings for either meter
HOW DID WE DO IT? WHAT DID WE DO?

WEc1 Water Performance Measurement

• Tracking Down Sub-meter
• Measures irrigation, cooling tower, and boiler water use
• Deduction Method
HOW DID WE DO IT? WHAT DID WE DO?

**WEc1 Water Performance Measurement**

- Performance Period: (4 Months)
  - Performance Period minimum is 3 months
  - Measured readings weekly during the 4 month performance period (Feb 1 through May 31)
CREDIT X CREDIT

HOW DID WE DO IT? WHAT DID WE DO?

WEc1 Water Performance Measurement

• Lessons Learned, Review, Comments:
  – Tried to pursue option 2, but sub-meter included dishwashers and water fountains
  – Sub-meter was not due for calibration, but needed calibration
  – Sub-meter was not read regularly or at all before performance period
  – More water was used than expected during the spring/summer months
WEc3 Water Efficient Landscaping {1-5 pts}

– Credit Intent & Requirements
  • Limit use of potable water or other natural water resources for landscape irrigation

– Option 1: Compare metered data to LEED Baseline
  • Calculate LEED Baseline by determining how much water would be consumed by conventional irrigation methods in mid-summer
  • Meter potable water and determine percent reduction
  • Requires sub-metering and performance period
WEc3 Water Efficient Landscaping {1-5 pts}

– Option 2: Theoretical calculations to estimate consumption

  • Estimate mid-summer irrigation by assessing site area and vegetation types and using provided factors to quantify site characteristics.
  • Use Estimated and baseline case to determine percent reduction
  • Same as LEED BD&C
  • This option was pursued
HOW DID WE DO IT? WHAT DID WE DO?

WEc3 Water Efficient Landscaping {1-5 pts}

– Option 3: Perform Irrigation assessment with Independent tools
  • Use irrigation performance and ranking tools based on local, regional, state or national sources to demonstrate reduction
HOW DID WE DO IT? WHAT DID WE DO?

**WEc3 Water Efficient Landscaping**

**Building Details**
- Original Landscaping and Irrigation plans available
- Entrance areas replanted with native plants (not reflected on plans)
- Site tour with Horticulture staff to identify plants and changes made

Transforming the Built Environment
WEc3 Water Efficient Landscaping

– Area Takeoff and identification of microclimate zones
HOW DID WE DO IT? WHAT DID WE DO?

WEc3 Water Efficient Landscaping

• Summary of differences
  – Baseline
    • Species Factor: Average
    • Changed prairie grass and perimeter mixed areas to turf grass
  – Design Case:
    • Species Factor: Low
HOW DID WE DO IT? WHAT DID WE DO?

**WEc3 Water Efficient Landscaping**

Table. Irrigation Design Case (July)

<table>
<thead>
<tr>
<th>Landscape Type</th>
<th>Area (sf)</th>
<th>k_s</th>
<th>k_d</th>
<th>kmc₁</th>
<th>K_L</th>
<th>ET₀</th>
<th>ETₗ</th>
<th>Irrigation Type</th>
<th>IE</th>
<th>CE</th>
<th>TWA (Gal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed (Perimeter)</td>
<td>13,545</td>
<td>0.2</td>
<td>1.1</td>
<td>1</td>
<td>0.22</td>
<td>0.19</td>
<td>0.0418</td>
<td>Sprinkler</td>
<td>0.625</td>
<td>1</td>
<td>565</td>
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<tr>
<td>Mixed (Perimeter)</td>
<td>6,248</td>
<td>0.2</td>
<td>1.3</td>
<td>1.4</td>
<td>0.364</td>
<td>0.19</td>
<td>0.06916</td>
<td>Sprinkler</td>
<td>0.625</td>
<td>1</td>
<td>431</td>
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<td>Shrubs (Building Area)</td>
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<td>1</td>
<td>0.5</td>
<td>0.1</td>
<td>0.19</td>
<td>0.019</td>
<td>Sprinkler</td>
<td>0.625</td>
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<td>45</td>
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<td>0.625</td>
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<td>1</td>
<td>0.1</td>
<td>0.19</td>
<td>0.019</td>
<td>Sprinkler</td>
<td>0.625</td>
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<td>138</td>
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<tr>
<td>Mixed (Parking Lot)</td>
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<td>1.4</td>
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<td>0.19</td>
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<td>296</td>
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<td></td>
<td></td>
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<td>1,645</td>
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Design total water applied (TWA) (gal) 1,645

Transforming the Built Environment
HOW DID WE DO IT? WHAT DID WE DO?

**WEc3 Water Efficient Landscaping**

**Table. Irrigation Baseline Case (July)**

<table>
<thead>
<tr>
<th>Landscape Type</th>
<th>Area (sf)</th>
<th>$k_s$</th>
<th>$k_d$</th>
<th>$k_{mc}^1$</th>
<th>$K_L$</th>
<th>$E_{T0}$</th>
<th>$E_{T_L}$</th>
<th>Irrigation Type</th>
<th>IE</th>
<th>TWA (Gal)</th>
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</thead>
<tbody>
<tr>
<td>Turf (Perimeter East)</td>
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<td>1</td>
<td>0.7</td>
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<td>0.133</td>
<td>Sprinkler</td>
<td>0.625</td>
<td>1,756</td>
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<td>Turf (Perimeter West)</td>
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<td>1</td>
<td>1.4</td>
<td>0.98</td>
<td>0.19</td>
<td>0.186</td>
<td>Sprinkler</td>
<td>0.625</td>
<td>1,184</td>
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<td>Shrubs (Building Area)</td>
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<td>1</td>
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<td>0.5</td>
<td>1</td>
<td>1.3</td>
<td>0.65</td>
<td>0.19</td>
<td>0.1235</td>
<td>Sprinkler</td>
<td>0.625</td>
<td>413</td>
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<tr>
<td>Turf</td>
<td>7,272</td>
<td>0.7</td>
<td>1</td>
<td>1</td>
<td>0.7</td>
<td>0.19</td>
<td>0.133</td>
<td>Sprinkler</td>
<td>0.625</td>
<td>943</td>
</tr>
<tr>
<td>Mixed (Parking Lot)</td>
<td>4,286</td>
<td>0.5</td>
<td>1</td>
<td>1.1</td>
<td>0.77</td>
<td>0.19</td>
<td>0.1463</td>
<td>Sprinkler</td>
<td>0.625</td>
<td>641</td>
</tr>
<tr>
<td>Total area</td>
<td>37,154</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Baseline Total Potable Water Applied (TPWA) (gal)</td>
<td></td>
<td>5,054</td>
</tr>
</tbody>
</table>
WEc3 Water Efficient Landscaping

• Lessons Learned, Review, Comments:
  – 67% Calculated Water Savings
  – Occupants were not aware of irrigation practices
  – Native plants do not require irrigation, could have achieved higher savings if some zones were cut and capped
    • Or could have shut off zones and compared against actual meter readings (Option 1)**
  – Coordinate with other teams on vegetated area
  – Room for improvement

Transforming the Built Environment
WEc4 Cooling Water Tower Management

– Credit Intent & Requirements
  • Reduce Potable water consumption for cooling tower
WEc4 Cooling Water Tower Management {1-2 pts}

• Option 1: Chemical Management {1pt}
  – Implement a water management plan addressing chemical treatment, bleed-off, biological control, and staff training
  – Install and maintain a conductivity meter and controls to automatically adjust bleed-off rates
WEc4 Cooling Water Tower Management {1-2 pts}

• (AND/OR) Option 2: Non-Potable Water Use {1pt}
  – Retrofit and/or maintain onsite cooling towers to use at least 50% non-potable water in makeup water
  – Install and/or maintain sub-meters to track potable and non-potable water for cooling tower makeup

• Why Not?
  – This option is rarely attempted due to the challenges associated with retrofitting an existing cooling tower to use non-potable water*
HOW DID WE DO IT? WHAT DID WE DO?

WEc4 Cooling Water Tower Management Details

- Plan was required
- Signatures required
- Everything else in place

Transforming the Built Environment
CLASS ACTIVITY!

Learning Activity
• Let’s see how easy it is to fill out a template and calculate water savings.

http://www.usgbc.org/sampleforms/Existing%20buildings/all/all
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