This presentation premiered at WaterSmart Innovations

watersmartinnovations.com
Evaluation of the Water Efficiency of zHome

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WaterSmart Innovations Conference
Michael Brent
Introduction

Cascade Water Alliance

- Suburban Seattle
- Serving 350,000 residents
- Provide water efficiency programs
- Municipal corporation – seven cities and water districts (Bellevue, Issaquah, Kirkland, Redmond, Sammamish Plateau and Skyway Water and Sewer Districts, Tukwila)
The zHome Project

- Ten-unit condominium in the Issaquah Highlands
- Ultra sustainable homes
- Constructed in 2010 – 11
- Occupancy in 2012 – 13
- Stakeholders
  - Ichijo Homes
  - City of Issaquah
  - Matt Howeland Development
  - Built Green
  - King County
  - Port Blakely Development
  - Puget Sound Energy
  - Cascade Water Alliance
What Makes A zHome?

- Energy – Zero net energy use
- Health – Low toxics
- Materials – Deep green construction
- Water – Goal of 71% reduction
Water Efficiency

- Rain water harvesting
- HE toilets, showerheads, faucets
- HE clothes washer, dishwasher
- Compost amended soils
- Native plants
- No lawn
zHome Fixtures and Appliances

- Caroma Sydney toilets (dual flush, WaterSense)
- Kohler Purest showerheads (1.5 gpm, WaterSense)
- Kohler Purest bathroom faucets (0.5 gpm, WaterSense)
- GE frontloading clothes washer (2.2 Cubic Feet, EnergyStar)
- Bosch Integra dishwasher (EnergyStar)
- Rainwater harvesting cistern (1,000 – 1,700 gallons)
  - Toilets
  - Clothes washer
Built Green Certification

- 5-Star rating
- First recipient of Emerald Green rating
WaterSense Certification

- All units certified
What Happened?

- Are the homeowners pleased with their WaterSense New Homes?
- Did the project achieve 71% reduction in municipal water use?
Survey of Residents

- In-Person Interviews
- Categories
  - Energy
  - Home Health
  - Green Materials
  - Water Efficiency
  - General Comments
# Fixtures and Appliances

<table>
<thead>
<tr>
<th>Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The toilet works well.</strong></td>
</tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Q2</th>
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</thead>
<tbody>
<tr>
<td><strong>The bathroom faucets work well.</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Q3</th>
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<tbody>
<tr>
<td><strong>The showerhead works well.</strong></td>
</tr>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Q4</th>
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</thead>
<tbody>
<tr>
<td><strong>The clothes washer works well.</strong></td>
</tr>
<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Q5</th>
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</thead>
<tbody>
<tr>
<td><strong>The dishwasher works well.</strong></td>
</tr>
<tr>
<td></td>
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</tbody>
</table>

Positive Responses = 87%
## Rainwater Harvesting

<table>
<thead>
<tr>
<th>Q6</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The cistern that supplies the toilet and clothes washer works well.</td>
<td>√√√</td>
<td>√√√√</td>
<td>√√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q7</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Neutral</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>The rainwater that comes from the cistern is relatively clean and odorless.</td>
<td>√√√√√√</td>
<td></td>
<td></td>
<td></td>
<td>√√√√√√</td>
</tr>
<tr>
<td>Q8</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Neutral</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>The cistern’s water supply lasts through the summer.</td>
<td>√√√</td>
<td>√√</td>
<td>√</td>
<td></td>
<td>√√√√√√</td>
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Positive Responses = 69%
# Landscaping

<table>
<thead>
<tr>
<th>Q9</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I don’t miss having a traditional grass lawn.</td>
<td>√√√√√√√√</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q10</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Neutral</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>I enjoy the native landscaping.</td>
<td>√√√√√√√√</td>
<td>√√</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q11</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Neutral</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>The rain gardens absorb and manage storm water runoff effectively.</td>
<td>√√√√√√√√</td>
<td>√√</td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

Positive Responses = 92%
## Values

<table>
<thead>
<tr>
<th>Q12</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conserving water is important to me.</td>
<td>✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓</td>
<td>✓</td>
<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Q13</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowing that my zHome uses less water, less energy, and was built with low toxicity/green building materials is important to me.</td>
<td>✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q14</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I enjoy living in my zHome.</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓</td>
<td>✓</td>
<td></td>
<td></td>
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</tbody>
</table>

Positive Responses = 96%
Fixtures

- Love the showerheads, plenty of flow.
- Bathroom faucets don’t always have enough pressure.
- Kitchen faucet is great.
- Water pressure for toilet refill seems low.
- The toilets work very well; like the dual flush features.
- Toilets don’t always clear the bowl, but no double flushes or clogs.
- Toilet stuck open once and drained the cistern.
- Like the central placement of the hot water heater.
Rainwater Harvesting – 1

- Cistern water was discolored because resident failed to clean cistern screen.
- The cistern ran out once due to the toilet fill valve being stuck open.
- Cistern capacity is adequate, but during the winter the pump in the cistern stopped the automatic function. Otherwise works well.
- The only complaint about the system here is that the pipe inside the cistern tank that supplies water to the house is uninsulated and it will freeze if there is sustained temperatures below freezing for a few days.
- Controller problem caused cistern water pump to run continuously.
- Birds were resting under Solar Panels, bird droppings may have contributed to poor quality cistern water.
General Comments

Rainwater Harvesting – 2

• Used municipal water to supplement cistern in July.
• Used municipal water to supplement cistern in August, 2013 and again in July, 2014.
• Had to use municipal water to supplement the cistern during summer of 2013.
• Water in clothes washer and toilet was a little dirty. Changed the filters (which was easy) and cleaned leaf screen and the water is better.
• Maintaining filters inside is sometimes an issue.
General Comments

Billing, Cost-Effectiveness

• Little connection between conservation and what I pay because of fixed cost.
• Little difference between the water bill from my zHome and my previous home, which had non-conserving fixtures and a large lawn.
• Water bills are not reduced because utility connection charge is the same.
• Being green doesn’t necessarily mean a financial advantage.
• Very little incentive to use less water since the cost per ccf is only a couple dollars. Very little financial incentive to install, use, and maintain a rainwater system when the base utility bill is over $150 and using less water only saves a couple dollars per ccf. Maintenance of the system alone costs much more than what could ever be saved ......
Average Daily / Per Capita Water Use

Unit #1

<table>
<thead>
<tr>
<th>Month</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
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<tbody>
<tr>
<td>Sept 2012</td>
<td>67</td>
<td>40</td>
<td>30</td>
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<tr>
<td>Nov 2012</td>
<td>75</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>Jan 2013</td>
<td>55</td>
<td>35</td>
<td>25</td>
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<tr>
<td>Mar 2013</td>
<td>40</td>
<td>25</td>
<td>15</td>
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<tr>
<td>May 2013</td>
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<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Jul 2013</td>
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<td>15</td>
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<td>Sept 2013</td>
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<tr>
<td>Nov 2013</td>
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<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Jan 2014</td>
<td>2</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Mar 2014</td>
<td>1</td>
<td>1</td>
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<tr>
<td>May 2014</td>
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<tr>
<td>Jul 2014</td>
<td>1</td>
<td>1</td>
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</table>
Average Daily / Per Capita Water Use
Unit #2

Municipal Water (Gallons)

Sept Nov Mar May Jul Sept Nov Jan Mar May Jul

2012 2013 2014
Average Daily / Per Capita Water Use
Unit #3

Municipal Water (Gallons)

Mar May Jul Sept Nov Jan Mar May Jul

2013 2014
Average Daily / Per Capita Water Use
Unit #4

Municipal Water (Gallons)

<table>
<thead>
<tr>
<th>May</th>
<th>Jul</th>
<th>Sept</th>
<th>Nov</th>
<th>Jan</th>
<th>Mar</th>
<th>May</th>
<th>Jul</th>
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2013 2014
Average Daily / Per Capita Water Use
Unit #5

Municipal Water (Gallons)

Nov Jan Mar May Jul Sept Nov Jan Mar May Jul

2012 2013 2014
Average Daily / Per Capita Water Use

Unit #7

Municipal Water (Gallons)

<table>
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<tbody>
<tr>
<td>Value</td>
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Graph showing the average daily per capita water use for Unit #7 from September 2012 to July 2014.
Average Daily / Per Capita Water Use

Unit #8

Municipal Water (Gallons)

Sept Nov Jan Mar May Jul Sept Nov Jan Mar May Jul

All Units – GPCD

Average = 18
What’s Good?

- Water efficiency is exceeding project goal
- Residents value water efficiency
- WaterSense New Homes recognition
- Fixtures and appliances working well
- No perception of sacrifice
- Extreme water efficiency is possible and practical
- Additional opportunities with green building
Not So Good

- Rainwater harvesting savings are less reliable than others.
- Rainwater harvesting requires more maintenance, education.
- Fixed connection charges are a disincentive to the success of WaterSense New Homes.
Next Steps

- Continue monitoring zHome
- Promote the success
- Pursue opportunities to promote WaterSense
  - Built Green
  - Habitat for Humanity
  - King County Housing Authority
Thank You!

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425.453.1810

Cascade Water Alliance
Water for today... and tomorrow