

High Performance Home Building Guide for Habitat for Humanity Affiliates



1 Holmes House built by TriState Habitat

Prepared by the Federation of American Scientists

October 1, 2010

Acknowledgments

This guideline was written by Lindsey Marburger, Federation of American Scientists, under contract to Lawrence Berkeley National Laboratory, with funding from the US Department of Energy's Building Technology Program. FAS would like to acknowledge and thank our Department of Energy program managers Edward Pollock, Terry Logee, and Samuel Taylor for their support and direction and our Lawrence Berkeley National Laboratory program manager Rick Diamond for his guidance, technical support, and for managing the contract.

Many thanks to David Beal and Janet McIlvaine from the Florida Solar Energy Center, Randy Wilkerson of TriState Habitat for Humanity, and Michael Baechler, Marye Hefty, and Theresa Gilbride from Pacific Northwest National Laboratory for their reviews and guidance. Thanks also to Ed Brown from Habitat for Humanity of Washington State for his contacts and insight and to all the Habitat affiliate staff who have contributed their time and invaluable perspective to this project.

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Summary

The purpose of this guide is to provide a roadmap to aid Habitat for Humanity affiliates in building high performing houses by using materials and techniques that are affordable, do not add any maintenance burden, and are volunteer friendly. This guide identifies key goals and elements necessary for achieving high performance construction and provides guidelines on how Habitat affiliates can achieve these goals without sacrificing their own goals of providing affordable, decent housing to families.

The guide is divided into 16 key element or steps, each of which is essential to building a higher performing house that uses safer, healthier, and more efficient materials, techniques, and processes.

Each of the 16 sections includes:

- recommendations on and priorities for improving building practice and decision making;
- an overview of the benefits to improving performance for that element;
- design guidelines and specifications;
- building process and evaluation guidelines and specifications;
- explanations of the available tools and their uses; and
- lists of resources available to achieve project goals.

Table of Contents

Table of Contents	4
Appendixes	4
How to Use this Guide.....	5
1. Become a Green Building Partner and Achieve Green Certification.....	6
2. Forming Partnerships	9
3. Education and Training.....	14
4. Integrated Design Process (IDP)	20
5. Quality Control Standards and Protocols	24
6. Construction Management Program (CMP) and Documentation.....	25
7. Compliance with Codes and Manufacturers Specifications	26
8. Cost Effectiveness.....	27
9. Construct to Maximize Habitat Advantages and Needs.....	29
10. Meet Needs of Family	30
11. Minimize Burden of Maintenance and Cost to Homeowners.....	32
12. Thermal Comfort and Indoor Air Quality	33
13. Materials.....	36
14. Location	39
15. Water Efficiency	44
16. Project Review, Evaluation, and Reporting	46
Profiles.....	49

Appendixes

1. Denver Metro Habitat Property Selection Matrix
2. Tacoma/Pierce County Habitat Eco-Charette Report

How to Use this Guide

Higher performing construction produces houses that are more sustainable, more affordable, safer, and healthier—positive attributes that can be achieved through improved techniques, processes, and materials. However, high performance construction is often relatively more expensive than standard construction. Because of this higher initial cost, high performance building is generally seen as not cost effective or realistic for the affordable housing market.

The purpose of this guide is to dispel this myth by providing a roadmap to aid Habitat for Humanity affiliates in building high performing houses by using affordable, volunteer friendly, materials and techniques. This guide identifies key goals and elements necessary to achieve high performance construction, and provides guidelines on how Habitat affiliates can achieve these goals without sacrificing their own goals of providing affordable, decent housing to families.

The guide is divided into 16 key element or steps, each of which is essential to building a higher performing house that uses, more efficient, safer, and healthier materials, techniques, and processes. Each of the 16 sections includes:

- recommendations on and priorities for improving building practice and decision making;
- an overview of the benefits to improving performance in that this element;
- design guidelines and specifications;
- building process and evaluation guidelines and specifications;
- explanations of the tools available to you and their uses; and
- lists of resources available to aid in achieving goals.

Many sections also contain one or more case studies of Habitat affiliates and Habitat affiliates who are building housing that is particularly sustainable, efficient, innovative, or in some way impressively high performing. At the end of this document are affiliate profiles of the ten affiliates interviewed for this guide. Each of the profiles contains the following data:

- basic information: name, location, and number of houses built
- high performance details: certifications, HERS scores, and partnerships
- main energy efficiency and high performance features and practices
- innovative practices
- recommendations from senior construction and green building staff members on how to improve your own affiliate's construction
- contact information for the staff member(s) interviewed in writing this guide

1. Become a Green Building Partner and Achieve Green Certification

Achieving green certification from a sustainable or high performance building program can be a valuable tool in constructing better quality, more affordable housing for your families. Pursuing green certification is also very educational as it encourages and requires experimentation with a multitude of high performance building techniques, materials, and technologies in order to find those that work best for your particular needs and climate. In addition, participation in green building programs can frequently be leveraged for additional federal or local funding and tax incentives, rendering the cost of a higher performing house equal to or less than the houses you are building now.

ENERGY STAR New Home

The ENERGY STAR New Home Program (www.Energystar.gov) is operated by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE). In most areas the basic requirement of ENERGY STAR certification is that the house achieves 15% energy savings over a typical existing home built to the International Residential Code. ENERGY STAR is an excellent program with which to begin your journey toward high performance housing as it focuses on energy efficiency, which is highly cost effective for families and can be achieved without expensive equipment and materials upgrades.

ENERGY STAR certification begins with reviewing information online about ENERGY STAR requirements and benefits and deciding whether to pursue the performance path or the prescriptive path (the Builders Option Package). This can be found at: http://www.ENERGYSTAR.gov/index.cfm?c=bldrs_lenders_raters.pt_bldr. Once you have decided on a path, the next steps are to sign up to become an ENERGY STAR partner and then to find a partner energy rater in your local area. Be aware that the Pacific Northwest, Hawaii, and Florida do not follow the standard ENERGY STAR path. If you are building in one of these areas you need to be aware of the different program requirements.

For detailed information about becoming an ENERGY STAR partner and having your project certified under the ENERGY STAR New Home program, see the following resources:

- A “how to” guide titled *Affiliate Steps toward Building ENERGY STAR Homes*: http://www.ENERGY STAR.gov/ia/partners/bldrs_lenders_raters/downloads/HFHFactSheet.pdf.
- The ENERGY STAR Partnership webpage (where you will find partner agreement forms and details): http://www.ENERGY STAR.gov/index.cfm?c=bldrs_lenders_raters.nh_join.
- To find a local ENERGY STAR Rater: <http://www.resnet.us/trade/find-raters-auditors>
http://www.energystar.gov/index.cfm?fuseaction=new_homes_partners.locator.

Note that some regional and state green building initiatives (such as the EarthCraft program) include ENERGY STAR certification as part of their certification. This means that by achieving their certification, you automatically receive ENERGY STAR certification as well. Contact your regional or state program for information on whether or not ENERGY STAR certification and requirements are included in their program.

Building America

DOE, its research teams, and the national laboratories operate the Building America program to conduct research through demonstration projects and production scale projects to provide builders with research results and guidance to construct homes that achieve energy savings of 40% higher than typical mid-1990s construction with the ultimate goal of making zero energy homes available to all Americans.

Building America has teamed with Habitat for Humanity through its Building America Industrialized Housing Partnership (BAIHP) research time on the design, construction, and evaluation of over 500 Habitat homes across the nation built by 50+ Habitat for Humanity affiliates in more than 20 states. BAIHP energy efficiency recommendations for Habitat homes need to meet four criteria to be successfully integrated into Habitat's construction process. They must be:

- Cost effective
- Volunteer friendly
- Readily available in current market
- Easily maintained and repaired

More information about BAIHP activities with Habitat, BAIHP partners, and case studies of Builders Challenge certified Habitat projects can be found at: <http://www.baihp.org/habitat/>.

Building America Builders Challenge Program

The DOE's Builders Challenge program is a high performance building and research program focused on quality control, energy efficiency, indoor air quality, and materials waste reduction. Builders Challenge certified houses must score a 70 or lower on the EnergySmart Home Scale (equivalent to a HERS 70) and meet the program's Quality Criteria, (http://www1.eere.energy.gov/buildings/challenge/pdfs/BuildersChallengeQualityCriteria_WEB.pdf) which specify several mandatory steps that must be included to qualify for the program. Partner builders receive both marketing and technical resources from the Building America program and the building research teams.

Builders can register to become a Builder Challenge partner and find out more information about what partnership entails here: <http://www1.eere.energy.gov/buildings/challenge/builders.html>.

NAHB Green Building Program

The NAHB Green Building Program is a program based on the ICC 700-2008 *National Green Building Standard*.

This green building standard has four levels for residential certification: bronze, silver, gold, and emerald, with emerald being the highest level. The program considers energy, water, and resource efficiency; lot design, preparation, and development; and occupation. An overview of the standard's requirements can be found at: <http://www.nahbgreen.org/Guidelines/ansistandard.aspx>. In order to see the full specifications and requirements of the program, you must purchase a copy of The National Green Building Standard, which can be found either through www.nahbgreen.org or through www.builderbooks.com (the cost is <\$40).

NAHB Green Building Program certification is achieved through partnership with an affiliated local green building program. These programs help coordinate verification services, oversee certification, and also

Green Certification NYC

New York City Habitat has been building green certified houses for over a decade, achieving both ENERGY STAR and LEED Gold certification. When starting the sustainable building and certification process, NYC Habitat recommends initially focusing on saving your families money through energy savings—a natural fit with the ENERGY STAR program and certification. Once your affiliate is comfortable meeting ENERGY STAR and building energy efficient, airtight houses, focus on introducing healthier building materials, especially into the interior of the houses. Once you have limited or eliminated VOCs and other toxins within the house, focus on practices and materials that are better for the environment. At this point, partner with and achieve certification from a green building program such as Builder's Challenge, NAHB Green Building, or LEED. NYC Habitat further recommends partnering with a good green consultant in achieving green certification as they can assist with paperwork and with answering questions and finding or obtaining resources. For example, research and consulting firm Steven Winter Associates, Inc. provides services to NYC Habitat that include third-party verification testing, design assistance, and answering technical question such as where to recycle drywall in New York City in order to reduce the waste stream as required for LEED certification.

offer educational services for interested builders (including Habitat affiliates). A list of local green building programs can be found at:
http://www.nahbgreen.org/WholsGreen/hba_findprogram.aspx.

To find out if your project is eligible for NAHB Green Building Program certification, use the online NAHB Green Scoring Tool. This online tool allows you to compare your project(s) to the National Green Building Standard and determine if a project is eligible for certification. You can also use the tool to make changes to existing projects and compare the scores of your various projects. However, always look for a local green building program before using the online tool as your local program may have slightly different standards from the national standards. You must register to use the tool, which can be done at:
<http://www.nahbgreen.org/ScoringToolRegistration.aspx>.

For those interested in both the NAHB Green Building Program and the Builders Challenge Program, a dual certification option is offered. To find out more about dual certification requirements and steps, see:
<http://www.nahbgreen.org/Guidelines/builderschallenge.aspx>.

And for anyone who has used this program before, note that the NAHB Model Green Home Building Guidelines will no longer be available after June 1, 2010 and all future projects should be designed to the National Green Building Standard.

LEED Affordable Housing

The Leadership in Energy and Environmental Design (LEED) for Homes Initiative for Affordable Housing is a program designed to recognize and address the inherent differences between affordable housing and market-rate housing. The programs' goals for houses include an energy savings of at least 20% over the code, sustainable materials selections, and quality control measures. An overview of this program can be found at:
<http://www.usgbc.org/ShowFile.aspx?DocumentID=3980>.

You can begin your path toward LEED for Homes by contacting a LEED provider in your state. The provider will be able to answer any questions you have and offer guidance on seeking LEED certification. Find a provider at:
<http://www.usgbc.org/DisplayPage.aspx?CMSPageID=147>.

Regional and Local Programs

There are a wide variety of local and regional sustainability programs throughout the country, some of which focus primarily on energy efficiency and some of which have broader sustainability goals. You may want to partner with and seek certification from one of these state, local, or regional programs as they are generally tailored toward the climate and resource specifications and needs of your local area. In addition, many of these

programs have a detailed knowledge of tax credits and discounts available in your area and offer practical resources to aid partners. For example, these programs often assist partners with house design; provide contact information for qualified third-party verifiers and other professionals; and aid partners in obtaining high performing products, materials, and services. In addition, some green building programs include ENERGY STAR certification as part of their program. By achieving this regional or local program certification, you achieve ENERGY STAR certification as well, which saves your time, paperwork, and money. Don't forget to ask about this!

A partial directory of green building programs, listed by state, can be found at:

<http://pathnet.org/sp.asp?id=20978>.

State Incentives

An additional resource to turn to is the Database of State Incentives for Renewable and Efficiency (DSIRE). DSIRE is a comprehensive source of information on state, local, utility and federal incentives and policies that promote renewable energy and energy efficiency. DSIRE is an ongoing project of the N.C. Solar Center and the Interstate Renewable Energy Council. Their website provides a quick source to find incentives to help offset the costs of high performance building. Find it here:

<http://www.dsireusa.org/index.cfm?EE=1&RE=1>.

A Tip from Other Affiliates:

Take the certification process slowly and in small steps. Don't necessarily start with Leadership in Energy and Environmental Design (LEED), a comprehensive and paperwork-intensive program likely requiring changing numerous aspects of your building and material/technology selection processes. Instead, start with an energy savings-only program, such as ENERGY STAR.

2. Forming Partnerships

Forming partnerships, especially with energy raters and energy design professionals, is arguably the most important resource in achieving your high performance and best practices building goals. Partnerships with manufacturers, utilities and other Habitat affiliates can be a valuable resource in moving forward.

Energy Raters

Why you need a rater?

At the most basic level, a rater does the independent quality control verification—including blower door and duct blaster tests—that provide a second (or third) set of eyes on the project, and are necessary for all green building certification programs. Partner raters for many programs also coordinate certification documentation and provide documentation assistance for clients and builder partners. Many raters, both those officially partnering with a green building program and independent raters, are experts on various green building programs; they can educate your affiliate on the differences between the programs and which programs will best suit the needs of your affiliate. Good raters will offer guidance on the best, most cost effective products and methods for meeting a given program's requirements; they can also provide technical support to help your affiliate meet your performance goals.

Rater Partnership

Addison Homes

Todd Usher of Addison Homes in Greenville, South Carolina has been involved with the Greenville Habitat affiliate as an energy efficiency consultant and 3rd party rater for over three years. The partnership began when Todd organized a visit for local affordable housing representatives to Earthcraft Atlanta and Atlanta Habitat to demonstrate to them the potential for high performance affordable housing. This trip proved the Earthcraft program and energy efficient building concept to Greenville Habitat's executive director, who agreed to partner with Addison Homes in achieving Earthcraft and ENERGY STAR certification. Addison Homes now certifies 15-20 of Greenville Habitat's homes as Earthcraft and ENERGY STAR, a process that includes performing energy modeling using REMRATE and carrying out blower door, duct blaster, and infrared inspection tests.

While not all Habitat affiliates have the benefit of a proactive local energy rater, in many areas raters and energy efficient consultants will provide subsidized services to Habitat if approached. And while the national ENERGY STAR rater database and regional or local green program rater databases are great resources for finding a certified rater, Todd suggests approaching raters in your area and proposing a partnership. In addition, Todd also recommends utilizing your network neighboring affiliates to find raters and other partners who may already be experienced in assisting Habitat affiliates in achieving green certification and improving their building practices.

Raters can be especially valuable in guiding your project design, including developing technical specifications for selecting materials and appliances, integrating advanced building techniques, and optimizing your design for climate appropriateness. In areas of the country that do not follow standard ENERGY STAR procedures, the rater will be a valuable source of information as to what the local program entails.

To find a rater willing and able to provide design and guidance services beyond basic verification, shop around, find raters who are partners with one or more green building programs, and ask other affiliates and builders for recommendations.

How do you find a rater?

The Residential Energy Services Network (RESNET) is one major rater certifying body and all raters certified to give a house a HERS score are required to be RESNET certified. You can find a directory of RESNET certified raters on their website at: <http://www.resnet.us/trade/find-raters-auditors>. RESNET has a partnership with the Building America Program and with Habitat for Humanity wherein volunteer raters give pro-bono rating services to Habitat affiliates. All volunteer raters participating in this Habitat partnership have the "Volunteer Energy Rater" emblem (see right) next to their names in the RESNET directory. More information on this partnership can be found here: <http://www.resnet.us/rater/partnership>.



If no raters in your area have the "Volunteer Energy Rater" emblem in the directory, contact neighboring affiliates, directly ask raters in your area if they are willing to volunteer their services, or inquire with representatives from your state Habitat office or local/regional green building program.

The ENERGY STAR New Homes program has a listing of ENERGY STAR partner raters who can act as third-party verifiers for your certification. In addition, many raters offer design and construction advice and assistance (on how, for example, to create an airtight building envelope). Contact the rater or look at their online information to find out what services they offer. The ENERGY STAR partner rater list can be found at: http://www.ENERGYSTAR.gov/index.cfm?fuseaction=new_homes_partners.locator.

You can also find ENERGY STAR raters through local green building programs, by contacting neighboring affiliates who are involved in green building certification, or through your local home builders association.

Other Partnerships

Other partnerships that can be useful to you in improving your building practice include green building program officials, green and energy efficiency consultants, manufacturers and distributors, utility companies, local technical schools, and other Habitat affiliates in your region.

State, Local, Utility and Federal Incentive Programs: There are many opportunities to find funding to support high performance building and green options. The Database of State Incentives for Renewables and Efficiency (DSIRE) is a comprehensive source of information on state, local, utility and federal incentives and policies that promote renewable energy and energy efficiency. Established in 1995 and funded by the U.S. Department of Energy, DSIRE is an ongoing project of the N.C. Solar Center and the Interstate Renewable Energy Council. Their website provides a quick source to find incentives to help offset the costs of high performance building. <http://www.dsireusa.org/index.cfm?EE=1&RE=1>.

Consultants: Green and energy efficiency consultants tend to be expensive, but may be worth the investment if you can find national or local grants to pay for or subsidize their cost. These consultants can help you find green materials, products, and services, offer advice on high performance building practices, and help you find the third-party verifiers and other professionals needed to obtain certification. They are especially useful when seeking a certification such as LEED that is complex and demanding in terms of documentation and project requirements.

Manufacturers and Distributors: Manufacturers and distributors can be a great resource in reducing your construction costs and upgrading your technology and materials as they can provide donated or discounted materials and products.



2 Donated Blown in Blanket System®--
TriState Habitat

Before seeking out new manufacturing partners, remember to take advantage of existing national partnerships such as Habitat's partnership with Home Depot, which provides donated materials to Habitat affiliates. Check myHabitat.org for information on national retail and manufacturing partners, what products or services they provide, and how your affiliate goes about acquiring the donation or discount.

You may also want to approach local manufacturers and suppliers/distributors about forming a partnership through which you acquire discounted or donated materials or technologies. These partnerships can and should be developed to be mutually beneficial. From the supplier's end, the donation or discount is generally tax deductible to them and an association with Habitat may be valuable for their reputation and as a source of advertising—consider offering free publicity and advertising to partners on your website, at the jobsite, and/or in printed materials. From the affiliate perspective, a local supplier partnership where the supplier donates or discounts products or services for your affiliate will save you money and will enable you to utilize higher performing products than would otherwise be cost effective. These in-kind donations are especially useful and

quite possibly necessary when experimenting with advanced building materials or when upgrading to expensive equipment and systems such as high-SEER HVAC systems or solar, heat pump, or gas tankless hot water heaters.

When you approach manufacturers or suppliers about forming a partnership, be specific about what products you want to utilize in your project, how the product(s) will benefit the homeowners and the affiliate, and why donating or selling the product to you at a discounted price will benefit their company.

Consider the following questions in seeking manufacturing or distribution partnerships: Why this product? Are there any current government tax credits or subsidies that cover or significantly reduce the price of this product to your affiliate? Why from this manufacturer/retailer/supplier? How does using this product fit into your mission? How much, if any, money would this save your family on operating costs? Does using this product over a second-best option have any non-monetary benefits to the family? Why should the company donate/subsidize this product? What are the benefits to them? Can your affiliate offer a valued service to the company, especially in the form of advertising (put their name on your website, in publications, at the construction site)? Is a partnership with this company sustainable or would it last only for this project? If only for one project, is it worth the time spent recruiting this partner?

Utility Companies: Utility companies in your area may be willing to provide services and resources for your affiliate and for ongoing monitoring and improvement of your projects' energy efficiency. Common services include meter-level monitoring and reporting, and technical assistance in training staff on energy efficiency issues, and sharing educational materials for homeowner and staff training. Many utilities offer home energy audits and some can do ENERGY STAR ratings for new homes in their service area.

Smart metering technologies enable you to perform real-time energy use modeling that will allow you to analyze the affect on energy use of your various high performance upgrades and house plans. In this way you can verify the cost effectiveness of each experiment and decide which experiments to integrate into future projects. If your local utility is moving toward smart metering or already has the capacity to smart meter, try suggesting that your affiliate be a smart metering pilot or early adapter—a mutually beneficial arrangement that will provide both your affiliate and the utility company with valuable data.

Utilities Partnership

Danville Utilities

The City of Danville, Virginia is the utility provider for the city and surrounding area through city-owned Danville Utilities. The utility has become very interested in energy conservation on both the new and existing homes side. Winter utility bills often reach \$500-600 per month in older neighborhoods, so the utility has begun providing technical support and funding for research into how Danville residents can save energy. They have partnered with Danville Habitat in their community outreach efforts by providing homeowner education materials, teaching the energy efficiency section of the homeowner curriculum, providing utility data, and purchasing the EPA homeowner energy efficiency guide for Habitat families. In addition, this past year Danville Utility provided Habitat with a grant that enabled the affiliate to install an 18.6 SEER heat pump, a tankless hot water heater, ENERGY STAR fans, and insulation that exceeded Earthcraft Virginia/ENERGY STAR requirements. Habitat and Danville Utilities have also begun a mutual conversation about how to reach out to the community and how to better educate the community about energy efficiency.

Some utility companies also offer discounts on ENERGY STAR rated thermostats and other energy saving products—inquire with the utility and utilize these discounts if they are available. In cases where your local utility company is owned by the city or town in which your house will be built, the city utility may also be willing to reduce or eliminate tie-in and other utility fees in exchange for your willingness to partner on the utility's community energy efficiency outreach campaigns. Consider the following mutually beneficial partnerships: allowing the utility to utilize your high performing house for community education through an open house or temporary education workshop or program; piloting smart metering; or retrofitting existing, derelict houses within city limits. In exchange for your partnership consider seeking discounted or donated energy saving technologies, discounted or free utility tie-in services, and/or educational programs and materials for your employees and homeowners.

Nearby Affiliates: By developing partnerships with other Habitat affiliates, especially neighboring affiliates, you have the opportunity to share resources, designs, materials, and best practices. Doing so will not only improve your own projects, but allow you to share your knowledge, experiences, and connections with other local affiliates. One model for these partnerships would be to set up informal meetings and collaborations between neighboring affiliates. Avenues for finding affiliates in your local area building to high performance standards include:

- asking your Habitat State Support Organizations staff;
- looking at Habitat profiles from the Building America Builders Challenge Program, found at:
<http://apps1.eere.energy.gov/buildings/publications/>;
- researching participants in the Home Depot Partners in Sustainable Building program; and
- scrolling for frequent posters on high performance building topics on the my.habitat.org discussion forums and knowledge center.

A second model, one based on the regional Habitat summits/workshops that take place in the Pacific Northwest, would be to hold formal quarterly or semi-annual meetings between all the Habitat affiliates in a region or state. The existing Pacific Northwest meeting is organized by the Habitat State Support Organization and rotates locations quarterly so that affiliates throughout the region get the chance to host and show off their recent projects. These meetings can be designed to last one or two days and should include both formal presentations and workshops and informal time for building affiliate relationships. Presentations should be made by Habitat affiliates who have taken innovative new steps in their projects; by high performance building manufacturers, sales representatives, or installation professionals seeking to work with Habitat; by building science professionals and green consultants; and by any other professional whose input could benefit attending affiliate representatives.

Affiliate Partnership *Pacific Northwest*

In the Pacific Northwest region (consisting of Oregon, Washington, and Idaho) a key mechanism for partnership between affiliates has been the quarterly regional construction managers meeting. This one-day meeting, which rotates between cities, includes tours of Habitat homes under construction, speakers and educational sessions. Speakers include building scientists, energy and utility representatives, land surveyors, and other experts. Most importantly, the meeting allows construction managers at different affiliates to build relationships with manufacturers and with one another. As a result of these meetings, affiliates in the region have shared and traded house plans, designs, techniques, and materials. Tacoma-Pierce County Habitat also reports that affiliates in this region are not only more aware of what their local counterparts are doing, but they cooperate and share resources in order to improve the building practice and knowledge of all affiliates. As one tangible example of a benefit of this collaboration, Tacoma-Pierce County has not only shared plans and materials with other affiliates, but has recently (in 2008) completed their first house with a mini-split, which was donated to them via a contact made at the regional construction managers meeting.

3. Education and Training

Staff

Staff education and training is one of the most important avenues for making your projects greener and higher performing.

Initial education and training: Begin the education process with a basic course or series of courses for staff on the principles and the goals of green or high performance building and how you plan to apply the principles to your upcoming projects. This initial education should seek to address the following issues: what does high performance mean for your affiliate, why are you transitioning to higher performing building, and what are your concrete performance goals for the next project and for improving your homes over the next 1-2 years?

Basic contents of the first course or series of courses must include basic principles and goals of high performance and green building as well as specific information on how those principles will be applied to your projects. Information covered in this course should include:

- information on any green certification you will be seeking and the requirements for that green building program;
- specific project goals for building envelope and duct leakage, monthly utility bill costs, and HERS score;
- specific long-term goals for the affiliate—where you will be going after this initial pilot;
- explanation of any changes to the construction documentation and management processes, waste management plans, public information, and quality control;
- new work assignments and roles, if relevant;
- air sealing walls, foundations, and the attic;
- any new framing techniques or processes;
- insulation—how much and why;
- proper window and door selection and installation;
- using energy efficient technologies, especially appliances and programmable thermostats;
- duct sealing and placement;
- selecting and installing high performance HVAC systems;
- the importance of mechanical ventilation in a very airtight structure and how your ventilation strategy will change; and
- the role of verification in green certification and quality control.
- Optional: If your affiliate is working toward higher indoor air quality simultaneously with energy efficiency, you should hold a course that covers the basic principles and practices behind IAQ Include: sealing the building envelope; properly ventilating the house through mechanical ventilation; limiting exposure to VOCs for homeowners and for those building the house by reducing or limiting carpeting, using low/no-VOC glues, finishes, and paints, and limiting or sealing all treated wood products made with VOC levels above the recommended limit (see Section 12 “Materials”).

Staff Education and Training ***TriState***

TriState Habitat makes each site leader responsible for the house meeting Energy Star and Green Buildings Standards; to aid volunteers in this effort, Construction Operations Manager Randy Wilkerson holds both small and large-scale trainings on sustainability and achieving Green Building and Energy Star certification. In addition, to promote buy in amongst staff and senior volunteers, he has turned energy efficiency into a competition wherein site leaders compete over who can produce the best performing, most energy efficient house, best HERS rated house. In addition site leaders take a lead in educating volunteers and subcontractors on high performance building and its benefit to the comfort and affordability of the house.

For help in setting up these courses and building a curriculum seek out neighboring affiliates, consultants, green building providers and professionals, utility providers, and ENERGY STAR or green building program raters, who are all valuable resources and may be willing to give a talk to staff or to provide educational materials on some aspect of high performance building.

You can also look to these resources and building professionals to obtain education tools or assistance in creating education tools such as videos, PowerPoint presentations, demonstrations, photographs or CAD drawings of building details (such as advanced framing techniques).

Ongoing education: After the initial green building course(s) are finished, you should institute an ongoing staff education program that seeks to instill a strong knowledge of high performance concepts, techniques, and products/materials in your staff. They should, in turn, be able to teach these concepts and practical applications to your volunteers, homeowners, other construction industry personnel, and the community. In your ongoing education process, increase the knowledge base and interest of your staff and all other partners by utilizing a wide variety of education tools and forums. Consider the following options:

- hold demonstrations of new products and techniques;
- bring in outside experts, including regional and Habitat officials, energy efficiency experts from your local utility or another source, building scientists, local developers or builders constructing green homes, manufacturers or sellers of high performing construction products, and staff from other Habitat affiliates already engaging in a sustainable or energy efficient technique you are adopting or plan to adopt;
- send staff to conferences and workshops on green and energy efficient building (seek out grants to pay attendance fees or ask conference/workshop organizers to offer you free or discounted attendance);
- organize site visits of green housing projects;
- participate in all Habitat building workshops in your region; and
- utilize a variety of technologies in your presentation of information, including movies, audio lectures and demonstrations, PowerPoint, presentations, webinars, and advanced technologies such as green and energy efficient building demonstrations and pilots in the virtual world and computer-based realistic building modeling software.

In addition, your affiliate should develop an efficiency and green building manual where staff can review procedures and materials; keep on hand at the build site.

Remember, as with your goal of improving one practice at a time in your projects, you may need to teach your staff one new practice at a time so that it can be successfully and efficiently implemented in your next housing project. Start simple with teaching about insulation and the building envelope and demonstrating advanced framing (for example, placing study 24" on center for wood framed houses), insulating, and proper air sealing. Then demonstrate proper duct placement and sealing. Once you are getting ENERGY STAR compliant blower door and duct blaster test results and all staff are comfortable, move onto other practices.

Volunteer Education and Training ***TriState***

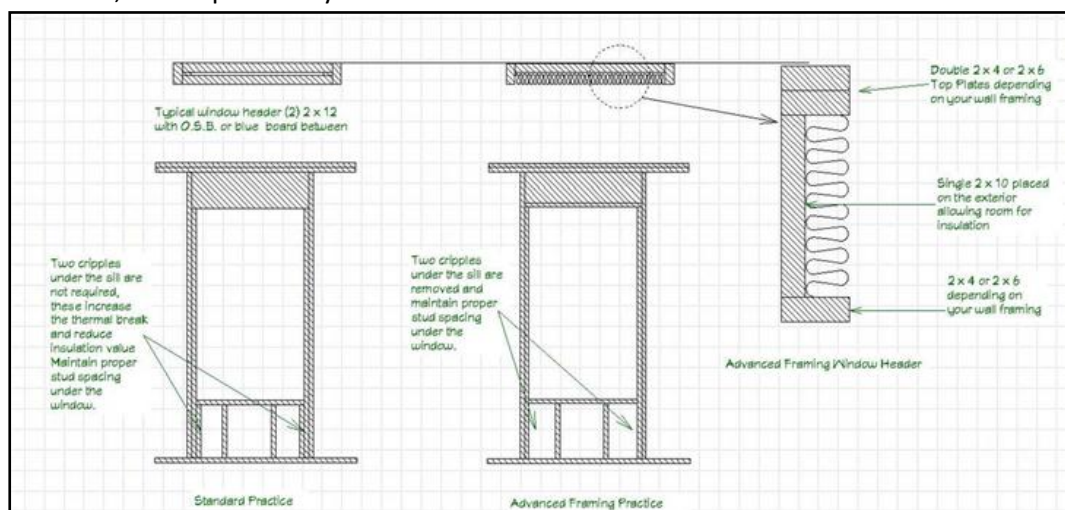
TriState Habitat teaches small classes for volunteers on topics such as how to hang drywall. It also teaches volunteers about long-term affordable housing, environmental impact, air sealing, and indoor air quality. To further enhance volunteers' knowledge and to improve their building practice, volunteers have access to detailed diagrams on the jobsite that illustrate how to carry out complex or technical processes such as installing windows or doing advanced framing. For example, on the jobsite the volunteers working on window installation are given handouts with drawings showing the 4 steps to proper installation accompanied by an explanation of why windows should be installed that way. Starting in 2010 TriState will give volunteers an installation manual for use in training and on the jobsite that will include both the paper diagrams and an accompanying audio training segment for each installation component.

Volunteers

Staff demonstrations and on-site visual aids are the most important tools for teaching volunteers high performance concepts and techniques. Look to experienced volunteers to informally educate less experienced volunteers, but to ensure high quality building, you should also hold frequent formal demonstrations and trainings for volunteers.

Training of volunteers should take the following forms:

1. At the beginning of each project hold a volunteer orientation to the project, responsibilities, the timeline, Habitat contact and safety information, and the project's specific goals. Where you have rotating groups of volunteers on the project rather than a consistent group, you may want to forgo a lengthy formal project orientation for each new set of volunteers, but you should hold a brief orientation at the start of every day or phase of construction.
2. Daily orientation. Held at the start of every day or project phase, use this very brief orientation (as little as 5 minutes) to state the timeline, list specific responsibilities, and explain the goals for the day or phase, including the specific high performance building goals.
3. Formally demonstrate the day's building practices, emphasizing high performance techniques. Demonstrate especially proper framing, insulating, air sealing, and window and door installation, techniques that you intend to use.



3 TriState Habitat's visual aid for building a proper header

4. Have visual aids demonstrating proper installation/building practices and keep them in an easily accessible area of the jobsite. These aids should reiterate the demonstrations from earlier in the day and provide a reference for volunteers. Support these demonstrations of proper building practices (especially framing, air sealing, and window and door installation) by providing volunteers with visual aids that should be stored onsite, all together, and near other building documentation. Visual aids should contain visual representations (such as drawings or photos) of the steps for properly completing a process or installation, lists of necessary materials and the order they are used in, written descriptions to accompany drawings, and a detailed diagram of the final, completed stage.
5. During the construction process, try photographing the framing, insulation, installation, and other complex processes as they are being done. Then, compile these photographs to create a visual reference to accompany the visual aids and use these as a guide for later volunteers.

Homeowners

Each Habitat affiliate provides the new homeowners with construction skills training, basic training and education in how to operate and maintain their new house, and a walk through/orientation to the new house. Many affiliates also provide financial education, job skills training, and access to other forms of education.

But homeowner education in a high performing house must go beyond this basic template of homeowner maintenance and repairs information to include education about the green features of the building, the benefits of each green feature, and training on how and why to maximize the effectiveness of these features. For example, the indoor air quality benefits of a house with a low air infiltration rate and properly sized mechanical ventilation will only be realized if the residents keep the windows closed and the energy efficiency benefits of good insulation and a programmable thermostat can only be realized if the homeowner knows how to properly utilize the thermostat for optimal comfort and energy savings.

Each high performance feature should be mentioned and fully explained in a pre move in classroom session, house walk through, orientation, and homeowner's manual. The classroom session and walk-through/orientation should introduce the basic concepts of high performance building, emphasize the benefits to the homeowner of high performance in general and of each key feature specifically, and should be accompanied by a demonstration of how to properly utilize each high performance feature and system so that its benefits to the residents are optimized. While each project's classroom and house-based education will be slightly different, it is recommended that you develop a course template and train a staff member or long-term volunteer how to teach the course to your families. The course template should, at a minimum, include education on and demonstrations of all the features and information listed in the Homeowners Manual (see below). It will be necessary to adapt the course and the manual to fit the specific high performance features and specifications of each house design, but the basic framework can remain standard.

The Homeowners Manual:

In the homeowner's manual, which should be provided to the family both in paper and electronic form, each high performance feature should be listed and fully explained. Necessary information includes:

- why the feature was chosen and its benefits;
- proper operation and maintenance of each feature;
- when each feature needs to be replaced (if relevant) and where to purchase or acquire replacements;
- what can be recycled and how to recycle in that jurisdiction;
- contact information for local recycling and hazardous waste disposal sites;
- information on and maps for local public transportation options;
- water efficient and climate appropriate landscaping options;
- an explanation of how to maintain existing landscaping, if relevant; and
- tips for maintaining indoor air quality by using healthy and affordable green cleaning materials and venting and operating the house properly.

Homeowner Education

NYC

Habitat for Humanity—New York City has written a Green Homeowner's Manual that covers not only the basics of how to care for energy efficient appliances and materials, but also explains how the house is sustainable and why that is advantageous to the family. This manual, which is customized for each project, educates homeowners on how to maintain healthy indoor air quality in the home, how to select green cleaning products, recycling guidelines in New York City, and how to save money on water and energy bills. A sample manual can be viewed at: http://www.habitatnyc.org/pdf/green_building/green_manual_template.pdf.

In addition to the manual Habitat-NYC offers two green orientation courses as part of their homeownership training program. One program, held offsite, educates the homeowner about how their project is green and how to maintain the high performance (and especially indoor air quality) of their sustainable home. The second, held onsite, consists of showing the homeowner how to use and optimize the green features of the home, including HVAC systems and low-flow water devices.

TriState

Randy Wilkerson of TriState Habitat recommends teaching basic home maintenance and energy efficiency classes to homeowners, demonstrating skills such as how to caulk and how to program their ENERGY STAR rated thermostat. TriState also gives homeowners detailed house plans that show water and gas shutoffs and the location of blocking for grab bars, as well as a DVD showing house construction and features. Both the plans and the DVD aid homeowners in future maintenance and accessibility adaptations, prolonging the life and functionality of the home.

Community

In order to build community support for your affiliate's work and for sustainable construction in your area, community outreach and education is essential. This education generally does not need to be formalized and does not need to include training about how to construct a better house. Instead, focus your educational efforts on teaching the community why high performing houses are better for residents, how they can be cost effective, and how they can decrease the residents' carbon footprint. You will want to use a variety of mediums and tools for your community education. Some of these efforts and tools cost little or no money or time, while some will cost considerably more.

Fairly simple and inexpensive communications media and tools include:

- Your affiliate website. Post key high performance details of your current projects, successes in obtaining a green certification or a lower HERS score, and updates about construction status.
- The jobsite. Post information about high performing features and products, their advantages, contact information for local high performance experts and retailers who can give neighbors more details or advice, and any other information you deem important or interesting. Limit the information to one large poster.
- Your ReStore. Post education information in the store, hold technique workshops and product demonstrations, and solicit ReStore donations of high performing building materials.
- Local newspapers and radio. Invite local reporters and interviewers out to the jobsite or go into the studio to speak about your work, how the community can get involved in Habitat, and what the community can learn from your affiliate's experiences.
- Industry groups. Speak at meetings of local industry groups such as the home builders association and realtors association. These meetings are likely to be more technically oriented—present the techniques and products you have used, the specific, measurable benefits of the high performance upgrades, and key lessons learned and recommendations for

how best to improve construction practices and choices in your specific city or region (consider climate, material and energy costs, and available incentives and tax credits).

More involved media and tools include:

- Green certification awards. Seek out and apply for awards from the state/local government, green certification programs, and other green building programs for your high performance housing. Whether you win or not, publicize your commitment to green building in order to interest the local community
- Open houses. Hold an open house or series of open houses with a finished project to show off your high performance features and educate the community about how to improve their own homes. Consider holding a general community open house and a more technical open house for area building professionals. Also consider holding the open house(s) in conjunction with another event or occasion such as Earth Day, the local Parade of Homes, or your affiliate's anniversary.
- Local schools and education partnerships. Form partnerships to cooperate on specific projects with local elementary, secondary, and technical schools, or community colleges. In forming these partnerships, consider the practical and conceptual education your affiliate can provide the students and what volunteer work the students can provide your affiliate. For examples of school and education partnerships, see Danville Case below.

Community Outreach

Danville

While Danville Habitat Manager of Construction Marlin Yoder describes community and homeowner education as the hardest process for them over the past few years, with the assistance of Danville Utilities and Earthcraft Virginia, Danville Habitat has undertaken numerous community education initiatives. Initiatives so far include outreach through the Earthcraft Virginia newsletter, local newspaper and cable station, and speaking with community groups. During the construction of an Earthcraft home, they held a community open house to showcase energy efficient building practices and teach the local community about the benefits of these building practices. About 40 nearby homeowners attended the open house, which was advertised through the local newspaper and cable TV channel. Danville Habitat has also spoken to area contractors at home builders' association meetings and has held a contractor open house.

In addition, Danville has developed a partnership with the building trades and marketing programs at the local community college. The building trades program works with Habitat onsite, with students learning high performance building from Habitat site leaders and staff. A building job training class, for example framed a house and set the roof trusses, providing high quality volunteer labor and learning about efficient framing from the experienced Habitat site supervisor. In addition, the community college marketing program has written the ReStore business plan for Danville Habitat and, in a year-long partnership, a local girls high school has integrated Habitat building and high performance, energy efficient housing concepts into its curriculum.

Denver

Offering another type of community outreach, Denver Metro Habitat, during its 30th anniversary celebration, held a Habitat open house with 400-500 attendees. This open house featured all of the affiliate's sustainable features. Educational materials showed visitors how and why Metro Denver builds houses and asked visitors to consider how their house is built by comparison. The highly successful open house not only educated the local community about the high performance housing practices of Habitat, but opened a community conversation about the importance of high performance building, how it can be successfully done, and its benefits to the homeowner, the community, and the environment.

4. Integrated Design Process (IDP)

An integrated design process, often referred to as a charrette, brings together all the design, engineering, construction, planning, and family support partners for the purpose of designing a project that optimally benefits the family, maximizes the efficiency and performance of the house and landscaping, and achieves a highly efficient building process.

How to Integrate the Design Process

The first meeting: During the initial planning and design phase of the project, you should hold 2+ meetings with all stakeholders. At the first meeting, all stakeholders should be briefed on the main goals and scope of and specifications for the project. The stakeholders should then break into working groups and the working groups should select a leader to moderate and report on discussion. (Disregard this step if there are <10 stakeholders present. In this case, the following topics should be discussed by the whole group.) Each working group should discuss one or more of the following topics:

- integrating desired high performance features into the basic design;
- integrating the needs and desires of the families, including any specific needs for this project;
- strategies for minimizing environmental impact and maximizing energy efficiency in the construction process and the housing project;
- minimizing waste and overlap in construction process; and
- strategies for achieving green certification (if relevant to project).

The suggestions of each stakeholder should be considered and reported on. After reconvening from the working groups, the recommendations of each working group should be presented and voted upon by the whole group. Recommendations receiving votes from a majority of the participants should be integrated into the project design and management plan, accompanied by a discussion of the best and most efficient method of integrating these recommendations.

Between meetings: After the first meeting, staff at your affiliate should internally review the design, plans, and specifications decided upon at the initial design meeting. This process should consider whether the agreed upon design and plans meet the needs and maximize the advantages of your affiliate, should include a financial review to assess whether the final

house price exceeds your price goal, and should include a review of all agreed upon specifications and building processes to ensure that your affiliate is capable of building to the plan.



4 The Woods at Golden Given perspective--Tacoma Habitat

In addition, you should develop a timeline of the project from obtaining the first permit through the family's move in. The timeline must include:

- a materials ordering schedule;
- deadlines for submitting documentation for permits and for green building certification;
- approximate dates of necessary inspections by local building and code officials;
- expected start dates and the amount of time required for all stages of construction;
- preliminary dates for independent verification work to be done;
- deadlines for financing and mortgage paperwork; and
- an expected family move in date.

This draft timeline does not need to be perfect—it will be reviewed, edited, and added to during the second design meeting.

Before the second design meeting, staff from your affiliate and contractors should also draw up a template for each contractor's scope of work. The scope can be brief, but should highlight any high performance processes, techniques, or materials the contractor must use. As with the timeline, these scopes are drafts that will be added to and edited in the second meeting. However you should draw up draft scopes with contractors as doing so will aid you in communicating the project's high performance requirements and goals and will clarify any confusion related to design specifications and expectations.

The second meeting: At this design meeting, the first order of business should be for all stakeholders to convene and review any changes made to the project design and plan. Once any changes to the plan have been discussed and voted on by the group, the timeline developed by your affiliate should be presented, reviewed, and amended as necessary. At this time the group should draw up a schedule for contractors and team of volunteers based on the timeline; it should explicitly show the order in which work will occur, start dates for each contractor and volunteer group, the length of time each contractor or group is estimated to need for each phase, and any collaborations necessary to make the construction process as efficient as possible.

Charettes

Tacoma/Pierce County

This affiliate is developing a 25-unit project called "The Woods at Golden Given," with potential funding through the Washington State Housing Trust Fund (WSHTF) and is currently building a 9-unit project called "Salishan" using WSHTF monies. The fund requires that grantees utilize an integrated design or charrette process. To meet this requirement they held a charrette facilitated by the State Department of Ecology and hosted by an architectural firm. The charrette design team included architects, land use planners, the site selection committee and director, construction site supervisor, CEO, board representative, and a couple of community members. The approximately 15 attendees broke out into topical small group sessions, and then came back together to vote on the decisions of the small groups. Though the project has not yet been completed, Site Development Director Gomer Roseman states that they will continue the process in the future as it lends a more thoughtful approach to community design and better results. The process is more work and takes longer, but yields "a different synergy" that has already resulted in superior results such as improved orientation for solar gain and more efficient infrastructure planning and connections. To read the full report on the Tacoma/Pierce County Golden Given eco-charrette, see Appendix 2.

Seattle/South King County

For this Seattle affiliate the same Washington State Housing Trust Fund requires a charrette integrated design process. In Seattle's case the charrette has consisted of architects, engineers, landscape architects, LEED providers, Ed Brown from Washington State Habitat, two Building America building scientists, key volunteers, the site supervisor, the construction manager, and family services representatives. Attendees broke into small groups to discuss: site issues, community issues, family issues, architectural issues, and mechanical issues, then came together to discuss and vote on small group decisions.

The charrette is designed to be sustainable for families by maximizing the utility and functionality of the house, while limiting the maintenance and cost to operate. During the charrette the affiliate encourages all participants to consider this goal and to focus on creating a healthy, durable, energy efficient house. To date, this process has yielded homes with longer lasting, more durable technologies and materials as well as superior utilization of site solar capacity.

Once the timeline and schedules are complete, present to the group your outlined scopes of work for review, discussion, and additions. The completed scope for each contractor/construction professional should include:

- the general and specific responsibilities of the contractor;
- an explanation of building techniques or processes the contractor will follow, especially where a new high performance technique or product will be used;
- a list of the exact products and materials that will be used and who will acquire the materials;
- a checklist of necessary engineer and building inspector inspections; and
- a copy of the work inspection timeline decided upon earlier in the meeting.

Scopes of work for staff members and volunteer leaders should also be settled upon at this meeting, including delegating responsibility for documentation tasks.

The integrated design meeting process should be transparent and should involve clear communication between all parties. To facilitate this, the contact information for all involved parties should be stored and shared with all parties both electronically and in paper form so that the lines of communication stay open throughout the construction process.

Remember to assign responsibility at the second design meeting for managing the green certification process and documentation or for organizing with partners to achieve certification. Upon concluding the IDP your affiliate should compile and report on the procedures followed in the integrated design process, the results of the IDP, and recommendations on how to improve this process in the future. This reporting will inform and improve future IDPs at your affiliate, will provide a valuable resource for other affiliates seeking to adopt an IDP, and will be useful as a tool for reporting your work to your Board, funders, and green building program partners.

When to Hold an Integrated Design Process Meeting

Use an IDP for all projects where your affiliate will:

- use new house design or plan;
- integrate a high performance feature or features that are significantly different from your current features;
- seek a new or higher level of green certification;
- undertake retrofits;
- build a multifamily housing project or projects;
- build a housing development or a large number of homes based on the same basic plan; or
- receive funding from a source that requires some form of charrette or documented IDP.

Integrated Design Recommendations

TriState

TriState Habitat Construction Operations Manager Randy Wilkerson oversees their comprehensive construction management plan and integrated design process. In the design phase, Randy begins his energy efficiency and quality control process by comparing his plans and the TriState building checklists with ENERGY STAR compliance to ensure that all ENERGY STAR requirements are being met. He then submits his plans to an independent rater, who gives design recommendations and a goal HERS score based on Remrate modeling. Randy next brings all involved site leaders and subcontractors together for a pre-build meeting. At this time, everyone is given high performance and energy efficiency details, including a target HERS score, as well as detailed specs and plans. Materials lists are also distributed that delineate who will order each material and in what quantity to limit ordering confusion and waste. TriState Habitat has just approved and is currently planning a pre-build build in which all subcontractors, site leaders, and senior construction staff will meet to review the design, high performance and energy efficiency details and specifications, the checklists and materials lists that will be used in the build, and scopes of work.

Who to Include in the Integrated Design Process

Include as many of the following individuals as possible: representative of homeowner services or a current homeowner, all project engineers, project architects, your property procurement/location staff, your construction manager(s) or supervisor(s), volunteer team leads, a city planner or someone from city permitting office, all contractors or a representative from each contracting company, upper management from your affiliate, and the HERS rater and green certifiers you intend to use.

In addition, you may want to include building scientists or green building specialists in your area, state-level Habitat representatives if applicable, a representative from a neighborhood or community planning or historical preservation group, landscape architects if relevant to the project, partners such as utility companies, members of your board of directors, and senior construction staff from neighboring affiliates who have experience in high performance building.

Benefits

An integrated design process may take longer than the traditional design process, but yields houses that better serve both the needs of the residents and the goals of the affiliate. The integrated process, by examining family needs and high performance or green goals from the very first step, allows these goals to be incorporated into the project in the most cost effective and efficient manner possible.

Benefits to your affiliate are likely to include:

- Maximizing your high performance upgrades. New technologies or materials can be integrated into a project early in the design phase, enabling their benefits to be fully realized as the high performing materials and technologies can be combined and their installation planned to maximize energy savings. For example, a comprehensive insulation package can be put together that maximizes the R-value of the foundation, walls, and attic, while still minimizing materials use for framing, limiting envelope penetrations, and incorporating greater structural strength appropriate for a region's specific climate and hazard conditions.
- A more efficient construction process. Disruptions to the construction process will be minimized by bringing all parties into the design process as each involved party has a defined and communicated scope of work, each party understands how that work relates to others' work and has documentation of that relationship, and all parties have a more comprehensive and thorough understanding of the goals of the project.
- Saving money by minimizing waste. Better communication between all parties involved in construction throughout the process and integrating new materials or technologies in the design phase allows others to offer feedback, lessons learned, and suggestions on how to change the design, select a better performing product, and save labor by condensing multiple construction activities into one step.

Quality Control *Seattle*

Seattle/South King County Habitat recommends testing as the single best method of ensuring and continually improving quality. Site supervision is obviously essential, but once the build is complete, blower door and duct blaster tests reveal how well best practice building techniques were followed and allow builders to improve with each build. Especially when considering air sealing, third-party testing and subsequent evaluation of that testing is the strongest quality control mechanism this affiliate (and many others) have in place.

In addition to testing and relying on their vigilant, well-trained site supervisors and construction manager, Seattle Habitat gives site supervisors checklists on key building processes, especially those that have been recently adopted, in order to ensure that everyone involved in the build is thinking about following best practice building. For example, they currently give all supervisors air sealing checklists to verify that all the necessary steps for an airtight house are followed.

5. Quality Control Standards and Protocols

Good quality control can be achieved by setting up, communicating, and documenting quality control protocols that are followed by all staff, volunteers, and contractors. Your affiliate should have a documented and well-understood set of protocols that you always follow to ensure quality construction that meets your high performance building goals.

Key strategies that should be included in your protocols include:

- review of building plans, specifications, and construction management plan to ensure that they align with the local building code and the requirements of any high performance certifications you intend to seek for the project;
- use of quality control checklists and forms, as described in Section 8 “Construction management program and documentation”;
- education of all personnel on proper installation and construction practices that comply with manufacturer and design specifications;
- rigorous oversight of work and volunteers by staff and engineers;
- third-party verification of each project; and
- internal review of each project, including identifying quantitative measurements for improvement based on the review. Consider benchmarking each project’s HERS score, building envelope air infiltration rating, and waste reduction. With each project your goals should be to improve your score in each of the three measured areas.

Especially when experimenting with new high performance techniques, materials, or technologies, the construction supervisor or team lead should oversee or verify that all work has been done properly. Work verification consisting of a formal review by staff or an independent building professional should be done at a minimum at the end of each stage of construction or once a week. All work should be verified to align with the plans and specifications, the manufacturer’s specifications, and your project’s waste stream and energy reduction goals.

An excellent overview of quality control standards and protocols can be found at the Building America Quality Control website. A sample quality control checklist from the Building America Program, including a checklist for both pre-drywall and finish verification and a resource appendix, can be found at:

<http://www.toolbase.org/PDF/BestPractices/QualityControlChecklist.pdf>.

6. Construction Management Program (CMP) and Documentation

You should first meet any construction management program (CMP) planning, permitting, and documentation requirements for the jurisdiction in which you are building. Submit the required documentation to the appropriate office in that jurisdiction. In addition to the CMP requirements in your local jurisdiction, your CMS should include all the information listed below.

General Information

The project address, date the plan was prepared and submitted (if applicable), and the names, specific roles, and contact information of involved parties, including architects, engineers, and contractors. Also include a list of necessary permits, a reference number for each building permit you have received, and the contact information for the office that issued the permit.

Project Description

The project description should include a brief (1-5 sentence) summary of the project, the primary use of the site (residential), the number of housing units planned for the site, the square footage of each housing unit, an list of all planned on-site parking and bicycle spaces (if applicable), and a site map showing each housing unit and where it will be situated on the lot.

Schedule

Include dates of overall construction, dates each contractor is expected to be working, dates of in street construction, and details of work that will be done in the street and on sidewalks.

Safety and Health

If you have not done so, create a safety program that ensures the safety of all volunteers, staff, and the neighbors. This plan should include emergency contact information; information on the types of barriers, fences, and locks that will be used to block off the work site to prevent injury and theft; lists of the required safety gear for the building site; a plan for medical treatment in the case of minor and major injuries of staff and volunteers; and health and liability insurance information. Communicate this plan to all staff and volunteers and place the safety information at the front of your CMP binder onsite, in the project CMP folder (both paper and electronic) at the office, and in a prominent position in any volunteer briefing packets or information.

Mitigate and Plan for Neighborhood Impacts

The goodwill of the neighborhood is important—to minimize disturbance to neighbors include in your CMP detailed explanations of your plans for dealing with: traffic management, work hours, noise control, lighting control, delivery and truck routes, worker access and parking, truck unloading and staging, police details, on-street parking occupancy, pedestrian access and sidewalk obstruction, and signing of the construction site.

Environmental Planning and Impact

The CMP should include detailed plans for waste disposal and recycling; including contact information for the companies you intend to use for disposal and recycling, a plan for dust mitigation at the site; a plan for storing and disposing of or reusing excavated dirt; a copy of your environmental impact assessment if one is performed for your project, and a detailed plan for achieving green certification (if applicable).

Make the CMP Available

Create a brief one-page overview of your CMP and hand the document out to neighbors; place it on community boards in local community centers, churches, and schools, and give it to the relevant local government offices (such as the building code, green building, and/or development services offices). The one-pager should include an explanation of the project, details about how the project will affect neighbors and how that affect will be mitigated, and if possible, a CAD sketch of what the house(s) will look like. You may also want to present your project at meetings of the local city council, neighborhood council, or neighborhood planning or civic organization.

Post the CMP at every jobsite entrance, along with all jobsite rules, and make it available on the build site for volunteers, staff, and neighbors, as well as in electronic form at the office. Store the CMP, documentation, and permits electronically in one easily accessible folder and on a shared drive, if possible.

For a good overview of project documentation, including preparing schedules, scopes of work, plans and specifications, and job ready and job completeness forms and checklists, see:

http://www1.eere.energy.gov/buildings/challenge/pdfs/BuildersChallengeQualityCriteria_WEB.pdf.

7. Compliance with Codes and Manufacturers Specifications

Even where it has not been adopted by your local jurisdiction, all projects should meet the latest International Residential Code (IRC), which at present is the 2009 IRC, as well as any local codes or standards specific to your jurisdiction. Where a local green or high performance code has been adopted for voluntary participation, you should seek to meet this green code except where the voluntary code is not cost effective or where the 2009 IRC is higher performing.

Especially in cases where your site is prone to specific hazards including radon, wind, snow loading, seismic, or flooding, but your local jurisdiction has not adopted specific structural codes to minimize those risks, you should engineer the house to meet the necessary structural specifications for hazard mitigation. Reference the hazard sections of the 2009 IRC for design calculations and hazard maps. Also consider hazard as a criteria for location selection and take steps to include hazard identification and risk assessment during the site selection process (put it on your site selection checklist!). While some hazards such as seismic events and hurricanes are unavoidable in large geographic areas, you should study local flooding and wind maps and avoid purchasing properties in identified high hazard risk areas. Minimizing location-specific hazards should be done not only for life safety and structural integrity considerations, but also to reduce the cost of insurance and hazard damages for families.

All materials, appliances, and technologies should be installed and used according to the manufacturers specifications. These specifications should be included in your building plan documentation. These materials have been engineered and assessed to operate as specified only when used or installed correctly; to yield the best performance these specifications must be followed, even when they differ from standard building practices. If questions arise as to proper installation or usage, contact the manufacturer or their local representative to clarify the proper procedure. Many manufacturers possess detailed CAD drawings of their products, materials, and installation—ask for these CAD drawings and, if available, put them with your building plan documentation. You may also want to consider laminating and/or making copies of these drawings and accompanying text so that volunteers and staff on the build site can easily refer to the manufacturer's specifications.

8. Cost Effectiveness

In order to meet the goal of providing affordable, decent housing to families, cost must be a primary consideration in making decisions about which building materials, appliances, and systems to select. Higher performing products are frequently more expensive to purchase and for this reason, Habitat and other affordable housing programs have traditionally not been early adapters of top of the line or innovative products.

However, considering only the initial purchase cost is misleading as this fails to account for the costs of the product over its useful life. Products that are less expensive upfront may end up costing inhabitants more money over the long term. In addition to the initial purchase cost, determining cost effectiveness requires a consideration of operational costs, longevity, repair costs, and non-monetary benefits to family. Collectively considering these factors is called a lifecycle cost analysis. Where possible, your affiliate should undertake a lifecycle cost analysis of each new material, product, or system may integrate into a project. Keep in mind that Habitat's 0% mortgage provides faster paybacks compared to a typical interest bearing loan.

The First Step in Analyzing for Cost Effectiveness

At a minimum, all appliances or systems that use energy or water should be evaluated in terms of operational cost versus initial cost by answering the question: Will installing the higher performing appliance or system have an equal or lesser operating cost (OC) over the lifetime of the mortgage than the cost of the standard product you are currently using?

A comparison of lifetime operating cost of an appliance or system can be evaluated through the equation: $\text{Lifetime OC} = (\text{price of high performing product} - \text{price of standard product}) + [(\text{expected annual utility cost of high performing product} - \text{annual utility cost of standard product}) * \text{number of years in the mortgage}]$. Or, in short: $\text{OC}_L = (P_{HP} - P_{ST}) + [(U_{HP} - U_{ST}) * T_M]$.

If the Lifetime OC is negative, then the high performing product is more cost effective than the standard product as the aggregate utility savings will be greater than the increased mortgage.

Where possible, energy use and cost effectiveness of all appliances, and systems should be independently verified by a testing organization such as ENERGY STAR, the National Fenestration Rating Council, or another American National Standards Institute (ANSI) accredited body.

Add Longevity and Repair Costs to Cost Effectiveness

In determining the cost-effectiveness of a high performance upgrade, you must look at both longevity and repair costs as these two factors are essential to determining a product or system's true operational cost. At a basic level, you should only install equipment that can be fixed either by the homeowner or locally by a certified and experienced professional. In addition:

- all major appliances should have a full manufacturer's warranty of at least 1 year and a limited warranty of 5 years or more;
- all major systems such as the HVAC system should have a warranty 10 or more years;
- roofing shingles should have a warranty of at least 30 years (and preferably lifetime); and
- all lighting fixtures should have standard sized bases and be fitted with either CFL or LED bulbs.

There is no reliable way of determining the specific longevity of a particular piece of equipment. However, due to the high cost of repair and replacement, wherever possible utilize equipment that is proven to be reliable and have a product life in the top 25% of its class.

Health and Environmental Cost Effectiveness

In all cases, but especially where a member of the family has specific needs or health concerns, better indoor air quality can equate to actual monetary value. Studies show that houses with better indoor air quality are healthier for residents, leading to fewer respiratory problems and lower medical bills. And while there is currently no standard or calculation for measuring the cost effectiveness of healthier building materials, where families have very young children or where one or more members of the family has allergies, asthma, any other respiratory condition, or a chronic disease that requires regular medical attention you should follow the following recommendations:

- eliminate all interior carpet;
- all interior materials should meet the safety recommendations under Section 12 “Materials” of this guide;
- follow all ASHRAE Standard 62.2 calculations for localized and general ventilation; and
- use either a MERV 14 or higher or a HEPA (High Efficiency Particulate Arresting) filter for your HVAC system.

The cost effectiveness of utilizing environmentally sustainable building materials is even more difficult to quantify than that of healthy building materials. However, many sustainable building practices can actually save you money because they involve reducing both the amount of materials used in and the amount wasted by each project. Focus first on reducing the volume of materials used (especially in framing), find uses for scrap materials (either on the building site or through a ReSale store), and look for sustainable products that are comparable in price to industry standard products, such as substituting fly ash for Portland cement in concrete.

Online Tools for Assessing Energy Cost Effectiveness

To assess the cost effectiveness of energy efficiency measures on a whole house level and an individual level, the Building Energy Optimization Tool (BEOpt) is a free software tool created by NREL that analyzes for optimal and near-optimal building designs. The goal of this software is to determine optimal building designs along the path to net-zero energy and the program allows the user to manipulate a wide variety of inputs and energy savings goals. It is a valuable tool for any affiliate seeking to improve the energy efficiency of a given design because you can directly analyze how an upgrade or set of upgrades will affect energy use. This software will be available for free download in 2010.

The Building Envelope Program at Oak Ridge National Laboratory (ORNL) has a number of interactive calculators that measure cost effective insulation levels for various climates, whole wall R-value, thermal mass, and other energy efficiency factors. The calculators can be found at:

www.ornl.gov/sci/roofs_walls/calculators/index.html.

- The insulation tool is a useful tool for determining the minimum insulation level you should be installing in your climate and for visualizing how to improve your building envelope through more and better insulation.
- The whole wall R-value calculator is particularly useful during the design phase as it provides valuable data on the projected energy efficiency of a given wall system. Note that this do-it-yourself calculator does not replace verification by a trained energy efficiency rater.

The Home Energy Saver (HES) is a useful web-based tool for analyzing the energy use of and potential energy savings in both new and existing homes. The online program allows the user to input specific data relevant to a house, including the house plan, utility bills, building envelope, appliances, energy systems, and other aspects of their house. The program then provides recommendations on which energy upgrades are likely to be the most cost effective and which will save the most energy. In addition, the HES provides data on the average energy use of other houses in the area, which allows you to compare the projected energy use of a house plan to comparable houses in your area. While not a perfect modeling tool, it provides valuable advice for determining which energy efficiency features to integrate into your projects. Find the Home Energy Saver at: www.hes.lbl.gov. For a building design software with greater complexity and accuracy, use the Home Energy Saver Pro, found at: <http://hespro.lbl.gov/index.php>.

9. Construct to Maximize Habitat Advantages and Needs

Much of the high performance building materials and products market emphasizes products that are either very expensive and out of the price range of the affordable housing market or products designed to minimize labor and the associated labor costs. Habitat builds affordable housing with volunteer labor, meaning minimal labor costs and a low-to-moderate materials budget; therefore, a majority of products on the high performance market are inappropriate for Habitat houses. When considering new or improved high performance measures for your project, the choices you make in product selection and construction practices should emphasize volunteer labor, ease of installation and maintenance, and efficiency in terms of cost, materials, and time.

Products that are determined not to be cost effective, that are designed to minimize labor costs, or which require specialty skills or equipment to install may not be appropriate for Habitat projects. However, if contractors, manufacturers, or suppliers are willing to donate supplies or labor (see Section 2 “Partnership” in this Guide for recruiting partners for donations) you may want to incorporate the contribution into your project as an experiment, even though this product or equipment would not generally maximize your affiliate’s needs and advantages.

Once every experimental project is complete, compare it to an earlier project that was based on the same design, but that do not include the experimental component. If the new component has a measurable benefit in terms of energy use, buildability, waste reduction, and resident happiness, consider integrating this component into future projects if doing so is judged cost effective or highly beneficial. Use the verification and review processes found in Section 16 “Project Review, Evaluation, and Reporting” to determine if a component is appropriate and beneficial for future use.

Volunteer Labor

Tacoma

If you have a regular volunteer group, utilize any special skills that your volunteers possess and create mechanisms for the skilled volunteers to pass their knowledge onto less skilled volunteers. Tacoma/Pierce County Habitat, for example, has a volunteer with the technical expertise to construct and cast radiant heating systems into the slab-on-grade foundation. Not only does he have constructed several radiant heat units for Tacoma Habitat, but he has also trained other volunteers in how to do so.

10. Meet Needs of Family

In fulfilling the Habitat mission of “decent housing” the house should meet all the needs of the family. In meeting the decent housing standard, consider the following needs:

- size of the family;
- adaptability of the house—consider whether a change of mobility or life situation will require expensive or difficult retrofits;
- cost and affordability;
- location;
- community; and
- accessibility.

The house should meet the following minimum accessibility standards for the 2003 ICC/ANSI A117.1 Standard for Accessible and Usable Buildings and Facilities:

- All toilets and showers in the house should meet the Building Blocks standards to enable grab bars to be easily and inexpensively installed at a later point in the house’s occupation.
- From Chapter 4: Accessible Routes—the house should meet the General, Accessible Routes, Walking Surfaces, Doors and Doorways, and Private Residential Elevators standards. In addition, excepting cases where the house and at least one main entrance are at ground level and require no stairs to access, the house should have space next to at least one exterior doorway to fit a ramp that complies with the Section 405 Ramps section.
- From Chapter 5: General Site and Building Elements—the house should meet the Handrails, Windows, and Stairways standards, where relevant.
- From Chapter 9: Built-In Furnishings and Equipment—where built-in furnishings and equipment have been designed and built into the house, the General, Dining Surfaces and Work Surfaces, and Benches built-in standards should be followed.

Meeting Family Needs *Seattle and Tacoma*

For Seattle/South King County Habitat and Tacoma/Pierce County Habitat, their state grants require they use an integrated design protocol or charrette in planning and designing projects. Kelly Morgan and Tom Gaylord of Seattle Habitat and Gomer Roseman of Tacoma Habitat all state that this process has improved the quality and integration of their projects, bringing the engineer, architect, construction manager, family services representative, and other stakeholders together early in the planning phase. This allows the needs and wants of the families to be expressed at a point in the project when their input can be easily integrated. The expressed needs and wants of the family should not be allowed to interfere with the basic goals of Habitat, to build decent, affordable housing. However, involving the family representative early in the process allows Tacoma-Pierce County Habitat to meet the specific needs of the family (such as any disabilities and size of family) and, where possible, to build in a family’s preferred area of the county and make basic landscaping customizations such as leveling and preparing room for a garden or play set.

In addition to these standards, all projects should be designed to accommodate the existing special needs of the family that will be occupying the house. Accommodations should be made for residents needing ramps, grab bars, specially sized toilet and bathing room facilities, non-standard electrical switch placement, and HVAC, ventilation, and materials choices that meet the needs of residents with severe dust, mold, and mildew allergies (as a simple benchmark for severity, consider whether the family member is forced to miss multiple days of school or work each month as a result of allergies).

The Habitat Neighborhood

Consider building a Habitat neighborhood in order to facilitate community building and neighborhood safety. Begin by acquiring a large parcel of land to create a Habitat development. Instead of building all the houses at once, build over several years and seek to build a Habitat



5 Stag Horn Villas community—Orlando Habitat

community where residents of earlier houses aid in building later houses. If properly incented families may volunteer to build later houses or make improvements to the development. Consider, for example, allowing <20% of the family's labor hours to be contributed toward a later Habitat house, providing job training in exchange for additional volunteer work, or doing additional landscaping or high performance upgrades for families who contribute additional volunteer work. This model for building community interest in high performance building also has the advantage of demonstrating improvements in best practices and building goals. For example, it is likely to reduce the waste stream as all scrap products can be centrally housed for reuse.

Building a Habitat Community Orlando

The Stag Horn Villas project is a multi-family community currently under construction by Habitat Orlando. The project consists of 58 townhomes in 10 buildings and is located on 3.9 acres in Orlando, Florida. Begun four years ago as an infill project, all the villas are ENERGY STAR certified and the project is Florida Green Building Coalition Gold certified and designed to foster a community amongst residents. The community feeling has been achieved through design by constructing shade porches that face another porch across a green area, allowing residents to visually see and interact with neighbors on a daily basis. When the project is completed, the residents will run their own condo association and will be receiving training from a professional management company and from Habitat Orlando, further fostering a sense of an organized community. In addition, by building villas simultaneously families are working together to complete their sweat equity hours and are forming friendships or associations prior to move-in. Already, Habitat Orlando reports that the families have a strong sense of community; for example, two families recently shared the cost of a rental truck to move into their new villas.

11. Minimize Burden of Maintenance and Cost to Homeowners

Maintenance

Minimize maintenance time and cost by selecting materials and equipment that have long warranties, are locally available, and can be repaired inexpensively and with easily acquired tools. Consider asking local hardware and home stores to make donations toward a basic maintenance kit that includes basic tools, CFL light bulbs, extra low-VOC paint, green cleaning supplies, filters, and any other supplies necessary for basic house maintenance.

Cost

Energy efficiency is the best way to minimize maintenance cost to homeowners. With payment of electricity and natural gas bills being the most expensive operating cost for homeowners in many areas of the country, the best way to save your families money is by building a house to at least ENERGY STAR standards. The three most important steps in achieving energy efficiency to reduce operating costs to your families are to:

- construct the building envelope to meet at least the ENERGY STAR performance path air sealing requirements;
- size HVAC systems correctly—use Air Conditioning Contractors of America Manual J software to size equipment, and Manual D to size duct work;
- seal and place the ducts to meet at least the ENERGY STAR performance path requirements;
- insulate the walls to at least the minimum R-value found in the IRC Table N1102.1/IECC Table 402.1.1 for your location;
- in heating dominated climates, insulate your foundation to at least an R-10; and
- insulate your attic to at least an R-40.

In addition, install ENERGY STAR rated appliances, fans and vents, and fenestration products whenever cost effective as defined in this Guide.

Longevity

Consider the longevity of appliances and major building components such as HVAC systems, siding, and the roof.

- Roof the house with shingles rated and guaranteed for a minimum of 30 years—ideally lifetime guaranteed shingles, or consider a metal roof.
- All siding should be rated and guaranteed to last at least 40 years in your environment.
- All exterior paint should be selected to last at least 10-15 years in your climate.
- All other systems and building components should be ranked in the top 25% of their product class in terms of expected longevity and warranty, if possible.

12. Thermal Comfort and Indoor Air Quality

Each house should be designed and constructed so that the interior space has high indoor air quality and maintains thermal comfort throughout the year. A comfortable and healthful conditioned space is largely a result of proper air sealing, ventilation, moisture control, and HVAC and duct design, so focus your efforts on constructing an extremely tight envelope and sizing the mechanical ventilation appropriately. Remember that your goal should be to “build it tight and ventilate right.”

Indoor airPLUS

The EPA Indoor airPLUS program is a high performance indoor air quality certification that can be added onto an ENERGY STAR certified project design. Once you have achieved ENERGY STAR building standards in your design, you may want to seek airPLUS certification as well. Whether or not you intend to seek this certification, the program’s construction specifications and verification checklist provide a useful starting point for assessing and improving your affiliate’s indoor air quality specifications and building practices (especially related to moisture management). The Indoor airPLUS verification checklist is an excellent post-build verification tool and your affiliate should use this checklist in your internal quality control verifications, adapting it to meet your needs, goals, and specifications. The airPLUS specifications and the accompanying checklist are available here:

http://www.epa.gov/indoorairplus/construction_specifications.html.

Air Sealing

Your primary indoor air quality goal should be to create a continuous air barrier in the building envelope through the use of products such as housewrap, tape, caulk, foam, weather stripping, gaskets, and sealant, and through the proper installation of vents, doors, and fenestration products. All seams, holes, and other breaks in the barrier should be sealed or filled—send a team of volunteers around before installing insulation, before hanging drywall, and after hanging drywall to ensure that every hole in the envelope is filled. Fill any wide cracks or gaps with foam board or another insulating material. To make sure the air sealing is done correctly, have a staff member perform caulking and sealing demonstrations and keep diagrams and checklists on the job site that list and then visually show what must be caulked, sealed, and filled with foam or foam board. Note that air sealing is the easiest and most cost effective manner of reducing household energy use. Unless you construct a tight building envelope, your blower door test will not meet the tightness goals set out in Section 16 “Verification” of <0.35 air changes per hour (ACH) or a leakage ratio of $<1.25\text{in}^2/100\text{ft}^2$ or $2.4\text{in}^2/100\text{ft}^2$ of surface area. Air sealing measures have the added benefit of keeping out bugs and rodents.



6 24" on center framing and sealed penetrations--TriState

Insulation

In extremely hot and cold climates (Climate Zones 1-2 and 5-7), more insulation is almost always better. However, past the point of cost effectiveness the insulation price increases while the energy savings benefit decreases dramatically.

A free tool for estimating cost effective insulation for your climate, based on zip code, was developed by the Building Envelopes Program (BEP) at Oak Ridge National Laboratory and is available at:

http://www.ornl.gov/sci/roofs+walls/insulation/ins_16.html.

The BEP also has an interactive calculator that measures whole wall R-value, which can be found at:

www.ornl.gov/sci/roofs_walls/calculators/index.html.

At a minimum, your house should be insulated to the following specifications:

- insulate your walls to at least the minimum R-value found in the IRC Table N1102.1/IECC Table 402.1.1 for your location;
- insulate your foundation to at least R-10; and
- insulate your roof to at least R-40.

Remember to make liberal use of the donated DOW foam board, an R-5 per inch value ($1/2'' = R-3$), in meeting your insulation goals.

Ducts

Design the size of the ducts and the HVAC load sizing together, using ACCA Manual J and D calculations for duct sizing. If possible, ducts should be located within the conditioned space rather than in an uninsulated attic and, if not, ducts must be insulated along their length to at least R-6 in hot and mixed climates and R-8 in cold climates. Ducts should also be air sealed at seams and joints with mastic. Proper duct sealing should be verified through a duct blaster test, details for which can be found in Section 16 "Verification".



7 Sealed ducts in conditioned space--TriState

HVAC

Size your HVAC equipment using ACCA Manual J Version 8 (including ventilation). This is a requirement of the ENERGY STAR and Builders Challenge program. Duct sizing uses ACCA Manual D. Filters should be a MERV 8 or higher.

Ventilation

Mechanical ventilation is especially important if you build an extremely airtight building as air will not be circulated and refreshed with outdoor air naturally. To appropriately plan and size your mechanical ventilation, follow ASHRAE Standard 62.2 for whole building mechanical ventilation. Whole house ventilation is necessary and should cycle at least 7.5CFM/person + .01 CFM/ft² floor area and the whole house ventilation should automatically run at least 1/3 of the time. In addition, the house should have local exhaust of at least 100 CFM intermittent in the kitchen and at least 50 CFM intermittent or 20 CFM continuous in each toilet, bath, shower, or laundry room.

If the intake vent is on the wall rather than the roof, it should be placed >10ft from the exhaust vent.

Pressure

Put transfer grills from each room to the central (open) area except in the cases of laundry rooms, powder rooms, closets, and pantries. If you do not wish to put in transfer grills, you must test with room-by-room pressure tests to verify that all rooms in the conditioned space of the home do not exceed +/- 2 Pascals pressure difference relative to the central areas of the home when interior doors are closed and the central air handler is operating.

Moisture

Follow the EPA Indoor AirPLUS requirements for moisture management, which includes construction specifications for water-managed site and foundations, walls, roofs, and indoor water management. For direction on how to achieve the requirements, download the Indoor AirPLUS Construction Specification Booklet and Checklist, both of which can be found at: http://www.epa.gov/indoorairplus/construction_specifications.html.

Safety

All water heating and space conditioning equipment should be located in a sealed combustion cabinet, direct vented, or power vented if in conditioned space.

Where combustion equipment is used or a garage is present, install a CO detector in or next to all living spaces, including one by each sleeping space. If your house plan has bedrooms in different areas of house, each sleeping area must have detector.

To ensure the safety and health of both your workers and families, select only materials that limit interior volatile organic compounds (VOCs), especially formaldehyde. The best methods of doing so are to: reduce or eliminate the use of whole floor carpeting; choose only wood products (including OSB) made with low-or no-VOC glues; and select only low-or no-VOC interior paints, coats, and primers. Where wood products with high levels of VOCs are used, they should be sealed with a low-or no-VOC varnish or other coating.

Wherever possible, follow the Builders Challenge guidelines for VOCs, which are as follows:

All adhesives should comply with the following maximum thresholds for VOCs:

- carpet pad adhesives: 50 g/L (excluding water)
- indoor carpet adhesives: 50 g/L (excluding water)
- wood flooring adhesives: 100 g/L (excluding water)
- subflooring adhesives: 50 g/L (excluding water)
- multi-purpose construction adhesives: 70 g/L (excluding water)
- paints, coatings, and primers applied to interior walls and ceilings: 50 g/L (excluding water).

In addition, installed kitchen and bath vanity cabinets should contain no added urea formaldehyde.

When installing carpeting, volunteers and staff must leave the house for at least 24 hours directly after the carpet has been unrolled to reduce exposure to VOCs during the period of greatest offgassing. If leaving the house for at least 24 hours is not possible, all workers must be equipped with properly sized respiratory safety equipment. Exposure to the high levels of VOCs in carpet can cause damage to the respiratory system.

In all homes, the soil should be tested for radon before construction begins and the house should be tested for radon upon the house's completion. Radon levels should never exceed more than 4 pCi/L, but ideally should be kept below 2 pCi/L. All houses in zone 1 or 2 (find your zone here: <http://www.epa.gov/radon/zonemap.html>) or located where the soil has tested positive for radon should have a radon detector installed. In addition to the radon detector, all houses in zones 1 and 2 and all houses located where the soil has tested positive for radon should have a radon prevention system. As radon prevention systems require periodic homeowner maintenance, the operation and maintenance of this system must be explained to the homeowner and included in the homeowner guide. Information on building a radon resistant home can be found at: <http://www.epa.gov/radon/pdfs/buildradonout.pdf>.

13. Materials

In making materials selection and design decisions during the planning stage of your project, consider the six following factors: local availability, minimization, climate appropriateness, safety, environmental footprint, and donations/discounts. Especially focus on selecting materials that meet the goals and priorities of the first four factors as they emphasize improving livability and affordability:

1. Local Availability

The first priority in materials selection is to utilize locally available materials and technologies and to use materials that are familiar to the contractors or staff who will be overseeing their use.

2. Minimization and Waste Reduction

Next, you should attempt to minimize the volume of construction materials used in the house. In wood framed homes this can be accomplished by utilizing advanced framing techniques (also referred to as Optimum Value Engineering), designing and constructing the house so that cuts and materials waste are minimized, and reusing scrap parts in later building steps. Minimizing materials will save you money and reduce the building's carbon footprint and environmental impact. Your goal should be to reduce your materials use by at least 25%. The first step in achieving this should be optimizing your framing through advanced framing techniques (you should seriously consider 2x6 at 24" on center wall framing and in-line framing techniques).

Waste Reduction

Metro Denver

Metro Denver Habitat saves materials and labor by building some components in a warehouse. Complex components such as window frames, door frames, partitions, window and door bucks, corners, and storage sheds are all built in a warehouse that is run by a member of the construction staff, with the assistance of three regular volunteers. Building in the warehouse not only helps regulate quality as the complex aspects of framing, etc. are carried out in a controlled setting, but it limits waste as cuts are precise and all scrap wood is centrally stored where it can be reused for other components.

DC

In order to reduce materials use and waste, DC Habitat uses 24" on center (California) framing and uses ICFs in the basement in order to eliminate the need for studs on this level. Habitat DC also recycles its excess concrete by creating concrete pavers for the rain garden; a task that can be easily given to short-term volunteers. DC Habitat, which has built more than 50 homes on one large plot of donated land, also uses 57 gravel recycled from a nearby demolition site below their slab on grade foundations. And in order to take advantage of the Dow blue Styrofoam XPS Insulation "blue board" donated to Habitat affiliates, DC Habitat Construction Manager Dave Gano has designed a header consisting of 2x12s and 4 pieces of blue board; in addition, double layers of blue board insulate the foundation and the basement level of each house.



8 Metro Denver warehouse for building components and storing scrap materials

3. Climate Appropriateness

The next focus in materials selection should be to use technologies appropriate for your climate zone. Select materials so that your house is not over- or under-engineered for your climate, is appropriately sealed, and only uses the HVAC equipment and mechanical ventilation necessary to maintain comfort and minimize energy bills. For detailed information about your climate and about climate appropriate technologies, the DOE Building America Program has detailed reports about best practices for each of the eight DOE Climate Zones (which are simplified IECC climate zones). Resources including a map of the DOE Climate Zones, best practice guides, and case studies can be found at:

http://www1.eere.energy.gov/buildings/building_america/publications.html.

A county-level guide to determining which climate zone your affiliate builds in can be found here:

http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/climate_region_guide.pdf.

4. Safety

To ensure the safety and health of both of your workers and families, select only materials that limit interior volatile organic compounds (VOCs), especially formaldehyde. The best methods of doing so are to: reduce or eliminate the use of whole floor carpeting; choose only wood products (including OSB) made with low or no-VOC glues; and select only low or no-VOC interior paints, coats, and primers. Where wood products with high levels of VOCs are used, they should be sealed with a low or no-VOC varnish or other coating.

Wherever possible, follow the Builders Challenge guidelines for VOCs, which are as follows:

All adhesives should comply with the following maximum thresholds for VOCs:

- carpet pad adhesives: 50 g/L (excluding water)
- indoor carpet adhesives: 50 g/L (excluding water)
- wood flooring adhesives: 100 g/L (excluding water)
- subflooring adhesives: 50 g/L (excluding water)
- multi-purpose construction adhesives: 70 g/L (excluding water)
- paints, coatings, and primers applied to interior walls and ceilings: 50 g/L (excluding water)

In addition, installed kitchen and bath vanity cabinets should contain no added urea formaldehyde.

5. Reducing the Environmental Footprint

Once you have integrated the first four material selection factors into your materials selection process and have minimized your waste stream, the next step is to consider the environmental footprint of your house. The most effective method of reducing environmental impact is to focus on reducing your project's carbon footprint by selecting materials with low embodied energy, such as recycled and locally produced materials. The best resource to date for information on the embodied energy of common construction materials is the Life-Cycle Inventory Database, produced by the National Renewable Energy Laboratory (NREL): <http://www.nrel.gov/lci/>. The Database is not specific to the construction industry, but does contain information on the embodied energy of board wood from various sources, wood products, metal products, and cement and concrete, as well as many other construction-related materials and processes. Note that you will need to register to use the LCI Database, but registration is free and allows immediate access.

For information on using recycled materials and recycling your own building materials, look to local developers, city and private recycling programs, residential demolition and remodeling companies, and neighboring affiliates. The EPA also offers resources and databases on finding green industrial materials suppliers and construction and demolition (C&D) materials recyclers through their website, found here:

<http://www.epa.gov/waste/conserve/rrr/imr/finding.htm>.

The Construction Materials Recycling Association lists contact information for construction recyclers by state; it can be found here: <http://www.cdrecycling.org/>.

6. Available Donations and Discounts

Integrate donated or discounted materials wherever possible, especially critical multipurpose materials such as insulation and sealants and also expensive, but essential equipment such as HVAC systems and hot water heaters. For more information on acquiring donated or subsidized materials from national partners, see MyHabitat.org. For details on contacting local manufacturers and suppliers to inquire about available donations and discounts, see Section 2 "Partnerships".



**9 Larabee Terrace donated blueboard--
Tacoma Habitat**

14. Location

In building a high performance house the location of the house is a key consideration. A high performing house should:

- have easy access to public transportation, essential services, and employment opportunities;
- have a minimal environmental impact; and
- be sited and oriented to minimize excavation and lot improvements and maximize the property's passive solar benefits.

Access

Convenient access to public transportation, necessary services, and employment is a critical component of a high performance location. Adequate access, as defined below, improves the livability and functionality of the house and also reduces the carbon footprint of the residents as they are able to commute, go to school, and obtain necessary goods and services by walking or taking public transportation.



10 The Bails Townhomes Community is located less than 0.5 miles from a Denver Light Rail station

Within no more than a half mile of the house there should be at least one public transportation stop or station for a form of transit that runs regularly from at least 8am to 8pm every day and provides a direct route to shopping, other essential services, and employment. Possible forms of public transportation include: buses, light rail, subways, and ferries. If possible in your area, choose a property that has access to multiple forms of public transportation. In addition, the neighborhood should have sidewalks at all points between the house and the public transportation stop, between the house and nearby schools, and between the house and nearby service facilities.

Within a half mile of the house there should also be at least four of the following service facilities:

- grocery store;
- gas station;
- convenience or hardware store;
- public school;
- library;
- community center;
- park;
- religious facility;
- public gym or athletic facility;
- doctors office, clinic, hospital, or dental clinic; and
- police or fire station.

Environmental Impact

As a key component of high performance housing is minimal environmental impact, the property on which the house is built should also be selected to minimize the environmental impact of construction and occupation. Strategies to achieve a minimal environmental impact include: infill development, reusing brownfields, and retrofits of existing buildings.

Infill development refers to building on vacant or underused parcels of land within an existing urban area or city center. This is likely the best way to build sustainably and to increase the likelihood of families having convenient access to service facilities and public transportation. Disadvantages to infill may include unusually shaped lots that require altering your house design, specific design code restrictions, existing on-site development that must be dealt with either through teardown or retrofit, and the higher cost of property in some urban areas. In city centers and urban areas that are either deliberately working to increase density or that are experiencing no or limited growth, consider asking the city, local infill development company, or infill advocacy organization for design guidance, assistance in tearing down existing structures, and discounted or donated parcels of land. A resource list with links to infill articles, reports, and guidebooks can be found at: <http://www.mrsc.org/Subjects/Planning/infilldev.aspx>.

Brownfields development refers to building on abandoned, idle, or underused property that has been contaminated—for example, former industrial sites, port areas, and landfills. Once cleaned, these brownfields can be redeveloped. Your affiliate may want to explore building on a brownfield as these properties are often located near city and economic centers and there may be tax incentives for building on a brownfield site. The EPA Brownfields Program offers information about brownfields in your area, existing partnerships for brownfield reuse, and incentives for brownfield redevelopment, which can be found at: <http://www.epa.gov/brownfields/>.

Retrofit of existing houses and unused or underutilized buildings lowers the environmental footprint of your project and can save you money. Consider retrofitting commercial buildings for multifamily apartments or townhouses, or retrofitting existing single family houses that have been foreclosed on or abandoned; these can often be obtained at a reasonable price. Note that retrofit construction requires a different set of materials, labor skills, and plans than new construction and that retrofit projects may not be appropriate for your affiliate.



11 The Rainier Vista phase 1 project features retrofit of existing rental housing into a mixed-income community of rental units, condos, and houses—Seattle Habitat

Developing the Property

Properties should be developed to maximize the natural advantages of the property, while minimizing the environmental impact of your housing design. High performance strategies for house siting and orientation include:

- **Reduce water and pollution runoff** by reducing or eliminating impermeable surfaces (i.e. concrete) from your landscaping and property. Replace impermeable surfaces with biopavers, gravel, or another hard, permeable material. Install adequate on-site water storage, runoff, and management drains, ponds, and caches. Other methods to limit pollution and water runoff include: installing a rain garden, and placing plants or bioremediating pavers along the edge of the property line or driveway.

- **Limit excavation** by selecting flat properties, placing all utilities lines and pipes in a trench, and situating that trench to align with any concrete work or other ground leveling/excavation work in order to limit labor and the volume of dirt that must be excavated and removed.
- **Work around vegetation.** Leave as many trees standing on the property as is feasible and safe. Especially in hot climates trees are a valuable tool for shade and cooling which will reduce summer air conditioning bills for your families.
- **Orient the house on the property** to maximize the property's passive solar heating your latitude and integrate passive solar elements into your design and materials selections. DOE has created free tools and resources that are useful in developing your passive solar designs and in making orientation decisions. A basic resource guide can be found at: http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/29236.pdf. To design a passive solar home that includes passive technologies, The National Renewable Energy Lab developed SUNREL, a building energy simulation software for design and energy modeling. It is found at: <http://www.nrel.gov/buildings/sunrel/>.
- **Dense housing development.** When your affiliate intends to build multiple units on one property, consider densely locating your housing so that a substantial portion of the property can be either turned into a park or left undeveloped in its natural state. Rather than single family suburban-style houses where each house has a small yard, build row houses, multifamily apartment complexes, or densely grouped single family housing units. While some municipalities require developments to leave a percentage of any new development in a natural state, many do not and you should seek to integrate this idea into your development plan.



12 Water runoff drains at Bails Townhome Community—
Metro Denver Habitat

House Orientation on the Property

Otero County

Otero County Habitat has eliminated east-west design, placing as many windows as possible on the south side of the house to allow passive heating in the winter. They also calculated the eave width necessary (16") for their latitude in order to minimize summer heat gain.

Evaluating a property

Purchasing property that is locationally high performing requires a methodical and formal consideration of a property's locational attributes. The most useful tool in evaluating the suitability of a piece of property for purchase is a checklist. Don't visit a piece of property without one. A checklist should list all of the essential locational attributes for easy reference and, ideally, it should be used in conjunction with a weighted evaluation that gives each attribute a different weight depending upon its importance to the overall property score. The weighted evaluation allows you to produce a concrete numerical rating of a property so that it can be ranked in comparison to other properties. (For an example of a weighted evaluation, see the Denver metro profile, below.)

Each checklist should be set up in a format that is easy to carry into the field and is no more than four pages long. To ensure that each attribute has been considered, each checklist should have a checkbox next to the attribute that the acquisitions staff checks once the attribute has been rated, discussed, or otherwise evaluated. Next, each attribute or question should be given a score, whether using a weighted evaluation or a simple rated checklist (i.e. 5=perfectly meets affiliate needs in this area and 0=meets none of affiliate needs in this area). The checklist should also have a designated space for comments or feedback so that additional information can be factored into the decision making process. This designated space can be located directly below each attribute or each section.

In terms of checklist organization, some attributes must or should be answered in the field; group these attributes together on the checklist so that they can be quickly answered on-site. On-site attributes include: fit and buildability of the lot, accessibility, and some of the family needs and preferences. Group together attributes that can best be answered in the office. In-office attributes include: price, connectivity, neighborhood characteristics, and safety and quality of schools. For in-office attributes that are less important and given a low weight in the evaluation, you will likely want to fill out these attributes after visiting the property as they are less important to the final decision than key attributes such as price, fit, and buildability.

The Checklist

While the specific needs and circumstances of each affiliate differ, each checklist or evaluation should take into account the following attributes and answer some or all of the following questions:

Price of lot: Does this lot fit into our budget? How does the lot price compare to other lots in this neighborhood? How does the lot price compare to lots in other neighborhoods or parts of the city/metropolitan area? Is this lot a good value (dollars/square foot and amenities provided)? Is the neighborhood zoned for single family houses, duplexes, multifamily housing, or some/all of the above? Will this lot be able to be used for multiple houses? Does putting multiple houses on the lot put it into our budget range? Note that you must consider the costs and characteristics of donated parcels of land—if they do not fit the needs of your affiliate, have high connection costs, or will be difficult to build on, their value may not be worth the initial savings from purchase price.

Fit of lot: How many houses or units could be built on the lot? How is the neighborhood zoned? Does building on this site contribute to sprawl or could building there contribute to a dense city/urban center? Will one of your existing housing plans fit well onto the lot? If not, can one of your housing plans be easily and inexpensively adapted to fit onto the lot? Does a neighboring or partner affiliate have a plan that you can use or adapt for the lot? Will the house you want to build fit into the neighborhood aesthetics? Does the lot allow you to build a house that meets your goals for passive solar, house orientation, solar power or solar hot water, septic tank location (if applicable), etc.?

Buildability: Does the property have an unusual shape, steep slope, poor solar orientation, poor soil, poor drainage, or structural deficit that will make building more difficult or expensive? Will any demolition need to be done? Is the demolition extensive and/or expensive? Does the lot have standing trees and will they need to be cleared before building or can they be incorporated into the landscaping design?

Code Compliance: Do local codes require building designs that fall outside of Habitat International's building criteria? For example, are there square footage mandates, required garages, or other code issues that will add costs to the project?

Hazards: According to local hazard maps, does this lot have a high hazard risk for radon, flooding, or for strong winds? Are these hazards region-wide (i.e. hurricanes and earthquakes) or localized? If localized,

can mitigation strategies (i.e. specialized design) reduce the risk to the house's safety and structural integrity? Are the available mitigation strategies prohibitively expensive?

Accessibility: Can the property be easily accessed by construction equipment during the construction process? Is the property in a neighborhood with sidewalks? Is there either ample street parking or room for a driveway for the family's car? Is the house located within walking distance of essential services? Is the house within walking distance of public transportation that connects to essential services, the main city center, and common areas of employment?

Connectivity: Are there sewer, electric, water, natural gas, and telephone/internet mains or lines available to connect to at the property line or will any of these need to be brought in from further away? Is curbside garbage and recycling service available?

Family needs and preferences: Consider some of the following characteristics: safety of the neighborhood, quality of the schools, proximity to city center, proximity to areas with employment availability, availability of public transportation, sidewalks and walkability of the neighborhood, proximity to necessary services such as grocery stores, and aesthetics of the neighborhood and how the Habitat house will compare with those aesthetics. A good way to find out the preferences of families in your area is to survey families on the most important location attributes of a home and appropriately weight the factors based on survey responses.

Location Checklists

Metro Denver

Metro Denver Habitat has formalized the process of site acquisition to ensure that each site purchased meets the needs of the families and the needs and limitations of their affiliate. Several years ago Metro Denver surveyed service families asking them to rank their priorities for housing location. The survey revealed that the service families highly value factors such as a low crime rate, school district quality, and accessibility to public transportation. Based on the results of this survey and their own internal considerations (especially the price and size of the lot) they developed an excellent rating system and checklist with weighted factors that is used to compare the attributes of each potential site. Originally created by a volunteer who had worked in government asset management, the checklist depends upon both inputs by the Habitat site acquisition manager and a team of site acquisition volunteers, who research statistics such as incidence of crime and school district test scores and free lunch programs.

Originally created to justify "why this property" to the board and to ensure that each property is objectively considered, Land Development Manager Andy Blackmun reports that because of the checklist, they now pay more attention to the technical aspects of the lots (grade, connections, etc.) as well as to issues of general desirability and transportation. And while price continues to be the ultimate determining factor in site acquisition, the checklist has improved Metro Denver's capacity to consider the value of a lot rather than simply the sticker purchase price. The Denver Metro Habitat Property Selection Matrix is Appendix 1 to this guide.

15. Water Efficiency

The most important water efficiency elements for Habitat houses are:

- minimizing and simplifying internal water piping;
- installing water saving devices; and
- landscaping so that families do not need to water or fertilize their landscaping in order to keep it alive and healthy.

Internal Piping

Design the plumbing to minimize the distance all hot and cold water is piped and, wherever possible, use straight, short runs to limit the potential for future breaking and leakage. For hot water piping especially, design the house so that the primary hot water appliances and fixtures (including the bathroom and kitchen sink) are within 20 feet of the hot water heater and so that no fixture or appliance is more than 50 feet from the hot water heater. The system should also be designed so that the piping between the hot water source and any fixture or appliance holds no more than 0.5 gallons. If you are using tankless hot water heaters the water heaters should be positioned as close to the primary appliances and fixtures as possible.

Once construction has been completed, your internal piping system should be verified using pressure-loss testing and visual inspection to ensure that there are no leaks and that your system maintains a static service pressure of no more than 60psi.

Water Fixtures

All water saving devices (toilets, heads and faucets, water heater) should be WaterSense certified to be low-flow.

WaterSense Certification

One certification program you may want to consider being involved with is the EPA WaterSense Single Family New Homes program, a water efficiency certification and labeling program with the goal of reducing both interior and exterior water consumption by 20%. Information on becoming a builder partner can be found here: <http://www.epa.gov/watersense/partners/builders.html>.

The program involves independent verification that the water system has no leaks and has a static service pressure of not greater than 60psi, designing the hot water system so that the piping/manifold between the hot water source and each fixture holds no more than 0.5 gallons, installing WaterSense rated fixtures and appliances, and limiting water use in landscaping. Full specifications for building a WaterSense certified house can be found here:

http://www.epa.gov/watersense/docs/home_finalspec508.pdf.

Water Savings Measures Otero County

Water conservation and efficiency is important nationwide, but particularly so in regions and climates with scarce water resources. In these regions, landscaping accounts for a large percentage of water use, especially when turf grasses for lawns and non-native plants are used. Where plants are used in landscaping drought tolerant plants should be selected. Otero County Habitat in New Mexico, for example, eliminates the lawn altogether, replacing lawn with gravel and limiting plants to mesquite trees that, once established, require no additional watering. A Build Green New Mexico partner, Otero County Habitat also features a central plumbing wall that limits plumbing runs to 20 feet or less and some low-flow fixtures.

Reference:

<http://www.zianet.com/OteroHabitat/home.htm>.

Landscaping

While the WaterSense specifications for interior water use should be followed, their landscaping water consumption limitations need to be tighter for Habitat affiliates in order to meet the Habitat goal of reducing operations cost and maintenance for families. Instead we recommend eliminating turfgrass altogether and replacing with a drought tolerant ground cover in all areas of the country except where turf grass can survive without additional watering or fertilization. Consider xeriscaping the yard, a system of landscaping and gardening that reduces or eliminates the need for supplemental irrigation. In some areas, terms such as water-conserving landscapes, drought-tolerant landscaping, zeroscaping, and smart scaping are used instead of xeriscaping. Typical plants used for xeriscaping are native to the area, and require little-to-no supplemental fertilizer. In addition, to prevent water runoff from the property, non-permeable paved areas should account for no more than 10% of landscaping area. If your affiliate is located in an area with moderate or greater rainfall, to further reduce runoff you may want to install a rain garden—talk to local nurseries or hardware stores about donating plants that are mature enough to need only minimal watering after the first year.



13 Rain Garden built by DC Habitat



14 Otero County Habitat hot-dry landscaping

The vegetation you plant must not need additional watering after the first year, must not need extensive pruning or maintenance, and should consist of indigenous plants wherever possible. Some families may express interest in planting and maintaining a garden. If you have the resources to clear and prepare a garden area, you are encouraged to do so. You may be able to recruit local nurseries to teach the family how to care for a garden and/or to donate healthy vegetable seeds or plants for the garden. Ultimately, the affiliate involvement should be limited to garden preparation and families rather than the affiliate being responsible for planting and maintaining the garden.

16. Project Review, Evaluation, and Reporting

After every project your affiliate must undertake a process of project review, evaluation, and reporting. Doing so is necessary to improving building practices and performance and to communicating your goals and mission to your board, families, and community. Standardizing and formalizing these processes will, in the long term, make them more efficient, easier to perform, and more useful. This post-construction stage involves several key elements, including: formal verification through third-party assessment, document review, internal build evaluation and comparison, and internal and external reporting.

Verification

Verification is the most important part of the project review process and the best measure of whether you are meeting your energy savings and air tightness goals. Each of your projects must be quality control verified through both testing and visual inspection, including the following procedures:

- Once completed, a certified third-party rater must perform a blower door test to test for air leakage. Your blower door test should yield a leakage ratio of $<1.25\text{in}^2/100\text{ft}^2$ or $2.4\text{in}^2/100\text{ft}^2$ of surface area. If you are testing for ACH, your blower door test should show <0.35 ACH.
- Unless your ducts are in the conditioned space, you must have a duct blaster test and that should show a duct leakage rate of $\leq 5\text{cfm}/100\text{ft}^2$. Note that percentage rated air handler flow is no longer accepted by the ENERGY STAR program and most software, but if using this method your ducts should have a leakage rate of $<5\%$ of the total air handling system.
- If the house does not have transfer grills between rooms, you should perform room-by-room pressure tests to verify that all rooms in the conditioned space of the home do not exceed ± 2 Pascals pressure difference relative to the central areas of the home when interior doors are closed and the central air handler is operating.
- Both senior construction staff and the third-party rater should walk through the house with a quality control checklist after framing, before hanging drywall, and after hanging drywall to ensure that all work has been done properly and according to the design specifications.
- The house must pass all inspections by engineers and local building officials as well as the inspections necessary for any green building and ENERGY STAR certification you are seeking.

Evaluate Build

After every build evaluate the build and any related training through discussion with staff, volunteer leads, contractors, and the family or family representative. It is highly recommended that you bring together all key stakeholders from the design charrette for a post-construction formal project evaluation to discuss the project's successes, problems or issues that came up during the project, and suggestions to remedy those issues or improve the next build.

Your formal project evaluation meeting should include review and assessment of the following project components:

- Documentation and education materials (see Document Review section below)
- Project timeline—what changes need to be made to future project timelines to accommodate realities of construction time, inspections, verification, and applying for ENERGY STAR and green certifications;
- Scopes and division of work among contractors, staff, and volunteers;
- Communication between all stakeholders involved in the charrette (the project team) and between project team and local building officials;
- New high performance materials and products used on the build;
- New construction processes and techniques (i.e. advanced framing);

- Verification tests, quality control inspections, and results;
- Reporting—develop a plan for reporting results of build, including successes, lessons learned, and verification results (including the HERS Index score and air tightness).

If you are unable to hold a formal evaluation meeting, assign a staff member to solicit feedback from contractors, volunteer leads, and other staff as they finish their work. All feedback and suggestions should be documented and your staff should use this feedback as a starting point for planning improvements in the next build.

Upon completing a house, review the cost-benefit of the house in terms of its final modeled HERS score (as determined by your certified third-party rater) versus expected monthly utility bills. Work with the local utility company on an agreement to have the monthly utilities information sent to you so that actual monthly energy usage can be compared to the modeled energy use and to previous houses you have built. In states that have “Sunshine” laws, utility bills are available to anyone who requests them; send a letter on your letterhead to the utility requesting the bills. In this way you can determine how effective your high performance upgrades have been in terms of energy and cost savings. If possible, have a smart meter installed on the house—this will allow you to see which of your energy efficient measures has been most effective and will improve your building in the future. Your state Habitat official, third-party rater, and utility company may all be good sources of information on smart meters and how to acquire one for your project.

Document Review

After each build review all your documentation, including your building plan and specifications, construction management plan documents, building checklists, scopes of work, the timeline, contractor agreements and contracts, construction “how to” guidelines and information for staff and volunteers, educational materials, and homeowner’s manual. Especially look over documents related to all new additions to the project, such as new building plans, materials, products, or processes, or additions to the homeowner’s manual and educational materials. At a minimum, ask volunteer leaders, construction staff, and contractors for their input on document clarity, quality of educational materials, and if there are any changes to checklists, specification drawings and explanations, or other documents that would be helpful to them in the next build.

Document Review

TriState

At the end of each build, Randy Wilkerson of TriState Habitat reviews all documents, checklists, materials lists, plans, and budget spreadsheets. Reviewing all documents is essential to meeting TriState’s goal of building continually better houses as the review clarifies the building process, ensures that the documentation and checklists were clearly understood and were followed throughout the building, and allows post-build budget analysis to be carried out. At this time, training materials are edited, new features and processes are added into the documentation and homeowner’s guide, and all materials are updated so as to be ready for the next build. In addition, compiling the final expense and budget spreadsheets, 3rd party HERS rating, and early utility bills allows Randy to ascertain if the added cost of any experimental efficiency and sustainability features are made up in reduced utility bills and maintenance costs for the family. And once the this determination has been made, a spreadsheet on HERS scores, building features, budgets, and expected savings is given to the board in order to justify the high performance features.

Reporting

After completing your build evaluation, share the results and lessons learned with your board, neighboring affiliates, and the community.

For each project, create a worksheet with the house cost (including cost justification), the final HERS score, your house's blower door and duct blaster test results, a list of high performance features, and the expected annual savings to the family. Present this information to your Board in order to quantitatively demonstrate the value of high performance building.

To raise community awareness of your affiliate, its high performance building practices, and the importance of high performance building in general, you should seek to utilize local media sources and special interest groups. For example, write up a brief article for a local paper or neighborhood newsletter, contact a local radio or television station and ask them to feature your project, or go speak at a local neighborhood or home builders or utility meeting. Often, inviting media and concerned staff members to the rater's final testing of the house (blower door and duct blaster) will generate significant interest and provide an ideal educational opportunity. For more ideas on how to reach out to the local community, see Section 5 "Education and Training—Community". In your media outreach it is important to emphasize the merits of high performance building. To aid you in doing so, include facts in your outreach such as: the HERS number and what that means in terms of energy efficiency savings, the expected annual utility bills and energy used, the annual monetary savings to your families, and other benefits such as increased indoor air quality/healthfulness.

For your first ENERGY STAR, LEED, or Builders Challenge certified home or to celebrate an affiliate milestone, you may want to seek out partners and hold a Habitat High Performance open house that features all of your excellent building practices and educates the community about these practices and their advantages over traditional building practices.

Reporting NYC

Habitat-NYC's Senior Project Manager for Housing Development, Gina Buffone, states that testing is their most important build evaluation tool. The testing required by the by the New York State Energy Research and Development Authority (NYSERDA), which includes a duct exhaust test and a blower door test, has been highly beneficial to improving their building quality and performance. Early duct exhaust tests, for example, revealed leaky and back drafting ducts. Based on these results this affiliate evaluated and improved their duct design and installation processes and their ducts now meet ENERGY STAR and LEED levels. Habitat-NYC's testing and independent evaluations are done by Steven Winters and Associates, a building science consulting firm, whose services Habitat-NYC acquired through a green building grant. Where an affiliate cannot obtain a grant to pay for third party testing and verification services, Habitat-NYC notes that many local companies will either donate the test or testing equipment or offer a subsidized rate to Habitat affiliates.

Seattle

Seattle/South King County Habitat reiterates that testing is the most important aspect of build evaluation. The blower door test especially evaluates whether they have met their air tightness and energy efficiency goals and provides an opportunity to improve air sealing quality practices both on that build and on future builds. Seattle Habitat also evaluates their projects over the long term by monitoring energy consumption at the meter. By entering into an agreement with the local utility company, Seattle Habitat is able to obtain monthly energy consumption data from each of their houses, which enables them to measure the impact of their energy efficiency measures on household level energy use. Through this data, the affiliate can determine the most effective measures to save their families energy and money, increasing the affordability and sustainability of their

Profiles

Each of the nine affiliates or affiliate partners interviewed for the case studies in this guide is profiled in this section. Profiles of each affiliate include the following information:

1. Basic information: name, location, and number of houses built
2. High performance details: certifications, HERS scores, and partnerships
3. Main energy efficiency and high performance features and practices
4. Innovative practices
5. Recommendations from senior construction and green building staff members on how to improve your own affiliate's construction
6. Contact information

Addison Homes and Greenville Habitat: Todd Usher, owner of Addison Homes, began his relationship with Greenville Habitat in Greenville, South Carolina by introducing Greenville Habitat to the Earthcraft House program in Atlanta. Addison Homes ENERGY STAR and Earthcraft certifies 15-20 homes per year as a third-party verifier (including blower door, duct blaster, and infrared inspection tests), does REMRATE energy modeling for Greenville Habitat, and consults on energy efficient, high performance building. Addison Homes has consulted on matters such as optimization of framing, air sealing, duct design, housewrap and insulation installation, and improving indoor air quality and thermal comfort.

Todd's recommendations to Habitat affiliates are: to air seal and caulk everything as doing so is "one of the easiest, least expensive" energy efficiency steps an affiliate can take; to consult and partner with energy efficiency and building professionals in order to optimize your building performance and investment; and to share knowledge and best practices with other, nearby affiliates.

Todd Usher, Owner

Contact: 864-848-2667

Website: www.addison-homes.com



15 Volunteer blower door test

Danville Habitat builds several houses each year and completed four in 2009. All of their houses are Earthcraft Virginia and ENERGY STAR certified, with their Earthcraft projects receiving HERS scores in the mid-50s. They have completed five Earthcraft homes that have saved families 40%-50% on their utility bills. Data is provided through a partnership with the local utility company. High performing features of Danville Habitat's projects include a tankless hot water heater, extensive air sealing that gives their houses an air infiltration rate of less than 10%, and a waste stream reduction of 30% overall and 90% for cardboard.



16 Earthcraft Virginia certified house

Marlin Yoder, Executive Director, recommends that affiliates pay attention to air infiltration first when seeking to improve their housing performance as this is a very simple place to start that yields great results. Marlin also recommends focusing on the sustainability of the house rather than simply energy efficiency, because this incorporates necessary elements such as indoor air quality and waste reduction. To achieve greater sustainability both in your own houses and in the greater community, affiliates should seek out and form robust partnerships with local and regional green building programs, utilities, schools, and any other organizations that may be able to provide advice or assistance,

Marlin Yoder, Executive Director

Contact: (434) 793-3630

Denver Metro Habitat builds 30-40 houses per year in the Denver, Colorado metropolitan area. Their HERS average score for houses built in the past year is a 57 and they are active in multiple green building programs. Green building certificates Denver Metro has received include: Five Star Plus ENERGY STAR, Builders Challenge, and LEED, and they are currently building a 24 unit Green Communities certified project.



17 Bails Townhome Community—Green Communities certified

Denver Metro's main recommendations to other affiliates are to get staff buy-in by going slowly, having a good argument for inclusion of new technologies, materials, and processes, and adding components that do not overwhelm either the staff or volunteers. Doing special projects or experiments such as a LEED certified or Builders Challenge house is an excellent tool to determine what you can and cannot do with regular houses. Construction Manager Bruce Carpenter stresses the importance of having a transparent and thorough evaluation process, which includes getting feedback from all involved staff.

Bruce Carpenter, Construction Manager and Andy Blackmun, Site Development Manager

Contact: 303-534-2929

Website: <http://www.habitatmetrodenver.org/>

Habitat New York City builds and renovates both condominiums and single family houses in all five boroughs of New York City. Since 1984 they have completed over 220 homes. Their recent projects have all been ENERGY STAR certified. They have completed one LEED Gold certified project and are working on one LEED multi-family project. NYC Habitat has also partnered with the New York Energy and Research and Development Authority (NYSERDA), the Partnership for Advancing Technology in Housing (PATH), and Steven Winters Associates, Inc., and organized the 2007 Habitat for Humanity Affordable Housing Green Building Symposium.

NYC Habitat's Gina Buffone recommends that in order to achieve high performance building affiliates partner with a good green consultant; educate themselves and their staff about simple, smart, high quality construction; improve building through testing; and build an airtight house, then use healthy materials inside the house. And most importantly, Gina recommends that affiliates not be afraid, reminding that if you start slow, achieving high performance building is easier than you think!

Gina Buffone, Senior Project Manager for Housing Development

Contact: 212-991-4000

Website: <http://www.habitatnyc.org/>



18 Atlantic Avenue Residences--LEED Gold certified project

Habitat for Humanity of Washington DC builds approximately 10 houses per year on their 53-lot development in the Deanwood neighborhood of Northeast Washington, DC. Over the past year their houses have been achieving a HERS score of 74-75 and have been ENERGY STAR certified. The houses are located in close proximity to public transportation (both a metro station and bus lines) and feature numerous recycled and high performing materials, including recycled gravel and rain gardens with recycled concrete pavers, permeable pavers on the driveways, ICFs in the basement, and Hardiplank siding.



19 Deanwood housing development

Dave Gano, Director of Construction and Land Development, recommends that affiliates take the transition to high performance building slowly, changing no more than a few processes and materials at a time in order to gain staff buy-in and ensure that the new materials are high performing and consistent with the capabilities of a volunteer labor force. In addition, Dave recommends taking advantage of and utilizing the materials and technologies donated to Habitat affiliates or given at a subsidized rate. DC Habitat, for example, uses multiple layers of donated DOW blue board to insulate walls, foundations, headers, and attics. And finally, to reduce waste Dave recommends reusing materials onsite as often as possible; DC Habitat, for example, has a central cutting station for their projects and has volunteers cast leftover concrete into stepping stones for the rain garden.

Dave Gano, Director of Construction and Land Development

Contact: 202-882-4600

Website: <http://www.dchabitat.org/>

Habitat for Humanity of Orlando in Orlando, Florida has been building single-family homes since 1986. In 2009 they built 17 town homes, all of which were ENERGY STAR certified. Four years ago Habitat Orlando began developing their first multi-family community, Stag Horn Villas, which is Florida Green Building Coalition (FGBC) Gold certified in addition to ENERGY STAR certified. The average townhome in this community, in 2009, received a HERS score of 72 and includes numerous high performing features, including: white roof shingles; a shade porch; low-VOC interior paint; recyclable carpeting; and security features such as a burglar alarm system, monitored fire sprinklers, and site illumination.



20 Stag Horn community

Habitat Orlando achieves its high energy efficiency through a combination of a good building design, careful construction, and the addition of green features. They made the decision to participate in the ENERGY STAR and FGBC rating programs as the affiliate's senior staff recognize that formal energy ratings and certifications are highly beneficial to both the affiliate and their families. According to Director of Construction Terry Eckert, "number one, of course, we get the ENERGY STAR® certification, which we think is really important for our homeowners to see they will have a low operating cost, and also to be able to show prospective donors and sponsors that we're in the forefront of what's happening in the building industry right now."

Terry Eckert, Director of Construction

Contact: 407-298-4807

Website: <http://habitat-orlando.org/>

Otero County Habitat in Alamogordo, New Mexico builds about four houses per year in the Alamogordo and Tula Rosa area. All houses in 2009 are Five Star ENERGY STAR certified and have a HERS score of between 60 and 70. In addition to being an ENERGY STAR partner, Otero Habitat is part of the Build Green New Mexico program and recently began working to develop a near-zero energy project with the help of energy efficiency consultants at, ConSol a member of the Building America Building Industry Research Alliance (BIRA) team. Located in a desert environment, Otero Habitat focuses on the solar orientation of their houses on the lots and passive solar heating through window placement and thermal mass.



21 Otero County project

Otero Habitat recommends to affiliates that they get involved with ENERGY STAR as it gives a good map of where to go, then move onto LEED or other green buildings programs. Jay Harroll, Building Committee Chair, has also found that paying professionals to install insulation is cost effective as the professionals can guarantee their work to be at ENERGY STAR minimum levels. In addition, he recommends finding out the interests and skills of long-term volunteers in order to optimize your utilization of volunteer labor. For example, he has found that volunteers are very interested in electrical and interior work and has volunteers experienced in both electrical and roofing, which allows Otero Habitat to install roofing and perform electrical work with largely volunteer labor.

Jay Harroll, Building Committee Chair

Contact: (575) 437-6562

Website: <http://www.zianet.com/OteroHabitat/home.htm>

Seattle/South King County Habitat builds 16-20 houses per year in Seattle and the surrounding metropolitan area. In addition to new, single family homes, Seattle Habitat builds multifamily units in the City of Seattle and has rehabilitated some existing homes. Recent houses have met the Evergreen Sustainable Development Standard (ESDS) and are ENERGY STAR certified, receiving a HERS score of almost 100 due to their use of electric resistance heating and heat recovery ventilators. Seattle Habitat's recent projects have featured a charette design process, partnership in design with Building America staff and LEED providers, and WaterSense certified appliances and fixtures.



22 Westway home rehabilitation project

Tom Gaylord and Kelly Morgan at Seattle Habitat recommend as the main criterion for making decisions looking at whether or not a particular design element or decision serves the family. The needs of the family, particularly the need for affordability take priority over other considerations and so all sustainability decisions should be modeled for cost effectiveness. Seattle Habitat receives modeling assistance from Washington State Habitat and Building America affiliates at Washington State University. Seattle Habitat also recommends evaluating a build through both verification testing (i.e. a blower door test) and monitoring a house's energy use over several years with the help of meter readings from the local utility. Though tracking energy use has just been implemented by Seattle Habitat, the affiliate expects that tracking will allow them to demonstrate the cost effectiveness of their energy efficiency and high performance upgrades.

Tom Gaylord, Site Development/Architect and Kelly Morgan, Site Development/Green Specialist

Contact: (206) 292-5240

Website: <http://www.seattle-habitat.org/index.shtml>

Tacoma/Pierce County Habitat built 16 houses in 2008 and is in the process of building a 25-unit development called The Woods at Golden Given. All of Tacoma Habitat's recent projects have been ENERGY STAR certified and The Woods is expected to obtain LEED Silver certification. They have worked with Washington State University Energy Outreach and the Building America Program and employ a charette in their housing design process. Key sustainable features of their projects have included solar panels, radiant in-floor heating, occupancy sensors, an on demand gas hot water heater, low VOC paint and adhesives, and formaldehyde free cabinets and engineered wood.

Tacoma Habitat recommends that other affiliates consider climate and build houses that fit the climate, but are not overdesigned. For example, in the mild climate of the Pacific Northwest (DOE Climate Zone Marine), insulating beyond the R-31 walls Tacoma Habitat employs does not save enough energy to justify the added expenditure. In addition, Site Development Director Gomer



23 Larabee Terrace Project

Roseman urges other affiliates not to be afraid to experiment with new designs, materials, equipment, and other sustainable features, noting that all experiments must be evaluated against their cost and benefits to the homeowner. Once a project is complete, affiliates should test the house to ensure that the energy and air quality goals will be met using (at minimum) blower door and duct blaster tests. In addition, Tacoma Habitat has been experimenting with detailed energy use monitoring in their different houses. By monitoring, for example, two almost identical houses—one that uses electric baseboard heating and one that uses radiant heating—they will be able to quantitatively determine how much energy and money the radiant floor heating is saving their families.

Gomer Roseman, Site Development Director

Contact: 253-627-5626

Website: <http://www.tpc-habitat.org/>

TriState Habitat builds single family houses in Ohio, Kentucky, and Indiana. TriState's lowest HERS score to date is a 50 on a house that achieved ENERGY STAR, LEED, and NAHB Gold certification. In addition, TriState partners with ENERGY STAR and with NAHB for both the National Green Building Program and Certified Aging in Place program. Their houses save families on average \$409 per year in operating costs. High performing features and technologies in their projects include Blown in Blanket System® in the exterior walls (achieving a wall value of R-30+, blown insulation of R-50 in the attics, a 92% efficient furnace, a Rinnai tankless water heater, extremely airtight construction practices, and drought tolerant landscaping.



24 Holmes House, HERS Index score of 50

Randy Wilkerson, TriState's Construction Operations Manager, is involved in teaching community members, local real estate agents, and building industry professionals about best practices building, and is dedicated to continually improving building performance both at TriState Habitat and throughout TriState's service area. Randy recommends that the key to improving your affiliate's high efficiency, high performance building is in the development of the building process. Each aspect of the planning, building, reporting, and evaluation process should be scrutinized and continually improved. Elements to consider in developing the process include building relationships with energy efficiency professionals; designing houses using a whole house design process that accounts for the needs of the family, is resource efficient, and utilizes climate appropriate and volunteer friendly technologies; creating a construction management plan and supporting documentation that integrate high performance building practices and materials; controlling quality on the build site; and reviewing and evaluating each build through independent testing, document and materials review, budget tracking, and disseminating build results and data to the board, community, and other stakeholders.

Randy Wilkerson, Construction Operations Manager

Contact: 513-942-9211

Website: <http://www.habitat-TriState.org/>

PROPERTY SELECTION MATRIX		Address / Type of Development	
Habitat for Humanity of Metro Denver Properties		Site:	
These site selection criteria are intended to evaluate individual sites for potential acquisition by HFHMD.			
WEIGHT:	RATING:	3 Good	
3 - 5 Very Important to crucial		2 Neutral	
2 Important		1 Poor	
1 Minimal Importance		0 Doesn't meet criteria	
* Note: Sites receiving a score of "0" in some critical criteria may be precluded from further consideration			
TECHNICAL SITE REQUIREMENTS		WEIGHT	X RATING = SCORE
1. Size * : The site must be of a size that supports the intended construction, whether single family, attached units (duplexes) or multi-family. Site size will vary depending on jurisdictional requirements for the type of development, configuration and neighborhood character. All sites which are considered for use should be of adequate size.		5	0
2. Topography : Minimal slope is desirable. The following scale is suggested: 3 (good) site slope of less than 2%, 2 (neutral) site slope of 2% - 4%; 1 (poor) site slope of greater than 4%; 0 (doesn't meet criteria) site slope of greater than 6%		4	0
3. Flood plain* : The site should not be located in the 100-year flood plain. 3-good-not in flood plain, 0-doesn't meet criteria - in flood plain		4	0
4. Planning/Zoning : The proposed site use should be compatible with applicable City or County planning/zoning; or if not compatible, it should be easily modified to conform. 3 (good) consistent w/planning, 2 (neutral) minor variation w/planning, 1 (poor) major variation w/planning, 0 (inconsistent/not compatible) Generally R-1 for single family, R-2 for duplex, etc.		4	0
5. Shape : A square or rectangular shaped site is desirable. The following criteria is suggested: 3 (good) if site is square or regular rectangular shape; 2 (neutral) if site is an "L" or triangular shape; 1 (poor) if site is another shape making development difficult.		3	0
6. Demolition/Abatement : The site should be free of, or require minimal demolition. Existing structures should not requirre extensive asbestos and/or lead paint abatement. 3 (good) minimal demolition required and no abatement, 2 (neutral) moderate site demolition required and minimal abatement, 1 (poor) significant site/building demolition required and/or extensive abatement of existing structures.		3	0
7. Site Contamination : The site should not be contaminated or have materials which prohibit development & are considered hazardous, such as heavy metals, PCBs, in-ground asbestos, etc. 3 (good) no problems, 2 (neutral) minimal problems, 0 EPA site or significant remediation		3	0
8. Soils/Geologic Issues : The site should be free from soils/geologic implications, such as expansive/collapsible soils, very high ground water table, etc. 3 (good) no soils soils/geologic obstacles, 2 (neutral) minimal soils/geologic issues, 1 (poor) significant soils/geologic issues		3	0
9. Water : Municipal water service should be available with minimum pressure of 60 psi and capable of providing domestic water service. 3 (good) only water service lines are needed, 2 (neutral) minimal main extension required, 1 (poor) major main extension required		3	0
10. Sanitary sewer : The site should have access to a municipal sanitary sewer system able to provide sanitary service. 3 (good) only service line needed, 2 (neutral) less than 200-foot main extension, 1 (poor) more than 200-foot main extension required.		3	0
11. Other Utilities : The site should have reasonable access to natural gas, telephone, electricity service and cable television. 3 (good) all utilities readily available, 2 (neutral) extensions of less than 200' required, 1 (poor) extensions of greater than 200' required		2	0
12. Easements/Restrictions : The site should be free of easements (utility, access, ditch etc.) or deed restrictions which may affect development. 3 (good) no easements; 2 (neutral) one easement; 1 (poor) greater than one easement		2	0
13. Ease of Title Transfer : Clear title to the site must be available. Factors to consider include time required to obtain title & difficulty of transfer. 3 (good) no difficulties, 2 (neutral) little difficulty, 1 (poor) difficult or lengthy		2	0
Subtotal		41	0
SOCIAL, SOCIETAL & SERVICE CONSIDERATIONS		WEIGHT	X RATING = SCORE
1. Neighborhood Crime : Home sites should not be located in high crime areas as HFHMD families have a strong desire to be safe and free of criminal activity. 3 (good) below average crime rate; 2 (fair) average crime rate; 1 (poor) above average crime rate		5	0
2. Site Desirability * : The site should have surroundings which provide a desirable environment for families; factors to consider include quiet, close-by amenities, lack of industrial development, lack of excessive traffic, etc. 3 (good), 2 (neutral), 1 (poor)		5	0

3. Public Transportation: Public transportation to / from the site should be available. 3 (good) bus stop adjacent to site, 2 (neutral) bus stop within 1/4 mile, 1 (poor) bus stop more than 1/4 mile, 0 (doesn't meet criteria) bus stop more than 1 mile	5		0
4. Proximity of Schools: The site should have ready access to schools. Elementary schools should be located such that children can walk to school without crossing major streets, or ride a school bus to school. Middle and high schools should be accessible by either walking, or by school bus, or public transportation. 3 (good) fully meets criteria; 2 (neutral) marginally meets criteria (violates one); 1 (poor) does not meet criteria (violates two of the criteria)	4		0
5. Quality of Schools: High quality schools are desirable. For purposes of evaluation, quality is determined by two criteria; CSAP score and the % of students participating in a school lunch program. Above average CSAP scores and a lower level of participation in a school lunch program are desired. 3 (good) above average CSAP and below 40% participating in school lunch program; 2 (average) average CSAP scores and about 40% participating in school lunch program; 1 (poor) below average CSAP and above 40% participating in school lunch program	4		
6. Surrounding Land Uses *: The site should be compatible with the existing surrounding land uses. Factors which should be considered include the land uses immediately adjacent to the site. 3 (good), 2 (neutral), 1 (poor), 0 (inconsistent)	4		0
7. Proximity to other HFHMD Development: When in close proximity, Habitat families can support one another. 3 (good) other HFHMD Development within 1 block, 2 (fair) other HFHMD Development within 3 blocks, 1 (poor) no other HFHMD Development in area	3		0
8. Proximity to Child Care Facilities: Site has ready access to child care facilities. 3 (good) within 1/2 mile of child care facility, 2 (fair) within 1 1/2 miles of child care facility, 1 (poor) more distant than 1 1/2 miles to child care facilities	3		0
9. Grocery Store: Site should be relatively near a grocery store. 3 (good) close proximity to grocery store 5 - 10 minute walk or about 1/4 mile, 2 (neutral) 10 - 20 minute walk or about 1/2 mile or readily accessible via public transportation, 1 (poor) the site is greater than 20 minute walk (about 1 mile) or not accessible via public transportation	3		0
10. Employment: The site should have access to areas of employment. 3 (good) less than 2 miles or readily accessible via public transportation, 2 (neutral) between 2 and 5 miles, 1 (poor) more than 5 miles or no public transit	2		0
11. Other Retail: The site should be proximate to other Retail Stores. 3 (good) distance of 1 mile or less, 2 (neutral) distance of 1 to 3 miles, 1 (poor) distance of greater than 3 miles	2		0
12. Parks: Site should have reasonable access to a park or playground. 3 (good) short walk of about 1/4 mile; 2 (neutral) moderate walk of about 1/2 mile; 1 (poor) long walk of about 1 mile	2		0
Subtotal	42		0
Total Score	83		0
Highest Possible Score			249
* Note: Sites receiving a score of "0" in some critical criteria may be precluded from further consideration			
POTENTIAL COST OF DEVELOPMENT			
Estimated Cost for the Development of the property to meet HFHMD Criteria based on available information at time of evaluation	HFHMD Historic Average Cost	Anticipated # of Units on Property	0
Acquisition Cost of Property / Site	\$0		\$0
Abatement / Mitigation Cost	\$0		\$0
Demolition Cost to ready Site for new Construction	\$0		\$0
Tap and Development Fees	\$0		\$0
Cost of Utilities	\$0		\$0
Building Cost of new Construction	\$0		\$0
Total Cost for Property			\$0
Total Property Cost per Unit	\$0		#DIV/0!
Total Unit Cost, including Construction	\$0		#DIV/0!

THE WOODS AT GOLDEN GIVEN

INTEGRATED DESIGN ECO-CHARRETTE REPORT

SUMMARY

On July 29, 2009, Tacoma / Pierce County Habitat for Humanity (TPCHFH) held an integrated design eco-charrette in Tacoma, Washington. The 15 participants¹ included TPCHFH staff members and volunteers, partners from BCRA, Apex Engineering, NW Solar Group, and representatives from local and state governmental organizations. Henry Izumizaki, *One Nation Foundation* CEO, greeted the participants via video address. *One Nation* is a national philanthropic initiative and an enthusiastic supporter of Habitat's mission.

The charrette was facilitated by Anya Caudill, a member of the Department of Ecology's Green Building group.

TPCHFH recently purchased 5.23 acres of land in Pierce County, south of Tacoma on Golden Given road, to be developed as a residential community. The vision for the Woods at Golden Given project is to create a nationally-recognized example of sustainable, affordable, and multi-cultural residential development. During the eco-charrette, participants became familiar with the site's features, challenges, and opportunities. They also explored different aspects of sustainable building and generated over *one hundred* ideas that could improve the project's environmental and social performance.

The results of the brainstorming exercises and discussions are outlined in this report and will provide guidelines for meeting and exceeding requirements of the Evergreen Sustainable Development Standard (Evergreen Standard) and the LEED for Homes® rating system. Meeting the Evergreen Standard is required in order to receive funding from the Washington State Housing Trust Fund.



1. ECO-CHARRETTE DISCUSSION

TPCHFH BACKGROUND

Tacoma / Pierce County Habitat for Humanity is an affiliate of Habitat for Humanity International (HFHI), a non-profit ecumenical Christian organization. HFHI seeks to eliminate poverty housing and homelessness from the world and make shelter a matter of conscience and action. It works in

¹ See *Appendices* for the list of participants and contact information.

partnership with people in need to build, or renovate, affordable housing and has developed strong relationships with local communities. The houses are sold at no profit and with no interest loans. More than 300,000 Habitat homes have been built around the world. For more information about HFHI, please visit their website at www.habitat.org.

Since 1985, TPCHFH has built over 160 homes in Pierce County, including homes built in Tacoma and the Gig Harbor / Key Peninsula area. TPCHFH is the only organization in Pierce County providing homeownership opportunities to households making 30% to 50% of the area median income.

The affiliate's selection committee accepts applications from families with substandard living conditions – barely insulated homes, children of different genders crowded into sleeping quarters with a parent, severe mold issues, and severe safety hazards. However, Habitat is not a handout, but a hand up. In addition to making a 0.5% down payment and 0% interest mortgage payments, homeowner families are required to commit 500 hours of 'sweat equity' building their own home and the homes of other Habitat families. For more information about the affiliate and its projects, please visit TPCHFH's website at: <http://www.tpc-habitat.org/index.html>.



2. PIERCE COUNTY HABITAT HOME

TPCHFH GOES GREEN

The affiliate not only builds affordable houses, they also build them sustainably, using low-toxic materials and resource-efficient techniques. Habitat homes already have a smaller footprint than an average single-family home due to their size policy. In recently completed projects, Habitat used progressive green building features such as:

1. Advanced framing to save lumber.
2. Insulating concrete forms for walls and extra insulation to improve energy efficiency.
3. Energy efficient heating, lighting and Energy Star appliances to lower utility bills.
4. Blower door / infrared testing for air leakage.
5. Laminate or linoleum to reduce 'off-gassing' associated with carpets and vinyl.
6. 98% of construction waste is recycled.
7. On-demand domestic hot water
8. Low flow plumbing fixtures



3. ONE INCH EXPANDED POLYSTYRENE FOAM APPLIED TO OSB SHEATHING TO PROVIDE CONTINUOUS THERMAL BREAK AND ADDITIONAL R-5 WALL INSULATION

TPCHFH is committed to building their homes to the highest green building standards feasible to ensure Habitat's families benefit from healthier indoor living conditions, lower utilities bills, and thriving natural environments.

THE ECO-CHARRETTE PROCESS

Eco-charrettes provide project stakeholders with an opportunity to generate as many high-performance, or 'green' ideas as possible in the project's early stages. Participants draw from their own expertise and share spontaneous creative ideas. They collectively develop and select the best as sustainable goals for the design team to consider and incorporate into the project. Charrettes can vary from a few hours to multi-day events, depending on project size, budget, and complexity.

The diverse viewpoints available at an effective charrette encourage integrated design. This synergistic approach results in better buildings, reduces costs, and saves resources and time for the owner and surrounding community.

Integrated Design

- **Integrated Design Eco-Charrette** looks holistically at the project's systems, before it is too late to change anything.



Fixing designs that don't work may not be as cheap...

4. SLIDE FROM CHARRETTE PRESENTATION

Project benefits include:

- Greater familiarity with and appreciation for building green.
- Creative and expert input; expanded network of expertise.
- Opportunity to identify and solve potential problems.
- Identifying 'green' goals and strategies.
- Long-term or life-cycle perspective of impacts from development.

Charrettes have become a common practice and are highly recommended for creating high-performance buildings, whether homes or skyscrapers. That's one reason they are required by certain sustainable building standards.

EVERGREEN SUSTAINABLE DEVELOPMENT STANDARD

In 2005, Washington became the first state in the nation to require publicly-funded buildings to build to specified green standards. Written to comply with Chapter 39.35D.080 RCW, the Evergreen Sustainable Development Standard (Evergreen Standard) states that the Department of Commerce (formerly Community, Trade, and Economic Development) shall “identify, implement, and apply a sustainable building program for affordable housing projects that receive housing trust fund (under chapter 43.185 RCW) funding in a state capital budget.” The technical committee charged with writing the Evergreen Standard selected as its basis the Enterprise Community Partners’ Green Communities™ Criteria. By late 2007, review of the new Evergreen Standard was completed. Effective July 2008, all projects receiving grants from the Washington Housing Trust Fund must meet or exceed its requirements.

The Evergreen Standard has 70 criteria, 33 of which are mandatory although not all of them apply to every project. The remaining 37 criteria are called ‘optional’. To recognize the different degrees of achievement possible, optional criteria have varying numbers of points assigned.

All projects must meet the applicable mandatory criteria and optional point threshold. For new construction that threshold is 50 points. Rehabilitation projects, also covered by the Evergreen Standard, must earn 40 points beyond the mandatory requirements, at minimum. For all projects, an Evergreen Standard checklist must be submitted with an application for funding.

A full copy of the Evergreen Standard forms and instructions are available at <http://www.commerce.wa.gov/site/1027/default.aspx>.

THE WOODS AT GOLDEN GIVEN ECO-CHARRETTE

GOALS

As part of the eco-charrette planning process, TPCFH staff listed their top three goals and desired outcomes for the event:

1. Establish working relationships between design professionals involved in this project.
2. Develop a low-impact conceptual plan for the development of this property that includes input from various specialists and stakeholders.
3. Gain experience (personal and institutional) in the charrette process.

INTRODUCTIONS AND THE MOST IMPORTANT ‘GREEN’ FEATURES

The charrette began with Gomer Roseman, Habitat’s Site Manager and charrette lead, welcoming the group and introducing participants. Anya Caudill, charrette facilitator, then talked about the Washington State Department of Ecology’s involvement with the green building movement, services provided by Ecology’s green building group, and the charrette process. Ground rules for the day were also established.

Introductions were followed by participants sharing their ideas of green building and vision for the most desirable green features in the future homes.

The Most Important Green Features

1. Containment of waste water and stormwater on-site
2. Low impact development
3. Stormwater to help recharge wetlands
4. Energy Star 2011
5. Litter dump clean up
6. Making power
7. Communal spaces
8. Separation of vehicular and pedestrian paths
9. Effective use of community areas
10. Efficient site design that includes all of the above
11. Keeping an eye on costs
12. Energy efficient
13. Whole community off-grid
14. Exciting / tangible benefits for families
15. Improved indoor air quality (due to proximity to SR-512 with heavy traffic)

PROJECT LOCATION AND DESCRIPTION

The project site is located in the Midland community, south of Tacoma. According to the Parkland-Spanaway-Midland (PSM) Communities Plan², Midland *“traces its settlement back to the 1890s, when it was a farming community, with a town site platted along the southern end of Portland Avenue. Today Midland is characterized by a mix of urban residential development interspersed with large lot residential areas, pastures, wetlands, and woodlands.”* The Plan’s vision for the community includes safe, quality neighborhoods, enough parks and playgrounds, alternate forms of transportation, enhanced natural areas, and a variety of housing available to serve different income levels. The TPCHF project goals support this vision and will contribute to the Plan’s implementation.

Since most participants were already familiar with the project’s location, the group did not visit the site during the eco-charrette. Instead, Gomer Roseman and a BCRA representative provided the group with the project and site overview, accompanied by maps and four conceptual designs developed prior to the eco-charrette. They also answered participants’ questions about the site.

At the time of the charrette, TPCHF was in the midst of negotiation for purchasing three adjacent properties in addition to the main parcel (see 5. aerial site photo).

The possibility that the final layout of the project may change in the future presented some challenges, as additional properties would affect road and utilities access, as well as provide more units and

² Parkland-Spanaway-Midland Communities Plan is available at: <http://www.co.pierce.wa.us/pc/services/home/property/pals/landuse/psmplan.htm>.

common space. However, most ideas generated during the workshop will be applicable to the expanded layout if the purchase is successful.

The parcel is zoned single family and designated as Moderate-Density Single Family (2-6 dwelling units per acre). Rob Jenkins is the project's planner from Pierce County Planning and Land Services.



5. AERIAL SITE PHOTO

SOILS, WETLANDS, AND TREES

The required geo-technical and Phase I Environmental Site Assessment surveys have been completed for this site. The soils are Kapowsin gravelly loam with the infiltration rate of 0.5 inches per hour. According to the Pierce County Geographic Information Services, this soil has a moderate to slow permeability and the water ponds above the substrate especially during the rainy season. Surface runoff is rapid and there is a high potential for erosion. These soils are formed in glacial till and found in Puget lowlands in west central Washington. These soils may present a challenge for managing stormwater on-site and special consideration is needed when using low impact strategies, such as pervious pavements and rain gardens.

Dawn Anderson, Pierce County Low Impact Development coordinator, noted that there is a new low impact development project near Gig Harbor that has similar soils conditions and their experience may be valuable for this project. Ms. Anderson offered her expertise and support in developing low impact strategies.

The site is located within the Clover Creek watershed. There are four wetlands on-site (identified as Wetlands A, B, C, & D on aerial site photo):

- Wetland A: category IV³ exempt from critical area ordinance.
- Wetlands B & C: category III mosaic requiring 50 feet buffer.
- Wetland D: category II requiring 50 feet buffer.

The east side of the property borders the **Pierce County South Midland Wetland Reserve**. Located on 15.3 acres, this wetland restoration and enhancement site provides numerous ecological benefits including flood control, water quality, and wildlife habitat. The reserve is currently closed to the public. For more information about the reserve, visit: <https://www.co.pierce.wa.us/pc/services/home/envIRON/water/ps/projects/southmidland.htm>.

There are **467** trees on the main parcel. **Seven** trees were deemed 'significant' and will be protected during the development. For more information about tree conservation regulations review the Pierce County Code Tree Conservation Ordinance (Chapter 18H.40), at: <http://www.co.pierce.wa.us/xml/Abtus/ourorg/council/code/title%2018h%20pcc.pdf#Page=19>



6. TREES ON SITE

ILLEGAL WASTE SITE AND EXISTING STRUCTURES

The long-time owner, who deeply cared for the property and planted the unique trees, passed away a few years ago. Afterwards the property became a rental, and an illegal solid waste dump site. The tenants charged a small fee for allowing tires, construction, demolition, and other solid wastes to be dumped onto the property. Most of the waste materials were stored in piles, others were buried underground.

As a condition of the sale, an extensive cleanup effort was required. Approximately 20 commercial-size trucks were needed to remove the accumulated waste. TPCHFH installed a fence to prevent trespassers from continuing to dump onto the property. The buried waste will be excavated and removed during the site preparation for construction. Fortunately, no indication of hazardous materials or contaminated



³ There are four wetland categories. Category I has the highest quality and Category IV has the lowest.

soils has been found so far. However, some amended soils may need to be brought on-site to enhance the landscaping and provide for safe gardening opportunities.



7. ABANDONED RESIDENCE WITH MATURE CHESTNUT TREE



8. ABANDONED SHED DECORATED WITH TEDDY BEARS

The two structures currently on-site (pictured above) are scheduled for demolition. TPCHFH will work with the local comingled construction and demolition recycling companies to salvage and recycle as much as possible.

PUBLIC TRANSIT AND ROADS

The closest bus route follows Pacific Avenue S (bus # 1) and is about 1.5 miles from the site. Walking to a bus stop on Pacific may not be safe due to a lack of sidewalks. Two transit centers are within three miles where residents can park and ride more than 10 different busses⁴.

The property has access to 104th Street East along its northern border. There is a private road on the east side and residential properties on the west. If adjacent properties are purchased, the west side will have access to Golden Given Road.

The Woods at Golden Given Roads

- 104th Street East
 - Road Classification: Collector Arterial
 - Distance from 104th St centerline to south R/W: 35 ft
 - R/W Width: 60 feet (Dedicate 10 feet along frontage)
- Golden Given Road East
 - Road Classification: Secondary Arterial
 - Distance from Golden Given centerline to west R/W: 35 ft
 - R/W Width: 70 feet

9. SLIDE FROM CHARRETTE PRESENTATION

⁴ Pierce County Transit website: <http://www.piercetransit.org/>.

WORKING IN SMALL GROUPS

Charrette participants split into three groups to brainstorm and generate sustainable strategies for the following areas:

1. Site development and improvements.
2. Energy efficiency and water conservation.
3. Healthy living environment.
4. Waste reduction and recycling (large group discussion).

The facilitator began each group exercise with an overview of the Evergreen Standard optional requirements and examples of green building strategies.

During lunch a short slide-show featured an energy-efficient and fully accessible home built several years ago in Vancouver, Washington. After lunch, David Wright (BCRA Landscape Architect) shared green building case studies. The presentation was inspiring and generated a lot of interest.

After each intensive brainstorming exercise, the small groups shared their ideas with the entire group. The information was captured on sticky notes, affixed by topic onto chart paper, and displayed. After the brainstorming sessions, each participant received four dots to vote for project strategies that are the most important to them.


Below are the suggestions generated by the group. Repeated or similar ideas were compiled under one item (e.g. *multi-functional community building* and *community room*). **Ideas that received three or more votes are in bold.**

EXERCISE #1

<i>Site Development and Improvements</i>	<i>Votes</i>
1. Solar orientation for homes.	6
2. Multi-functional, centralized community building (roll up doors, meetings, communication hub, guest room); community room (childcare, teen observable area, meeting space, kitchenette).	5
3. Balance between community area and personal area.	4
4. Passive use of wetland 'D' – trails, observation area.	3
5. Green roof for community building (green roof maybe ambitious for each home, but could be demo for community building).	2
6. Consider solid waste management.	2
7. Community.	2
8. Multi-generations (activities for children, adult, and elders).	2
9. Strong homeowners association plan; Homeowners' Association responsibilities (community building, common areas); maintenance of common areas.	2
10. Chicken coop.	1

<i>Site Development and Improvements</i>	<i>Votes</i>
11. Communication facilities (for e-mail, internets access) at community building.	1
12. Need for “forced” interaction (mailboxes near common areas).	1
13. Market for demonstration projects (wi-fi, roofing, pavement, etc.).	1
14. No net increase in run-off, aim for reduction.	1
15. Site preparation for pervious surface installation.	1
16. Ways to cut cost (solar tubes, passive design, collectors – companies that want demo, avoid technology that requires maintenance).	1
17. Access from private road required?	-
18. Contact <i>Construction Center for Excellence</i> ⁵ to see if they are interested in training their green construction students at the project, especially when certain specialized skills are required.	-
19. Accessibility.	-
20. Address potential mosquito issues (wetlands B & C).	-
21. Affordable, simple living – some busy families may not have time for gardening (pea-patch sign up if they want a plot).	-
22. Alley access concept.	-
23. Balance cut and fill on-site.	-
24. Buffer zone averaging, smooth the edges.	-
25. Check for site contamination.	-
26. De-mystifying living green. Families just looking for a house, if green cuts costs that’s great, but they as home owners won’t want to maintain.	-
27. Education signage (different languages?).	-
28. Focus on the wetlands (design concept #2).	-
29. Food independence (closed system, training).	-
30. Groundwater will drive design.	-
31. Guest parking (on street or more space on-site; accessibility to visitors).	-
32. Kids play area (hard surface play), part of picnic area off street.	-
33. Look for professional services to volunteer time for the project.	-
34. Maintenance shop / tool room / work shop.	-
35. Maximize existing tree cover to help evapotranspiration.	-
36. Minimize cost going in. Take headache out of maintenance and up-front costs; limit infrastructure.	-

⁵Construction Center for Excellence website: <http://www.rtc.edu/CCE/>.

<i>Site Development and Improvements</i>	<i>Votes</i>
37. Open space & wetlands together.	-
38. Access to other lots. (Shaded portion on drawing shows parcels in question.)	-
	
39. Parking structures, community building located to maximize solar access.	-
40. Pervious surface installation – volunteer friendly.	-
41. Picnic shelters with bank of solar panels.	-
42. Rainwater for irrigation.	-
43. Use native plant materials.	-
44. Use of grey water (common building).	-
45. Wetland buffer enhancement.	-

EXERCISE # 2

<i>Energy Efficiency and Water Conservation</i>	<i>Votes</i>
1. Keep it simple.	6
2. Rain gardens.	5
3. ICF⁶ wall for common wall for duplex units.	3
4. Native landscaping, amend native soils.	1
5. Education of dynamics of home and site.	1
6. Mini split.	1
7. Accommodating different homeowners' heating preferences, but keeping with a community ideal so people don't feel like they are paying for others heating.	-
8. ADA for one bedroom and bath.	-
9. Architectural elements strategically placed (roofs, windows, homes).	-
10. Community water system.	-
11. Crawlspace vs. slab: cut costs for trucking, heat/cooling system in the ground.	-
12. Dual use devices (heating/cooling, storage/use of rainwater).	-
13. Educating the user (annual update).	-
14. Electric car outlets for charging.	-
15. Electric fired boiler.	-

⁶ Insulating Concrete Forms.

<i>Energy Efficiency and Water Conservation</i>	<i>Votes</i>
16. Energy for common areas, P.V. – lighting and exterior light.	-
17. Energy Star 2011.	-
18. Families want the single-family homes- obviously different units, so they don't look like duplexes.	-
19. Gas line is not available at this property.	-
20. Geothermal opportunity.	-
21. Gray water system for irrigation and flushing. Community CTR.	-
22. Hard for families coming from an apartment situation to get an idea about watering gardens, keeping up with plants.	-
23. Landscaping – location: shade houses from sun; native plants, sun/shade tolerant; want openness for solar gain (mostly donation).	-
24. Lobby for school bus stop on-site.	-
25. Lobbying for bus stop – less people driving around.	-
26. Low U-factor ⁷ windows and passive solar shades.	-
27. Lower ACH/50 ⁸ .	-
28. Methodology to reduce phantom electrical load.	-
29. Proper installation and construction to increase efficiency.	-
30. Rain garden / cistern irrigation cycle – 6,000 gallons cistern for two homes, offset city water.	-
31. Reduce footprint of homes, 2 floors, duplex units, one less exit wall.	-
32. Reduce thermal bridging (advanced framing).	-
33. Reduce water heating requirement; reduce water usage by 50%.	-
34. Reuse of rainwater – irrigations and toilet flushing.	-
35. Slab totally insulated.	-
36. Solar heating – water too. Heat recovery system, shared walls.	-
37. Solar hot water minimum and ready for P.V.	-
38. Solar tubes.	-
39. Training program for transfer of knowledge.	-

⁷ U-factor (value) measures the rate of heat loss and is generally between 0.20 and 1.20. The lower the U-value, the greater a window's resistance to heat flow and the better its insulating value.

⁸ ACH/50 refers to the number of air changes inside a house within an hour at a house pressure difference of 50 Pascals. The lower the number of air exchanges, the better the insulation qualities of the home envelope.

<i>Energy Efficiency and Water Conservation</i>	<i>Votes</i>
40. Use rain barrel.	-
41. Using electricity – we are trying to minimize use, maximize conservation. Same with water. Cut energy costs.	-
42. Water efficiency (surfaces and pathways – level, but pervious; moss, dirt, etc. could clog it; pavers – hard to get volunteers).	-

EXERCISE #3

<i>Healthy Living Environment</i>	<i>Votes</i>
1. Cultural sensitivity in design.	3
2. Mold resistant materials in humid areas.	1
3. Use of natural products, e.g. linoleum, wood, etc.	1
4. ADA entrance, egress, 1 bedroom & bathroom accessible; able to install a lift if needed.	1
5. Air flow controlled by occupancy sensor (9 hours).	1
6. Low VOC ⁹ architectural coatings.	-
7. Mechanically ventilate the house (4 air exchanges per hour).	-
8. Seal in off-gassing. Minimize off-gassing. Salvaged/recycled wood, 'windfall'.	-
9. Bamboo? Hard-surfaced floors – easier to keep clean; low / no VOC paints, glues, primers, etc.	-
10. Homes sharing roof of parking structures; shared footprint.	-
11. Reverse refrigerators (freezer on the bottom).	-
12. Bigger eaves, curtains.	-
13. Nightlights – simple LED; cupboards lights.	-
14. Open floor plans (hang out in the kitchen more; a lot of cooking = high heat + moisture).	-
15. Saving power inside: motion sensors for lights; charging stations that can turn off; appliances without extra stuff (clocks, etc.).	-
16. Slag concrete ¹⁰ .	-
17. Formaldehyde free insulation.	-
18. Recycled carpet for stairways.	-
19. Recycled glass under slab (natural pesticide).	-

⁹ Volatile Organic Compounds.

¹⁰ Slag concrete is made with granulated blast-furnace slag left after iron processing in a blast-furnace.

<i>Healthy Living Environment</i>	<i>Votes</i>
20. Meet or exceed the Evergreen Standard.	-
21. Try to eliminate hallways.	-
22. Heat recovery from exhaust air (cost prohibiting).	-
23. Vaulted ceilings – noise attenuation volume.	-
24. Solar preheat volume.	-
25. Solar preheat water.	-
26. Peak usage (water heater activated in off-peak time).	-
27. Education! Air quality, exhaust fan operation.	-
28. Monitor utilities and feedback (group).	-

EXERCISE #4

<i>Waste Management¹¹</i>	<i>Votes</i>
1. Separate containers.	-
2. Education.	-
3. Recycling bins (comingled, glass).	-
4. Advertize resources like 2good2toss.com.	-
5. Incentives / peer pressure.	-
6. Individual v. communal waste and recycling.	-
7. On-site chipping for mulch during construction.	-
8. On-site food composting.	-

OTHER IDEAS

Additional ideas discussed in the large group or during breaks are shown below.

<i>Other Ideas</i>	<i>Votes</i>
1. Consider language barriers and a limited background in environmental issues.	-
2. Homeowners' Association (HOA) meeting room 25 x 25 ft.	-
3. ADA-compliant – concept #4.	-
4. Balancing density with 'American Dream'.	-

¹¹ Currently TPCFH recycles 98% of its construction waste. During the charrette exercise the group focused on waste and management of recyclables when the homes will be occupied.

<i>Other Ideas</i>	<i>Votes</i>
5. How will the open space be maintained?	-
6. Grow own food.	-
7. Fire control – without sprinklers?	-
8. 9 th Avenue access – private – right-of-way. Check with the county.	-
9. New stormwater manual – big ponds. Check with the county.	-

PROJECT PRIORITIES

Out of 124 recorded suggestions, 27 ideas received one or more dots. The *Site Development and Improvements* discussion generated the largest number of ideas and received 35 votes, followed by Energy Efficiency and Water Conservation (17 votes), Healthy Living Environment (7 votes), and Waste Management (0 votes)¹².

The following 8 suggestions received the most votes (3+ dots):

<i>Suggestions</i>	<i>Votes</i>	<i>Comments</i>
1. Solar orientation for homes	6	<i>Often, when the lots become available for construction, they had already been plotted and subdivided in a way that did not consider solar potential for the future homes. This project presents a rare flexibility in designing the community in a way that would allow taking advantage of solar energy potential. Whether it is an installation of solar hot water heaters, photovoltaic panels, or rotating the homes so it prevents them from overheating in the summer, this opportunity should not be missed!</i>
2. Keep it simple	6	<i>New technologies may require a significant commitment from the future homeowners. If the maintenance is complicated and requires a lot of time and additional training, it may be difficult for the owners to keep the systems running properly. This may result in system failure and poor environmental performance. The systems should not be rejected from consideration just because they appear to be complex, but the ease of maintenance should be considered when deciding on what technologies to use.</i>
3. Rain gardens	5	<i>Bioswales and rain gardens have been proved to improve stormwater management on-site. If planned for in advance, they can significantly attenuate the amount of runoff from the roofs and pervious surfaces, protecting homes' foundation from moisture and mitigating flooding hazards. Project staff may want to salvage the native plants on-site</i>

¹² One vote was missing.

<i>Suggestions</i>	<i>Votes</i>	<i>Comments</i>
		<i>and plant them in the rain gardens in the future.</i>
4. Multi-functional, centralized community building (roll up doors, meetings, communication hub, guest room); Community room (childcare, teen observable area, meeting space, kitchenette)	5	<i>Many ideas were related to the use of open space and a community facility. The group focused on the community building that can potentially become a hub for the residents' interaction and a display of the most advanced environmental technologies. Strategic placement of this facility is very important to ensure it is accessible and interactive. A strong HOA plan is required as well.</i>
5. Balance between community area and personal area	4	<i>Everyone has their own preference regarding the amount of personal and shared space around his or her home. For many families, the 'American Dream' means having their own home and yard. For others, the benefits of the denser developments, less yard work, and access to bigger play areas are more appealing. While it is hard to satisfy everyone's personal preferences, a smart design can successfully address different needs if they are taken into account early in the process.</i>
6. Cultural sensitivity in design	3	<i>Habitat families come from various cultural backgrounds. While integration is a big part of their new lives in the U.S., there are certain things that are defined by their original cultural identity. For example, in some cultures the number of windows in the house is important. In others, obscuring the front door from a direct view of the kitchen makes the tenants' life better. Certainly, not every cultural preference may be taken into account, but some of them are easy to incorporate. Habitat staff may want to consult with the families¹³ from different countries to find out more about their cultural preferences and provide this information to the architects and designers.</i>
7. ICF wall for common wall for duplex units	3	<p><i>Insulating Concrete Forms (ICF) technology is one of the wall systems that improve building energy performance. These forms or blocks are made from foam insulation and concrete is poured inside them. In addition to the insulation qualities, they are also durable and improve acoustics.</i></p> <p><i>There are some environmental concerns related to the use of foam insulation which is often made of polystyrene. The blowing agents in the foams may contain</i></p>

¹³ The design team, Habitat staff, and volunteers may want to arrange for an additional meeting with Habitat families, potential and current. This meeting can be used to educate the families about green building and to gather their perspective on what they would like to see in their homes.

<i>Suggestions</i>	<i>Votes</i>	<i>Comments</i>
		<i>hydrofluorocarbons (HFCs) or chlorofluorocarbons (CFCs). HFCs have a very high global warming potential, while CFCs are known for ozone depletion. Careful consideration needs to be given when choosing foam insulation materials. Also, polystyrene recycling and re-use options are rarely available.</i>
8. Passive use of wetland 'D' – trails, observation area	3	<p>One of the participants commented on how pleased he was to participate in a construction project's discussion that treated wetlands as amenities rather than an annoying feature that is better off if filled.</p> <p>It was recommended to check with the biologist to ensure that the wetlands hydrology is not disrupted due to the project.</p> <p>Also, a split-rail fence with signage or a permanent planting along the wetland buffers may be required or recommended upon completion of construction activities in order to protect the critical areas from disturbance. The fence has to allow free animal passage¹⁴. As with other environmental features at the site, it was suggested to consider signage translated into several languages.</p>

Participants used the ESDS checklist as a reference during the charrette. The group was confident that the project will not only meet the requirements to be eligible for the Housing Trust Fund support, but will significantly exceed them. We hope that the strategies outlined in the checklist and ideas generated during this charrette will be integrated into the project to their fullest extent, and discussions begun at this training will continue as the project progresses.

*Report prepared by Anya Caudill, Green Building Group
Waste 2 Resources Program, Southwest Regional Office
Washington State Department of Ecology
August 2009*

¹⁴ A useful brochure: *A Landowners Guide to Wildlife Friendly Fences: How to Build Fence with Wildlife in Mind* at <http://fwp.mt.gov/content/getItem.aspx?id=34461>.

APPENDICES

ABOUT ECOLOGY'S GREEN BUILDING GROUP AND FACILITATOR:

Anya Caudill is a certified National Charrette Institute (NCI) Planner and graduate of the Masters in Environmental Studies program at The Evergreen State College. Before joining the Department of Ecology, she worked for the Thurston County Environmental Health Department and Raytheon Technical Services Company.

Anya is the Solid Waste Facilities and Sustainability Specialist at Ecology's Waste 2 Resources Program in Lacey, Washington. She can be reached at anya.caudill@ecy.wa.gov or 360/407-6084.

Four regional staff (including Anya), a state-wide coordinator, and a management liaison make up Ecology's Green Building Group, which currently offers complementary charrette facilitation services to building projects affected by RCW 39.35D.

This law requires new state-funded construction over 5,000 sq ft to be built to LEED Silver standards, at minimum. Exceptions to this mandate include public schools and affordable housing projects receiving any Washington Housing Trust Funds. These projects must follow the Washington Sustainable Schools Protocol and the Evergreen Sustainable Development Criteria. The Green Building Group is available to help public and non-profit groups understand and meet these standards.

RESOURCES:

A Landowners Guide to Wildlife Friendly Fences—How to Build Fence with Wildlife in Mind: <http://fwp.mt.gov/content/getItem.aspx?id=34461>

Low Impact Development Technical Manual: http://www.psp.wa.gov/downloads/LID/LID_manual2005.pdf

One Nation Foundation: <http://www.onenationfoundation.org/>

Parkland-Spanaway-Midland Communities Plan: <http://www.co.pierce.wa.us/pc/services/home/property/pals/landuse/psmplan.htm>

Tacoma / Pierce County Habitat for Humanity: <http://www.tpc-habitat.org/>

The Evergreen Sustainable Design Standard: <http://www.commerce.wa.gov/site/1027/default.aspx>

U.S. Green Building Council: <http://www.usgbc.org/>

Washington Department of Ecology's Recycle Database: <http://1800recycle.wa.gov/>

Washington's online exchange for reusable building materials and household items: <http://www.2good2toss.com>

THE WOODS AT GOLDEN GIVEN ECO-CHARRETTE

AGENDA

WEDNESDAY, JULY 29, 2009

8:20 am	Gather, seating, refreshments
8:30	Welcome – <i>Gomer Roseman</i>
8:35	Introductions: What is a good building / what green feature would you like to see? Charrette process and ground rules – <i>Anya Caudill</i>
9:00	The Evergreen Sustainable Design Standard overview – <i>Anya Caudill</i>
9:10	“The Big Picture” – Henry Izumizaki, One Nation (Video)
9:20	Project overview: goals, limitations, “must haves”, standard practices, available skills and experience, observations from previous projects plus expected outcomes for this charrette – <i>Gomer Roseman</i>
9:30	Site conditions and preliminary concepts – <i>BCRA</i> Questions about the project and site - <i>All</i>
10:00	<i>Break</i>
10:10	Site Development and Improvements: small groups brainstorming exercise on stormwater management, low impact development, wetlands, and common space
11:05	Small groups report
11:15	Energy Efficiency and Water Conservation: small groups brainstorming exercise on building design and orientation, solar power (passive and active), water efficiency
11:45	Small groups report
12 pm	<i>Lunch (provided by BCRA)</i>
12:30	Healthy Living Environment: small groups brainstorming exercise on material choices, indoor environmental quality, mechanical systems, and floor plans
1:00	Small groups report
1:10	Waste reduction and recycling – <i>large group discussion</i>
1:20	Dot-Voting (participants vote on their preference for the most important features to be incorporated into the project)
1:30	<i>Break (tally dot vote)</i>
1:40	Integrated Design Brainstorm: consider the project as a whole and incorporate the dot-voting results, point-earning choices, and other options and innovation.
2:15 – 2:30	Final comments / questions / summary / thanks

CHARRETTE PARTICIPANTS

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