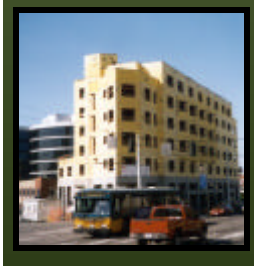
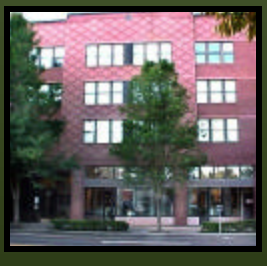
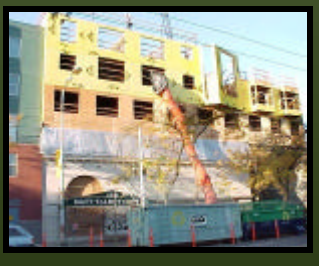



SEAGREEN

GREENING SEATTLE'S AFFORDABLE HOUSING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Greening Seattle's Affordable Housing

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Cover Photos

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Disclaimer

The SeaGreen Affordable Housing Guide is intended for use as an aid to "greening" affordable housing by affordable housing owners, developers and professional design teams comprised of licensed builders and contractors, architects, and engineers. The guide assumes a professional level of expertise and familiarity with building technology and should not be used by untrained builders or consumers without expert assistance.

The guide is not intended to eliminate or substitute for the professional's own judgment or accepted engineering and construction practices. It is the responsibility of the professional to design systems with methods and materials that are project appropriate. Product information provided in the guide is not intended to act as a recommendation for using a particular product in a specific application.

Use of this guide does not relieve the user from complying with all applicable laws, regulations and proper analysis and monitoring in the design and operation of the buildings.

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INTRODUCTION

Originally defined by The World Commission on Environment and Development, The Brundtland Commission, 1987, sustainability generally means "meeting the needs of the present without compromising the ability of future generations to meet their own needs."

Sustainable building integrates building materials and methods that promote environmental quality, economic vitality, and social benefit through design, construction and operation of the built environment. Sustainable building merges sound environmentally responsible practices into one discipline that looks at the environmental, economic and social effects of a building or built project as a whole.

The City of Seattle has now added sustainable building to its widely recognized reputation for environmental leadership.

Sustainability

Meeting the needs of the present without compromising the ability of future generations to meet their own needs.

The City's sustainable building program is part of Mayor Greg Nickels' Environmental Action Agenda, announced on Earth Day 2002 which includes:

- Lean, Green City Government that is healthy, resource-efficient and environmentally responsible.
- Healthy Urban Environments with thriving, diverse nature and neighborhoods.
- Smart Mobility that is efficient, fair, convenient and clean transportation.

Greening affordable housing is part of Mayor Nickels' agenda to help promote more sustainable approaches to managing the built environment in a socially equitable way so those in our communities who can least afford it will benefit from healthy, high quality affordable housing.

Development has an environmental impact. The statistics are compelling. Buildings consume or are responsible for:

- 40% of the world's total energy
- 25% of world's timber harvest
- 16% of fresh water withdrawal
- 35% of all carbon dioxide (CO_2) emissions
- 60% of the electricity generated in the U.S
- 30% of raw materials produced in the U.S.

More than 210 million tons of solid waste is generated and disposed of annually, a substantial portion of which is attributed to construction site and building use waste.

Seattle is one of the first metropolitan areas in the country to be challenged with an Endangered Species Act listing within its urban core, further challenging the building industry to reduce impacts on salmon habitat.

We as a community of affordable housing providers have an opportunity to develop affordable housing using green building strategies to reduce the impacts contributing to depletion of natural resources, water quality, air pollution, and global warming, while also lowering operating costs and maintenance needs.

What are the benefits of sustainable building

SeaGreen Affordable Housing Guide was developed to promote energy conservation, operational savings and sustainable building practices in affordable multifamily housing projects. The strategies included in the following pages work to reduce operating costs, promote healthy environments and protect and conserve resources in City funded affordable housing projects. Venturing beyond current practice, these strategies protect and enhance Seattle's affordable housing stock and the community as a whole.

In addition to increasing resource efficiency and reducing environmental impacts, sustainable building strategies can yield cost savings through long term reduced operating costs. Specifically these benefits include improved energy performance and comfort, a healthier indoor environment, increased durability of building components, and simplified maintenance requirements that can lead to a better bottom line for property managers and owners. Sustainable building works as a set of strategies to improve the economics of managing affordable housing while also improving the quality of affordable housing. Multifamily housing also increases urban density, reducing transportation impacts from sprawl.

The basis for establishing sustainable building strategies was the focus of Greening Seattle's Affordable Housing, an all-day workshop sponsored by Impact Capital and the Seattle Office of Housing and facilitated by O'Brien and Company in April of 2002. Attending non-profit housing development groups and their project design teams (stakeholders) developed a set of goals or guiding principles related to sustainability and providing quality affordable housing.

Housing professionals at 'Greening Seattle's Affordable Housing' workshop discuss enhanced design recommendations.

Guiding Principles for Greening Seattle's Affordable Housing

- Cost-effective to build, durable and practical to maintain
- Results in a high quality, healthy living environment
- Reduces utility costs to residents
- Enhances the residents' connection to nature
- Protects the environment by conserving resources, including energy, water and materials
- Advances the health of local and regional ecosystems

Chapter Overview

The guiding principles from the workshop were the foundation for the guide's six chapters.

Chapter 1—Enhanced Design
Enhanced design incorporates sustainability up-front, uses an integrated and total systems approach to the development process, ensures aesthetics and livability, and educates and informs throughout the life cycle of the building (from pre-design through to closeout). The goal is to encourage a written commitment that carries through the project objectives from start to finish.

Sustainable building strategies should be considered from the moment that the developer initiates the project. The professional development team should include a developer, architect, engineer, landscape architect, contractor, asset and property management staff that are committed to applying environmentally sensitive building principles and practices.

Chapter 2—Site & Water
Sustainable design and site planning integrates design and construction strategies to minimize environmental site impacts, reduce construction costs, maximize energy, water, and natural resource conservation, improve operational efficiencies, and promote alternative transportation. Water management practices help to protect salmon.

Chapter 3—Energy Efficiency
Energy conservation helps maximize tenant comfort and reduce utility bills. Conservation measures slow the: accumulative impacts of energy production and delivery; extraction of non-renewable natural resources; degradation of regional air quality; global warming; and increasing concentration of pollutants.

Chapter 4—Health & Indoor Air Quality
Minimize exposure of residents and workers to toxic materials. Use safe, biodegradable materials and alternatives to hazardous materials.

Chapter 5—Materials Efficiency
Reducing, reusing, and recycling building materials conserves local and regional natural resources. There are many building products on the market and techniques that contribute to more durable and less resource intensive buildings.

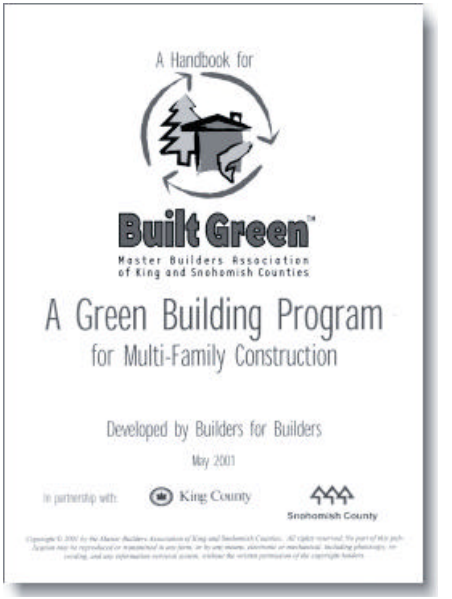
Chapter 6—Operations & Maintenance
O&M practices impact the building owner's costs and residents' health, comfort, and safety. Sustainable building O&M practices enhance tenant health and operational savings. The key to successful building performance is O&M plans, education, and design that is convenient and cost-effective.

SeaGreen Guide & Built Greenä Certification

The SeaGreen Guide was designed to be compatible with the Master Builders Association of King and Snohomish Counties' Built Green™ Program. SeaGreen is different in that it relates specifically to affordable multifamily housing developed by our housing partners.

Built Green™ is a program of the Master Builders Association of King and Snohomish Counties, developed for and by builders and developers to set standards of excellence. It is a voluntary, self-certification program, most often used in market-rate housing development, that provides recognition for meeting those standards.

Enrollment and certification offers a recognized level of achievement and access to informational resources on sustainable building. Enrollment fees are minimal, but through a Memorandum of Understanding with Master Builders, fees may be waived for affordable housing projects.



Master Builder's Built Green™ Program offers a Multi-Family Handbook that provides more detail on the *Action Items* included in this guide. For easy reference, each *Action Item* in the guide denotes its Built Green™ equivalent. For more information on strategies and resources, refer to the Built Green™ Program Multi-Family Handbook.

To learn more about the Built Green™ program and how to participate see www.builtgreen.net or call (800) 522-5209.

City Incentives

Seattle City Light and Seattle Public Utilities offer financial incentives for projects that participate in Built Green™. For more information, contact Peter Dobrovolny, peter.dobrovolny@seattle.gov or (206) 615-1094.

Using this Guide

The guide begins with a sustainability plan template, consisting of a checklist, developers may use to identify their sustainable building strategies. Seattle Office of Housing strongly encourages developers to submit a sustainability plan with applications for funding.

Essential items are identified in bold. Some Action Items were identified by stakeholders as achievable and essential strategies for affordable housing projects. Items that were considered more difficult to achieve were listed as recommended strategies. The intention is to achieve as many positive benefits in each project as is realistic, while balancing other project constraints.

Following the sustainability plan template, six chapters outline the "why" and "how" of each specific Action Item. The chapters cover these six sustainable building areas:

1. Enhanced Design
2. Site & Water
3. Energy Efficiency
4. Health & Indoor Air Quality
5. Materials Efficiency
6. Operation & Maintenance

The range of strategies gives developers a variety of options to choose from that allow flexibility for rapidly changing technologies and practices. The City of Seattle encourages project teams to incorporate as many sustainable strategies as is practical to meet the basic guiding principles of the program. The guide also acts as a resource for information, methods, materials, vendors and related Seattle City programs. Resources and appendices are found at the back of the guide.

Sustainability focuses on desired outcomes that may require a series of building choices. Developers will make choices based on life cycle cost comparison of replacement components and long-range utility cost analysis.

SEAGREEN SUSTAINABILITY PLAN TEMPLATE

CHECKLIST

Chapter 1 Enhanced Design

Design Development

NEW	REHAB	ACTION ITEM
☒	☒	1-1 **Essential:** Submit Sustainability Plan Template.
	☒	1-2. **Essential for Rehabs:** Evaluate opportunities for deconstruction – systematic disassembly of a structure to remove and salvage usable materials prior to demolition.
	☒	1-3. **Essential for Rehabs:** Inspect for asbestos and lead prior to remodel. Abate as required.
☐	☐	1-4. Site building(s) within 1/4 mile of mass transit and within 1/2 mile of stores and services. ★*2-44*
☐	☐	1-5. Preserve and create open space. ★ *2-7, 2-11, 2-43*
☐	☐	1-6. Use efficient building footprint and maximize space efficiency. ★*5-3*
☐	☐	1-7. Site buildings for optimum access to natural ventilation. Design buildings to maximize natural ventilation. ★*4-43*
☐	☐	1-8. Site buildings to maximize solar access. Design buildings to take advantage of solar heating potential and daylighting opportunities. ★*3-16, 3-17, 3-18*
☐	☐	1-9. Design below-ground space for non-occupancy uses.
☐	☐	1-10. Specify regionally manufactured building materials (within 500 miles). ★*5-33*
	☐	1-11. For Rehabs, investigate for mold and mildew prior to and during remodel. Remediate/repair as appropriate.
☐	☐	1-12. Evaluate life cycle cost benefits.
☐	☐	1-13. Provide permanent interpretive signs highlighting key environmental and other features.

Construction Documents

☒	☒	1-14. **Essential:** Reflect sustainability plan in your contract documents and project management.

★ *Built Green™ chapter - action point*

Close-Out

NEW	REHAB	ACTION ITEM
■	■	1-15. **Essential:** Reflect sustainability goals in O&M Manual.
☐	☐	1-16. Air out the building prior to occupancy. At least 2 weeks prior to occupancy restrict all use of toxic solvents, paints, etc. and for final cleaning use only low-toxic, non-toxic and environmentally benign maintenance materials and practices. ★*4-2, 4-23*
☐	☐	1-17. Conduct owner orientation/operation walk-through.
☐	☐	1-18. Conduct 3rd party verification/certification that sustainable products and practices were used in the project. ★*3-3*

Chapter 2 Site & Water

Site Management

■	■	2-1. **Essential:** Complete a comprehensive site inventory.
■	■	2-2. **Essential:** Perform level 1 site assessment to determine soil conditions and previous uses of site.
☐	☐	2-3. Perform level 2 site assessment for a more comprehensive geotechnical soil survey.
☐	☐	2-4. Preserve existing trees and shrubs on site, including street trees. ★*2-4*

Surface Water

■	■	2-5. **Essential:** Manage surface water. Minimum requirement is to design on-site stormwater facilities to City of Seattle's stormwater specifications. ★*2-8, 2-12, 2-16 (possibly 2-18, 2-19)*
■	■	2-6. **Essential:** Provide erosion and sedimentation control during construction and minimize site disturbance. Design site erosion control plan to City of Seattle's erosion control specifications. ★*2-3, 2-8, 2-9, 2-10, 2-22 (possibly 2-21 through 2-39)*

Landscape / Irrigation

■	■	2-7. **Essential:** Avoid herbicides and pesticides during site prep. Select least toxic natural products. ★*2-33*
■	■	2-8. **Essential:** Incorporate sustainable principles in landscape plan. ★*6-3*
■	■	2-9. **Essential:** Install landscape plan that incorporates sustainable principles. ★*6-7, 6-8, 6-9*

NEW	REHAB	ACTION ITEM
☐	☐	2-10. **Essential:** In new construction and when replacing existing landscaping, use native and drought tolerant plants and trees for landscaping, except for edible landscaping. Limit lawn to play and recreational areas. ★*6-10*
☐	☐	2-11. **Essential:** If irrigating with potable water, install high efficiency drip irrigation system. ★*6-11*
☐	☐	2-12. **Essential:** Clearly label all storm sewer inlets to inform residents about proper surface water protection.
☐	☐	2-13. Specify and install permeable surfaces and paving in low traffic areas (fire access, overflow parking, patios, driveways, pathways, etc.). ★*2-17*
☐	☐	2-14. Install rainwater catchment system for non-potable water reuse. ★*6-13*
☐	☐	2-15. Evaluate use of greywater for irrigation. ★*6-12, 6-15*
		Indoor Water Conservation
☐	☐	2-16. **Essential:** Install water conserving plumbing fixtures: 1.6 gpf toilets, 1.0 gpf urinals, 2.0 gpm showerheads or better & 1.0 gpm faucet aerators. Option for urinals: waterless type. ★*6-16, 6-17, 6-18*
☐	☐	2-17. Install water conserving appliances: Energy Star® or front-loading (horizontal or H-axis) clothes washers and energy efficient or Energy Star® dishwashing machines. ★*6-43, 6-44*
		Design
☐	☐	2-18. **Essential:** Design exterior to properly drain water away from the buildings including patios, decks, window sills, and thresholds. ★*4-25, 4-28, 4-29*
☐	☐	2-19. **Essential:** Provide secure bicycle parking. ★*6-27*
☐	☐	2-20. Provide pedestrian-friendly-design amenities.
☐	☐	2-21. Provide on-site transportation shelters OR create easy access to existing public transportation options/facilities. ★*6-28*
☐	☐	2-22. Size parking capacity to meet minimum local zoning requirements.
☐	☐	2-23. On larger projects with internal streets, install traffic calming devices, such as curb bulbs.

★ *Built Green™ chapter - action point*

Chapter 3 Energy Efficiency

Building Envelope & Air Sealing

NEW	REHAB	ACTION ITEM
☐	☐	3-1. **Essential:** Document envelope improvements of at least 10% beyond code. ★*3-1*
☐	☐	3-2. **Essential:** Flash and seal all penetrations between interior spaces and outside. Seal all penetrations for ducting, wiring, plumbing, lights and fans. ★*3-5, 3-23*
☐	☐	3-3. Upgrade energy performance of concrete slab on grade. ★*3-1*
☐	☐	3-4. Upgrade energy performance of windows and doors. ★*3-1*
☐	☐	3-5. Perform blower door test to determine cost-effective air sealing and combustion safety for sample units(s). ★*3-8*
☐	☐	3-6. Perform duct leakage test to determine cost-effective air sealing and combustion safety for sample units(s). ★*3-24*
☐	☐	3-7. Upgrade energy performance of ceiling and walls. ★*3-9, 3-10, 3-11, 3-12, 3-14, 3-15*
☐	☐	3-8. Specify and install insulated concrete forms. ★*3-6*

Mechanical/Equipment

☐	☐	3-9. **Essential:** Heating Systems—Compare two or more systems from the list (see text, Chapter 3) by completing a Life Cycle Cost Analysis.
☐	☐	3-10. **Essential:** Heating Controls—Install accurate thermostats throughout. Specify a product that provides highly accurate thermostatic control over the heating system of plus or minus 2 degrees F. ★*3-26, 3-27, 3-29*
☐	☐	3-11. **Essential:** Delivery System—If installing ductwork, install inside conditioned space and seal ductwork in crawls and attics with mastic. When installed outside conditioned space, insulate to wall insulation standard or higher. Design short runs. Use flex only for straight runs; otherwise use metal. ★*3-23, 3-25*

NEW	REHAB	ACTION ITEM
☐	☐	3-12. **Essential:** Install high-energy factor water heater (minimum = 0.64 for gas, 0.93 for electric). Option for gas water heater to go to 0.83. ★*6-37, 6-38, 6-39*
☐	☐	3-13. **Essential:** Insulate bottom of hot water tank. Insulate hot water pipes in unconditioned spaces. ★*3-32*
☐	☐	3-14. Install instant (tankless) hot water systems where appropriate to achieve energy savings. ★*6-36*
☐	☐	3-15. Install energy-efficient elevators.
Electrical, Lighting & Appliances		
☐	☐	3-16. **Essential:** Specify and install efficient outdoor lighting (30 lumens per watt or better) with low temperature ballasts. Install lamps with automated controls, including but not limited to photo sensors, timers and motion control sensors. ★*3-37, 3-39, 3-40, 3-42*
☐	☐	3-17. Specify and install Energy Star® lighting fixtures, lighting systems and appliances. ★*3-37, 3-38, 3-39, 3-40, 6-31, 6-43, 6-44, 6-45*
☐	☐	3-18. Install solar water heating system for common hot water heating. ★*3-46*
☐	☐	3-19. Provide solar site lighting for walkways or outdoor area lighting. ★*3-43*
Design		
☐	☐	3-20. Daylight interior. ★*3-35, 3-36*
Innovation		
☐	☐	3-21. Purchase Green Power.

★ *Built Green™ chapter - action point*

Chapter 4 Health & Indoor Air Quality

Materials

NEW	REHAB	ACTION ITEM
■	■	4-1. **Essential:** Use least-toxic, decay-resistant, outdoor building materials. No CCA (Chromated Copper Arsenic). ★*5-80, 5-81*
	■	4-2. **Essential:** For Rehabs, provide a lead-safe environment.
☐	☐	4-3. Install urea-formaldehyde free underlayment, cabinets and storage units. ★*4-18, 4-19*
☐	☐	4-4. Specify *low-toxic*, solvent-free, no-VOC (volatile organic compound) or low-VOC (below 100 g/liter) paints and primers. Specify water-based wood finishes and stains. ★*4-23*
☐	☐	4-5. Specify low-toxic, low-VOC adhesives and sealants. ★*4-17*
☐	☐	4-6. Avoid carpets on slab-on-grade. ★*4-12*
☐	☐	4-7. Install hard surfaces in living rooms and sleeping areas. ★*4-14*
☐	☐	4-8. If using carpet, install Carpet and Rug Institute's CRI IAQ label and low pile or less allergen-attracting carpet and pad. Install carpet by tacking (no glue) and limit use to one-third of the unit's square footage. ★*4-10, 4-11, 4-13, 4-15*
☐	☐	4-9. Ensure proper installation of under-slab vapor barriers. ★*4-27*

Fresh Air Ventilation

■	■	4-10. **Essential:** Provide make-up air. ★*4-37*
■	■	4-11. **Essential:** At a minimum install medium-efficiency air filters in ducted forced air systems. Option: Use "washable" type air filter. ★*4-40*
■	■	4-12. **Essential:** Install kitchen range hood, bath, laundry or ceiling exhaust fan vented to the outside to remove excess moisture and odors OR install multi-port attic fan to exhaust kitchen, laundry and bathroom. ★*4-48*
☐	☐	4-13. Provide for whole house ventilation with controlled supply and exhaust providing maximum Air Changes per Hour (ACH) for 24 hours per day as required by code.

NEW	REHAB	ACTION ITEM
☐	☐	4-14. Flush out building prior to occupancy with fresh outdoor air. ★*4-5, 4-6, 5-5*
☐	☐	4-15. Use operable windows for cross ventilation in combination with mechanical ventilation systems to assure good air flow and ample fresh air for building occupants. ★*4-37, 4-43*

Education

☐	☐	4-16. Implement a "No Smoking" policy for common areas. Consider designating smoking and non-smoking units, floors or buildings.
☐	☐	4-17. Educate residents on ways to maintain good indoor air quality including minimizing and treating mold, reducing track-in of dirt and the importance of using mechanical ventilation properly.

Chapter 5 - Materials Efficiency

Waste Management & Recycling

☐	☐	5-1. **Essential:** Develop and implement a waste minimization plan, establishing targets for demolition and construction waste recycling by types of materials. (Goal: 80% total waste reuse and recycling by weight.) ★*5-18, 5-19 through 5-30*
☐	☐	5-2. **Essential:** Require subcontractors to participate in waste minimization efforts. ★*5-8, 5-24*
☐	☐	5-3. **Essential:** Include Seattle/King County's Construction Recycling Directory and the Contractor's Guide as part of the bid package.
☐	☐	5-4. Reuse and recycle parts or all of existing building during renovation or redevelopment. Install used/salvaged building materials where appropriate. ★*5-9 through 5-17*
☐	☐	5-5. Use suppliers who offer reusable or recyclable packaging. ★*5-4*

Foundation

☐	☐	5-6. **Essential:** Specify cast-in-place concrete mix with minimum 25% fly ash substitution for Portland cement. Preferred 50%. ★*5-47*
☐	☐	5-7. **Essential:** Specify recycled aggregate base. ★*5-48*

★ *Built Green™ chapter - action point*

Framing

NEW	REHAB	ACTION ITEM
☐	☐	5-8. Use efficient structural systems, such as Advanced Framing, engineered structural lumber, etc. ★*5-36 through 5-43*
☐	☐	5-9. Specify 3rd-party certified sustainably harvested framing. Do not specify old growth lumber, other than "recovered" or "salvaged" materials. ★*5-44, 5-45*

Roof & Skin

☐	☐	5-10 Select durable and recyclable roofing and siding materials. ★*5-63, 5-66, 5-74, 5-75, 5-76*
☐	☐	5-11. Use recycled-content insulation (e.g. cellulose insulation.) ★*5-77*

Interior Finishes

☐	☐	5-12. When suspended ceiling panels are specified, install recycled-content acoustical ceiling tiles.
☐	☐	5-13. Specify 3rd-party certified sustainably-harvested finish woodwork. ★*5-71, 5-72*
☐	☐	5-14. Specify recycled-content drywall. Install hard surface drywall in high-wear areas. ★*5-58*
☐	☐	5-15. Install alternative to sheet vinyl for kitchens and bathrooms. Other flooring choices include natural linoleum, tile and vinyl composition tile (VCT) with recycled-content. ★*5-53, 5-56, 5-57*

Chapter 6 Operations & Maintenance

☐	☐	6-1. **Essential:** Prepare a plan for annual scheduled maintenance of all aspects of the building and site, including but not limited to, building envelope, roof, vents, filters, plumbing, combustion equipment and landscaping. ★*6-2*
☐	☐	6-2. **Essential:** Prepare a sustainable landscape O&M plan. ★*6-3*

NEW	REHAB	ACTION ITEM
■	■	6-3. **Essential:** Provide adequate space and convenient placement of resident recycling. Develop recycling and disposal procedures for staff. ★*6-50, 6-51*
■	■	6-4. **Essential:** Design properly ventilated separate storage area for maintenance supplies and paints. ★*6-46*
☐	☐	6-5. Develop a tenant manual to provide guidance on living in a residence that incorporates green or sustainable features. ★*6-1*
☐	☐	6-6. Incorporate a garbage disposal plan in the building/site design.
☐	☐	6-7. Provide training for O&M staff. ★*6-4*

★ *Built Green™ chapter - action point*

Chapter 1 Enhanced Design

Enhanced design incorporates sustainability up-front, uses an integrated and total systems approach to the development process, ensures aesthetics and livability, and educates and informs throughout the life cycle of the building (from pre-design through to closeout). The goal is to encourage a written commitment that carries through the project objectives from start to finish.

Sustainable building strategies should be considered from the moment that the developer initiates the project. Create a professional development team that includes a developer, architect, engineer, landscape architect, contractor, asset and property management staff that are committed to applying environmentally sensitive building principles and practices.

Design Development

*This section includes primary design considerations that must be addressed before the construction document phase. Other design considerations, included in chapters 2 through 6 also need to be considered prior to construction. Be sure to review all **Essential** Action Items and look at all possible recommended Action Items up-front. It is always easier, and therefore more cost-effective, when actions are considered in pre-planning.*

1-1 **Essential:** Submit Sustainability Plan Template.

WHY

- A Sustainability Plan provides a framework for setting goals for the project and assessing progress towards those goals.
- Planning improves the opportunity for integrated design by letting all players know what the goals are and how you hope to achieve them.
- Planning optimizes the environmental and economic performance benefits you can achieve with your project.

HOW

- Assemble a development team with the capacity and desire to incorporate the SeaGreen Affordable Housing Guidelines into the project. Requests for qualifications or proposals should seek expertise in sustainable design.
- Hold at least one initial meeting of full design team to review the requirements and recommendations outlined in this Guide. Make a preliminary determination of which Action Items are appropriate for the project.
- Use the Sustainability Plan Template to identify sustainability goals. Briefly outline the steps that will be used to ensure implementation. Identify roles and responsibilities for investigating and implementing specific Action Items, checking off Action Items in the Guide that are suitable for the project.
- Use the Sustainability Plan Template to measure your progress and to orient the design and construction professionals subsequently joining the design team. This document can be used to communicate goals with City departments, such as DCLU, Seattle Public Utilities, City Light and Seattle Transportation.

- Meeting early on with appropriate City Departments is strongly encouraged. The plan can also be used as a framework for introducing sustainability into the neighborhood design review process.

- Fine-tune the plan by reviewing the design program intent and the list of Action Items. Develop a schedule for finalizing key points in the design process.

Portland Office of Sustainable Development

Deconstruction is an economical alternative to demolition.

1-2

Essential for Rehabs: Evaluate opportunities for deconstruction – systematic disassembly of a structure to remove and salvage usable materials prior to demolition.

WHY

- Seattle offers many cost-effective alternatives to conventional demolition

- Reuse is the highest waste management priority and represents the best use for discarded materials.

- Reuse may provide financial benefits with lower disposal costs and resale revenue.

HOW

- Evaluate structural components, fixtures or other building elements for reuse in the project.
- Coordinate with contractor on design team.
- Consult with local salvage or deconstruction vendor. They may perform a waste evaluation to determine the types and quantities of reusable materials.
- Contact the Business and Industry Resource Venture for assistance in locating vendors, recycling and reuse opportunities and information, and additional resources, including how to perform a waste evaluation (see Resources).

COST

- Potential cost savings in resale proceeds and reduced dump fees.

1-3

Essential for Rehabs: Inspect for asbestos and lead prior to remodel. Abate as required.

WHY

- Asbestos is a naturally occurring mineral fiber recognized as a health risk if fibers become airborne and inhaled. Though now tightly controlled, asbestos is commonly found in pre-existing systems and a variety of construction materials. Remodeling may disturb these materials and create an unsafe environment with possible health risks due to inhalation of airborne asbestos during construction for workers and for occupants if contamination is not properly managed.
- The Environmental Protection Agency (EPA) and the Washington Occupational Safety and Health Administration (OSHA) require that an asbestos survey be performed to determine the presence of asbestos containing materials in or on a structure prior to any remodeling, renovation, or demolition work.
- Managing potential lead contamination protects workers and occupants from associated health risks of lead exposure. Remodeling wastes often includes painted materials with lead-based paint, especially in buildings built prior to 1978. Lead paint presents problems if it is peeling or in the form of dust or chips, which are toxic to humans if ingested or inhaled. Lead solder was commonly used on copper pipe up until 1980 when it was banned in Seattle.

- Proper control and disposal protects against land and water pollution caused by the release of lead into the environment.

HOW

- Conduct asbestos survey. For friable Asbestos Containing Materials (ACM) removal, documentation demonstrating abatement and disposal by a certified asbestos removal contractor is required. For non-friable ACM removal, documentation demonstrating compliance with federal, state, and local regulations and disposal at an authorized landfill is required.
- The Toxicity Characteristic Leaching Procedure (TCLP) test is usually used to confirm the presence of lead in paint. Conduct the test or hire a qualified contractor to perform the test and report results. Abate as required and follow disposal requirements. As a worker safety measure, provide information to general contractor.
- Specify all ductwork is sealed against dust, etc. during construction.

1-4 Site building(s) within 1/4 mile of mass transit and within 1/2 mile of stores and services.

WHY

- Siting projects close to transit and services can reduce on-site parking needs and save associated construction costs.
- It can reduce residents' need to own a car and eliminate the costs associated with auto ownership.
- Pedestrian and transit-oriented neighborhoods provide residents with a range of services, parks and employment opportunities within walking and biking distance. Streets are more populated, friendly, and safe.

HOW

- Seek out potential development sites within 1/4 mile of mass transit and within 1/2 mile of stores and services.
- If the neighborhood is lacking services, evaluate the viability of incorporating commercial, retail, or other community services into the development.

- Provide pedestrian access routes, including pathways and bicycle routes to provide safe and convenient access to services and provide bicycle storage facilities to encourage non-motorized transportation.
- Locate a “Flex-Car” station near site if available.
- **See also** Chapter 2: Site & Water, Action Items 19-20.

1-5 Preserve and create open space.

WHY

- Natural areas that include native vegetation, preserved as open space, offer many benefits: surface water management and flood control; on-site recreation areas for trails and other pedestrian uses; and wildlife habitat corridors.
- Preserving open space can serve also to protect environmentally sensitive areas.

HOW

- Cluster units, buildings and site infrastructure on the site avoiding environmentally sensitive areas.
- Design building footprint and traffic paths to limit impact on site features and refrain from modifying natural topography.
- Limit clearing and grading of native vegetation to minimum amount necessary to build, allow access to utilities and site amenities, including parks and to provide fire protection.

1-6 Use efficient footprint and maximize space efficiency.

WHY

- Smaller, more efficiently designed buildings conserve energy, water, and materials, reduce operating costs, and create more space for on-site surface water management, as well as for resident activities such as recreation and vegetable gardens.
- Focusing on function rather than space tends to create a more livable space.

HOW

- For common areas: design for safety and efficient public circulation and egress while maximizing interaction between residents. Public spaces should be designed to accommodate future adaptation. Consider including space for community gardening.
- Simplify building shape.
- Provide a common wall water access to reduce pipe runs, that is, locate kitchens above laundries and baths above kitchens.
- Layout the interior for efficient use of space. For instance a wider unit entry can provide added space for computer desk, storage, etc.
- Design floor plans to accommodate future adaptation. For example, design partition walls for future changes in common space or office space.
- Use standard dimensions in design to maximize materials efficiency: results in less wasted lumber, drywall, and other materials. Consider reducing lumber size at partitions from standard 2x4 to 2x3 or advanced framing options.

1-7

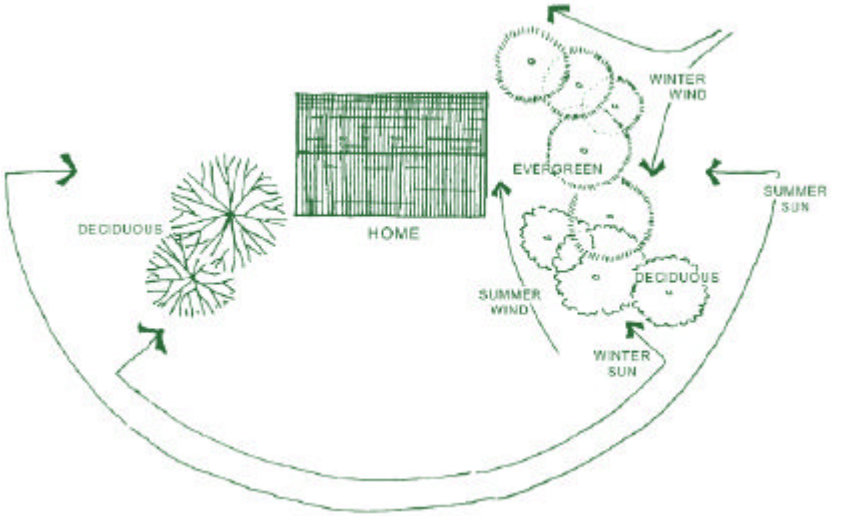
Site buildings for optimum access to natural ventilation.
Design buildings to maximize natural ventilation.

WHY

- Using natural ventilation can reduce or eliminate the need for mechanical air conditioning. Maximizing natural ventilation reduces up-front equipment costs and operating costs.
- Optimizing natural ventilation contributes to a more comfortable living environment.

HOW

- Stagger buildings to allow individual units to catch breezes and discourage stagnant air buildup associated with conventional design.
- Design for cross ventilation and courtyards.
- Microclimates can be created by locating trees and shrubs in relationship with incoming breezes.



Site analysis includes sun and wind patterns - information that influences site and building design. For example, well-placed landscaping can block winter winds, channel summer winds and shade buildings from summer sun.

1-8

Site building(s) to maximize solar access. Design buildings to take advantage of solar heating potential and daylighting opportunities.

WHY

- Maximizing solar access creates more energy efficient, healthy and comfortable spaces.
- Good daylighting can provide a sense of wellbeing. In addition, it has been proven to improve learning and productivity in school settings and work environments.
- Sunlight through clear glazing or open windows kills pathogens that can affect resident health.

HOW

- Properly size overhangs to prevent excessive solar gains in the summer while allowing the sun to enter the building during the heating season.
- To make the best use of passive solar: orient the majority of the building's glazing within 22 degrees of due South–remember to make the correction for magnetic North, which is 21 to 22 degrees East in the Puget Sound area; specify south windows to maximize solar gain; and design adequate thermal mass.

- Install windows adjacent to walls to help bounce sunlight deep into interior spaces.
- Consult the Lighting Design Lab to evaluate daylighting options. (See Resources 3)
- Use trees and other natural landscaping to provide east and west shading strategies to help protect against overheating.

1-9 Design below-ground space for non-occupancy uses.

WHY

- To ensure no resident is subjected to excessive mold and mildew problems.

HOW

- Design any below-ground space for non-occupancy uses.
- If the building includes below-ground units, take extra measures to incorporate proper insulating moisture control and ventilation to avoid trapping mold.
- **See also** Chapter 1: Enhanced Design, Action Item 11.

1-10 Specify regionally manufactured building materials (within 500 miles).

WHY

- Purchasing regionally manufactured materials and products supports the local economy and reduces transportation costs and impacts, i.e. pollution, road maintenance and oil drilling.

HOW

- Work with suppliers to identify regionally manufactured building materials.
- Many materials listed in the Resource section are manufactured in the Pacific Northwest.

1-11 For Rehabs, investigate for mold and mildew prior to and during remodel. Remediate/repair as appropriate.

WHY

- The presence of indoor mold growth indicates high levels of biological contaminants that contribute to unacceptable indoor air quality. Mold removal and repair protects occupants against potential health effects and symptoms associated with mold exposures, including allergic reactions, asthma, and other respiratory complaints.
- Additionally, mold remediation/repair protects against further damage to building structure and furnishings. This reduces negative environmental impacts due to the extraction of virgin materials and disposal.

HOW

- Look for signs of water collection or leaks and remove the source of the moisture.
- Look for staining or discoloration in drywall and in and around windows and remove and repair as necessary.
- Look for adequate ventilation in kitchens, bathrooms, attics, and crawlspaces.
- If you can smell a musty odor or if you suspect a large leak, it is advisable to consult a professional environmental inspector or building envelope specialist. They should be equipped with both penetrating and non-penetrating moisture meters and be prepared to inspect all possible areas of the building and offer a report. Remediate and repair as necessary and remove the source of the problem.
- Specify all ductwork is sealed against dust, moisture, etc. during construction.

COST

- Identifying and eliminating the source of the problem, as opposed to simply treating mold, will incur costs for inspection and repairs. Remediation may require redesigning elements of the building that could add costs.

1-12 Evaluate life cycle cost benefits.

WHY

- A life cycle cost analysis can be used to develop a cost-effective 20-year capital needs replacement schedule.
- A life cycle cost analysis or other method can accurately show long-term cost implications of choice. Sustainable choices can sometimes mean a first cost premium when compared to conventional choices, but over the long-term provide greater durability, reduced maintenance and replacement costs and lower utility bills.

HOW

- Analysis should relate to a sustainability plan and focus on an integrated design approach rather than on a specific technique or product. For instance if the design intent includes energy efficiency, several techniques or products combined would be used to optimize energy efficiency. You would want to look at these options as a package, then make adjustments to balance highest efficiency for the least life-cycle cost.

1-13 Provide permanent interpretive signs highlighting key environmental and other features.

WHY

- Creating community awareness of special environmental features within a community helps foster a sense of stewardship and a greater understanding of the interconnectedness of built and natural environments.
- Connection to place helps foster a sense of stewardship overall.
- Fish friendly signage like “Dump no oil—drains to streams!” at storm drains is an important water quality message.
- **See also** Chapter 2: Site & Water, Action Item 12.

HOW

- Use signs to identify features, such as “*Built Smart* energy efficient building,” “drought tolerant landscape” or "Habitat Area." Describe its environmental protective function, or provide additional information on the sustainable feature. Sometimes a sustainable feature is subtle enough that it requires an informative message.

- Use interpretive signage to highlight cultural or historical landmarks, to further develop a sense of place.
- Energy Star®, green label, and other similar product identifiers should be displayed.

Construction Documents

1-14

Essential: Reflect sustainability plan in your contract documents and project management.

WHY

- Contract documents are the best means to convey to contractors the sustainability plan in concrete terms, and to make sure the sustainability goals are actually achieved.
- Frequently, substitutions are made in the field during construction that can undermine the initial intention of the sustainability plan as a whole or specific Action Items.
- To ensure Required Action Items are implemented in the project.

HOW

- Prepare specifications, bid packages, purchasing criteria for materials and services, salvage instructions, etc. reflecting the project's sustainability goals. Incorporate specific requirements for products and techniques consistent with Action Items identified in the Sustainability Plan, and determined through the design process to be appropriate for the project.
- Include sustainable building items in base bid. Adding them through change order can increase their cost.
- Use "or *approved* equal" rather than "or equivalent" for allowable substitutions. Ensure the approval process includes a review for environmental preferences.

- Specifications should call out environmentally preferable attributes or environmental performance reference standards for products and techniques intended to satisfy Action Items identified for the project. Clearly state that substitutions must perform to the intended design standard. Avoid ambiguous language such as “contractor is encouraged” or “as much as possible.”
- In addition to contract documents, provide the contractor with a copy of the Sustainability Plan.
- Change orders should meet required Action Item objectives and /or intent. If there are change orders, strive to ensure that details of the sustainability plan are not undermined.
- Develop a contractor’s checklist that incorporates in-the-field verification of preferred installation and practice. **See also** Chapter 1: Enhanced Design, Action Item 18.
- Be familiar with the plans and specifications. Assign your project manager with responsibility to achieve desired outcomes.

Close-Out

1-15 **Essential:** Reflect sustainability goals in O&M Manual.

WHY

- An O&M Manual can significantly increase the chance that actions taken on the project, as part of the Sustainability Plan, will produce the environmental and economic benefits desired over the life of the building.
- To make sure routine maintenance does not reduce environmental performance of green or sustainable products installed in the building.
- To make sure custodial and maintenance staff have the information they need to maintain the level of sustainability achieved in the building when they need to replace products for wear and tear. Feedback on the positive (or negative) results of using a particular “green” product is useful information to designers in future projects.

HOW

- Provide an outline of the O&M manual with project submittal.
- Review Chapter 6: Operations & Maintenance for specific issues that should be addressed in an O&M Manual incorporating sustainability. The O&M Plan should include a maintenance schedule, operating tips, and a list of green/sustainable products installed in the project, noting preferred maintenance and replacement procedures for those products.
- Integrate maintenance and operations procedures for sustainable design features (materials and equipment) with "conventional" operations and maintenance. Eliminate or modify "conventional" practices that substantively conflict with sustainability goals.
- Incorporate a summary of policies and requirements that are relevant during the occupancy of the building. For example, if there is a requirement for Integrated Pest Management of building and landscape pests, it should be included in this section of the O&M Manual. **See also** Chapter 6: Operations & Maintenance, Action Item 2.
- Require annual updates and review of the O&M Manual with the Maintenance Staff. Include update and review of approved products list for maintenance.
- Address any problem substances such as encapsulated asbestos, that may still be in building after occupancy. Include a hazardous materials management plan.
- When handing over the manual, an initial training should be conducted. Equipment manufacturers will often provide orientation.

1-16

Air out the building prior to occupancy. At least 2 weeks prior to occupancy restrict all use of toxic solvents, paints, etc. and for final cleaning use only low-toxic, non-toxic and environmentally benign maintenance materials and practices.

WHY

- Using toxic chemicals or environmentally inappropriate practices to prepare for building occupancy can significantly undermine any efforts made to design a project that is healthy for the occupants.
- Wet carpet cleaning saturates carpet with more moisture than can evaporate and traps it below the carpet's surface, creating a potential mold problem.

HOW

- Specify low-toxic maintenance materials throughout construction, and in particular as part of close-out. Disallow the use of chemical solvents for interior surfaces. Soy- or citrus-based cleaning products are preferable alternatives.
- Provide construction signage that instructs construction clean-up crews in proper close-out procedures.
- For rehab: Specify steam cleaning for carpets, no wet carpet cleaning.
- Specify the use of HEPA filters for vacuum cleaners used during construction, and at close-out. HEPA or Filtreat vacuum filters can trap dust mites and other very fine pollutants when properly used.

COST

- Quality HEPA or Filtreat vacuum cleaners cost $400 or more retail, and their specialized filters cost between $20-60 each. High quality Hepa vacuum cleaners do not need filter replacement very often.

1-17 Conduct owner orientation/operation walk-through.

WHY

- Combined with a good O&M Manual, a walk-through and orientation can ensure that the environmental and economic benefits intended through the Sustainability Plan are achieved.

HOW

- Develop and orient staff to O&M Manual prior to the scheduled walk-through and allow an opportunity for a question and answer session.

1-18 Conduct 3rd party verification/certification that sustainable products and practices were used in the project.

WHY

- Frequently, lack of information, scheduling problems, or other unforeseen circumstances may stand in the way of implementation of a sustainable feature as the designer intends.

HOW

- For energy and indoor quality features, you can use the help of qualified specialists in programs such as Energy Star® Seattle City Light's *BUILT SMART*, or the American Lung Association's Healthy House Program to certify your project has met its goals. See Resources Section for contact information. For large buildings it is recommended that a commissioning specialist be engaged early and contracted to assure quality performance of all systems.

- For construction waste management recognition, participate in *Construction Works* program through the Business Industry Resource Venture (BIRV.) See resource section.

Chapter 2 Site & Water

Sustainable design and site planning integrates design and construction strategies to minimize environmental site impacts, reduce construction costs, maximize energy, water, and natural resource conservation, improve operational efficiencies, and promote alternative transportation. Water management practices help to protect salmon.

Site Management

2-1

Essential: Complete a comprehensive site inventory.

WHY

- A thorough site inventory identifies design and construction opportunities and barriers.
- Solar and wind exposure affects building performance, including: resident comfort, energy costs, and building functionality.
- Accurate identification of easements, utilities, and other right-of-way issues reduces potential conflicts and unforeseen project costs.

HOW

- Obtain a site survey including information relevant to zoning, utilities, adjacent buildings, easements, elevation and drainage patterns, streets, curbs, sidewalks and curb cuts.
- For projects that present site design opportunities, perform a comprehensive site inventory prior to preparing a schematic site plan. In addition to typical survey information have project manager or design team members assess information about conditions that may effect building performance and energy consumption such as seasonal wind patterns, solar access and environmental features (trees, vegetation, wetland areas, etc.) and surface water drainage patterns. Evaluate how natural conditions can work within the other sustainable building strategies in your plan.
- **See also** Chapter 2: Site & Water, Action Item 2.

COST

- An accurate and complete site survey will assist designer and identify savings.

2-2

Essential: Perform level 1 site assessment to determine soil conditions and previous uses of site.

WHY

- Level 1 site assessment is a records investigation of the site's geotechnical conditions, often performed before purchase of the property. The assessment should include: past uses of site, water table, underground water streams, drainage conditions, and compaction and overall soil quality and/or fill capacity for supporting structural footings, slabs, new drainage and surface pavement.

HOW

- Consult a licensed geotechnical engineer for level 1, site assessments.
- It is not sufficient to use an earlier survey for your project - a geotechnical investigation is relevant only to the proposed building and site design. Site conditions may have changed since the last study. Soils may have been contaminated with hazardous materials.
- The studies should clearly assess all major portions of a site to avoid problems in the construction phase. For example, if the soil is found to be of poor quality (infiltration and compaction) during foundation excavation, bringing in new fill and hauling away existing soils will add significant costs to the project.

COST

- The cost for a level 1 site assessment, often required by lenders, begins at approximately $2,000-3,000 depending on site and accessibility.

2-3

Perform level 2 site assessment for a more comprehensive geotechnical soil survey.

WHY

- Level 2 site assessment is a physical, on-site survey performed if a level 1 site assessment indicates potential geotechnical risk.
- A geotechnical (soil) survey identifies soil conditions—soil drainage conditions, compaction, underground water sources, bearing capacity—underneath major proposed structures. It is performed after preliminary schematic architectural design.

HOW

- Consult a licensed geotechnical engineer for geotechnical (soil) survey, level 2 site assessments.

COST

- Geotechnical (soil) surveys are approximately $2,000 for a single-family lot; $4,000 for a one-acre multi-family site; and $10,000-15,000 for a five-story mid-rise structure with adjacent party walls.

The distance a tree's roots extend from its trunk can be greater than the tree's height. Protect roots from damage during development.

2-4 Preserve existing trees and shrubs on site, including street trees.

CODE

Code allows for tree preservation *or* tree planting, but emphasizes the preservation of large (over 6" diameter) healthy trees. There are no restrictions on tree removal for structural additions, only for new construction. There are other considerations to determine which regulations apply, see DCLU Client Assistance Memo (CAM) 242, available on-line at seattle.gov/dclu/publications.

WHY

Mature trees can provide excellent protection against winter winds and summer sun — improving comfort and lowering energy costs. In addition, trees provide food sources, such as fruits, and cover for wildlife habitat.

HOW

Protect root systems of existing trees from damage.

During building layout, identify existing plants, including trees and understory plants that you want to save. For vegetation that needs to be cleared, reuse on site.

- Retain trees over 8" caliper unless they're hazardous or cannot be incorporated into site plan. Such trees must be replaced 1-to-1 in landscaping. Trees may be relocated to accommodate new construction.
- Define protected areas on plans and field stake or flag on site. Fence critical areas, including tree root zones.
- Clear only areas actually needed to install driveways, parking areas, and building foundations. Avoid constructing paved areas over sensitive tree roots.
- Review site areas to be graded with excavation crew to ensure compliance with preservation plan. Check grading operations frequently to prevent accidental damage to marked areas.
- Never park heavy equipment or store heavy materials under trees.
- Many native plant species don't grow well in alkaline soils and should not be planted where their root systems will be near concrete.
- Consult with City of Seattle Arborist.

Surface Water

2-5

Essential: Manage surface water. Minimum requirement is to design on-site stormwater facilities to City of Seattle's stormwater specifications.

CODE

- All projects are required to implement a stormwater management plan using the City of Seattle's DCLU Construction Stormwater Control Technical Requirements Manual.
(Director's Rule 16-2000: seattle.gov/dclu/codes/Dr/dr2000-16.pdf)
- The City requires stormwater treatment for new parking lots of 5,000 square feet or more when the ultimate discharge point will be a lake, stream, or Puget Sound. A variety of treatment strategies are allowed, including infiltration.

Seattle Office of Housing

Bioswales reduce erosion and cleanse stormwater before it enters the water table.

A bioswale is a shallow trench planted with trees, shrubs and ground cover that detains and filters stormwater before allowing it to infiltrate the groundwater system.

WHY

- Maximizing on-site treatment of stormwater runoff increases on-site filtration, prevents pollutants from entering waterways, and reduces soil erosion.
- Effective stormwater management can help reestablish proper water functions that may have been disrupted during site development.
- Water storage and nutrient collection processes contribute to forming a healthier ecological community within the landscape.
- Federal funding requires State Department of Ecology stormwater rules, which may require biological assessment if within a certain distance to water sources.

HOW

- Use Best Management Practices (BMPs) to retain and treat on-site stormwater. Stormwater facility design depends on site drainage, soils, and space constraint factors. See DCLU's stormwater specifications for specific options to meet the city's requirements.

- Minimize situations where rain has no chance to infiltrate into the ground. Limit total impervious areas, surfaces that do not allow stormwater infiltration, including roofs, driveways, sidewalks, and streets. Disconnect impervious surfaces from each other as these magnify stormwater runoff problems. A paved driveway, for example, should not drain onto a paved street. Separate impervious surfaces with areas of turf, other vegetation, or gravel.

- Amend disturbed soil with compost to a depth of 8 to 10 inches to restore soil environmental functions.

- Projects can receive impervious surface reduction credits by employing practices that increase pervious surface.

- Another option is a "green" or "eco-roof" — a roof system designed to capture stormwater and infiltrate into a roof-top planting system. The remaining runoff from an eco-roof can also be directed to retention ponds, bioswales, and landscapes.

2-6

Essential: Provide erosion and sedimentation control during construction and minimize site disturbance. Design site erosion control plan to City of Seattle's erosion control specifications.

CODE

- The City of Seattle standard specification for erosion control and roadside planting sets minimum requirements for all development and ground-disturbing activities.

- The City's drainage code requires erosion control for all construction projects. Small projects may be required to provide an erosion control checklist with the building permit application. Projects that include 5,000 square feet or more of new impervious surface are required to provide an erosion control plan stamped by a licensed civil engineer.

WHY

- Erosion control during site development keeps valuable topsoils on site and reduces pollution, stormwater, and sediment runoff into local waterways. Erosion control Best Management Practices (BMPs) help avoid stormwater related problems that can delay construction, add costs, cause environmental degradation, and damage public and private properties downstream.

- Compacted soils resulting from construction are less able to absorb water, resist plant root penetration, and lack the porosity needed for adequate aeration. As a result, they increase stormwater runoff.
- Federal funding requires State Department of Ecology stormwater rules, which may require biological assessment if within a certain distance to water sources.

HOW

- For relatively flat sites consider using a pin foundation system.
- Submit a site plan that outlines erosion control mitigation measures for all phases of site work with building permit-application. Select from the menu of Best Management Practices (BMPs) in the City's erosion control specifications to minimize runoff.
- BMPs include retaining all native topsoil on site and protecting stockpiles from erosion, compost barriers or filter berms, limiting equipment use zones, mulching exposed areas, sediment fencing, gravel construction entrances, and filter swales.
- Check and maintain all BMP strategies regularly to avoid BMP failure, or implement supplemental BMPs as back up, in case of primary BMP failure.
- Construct stormwater detention facilities as a first step in grading.
- Use compost to stabilize disturbed slopes.

COST

- Minimal: For most sites, erosion mitigation strategies are inexpensive. More complicated sites, for instance those with steep slopes or adjacent to waterways, may have higher costs associated with more sophisticated strategies and monitoring. Using compost for erosion control has been shown to reduce overall construction costs.
- **Note:** Using compost for erosion control is a relatively new application. Check with your local code enforcers and stormwater management officials first. Slightly coarse to coarse types of compost are well suited for holding surface soil in place even during heavy rainfall.

Landscape / Irrigation

2-7

Essential: Avoid herbicides and pesticides during site prep. Select least toxic natural products.

WHY

- Seattle code prohibits the transport or introduction of pollutants, in addition to sediment, into stormwater. See DCLU Director's Rule 16-2000, Construction Stormwater Control Technical Requirements Manual, p. 107, for requirements and Best Management Practices related to pesticide control, handling of petroleum products, nutrient application control, solid waste handling and disposal, and use of chemicals during construction.

- Pesticides and herbicides pose a significant long-term health hazard to people and local ecosystems. Many substances do not safely break down, putting play areas, buildings, and groundwater at risk of contamination. Many products have been restricted or banned only after prolonged use and testing reveal long-term hazards. For example, the EPA now classifies diazinon, a common garden pesticide, as a Restricted Use Pesticide, to be used only by professional pest control operators.

HOW

- There are many less-toxic alternatives to most herbicides and pesticides on the market today. Vinegar-based herbicides and insecticidal soaps are effective alternatives.

- To remove invasive species like blackberries or horsetail, herbicides will rarely be effective — their roots must be completely dug out of the ground.

2-8

Essential: Incorporate sustainable principles in landscape plan.

WHY

- Site development alters natural site conditions. Simple planting choices can support or recreate habitat for birds, insects and other wildlife.

- Strategically locating vegetation reduces overheating of buildings, resulting in reduced operational costs for the owner, greater comforts for residents, and less energy use. A well-placed windbreak of evergreens can reduce a building's heating bill by up to 20%.

- A landscape provides opportunities for residents to use and enjoy the outdoor environment such as garden spaces with edible plants, and places where children can learn about the natural cycles of a landscape.
- Grass lawns and some ornamental plant species can be invasive and costly to maintain. They require more water, labor, herbicides, pesticides and fertilizers to maintain.

HOW

- Optimize existing site vegetation.
- Consider xeriscaping. Xeriscaping embodies the principles of water conservation through creative landscaping.
- Specify that disturbed soils will be amended with 8 to 10 inches of compost or for turf areas, use a combination of sand and compost to ensure proper drainage.
- Plant native and drought-tolerant plants, grasses, shrubs, and ground cover. Cluster plants with similar water needs ("water-use" zones). Keep in mind some low water use plants may have certain needs, such as shade, which when not met can lead to increased water use. Maintain a 3-inch minimum layer of mulch in planted areas.
- Limit lawn to play or recreational areas. Centralize into one shared space.
- Locate trees for shading and wind breaks. Provide plantings on the south to create shade and channel breezes in summer without obstructing sun in winter and provide plantings on the east and northeast to filter the sun without blocking the light.
- Build paved areas away from south windows and shade with plantings. Use light-colored pavement.
- Create community or apartment gardens. This can be as simple as setting aside land for resident use, or developing a formal community garden and management plan. Make information on gardening available to residents in their native languages.
- **See also** Chapter 2: Site and Water, Action Item 10.

Seattle Office of Housing

Community gardening can be as simple as designing land to be available to residents.

2-9	**Essential:** Install landscape plan that incorporates sustainable principles.
WHY	This Action Item is specifically called out to emphasize the importance of installing the specified landscape.
HOW	Instruct crews and/or subcontractors in methods, materials and sustainable practices specified in the plan. **See also** Chapter 2: Site & Water, Action Items 8 and 10.

Seattle Office of Housing

This lush landscape is comprised of native and drought-tolerant plants.

2-10

Essential: In new construction and when replacing existing landscaping, use native and drought tolerant plants and trees for landscaping, except for edible landscaping. Limit lawn to play and recreational areas.

WHY

- In the summer, up to 50% of the water used by municipal systems is for outdoor irrigation at a time when water reservoirs are at their lowest.
- Grass lawn is water intensive—needing about 35 inches of water per year to thrive, most of it during the summer. While lawn is appropriate for some landscaping, such as for play areas; it should be minimized wherever possible.
- Reduce maintenance costs and water use by replacing underutilized turf with native and/or edible landscaping.
- Native vegetation is well adapted to our climate and in a landscape provides excellent erosion, sediment, dust, and pollution control. Native plants are also more resistant to naturally occurring disease, insects and low levels of nutrients, reducing need for fertilizers, pesticides or herbicides.

HOW

- Design landscape with native, drought tolerant plants and include edible plants for resident use, if appropriate. Maintain a 3-inch minimum layer of mulch in planting areas.
- Avoid plant species with invasive growth or seeding habits. Do not plant English Ivy (Hedera helix). Landscape designs should be checked against the Washington State Department of Ecology and King County lists of noxious weeds.
- Select disease resistant cultivars and avoid insect-prone species.
- Vigorous groundcovers, shade canopies and plant spacing are factors that can reduce the need for weed control.
- Select plants that can adapt to summer heat created by buildings and pavement.
- Involve landscape designer in architectural design process to identify appropriate areas for landscaping.
- Combine the landscape plan with stormwater management. A well-designed system will provide surface water filtration and aesthetic benefits.
- For lawn, don't plant turf in heavy shade or in areas with saturated soils or steep slopes.
- Select a grass mix that is suitable for the sun conditions and the lawn's intended use, and also one that grows slowly and requires less irrigation or maintenance, such as "eco-turf" or locally adapted rye-fescue seed blends. Limit the use of lawn to play or recreational areas.
- **See also** Chapter 2: Site & Water, Action Items 8 and 9.

COST

- This measure can save money by reducing maintenance and irrigation costs. Native plants usually do not cost more than conventional ornamental planting materials.

2-11

Essential: If irrigating with potable water, install high-efficiency drip irrigation system.

WHY

- On average outdoor water use accounts for about 50% of residential water use. Native landscapes or carefully selected plantings can tolerate no irrigation even in dry periods once they have been established.
- Drip irrigation, the slow application of water to a plant's root zone, can cut water use by half or more. Accurate delivery reduces evaporation and eliminates overspray, and proper scheduling eliminates wet/dry fluctuations that stress plants. Drip systems can easily be modified to accommodate changes in a landscape or to provide separate schedules for different watering requirements, i.e. in amount and frequency.

HOW

- If irrigation is necessary, use high efficiency drip irrigation equipment and scheduling.
- Native, drought-tolerant landscapes are hardy and well-adapted to our climate. Use manual or drip irrigation system for generally 1-2 growing seasons to establish the landscape. After they have been established, the temporary irrigation system can be removed.
- Design and installation of drip irrigation systems should be accomplished by a certified irrigation specialist and conform to local water use ordinances. The system should include a clock timer, filter to prevent clogging and pressure regulator to reduce incoming City water line pressure. To prevent vandalism or accidental damage, lines can be buried 6" below ground. Installers can advise regarding spacing and size of emitters as well as watering schedules.
- Plants with similar water needs should be grouped together in "water use" zones, with irrigation schedules matching their needs.
- Drip irrigation systems require regular monitoring to ensure system is operating properly. Also, there is the possible damage from landscape maintenance equipment. Be sure to include as-builts with locations clearly defined as well as information about how the system works in the Operations & Maintenance Manual.
- Less-expensive alternative is installation of above-ground soaker hoses.

2-12

Essential: Clearly label all storm sewer inlets to inform residents about proper surface water protection.

WHY

- Storm sewer inlets are not places to dump paints or landscape wastes such as fallen leaves. Providing a visual reminder that storm sewer inlets connect to area waterways can help to educate community members. For example, a simple painted stencil can be used that reads, "Caution—leads to stream!"

HOW

- See the Resources Section for information on where to obtain free stenciling materials in the City.

2-13

Specify and install permeable surfaces and paving in low traffic areas (fire access, overflow parking, patios, driveways, pathways, etc.).

WHY

- Permeable surfaces facilitate on-site stormwater infiltration by reducing the percentage of hard surfaces.
- Projects can receive impervious surface reduction credits for employing this strategy, decreasing the size and cost of stromwater detention infrastructure required on their projects.

HOW

- A variety of permeable surfaces are available: special permeable concrete/pavement; brick or stone pavers; and manufactured products made of concrete, plastic and/or gravel. Some products support turf growth.
- When installing permeable parking surfaces, carefully follow manufacturer's installation instructions to ensure proper drainage and durability. Properly maintain these areas.
- Permeable paving is most suitable in areas such as low-traffic parking areas, footpaths, patios, and common outdoor gathering spaces.

COST

- Pervious paving materials may cost more than conventional paving materials (such as asphalt), but pavement replacement is simplified, and expensive measures such as asphalt cutting for underground repairs are eliminated. Also from an integration standpoint, there may be some cost savings by minimizing or eliminating connections to City stormwater systems. Possible reductions in stormwater management installations may also be cost saving.

2-14 Install rainwater catchment system for non-potable water reuse.

CODE

- The City of Seattle does not currently allow rainwater collection on residential projects. DCLU, Seattle Public Utilities and Public Health are developing a policy for future approval.

WHY

- Rainwater can be harvested for landscape irrigation and/or for flushing toilets, reducing water/sewer utility bills.
- The City of Seattle may allow rainwater collection when the system is used for irrigation or non-potable water uses (toilet flushing).

HOW

- A rooftop rainwater collection system consists of a suitable roof and guttering system, storage tank(s) or cistern and a simple filtration or screening system. The irrigation system can be supplied using the tanks and a small-scale pressurized pump system. Consider space constraints for cistern(s).
- Use appropriate roofing materials such as metal, tile, or fiber cement. Lead-containing materials, such as flashing, should not be used in catchment roofs. Likewise, ensure that no zinc galvanized ridge caps, copper flashing, or copper wires for moss prevention are used.
- Construct cistern or tank storage sized for the rainfall amount and roof size, with appropriate overflow devices. Cisterns can be made of concrete, ferro-cement, stone, or prefabricated metal, plastic, or fiberglass. Use only watertight, opaque materials and provide a cover to discourage mosquito breeding.
- Provide an overflow route to direct excess flows away from building and in such a manner as to avoid impact to downstream properties.
- Whether a rooftop cistern will be sufficient to meet all of the irrigation demands during the dry season will be dependent upon the irrigation requirements of the landscape and the system's storage capacity.

2-15 Evaluate use of greywater for irrigation.

CODE

- Greywater systems are currently treated as an “exception” to the code. Systems are approved, on a case-by-case basis as “experimental” systems, requiring compliance with stringent local and state regulations. If approved, greywater irrigation systems are required to be subsurface. Factors affecting the approval and use of greywater irrigation systems include soil depth and characteristics as well as drainage and flooding patterns. Other guidelines include setbacks for greywater irrigation lines from property and potable water lines.

WHY

- Greywater is all wastewater generated in the building except from toilet flushing. Sometimes referred to as “reclaimed” or “recycled” water, this includes wastewater from laundries, showers, tubs and sinks.
- Greywater can be collected and stored for irrigation conserving water.
- Irrigation can be responsible for up to 50% of residential potable water use during the dry summer months.

HOW

- To use greywater, a dual plumbing system must be installed to separate it from blackwater, which is wastewater generated from toilet flushing. Note: If you choose to plumb for greywater irrigation, you should also consider providing plumbing to use greywater for toilet flushing.
- In cases where greywater for irrigation is acceptable, plumbing for grey-water would be hooked up to the irrigation system. The irrigation system can be supplied using the tank(s) and a small-scale pressurized pump system.

COST

- The best opportunities for financial benefits may be in properties with common laundries and large irrigation needs, rather than trying to make use of greywater from individual units. Linking these systems could yield up to 20% savings on water bills.

Indoor Water Conservation

2-16

Essential: Install water conserving plumbing fixtures: 1.6 gpf toilets, 1 gpf for urinals, 2.0 gpm showerheads (or better) & 1.0 gpm faucet aerators. Option for urinals: waterless type.

CODE

- 1.6 gpf toilets, 2.5 gpm faucets and showerheads.

WHY

- Showers and faucets account for approximately 25% of indoor water use. Saving water translates into utility savings for residents.
- Water-conserving fixtures can reduce the amount of water used in showers by 75% and sinks by 50% compared to pre-1992 fixtures.

HOW

- Specify fixtures that minimally meet performances thresholds of the requirement.
- Specify the gpm (gallons per minute), not just “low flow,” which can refer to shower fixtures up to 3.5 gpm. For showerheads, 1.5 gpm fixtures are available at competitive prices. Specify showerhead with on/off toggle.
- Include flow controls in common area faucets.
- Specify low water use toilets that are durable and perform well. Not all low water use toilets are alike. Dual flush toilets, which have a half-flush/full flush feature, provide water savings beyond the standard low flush toilets. "Waterless" urinals use almost no water, relying on a chemical flush.

COST

- The added cost of higher-performance low-flow showerheads is minimal, generally less than $25 per unit. These measures may save more than $100 per year in combined water and energy costs.
- A durable and effective water-conserving toilet typically costs $90-130. Less expensive models may be less durable and result in high maintenance costs. No premium for waterless type urinals, but additional janitorial considerations necessary.
- Seattle Public Utilities offers various incentives for water conservation. See Resources.

2-17

Install water conserving appliances: Energy Star® or front-loading (horizontal or H-axis) clothes washers and energy efficient or Energy Star® dishwashing machines.

WHY

- Horizontal-axis or front loading washing machines offer up to 30% water and energy efficiencies compared to vertical or top-loading machines. The most water efficient dishwashers use as little as 3.9 gallons per cycle at the economy setting.

HOW

- Specify Energy Star® rated washing machines and dishwashers. For washing machines, specify horizontal-axis or front-loading styles.

COST

- Seattle Public Utilities offers incentives through its Washwise Program.

Seattle Office of Housing

Broad roof eaves improve aesthetics, reduce thermal gain in summer and divert rain away from foundation.

Design

2-18

Essential: Design exterior to properly drain water away from the buildings including patios, decks, window sills, and thresholds.

WHY

- In Seattle's rainy climate, a well-designed roof that includes a substantial roof eave, protects buildings against water and sun damage, significantly increasing a building's durability.

- Generous roof eaves and other water-draining details can add to the aesthetic value of the structure, street appearance and tenant satisfaction.
- Damage from bulk water entry is a significant problem in housing, contributing to moisture related problems such as mildew and wood rot.
- Additional architectural features like covered porches and patios greatly increase the usability of limited exterior spaces. Careful architectural detailing and construction supervision ensures proper water drainage. Poor detailing results in water damage from bulk water entry.

HOW

- Properly flash all roof penetrations. Extend eaves out far enough to keep water off windows. Although a 12" minimum overhang is sufficient, an 18-24" eave overhang is the most effective at draining water away from a structure.
- Slope new and rebuilt walkways, stairs, patios and thresholds away from the buildings.
- Grade site and grounds to drain away from the building. Garage floor and driveway are sloped to drain out.
- Divert water away from building. Direct gutters and downspouts to flow onto splash blocks or approved drain system so water drains away from building and in the best case infiltrates on site. Use bioswales as a strategy to stormwater management. Bioswales are a shallow trench planted with trees, shrubs, and ground cover that detains and filters stormwater before allowing it to infiltrate the groundwater system.
- Include and emphasize durable water resistant and long-lasting products or techniques.

COST

- Some upfront costs for decking and roofing materials. Trusses that overhang 12" should add little or no cost.
- Costs are reduced through long-term operations and maintenance savings.
- Eaves may add value to the property.

Seattle Office of Housing

Include bicycle parking in convenient, secure public areas, such as courtyard or near auto parking.

2-19 **Essential:** Provide secure bicycle parking.

CODE

- In certain zones, the City of Seattle requires long-and short-term bicycle parking based on number of units in multi-dwelling buildings (SMC 23.54.015I).

WHY

- Bicycle parking requires only 12-20% of the space and cost of a single auto parking space.
- Bicycling reduces pollution. The majority of auto trips in a city are less than two miles and could easily be made by bicycle, especially with the aid of bike baskets or trailer.
- Secure bicycle parking is a popular amenity and keeps bicycles out of living units.
- Bicycling is a healthy and cost-effective transportation alternative.

HOW

- Provide convenient and secure long-term bicycle parking sized to the number of units. Include repair work area.
- Construct well-covered and visible outdoor bicycle parking facilities for residents and guests.
- Develop a plan that would encourage bicycle use and draw tenants to your building.

2-20 Provide pedestrian-friendly design amenities.

WHY

Making the streetscape more inviting for walkers and bicyclists creates opportunities for social interaction and increases safety.

HOW

Design for minimum front yard setbacks, include porches or bay windows. Provide interesting and varied materials for fencing to enhance appearance and security and exterior finishes to add character and promote interest. Coordinate lighting.

COST

Some amenities may add more up-front costs; others do not, if designed carefully.

2-21 Provide on-site transportation shelters *or* create easy access to existing public transportation options/facilities.

WHY

Provide user-friendly shelters for residents who use public transportation to encourage ridership.

If you cannot provide shelters, then creating easy access to existing facilities provides residents with convenient alternatives and minimizes unnecessary destruction of landscaping features that may be in the path to existing public transportation.

HOW

Shelters should be conveniently located to bus stops and other transit opportunities, and provide necessary protection from the weather elements. Make sure the shelters are attractive, safe, and include amenities like benches, landscaping, pubic art, and phones.

Create pedestrian paths to promote easy access to public transportation, services, or simply to facilitate movement throughout the complex and to the surrounding neighborhood.

2-22 Size parking capacity to meet minimum local zoning requirements.

WHY

- The biggest contributor to "global warming" is burning fossil fuel, primarily car emissions.
- New parking lots in Seattle must mitigate all stormwater on site.
- It is not an economical or efficient use of land to create surface parking lots.
- Parking lots concentrate and deposit toxic "automobile dandruff" — oil, rubber, metals — into soils and local waterways.

HOW

- Supplement auto parking with bicycle parking. Contact DCLU for minimal parking requirements.
- Survey the tenants' actual parking needs and parking capacity of the area.
- Consider sharing parking with other buildings in the area.
- Consider on-site car sharing program to reduce per unit parking needs (Flex-Car). This is currently only available in certain neighborhoods.

2-23 On larger projects with internal streets, install traffic calming devices, such as curb bulbs.

WHY

- To maximize and facilitate pedestrian traffic, reduce risk, and provide for safety of residents.

HOW

- Devices that "calm" traffic include pedestrian crosswalks, curb bulbs, and traffic circles or roundabouts. Neighborhoods in Seattle have employed these devices; especially curb bulbs and traffic circles, with great success.

- The City has allowed reducing the width of the street by including reinforced shoulder on both sides that allow for emergency vehicles and parking on both sides.

- Contact Seattle Department of Transportation to request traffic calming devices. (206) 684-5008.

Chapter 3 Energy Efficiency

Energy conservation helps maximize tenant comfort and reduce utility bills. Conservation measures slow the: accumulative impacts of energy production and delivery; extraction of non-renewable natural resources; degradation of regional air quality; global warming; and increasing concentration of pollutants.

Building Envelope & Air Sealing

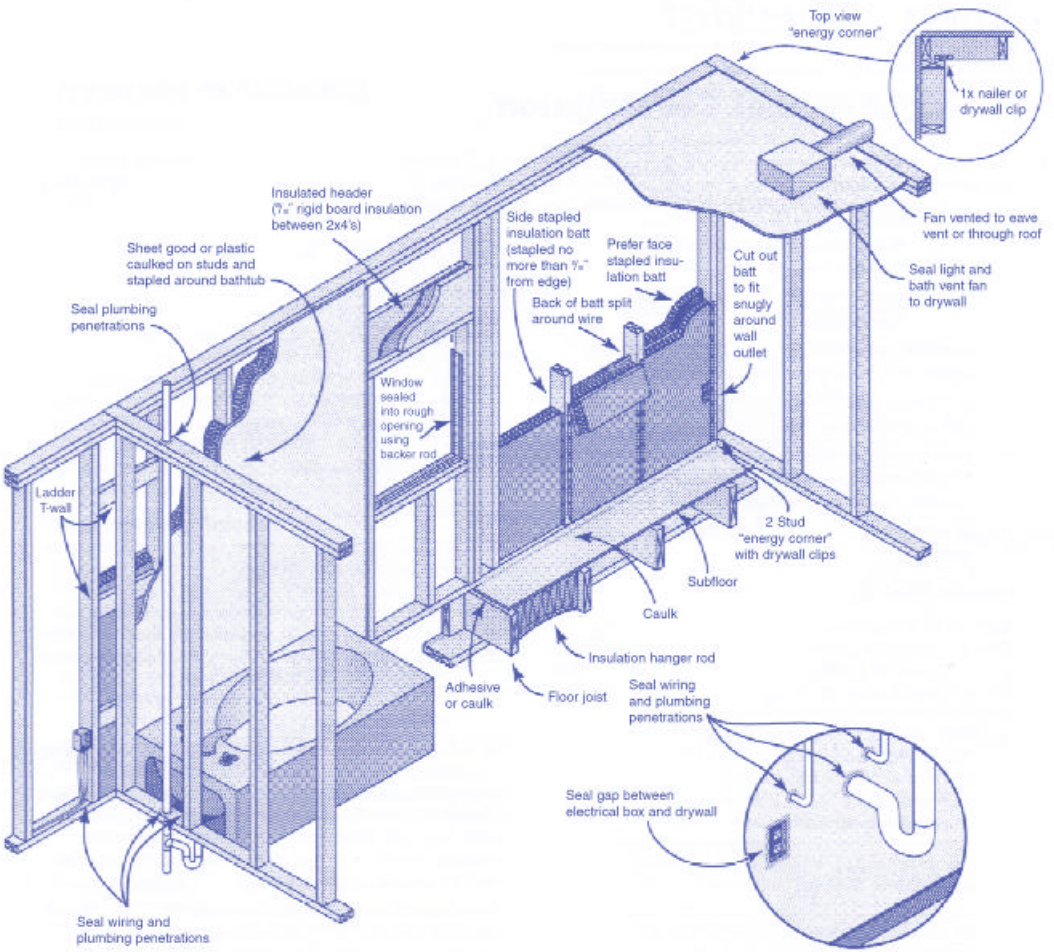
3-1 **Essential:** Document envelope improvements of at least 10% beyond code.

WHY

- Code sets minimum standards for energy efficiency. However, code requirements do not represent the optimal solution.
- Minimizes cost of energy to occupants and housing owners, without sacrificing comfort or livability.
- Envelope improvements beyond code may help eliminate or reduce mold and mildew problems.

HOW

- Washington State University has developed a free worksheet that allows for component performance trade offs. It is available in Excel spreadsheet format at the WSU code support website, see Resources.
- Participate in the City's BUILTSMART program and design project with a goal to maximize energy efficiency and exceed code regulations by at least 10%. You may also use eQuest®, Energy 10 or other software, a spreadsheet, or code forms to document improved performance (Total UA of the proposed building / UA of the WSEC code reference building).
- Upgrade energy performance of windows and doors.
  See also Chapter 3: Energy Efficiency, Action Item 4.



3-2

Essential: Flash and seal all penetrations between interior spaces and outside. Seal all penetrations for ducting, wiring, plumbing, lights and fans.

WHY

- Flashing reduces rain and water penetration in exterior walls, helping prevent moisture damage and expensive repairs.

- A well-sealed "tight" building envelope conserves energy. Conversely, a "leaky" building envelope may lose up to 20% of its overall insulation value to air infiltration. Buildings may also lose heat through unsealed penetrations to unheated attics or crawl spaces. In addition, ventilation systems will be more effective when installed in a tight building envelope.

- Additional benefits may include improved comfort by reducing drafts, improved occupant control of the distribution of heat to individual rooms, and a reduction of dust introduced into the building.

- **See also** Chapter 4: Health & Indoor Air Quality, Action Items 10,11,12,13.

HOW

- On plans and documents, clearly detail flashing and air sealing. Show how building paper or wrap is fastened at window and door openings.

- The insulation contractor is usually responsible for air sealing to meet the energy code. The general contractor should seal remaining penetrations prior to insulation installation in order to ensure complete air sealing.

- Specify use of low-VOC and/or non-CFC propellant caulks and sealants.

- Look for common air leakage sites, such as rim joists between conditioned floors; ceiling recessed light fixtures, unless IC rated and installed with appropriate gaskets and/or trim; drain pipe holes for showers and tubs over crawl space or garage; and chases for plumbing or ductwork.

- Install quality, self-closing dampers on vents to prevent backdrafts on windy days.

- Heating distribution system should be installed inside conditioned space and seal ductwork in crawls and attics using mastic. This can improve heat distribution by 15%.

- Tightly sealed buildings must incorporate adequate ventilation in order to ensure that moisture is not trapped within.

COST

- Energy code Section 503.10.2 requires all supply or return ducts to be sealed using mastic unless ducts are located in conditioned space. It shouldn't cost extra to meet code.

3-3 Upgrade energy performance of concrete slab, on grade.

WHY

- Contributes to the overall energy performance of the building.
- Contributes to minimizing mold and mildew problems.

HOW

Concrete Slabs: Insulate perimeter edge of concrete slab floor with below grade approved R-15 edge insulation foam board. Insulate between heated space and garage slab. For a floating slab inside a foundation wall, a pressure-treated lumber strip can be ripped to fit over the top of the insulation, flush with the top of the slab. On a monolithic slab, the edge insulation can be taper-cut and fitted with flashing. Exposed insulation can be coated with stucco to protect from sunlight and mechanical damage. Fully insulate below slab-on-grade with R-5 minimum.

3-4 Upgrade energy performance of windows and doors.

CODE

- Windows: code requires windows with U-value = 0.35 or 0.40 depending on occupancy type (R-1 or R-3) and the amount of glazing.
- Entry Doors: code requires exterior doors with U-Value = 0.20 and allows one unlabeled or untested exterior swinging door of 24 s.f. It is recommended that exterior doors have U-Value = 0.20.

WHY

- Upgrading performance of windows and doors contributes towards the goal of improving envelope performance beyond code.
- Contributes to improving comfort in the units and reduces utility costs to residents.

HOW

- Windows: Specify and install double glazed, low-e windows and sliding doors with U-value = 0.35 or less (Built Smart requires 0.33). U-value measures the rate of heat flow through a window. A lower U-value means lower heat loss in winter or heat gain in summer. Changing from U = 0.40 to U = 0.35 seems like a small change, but represents a 15% improvement in performance.
- Another consideration in window selection is the solar heat gain coefficient (SHGC), which measures the amount of solar heat that a window allows to pass. Select windows to assist with passive solar heating where appropriate.

- Entry Doors: Insulated entry doors are important to comfort. An insulated core door is about R-5—a 63% reduction in heat loss. Specify exterior doors with insulated cores and complete weatherstripping, including the threshold. Note that some door insulation is polyisocyanate foam, which is made with ozone-depleting HCFCs that should be avoided. Installation is standard. Refer to the schematic site plan for identification of exterior doors requiring extra attention due to wind and other climatic conditions.

COST

- Windows with high quality frames are energy efficient and likely to operate indefinitely with little or no maintenance.
- Windows with U = 0.33 or less are readily available from most manufacturers and commonly used in this market with little cost increase.

3-5 Perform blower door test to determine cost-effective air sealing and combustion safety for sample unit(s).

WHY

- A blower door test is an excellent diagnostic tool used to both identify hidden air leakage paths and moisture flows in a unit/building and to quantify air leakage ranges. Blower doors are also used to locate duct leaks.
- A thorough test can evaluate thermal comfort, and potential indoor air quality and combustion hazards. A test is necessary in any dwelling with a gas furnace or water heater to indicate danger of backdrafting and spillage of combustion byproducts.
- A blower door test is useful during renovations to achieve cost-efficient air sealing. Significant leaks can be quickly identified and the crew can be certain that leaks have been effectively sealed. Combustion safety can be documented as well.

HOW

- These tests are conducted after drywall is mudded and exterior doors are installed, while leaks can still be sealed.
- A blower door consists of a variable speed fan sealed into an exterior doorway and used to blow air into or out of the unit. When air is blown out, the unit develops a slight negative pressure (or vacuum) relative to outside. The pressure differential drives outside air into the unit (infiltration) through any available openings in the exterior shell. These leaks can be located by touch or with smoke, then sealed.

- In addition, the pressure induced by the blower door can be used to yield a quantitative estimate of the "leakiness" of the unit/building (in square inches). Additional calculations yield the approximate natural air change rate (ACH).

- Note: For large projects, it is acceptable to perform a test on each representative unit (randomly selected), and then seal all similar units at the identified weak points.

3-6 Perform duct leakage test to determine cost-effective air sealing and combustion safety for sample unit(s).

WHY

- The "duct blaster" test will check the efficiency of heating ducts in attics and crawl spaces. Inadequately sealed ducts lose 20-30% of their heat into unconditioned space, draw in pollutants from attics, and cause pressure imbalances and discomfort in the dwelling.

HOW

- Conduct a duct blaster test.

- Interior vents are sealed with foam inserts for the test while air is blown into the system. Leaks are located by touch or with smoke.

- Leaks should then be sealed with mastic to ensure a proper seal.

3-7 Upgrade energy performance of ceiling and walls.

WHY

- Saving energy reduces utility costs to residents and operating costs for building owners. If energy costs continue to rise, additional energy savings will be realized into the future.

- Advanced Wall Framing is a code-recognized process that incorporates 24-inch on-center framing with increased insulation. Other features include two-stud corners and intersections, insulated headers, oversized or raised heel trusses to allow full depth of attic insulation, and full insulation where interior partition walls meet exterior walls. Framing studs at 24" o.c. instead of 16" o.c. reduces thermal bridging by almost one-third. Advanced framing uses 20-30% less wood and reduces labor costs compared to traditional framing practices. 24" o.c. framing; insulated box headers; and two-stud corners provide space for better insulation and increase energy efficiency.

- Upgrading the insulation product also may reduce noise transmission, and can reduce waste materials like scrap paper and glass when insulation products contained recycled content.

HOW

Advanced Framing

- Use Advanced Framing, alternative wall system and/or rigid exterior insulation. In design and construction documents, specify 2x6, 24" advanced framing modules and other advanced framing techniques, such as framing with single top plate.
- EEBA Builders Guide shows rigid insulation outside of studs. See General Resources.
- Inform insulation and drywall contractors if 24" o.c. framing is used. Drywall should be rated for 24-inch stud spacing. Half-inch drywall is rated by manufacturers to span 24" Drywall can be upgraded to 5/8" to prevent deflection in wall surfaces between studs. Use 5/8" on ceiling with 24" spacing so it doesn't sag. Fewer studs mean fewer plumbing and electrical penetrations and fewer nail or screw holes to seal and sand. Although more insulation is required, wider stud spacing results in fewer pieces of insulation and therefore faster installation. Tip: To eliminate concerns about "wavy walls," install exterior sheathing horizontally rather than vertically.
- Exterior materials (sheathing, siding) rated for 24" spans include APA 303 sheet sidings and Hardiplank cementitious siding.
- **See also** Chapter 5: Materials Efficiency, Action Item 8 & Appendix A.

HOW

Enhanced insulation product

- Consider blown-in options like Dense-pak or BIBS (Blow-in Blanket System™) that achieve high R-values and cut air leakage by completely filling cavities and hard-to-reach areas.
- In new construction, install high recycled-content insulation with the following R values: R-38 ceilings/R-21 walls/R-30 floors/R-10 slab edge. Rehab insulation values depend on pre-existing conditions. Cellulose from scrap paper or fiber is available with up to 95% recycled content and fiberglass with more than 20% post-consumer glass content. Also consider recycled cotton as an alternative to fiberglass.
- **See also** Chapter 5: Materials Efficiency, Action Item 8 for a discussion of Structural Insulated Panels (SIPs).

COST

Advanced Framing

- Advanced framing saves at least 10% on typical framing costs and up to 28% on material costs.
- Construction cost savings is estimated at $0.29 per square foot of wall area. Total savings for this measure alone are 2 to 4% of total energy use.

COST

Enhanced insulation product

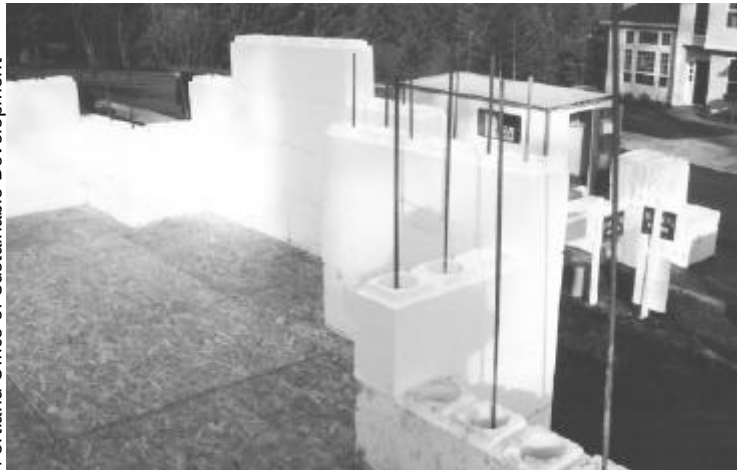
- For new construction, installation of “wet” sprayed-in cellulose can cost twice as much as fiberglass batts, but saves the labor costs of thorough air sealing and prevents air leaks that reduce R-value.
- For rehabs, blown-in cellulose insulation is competitive with blown-in fiberglass.

3-8 Specify and install insulated concrete forms.

WHY

- ICFs are used to make structural concrete walls, and can be used to make either foundation or above-grade walls. Insulating concrete forms (ICFs) are rigid plastic foam forms that hold concrete in place during curing and remain in place afterwards to serve as thermal insulation for concrete walls. The foam blocks, panels, or planks are lightweight and result in energy-efficient, durable construction.
- Insulated concrete form (ICF) systems are available with insulation values from R-17 to R-26. They offer excellent energy efficiency, air sealing, noise control, and structural strength. ICFs are suitable for use in below-grade walls because they eliminate the need for furring out concrete walls for insulation. An ICF system eliminates most of the wood in standard framing.
- The primary drawback to this system for above-ground exterior walls is that they may be difficult to modify if the units were enlarged or added onto. Also, the production of concrete is energy intensive.

Portland Office of Sustainable Development



Insulated concrete forms eliminate the need for formwork and extra insulation.

HOW

- An ICF system consists of hollow foam insulation blocks or panels that are filled with reinforcing steel and concrete. A typical ICF block is 10" in width. Blocks and rebar are laid in courses and filled from concrete pumpers. Walls can go up quickly.
- The ICF system called Rastra combines cement with foam plastic for enhanced insect and fire resistance and bulk water control.
- ICFs do not automatically eliminate leakage through or around windows. Systematic air sealing of the entire building is the most effective way to reduce infiltration.

Mechanical / Equipment

3-9

Essential: Heating Systems—Compare two or more systems from the list below by completing a Life Cycle Cost Analysis.

WHY

- In July of 2002, changes to the residential energy code changed the fuel type and system type selection process. The code became fuel-neutral and the reduced shell cost advantages that favored gas, as a fuel choice, are no longer available.
- Lowest first cost often dictates installation of electric resistance heating. However, these systems may not be the best choice with regard to energy efficiency and long-term maintenance issues. Better quality and more durable systems can reduce operating and maintenance.

HOW

- When choosing a mechanical/HVAC system consider what will work best for the building, based on its orientation, population, types of units, number of occupants, etc. Try to choose the system that best achieves the lowest total cost for a 20-year life.
- Energy efficiency above code is required and appropriate equipment sizing must be applied for each choice.
- The following are example heating system and domestic hot water options:

Electric	Natural Gas
Zonal *(room by room)* • baseboard + electric H_2O • fan coil + electric H_2O • electric resistance radiant + electric H_2O • package thermal heat pumps + electric H_2O	Zonal • hydronic fan forced + gas H_2O
Unit System • forced air furnace + electric H_2O • central heat pump + electric H_2O	Unit System • forced air furnace + gas H_2O • hydronic baseboard + gas H_2O • hydronic radiant + gas H_2O
Whole Building • central heat pump + (central or unit) electric H_2O	Whole Building • central gas (forced air or hydronic radiant) + central gas H_2O

- Perform life cycle cost analysis. Better Bricks through Seattle City Light is a resource for conducting these analyses. See Resources section.
- Proper sizing and design can save money by matching system size to actual building and climate characteristics.

3-10

Essential: Heating Controls—Install accurate thermostats throughout. Specify a product that provides highly accurate thermostatic control over the heating system of plus or minus 2 degrees F.

WHY

- Accurate thermostats can save money by giving occupants accurate feedback on temperature settings. Inexpensive thermostats may be off by as much as 10°F and typically allow wide temperature swings.

HOW

- Install accurate thermostats throughout.

3-11	**Essential:** Delivery System—If installing ductwork, install inside conditioned space and seal ductwork in crawls and attics with mastic. When installed outside conditioned space, insulate to wall insulation standard or higher. Design short runs. Use flex only for straight runs; otherwise use metal.

WHY

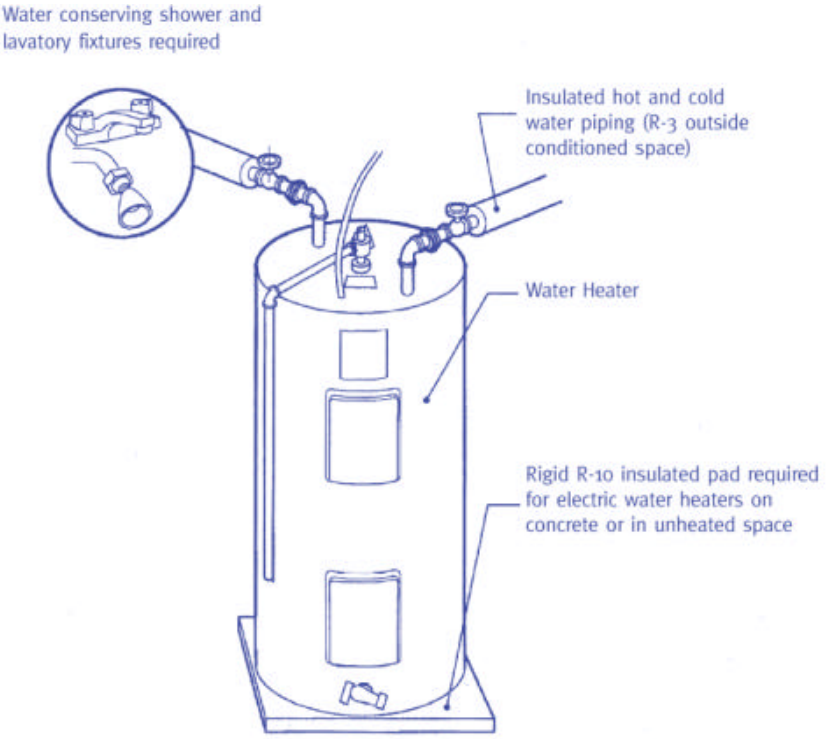
- A heating system's efficiency can be improved by 30% or better if the entire heating system is located within the heated space.
- Field research in the Northwest shows that conventionally sealed ductwork installed in attics, crawl spaces or garages often loses 20 to 30% of conditioned air. Efficiency of the heating distribution system can be improved by 15% if the ducts are sealed better than conventional practice. Energy code specifically prohibits the use of duct tape to seal ducts. Using mastic to seal commonly used fittings or using improved duct fittings with gaskets reduce the air leakage rate of the heating system and the structure as a whole.
- Locating ducts inside conditioned space not only eliminates heat loss, the ducts can be shorter. With a quality thermal envelope, supply registers can be placed on interior walls or ceilings instead of under windows, saving on duct runs.
- **See also** Chapter 3: Energy Efficiency, Action Item 2.

HOW

- Consider duct placement during design instead of leaving it up to the heating contractor to determine during construction. Provide chases for runs to and from upper floors.
- Specify sealing with mastic to significantly reduce air leaks.
- Forced Air Systems: Locate most ducts inside heated space; ducts outside heated space to be insulated to wall insulation standard.
- Hydronic Systems: Locate most components inside the heated space.

COST

- In many cases this will be a no-cost measure. For forced air heating systems, moving the ducts inside usually increases the cost of framing and drywall. But the HVAC bid should be lower, off-setting these costs. Even if the total cost increases the energy savings will more than pay for the change in construction details.



3-12	**Essential:** Install high-energy factor water heater (minimum = 0.64 for gas, 0.93 for electric). Option for gas water heater to go to 0.83.
WHY	• Current code requires domestic hot water systems meet the requirements of the 1987 National Appliance Energy Conservation Act (NAECA). Upgrading electric water heater efficiency from an Energy Factor (EF) of .88 to .93 can save 225 kWh per year. Upgrading gas water heater efficiency from an EF of .55 to .60 can save 18 therms per year, so going to .64, or even 0.83 will only add additional energy savings. • Saving energy reduces CO_2 emissions and reduces use of fossil fuels.
HOW	• Be careful to avoid heat loss through heat traps when you have a hot water tank on lower floors feeding upper stories.
COST	• No increase in costs for required actions, there may be cost implications for the .83 gas option. Rebates are available for high efficiency residential hot water heaters from Seattle City Light (electric models) and Puget Sound Energy (gas models).

3-13

Essential: Insulate bottom of hot water tank. Insulate hot water pipes in unconditioned spaces.

WHY

A water heater placed directly on an unheated or concrete floor loses heat through the bottom. Copper is a good conductor of heat—therefore, pipes lose heat quickly.

HOW

Blueboard™ (R-10) or similar product for electric tank. For gas water heater, set tank on a raised platform. Insulate both hot and cold water pipes, even if the plumber has installed anti-siphon loops. This reduces standby heat loss from the water tank. The tank continuously heats the piping and the water in it even when no water is being used. They act as "cooling rods." Insulating them reduces the rate of heat loss.

COST

No significant increase in cost.

3-14

Install instant (tankless) hot water systems where appropriate to achieve energy savings.

WHY

This Action Item is recommended for new construction; it may be less cost-effective in rehabs.

Instant, supply-on-demand or "tankless" water heaters, only heat the water used. Instead of storing hot water in an insulated tank, the water is heated, on demand, at the point of use. These systems can save as much as 3 to 4 gallons of water per use, considering that this is the amount of cooled water that must be drained before hot water arrives at the faucet in traditional systems. These systems can reduce water heating energy costs by up to 50%. In addition, standby energy losses represent 10% to 20% of a household's annual water heating costs.

In the past, instant hot water systems were either electric (converting only a third of the primary energy into usable thermal energy), or if they were gas fired, they were equipped with continuously burning pilot lights that wasted energy. Newer, gas-fired models without continuously burning pilot lights are available. Such systems can save water *and* energy. It should be noted that tankless water heaters only save water if they are located close to the point of use.

HOW

- Consider tankless instant hot water systems.
- Specify models with electronic ignition.
- Specify models that are compatible with back up passive systems, such as solar or drainwater heat recovery (DHR). Solar hot water compatible (i.e. their heating mechanism can modulate down to zero) models cost the same as other models, but will allow retrofitting to a solar hot water system later. Drainwater heat recovery (DHR) devices fit into existing drain lines to capture some of the exiting energy from warm wastewater. DHR systems use drainwater to preheat cold water going to a shower or to a water heater. DHR systems reduce the energy needed to heat water and can increase the capacity of water heaters.

COST

- DHR systems cost between $95 and $280 not including installation, about $400 installed.

3-15 Install energy efficient elevators.

WHY

- New energy efficient models are available that have systems that run 50% more efficiently than conventional oil hydraulic machines.

HOW

- Specify energy-efficient and space-efficient models.

COST

- The higher initial cost of an energy efficient elevator is offset over time with the savings in both energy use and energy cost. Conducting a *Life Cycle Cost Analysis* will help you evaluate the best choice for your project.

Electrical, Lighting & Appliances

3-16 **Essential:** Specify and install efficient outdoor lighting (30 lumens per watt or better) with low temperature ballasts. Install lamps with automated controls, including but not limited to photo sensors, timers and motion control sensors.

WHY

- A comprehensive approach to lighting design evaluates and optimizes the lighting design for energy use, human response, cost, how well the technologies work, and ease of maintenance. With thoughtful design and fixture selection, efficient lighting greatly improves a building's appearance. Outdoor light fixtures, including post- and wall-mounted fixtures, floodlighting, and ground-level walkway lighting, can provide safety and decoration.
- Conventional outdoor floodlights are designed to "broadcast" illumination so as to cover as much area as possible. However, the lack of "light control" in a floodlight causes many detrimental and unwanted side-effects, such as blinding glare, intrusion into neighboring buildings and natural areas (called *light trespass)*, and waste light up into the night sky (called *light pollution)*. Additionally, lack of lighting controls wastes energy.
- Fluorescent and high-intensity discharge bulbs have long life, high light output, and relatively small size. They can be used for most types of outdoor lighting including large-area floodlighting.
- Automated controls reduce energy consumption and are easier to operate.

HOW

- Use low wattage, energy efficient bulbs that provide only as much illumination as needed, distribute the illumination using shielded fixtures that point light downward and to the sides as needed, and only use outdoor nighttime lighting for as long as it is absolutely necessary. Do not exceed the Illuminating Engineering Society of North America (IESNA) footcandle level requirements as stated in the Recommended Practice Manual: Lighting for Exterior Environments.
- Photo sensors may be the lowest-maintenance and most reliable choice of automated control. Timers need periodic resets. Solicit your electrical supplier or contractor's advice and specify an Energy Star® system.

- Motion control sensors are another way to reduce usage by providing light only when needed. Note: This type of system may be demanding on bulbs and less durable in moist climates.
- Reduce light trespass onto neighboring properties. Use shielded lighting fixtures. Mount at appropriate level to cast light where people need it without over lighting the area.

COST

- Varies widely depending on design and lighting needs.

3-17 Specify and install Energy Star® lighting fixtures, lighting systems and appliances.

WHY

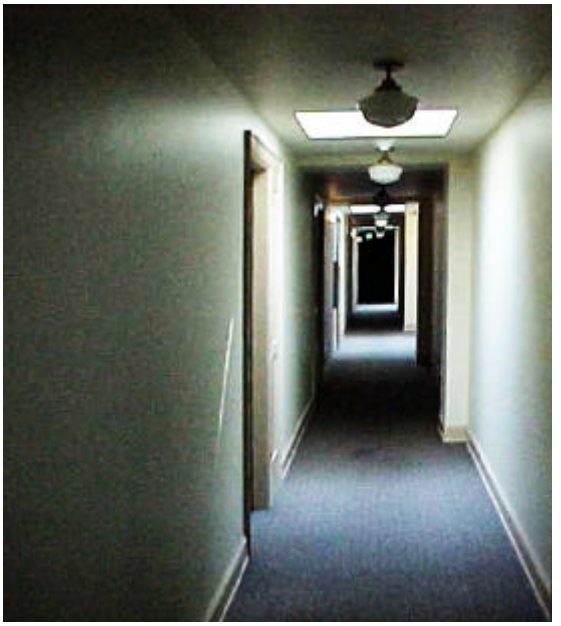
- Energy Star® products reduce energy and water consumption, and residents' utility bills.

HOW

- The Energy Star® label is familiar to suppliers and dealers. Currently, Energy Star® residential products include refrigerators, dishwashers, clothes washers, thermostats, furnaces, heat pumps, windows, compact fluorescent lighting, outdoor lighting and interior fixtures of all kinds.
- Be knowledgeable about lighting choices and match the needed illumination to the anticipated use. Bathrooms may need more light than bedrooms.
- The EPA publishes an updated list of even more efficient appliances on its website.
- Some of the more efficient washer/dryer units are available in coin-operated models.

COST

- Many Energy Star® products don't cost more than less efficient products.
- The City offers rebates for the purchase of energy efficient clothes washers listed on its website.



Seattle Office of Housing

Skylights can daylight your interior corridors.

3-18 Install solar water heating system for common hot water heating.

WHY

- Water heating is the second largest portion of a residential energy bill after space heating.

HOW

- Prioritize hot water conservation by designing an efficient system and installing Energy Star® equipment.
- Conduct site analysis. Vendors of solar systems can help evaluate the suitability of the project for a solar water system.

NOTE

- Geographic location, system design, collector orientation, and collector size will determine how much energy can be garnered for hot water heating. A solar water heating system may result in immediate positive cash flow if the monthly cost of financing the system is less than the net savings. Limitations include the need for regular maintenance, possibility of vandalism, and a long payback period. Initial costs can be relatively high. Solar panels may be aesthetically unacceptable to some. Lastly there is potential for freezing with passive systems. Check local building codes to determine codes related to the installation of solar water heaters. The Solar Ratings and Certification Corporation runs a certification program for solar water heating systems (see Resources).

3-19 Provide solar site lighting for walkways or outdoor area lighting.

WHY

- Solar powered outdoor lighting uses a photovoltaic (PV) panel to generate electricity during the daytime, which is then stored in a battery. At night, that stored electricity is used to power the light.

HOW

- Some models are manual, while others are turned on automatically by light-sensing controls or activated by motion-sensing devices. Most of these walkway or security lights require no wiring or installation other than pushing the stake into the ground, or screwing the fixture to a garage wall.
- Most of the widely marketed solar walkway lights do not put out a lot of light, but they are useful for lighting the path to the door so tenants can find their way. Larger solar lights are available and provide a lot of light.
- Check product capacity to work overnight and during extended cloudy days.

COST

- Larger solar lights can be expensive.

Design

3-20 Daylight interior.

WHY

- This design feature is included under Energy Efficiency to underscore the savings associated with proper design.
- Daylighting interior spaces reduces the need for electrical lighting.

HOW

- Daylight interior corridors.
- The depth of daylight distribution is a function of window height relative to the working plane. Increased ceiling height gives more flexibility, allowing devices such as lightshelves to bounce light deeper into the interior.
- Separate the window into upper and lower portions, to independently control daylight, natural ventilation and view.

- Use light colors on reflecting interior surfaces, especially walls and ceilings, to increase the daylight due to reflectance that reaches areas remote from windows.
- Use splayed, light-colored window sills and reveals to reduce contrast and glare.
- Align interior partitions perpendicular to windows to avoid blocking daylight.
- Shape the ceiling and use secondary reflecting surfaces to further diffuse daylight.
- Use toplighting when possible.
- Avoid creating glare.

COST

- Paint color choices make no difference in cost.

Portland Office of Sustainable Development

These windmills produce 'green power' without causing pollution or disrupting salmon migration.

Innovation

3-21 Purchase Green Power.

WHY

- Purchasing Green Power from your local utility promotes the development of non-polluting renewable energy sources. For instance, Seattle has created the Seattle Green Power Program. In 2002 City Light will bring Seattle's first wind-generated electricity into service.
- Helps ensure clean air with no greenhouse gas emissions, clean energy and a high quality environment for future generations.

HOW

- City Light customers can elect to partner with their electric utility to purchase new clean, renewable energy sources. Customers would make voluntary payments that will go toward building and acquiring a wider range of new renewable energy sources, like the wind-generating program.

COST

- Green Power can be purchased from City Light in increments of $3, $7 or $10 (business customers may choose to pay more). 40% of funds collected go toward development of demonstration projects such as solar panels on public schools. The other 60% goes toward cost-effective renewable resources.

Chapter 4 Health & Indoor Air Quality

Minimize exposure of residents and workers to toxic materials. Use safe, biodegradable materials and alternatives to hazardous materials.

Health and Indoor Air Quality is a significant green building issue directly affecting residents. The goal of affordable housing is to provide safe, as well as, affordable housing for low-income residents. Safety includes using materials that do not cause negative health impacts for residents, especially for the more sensitive groups such as children, seniors and those with existing respiratory problems.

Materials

4-1

Essential: Use least-toxic, decay-resistant, outdoor building materials. No CCA (Chromated Copper Arsenic).

WHY

- CCA pressure treated lumber, the most commonly used wood treatment, contains arsenic and chromium — two highly toxic compounds that leach into surrounding soils. CCA is hazardous to manufacture, handle and dispose. CCA lumber leaches these toxins 6-24 inches into surrounding soil. Do not use for raised beds. CCA is most toxic up to three weeks after treatment, when solution remains on the surface of wood. CCA treated lumber is not recyclable.
- Effective alternatives include ACQ (Ammonium Copper Quaternary) treated wood and plastic lumber.

HOW

- Specify the use of ACQ-treated wood where pressure-treated wood cannot be avoided (mud sills, deck framing, etc.). ACQ is effective in above-ground and ground-contact applications and less toxic than CCA.
- Specify plastic lumber for applications where humans will contact the wood and where food will be eaten and grown (decking, picnic tables, benches, handrails, play equipment, raised garden beds). Plastic lumber contains post-consumer recycled polyethylene. A variety of products are available, including some that contain wood or fiberglass to improve their structural capabilities.

COST

- ACQ-treated lumber has a $75-$100 per 1000 b.f. premium over CCA pressure treated lumber.
- Plastic lumber is 2 to 3 times more expensive than conventional materials ($1.85 per linear ft. for 1x6 HDPE formulation). Differential cost offset by longer service life and lower/easier maintenance.
- Similar to plastic wood example above. Example, $1.68 per lin. ft. for 5/4 x 6 inch for TREX (1999). Differential cost offset by longer service life and lower/easier maintenance.

Portland Office of Sustainable Development

Patio built with 'plastic' lumber and ACQ-treated wood.

4-2 **Essential for rehabs**: Provide a lead-safe environment.

WHY

- Lead abatement protects workers and occupants from associated health risks of lead exposure. Remodeling wastes often include items such as wood trim, siding and other architectural components that have been painted with lead-based paint, especially in facilities built prior to 1978. Lead paint presents problems if it is peeling or in the form of dust or chips, which are toxic to humans if ingested or inhaled.
- In addition, proper control and disposal protects against land and water pollution caused by the release of lead into the environment.

HOW

- Painting contractors should be experienced in lead-safe practices while painting, cleaning, preparing surfaces and removing paint containing lead.
- Contractors should use high efficiency vacuum systems to collect construction dust, blasting materials that encapsulate heavy metals, and paint stripping methods that do not generate dust.

COST

- Control costs by being informed about regulations and requirements and know the conditions in your building. Hiring an industrial hygienist to provide a work plan, estimate and specification prior to bidding is recommended.

4-3 Install urea-formaldehyde-free underlayment, cabinets, and storage units.

WHY

- Particleboard is made with large quantities of urea formaldehyde binder, and off-gasses formaldehyde, a highly toxic volatile organic compound (VOC).
- Particleboard is less durable than plywood or MDF.

HOW

- Specify urea-formaldehyde-free plywood or Medium Density Fiberboard (MDF).
- When particleboard must be used, thoroughly seal all surfaces and edges with a water-resistant finish to reduce VOC off-gassing.
- Consider strawboard products, such as WheatBoard™, made from agricultural waste. Strawboard can be veneered or naturally finished.

COST

- Urea-formaldehyde-free cabinets can require up to a 40% cost premium over cheaper products but may have a longer life cycle. A life cycle cost analysis of this component is a good tool to use when making selections.

4-4 Specify *low-toxic*, solvent-free, no-VOC (volatile organic compound) or low-VOC (below 100 g/liter) paints and primers. Specify water-based wood finishes and stains.

WHY

- Toxicity is the degree to which a substance or mixture of substances can harm humans, animals, or the environment. A “low-toxic” chemical or mixture is one that does not bear warning labels, such as “Danger,” “Warning,” or “Caution.” Definitions of low-toxic vary, but generally it means that the product does not contain chemicals considered toxic under federal OSHA and SARA guidelines.
- Volatile organic compounds (VOCs) are chemicals that contain carbon molecules that are volatile enough to evaporate from material surfaces into indoor air at normal temperatures (referred to as off-gassing). Paints and primers off-gas VOCs that are health hazards to residents and workers.

The ability of VOCs to cause health effects varies greatly from those that are high risk, to those with no known health effect. About 50 VOCs, some of them common in construction materials, are known to cause cancer. Different products contain different types and levels of VOCs. Low-VOC products contain lower levels of VOCs than comparable products.

VOCs also contribute to air pollution, especially ozone depletion.

HOW

Specify low-toxic, solvent-free, or no-VOC paints and primers. Some paints are labeled "VOC-compliant" because of recent regulations that require lowered levels of VOCs. However, the VOC levels in many paints are still higher than what is healthy.

Select paints and primers that contain less than 100 g/L (grams per liter) VOCs or have a *"Green Seal"* rating.

COST

No- or low-VOC paints typically cost 0-15% more than regular paints.

Portland Office of Sustainable Development

Non-toxic adhesives and sealants are safer for workers and residents.

4-5 Specify low-toxic, low-VOC adhesives and sealants.

WHY

Adhesives and sealants may off-gas toxic chemicals, including VOCs long after installation.

See also Chapter 4: Health & Indoor Air Quality, Action Item 4.

HOW

Select products labeled low-toxic, low-VOC, environmentally friendly, or worker-safe. Ask manufacturers for MSDS sheets and check for hazardous product contents.

COST

No additional cost.

4-6 Avoid carpets on slab-on-grade.

WHY

- Carpet off-gasses when it is new. In addition, carpets attract allergens such as dirt, pollen, mold spores, dust mites, and other microbes.
- Carpets on slab-on-grade contribute to unnecessary and unhealthy moisture in the building; this can lead to mold growth and associated health problems.
- Using concrete slab as the finish flooring is resource-efficient because it eliminates use of additional flooring materials and adhesives, increases durability and reduces maintenance. It also provides a long service life.
- It provides a healthier living environment because the smooth, hard surface does not attract and retain dust, molds and other indoor pollutants. Nor does it require adhesives generally used to install additional flooring layers.

HOW

- Seal the concrete with a low-VOC sealer to avoid off-gassing from chemical additives in the concrete.
- For passive solar applications, concrete flooring can function as thermal mass.
- Note: Consider a radiant heat option with concrete floor.

COST

- Special decorative finishes or additives are available at an additional cost.

4-7 Install hard flooring surfaces in living rooms and sleeping areas.

WHY

- Carpets are “dirt sinks” - collecting dust, insects, and contaminants that are hard to remove. They are breeding grounds for molds and dust mites. When subject to moisture, carpets grow molds that can be harmful to humans.
- Most common types of carpet pad (such as ReBond) generate more VOCs and harbor more mold growth than fiber or waffle pads.
- The glues used to install carpets off-gas VOCs.

HOW

- Avoid carpet in bedrooms and living areas.
- In high traffic areas, specify solid wood floors, laminated wood floor products, natural linoleum. If using vinyl, vinyl composition tile (VCT) is preferred. Do not use sheet vinyl that is less durable and more toxic than other flooring options. Vinyl is made from PVC, a petroleum-based, highly toxic substance that contains phthalates.
- For common areas on concrete slabs, consider staining and sealing concrete in lieu of installing additional flooring material.
- Certified sustainably harvested and salvage wood flooring is readily available, durable and can be refinished repeatedly.
- Use water-based stains and finishes to reduce off-gassing.
- Laminated wood flooring is a cost-effective wood-floor alternative. Its “floating floor” design allows for easy replacement of damaged tiles and disassembly. Note: While very durable, these systems cannot be refinished and are not recyclable.
- Hard surfaces may increase noise. Consider related measures that mitigate sound transfer, such as sound batts or RC-channel.

COST

- Costs vary depending on what flooring systems are used.

4-8

If using carpet, install Carpet and Rug Institute's CRI IAQ label and low pile or less allergen-attracting carpet and pad. Install carpet by tacking (no glue) and limit use to one-third of the unit's square footage.

WHY

- Limiting carpet to one-third of the unit's square footage not only provides a healthier indoor environment, wood and tile floors are more durable than carpet, so they cost less per year of use.
- Carpets require frequent replacement and are filling up our landfills at an alarming rate.

HOW

- The Carpet and Rug Institute (CRI) has developed a testing and labeling program to aid in the selection of low-emitting carpet, adhesives, and cushion material. Specify that all carpets used have the CRI IAQ label; this indicates a representative sample of the product has been tested by an independent laboratory to meet the established requirements.
- Consider specifying a PET (polyethylene terpthalate) recycled-content or durable nylon carpet over a fiber or waffle pad. Carpet made with Nylon 6 can be recycled by chemically renewing in a de-polymerization process and then manufactured into new carpet fibers. Consider integral cushion recycled-content carpet with a dry, peel-back adhesive that minimizes VOC off gassing. Avoid Olefin™ and other less durable brands.
- If space is available, unroll and air out carpet prior to installation.

COST

- Costs vary depending on what carpets are used. PET and nylon carpet are cost competitive with non-recycled content products. Fiber or waffle carpet pads cost about $2/sq. yd. more than the least expensive pads.
- **See also** Chapter 4: Health & Indoor Air Quality, Action Item 6.

4-9

Ensure proper installation of under-slab vapor barriers.

WHY

- Vapor barriers prevent moisture from migrating into the building and they also protect against radon and other unwanted soil gases that may enter the building.

HOW

- If slab is installed, use gravel fill beneath the foundation slab with a poly membrane (minimum thickness of 6mm) or vapor retarder, sealed over the gravel prior to pouring the basement floor. Seal the poly barrier at the edges and seams to prevent moisture and soil gases from entering the building.

Fresh Air Ventilation

4-10

Essential: Provide make-up air.

WHY

- Ventilation can reduce or eliminate mold, especially in bathrooms.
- Ventilation can control odors, stuffiness, and excess moisture, if good fans and controls are selected and installed correctly.
- Effective ventilation costs more up-front but saves on on-going cleaning, repainting and repair.
- Mechanical ventilation is a good partner with operable windows. In fair weather, windows can be opened. In cold weather the mechanical system can provide fresh air without discomfort or a substantial energy penalty.

HOW

- Vent to the outside.
- Install quiet fans (1.0 or less sones) so they will be used.

4-11

Essential: At a minimum install medium-efficiency air filters in ducted forced air systems. Option: Use “washable” type air filter.

WHY

- Medium-efficiency filters are inexpensive but effectively remove most common particulate pollutants like dust or pollen. The pleats in the filter remove 40% - 50% of all particulate matter.
- “Washable” filters last longer and minimize landfill waste.

HOW

- Specify medium-efficiency filters and make sure information about filter size, type and replacement schedule is included in the O&M Manual.

4-12	**Essential:** Install kitchen range hood, bath, laundry, or ceiling exhaust fan vented to the outside to remove excess moisture and odors. *or* Install multi-port attic fan to exhaust kitchen, laundry and bathroom.

WHY

- Ventilation can reduce or eliminate mold, especially in bathrooms.
- Ventilation can control odors, stuffiness, and excess moisture, if good fans and controls are selected and installed correctly.
- Effective ventilation costs more up-front but saves on-going cleaning, repainting and repair.
- Mechanical ventilation is a good partner with operable windows. In fair weather, windows can be opened. In cold weather the mechanical system can provide fresh air without discomfort or a substantial energy penalty.
- This Action Item is not required for rehabs but may be feasible and beneficial in substantial rehabs.

HOW

- Option 1: Continuous ventilation
  - Always on
  - Constant low airflow
  - Quiet
  - Not dependent on occupants to operate control
  - Cost-competitive

  Elements:
  - Multi-port fan installed in attic space, vented through roof
  - Pickups located in bath(s) and kitchen to remove moisture and odors quickly
  - Airflow sized to number of occupants or lifestyle
  - Fresh air intakes in windows or through outside walls.
- Option 2: Intermittent ventilation
  - Provides spot removal of pollutants
  - Least change from current practice
  - Can provide acceptable minimum ventilation
  - Relies on tenant

  Elements:
  - Upgraded bath fan(s): 70-90 cfm, 1.5 sones or less
  - Upgraded control: timer switch to ensure adequate run time
  - Kitchen ceiling fan or range hood that exhausts outdoors
  - Kitchen ceiling fan: 90-110 cfm, 2.5 sones or less
  - Fresh air intakes in windows or through outside walls

- Medium efficiency filters: Rated 30% or better on "Dust Spot Efficiency" test
- Electrostatic or media filter types acceptable.

Vent to the outside.

For hood fans, it is best to hard-wire the fan to the stove.

COST

Higher quality fans cost more than conventional fans. A standard bath fan costs between $20-$25, while an upgraded fan costs between $45-$65. Fans, controls and fresh air vents may add about $120-$200 per unit.

4-13

Provide for whole house ventilation with controlled supply and exhaust providing maximum Air Changes per Hour (ACH) for 24 hours per day as required by code.

CODE

Washington State Ventilation and Indoor Air Quality Code (available on line at www.energy.wsu.edu/buildings) prescribes minimum and maximum ventilation rates based on the floor area of the unit or home. In multi-family, the rates are applied to individual units, hall and other common areas are calculated separately (See Tables 3-2 and 3-4 in the Code).

WHY

When set up and operated properly, whole house fans provide consistent fresh air in the unit. They are especially critical in tight buildings.

HOW

Installing continuous exhaust ventilation or humidistat control ventilation is preferred.

Whole house fans can be set up either to exhaust air from the unit or to supply fresh air to the interior of the unit. If set up for exhaust, it is essential to provide for outside make-up air to maintain balanced air pressure and prevent backdrafting from fuel burning devices. If set up as a supply fan, provide for either passive or mechanical venting so that air pressure in the building is only slightly positive. If too high, the air pressure in the building will force moisture into and through the walls of the building.

Include proper operating and maintenance information for the whole house ventilation system in the O&M Manual.

4-14 Flush out building prior to occupancy with fresh outdoor air.

WHY

- Interior air within a new building may be polluted with construction dust, odors and hazardous chemicals.

HOW

- Protect materials stored on site from moisture to prevent molds and construction dust from being carried into building.
- Seal all ducts and protect HVAC equipment until construction and cleaning is complete to avoid contaminating system.
- Ventilate during construction.
- At a minimum, thoroughly ventilate completed building for 72 hours prior to occupancy. Clean all surfaces of construction dust.
- When possible, flush newly built spaces with 100% outdoor air for seven days prior to occupancy, after final paint touch-up and floor-covering installation. Use the full air capacity of the HVAC system or at least 2.5 ACH (air changes per hour), provided by temporary fans if necessary. If possible, do the flush-out before furniture installation, to avoid pollutants being adsorbed into furniture and released later.
- Avoid “bake-outs” that may damage materials and/or drive VOCs into other surfaces.
- If space is available, unroll and air out carpet prior to installation.
- If the buildings' HVAC system is used, replace or clean filters after the flush, and prior to occupancy. Cautions: HVAC systems with minimal outdoor air capacity often require supplemental temporary fans; most with "economizer" capacity can provide 2.5 ACH.
- Educate residents about their own furnishings and belongings that may contribute toxic off-gassing into units. Toxic off-gassing materials brought in by the tenants reduces the impact of IAQ measures employed during design, construction and close-out.

- A flush-out will have minimal effect on materials with prolonged emissions, such as rubber flooring, carpet backing and wood products with formaldehyde glue. Effectiveness of this Action Item is dependent on what materials you used as noted in previous Action Items 1-9.

COST

- There is a small construction management and electricity cost for a flush-out. However, it is an important step for protecting the health of occupants and reducing complaints during the critical early occupancy period. It helps to avoid sick time, disability leave and potential lawsuits.
- If occupancy is on a very tight moving schedule, the extra time before moving in may be costly. Benefits and potential consequences should be considered carefully.

4-15 Use operable windows for cross ventilation in combination with mechanical ventilation systems to assure good air flow and ample fresh air for building occupants.

WHY

- Fresh air is essential to residents' physical and mental health. To accomplish this, buildings should have both operable windows and a mechanical ventilation system. Tenants appreciate being able to control their indoor environments with these options.

HOW

- Install operable windows throughout units for cross ventilation and cooling.
- Install pinlocks or bolts for security while windows are open.

Education

4-16 Implement a "No Smoking" policy for common areas. Consider designating smoking and non-smoking units, floors or buildings.

WHY

- Cigarette smoke contains chemicals and particulates that accumulate throughout the building and are nearly impossible to remove completely. These compounds create offensive odors and health hazards for all residents.
- Environmental tobacco smoke (ETS), also called "secondhand smoke," is a major indoor air pollutant and contains about 200 known toxins, including formaldehyde and carbon monoxide, as well as 43 other carcinogens.

- According to the American Lung Association, ETS causes an estimated 3,000 lung cancer deaths and 35,000 to 50,000 heart disease deaths in non-smokers, as well as 150,000 to 300,000 cases of lower respiratory tract infections each year in children under 18 months.

HOW

- Educate residents about the risks of indoor smoking and impacts on children.
- Maintain "smoke-free" units for occupants with compromised health or special needs.
- If there are areas in the building used for smoking, provide adequate ventilation.

4-17

Educate residents on ways to maintain good indoor air quality including minimizing and treating mold, reducing track-in of dirt and the importance of using mechanical ventilation properly.

WHY

- Informed residents can contribute towards creating a healthier living environment through careful product selection, maintenance, and living practices.

HOW

- The American Lung Association offers educational events and literature about creating healthy living environments.
- Translate educational materials into the languages used by residents in the building.
- **See also** Resources section for more information.

Chapter 5 Materials Efficiency

Reducing, reusing, and recycling building materials conserves local and regional natural resources. There are many building products on the market and techniques that contribute to more durable and less resource intensive buildings.

Waste Management & Recycling

5-1 **Essential:** Develop and implement a waste minimization plan, establishing targets for demolition and construction waste reuse and recycling by types of materials. (Goal: 80% total waste reuse and recycling by weight).

WHY

- Reduces impact on landfills. Construction, demolition and land-clearing (CDL) waste accounts for 25% of the materials sent to regional landfills. More than half of this waste comes from the demolition phase.
- Executing a waste minimization plan and salvaging, reusing, and recycling C&D waste reduces disposal costs and may provide cost savings and revenue.
- The following materials are readily recyclable in the Seattle area and generally cost less to recycle than to dispose of as garbage: cardboard, clean wood, engineered products, concrete, asphalt, brick, drywall, land clearing debris, metals, paper and beverage containers from the job shack, and window glass.

HOW

- Specify preparation and submittal of a waste minimization plan for the project that identifies demolition goals (if applicable) and establishes policies and procedures to recycle the maximum construction waste. Require general contractors and their subs to participate in the program by making this a condition of the contract specifications. Contact the Business & Industry Resource Venture (see Resources) to request a sample Job-site Specification and Construction Waste Management Plan, and assistance in writing and reviewing both.
- Consider deconstruction/salvage for the demolition phase of the project rather than a regular demolition contractor. Remember to address hazardous materials. Since the majority of construction waste originates in the deconstruction phase, it is a key element in reaching the 80% total waste reuse and recycling goal.
- Set up on-site collection for materials called out in the plan or consider contracting with a recycling provider that handles mixed waste.
- Create salvage and recycling staging and sorting area.

COST

- Little or no cost premium and could provide savings. Waste mitigation activities and deconstruction costs are offset by the reduction in tipping fees.
- Donations of salvaged materials from deconstruction to a non-profit, such as The RE Store, are tax deductible.

5-2

Essential: Require subcontractors to participate in waste minimization efforts.

WHY

- Subcontractors typically are responsible for managing their own waste. Subcontractors need to be aware and committed to the program you've established, or it will not succeed.

HOW

- Include requirement in bid and contract negotiation process.
- Include a preference to buy recycled-content products.
- Make sure each sub has a copy of the plan and has been trained in the recycling program. Ask them for input and suggestions about collection containers and project phasing.
- Recognize and support subcontractor participation. Monitor activity and contractor's log regarding transport of waste materials.

5-3

Essential: Include Seattle/King County's Construction Recycling Directory and the Contractors Guide as part of the bid package.

WHY

- These easy-to-use documents will assist contractors in achieving Action Items 1, 2 and 4.
- The Construction Recycling Directory is a directory of recycling haulers, recycling facilities, reuse and salvage services, and materials exchanges.
- The Contractors Guide has simple how-to's for reducing waste, recycling and using recycled-content building products.

HOW

- Contact the Business and Industry Resource Venture for copies of these documents (see Resources).

COST

- Free

5-4

Reuse and recycle parts or all of existing building during renovation or redevelopment. Install used/salvaged building materials where appropriate.

WHY

- The energy spent to extract, process, transport, and install materials is significant. Reusing and recycling parts or all of an existing structure saves resources, reduces waste, and saves landfill tipping costs.
- Reusing and restoring older structures supports historic preservation and helps maintain the character of our communities.

HOW

- Evaluate viability of reusing existing structure, including foundations, footings, slabs, and sidewalks, at the beginning of the design process. Review regulatory requirements needed to bring structure up to current codes.
- Focus on improving energy efficiency in reused structures. New insulation can be blown into walls, studs can be furred out to allow more room for insulation, or foam panel insulation may be installed under exterior siding.
- Incorporate salvaged building elements like studs, doors, and hardware into project. Inspect, mark, and warehouse materials to be reused or recycled during demolition. Note, salvaged studs can only be used for non-structural walls unless the lumber is professionally re-graded. See DCLU Client Assistant Memo #224 for code issues related to reusing building materials.
- Evaluate viability of deconstruction in lieu of traditional demolition. Deconstruction diverts most C&D waste from landfills and is cost competitive.
- **See also** Chapter 1: Enhanced Design, Action Item 2.

Seattle Office of Housing

The shell of this existing brick apartment building was retained and reused. Behind and integrated with the old brick building is a new courtyard and five-story structure.

5-5	Use suppliers who offer reusable or recyclable packaging.
WHY	Packaging adds significantly to the amount of waste generated on-site. Much of it cannot be recycled.
HOW	Convey to suppliers about using materials with reduced packaging and a take-back policy. Recycle pallets, cardboard, foam packing and shrink wrap.

Foundation

5-6	**Essential:** Specify cast-in-place concrete mix with minimum 25% fly ash substitution for Portland cement. Preferred 50%.
WHY	The production of cement is highly energy- and resource-intensive.

- Substituting fly ash for a percentage of cement strengthens and improves the workability of concrete, reduces CO_2 emissions, and reuses a waste product from coal power plants.
- Flyash added to concrete yields a better finish.

HOW

- Specify a concrete mix with 25-50% fly ash content.
- Fly ash concrete takes longer to cure to full strength that could affect construction schedules on large projects. Low-rise construction scheduling should not be affected. A 25% fly ash mix reaches 50% strength in five days and 75% strength in 10 to 12 days.

COST

- No cost premium.

5-7 **Essential:** Specify recycled aggregate base.

WHY

- Portland cement concrete can be reclaimed during demolition operations and crushed into a coarse granular material that can be used as a substitute for crushed virgin rock.
- Recycled concrete aggregate is increasingly available and is often an economical alternative to new aggregate. Project managers can ensure that their contractors are aware of opportunities to recycle this material and can require the use of recycled material in construction.

HOW

- Users of recycled concrete aggregate should take customary precautions to ensure the material is suitable for the intended application.
- Specifications are available for several applications, including backfill, general fill, pipe-bedding, and as aggregate base course for pavement construction in new construction.
- Crushed glass also works well and is free draining.
- **See also** Resource section.

Seattle Office of Housing

This affordable housing project used structural insulated building panels (SIPs).

Framing

5-8 Use efficient structural systems, such as Advanced Framing, engineered structural lumber, etc.

WHY

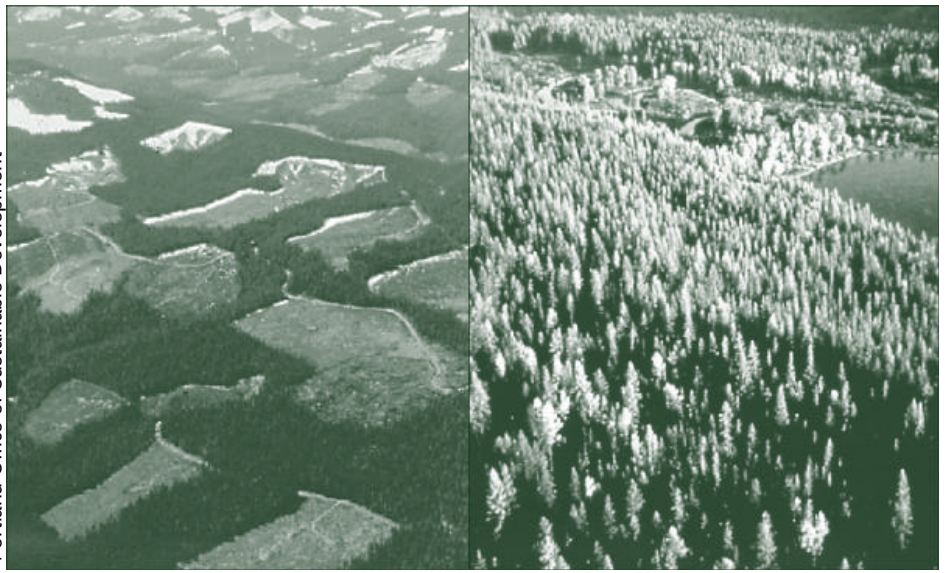
- Efficient structural systems reduce wood waste. Structural insulated building panels (SIPs) — custom-cut wall and roof systems of rigid insulation sandwiched between exterior layers of wood composite board—have excellent air sealing and insulation properties, use less wood, and save installation time. Note, SIPs cannot be reused or recycled.
- Advanced Framing improves building envelope performance and reduces lumber use by 20-30%.
- Engineered wood utilizes more of the tree and incorporates under-sized or under-valued species that might otherwise go to waste.
- Engineered joists are lighter weight and more dimensionally stable than traditional joists.

HOW

- Specify the use of engineered floor, roof, and rim joists. Investigate the viability of SIPs.
- Evaluate use of Advanced Framing features including 24” on-center, 2-stud corners, and insulated headers.
- **See also** Chapter 3: Energy Efficiency, Action Item 7 and Appendix A.

COST

- On a per-linear foot basis, engineered joists cost 40% more than solid sawn lumber. Price premiums are offset through reduced labor costs, increased spacing of components, and fewer problems with material flaws. 24" o.c. framing can reap substantial savings from reduced labor in wallboard finishing.



Portland Office of Sustainable Development

Conventional timber harvest practices fragment landscapes, cause erosion and accelerate habitat loss.

5-9

Specify 3rd-party certified sustainably harvested framing. Do not specify old growth lumber, other than "recovered" or "salvaged" materials.

WHY

- Less than 10% of the United States' old growth forest remains.
- Second-growth uncertified lumber material comes from tree farms replanted with a single tree crop, and treated with herbicides and pesticides.
- Salvaged, recovered, and recycled materials are a less expensive and environmentally responsible alternative to virgin materials.
- Sustainably harvested lumber refers to timber that has been certified by an independent, third-party organization such as Rainforest Alliance or Scientific Certification Systems.
- Currently, Forest Stewardship Council (FSC) standards are considered the world's most stringent. FSC-certified lumber is available in our region.

HOW

- Specify FSC-certified lumber products, including framing material and sheet goods. In the Northwest, FSC-certified Douglas fir is in short supply at this time. However, FSC-certified Hemlock fir is more plentiful and less expensive. Order framing material at the beginning of design/ engineering process — at least three months in advance of delivery date to avoid delay. Contact the non-profit Certified Forest Products Council to help write project specifications. This resource is free.
- Specify reclaimed lumber and recycled-content finish materials. Both are readily available in the Seattle area.
- Re-grade salvaged material for structural use. Contact a lumber grader to learn more about re-grading services.
- **See also** Resource section.

COST

- FSC-certified materials carry a 5-10% price premium.
- When combined with advanced framing, certified wood products become more cost effective.
- Salvage lumber can be purchased for less than half the price of new wood. It must be professionally re-graded for structural use. Grading costs range from $300 per half day to $500 per full day. A lumber grader can grade enough material for a 5,000 sq. ft structure in one day.

Roof & Skin

5-10 Select durable and recyclable roofing and siding materials.

WHY

- Exterior cladding and roofing materials with longer warranties offer better protection from the elements, improving building envelope performance and reducing maintenance costs over the lifetime of the building.
- Several new composite options are available that provide lower maintenance along with durability. Many of these options include recycled-content or reclaimed materials: fiber-cement composites, asphalt shingles, plastic shakes, ridged sheet material made with fiber and asphalt, and metal shingles.

- Fiber-cement composites that contain reclaimed wood fiber are resource-efficient, durable, low maintenance, and offer a very good fire rating when compared to wood or metal siding. Sometimes the wood can also be harvested from small diameter, fast-growing tree species. Many of the fiber-cement composites offer a 50-year warranty.

- Metal siding currently includes recycled-content. and offers durable and low-maintenance alternatives to wood siding. Metal offers the greatest opportunity to use post-consumer recycled-content in your project. Aluminum or steel siding products contain high percentages of recycled metal—up to 100%. The scrap is also recyclable.

- The use of vinyl siding raises concerns for several reasons. When burned, it releases dioxins. Also, one of its constituent chemicals is vinyl chloride, a known human carcinogen.

HOW

- Specify roof and siding materials with maximum durability and warranty.

- Specify and install 30-lb. building paper for roof underlayment.

- Install siding air infiltration barriers per manufacturer's specifications. Follow installation instructions carefully to minimize infiltration rates.

- Establish guidelines within the operations and maintenance manual for annual or biannual cleaning of the roof. Specify that no bleach or other harmful cleaning solutions be used. Such solutions poison adjacent soils and plants.

- Consider specifying cementitous siding such as Hardiplank. When properly installed, cementitous siding can last three times longer than wood siding and takes paint well. Cementitous siding requires additional installation time.

- If your goal is to use a durable, low maintenance, economical alternative to vinyl, consider a polypropylene siding that is comparable in appearance and performance. Aluminum siding is still available as well.

COST

- There is a slight cost premium for 25- to 30-year roof and siding products over products with a 15- to 20-year warranty.

5-11 Use recycled-content insulation (e.g. cellulose insulation.)

WHY

- Three commonly available types of insulation include recycled-content: cellulose, fiberglass, and mineral wool.
- Cellulose insulation is made from 100% post-consumer recycled newspapers or telephone books. The insulation can be dry-blown or poured loose-fill into enclosed cavities, but is most commonly wet-sprayed. When sprayed, the product leaves few voids, reducing problems with air infiltration. Cellulose is usually mixed with boric acid or sodium borate as a fire retardant. An additional benefit of boric acid is that it kills carpenter ants and termites.
- Several brands of fiberglass insulation batts are manufactured using recycled glass, including post-consumer glass collected in curbside recycling programs.
- Mineral wool insulation is another option and is available in loose-fill or batts. It has, on average, 75% post-industrial recycled-content.

HOW

- Specify recycled-content insulation.

Interior Finishes

5-12 When suspended ceiling panels are specified, install recycled-content acoustical ceiling tiles.

WHY

- Recycled content ceiling tiles are becoming the industry standard, making them easy to specify and install.

HOW

- Specify ceiling tiles with post-consumer recycled content.
- For rehab projects, remove and recycle old ceiling tiles. Call Sepia Interior Supply to arrange for recycling. (See Resources.)

COST

- No cost premium.

5-13 Specify 3rd-party certified sustainably harvested finish woodwork.

WHY

- Slow-growing hardwoods have been over-harvested.
- Sustainably forested lumber is certified as sustainably managed by an independent, third-party certification organization. Currently, Forest Stewardship Council (FSC) standards are considered the most rigorous certification standards.

HOW

- Specify certified sustainably harvested finish wood materials. There are many certified solid and veneered products available locally.
- **See also** Chapter 5: Materials Efficiency, Action Item 9.

5-14 Specify recycled-content drywall. Install hard surface drywall in high-wear areas.

WHY

- Recycled-content drywall contains "synthetic" gypsum, a waste byproduct of flue gas scrubbers, and reduces the demand for virgin gypsum, mined from the ocean floor.
- Use of hard-surface drywall in high-wear common areas can reduce maintenance costs. Note that hard-surface drywall is not as easily recyclable as regular drywall.

HOW

- Specify drywall with "synthetic" or recycled gypsum.
- Note that all gypsum manufacturers use 100% recycled paper for the facing. Not all drywall suppliers carry drywall with recycled gypsum content. Specify recycled gypsum content or "synthetic" gypsum rather than "natural" gypsum.

Cost

- Recycled content drywall is widely available and cost-competitive with non-recycled content products.
- Hard surface drywall has a slight cost premium. However, it reduces long term maintenance costs in high-wear areas like common hallways and utility rooms.

5-15	Install alternative to sheet vinyl for kitchens and bathrooms. Other flooring choices include natural linoleum, tile and vinyl composition tile (VCT) with recycled-content.
WHY	• Sheet vinyl is less durable and more toxic than other flooring options. Vinyl is made from polyvinyl chloride (PVC), a petroleum-based, highly toxic substance that contains phthalates used as softeners that are known endocrine disrupters. Vinyl chloride is also a known carcinogen. Production of this material creates air pollution problems, but in addition, it impacts indoor air quality in the building, off-gassing VOCs long after installation is complete. • Natural linoleum and tile are made from natural and abundant materials and are very durable.
HOW	• Specifying natural linoleum or tile is the best choice. Verify that the moisture content of the substrate (underfloor) meets the linoleum manufacturer's requirements. • If vinyl is used, specify vinyl composition tile (VCT). It contains fewer VOCs and phthalates than sheet vinyl. Damaged tiles can be replaced individually. "Hot waxing" reduces permeability.
COST	• Slight premium: natural linoleum costs about $16-22 sq. yd. but is extremely durable and can last up to 40 years. Quality sheet vinyl costs about $16-17 sq. yd. with an average life of 7 years. Small rooms can utilize "scraps" or roll ends of linoleum that cost about $7 sq. yd. Tile prices begin at $2 sq. ft. The durability of linoleum and tile make them cost effective over time.

Chapter 6 Operations & Maintenance

O&M practices impact the building owner's costs and residents' health, comfort, and safety. Sustainable building O&M practices enhance tenant health and operational savings. The key to successful building performance is O&M plans, education, and design that is convenient and cost-effective.

6-1

Essential: Prepare a plan for annual scheduled maintenance of all aspects of the building and site, including but not limited to, building envelope, roof, vents, filters, plumbing, combustion equipment and landscaping.

WHY

- A regularly maintained building and site will provide optimum environmental and economic performance.

HOW

- Use the information compiled for Chapter 1: Enhanced Design, Action Item 15, including preferred maintenance to develop a schedule matrix.
- Include this plan within the overall O&M Plan.
- **See also** Chapter 1: Enhanced Design, Action Item 15.

COST

- No additional cost to construction budget.

6-2

Essential: Prepare a sustainable landscape O&M plan.

WHY

- Pesticides and herbicides may not break down before reaching the water table and are harmful to many plants, animal species, and humans. While occasional use of these products seems insignificant, the cumulative effect can be devastating to water habitat.
- A sustainable landscape O&M plan can provide the information property management and custodial staff need to ensure a functional landscape that does not rely on pesticides and herbicides.

HOW

- Begin the plan with a statement as to the importance of using environmentally preferable methods in landscaping.
- Landscaping policies to reduce pesticide use, such as Integrated Pest Management (IPM) should be stated in the plan.
- Provide specific guidance on proper soil preparation including preferred amendment techniques, soil and vegetation management, and irrigation. Plan should provide details on how to care for existing landscaping and include a list of other plants that are appropriate for the site.

COST

- No additional cost.

Seattle Office of Housing

A well placed and labeled system encourages recycling in a common area.

6-3

Essential: Provide adequate space and convenient placement of resident recycling. Develop recycling and disposal procedures for staff.

WHY

- By making recycling easy, it is less likely that recyclables will end up in the garbage. A well-organized recycling system within the dwelling simplifies sorting of materials and takes up little space.
- Recycling minimizes the long-term cost of disposal that contributes to the overall effectiveness of a building's operation.
- Proper disposal is essential in maintaining a well-kept, sanitary facility that contributes to a high quality healthy living environment.

HOW

- Provide a recycling system in each unit in addition to any exterior common recycling containers. The location of recycling center should be convenient to tenants without imposing on the aesthetics of the building.
- Consult with Seattle Public Utilities Solid Waste early in planning to determine size of bins, location and truck access.
- Good signage will help ensure an effective recycling program.
- Include recycling and disposal procedure in the staff O&M Manual and in the tenant manual.

COST

- If designed properly, there is no additional cost. A thoughtful plan may save on monthly garbage fees.

6-4

Essential: Design properly ventilated separate storage area for maintenance supplies and paints.

WHY

- Cleaning and maintenance supplies, with the exception of the non-toxic alternatives discussed in this manual, off-gas many unhealthy substances, including volatile organic compounds.

HOW

- If integrating a maintenance storage area within the development, locate it away from air intakes and windows, properly ventilate, and thoroughly seal and isolate it from interior living spaces.
- Extra attention should be paid to these safety measures in rehab and smaller projects.
- Include instructions on maintaining these areas in the O&M manual.

COST

- As this is already required by code, there are no additional costs.

6-5

Develop a tenant manual to provide guidance on living in a residence that incorporates green or sustainable features.

WHY

- A manual can help owners or tenants make choices that enhance the green or sustainable features of their building, such as using non-toxic cleaning supplies, or that prevent problems that could decrease the sustainability of their building, such as notifying property managers of leaks that could cause mold.
- A tenant manual can enhance the sense of community and stewardship.
- Residents may be unfamiliar with sustainable systems or features installed in their building and may need training in operating them properly to enjoy fully the environmental and economic benefits intended through the design.

HOW

- Incorporate the SeaGreen Affordable Housing Guiding Principles or the Sustainability Goals for your project as a starting point for educating residents on this unique aspect of their building.
- A manual can be enhanced through visual aides, such as signage around the building, and discussion at tenant meetings on specific aspects of the building. It will be important to ensure written materials are available in non-English formats.

Topics that should be included in the manual include the use of non-toxic cleaning solutions, recycling procedures, proper trash disposal, organic gardening techniques, and treatment of any critically sensitive areas on site such as wildlife corridors, streams, or buffers. Design features that require specific and perhaps unconventional practices to work effectively should be covered. For example, for zoned heating, tenants should be informed as to how to deal with rooms with different heating needs and/ or how to program their thermostats.

COST

- No additional costs.

6-6 Incorporate a waste disposal plan in the building/site design.

WHY

- By making trash disposal easy and accessible, it is more likely that garbage/recyclables will end up in the appropriate containers. A well-organized trash system promotes safety and sanitation and may reduce maintenance and expense. Poorly maintained trash areas invite pests, rodents and unauthorized dumping.

HOW

- Provide disposal options convenient to tenants.. Consider trash chutes or trash rooms.
- If appropriate, provide for intermediate disposal locations serviced by management.
- Provide convenient and accessible common area trash collection containers.
- Good signage will help ensure an effective disposal program. Insist on environmentally responsible practices.

COST

- If designed properly, there is no additional cost. Consult with your garbage service provider for service options and rates.

6-7 Provide training for O&M staff.

WHY

- O&M activities can be critical in achieving actual environmental and economic performance.
- Turnover in O&M staff makes regular training a good idea.

HOW

- Provide a list of training opportunities in the Seattle area. Free and low-cost training are routinely available. Vendors of systems equipment often provide training to ensure good performance of their product and reduce complaints.
- Develop a schedule for training to ensure information is reviewed annually or regularly.

APPENDIX A
ADVANCED FRAMING

Advanced framing was derived from Optimum Value Engineering, a set of efficient framing practices developed and promoted by the National Association of Home Builders Research Center since 1974.

Advanced framing techniques include:

- Designing and engineering structures for efficient use of lumber and wood materials
- Framing one- and two-story walls at 24" on center rather than at 16"
- Aligning windows and other openings with framing layout
- Use of box headers designed for loading conditions
- Eliminating unnecessary studs, such as at corners and T-walls
- Eliminating redundant framing such as drywall backer studs and ceiling blocking by using drywall clips.

Advanced framing reduces the amount of framing material used in structures with no sacrifice in structural performance, while creating a more comfortable, durable and energy-efficient building.

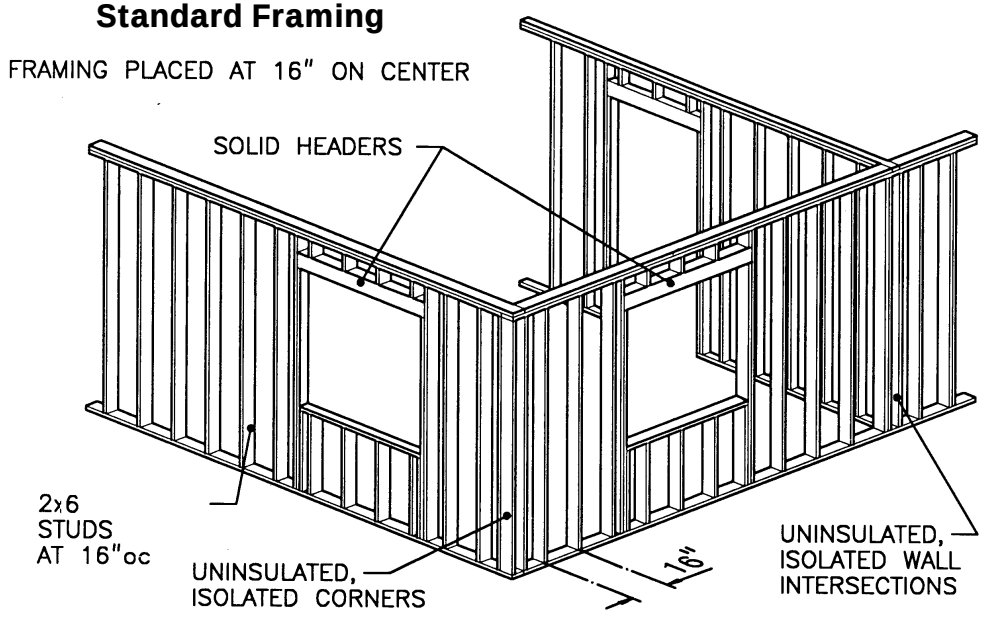
Designing and engineering for materials efficiency

- Designs based on a 24" module will reduce waste from off-cuts. Aligning windows and other rough openings with framing layout can eliminate studs.
- A framing plan can save money on framing costs by clarifying the structure and decisions that otherwise the framing crew may have to make on the job. When in doubt, the job-site solution is usually to add lumber. For example, a plan can show whether headers on gable end walls are necessary, or the number of studs in a column.

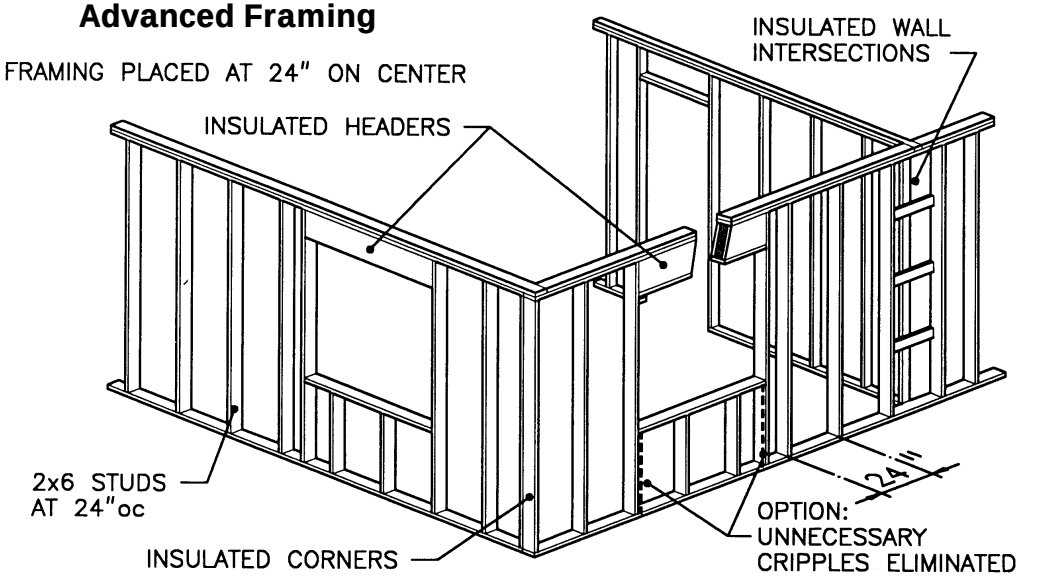
Framing at 24" on center rather than at 16"

- 2x6 walls can be framed at 24" on center for the top two floors of construction with normal roof and floor loads. 24" framing reduces material, labor and energy costs. It saves the most material on long straight wall runs.
- Standard half-inch drywall is span rated for 24". APA 303 rated sheet siding will span 24". Cementitious siding may span 24" with extra attention.
- 19.2" or 24" joist spacing with thicker plywood subflooring is a possibility for further savings.

Standard Framing



Advanced Framing



Use of box headers designed for loading conditions

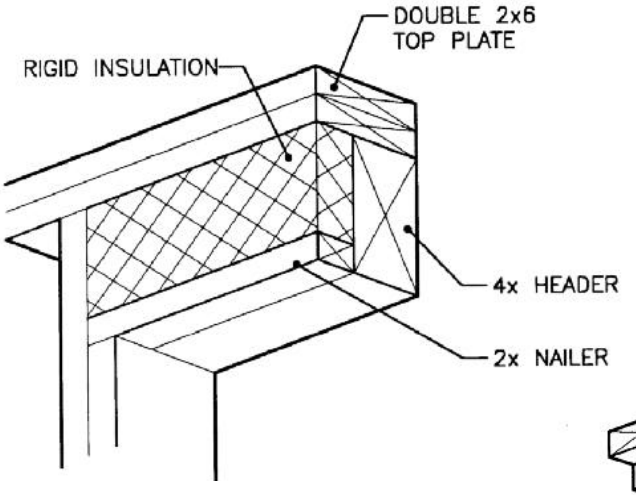
- Headers from solid lumber may be oversized and waste material. Smaller dimensional lumber and plywood can be used to assemble box headers.

- Box headers in exterior walls result in energy savings as well as material savings by creating more space for insulation. Manufactured/engineered insulated headers are easy to cut and very well insulated.

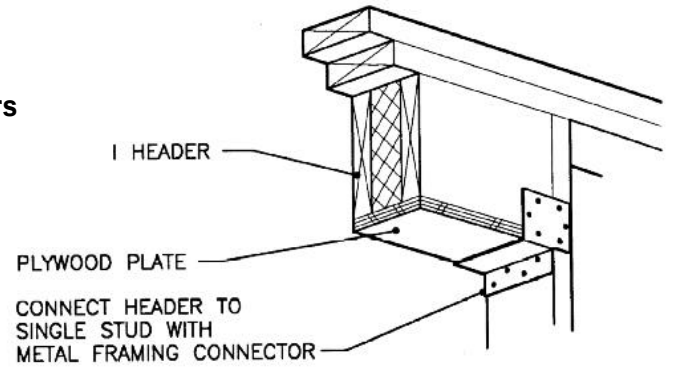
- Headers in non-load bearing walls should be reviewed to determine if they are needed.

Eliminating unnecessary framing at intersections

- Three-stud “partition-posts” and stud-block-stud channels at interior/exterior wall intersections are usually unnecessary unless expressly engineered.



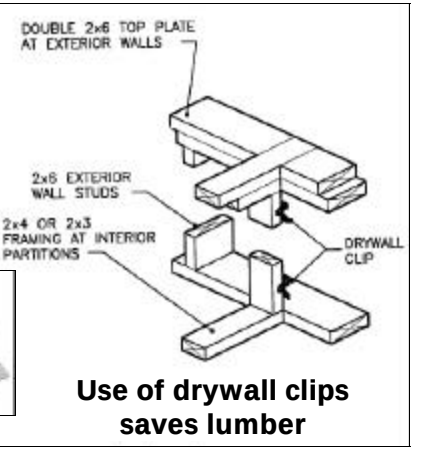
Insulating Solid Headers



Use of Box Header and Header Hanger

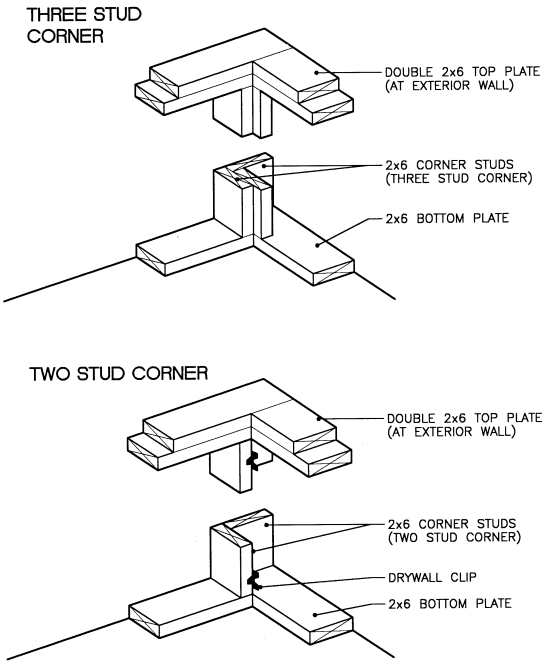
- Partitions can be nailed to flat blocks (esp. from off-cuts) inserted between studs or directly to exterior wall studs. This technique, known as ladder blocking, also allows more insulation to be placed in the exterior wall cavity.

- Drywall clips or stops employed at wall and ceiling intersections also reduce the need for wood blocking. They create floating connections that reduce corner cracking caused by wood shrinkage and truss uplift. Drywall clips can save about $100 per 1000 SF floor area.

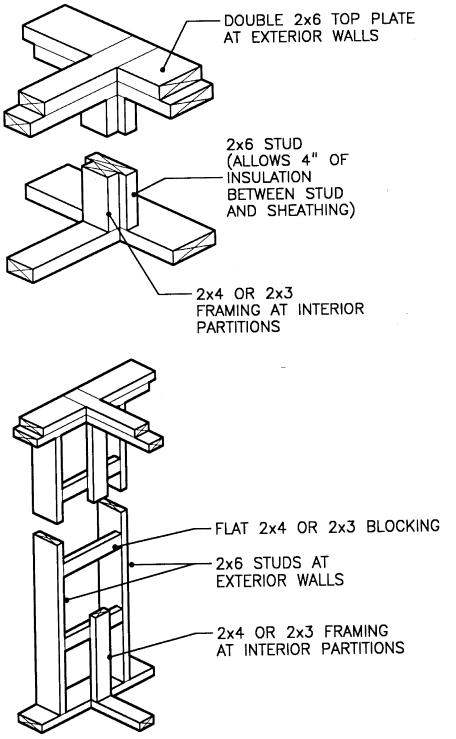


Use of drywall clips saves lumber

Intersection of Exterior Walls



Intersection of Interior Partitions



APPENDIX B
HEATING SYSTEMS

Digital Thermostat

WHY

- A quality digital thermostat allows residents to precisely regulate a unit's temperature. Cheaper thermostats typically heat to a temperature up to 5 degrees higher or lower than specified.
- A digital thermostat is easily programmed to heat the house to different levels at different times depending on residents' needs, potentially significantly lowering heating costs.

HOW

- Specify a high-quality thermostat that is simple to program and explain the system to residents when they move in.

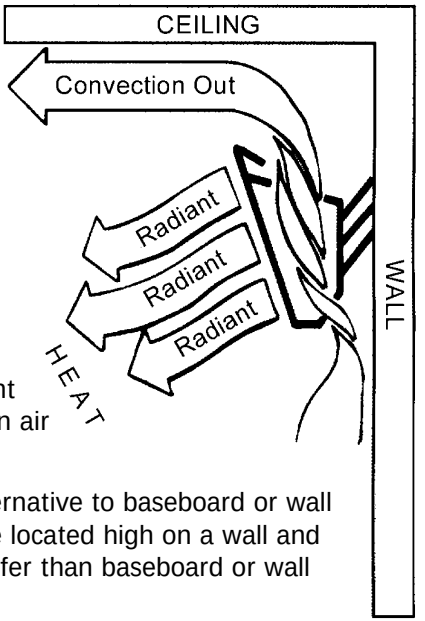
COST

- Approximately $60-100 per unit.

Radiant Cove Heaters

WHY

- These electric systems radiate heat directly to objects in their "line of sight." The heaters are long rectangular metal units that are placed high on a wall, where they are out of the way of furniture, doors and small children.



- The system is zonal, so the temperature of each room can be independently controlled.
- People prefer radiant heat from sources like sunshine, fireplaces, wood stoves or warm floors to other forms of heat. Radiant heat is perceived as comfortable even when air temperatures are low.
- Radiant cove heaters are an affordable alternative to baseboard or wall heaters. In addition, because the units are located high on a wall and operate at lower temperatures, they are safer than baseboard or wall heaters.
- Radiant heaters can be more energy efficient than other resistance heat because they maintain comfort at lower temperature settings.

- Radiant cove heaters are an affordable alternative to baseboard or wall heaters. In addition, because the units are located high on a wall and operate at lower temperatures, they are safer than baseboard or wall heaters.
- Radiant heaters can be more energy efficient than other resistance heat because they maintain comfort at lower temperature settings.

HOW

- Radiant heaters make sense in new or properly weatherized buildings. Radiant cove heaters are easily installed high on the wall of each room in which heating is needed. They can also be readily installed in rehabs where the owner is converting from baseboard or wall heaters.

COST

- The cost of installing radiant cove heaters is about the same as higher quality wall heaters and slightly more than baseboard heating. However, the system costs 10% to 15% less to operate and maintains acceptable levels of comfort.

High Efficiency Gas Sealed Combustion Forced Air Furnaces

WHY

- "Sealed combustion," means there is little chance of combustion gas spillage or backdrafting, a safety benefit for occupants.
- Higher efficiency ratings translate to lower monthly gas costs. Some furnaces have more efficient blower motors that also reduce electric bills.
- In rehabs, sealed combustion may avoid the cost of relining a chimney.

HOW

- Furnace efficiency is wasted if the unit is tied to an inefficient duct system, which is common. The ducts should be sealed to eliminate air leaks in crawl spaces, attics and garages (where furnaces are located in the garage).

COST

- Approximately $3200 per unit.

Water Heater
Water Boiler Supplied Fan Assisted Heaters & Hydronic Baseboard (i.e. “Turbonics”)

WHY

Hydronic heat is:

- Quiet, with no large fans or ducts to transmit noise
- Clean, gently circulating room air by convection without creating dust or odors
- Even, warming the full length of cold walls and windows for the greatest comfort
- Flexible, allowing placement of furnishings without concern for blocking registers
- Simple to install, particularly for retrofitting existing buildings
- Efficient, moving warm water through small pipes with less heat loss than ducts
- Zoned for room to room control.

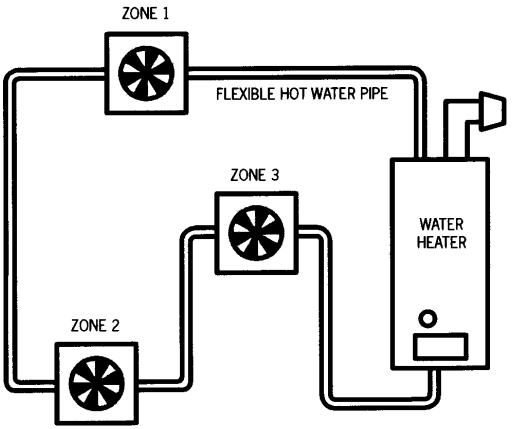
HOW

Contact your supplier for information on specific systems, their requirements and qualified contractors.

COST

At this time these systems are almost as high in price as forced-air systems, because contractors without experience installing these systems tend to bid high.

It is expected that the installation costs for these systems in the Seattle market will drop dramatically as more contractors become familiar with their installation.



General Resources

BuildingGreen
Publishers of Environmental Building News, GreenSpec Directory and Green Building Advisor.
www.buildinggreen.com

Built Green™
Master Builder's Association of King and Snohomish Counties
2155 112th Ave. NE Suite100
Bellevue, WA 98004
800-522-2209
Voluntary, self-certifying program that identifies more than 200 environmentally-friendly building strategies in six categories that you can use to construct your building to a 1-star, 2-star, or 3-star certification level. A multi-family construction handbook is available containing extensive resource listings.
www.builtgreen.net

Building Science Corporation
Westford, MA 01886
978-589-5100
Offers technical advise and useful information regarding frequently found problems in buildings and how to avoid them. Publishes *Builder's Guide* by Joe Lstiburek.
www.buildingscience.com

City of Seattle
City Light Built Smart Program 206-684-4283
Department of Construction & Land Use 206-684-0806
Department of Transportation 206-684-5008
Seattle Public Utilities 206-684-4150
Office of Housing 206-684-0304
Sustainabile Building
www.seattle.gov/sustainablebuilding

Energy & Environmental Building Association (EEBA)
10740 Lyndale Ave. S., Suite 10W
Bloomington, MN 55420
952-881-1098
A non-profit that promotes environmentally responsible new building technology, standards for energy efficiency and best field practices and applications. Builder field guides available.
www.eeba.org

Environmental Home Center
1724 4th Ave. S.
Seattle, WA 98134
800-281-9785
A source for green building materials both retail and on-line.
www.built-e.com

Iris Communications
Eugene, OR
800-346-0104
Excellent resource for various publications relating to environmental design and energy efficient products.
www.oikos.com

NAHB Research Center
400 Prince George's Blvd.
Upper Marlboro, Maryland 20774
800-638-8556
Is a not-for-profit subsidiary of the National Association of Home Builders (NAHB).
www.nahbrc.org

Northwest EcoBuilding Guild
Seattle, WA
206-389-7281
Green Pages, is an annual listing of ecologically sustainable designers, contractors, suppliers and professional services. Available at the Environmental Home Center or on-line at www.ecobuilding.org

Washington State University Cooperative Extension
800-723-1763
Provides educational materials and technical assistance, including an Excel spreadsheet you can use to determine energy component tradeoffs.
www.energy.wsu.edu/buildings

Washington Toxics Coalition
4649 Sunnyside Ave. N. Suite 540E
Seattle, WA 98103
206-632-1545
www.watoxics.org

RESOURCES 1
Chapter One: Enhanced Design

Asbestos & Lead

City of Seattle
seattle.gov/util/services/waterquality/lead.htm

Environmental Protection Agency
Several links to asbestos related websites
www.epa.gov/opptintr/asbestos/index.htm

King County
Information on lead based paint and abatement.
www.metrokc.gov/hazwaste/lhwmp/leadpaint.html

National Lead Service Providers
Lists of qualified lead service providers—lead inspectors, risk assessors, abatement contractors, analysis laboratories, lead trainers.
www.leadlisting.org

Puget Sound Clean Air Agency
www.pscleanair.org

Deconstruction

Earthwise
707 S. Lander
Seattle, WA 98134
206-624-4510
Sells used building materials. Crews can remove materials from your site. Contact prior to demolition work.

Building & Industry Resource Venture (BIRV)
1301 5th Ave. Suite 2400
Seattle, WA 98101
206-389-7304
Provides free information, technical assistance and referrals to help Seattle design and construction professionals with general sustainable building education, City of Seattle incentive programs, construction waste management, green building materials, stormwater management and water conservation.
www.resourceventure.org

Industrial Materials Exchange (IMEX)
206-296-4899
Free catalog listing for available and wanted waste materials.
www.metrokc.gov/hazwaste/imex

RE Store
1440 NW 52nd St.
Seattle, WA 98107
206-297-9119
Sells used building materials. RE Store crews can remove materials from your site. Contact prior to demolition work.
www.re-sources.org

Second Use Building Materials
7953 Second Ave. S.
Seattle, WA 98108
206-763-6929
Sells used building materials. They can pick up materials from your site. Contact prior to demolition work.
www.seconduse.com

Design

Global Green USA
227 Broadway Suite 302
Santa Monica, CA 90401
310-394-7700
The Manual "A Blueprint for Greening Affordable Housing: Developer Guidelines for Resource Efficiency and Sustainable Communities" prepared with support from the US Department of Energy.
www.globalgreen.org

NAHB Research Center
National Association of Home Builders
400 Prince George's Blvd.
Upper Marlboro, MD 20774
800-638-8556
"Cost Effective Home Building, A Design and Construction Handbook" available.
www.nahbrc.org

Maintenance & Cleaning Products

Green Seal
1001 Connecticut Ave. NW Suite 827
Washington, DC 20036
202-872-6400
Information, product standards, certification and recommendations for environmentally responsible products and services.
www.greenseal.org

Mold & Mildew

Building Science Corporation
70 Main St.
Westford, MA 01886
978-589-5100
"Builder's Guide" by Joe Lstiburek includes illustrations and resources for design, foundations, framing, HVAC, insulation, drywall, plumbing, electrical systems, painting, sheathings, and windows all with respect to moisture control, energy efficiency and proper ventilation. Also "Moisture Control Handbook: Principles and Practices for Residential and Small Commercial Buildings" by Joe Lstiburek and John Carmody.
www.buildingscience.com

Iris Communications
Eugene, OR
800-346-0104
"Prescriptions for a Healthy House, A Practical Guide for Architects, Builders, and Homeowners" by Paul Baker, Eric Elliott and John Banta, identifies the full range of potential indoor health problems and offers solutions.
www.oikos.com/catalog

NAHB Research Center
National Association of Home Builders
400 Prince George's Blvd.
Upper Marlboro, MD 20774
800-638-8556
www.nahbrc.org/ToolBase

Washington State Dept. of Health
360-236-3363
www.doh.wa.gov/ehp/ts/IAQ.htm

RESOURCES 2
Chapter Two: Site & Water

Brownfield Information & Assistance

Brownfields are development sites believed to be contaminated with hazardous materials. The level of contamination can be determined by a level 1 or 2 site assessment or pollutant mapping.

EnviroOne.org
A non-profit organization dedicated to be a "one-stop center" for everything environmental. Useful links to Brownfield information at www.enviroone.com.

Fixtures

SETS Systems Electric Tankless Water Heaters
Meet HUD criteria.
877-666-8265
www.tankless-water-heater.com

Terry Love Plumbing & Remodel
Bellevue, WA
425-649-5683
Free advise on several low-flow toilet choices on website.
www.terrylove.com

Takagi Industrial Co.
6 Goddard
Irvine, CA 92618
949-453-8388
Manufactures tankless gas water heaters.
www.takagi-usa.com

Pesticide & Herbicide Alternatives

Bioganic Safety Products
Herbicides and pesticides made from natural ingredients.
www.bioganic.com

King County
General information on pesticides and herbicides.
www.metrokc.gov/hazwaste/house

Natural Lawn and Garden Hotline
206-633-0224
Less-toxic ways to control specific pests.
www.cityofseattle.net/util/rescons

Northwest Coalition for Alternatives to Pesticides
P.O. Box 1393
Eugene, OR 97440
541-344-5044
www.pesticide.org

Washington Toxics Coalition
4649 Sunnyside Ave. N. Suite 540E
Seattle, WA 98103
206-632-1545
www.watoxics.org

Landscaping & Irrigation

Promote native and drought tolerant plants, natural landscape design, and low-water gardening practices. Allow surface water to recharge soils.

Seattle Public Utilities
Natural Lawn & Garden Hotline 206-633-0224
Information on low-water gardening and links to landscape professionals.
seattle.gpv/util/rescons *or* www.savingwater.org

King County
Information and lists of native plant sources.
dnr.metrokc.gov/wlr/pi/npnursery.htm

Washington Native Plant Society
www.wnps.org

Washington State University Cooperative Extension
King County 206-205-3100.

Preserving Trees

City of Seattle
Department of Transportation
Tree Stewards Program
206-684-5008

Plant Amnesty
Information on preserving existing trees and avoiding construction damage to trees.
www.plantamnesty.org

Pacific Northwest Chapter, International Society of Arboriculture
List of certified arborists in King County.
www.pnwisa.org

Permeable Paving

Permeable paving products differ in cost, aesthetic qualities, and infiltration properties.

Concrete Network
Information and project specifications guide for porous concrete.
www.concretenetwork.com/concrete/porous_concrete_pavers/

Mutual Materials
Bellevue, WA
425-452-2300
Information on UNI Eco-Stone Interlocking Concrete Paving Systems.
www.mutualmaterials.com.

Invisible Structures
Aurora, CO
800-233-1510
Grasspave^2 is a recycled plastic reinforcing grid porous paving system. Gravelpave^2 contains 100% post-consumer recycled plastic content. A porous geotextile filter fabric backing holds small aggregate particles in place. Compacts less than conventional gravel paving.
www.invisiblestructures.com

Soil Stabilization Products Company, Inc.
Merced. CA
800-523-9992
Road Oyl is a non-toxic petroleum alternative paving resin. It is costlier than asphalt but less than concrete. Depending on aggregate used, you can create different shades. Also, Geoblock sod-covered system made of up to 50% recycled content polyethylene.
www.sspco.com

Rainwater Harvesting

Rainwater harvesting provides a simple way to conserve water and prevent runoff by collecting water to be used for irrigation and toilet flushing.

Northwest Drainage Masters
360-887-1149

Sustainable Building Sourcebook
Austin, TX
www.greenbuilder.com/Sourcebook/rainwater.html

Texas Water Development Board
1700 N. Congress Ave.
Austin, TX 78711
512-463-7847
www.Twdb.state.tx.us/publications/reports/RainHarv.pdf

Storm Sewer Inlet Stenciling

City of Seattle
Seattle Public Utilities Environmental Partnerships Team
710 Second Avenue, Suite 505
Seattle, WA 98104
206-233-7187
www.cityofseattle.net/util/surfacewater/stencilling.htm

Surface Water Management

City of Seattle
Stormwater and erosion control information.
www.cityofseattle.net/dclu/codes/sgdccode.htm

Sea Streets
206-684-8921
Is an alternative street design in Seattle that provides drainage improvements and pedestrian amenities. John Arnesen, Project Manager.
www.cityofseattle.net/util/SEAstreets

Stormwater Manager's Resource Center
Sponsored by a grant from the Environmental Protection Agency, Office of Water and Wastewater Management.
www.stormwatercenter.net

Greenroofs.com
Alpharetta, GA
A website of information warehouse on green-oof resources. Eco-roofs or greenroofs can be used to dramatically reduce stormwater runoff.
www.greenroofs.com

Transportation

FlexCar
800 5th Ave Suite 101
Seattle, WA 98104-9643
206-684-4150
Members pay a low hourly rate which provides access to cars, insurance and gas. (Discount available to employees of some area businesses.) Vehicles located throughout Seattle metropolitan area. Flexcars also available in other US metropolitan areas.
www.flexcar.com

Water Conservation Programs

Seattle Public Utilities
206-684-4150
Low-income Water Conservation Retrofit Plan administered jointly with SPU and the Office of Housing to fund and assist with installation of cost-effective water conservation measures. Measures can include low-flow toilets, showerheads, faucet aerators, H-axis laundry machines and irrigation systems.

RESOURCES 3

Chapter Three: Energy Efficiency

General Energy Information

City of Seattle
Department of Construction and Land Use
Energy code information.
www.cityofseattle.net/dclu/energy

Energy Ideas Clearinghouse
EIC serves energy professionals in the Pacific NW by providing centralized access to information and technical assistance for increasing energy efficiency.
www.energyideas.org

Oak Ridge National Lab
PO Box 2008
Oak Ridge, TN 37831
Whole wall R-values and roofing system online calculators.
www.ornl.org

Sustainable Buildings Industry Council
1331 H. St. NW, Suite 1000
Washington, DC 20005
202-628-7400
SBIC is a nonprofit organization whose mission is to advance the design, affordability, energy performance, and environmental soundness of residential, institutional and commercial buildings nationwide.
www.sbicouncil.org

US Department of Energy
Energy Efficiency and Renewable Energy Clearinghouse (EREC) is a free information source.
www.eren.doe.gov

Washington State University Cooperative Extension
Energy Program
Olympia, WA
360-956-2000
www.energy.wsu.edu/buildings

Air Sealing & Blower Door Tests

When inquiring about a blower door and/or duct blaster test, describe what issues you wish to focus on solving: indoor air quality, energy efficiency, duct leaks or backdrafts. Many full-service heating contractors will perform these tests.

Bonneville Power Administration
800-622-4520
Purchase for $10, BPA's "Super Good Cents Builder's Guide to Energy-Efficient Construction".

The Energy Conservatory
Minneapolis, MN
612-827-1117
A leader in the building performance testing industry. Provides building professionals with the specialized tools and training needed to produce more efficient, affordable and healthy buildings.
www.energyconservatory.com

Appliances

Energy Star
Energy Star is a voluntary partnership between the US Department of Energy, the US Environmental Protection Agency, product manufacturers, local utilities, and retailers. Website contains a store locator and more information on the Energy Star labeling and program.
www.energystar.gov

Elevators

Kone Elevators
1207 Westlake Ave. N.
Seattle, WA 98109
206-285-1313
Highest energy efficient elevator available now.
www.kone.com

HVAC (Heating, Venting, Air Conditioning)

Seattle City Light
BUILTSMART for Affordable Housing
206-684-4283
This program gives technical and monetary assistance for new construction and major rehabilitation in low-income apartment buildings.
seattle.gov/light/conserve/resident/cv5_abs.htm

Insulation

Cellulose Manufacturers Association
Dayton, OH
888-881-2462
www.cellulose.org

HMI (Hamilton Manufacturing)
Twin Falls, Idaho
208-733-9689
Manufactures cellulose high-recycled content insulation.
www.hmi-mfg.com

Johns Mansville International
Denver, CO
800-644-4013
Manufactures Goldline™ fiberglass insulation that contains 25% recycled glass, including 18% post-consumer remelted bottle glass and a formaldehyde-free insulation.

North American Insulation Manufacturers Association
44 Canal Center Plaza
Alexandria, VA 22314
703-684-0084
Promotes energy efficiency and environmental preservation through the use of fiberglass, rock wool, and slag wool insulation, and to encourage the safe production and use of these materials.
www.naima.org

US GreenFiber
Portland, OR
503-286-9987
Manufactures cellulose high-recycled content insulation. Call for contractors using their products.

USG Interiors
Tacoma, WA
253-627-0379
Manufactures Thermafiber™ loose-fill mineral fiber made with rock wool.

Insulated Concrete Forms

Eco-Block, LLC
800-595-0820
www.eco-block.com

Insulating Concrete Form Association
847-657-9730
An industry trade group.
www.forms.org

Structural Insulated Panel Association
ICF and SIP manufacturers/suppliers.
www.sips.org

Lighting

Lighting Design Lab
400 E. Pine St. Suite 100
Seattle, WA 98122
800-354-3864
Promotes quality design and energy efficient technologies through education, training, consultations, technical assistance and demonstrations.
www.lightingdesignlab.com

Northwest Natural Lighting
19019 36th Ave. W. Suite E
Lynnwood, WA 98036
888-246-6006
Complete showroom with installed Solatube(s)
www.nwnaturallighting.com
or www.solatube.com

Sealants

Albina Wholesale
888-639-3330
Local source for low toxic duct mastics.
www.albina.com

Convenience Products
800-325-6180
Manufacturer of expanding foam sealants. Touch'n Seal line for contractors and Touch'n Foam line for consumers are the first ozone-safe products in the U.S. Formaldehyde-free. Touch'n Foam is solvent-free.
www.conveniencepproducts.com

Gensco
Tacoma, WA
253-951-8203
Local source for low toxic duct mastics.
www.gensco.com

Instafoam
Division of Flexible Products Co.
800-800-3626
Manufacturer of InstaSeal (low and full-expanding); Foam Plus (full-expanding); Great Stuff (low-expanding).
www.itsgreatstuff.com

Solar Water Heating

E-Build, Inc.
Brattleboro, VT
802-257-7300
Green-Spec—The Environmental Building News Product Directory and Guideline Specifications.
www.buildinggreen.com

Iris Communications
Eugene, OR
800-346-0104
REDI Guide (Resources for Environmental Design Index) a good resource for energy-efficient products.
www.oikos.com

Solar Rating and Certification Corporation
c/o FSEC
1679 Clearlake Road
Cocoa, FL 32922-5703
321-638-1537
Provides independent third party certification and a national rating system for solar energy equipment.
www.solar-rating.org/srcc@fsec.ucf.edu

RESOURCES 4
Chapter Four: Health & Indoor Air Quality

General Information

American Lung Association of WA
2625 Third Ave.
Seattle, WA 98121
800-732-9339
Many resources, articles, and checklists related to healthier indoor air and the dangers of indoor environmental pollution.
www.lungusa.org/air

Adhesives and Sealants

ChemRex
Shakopee, MN
800-433-9517
Manufactures innovative products and systems that make buildings more durable, waterproof, and comfortable.
www.chemrex.com

John Latta Associates, Inc.
4621 Airport Way S.
Seattle, WA 98108
800-333-8877
Sealant Specialists is a distributor of quality elastomeric sealants and waterproofing products.
www.sealantspecialists.com

W.F. Taylor
Fontana, CA
800-397-4583
Manufactures *Envirotec*, a line of low-toxic flooring and multi-purpose adhesives.
www.wftaylor.com

Air Filters

Medium-efficiency pleated filters are available through the following manufacturers.

Eco-Air Products
San Diego, CA
800-284-8111

Farr Company
Los Angeles, CA
800-333-7320
www.farrco.com

Honeywell, Inc.
Golden Valley, MN
800-328-5111
www.honeywell.com

Carpets & Flooring

Many local suppliers stock CRI IAQ label carpets.

Carpet and Rug Institute
P.O. Box 2048
Dalton, GA 30722
800-882-8846
Information on CRI IAQ label carpets
www.carpet-rug.com

ForboLinoleum, Inc.
Humboldt Industrial Park
PO Box 667
Hazelton, PA 18201
800-842-7839
Marmoleum (natural linoleum) manufactured in Europe and available through many local retailers.
www.themarmoleumstore.com

Formaldehyde-free & Formaldehyde-low Products

SierraPine Ltd.
(formerly Medite Corp.)
Springfield, OR
800-676-3339
Medex, Medite II, and Medite FR MDF, formaldehyde-free alternatives for underlayment, cabinet frames, countertops, interior door and window casings, and trim. Available through local suppliers.
www.sierrapine.com

Pacific Northwest Fiber
610 10th St. PO Box 610
Plummer, ID 83851
208-686-6800
Manufactures PacificBoard™ a formaldehyde-free premium strawboard. Strawboard is an excellent alternative to particleboard. It utilizes straw, an agricultural waste product, to produce a strong, formaldehyde-free binder.
www.pacificfiber.com

Neil Kelly Signature Cabinets
Portland, OR
503-288-6345
Neil Kelly Naturals Collection is a line of manufactured cabinets that uses certified woods and veneers as well as environmentally friendly finishes and case materials.
www.neilkelly.com

Mold & Mildew

Building Science Corporation
Westford, MA 01886
978-589-5100
Offers useful information regarding frequently found problems in buildings and how to avoid them. Moisture control is emphasized.
www.buildingscience.com

Outdoor Building Materials

Arsenic is a known human carcinogen. Chromate Copper Arsenate (CCA) treated wood is toxic to human beings. Specify and use arsenic-free ACQ treated lumber. Other alternatives are products made from recycled wood and polymer resins.

Dunn Lumber
Locations throughout metro area.
206-632-2129
Sells non-CCA treated outdoor products.
www.Dunnlum.com

Fiber Composites LLC
34570 Random Drive
New London, NC 28127
704-463-7120
Manufactures a sturdy, low-maintenance, long lasting wood alternative (Fiberon) made of premium recycled wood and polymer resins.
www.fibercomposites.com

Home Depot
Locations throughout metro area.
Sells recycled plastic lumber and fiber composite products.
www.homedepot.com

Lowes Home Improvement Warehouse
Locations throughout metro area.
Sells recycled plastic lumber and fiber composite products.
www.lowes.com

Plywood Supply
7036 Northeast 175th St.
Kenmore, WA 98028
425-485-8585
Supplies arsenic-free ACQ treated wood. For more information on ACQ treated wood, visit www.treatedwood.com

Trex Company
Winchester, VA
Trex Easy Care Decking available at local retailers. Check website for store locations.
www.trex.com

Sherwin-Williams
Cleveland, OH
800-336-1110
Interior Health Spec, zero-VOC paint.
www.sherwinwilliams.com

Paints and Finishes

Best Paint Company
5205 Ballard NW
Seattle, WA 98107
206-783-9938
Manufactures low and no-toxic paints.

Preferred Products, Inc.
Seattle, WA
800-774-0034
CURATOR Commercial Waterborne Finish is an easy-to-use, two-component, 100% urethane waterborne finish designed especially for high wear residential and commercial applications.

Kelly-Moore Paint
6101 Airport Way S.
Seattle, WA 98108
206-767-3140
Enviro-Cote line.
www.kellymoore.com

Miller Paint
1500 NW Leary Way
Seattle, WA 98107
206-784-7878
Acro-Latex and Super Paint lines have no solvents.
www.millerpaint.com

Rodda Paints
5055 4th Ave. S.
Seattle, WA 98134
206-767-6043
Horizon Clean Air Select line of paints.

Ventilation

NuTone
800-400-1245
QT-80 to QT-100 lines. Available through electrical distributors.
www.nutone.com

Panasonic
253-872-8750
FV-05VQ to FV-11VQ lines. Available through electrical distributors.
www.panasonic.com/building

Seattle City Light
BUILTSMART for Affordable Housing
206-684-4283
This program gives technical and monetary assistance for new construction and major rehabilitation in low-income apartment buildings.
seattle.gov/light/conserve/resident/cv5_abs.htm

RESOURCES 5

Chapter Five: Materials Efficiency

General Building Materials

ebuild
The largest database of building products.
www.ebuild.com

Environmental Home Center
1724 4th Ave. S.
Seattle, WA 98134
800-281-9785
High quality choices for green building products and materials.
www.built-e.com

GreenSpec
BuildingGreen's product information service. It contains detailed listings for more than 1,500 green building products with environmental data, manufacturer information, and links to additional resources.
www.greenspec.com *and*
www.buildinggreen.com

NAHB Research Center
800-898-2842
Tool Base Hotline is available to answer questions about materials with longer life cycles.
www.nahbcrc.org/ToolBase

National Institute of Standards and Technology
Balancing Environmental and Economic Performance of Building Materials BEES 2.0 Software provides environmental and economic life cycle analysis of building materials. Available as a free download.
www.bfrl.nist.gov/oae/software/bees.html

Recycled Content Building Materials Product Guide
A listing of building products containing recycled materials organized by CSI divisions and local vendors that sell the products.
dnr.metrokc.gov/swd/bizprog/sus_build/RCBMG.pdf

Acoustical Ceiling Tiles

Armstrong Commercial Ceilings
877-276-7876
Recycled content dropped ceiling panels.
www.armstrong.com

Sepia Interior Supply
6525 NE 175th St.
Kenmore, WA 98028
425-486-3353
www.sepiasupply.com

Aggregate

WSDOT - 1998 Standard Specifications for recycled aggregate are available at www.metrokc.gov/procure/green/concrete.htm#8.

Concrete – Coal Fly Ash

ISG Resources, Inc.
Mercer Island, WA
Produces and distributes coal fly ash to concrete contractors. ISG can recommend a concrete source in your area.
www.flyash.com

Construction Waste Management

Business & Industry Resource Venture
1301 5th Ave. Suite 2400
Seattle, WA 98101
206-389-7304
Provides free information, technical assistance and referrals to help Seattle design and construction professionals with general sustainable building education, City of Seattle incentive programs, construction waste management, green building materials, stormwater management and water conservation.
www.resourceventure.org

Construction Recycling Directory and Contractor's Guide for Seattle/ King County
206-389-7304
A directory of recycling haulers, recycling facilities, reuse and salvage services, and materials exchanges. Contractor's Guide includes simple how-to's. Available online or call the Business & Industry Resource Venture for a free hard copy.
www.resourceventure.org/construction.htm

Industrial Materials Exchange (IMEX)
206-296-4899
An online and printed catalog listing for available and wanted waste materials.
www.metrokc.gov/hazwaste/imex

RE Store
1440 NW 52nd St.
Seattle, WA 98107
206-297-9119
Sells used building materials. RE Store crews can remove materials from your site. Contact prior to demolition work.
www.re-sources.org

Reusable Building Materials Exchange
Features item descriptions, contacts, and cost information.
www.rbme.com

Second Use Building Materials
7953 Second Ave. S.
Seattle, WA 98108
206-763-6929
Sells used building materials. They can pick up materials from your site. Contact prior to demolition work.
www.seconduse.com

Drywall (Gypsum Board)

Georgia Pacific
Tacoma, WA
360-904-0142
High recycled content regular drywall.
www.gp.com

US Gypsum
125 South Franklin
Chicago, IL 60606
800-874-4968
Fyberrock is high-recycled content hard-surface drywall.
www.usg.com

Engineered Structural Lumber Products

APA—The Engineered Wood Association
PO Box 11700
Tacoma, WA 98411
253-565-6600
www.apawood.org

Premier Building Systems
Fife, WA
800-275-7086
Structural insulated building panels replace conventionally framed exterior walls with a factory produced system of two layers of Oriented Strand Board sandwiching rigid foam insulation.
www.pbspanel.com

Shirey Contracting, Inc.
Issaquah, WA
425-427-1300
Enercept structural insulated building panels.
www.shireycontracting.com

Trus Joist (Weyerhauser)
8541 154th Ave. NE
Redmond, WA 98052
800-648-3936
Manufactures engineered joists.
www.tjm.com

Flooring Alternatives

ForboLinoleum, Inc.
Humboldt Industrial Park
PO Box 667
Hazelton, PA 18201
800-842-7839
Marmoleum (natural linoleum) manufactured in Europe and available through many local retailers.
www.themarmoleumstore.com

Formaldehyde-free & Formaldehyde-low Products

SierraPine Ltd. (formerly Medite Corp.)
Springfield, OR
800-676-3339
Medex, Medite II, and Medite FR MDF, formaldehyde-free alternatives for underlayment, cabinet frames, countertops, interior door and window casings, and trim. Available through local suppliers.
www.sierrapine.com

Pacific Northwest Fiber
610 10th St. PO Box 610
Plummer, ID 83851
208-686-6800
Manufactures PacificBoard™ a formaldehyde-free premium strawboard. Strawboard is an excellent alternative to particleboard. It utilizes straw, an agricultural waste product, to produce a strong, formaldehyde-free binder.
www.pacificfiber.com

Outdoor Building Materials

Do not use CCA (chromate copper arsenate) treated wood. Arsenic-free ACQ treated lumber is okay.

Fiber Composites LLC
34570 Random Drive
New London, NC 28127
704-463-7120
Manufactures a sturdy, low-maintenance, long lasting wood alternative (Fiberon) made of premium recycled wood and polymer resins.
www.fibercomposites.com

Home Depot
Locations throughout metro area.
Sells recycled plastic lumber and fiber composite products.
www.homedepot.com

Lowes Home Improvement Warehouse
Locations throughout metro area.
Sells recycled plastic lumber and fiber composite products.
www.lowes.com

Plywood Supply
7036 Northeast 175th St.
Kenmore, WA 98028
425-485-8585
Supplies arsenic-free ACQ treated wood. For more information on ACQ treated wood, visit www.treatedwood.com

Trex Company
Winchester, VA
Trex Easy Care Decking available at local retailers. Check website for store locations.
www.trex.com

Roofing and Siding

CertainTeed Corporation
800-233-8990
www.certainteed.com

EcoStar
Chicago, IL
800-572-7672
Majestic Slate is a 100% recycled and recyclable lightweight slate tile made of industrial rubber and plastics.
www.ecostarinc.com

James Hardie Building Products
26300 La Alameda, Suite 250
Mission Viejo. CA 92691
888-542-7343
Manufactures cementitious siding.
www.jameshardie.com

PABCO Roofing Products
1718 Thorne Rd.
Tacoma, WA 98421
800-426-9762
www.pabcoroofing.com

Salvaged Materials

Earthwise
707 S. Lander
Seattle, WA 98134
206-624-4510
Sells used building materials. Crews can remove materials from your site. Contact prior to demolition work.

Resource Woodworks
Tacoma, WA
253-474-3757
Offers reclaimed Douglas fir and redwood flooring, paneling, and trim.

RE Store
1440 NW 52nd
Seattle, WA 98107
206-297-9119
Sells used building materials and more. Also accepts them for resale. Operated by RE Sources, a non-profit organization.
www.re-sources.org

Reusable Building Materials Exchange
Features item descriptions, contacts, and cost information.
www.rbme.com

Second Use Building Materials
7953 Second Ave. S.
Seattle, WA 98108
206-763-6929
Sells and accepts used building materials.
www.seconduse.com

Sustainably Harvested Lumber

Certified Forest Products Council
14780 SW Osprey Drive #285
Lake Oswego, OR 97007
888-737-3877
Information on sustainably harvested lumber. Free advice and service in specifications writing and locating of certified wood.
www.certifiedwood.org

CollinsWood
1618 SW 1st Ave. #300
Portland, OR 97201
800-329-1219
Certified framing lumber and sheetgoods.
www.collinswood.com

Edensaw Woods
3223 Third Ave. S.
Seattle, WA 98134
877-333-6729
Offers certified wood including ash, beech, birch, cherry, Honduras mahogany, fir, maple, poplar, red oak and white oak.
www.edensaw.com

Endura Wood Products
1303 SE Sixth Ave.
Portland, OR 97214
503-233-7090
Large line of certified wood and wood products.
www.endurawood.com

Forest Stewardship Council (FSC)
1134 29th St. NW
Washington, DC 20007
202-467-8391
Information on sustainably harvested lumber.
www.fscoax.org

Lumbermen's Building Centers
3773 Martin Way E. Building A
PO Box 3406
Olympia, WA 98509
360-456-1880
Offers certified wood. Several locations in Metro area.
www.lumbermens-building.com

RESOURCES 6
Chapter Six: Operations & Maintenance

Cleaners

Green Seal
1001 Connecticut Ave. NW Suite 827
Washington, DC 20036
202-872-6400
Information and product recommendations for healthy and environmentally responsible products and services.
www.greenseal.org

Home Ecology
Information on non-toxic cleaning supplies.
www.homeecology.org

Recycling

City of Seattle
Seattle Public Utilities
Apartment recycling program.
seattle.gov/util/RecyclingSignupForm

E.B. Bradley Co.
3314 S. 116th St.
Seattle, WA 98168
206-248-5250
Rev-a-Shelf, under-counter recycling system manufactured by Feeney Co.

Systems Maintenance

Check with your mechanical contractor to set up quarterly and annual maintenance on your heating and venting systems.

Training

City of Seattle
Office of Housing
206-684-0304
Call Joanne Quinn, Sustainability Specialist for staff basic training on Sustainable Building.
seattle.gov/housing/10-PropertyManagers

GLOSSARY

Bioswale - A shallow trench planted with trees, shrubs, and ground cover that detains and filters stormwater before allowing it to infiltrate the groundwater system.

BTU (British Thermal Unit) - a unit of heat. Can be used to measure heat output or the embodied energy of a material.

Charrette - A short and intensive design process that usually involves people from different backgrounds and disciplines in order to gain a broad, integrated perspective on issues at hand. See also Integrated design.

Composting - A waste management system for plant material (e.g. kitchen scraps and garden thinnings) that involves the biological decomposition of organic material into a rich soil amendment.

CFC (chlorofluorocarbon) – A gas often used as a propellant that traps heat in the atmosphere and contributes to global warming.

Cradle-to-cradle - An understanding of the life cycle of materials and their embodied energy that accounts for the original extraction or harvest of material to its end-life and eventual reuse.

Cradle-to-gate - An understanding of the life cycle of materials and their embodied energy that accounts for the original extraction or harvest of material to the beginning of its first use.

Ecoroof - A roof covered with soil mix and vegetation. Stormwater is absorbed by the soil and vegetation, reducing and detaining stormwater runoff.

Ecosystem - A complex and interdependent set of natural conditions and elements. Habitat survival depends directly and indirectly on ecosystem health.

Embodied energy - A representation of the energy used to grow, harvest, extract, manufacture, transport and dispose of a material.

Formaldehyde - Urea formaldehyde, a harmful VOC, is a binding agent commonly used in composite wood products (OSB, particleboard, etc.). It is a probable carcinogen and poses a range of hazards to human health.

Fossil fuels - Non-renewable resources such as coal, oil and natural gas, the use of which causes pollution and contributes to global climate change.

Greywater - Water that has been used within the home and/or roof runoff. Greywater sources do not include sewage. Greywater can be captured, treated, and used as a non-potable water source.

Habitat - The place where an animal or plant species lives.

HCFC (Hydrochlorofluorocarbon) - Compound used instead of CFC, with approximately one-tenth the environmental damage of CFC.

Integrated design - An approach where the design of each system takes into account and balances the design of other systems. Often an interdisciplinary approach, effective integrated design begins at the earliest stage of a project with a guiding set of principles. See also "charrette."

Low-e(missivity) windows – Energy-efficient windows that allow light to pass through but block the flow of heat.

Microclimate - A unique set of climatic conditions caused by landscape and/or building features. For instance, a paved parking area will absorb and radiate heat to the areas around it. Vegetation can block heavy prevailing winds or funnel them into a concentrated area.

Native species - Native plant species are well adapted to local climatic conditions and can flourish with little or no maintenance or watering. Native species are common to wild areas of the same climate, though the term is often used to include other well adapted species.

Naturescaping – Landscaping featuring native plants, natural landscapes, and water-friendly gardening practices. It reduces water usage, can eliminate use of harmful chemicals, attracts beneficial wildlife, and requires little maintenance.

Off-gassing - Emission of chemical compounds (e.g. VOCs) into the air from newly installed building materials and finishes.

Passive solar - Non-mechanical methods of using sunlight to heat the home. Conceptually, sunlight is allowed into the house to heat a thermal mass such as a slab floor, which in turn radiates the heat back into the house when needed at night.

Permaculture - A design system that integrates landscape and building issues, permaculture emphasizes low maintenance, edible landscaping, and single design features (including plants) that fill more than one function.

Phthalates - Class of chemical compounds used to soften PVC. These compounds are more concentrated in flexible sheet vinyl, for instance, than in vinyl tiles. Phthalates, which are endocrine disruptors and are linked to birth defects, are now being commonly discovered at high levels in tests of humans in the US.

R-value - A unit of thermal resistance measuring resistance to heat flow through a single material. The higher the R-value, the greater the insulating properties.

Sone - A unit measuring intensity of sound. Select ventilation systems with low sone ratings.

Sustainability - One common definition is that of meeting the needs of the present without compromising the ability of future generations to meet their needs.

U-value - A unit of thermal resistance measuring rate of heat flow through a material assembly rather than a single material. For instance, whereas insulation is measured by R-value, the entire wall assembly is measured by U-value. A lower U-value means better insulating properties.

VOC (volatile organic compound) - A class of chemical compounds that can cause short- and long-term health problems. VOCs can be emitted (off-gassed) by many building materials and finishes, including particleboard and solvent-based finishes. Volatile: evaporates readily at room temperature; Organic: carbon-based; Compound: combines two or more elements. Many VOCs are harmless, but the term has come to be applied to those that endanger health.

Watershed - Area of ecosystem(s) bounded by the highest topographic points and focused around where water flows and drains. All water in an area—including the pollutants it carries—flows to the lowest point of the watershed.

Xeriscaping – Similar to naturescaping, xeriscaping features water-friendly gardening practices. Name derived from "*zero-water landscaping*."

Resources used in developing SeaGreen Affordable Housing Guide include:

- *G-Rated: Greening Portland's Affordable Housing Resource Guide*
  Portland Office of Sustainable Development

- *Built Green™ Handbook for Multi-Family Projects*
  Master Builders Association of King and Snohomish Counties

- *Built Smart for Affordable Housing*
  Seattle City Light

- *Sustainable Building Policy*
  City of Seattle

Seattle Office of Housing
700 Fifth Avenue - Suite 5700
Seattle, WA 98104

(206) 684-0721
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