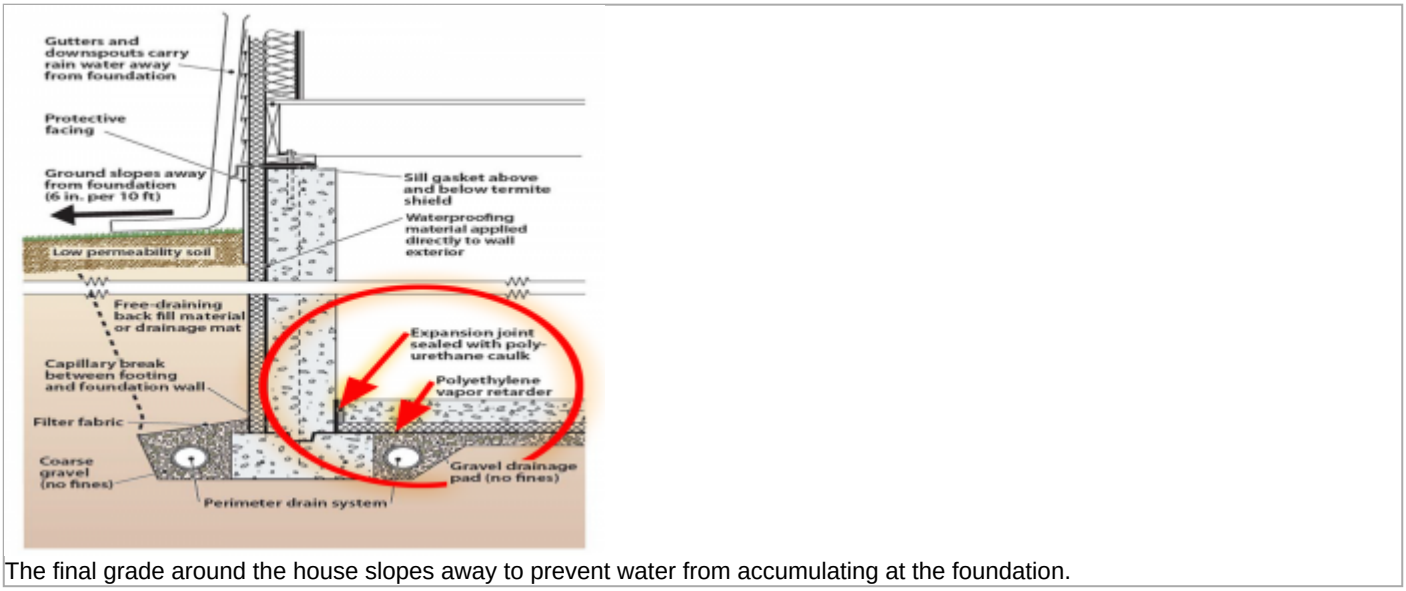
Final Grade Slopes Away from Foundation

Last Updated: 03/14/2016

Scope



The final grade around the house slopes away to prevent water from accumulating at the foundation.

To direct storm water runoff away from the foundation

- Slope the final grade away from the house at least 0.5 inch per foot for 10 feet.
- Tamp (mechanically compact) the back-fill to prevent later settling.
- If setbacks limit the space to less than 10 feet, install either swales or drains designed to carry water away from the foundation (**ENERGY STAR 2015**).

See the **Compliance Tab** for related codes and standards requirements, and criteria to meet national programs such as DOE's Zero Energy Ready Home program, ENERGY STAR Certified Homes, and Indoor airPLUS.

Description

Because no waterproofing system is 100% foolproof, the best defense against water intrusion through the foundation is to prevent water from saturating the soil around the foundation. This can be done by constructing the foundation and grading the site so that water drains away from the house on all sides (see Figure 1).

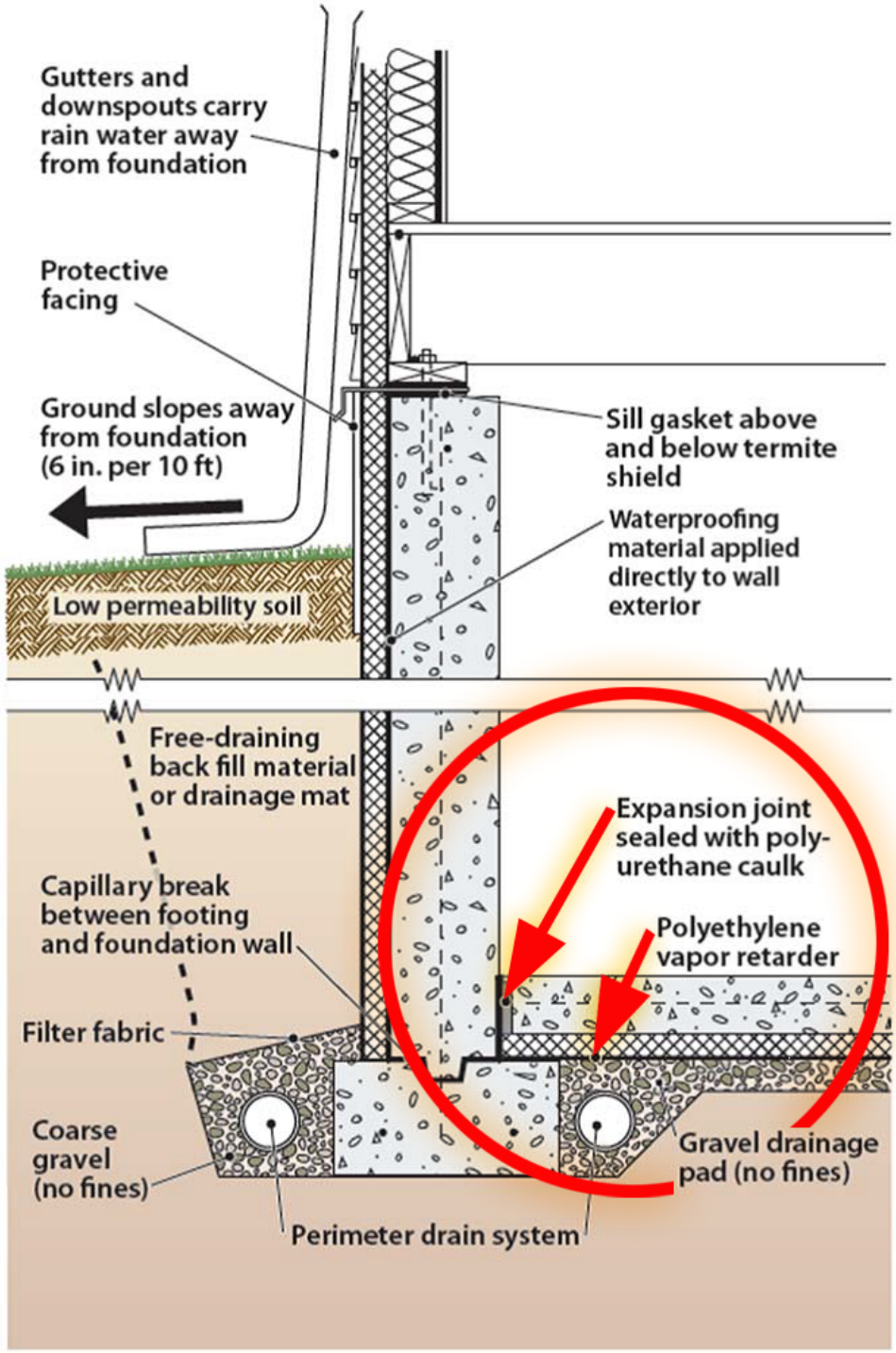


Figure 1 - The final grade around the house slopes away from the foundation. Proper selection of backfill soils, filter fabric-covered footing drains set in gravel, and a capillary break protect the home's foundation from water intrusion.

How to Grade the Site

1. Grade to build up the site before construction, if needed, to create a slope that will carry water down and away from the foundation on all four sides.
2. After construction, back-fill to the foundation walls, grade the slope, cap the top layer of the grade with 2 to 4 inches of silty clay, and mechanically compact the soils to prevent later settling.

The **2009**, **2012**, and **2015** International Residential Code requires impervious surfaces within 10 feet of the building's foundation to have a slope of 2% away from the foundation. **ENERGY STAR Certified Homes** requires a final grade slope of ? 0.5 inch per

foot away from home for ? 10 feet. ENERGY STAR also states

- Tamping of the back-fill is not required if either: proper drainage can be achieved using non-settling compact soils, as determined by a certified hydrologist, soil scientist, or engineer; OR, the builder has scheduled a site visit to provide in-fill and final grading after settling has occurred (e.g., after the first rainy season).
- If setbacks limit the space on any side of the home to less than 10 feet, or if walls, slopes or other physical barriers prevent the construction of slopes away from the foundation, then install either swales or perimeter drains designed to carry water away from the foundation. (See the discussion of swales and drains below.)

Swales

A swale is a trapezoidal channel that is dug to receive storm water overflow, allowing it a path to flow away from the home (Figure 2). Swales can provide a means to slow water runoff and allow natural percolation into the soil on site. They are typically located along property boundaries along a natural grade; they will also draw in water that would otherwise sit in a flat yard and they can divert water flowing toward the house from an upward sloping yard. Swales are typically planted with specific types of vegetation to reduce erosion, to help remove any pollutants found in the storm water runoff, and to improve the aesthetics of the design. While each site is unique, the following steps provide general guidance for constructing a swale to divert water down and away from the house (**EPA 2006**).

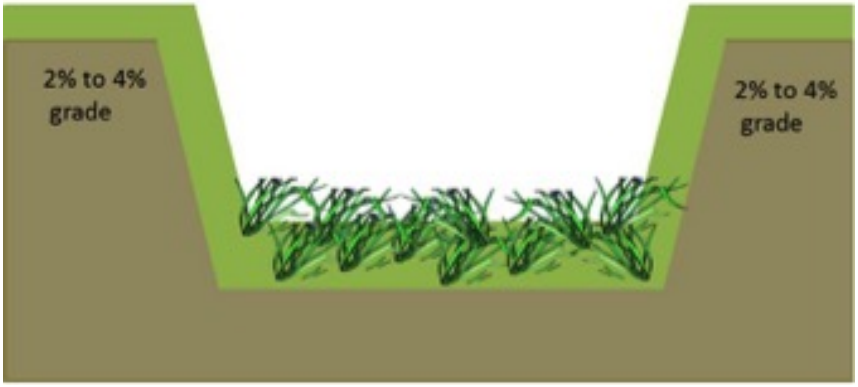


Figure 2 The final grade around the house slopes away from the foundation. Proper selection of backfill soils, filter fabric-covered footing drains set in gravel, and a capillary break protect the home's foundation from water intrusion.

How to Construct a Swale

1. Do not construct vegetated swales in gravelly and coarse sandy soils that cannot easily support dense vegetation. If available, use alkaline soils and sub-soils to promote the removal and retention of metals. Use non-settling compact soils, as determined by a certified hydrologist, soil scientist, or engineer. Know that the following factors will decrease the effectiveness of a swale: compacted soils, large storm events, frozen ground, short grass heights, steep slopes, and high runoff velocities, and high discharge rates.
2. Do not compact the soil in the swale trench. Soil infiltration rates should be greater than 0.2 millimeters per second (one-half inch per hour); therefore, care must be taken to avoid compacting the soil during construction.
3. Choose plants that will aide in filtration. A fine, close-growing, water-resistant grass should be selected for use in vegetated swales, because increasing the surface area of the vegetation exposed to the runoff improves the effectiveness of the swale system. Pollutant removal efficiencies vary greatly depending on the specific plants involved so the vegetation should be selected with pollution control objectives in mind. In addition, care should be taken to choose plants that will be able to thrive at the site. Examples of vegetation appropriate for swales include reed canary grass, grass-legume mixtures, and red fescue. The best plants to use in a swale will depend on the region and location. Local cooperative extension programs based at land grant universities often have a list of plants that will work well in a swale. See **www.extension.org** for the extension office in your climate zone.
4. Construct the swale in a parabolic or trapezoidal cross-section with side slopes no steeper than a 3:1 width-to-height ratio. The overall slope of the swale (the longitudinal channel or from water-entry point to water exit point) should slope consistently between a 2% and 4% grade. Slopes less than 2% can lead to pooling; slopes greater than 4% can lead to excessive water velocity and contribute to soil erosion (**West Virginia 2012**).
5. Build the swale large enough (deep and wide) to comfortably divert the volume of water occurrence (rain fall or snowmelt runoff) expected for a 6-month-frequency, 24-hour storm event. To determine the rain volume for this type of storm event in your location, contact the U.S. Geological Survey. Swales are generally not used where the maximum flow rate exceeds 140 liters/second (5 cubic feet per second).
6. Schedule a site visit to fill in soil and conduct final grading after settling has occurred (e.g., after the first rainy season).

Drains

Another alternative for storm water management are drains, which can be installed to divert water from downspouts away from the home or to collect and direct surface water away from the foundation. A gutter drain pipe may be a surface pipe that collects

water from gutters and downspouts and transfers it to a point on the ground surface at least 10 feet away from the home or a below-ground drain pipe that disperses the water underground to a drywell, the storm sewer, or another approved discharge point. Information about gutters and downspouts is covered in more depth in the guide **Gutters and Downspouts**.

How to Install a Downspout Drain

1. Install drains for the gutters and downspouts that terminate to an underground catchment system at least 10 feet away from foundations or direct water to an underground storm sewer or other approved discharge point. Use a non-perforated, smooth or corrugated plastic pipe as the drain.
2. If a rainwater harvesting system is installed, properly design the drain to adequately manage the overflow and meet the discharge-distance requirement of 10 feet.
3. Connect and seal the pipe directly to the downspout.
4. Bury the drain pipe at a slope consistent with the final grade around the home (i.e., sloped ? 0.5 inch per foot away from home for ? 10 feet). Do not connect the gutter drain pipe to the perforated foundation drain pipe; this practice will soak the foundation (see Figure 3).

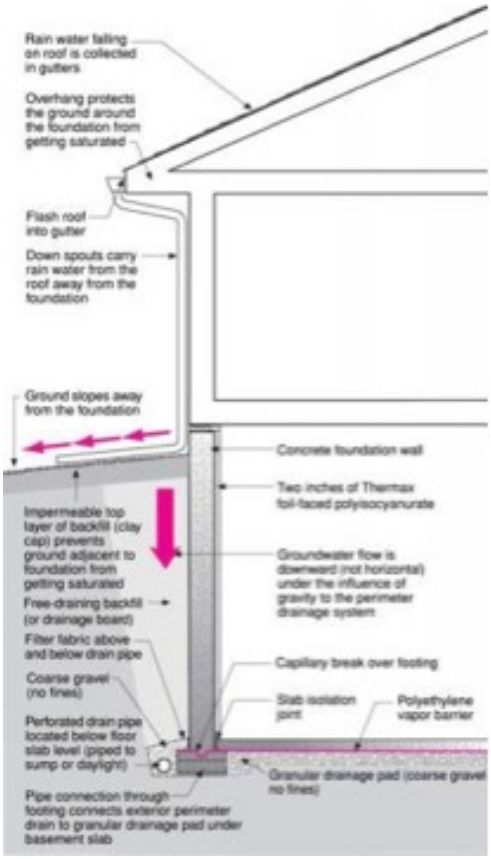


Figure 3 – Use proper site grading, footing drains set in coarse gravel, gravel beneath the slab, free-draining plus impermeable backfill, and a polyethlylene vapor barrier to protect the foundation from water intrusion.

Ensuring Success

Visually inspect that back-fill has been tamped and final grade sloped ? 0.5 inches per foot away from home for ? 10 feet. Where setbacks limit space to less than 10 feet, see that swales or drains are installed to carry water from the foundation.

Climate

No climate specific information applies.

Training

Right and Wrong Images

Display Image: ES_WMSBC_1.1_1.2_PG12_2b_32311_0.jpg

Reference: Water Management System Builder Checklist Guide

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Water Management System Builder Checklist.

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Reference: Water Management System Builder Checklist Guide

Author(s): EPA
Organization(s): EPA

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Reference: Water Management System Builder Checklist Guide

Author(s): EPA
Organization(s): EPA

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Reference: Water Management System Builder Checklist Guide

Author(s): EPA
Organization(s): EPA

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Reference: Water Management System Builder Checklist Guide

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Water Management System Builder Checklist.

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Reference: Water Management System Builder Checklist Guide

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Water Management System Builder Checklist.

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Reference: Water Management System Builder Checklist Guide

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Water Management System Builder Checklist.

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Reference: Water Management System Builder Checklist Guide

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Water Management System Builder Checklist.

Display Image: ES_WMSBC_1.1_1.2_PG12_8h_32311_0.jpg

Reference: Water Management System Builder Checklist Guide

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Water Management System Builder Checklist.

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Reference: Water Management System Builder Checklist Guide

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Water Management System Builder Checklist.

Display Image: ES_WMSBC_1.1_1.2_PG12_9i_32311_0.jpg

Reference: Water Management System Builder Checklist Guide

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Water Management System Builder Checklist.

CAD

None Available

Compliance

The Compliance tab contains both program and code information. Exact code language is copyrighted and may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

ENERGY STAR Certified Homes

The ENERGY STAR Certified Homes (Version 3.0, Revision 08), Water Management System Builder Requirements, Section 1, Water-Managed Site and Foundation, states:

1.2 Back-fill has been tamped and final grade sloped >= 0.5 in. per ft. away from home for >= 10 ft. See footnote (2) for alternatives.

(2) Swales or drains designed to carry water from foundation are permitted to be provided as an alternative to the slope requirements for any home, and shall be provided for a home where setbacks limit space to less than 10 ft. Also, tamping of back-fill is not required if either: proper drainage can be achieved using non-settling compact soils, as determined by a certified hydrologist, soil scientist, or engineer; OR, the builder has scheduled a site visit to provide in-fill and final grading after settling has occurred (e.g., after the first rainy season).

Note: It is the exclusive responsibility of builders to ensure that each certified home is constructed to meet these requirements. While builders are not required to maintain documentation demonstrating compliance for each individual certified home, builders are required to develop a process to ensure compliance for each certified home (e.g., incorporate these requirements into the Scope of Work for relevant sub-contractors, require the site supervisor to inspect each home for these requirements, and/or sub-contract the verification of these requirements to a Rater). In the event that the EPA determines that a certified home was constructed without meeting these requirements, the home may be decertified.

DOE Zero Energy Ready Home

Exhibit 1: Mandatory Requirements. Certified under ENERGY STAR Qualified Homes Version 3 or 3.1.

U.S. EPA Indoor airPLUS

Certified under ENERGY STAR Qualified Homes Version 3 or 3.1.
No additional Indoor airPLUS requirements.

2009, 2012, and 2015 IRC

Section R401.2 Drainage. This requires that surface water should drain to a storm sewer conveyance or another approved collection point that doesn't create a hazard. Lots must be graded to drain water away from the foundation walls and the grade should fall at least 6 inches within the first 10 feet. If physical barriers such as walls, slopes, or the lot lines limit the ability to achieve 6 inches of slope within 10 feet of the foundation, then drainage can be achieved by installing drains or swales.

Section R401.5. Footing drains of drain tile, gravel, crushed stone, perforated pipe, or some other approved systems must be installed at the footing perimeter of any building with concrete or masonry foundations that has a basement. The drainage pipe must sit on a bed of gravel 2 or more inches thick that extends at least a foot from the edge of the footing. The drain pipe should be covered with an approved filter fabric then be topped with 6 or more inches of washed crushed gravel or crushed rock. This drain pipe must discharge by gravity or mechanical means into an approved drainage system. A drainage system is not required when the foundation is installed on well-drained ground or sand-gravel soils designated as Group 1 soils by the United Soil Classification System.

Section R408.6. Finished Grade, permits the finished grade of the crawlspace floor to be level with the bottom of the foundation wall footings. However, if there is evidence that the groundwater table can rise to within 6 inches of the finished floor of the building perimeter or if there is evidence that surface water is not readily draining from the building site, then level of the crawlspace dirt floor must be as high as the outside finished grade, unless an approved drainage system is provided.*
*Due to copyright restrictions, exact code text is not provided. For specific code text, refer to the applicable code.

More Info.

Access to some references may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

Case Studies

1. **New Whole-House Solutions Case Study: New Traditions Homes, Landover Commons, Vancouver, WA**
   (873 KB)
   Author(s): PNNL
   Organization(s): PNNL
   Publication Date: April, 2012
   Case study about energy efficienct new home construction that also incorporated moisture management techniques for durability in the damp Northwest climate.

References and Resources*

1. **DOE Zero Energy Ready Home National Program Requirements**
   Author(s): DOE
   Organization(s): DOE
   Publication Date: August, 2015
   Standard requirements for DOE's Zero Energy Ready Home national program certification.

2. **ENERGY STAR Certified Homes, Version 3 (Rev. 08) National Program Requirements**
   Author(s): EPA
   Organization(s): EPA
   Publication Date: September, 2015
   Document outlining the program requirements for ENERGY STAR Certified Homes, Version 3 (Rev. 08).

3. **Groundwater Control**
   Author(s): BSC
   Organization(s): BSC
   Publication Date: May, 2009
   Information sheet about groundwater control.

4. **Water Management System Builder Checklist Guide**
   Author(s): EPA
   Organization(s): EPA
   Publication Date: February, 2011
   Guide describing details that serve as a visual reference for each of the line items in the Water Management System Builder Checklist.

5. **West Virginia Stormwater Management and Design Guidance Manual.**
   Publication Date: May, 2012

*Publication dates are shown for formal documents. Dates are not shown for non-dated media. Access dates for referenced, non-dated media, such as web sites, are shown in the measure guide text.

Contributors to this Guide

The following Building America Teams contributed to the content in this Guide.

Pacific Northwest National Laboratory