

IMPACT AND SOLUTION IDENTIFICATION GUIDE FOR RESILIENT HOUSING

Adapted to the realities
of First Nations to cope
with climate change

1st edition / March 2020

Paysage du Québec © Sebastien Marchand, Unsplash



FNQSDI
FIRST NATIONS OF QUEBEC AND LABRADOR
SUSTAINABLE DEVELOPMENT INSTITUTE

IMPACT AND SOLUTION IDENTIFICATION GUIDE FOR RESILIENT HOUSING

Produced in collaboration between Écohabitation and
the First Nations of Quebec and Labrador Sustainable
Development Institute



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Écohabitation is a non-profit organization that facilitates the emergence of healthy, resource and energy efficient, sustainable, affordable and accessible housing for all. It achieves its mission through promotion, awareness-raising, training and support activities for the general public, housing sector stakeholders and political decision-makers.

To support First Nations in adapting to climate change, Écohabitation is now offering a practical guide to identifying the impacts, risks and solutions for safe and resilient housing.

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INTRODUCTION

It's a fact, the climate is warming, and extreme weather events are increasing in both number and intensity. The effects are now clearly visible : increase in hot extremes of temperature and in the duration of heat waves, increase in episodes of extreme precipitation and annual accumulations, rise in sea level, delayed freeze-up in the St. Lawrence Estuary and Gulf, increase in the number of freeze-thaw cycles in the winter, etc.

As a symbol of safety and protection, the house is a place that gathers and protects families. When extreme weather events like floods, strong winds or ice storms create power outages, the house must resist and retain its protective function. A well-designed and maintained home will cope with the effects of extreme weather and minimize the negative impact on its occupants.

In general, buildings in Quebec are not well adapted to the effects of climate change. In the past, building standards were less restrictive and did not take into account a changing climate. Existing homes must be adapted, and where necessary renovated, to be more durable and better equipped to withstand extreme weather events that are increasing in frequency and intensity. It is possible to achieve this by taking simple actions and without incurring significant additional costs.

Écohabitation, in partnership with the FNQLSDI, has produced this guide in order to increase the knowledge of First Nations housing stakeholders and facilitate the implementation of adaptation measures to climate change.

It is difficult to predict what will happen to the weather on a short-term basis and to the climate on a long-term basis. However, scientists agree that extreme weather events are becoming increasingly frequent and intense and will be more so in the future.

A GUIDE TO DEAL WITH THIS

This guide highlights eight climate risks and identifies the adaptation measures to be implemented during the renovation of existing housing or the construction of new housing.

The purpose of this guide is to equip tenants, owners and managers of already built dwellings as well as future constructions to deal with the threats of climate change. There are two words to keep in mind : adaptation and prevention. And there are many ways to achieve this : maximum insulation, airtight envelope, choice of durable materials with low impact on health and the environment, efficient heating and air conditioning, building sealing, regular housing component maintenance, etc. Discover a series of solutions on the following pages.

SUMMARY OF CLIMATE CHANGE RISKS AND SOLUTIONS

This section summarizes the eight climate risks, their impacts and the solutions identified in order to renovate or build resilient and safe housing. Each point is presented in more detail on the following pages.



1. ABUNDANT RAIN AND FLOODS

Water is the house's number one enemy. Develop the land and protect the foundations by steering the water away from them using drains and gutters. Seal and waterproof walls, foundations, doors and windows.



2. WINTER STORMS (COLD, SNOW AND ICE)

Insulate and seal the walls to protect against the impacts of cold and prevent mould. Install ventilation devices to foster good humidity management and ensure healthy indoor air. Tilt the roof to protect from winds and the accumulation of snow and ice. Install an EPA or CSA approved backup heater, carbon monoxide (CO) detectors and backup batteries in the event of power failure.



3. STRONG WINDS

Protect your home and reduce damage from wind-driven debris and rain by limiting the generation of debris and strengthening the fasteners of exterior cladding, roofing and structural elements attached to the house or exterior accessories.



4. FOREST FIRES

Keep all combustible materials away from the house and design a well-sealed envelope to better control the quality of the indoor air. Select and safely install fire-resistant cladding, doors and windows.



5. HEAT WAVES

Adopt strategies to obtain 90% shade on the house on the south side. Install an air conditioning system, plant dense vegetation and protect windows and doors from the sun to increase comfort and reduce the need for air conditioning.



6. FREEZE-THAW CYCLES

Implement strategies to keep water away from the foundations and the house in general. Limit the freeze-thaw impact on mineral surfaces.



7. EROSION

Not only does erosion cause landslides in coastal areas, but it also contributes to the deterioration of waterways everywhere. Build away from the coast and landscape in such a way as to minimize erosion and the amount of runoff. Create terraces or retaining walls and plant plants.



8. INSECTS AND PESTS

Design the exterior arrangements and cladding of the building envelope to allow for controlling carpenter ants, ladybugs (firewood), wasps (places to nest), rodents and other pests without using insecticides that are harmful to health and the environment.



ABUNDANT RAIN AND FLOODS

OUTDOOR ARRANGEMENTS

- A.** Install rigid French drains (BNQ) all around the outer base of the footings of the foundation. Rigid drains are recommended over flexible grooved drains, as they are less vulnerable to clogging.
- B.** Backfill the foundations with 3/4 washed stone or sand to facilitate water dispersal.
- C.** Create a slope (at least 5 degrees) if the ground is flat to channel rainwater away from the house.
- D.** Do not forget surface drains and channels. They can help curb the accumulation of surface water or upwelling of the water table. This requires major excavation work with a backhoe.

HOUSE

- 1.** During construction, lay a capillary break between the footing and the wall of the foundation. Use a specialized membrane, or a standard 6 mil polyethylene sheeting. Avoid the use of tar or spray coatings alone for the waterproofing of foundations.
- 2.** Install a sump connected to the drain and equipped with a pump and a backup battery in the event of a power failure.
- 3.** Install a backwater valve for houses connected to a sewer system (especially in urban areas). This device prevents sewage from an overloaded main sewer connection from backing up to the basement. The valve closes automatically when the sewage flows back.
- 4.** Elevate valuables and electrical appliances if there is a risk of flooding in the basement. When renovating, choose non-absorbent wall finishes and floor coverings (such as ceramic) and raise electrical outlets and baseboards.
- 5.** Even if this is still common practice, never install vapour barriers inside the foundation walls. Doing so may trap moisture and cause rot.
- 6.** For conventional shingle roofs, install gutters all around the roof (slopes that receive water) and lengthen the downspouts to the ground by at least 10 feet and direct them away from the house. Disconnect the downspouts connected to the foundation drain or the sewer to avoid clogging up the systems. Clean the gutters annually.
- 7.** Fit windows located near or at ground level with a window well, a steel protection which is fixed to the foundations and serves to hold back the ground. Seal cracks in the foundations and around basement windows.
- 8.** Install flashings at the top and sills with drip edges at the bottom of all doors and windows.

8. Install flashings



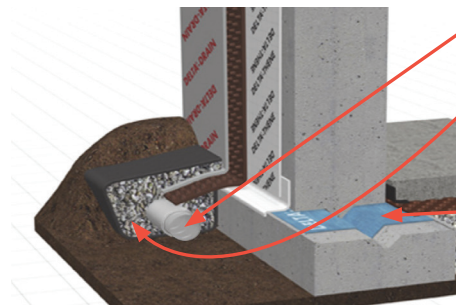
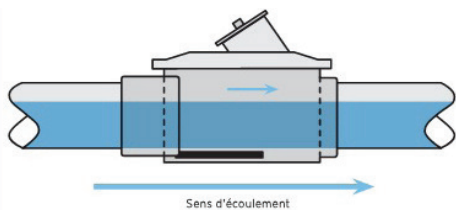
8. Install windowsills with drip edges



D. Surface drain or channel



3. Backwater valve

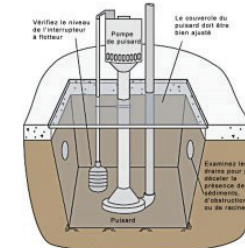


A. Rigid drains

B. Rock or sand embankment

1. Capillary break (blue membrane)

2. Sump

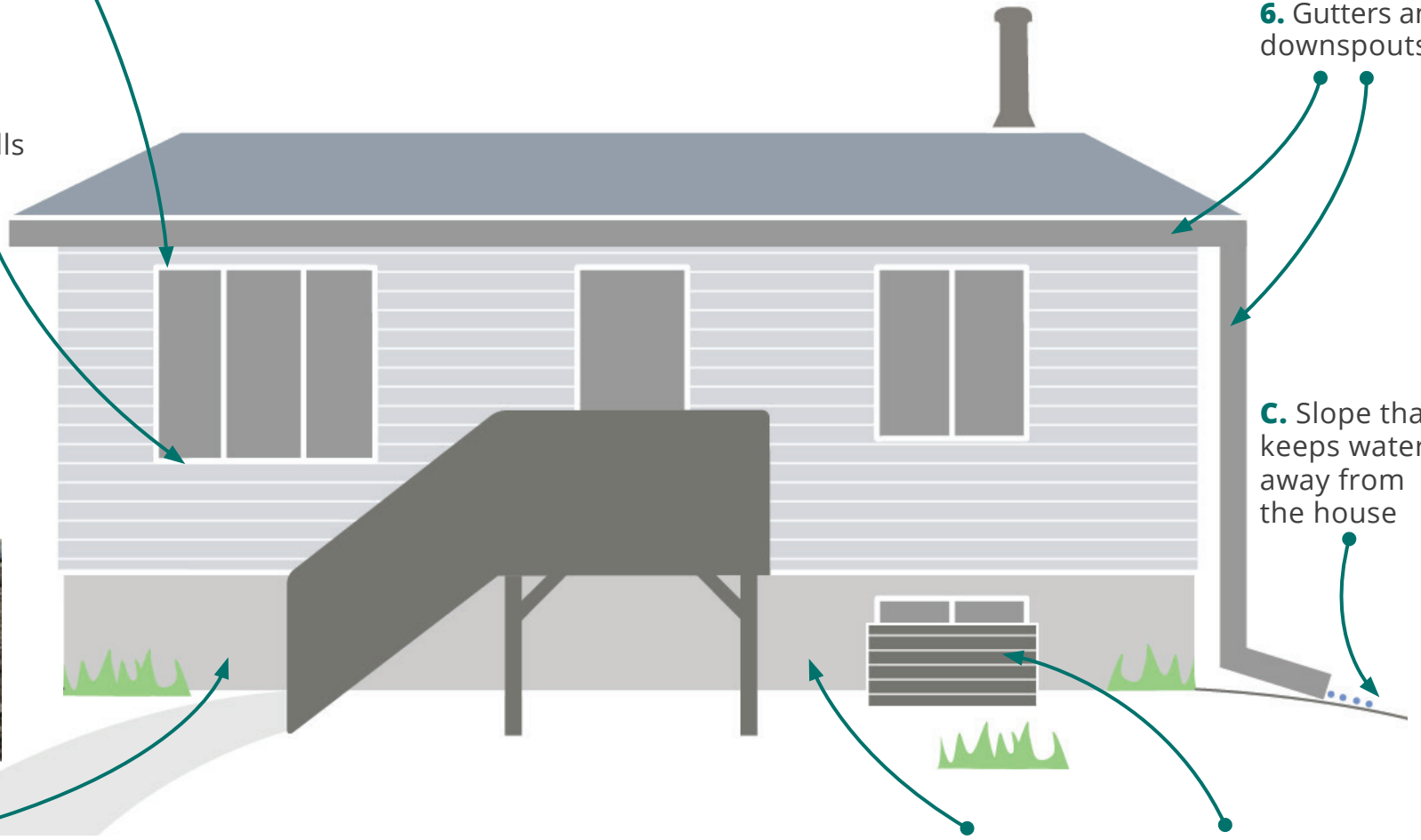


7. Window well



6. Gutters and downspouts

C. Slope that keeps water away from the house





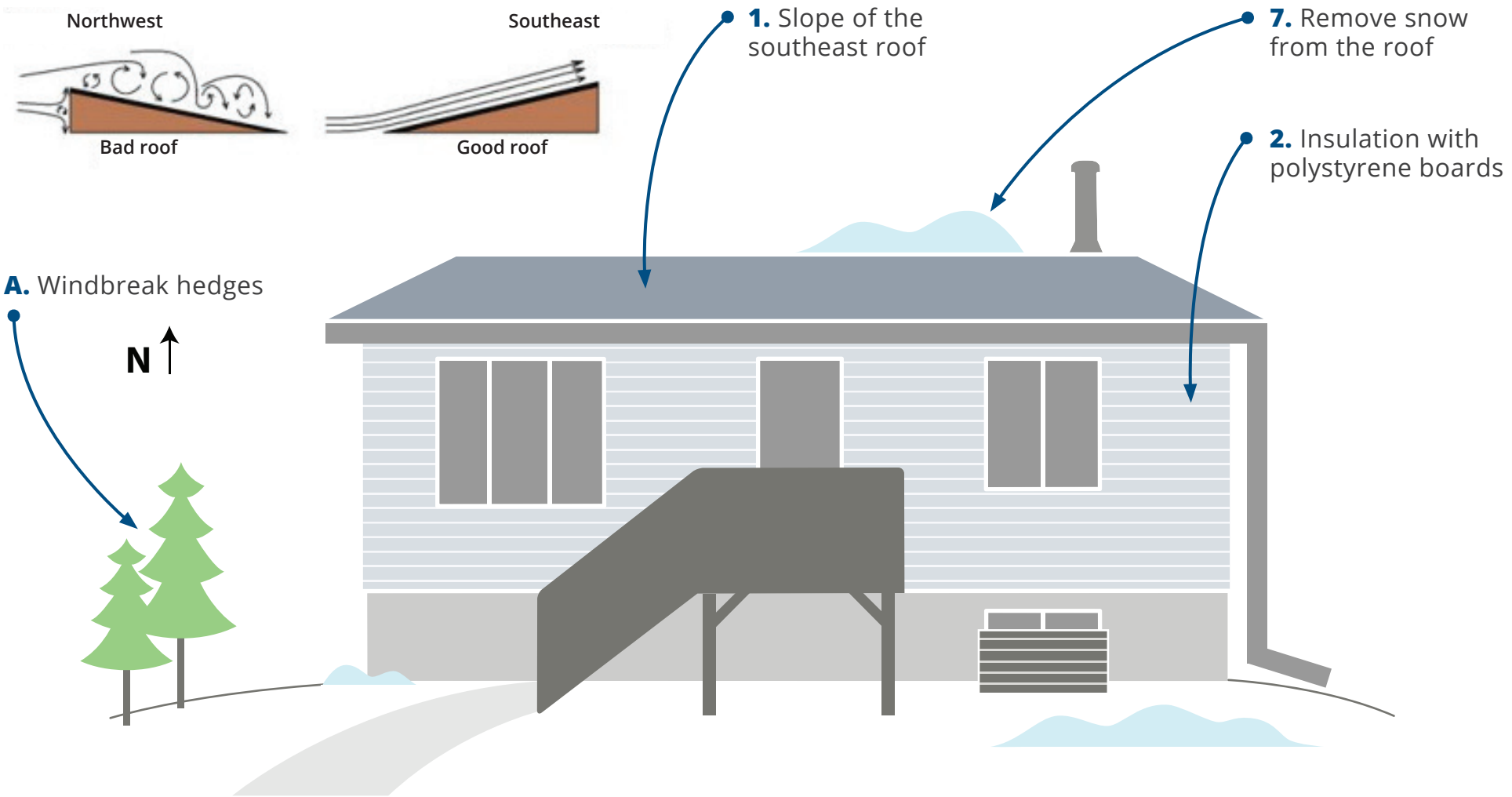
WINTER STORMS (COLD, SNOW AND ICE)

OUTDOOR ARRANGEMENTS

- A. Plant windbreak hedges more than 2 metres from the house. It is best to protect the entire northern part from winter wind by planting conifers from the northwest to the northeast. If this is not possible, try to place conifers in the axis of the prevailing winds.

HOUSE

1. Slightly tilt the roof slope towards the prevailing winds (often northwest in Quebec) to limit the cooling of the roof in winter.
2. Take advantage of renovations of interior (gypsum) or exterior (clapboard) coverings to insulate with expanded polystyrene panels at least 2 inches or R-10.
3. Insulating goes hand in hand with waterproofing. Create a suitable wall composition in four layers : vapour barrier (interior side of the house), interior insulation, exterior insulation and air barrier (Tyvek type). In a cold climate like in Quebec, the humidity inside the house, especially the humidity we produce through our activities (particularly in the bathroom and kitchen), must not penetrate inside the walls.
4. Use an air exchanger to allow humidity control inside the house, ensure good indoor air quality and recover heat. Clean the filters every 6 months to ensure the proper functioning of the device.
5. Install exhaust fans in damp areas of the house, such as bathrooms and kitchens, which carry moisture to the outside. For the range hood, choose a minimum air flow of 2.83 m³/min (100 CFM or ft³ / min). For the bathroom, install a device with a timer button (5 to 10 minutes) whose sound level does not exceed 1 sone (1.0 maximum) while being ENERGY STAR and HVI approved.
6. Maintain a temperature and set the thermostats above 12° C during the winter to prevent freezing of the pipes. Insulate all exposed pipes, especially those that go into an attic closet with thermal tape or foam insulation. For crawl spaces, insulate the sides of the foundations and the rim joists.
7. Remove snow from the roof after a large accumulation. Caution is advised and it is important to be careful not to damage the coating which affects the waterproofing of the roof. Leave one or two inches of snow and use a plastic shovel instead of a metal one.



A. Windbreak hedges

4. Use an air exchanger



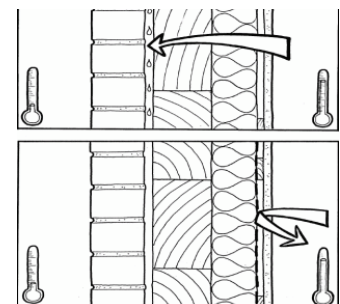
5. Bathroom and kitchen fans



6. Adjustable thermostats



3. Insulation and sealing





WINTER STORMS (COLD, SNOW AND ICE)

HOUSE (CONTINUED)

8. Power outages are very common during ice storms. Always have access to a backup heating source. Opt for a high efficiency waterproof stove or fireplace, installed in closed combustion (i.e. with an outside air intake that provides the oxygen supply necessary for combustion). This will avoid having to draw the oxygen necessary for combustion from the ambient air of the house. Choose a device that is EPA certified or that complies with the requirements of the CSA B415 standard, which guarantees that the device limits the threshold for emissions of fine particles that are harmful to health.
9. Install a carbon monoxide (CO) monitoring device on each floor, including a detector near the stove or fireplace. When fossil fuels are burned improperly, homes can produce CO, a colourless and odourless gas that can cause headaches, nausea, asphyxiation and even death. For health reasons, never burn soiled (painted, varnished or treated) wood. Also check the smoke detectors.
10. Acquire back-up batteries (power packs) to have a source of energy during power outages for lighting and small devices such as cell phones.
11. During a power outage, do not use a camping stove or barbecue indoors if you need to cook. Cook preferably outside.



8. Auxiliary heating



9. CO detectors



10. Backup batteries



11. No indoor use of camping stoves or BBQs



STRONG WINDS

OUTDOOR ARRANGEMENTS

- A. Pick up debris around the house. Close the propane tanks and store the other explosives. Fasten or remove accessories that are outside such as parasols, garbage cans, garden furniture, barbecues, air conditioners, antennas, etc.

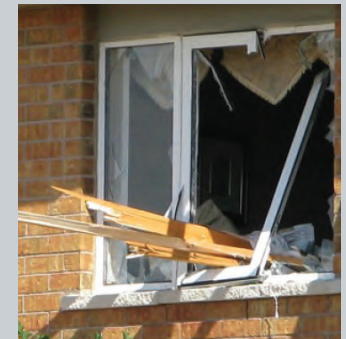
HOUSE

1. Strong winds can also cause power outages. Consider putting in place the measures on page 10.
2. Ensure that the roof is in good condition. A roof resistant to strong winds must have 15 mm thick plywood panels fixed with nails or screws (avoid staples).
3. Reinforce the connections between the walls and the roof to prevent it from lifting. Install additional spacers in the trusses and gables as well as fittings (single or double straps, supports, toe nailing and hurricane straps).
4. Securely install ridge vents, roof vents and soffits designed for strong winds. Vents and soffits must be watertight, securely anchored, and certified to resist water infiltration caused by wind-driven rain.
5. Reinforce the walls by adding metal connectors at the junction of the floors and the foundation (see diagram on page 14). Securely fasten the cladding to the walls.
6. Protect windows and glass doors (which are especially vulnerable) by installing hurricane shutters. These shutters can be purchased (usually in metal or wood) or made with plywood panels (marine, 15 mm thick) and temporarily placed outside over doors or windows. Install all wall anchor hardware permanently before a storm threatens the area. At the design stage, avoid placing doors and windows near corners.
7. Securely anchor the support columns of balconies, verandas, carports and other overhanging structures (protruding from the house). These structures are especially vulnerable as they are often constructed of light materials such as wood.

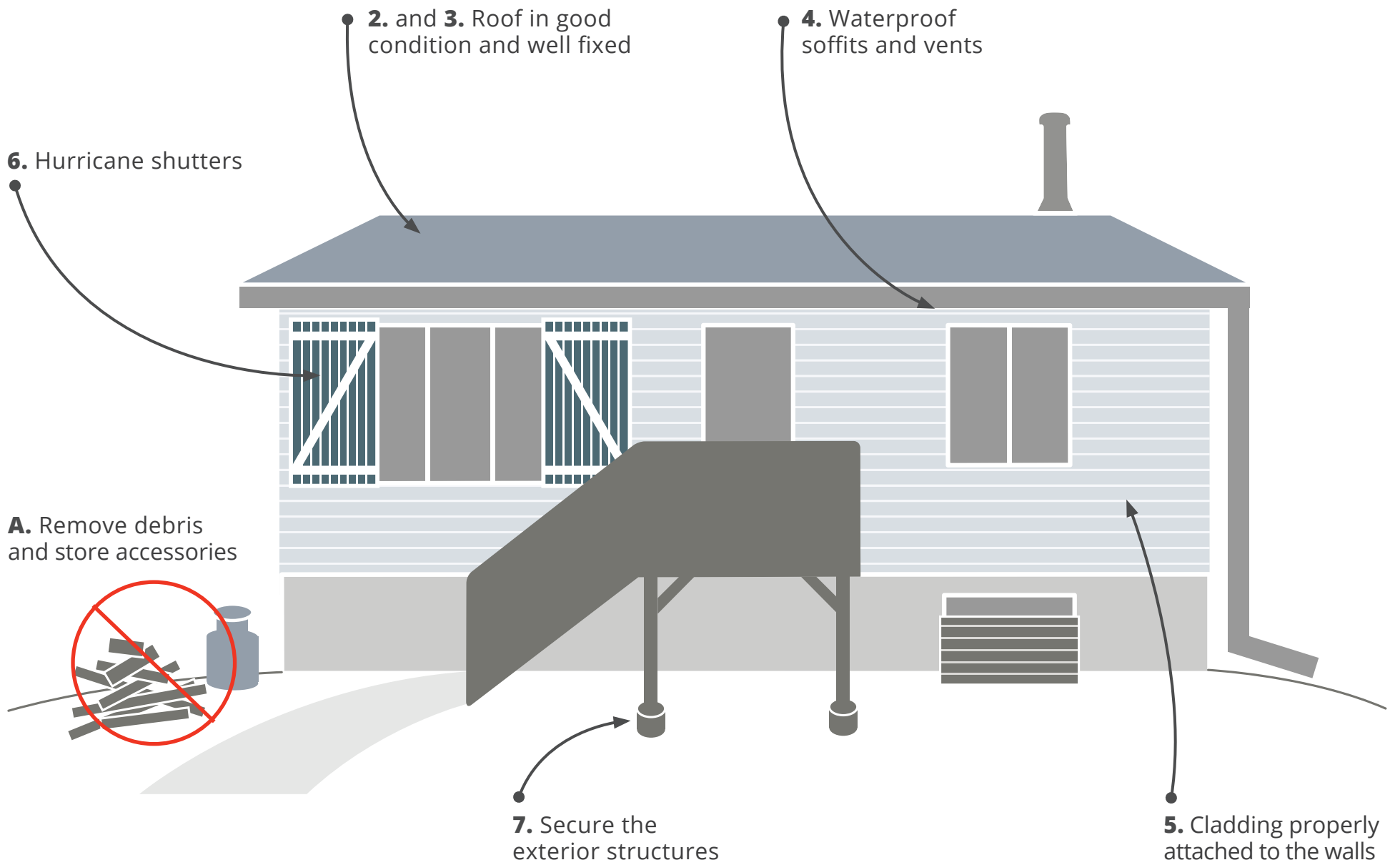
It is not the winds as such that cause the most damage, but rather wind-blown debris such as tree branches, traffic signs, roof shingles and metal siding that can damage the walls and easily enter the house through unprotected windows and patio doors. Heavy rain can also cause water infiltration and ultimately mould problems.



Wind-blown soffits

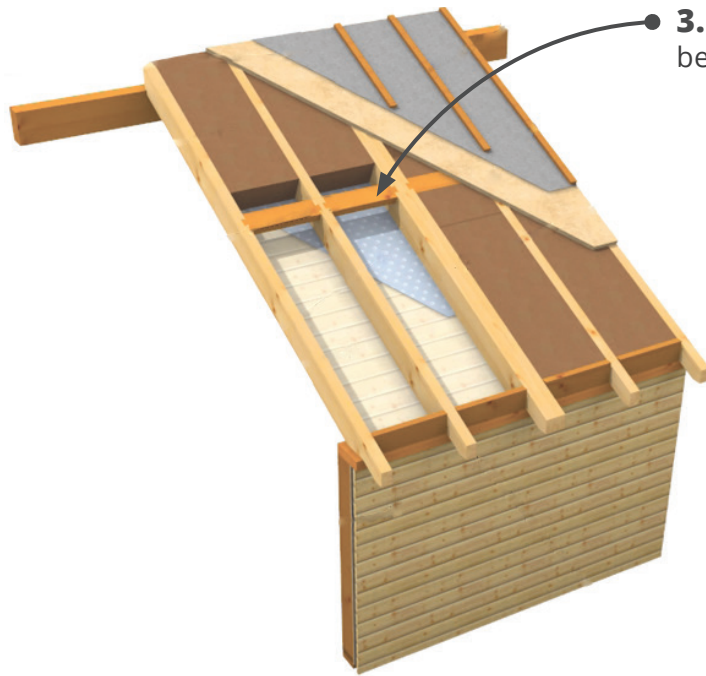


Windows damaged by wind-blown debris





STRONG WINDS



3. Spacer : structural element placed perpendicularly between two rafters and used to solidify the roof

5. Reinforcement of the connections and junctions between the walls and the roof
Source : Simpson Strong Tie

Continuous Load Path To Resist Uplift Forces

- Roof to Wall Connection**
 - Roof member to top plate connections
 - Top plate to stud connections
- Upper Wall to Lower Wall Connection**
 - This connection is not required for a single story home.
- Lower Wall to Foundation Connection**
 - Stud to sill plate connections
 - Sill plate to foundation connections
 - These connections are not required for uplift but may be required to transfer shear loads.



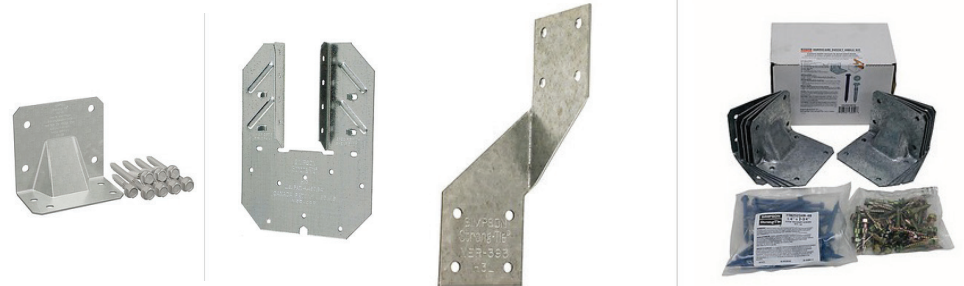
6. Example of permanent wooden shutters (also decorative) with central metal frame



Do-it yourself shutters with 15mm thick marine plywood panels with typical fasteners (permanently installed)



Example of typical hardware for permanent shutters



Examples of connections and junctions



FOREST FIRES

OUTDOOR ARRANGEMENTS

- A. Within a 1.5 metre perimeter along the exterior walls of the house, avoid highly flammable plants (such as juniper, cedar, tall grass and fir) and wood chips.
- B. Avoid a concentration of wooden elements attached to the house such as fences, stairs, balconies, decks and verandas, which constitute highly flammable elements. If possible, use alternative materials such as concrete, metal or composite boards. Keep all structures attached to the house in good condition and clean.
- C. Create a firebreak zone within 10 metres of the house. Avoid gathering combustibles such as firewood, petroleum or flammable products (propane, gasoline, etc.), recreational vehicles (ATVs), construction materials and collections of objects or debris. Mow the lawn or tall grass.
- D. For sheds and garages within 10 metres of the house, follow the same recommendations as for the main house.

HOUSE

1. Sealing the house is a priority during forest fires. An airtight envelope will help curb the infiltration of smoke and particles harmful to health (see the waterproofing measures on page 8). During a forest fire, keep doors and windows closed and use the recirculation function of the ventilation system.
2. Clean and remove needles, dead leaves or other debris that could ignite from the roof. Asphalt shingles are fire resistant, but not very durable or environmentally friendly. When the time comes to change the roof covering, a good durable and fire-resistant alternative is sheet metal.
3. When the time comes to change the exterior cladding (also for the shed), change to a non-combustible material such as metal (aluminum or sheet metal pitch).
4. From the ground to the roof, eliminate places where the embers can accumulate and ignite the exterior cladding and the roof. If necessary, repair damaged cladding. Use metallic products for cornices, vents and ventilation openings and equip them with screens.
5. Choose doors and windows with double or triple glazed tempered glass, which offers better fire protection than single glazing.
6. Indoor and outdoor fireplaces can cause forest fires. Equip chimneys or fire circles with certified screens or spark arresters.



4. Close the cornices, vents and ventilation openings

5. Doors and windows made of double or triple glazed tempered glass

6. Chimney with approved spark arrester

C. Maintain the structures attached to the house

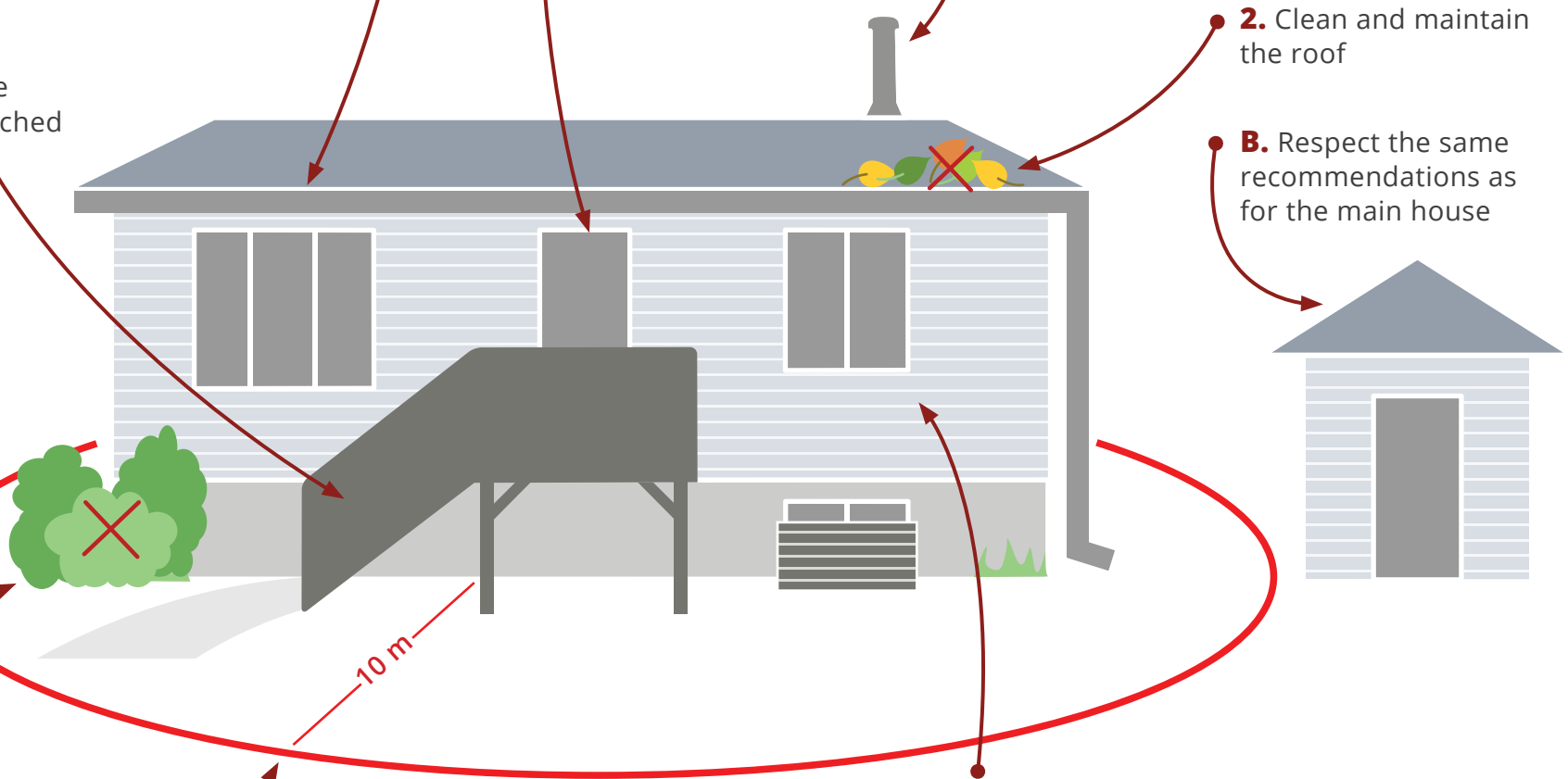
2. Clean and maintain the roof

B. Respect the same recommendations as for the main house

A. No combustibles within 1.5 metres of the house

B. Create a fire break within 10 metres of the house

4. Exterior and roof cladding in non-combustible material





HEAT WAVES

OUTDOOR ARRANGEMENTS

- A. Plant dense vegetation on the south side such as deciduous hardwood (which loses its leaves in the fall) which will protect the house from the strong rays of the sun in summer. Ideally, the distance between the facade and the mature trees should be one and a half to two times their height. If they are further away, their shade will not hide the house in summer, and they will not provide protection from the wind in winter.

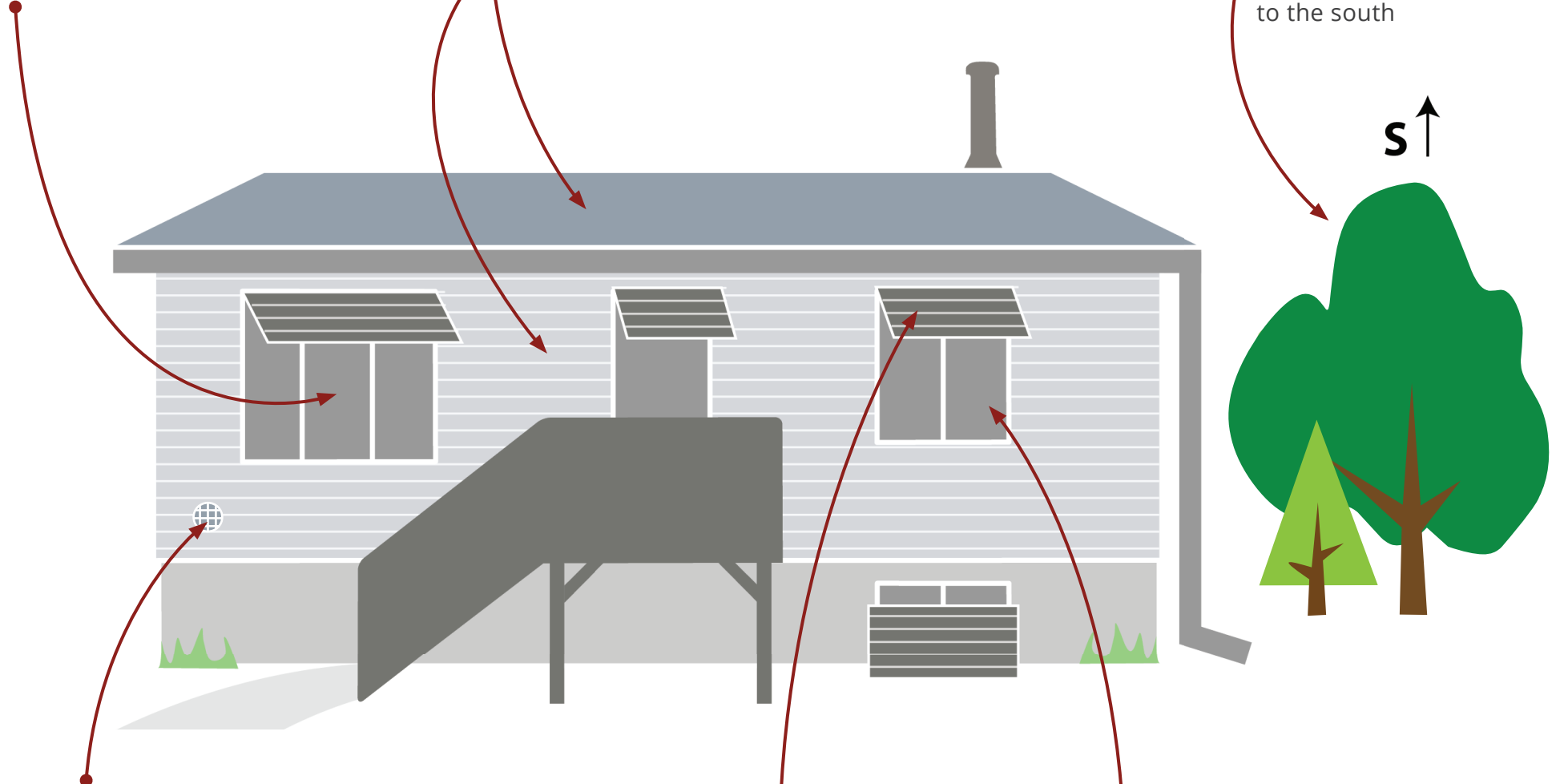
HOUSE

1. Use a mechanical ventilation device such as an air exchanger. Maintain every 6 months the air inlets and outlets as well as the air exchanger system filters.
2. Install an air conditioner if necessary
3. Favour light-coloured ENERGY STAR rated roof shingles. If possible, opt for a more durable cladding such as silver lined sheet metal cladding that reflects the sun's rays.
4. Install sun visors (louvers) or sunshades over south-facing windows : these horizontally projecting structures are installed to create shading on the windows, facades, terraces and other elements surrounding the house. No annual maintenance is required. For sunshades with blades, only the thickness of the boards will block the sun.
5. Install blackout/thick curtains or window blinds. Although less effective than the exterior options, they can give the impression of blocking part of the radiation, but they still let infrared radiation and therefore heat inside. They also help limit the feeling of cold near windows during colder periods.
6. When changing windows, favour triple glazing rather than double. The additional cost is minimal, and comfort will be significantly increased.

6. Consider triple glazed windows

3. Lighter-coloured roof shingles

A. Deciduous hardwoods to the south



1. Clean dryer outlets and other air inlets and outlets

1. Use an air exchanger

4. Sunscreen or sunshade

5. Curtains on doors and windows





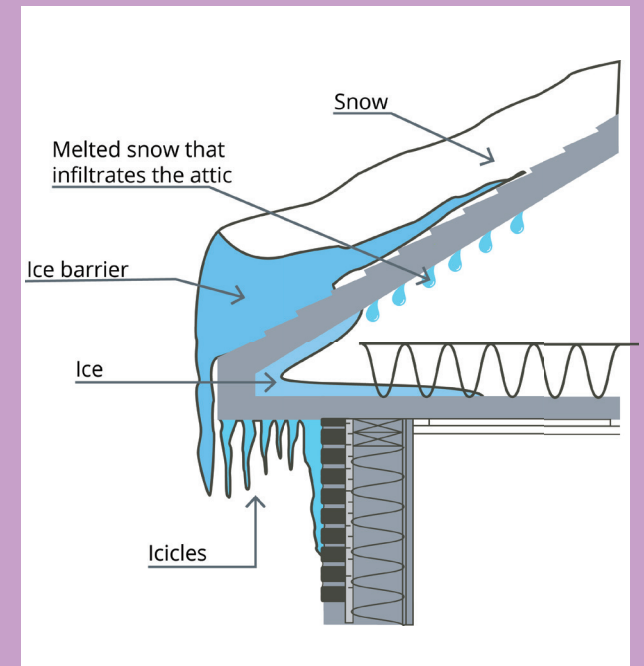
FREEZE-THAW CYCLES

OUTDOOR ARRANGEMENTS

- A. New constructions should be built on an elevated site, ideally on a monolithic slab with insulation around the perimeter to prevent frost from penetrating the earth around the foundations.
- B. Clear snow near windows, especially in the basement, in anticipation of melting snow that could lead to water infiltrations.

HOUSE

1. Seal and insulate the roof to prevent heat from escaping as well as ice barriers and water infiltration. Find all openings (hatches or access doors, plumbing ventilation columns, electrical cable conduits, vents or chimneys) that open to the attic and roof, then seal and insulate.
2. Ideally install the insulation outside the foundation rather than inside. By eliminating seasonal freeze-thaw cycles, it is possible to prevent thermal shocks which can cause the foundations to crack.
3. Install chimneys and vents within 24 inches of the ridge beam with a support to prevent snow and ice on the roof from damaging them.
4. If possible, plan architectural elements (overhangs of roofs or balconies), roof slopes that are accentuated or extended above the windows, soffits that are longer on the south side or balconies above windows and doors, as they prevent the accumulation of water at the foundations in addition to minimizing solar overheating.
5. Clean gutters in the fall to ensure proper roof drainage in mild winter weather.
6. At the very bottom end of the exterior cladding, install a flashing that keeps water away from the foundations. The flashings must also be placed at the junctions of balconies and terraces. Flashings are absolutely necessary if there are no roof overhangs.
7. Erect balconies or terraces on a solid base, such as sonotubes buried below frost level. Place a membrane over the sonotubes to drain off standing water.



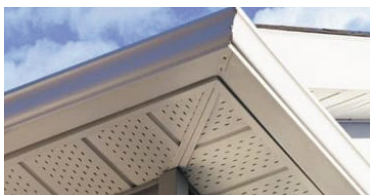
Example of ice barrier formation on the roof.
Source: Écohabitation

5. Clean gutters in the fall

3. Properly installed chimneys and vents



4. Architectural elements keeping water away from foundations



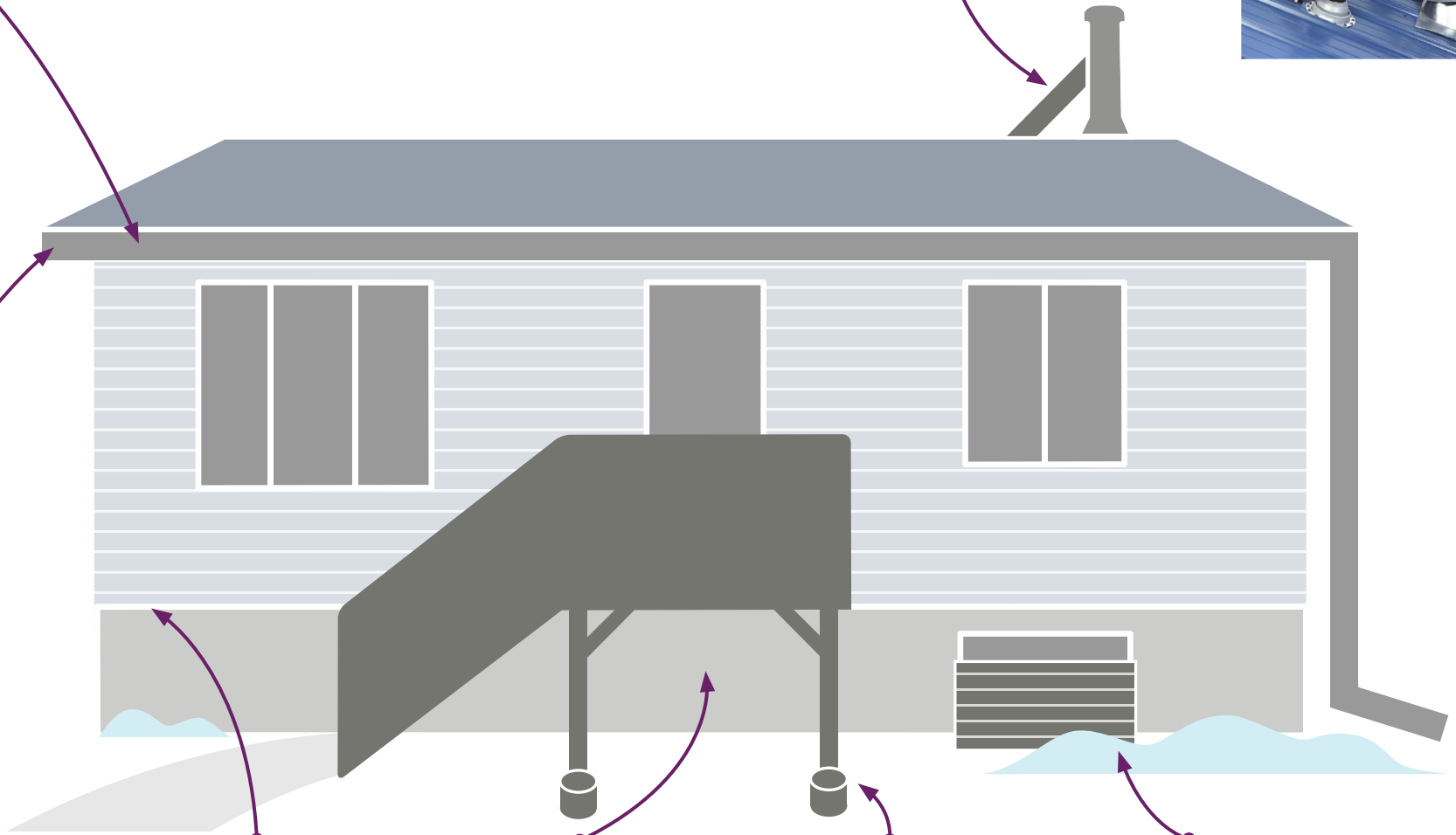
5. Flashings at the bottom of the exterior cladding



2. Exterior insulation on the foundations

7. Erect balconies or terraces on a solid base

B. Clean snow near windows





EROSION

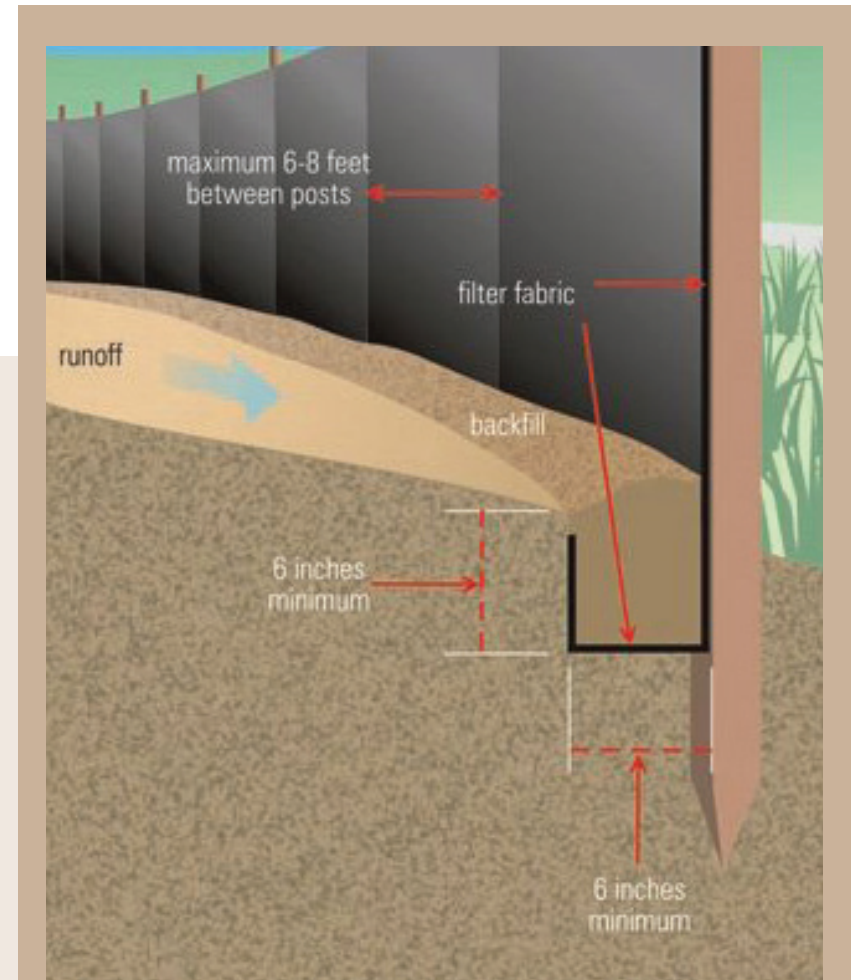
OUTDOOR ARRANGEMENTS

- A. Avoid using ATVs and vehicles on slopes of loose soil.
- B. To slow erosion, maintain the natural aspects of a site and keep the vegetation in place. When the soil has been disturbed, revegetate with local species that are known to retain the soil. Develop a riparian buffer for all dwellings on the edge of the banks.
- C. Keep any new construction away from banks and follow the safety zones recommended by the local authorities and experts.

HOUSE

Before construction or when relocating the house, design and plan the following appropriate erosion control measures :

1. Pile the disturbed topsoil layer and protect it from erosion (for reuse).
2. Control the course and speed of runoff water flow with anti-erosion (sediment) barriers or other comparable measures.
3. Protect watercourses with sediment barriers on construction and renovation sites.
4. If the floors of an inclined surface (25% slope, or 4:1 slope) are disturbed during construction, create levels and use anti-erosion mats, compost covers, filter tubes and berms or other similar approaches to stabilize soils.
5. Dig channels to divert surface water from the slopes of the roof or the parking lot.
6. If the dwelling is put at risk by erosion, consider relocating it to a safe place.

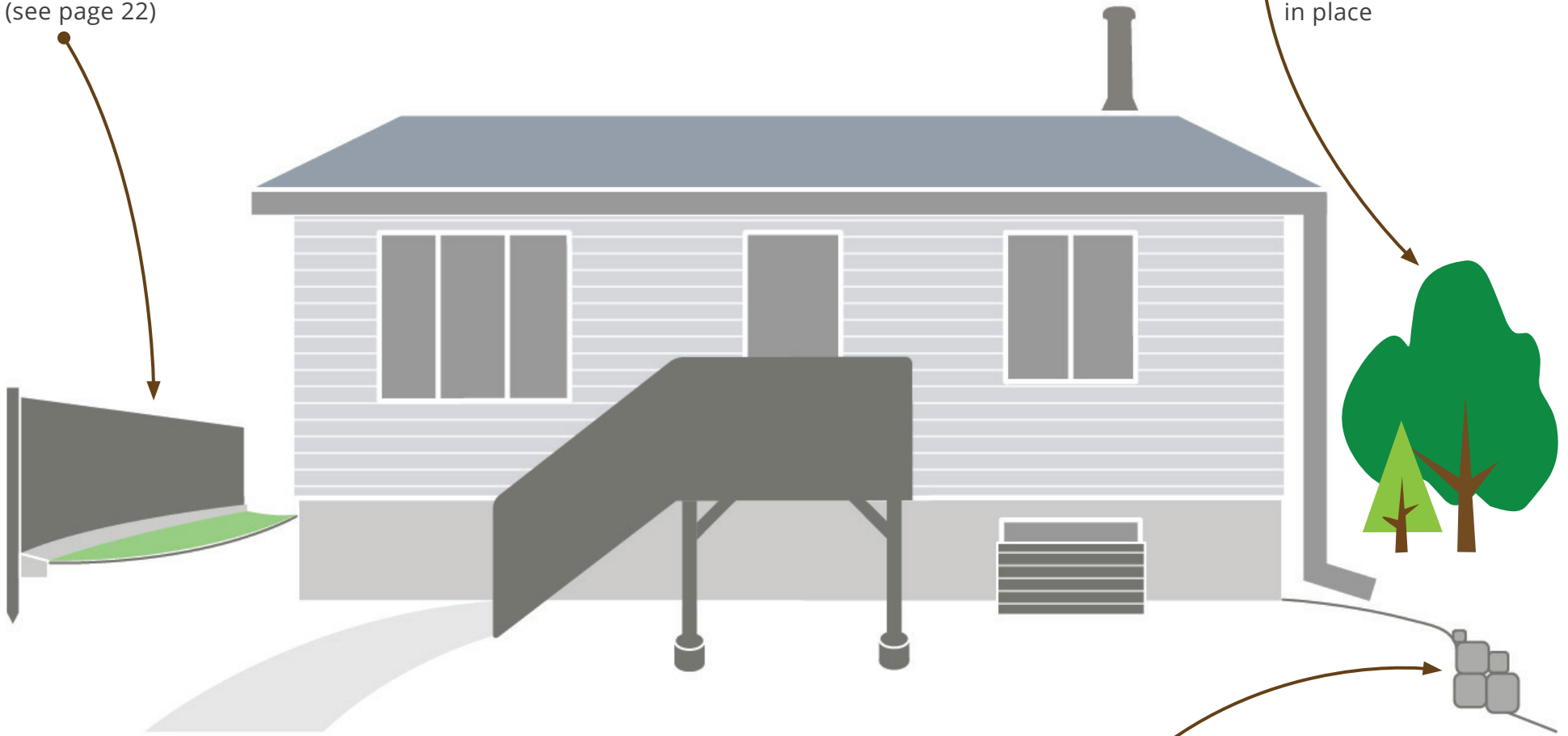


Construction of an anti-erosion (sediment) barrier

Source: Écohabitation

2. and 3. Install sediment barriers (see page 22)

B. Keep vegetation in place



A. No vehicles on slopes and loose soil

1. Protect topsoil against erosion

5. Dig channels

4. Protection of inclined surface : retaining walls or terraces





INSECTS AND PESTS

OUTDOOR ARRANGEMENTS

- A.** Create a maintenance strip of crushed stone or river stone over a width of two feet all around the house. This helps keep away water that attracts insects, while limiting splashing on the walls and reducing the risk of water and moisture reaching the foundations. Otherwise, keep the grass long near the foundations.

HOUSE

1. Carpenter ants feast on wet wood. Keep all wood (e.g., cladding, balconies, sheds, patios, etc.) at least 30 cm (12 inches) above the ground.
2. Seal cracks, joints, ends and junctions of two different materials (e.g., foundations and exterior cladding) with caulking paste. Silicone, butyl and polyurethane based products are more durable.
3. When an opening cannot be caulked or sealed, install corrosion and rodent resistant screens (copper or stainless steel).
4. Cover any insulation exposed to external conditions by laying a trellis followed by a cement or acrylic coating. If the insulation at ground level is visible or in direct contact with the outside, then it is exposed to pests as well as to mould and UV rays of the sun, which could cause it to deteriorate quickly.

MAIN PESTS

Exterior wood cladding can be attacked by insects, rodents, fungi, vegetation, etc. Wood cladding must be protected so that it does not crack, rot, stain or deform.

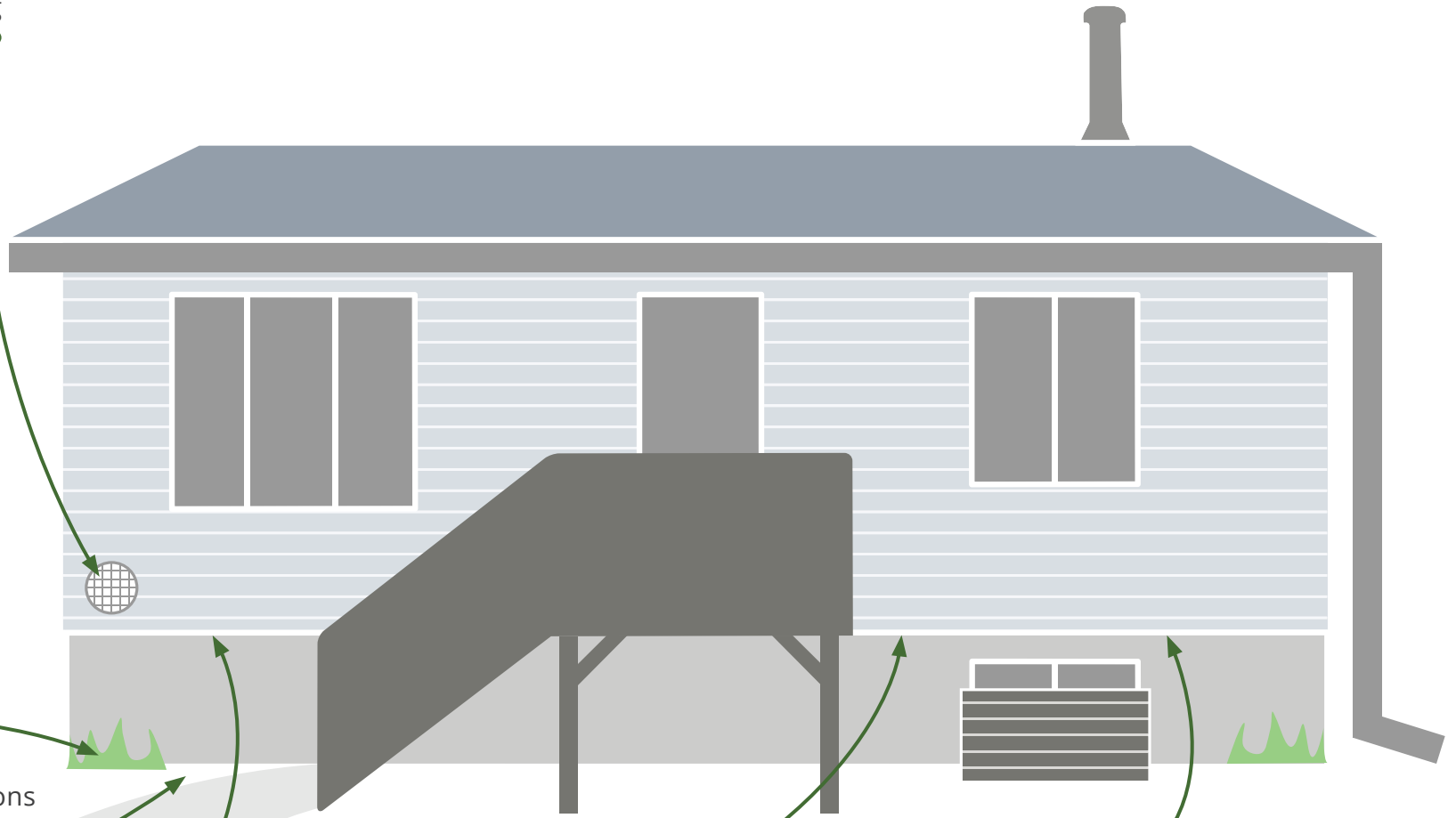
Insects

- Termites (uncommon in Quebec due to the cold climate, but global warming may change this)
- Ants (carpenter ants)
- Wasps and bees
- Ladybugs

Animals

- Rodents: mice and field mice
- Squirrels
- Raccoons
- Skunks
- Birds: swallows and others
- Bats

3. Install wire netting



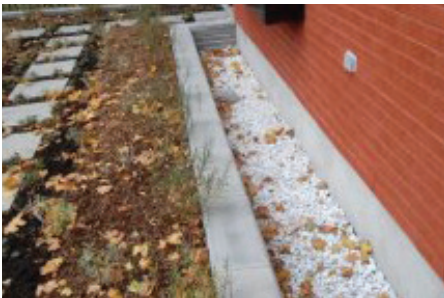
A. Cut the weeds around the foundations

A. Add a maintenance strip

1. Wood 30 cm from the ground

2. Waterproofed with caulking paste

4. Protection of insulation (ant infestation in unprotected wet organic insulation)



CONCLUSION

With today's climate change, it has become essential to design, build, renovate and maintain homes so that they are resilient to weather conditions. It is for this reason that this guide presents a series of measures to be adopted to deal with climate change.

We can all take simple steps to protect our homes and the safety of the people who live in them. It is possible to change the way we do things to adapt to the impacts of climate change.

Getting informed, such as by reading this guide, is the very first step in an adaptation process! This process is organized around five main steps which are described below :

1. Get informed : understand the challenges posed by climate change and the solutions to deal with it.
2. Assess the current situation : identify the weak points and the risks that apply to your house or to the entire building stock in your community.
3. Prioritize: select and prioritize in the short- and long-term the most important actions and renovations to be implemented.
4. Plan and budget: plan and set aside the funds necessary for carrying out the work
5. Realize and monitor: carry out the work and monitor the condition of the house and the work over time.

Écohabitation and the FNQLSDI wish you all the best in your adaptation efforts!

REFERENCES AND COMPLEMENTARY RESOURCES

Guides et conseils Écohabitation. *Fondations - rénovation.* www.ecohabitation.com/guides/fondations-renovation

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