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Across the country, public officials and others are focusing their pollution control efforts on stormwater management in both urban and rural areas. It is through stormwater that many pollutants such as sediment, nutrients, bacteria, heavy metals, and others reach surface water. This is called nonpoint source pollution. It cannot easily be traced to one source or one property. Rather, small amounts accumulate from many sources and many properties (*Table 1*). Contaminants are carried by stormwater from streets, parking lots, sidewalks, driveways, yards, gardens, and other areas. As citizens we have a responsibility to reduce the effects that stormwater runoff has on our environment. There are certain low-cost, low-maintenance activities that everyone can do to reduce both pollutant loading and stormwater runoff from our homes and lots.

Stormwater runoff is water from rain or melting snow that does not soak into the ground. It flows from rooftops, over paved areas and bare soil, and across sloped lawns. As it flows, this runoff can collect and transport soil particles, pesticides, fertilizer, oil and grease, leaves and grass clippings, litter, animal wastes, and other potential pollutants. A heavy rainstorm isn't the only time that pollutants are collected and carried toward streams, rivers, wetlands, or lakes. A relatively light rain or the flow from a garden hose or lawn irrigation system can start the process by moving pollutants into the street or storm drain. During the next precipitation event, these pollutants and others are picked up and carried further, eventually being deposited in a water body.

Natural surface drainage and constructed storm drains convey runoff from your property to a nearby stream or other water body. Contrary to popular belief, most storm drains or storm sewers do not carry stormwater to wastewater treatment plants. Instead it flows directly to streams or other water bodies (*Figure 1*).

Table 1. Common stormwater pollutants and their sources.

<i>Pollutant</i>	<i>Common Sources</i>
Sediment (sand, silt and clay particles)	Bare spots in lawns and gardens, roofs, construction sites, streambank erosion, farm fields, wastewater from washing vehicles
Nutrients (nitrogen, phosphorous and others)	Over-application or spilled fertilizer, pet waste, livestock manure, grass clippings, and leaves
Chemicals	Over-application of pesticides, spilled or leaking pesticides, solvents, or other household hazardous wastes, de-icing salts
Disease Organisms (bacteria, viruses)	Pet waste, livestock manure, garbage
Hydrocarbons	Engine exhaust, fuel and oil spills and leaks, vehicle tire wear, burning plastics
Metals	Vehicle brake and tire wear, engine exhaust, metal gutters and downspouts

Polluted stormwater degrades our streams, rivers, lakes, and wetlands. Soil particles cloud water and impair habitat for fish and aquatic plants. Nutrients such as phosphorus promote the growth of algae, which crowds out other aquatic life. Chemicals such as antifreeze and oil leaking from cars, spilled or carelessly applied fertilizers and pesticides, and metals from galvanized gutters and downspouts threaten the health of fish and other aquatic life. Bacteria and other

disease-causing organisms from pet and animal waste can make nearby lakes and ponds unsafe for wading and swimming.

Stormwater also can be a problem closer to home. It can flow down a poorly sealed or unused well which has not been properly decommissioned and contaminate the drinking water supply. Pollutants in runoff may quickly reach groundwater, especially in areas with porous, sandy soils.

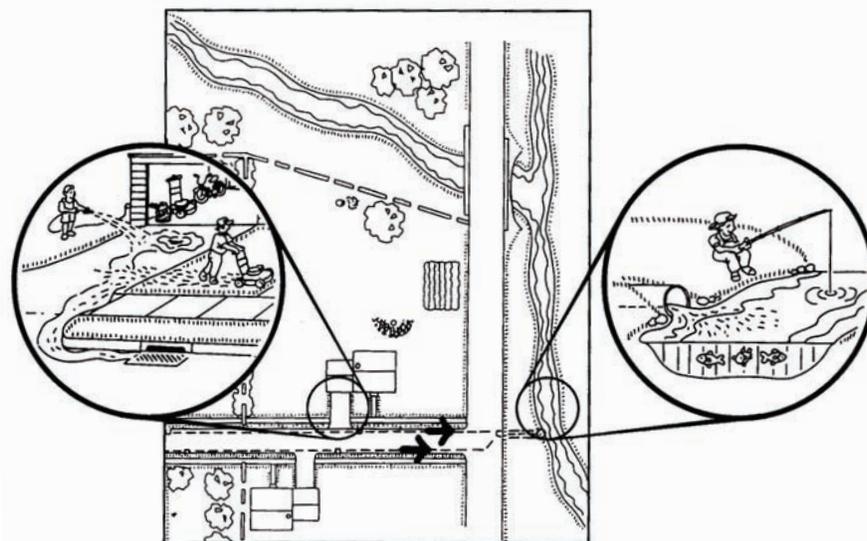


Figure 1. Runoff that flows into storm drains usually goes directly to streams, rivers, or lakes without treatment.

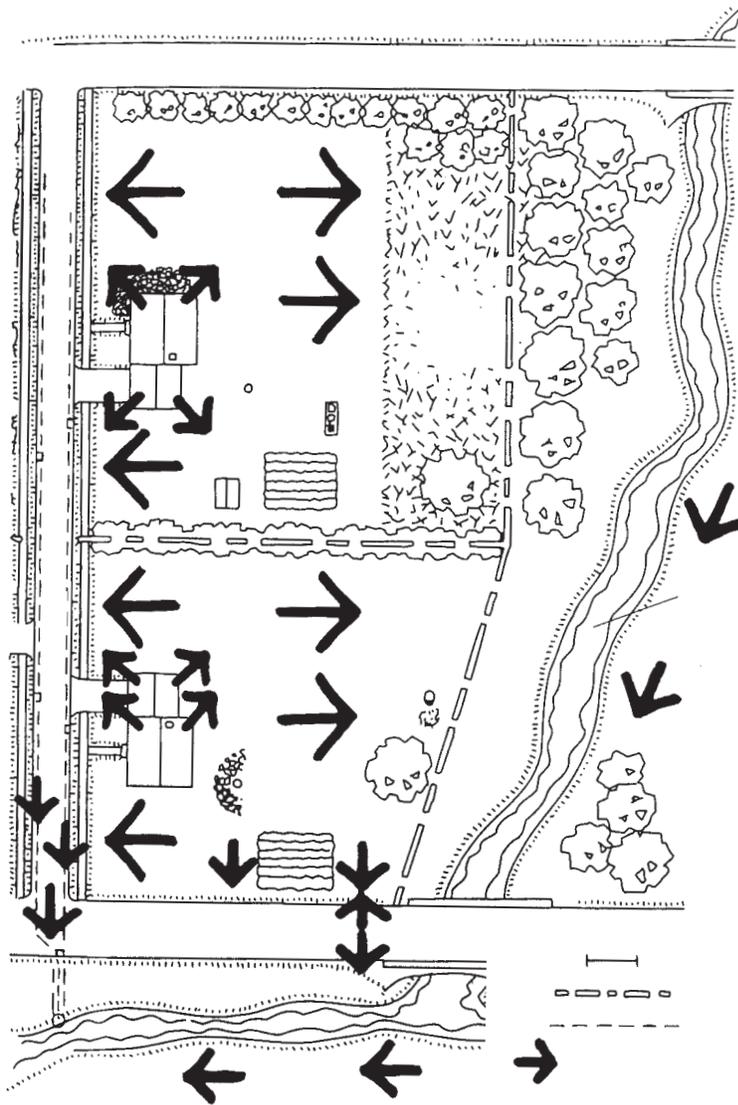


Figure 2. Example of sketch showing direction of surface runoff and stream flow.

Reducing Pollutants in Runoff

Stormwater is unavoidable, but its negative effects can be reduced by keeping harmful chemicals and other materials out of the runoff. This section reviews some potential sources of contamination and offers ways to minimize them.

Where does stormwater go?

The next time you are home during a rainstorm (when lightning is not occurring), head outdoors with your boots and umbrella and watch where the rainwater goes. On a sketch of your property, draw arrows showing the direction that stormwater flows off rooftops, driveways, sidewalks, and yards. A sample sketch is shown

in Figure 2. Does water soak into the ground quickly or does it puddle in places and flow off the lawn, driveway, or other areas? Soil type and condition affects water infiltration rate (how fast water soaks into the ground). As you might expect, water infiltrates quickly into sandy soil but takes much longer to soak into fine-grained silt or clay soils, especially when these soils are compacted.

Note how far it is to the nearest storm drain, road ditch, stream, or body of open water. Note whether runoff flows onto your property from adjacent lots, streets, or stormwater systems. Be sure to observe during more than one rain event to get a good understanding of runoff flow during small and large storms.

Are yard and garden wastes kept out of stormwater?

If left on sidewalks, driveways or streets, grass clippings and other yard waste will wash away with the next storm. Although leaves and other plant debris accumulate naturally in streams and lakes, homeowners can contribute excess amounts of plant matter, especially in areas where there are many homes. This can lead to water that is unattractive or green with algae and unsuitable for recreation. Bacterial degradation of these organic wastes can significantly reduce oxygen levels in shallow waters during summer months, leading to fish kills. Grass clippings, leaves, or other debris can clog storm drains, resulting in localized flooding. In many municipalities, it is illegal to leave clippings in the street or to dump them in nearby streams or lakes. Avoiding the problem is easy — sweep clippings back onto the grass and compost leaves and garden wastes to recycle nutrients (Figure 3). (Refer to Neb-Guide G1855 *Stormwater Management: Yard Waste Management*.)

Do you use and handle chemicals safely?

Proper handling and application of pesticides, fertilizers, and other chemicals is extremely important. When mixing chemicals, consider placing the sprayer in a washtub or other large container so any spills will be contained. If you do spill chemicals, act quickly to control, contain, and clean up the spill following label directions. Don't simply hose it away. This is particularly important on paved surfaces.

Using more pesticides or fertilizers than needed contributes to water contamination. In fact, to reduce lake and stream water quality degradation, many communities throughout the United States have enacted a ban on lawn fertilizers containing phosphorus. It is critical to use only the amount of material needed based on soil tests, pest identification, or other analyses. Always read and follow label directions.

Timing of applications also is important. For instance, some

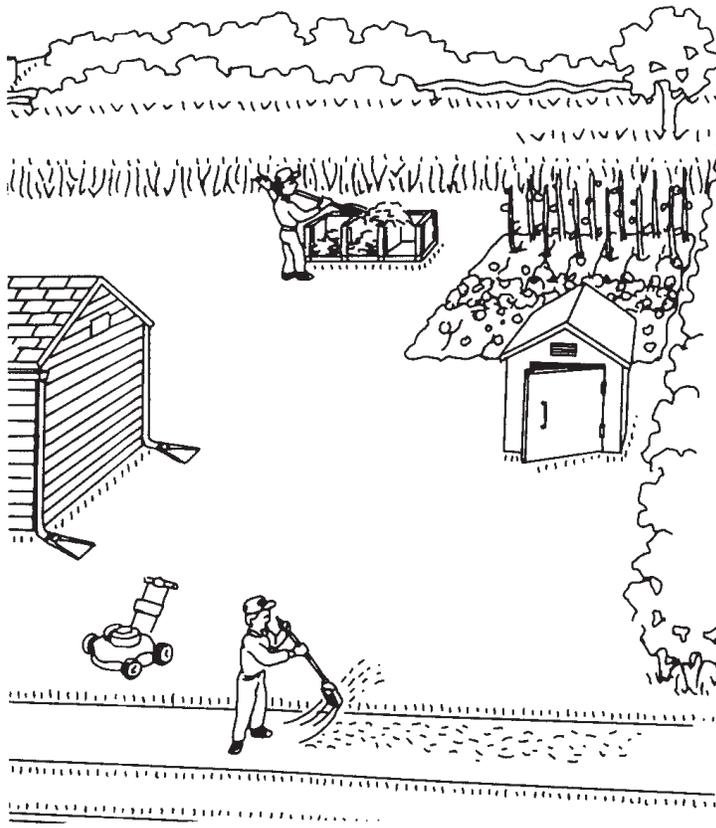


Figure 3. Sweeping grass clippings onto the lawn and composting help to keep yard waste out of storm sewers.

pesticides require moisture for activation. If the soil is dry, some water in the form of rainfall or irrigation following application will be needed to activate the pesticide. On the other hand, if the soil is at or near saturation, any additional moisture has the potential to leave the area as runoff. Runoff can occur under all soil moisture conditions during a heavy rain. Do not apply fertilizers or pesticides if heavy rain is expected within 24 hours. (Refer to NebGuide G1844 *Stormwater Management: Pesticide Use in the Lawn and Garden*.)

Are fertilizers, pesticides, and other chemical products stored outside the reach of stormwater?

Most households store a certain amount of lawn and garden products, solvents, and many other chemicals. If stormwater or floodwater reaches these materials, it can transport them

into surface waterways and groundwater. Pool chemicals, salt for water softeners, and a wide variety of other chemical products also can cause contamination if they are washed away. Keeping such products in original, waterproof containers and storing them up high and out of the potential path of runoff or flood water is important. You can reduce storage problems by buying small containers (ideally only the amount needed for a particular task) and then using up the product according to label directions.

Are any car or truck wastes being carried away by stormwater?

Oil, antifreeze, brake fluid, and other automotive fluids that have leaked or spilled onto the driveway are easily carried away by a rainstorm. An oily sheen on runoff from your driveway is a sure sign that you need to be more careful. Pans, carpet scraps, and matting can be used to

catch drips. Routine maintenance can help prevent your car from leaking and identify potential leaks. If you change your own oil, be careful to avoid spills and collect the used oil for recycling. Oily vehicle parts and fluid containers should be stored where rain and runoff cannot reach them. Never dump oil, antifreeze, gasoline, solvents, or other materials down a storm drain, in a ditch, or on the ground. These wastes will end up in a nearby stream or lake or they may pollute your drinking water.

Washing your car in the driveway creates runoff without the help of a rainstorm — the hose provides the water. The dirty, soapy runoff flows directly into street gutters and storm drains, carrying oil, sediment, and other pollutants as it goes. The best alternative is to take vehicles to a commercial car wash that sends its dirty water to a wastewater treatment plant. Although it may seem like a good solution, washing vehicles on a lawn is not recommended. Doing so causes wear and tear on the turf and creates compacted areas that can contribute to additional runoff. Also, turfgrass damage can occur from vehicle fluid leaks, detergents, and cleaning products.

How are animal wastes kept from becoming a pollution problem?

Wastes from dogs and cats and other commonly kept animals like exotic birds, rabbits, goats, and chickens can be troublesome in two ways. First, pet and livestock feces contain nutrients that can promote the growth of algae if they enter streams and lakes. Second, animal wastes can be a source of disease. The risk of stormwater contamination increases if pet wastes are allowed to accumulate in animal pen areas or are left on sidewalks, streets, or driveways where runoff can carry them to storm drains or surface water. Wastes that are not mixed with litter or other materials can be flushed down the toilet. Or, feces may be bagged or wrapped and put into the garbage for disposal.

Do you use salt or other deicing products?

Salt and deicers eventually wash off paved surfaces and end up in the soil or water. From your driveway or sidewalk, deicers can readily flow to storm drains and into streams and lakes. Salt in high concentrations is harmful to wildlife and plants. Use minimal amounts of these chemicals to help keep them out of natural systems. Consider selecting newer deicer formulas that have been developed to be less toxic to wildlife, pets, and plants. Or, consider using gravel, sand, or kitty litter as an alternative. Chipping ice off pavement is an even better choice, although care must be taken not to damage the pavement surface. Also, removing snow before it is walked or driven on will help minimize the formation of ice, reducing the need for deicers.

Landscaping and Site Management to Control Runoff

Some stormwater risks can be controlled by making changes to buildings, paved areas, soil surfaces, and other landscape features. This section reviews some easily addressed problems as well as major landscape alterations you might want to consider.

Are there areas of bare soil around your home?

Areas of bare soil often exist in vegetable and flower gardens, on newly seeded lawns and around construction projects. Even on gentle slopes, water from rain and snow can remove large amounts of soil and carry it to streams, rivers, lakes, or wetlands. Planting grass or other ground cover is an excellent way to limit erosion. Putting straw or other mulch over gardens or newly seeded areas will slow erosion. Be careful not to use too much material or it will smother emerging grass. Spread one to two small square bales of straw for each 1,000 square feet of newly seeded lawn. On bare soil between garden rows, you can use grass

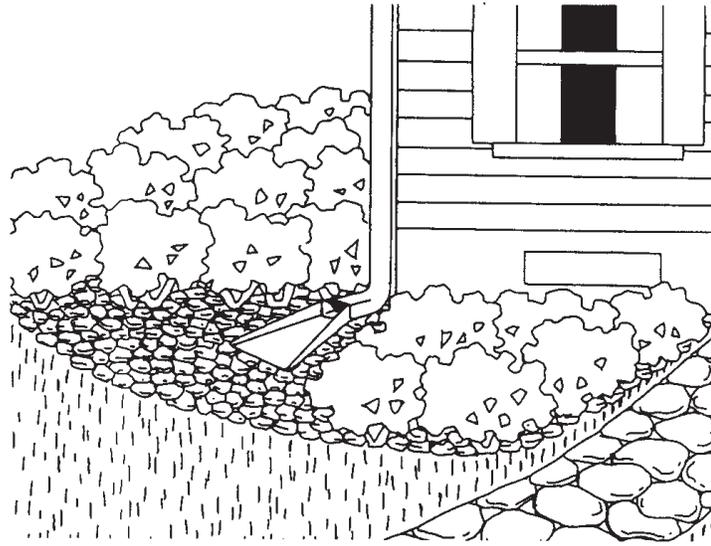


Figure 4. Roof drainage should be directed to the lawn, flower beds, or rain garden and away from the foundation and paved surfaces.

clippings or thicker layers of straw to suppress weed growth as well as reduce water loss.

Unbroken straw bales, diversion ditches, and/or commercially available silt fences around construction sites can help slow runoff and trap sediment on-site. If you are working with a contractor, insist that precautions are taken to control erosion and runoff during construction.

Can you reduce paved surfaces or install alternatives?

Concrete and asphalt streets, driveways, walkways, patios, and similar areas prevent rainwater from soaking into the ground. Where feasible, use permeable surfaces such as bricks, interlocking pavers, cobblestones, turf pavers, porous pavement, gravel, wood chips, mulch or other materials that provide spaces for rainwater to seep into the ground. Although some of these materials require specific or additional maintenance practices (for example occasional vacuuming of porous pavement to limit clogging of the pore spaces), they can deliver significant environmental and aesthetic benefits over time. Many, due to their design, are more flexible than traditional concrete or asphalt, making

them less costly to maintain as well. If an area must be paved, keep it as small as possible.

Some cities and municipalities limit the total impervious area allowed on a property. Check with your planning and zoning department about minimum amounts of porous area that might be required where you live.

Does roof water flow onto pavement or landscaped areas?

Your house and other roofs, like pavement, shed water. If downspouts from roof gutters empty onto grassy, vegetated or mulched areas, the water will have a much better chance to soak into the ground. Direct downspouts away from foundations and paved surfaces (*Figure 4*). Where space and appropriate conditions exist, consider installing a rain garden, which is a small area designed to temporarily hold rain water that comes from a house roof, driveway, or other open area. Water collected in the rain garden slowly infiltrates into the soil to support plant growth, which is typically a mixture of perennial flowers, ornamental grasses, and woody shrubs that are adapted to both wet and dry conditions. A rain

garden is not a pond or wetland. It is dry most of the time and holds water only after a rain. (Refer to NebGuides G1758 *Rain Garden Design for Homeowners*, G1759 *Plant Selection for Rain Gardens in Nebraska*, and G1760 *Installing a Rain Garden in Your Yard*.)

Alternatively, consider using cisterns or rain barrels to catch rainwater for watering lawns and gardens in dry weather. Utilizing the water from your rain barrel or cistern within 48 to 72 hours is recommended. Check with your local county or city health department to see if they have any specific requirements regarding rainwater capture, storage, and use. For roofs without gutters, plant grass, spread mulch, or use gravel under the eave drip line to reduce soil erosion and increase the soil's infiltration capacity

Can you change the layout of your landscape to reduce runoff?

If possible, take an active role in planning your site design before home construction begins, taking soils, topography, and drainage into consideration. Many times, alterna-

tives to wide, paved driveways and sidewalks and preserving any natural drainage ways will provide economic advantages to the new homeowner.

An essential part of stormwater management is keeping water from leaving your property or at least slowing its flow as much as possible. Two good approaches to enhancing on-site stormwater infiltration are protecting native or undisturbed soil from compaction during construction and loosening compacted soils by incorporating compost or other organic matter. The pore spaces in native or amended soil will help retain water on-site and increase infiltration, regardless of site location (slopes, flat areas, turf, landscape planting beds, etc.)

Many lawns are sloped to encourage water to flow onto neighboring property or streets. Instead, you could provide a rain garden or low areas landscaped with shrubs and flowers to encourage water to soak into the ground. If your yard is hilly, you can terrace slopes to slow the flow of runoff. If you have a large lot, consider "naturalizing" areas with prairie, woodland, or wetland plants. If your

property adjoins a lake or stream, one of the best ways to slow and filter runoff is to provide a buffer strip of thick vegetation along the waterfront. (Refer to NebGuides G1557 *Planning Your Riparian Buffer: Design and Plant Selection* and G1558 *Installing Your Riparian Buffer: Tree and Grass Planting, Postplanting Care and Maintenance*.)

Residential Lot Stormwater Management Worksheet

Following is a worksheet listing many stormwater management topics and practices. This worksheet is designed to help you:

- Evaluate your activities according to how they might affect water quality.
- Analyze the relative safety of your stormwater management practices, using easy-to-understand "risk level scores."
- Determine which of your practices are reasonably safe and effective and which practices might require modification to better protect surface and ground water.

Further Information

For additional information about stormwater management, contact the following agencies.

University of Nebraska–Lincoln
Extension
(www.extension.unl.edu)

Local Natural Resources District
(www.nrdnet.org/nrd_guide/find_nrd.html)

Natural Resources Conservation
Service
(www.ne.nrcs.usda.gov)

Nebraska Department of Environ-
mental Quality
(www.deq.state.ne.us)

Acknowledgments

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Stormwater Management on Residential Lots: Assessing the Risk of Surface and Ground Water Contamination

- For each category listed on the left that is appropriate to your property, read across to the right and circle the statement that best describes conditions on your property. If there is not a descriptive statement that exactly fits your situation, use your judgment to select the risk level that best applies. (Skip and leave blank any categories that don't apply to your property.)
- Look above the description you circled to find your "Risk Level Number" (1, 2, 3, or 4) and enter that number in the right-hand blank under "YOUR RISK SCORE".

	<i>High Risk</i> (Risk Level 4)	<i>High-Moderate Risk</i> (Risk Level 3)	<i>Moderate-Low Risk</i> (Risk Level 2)	<i>Low Risk</i> (Risk Level 1)	<i>Your Risk Score</i>
Potential Contaminants in Runoff					
Grass clippings, leaves, and other yard waste	Grass clippings, leaves, and other yard wastes are dumped down a storm drain or near a surface water body.	Grass clippings, leaves, and other yard wastes are left on driveways, streets, and other paved areas to be carried off by stormwater.	_____	Grass clippings, leaves, and other yard wastes are swept off paved surfaces and onto lawns away from water flow routes. Leaves and other yard wastes are composted.	
Handling and use of pesticides, fertilizers, and outdoor chemicals	Spills are not cleaned up. Products are used in greater amounts than what is recommended on the label.	Granules, etc. are left on driveway, sidewalks, or other paved areas to be carried off by stormwater.	_____	Spills are cleaned up immediately, particularly on paved surfaces. Recommended amounts of chemicals are applied according to label instructions.	
Timing of pesticide, fertilizer, and outdoor chemical use	Application is made when heavy rain is forecast within the next 24 hours and on saturated soils or areas where runoff is likely.	Application is made when heavy rain is forecast within the next 24 hours and on unsaturated soils or areas with little slope.	Application is made when light rain is forecast within the next 24 hours and on saturated soils or areas where runoff is likely.	Application is made when no or only light rain is forecast within the next 24 hours and on unsaturated soils or areas with little slope.	
Storage of pesticides, fertilizers, and other potentially harmful chemicals	Chemicals are stored in non-waterproof containers outdoors.	Chemicals are stored in waterproof containers outdoors, but within reach of stormwater.	Chemicals are stored in waterproof containers outdoors, out of the reach of stormwater.	Chemicals are stored in waterproof containers in a garage, shed, or basement that is protected from stormwater.	
Automotive wastes	Used oil, antifreeze, or other wastes are dumped down a storm drain or on a paved surface.	Used oil, antifreeze, or other wastes are dumped in a ditch or on the ground.	Drips and spills are not cleaned up. Car parts and other vehicle wastes are left on unpaved areas outside.	Oil drips and fluid spills are cleaned up. Dirty car parts and other vehicle wastes are kept out of reach of stormwater runoff.	
Vehicle washing	Cars, trucks, or other items are washed on a driveway, street, or other paved area.	Cars, trucks, or other items are washed on a gravel or rocky area.	Cars, trucks, or other items are washed on a lawn.	Cars and trucks are taken to a commercial car wash.	
Pet and animal wastes	Animal and pet wastes are left on paved surfaces or dumped down a storm drain.	Animal and pet wastes are left to decompose on grass or soil. Wastes are concentrated in a small area such as a pen.	Animal and pet wastes are left to decompose on grass or soil. Wastes are scattered over a wide area.	Animal and pet wastes are flushed down the toilet or wrapped and placed in the garbage for disposal.	

	<i>High Risk (Risk Level 4)</i>	<i>High-Moderate Risk (Risk Level 3)</i>	<i>Moderate-Low Risk (Risk Level 2)</i>	<i>Low Risk (Risk Level 1)</i>	<i>Your Risk Score</i>
Landscaping and Site Management					
Landscaping	There is no landscaping to slow the flow of runoff. Soils are compacted, limiting infiltration. Yard is hilly, allowing runoff to occur.	No areas are landscaped to encourage water to soak in and soils are compacted. Yard is relatively flat, reducing the amount of runoff that occurs.	Yard is landscaped and soils are amended to slow the flow of stormwater and provide areas where water soaks into the ground. Yard is hilly, allowing some runoff to occur.	Yard is landscaped and soils are amended to slow the flow of stormwater and provide areas where water soaks into the ground. Yard is relatively flat and little runoff occurs.	
Yard and gardens	Large areas of yard or garden are left without mulch or vegetation for long periods.	Small areas of yard or garden are left without mulch or vegetation for long periods.	Grass or other ground cover is used, but is spotty, particularly on slopes.	Bare spots in the lawn are promptly seeded and topped with a layer of straw or mulch. Bare soil in gardens is covered with mulch.	
Paved surfaces	Large areas are paved for walkways, patios, and other areas.	Some small areas are paved for walkways, patios, and other areas.	Alternatives such as gravel, rock, paving blocks, brick, or flagstone are used for walkways, patios, and other areas.	Alternatives such as wood chips or mulch are used for walkways, patios, and other areas.	
Roof drainage	Most or all downspouts are connected directly to storm drains.	Most or all eave drip lines or downspouts discharge onto paved surfaces where water runs off.	Most or all eave drip lines or downspouts discharge water onto grassy or mulched areas where some water runs off.	Most or all eave drip lines or downspouts discharge water onto a grassy or mulched area or rain garden where water soaks into the ground.	
Lot during construction	Soil is left bare until construction is completed and no sediment barriers are used.	Soil is left bare until construction is completed. Sediment barriers are installed, but are poorly maintained allowing some muddy runoff to leave the site.	Soil is left bare until construction is completed. Sediment barriers are installed and maintained to detain muddy runoff until grass covers soil.	Bare soil is seeded and mulched as soon as possible (before construction is completed). Sediment barriers are used until grass covers soil.	
Buffer strips	Bare soil, sand, or gravel exists next to a stream bank or lakeshore. Stream banks or lakeshores are eroding.	Spotty mowed vegetation exists next to a stream bank or lakeshore.	Mowed grass exists next to stream bank or lakeshore.	Buffer strips of thick vegetation are left along a stream bank or lakeshore.	

Look over your worksheet scores for individual activities:

- **Low risk** practices (1s): are ideal and should be your goal. Cost and other factors may make it difficult to achieve a low risk rating for all activities.
- **Moderate-low risk** practices (2s): provide reasonable water quality protection.
- **High-moderate risk** practices (3s): do not provide adequate protection in most circumstances.
- **High risk** practices (4s): pose a serious danger of polluting water, especially over time if not corrected.

Consider how you might modify your practices to better protect ground and surface water. Some concerns can be taken care of immediately while others could be major or costly projects requiring planning and prioritizing before you take action.

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