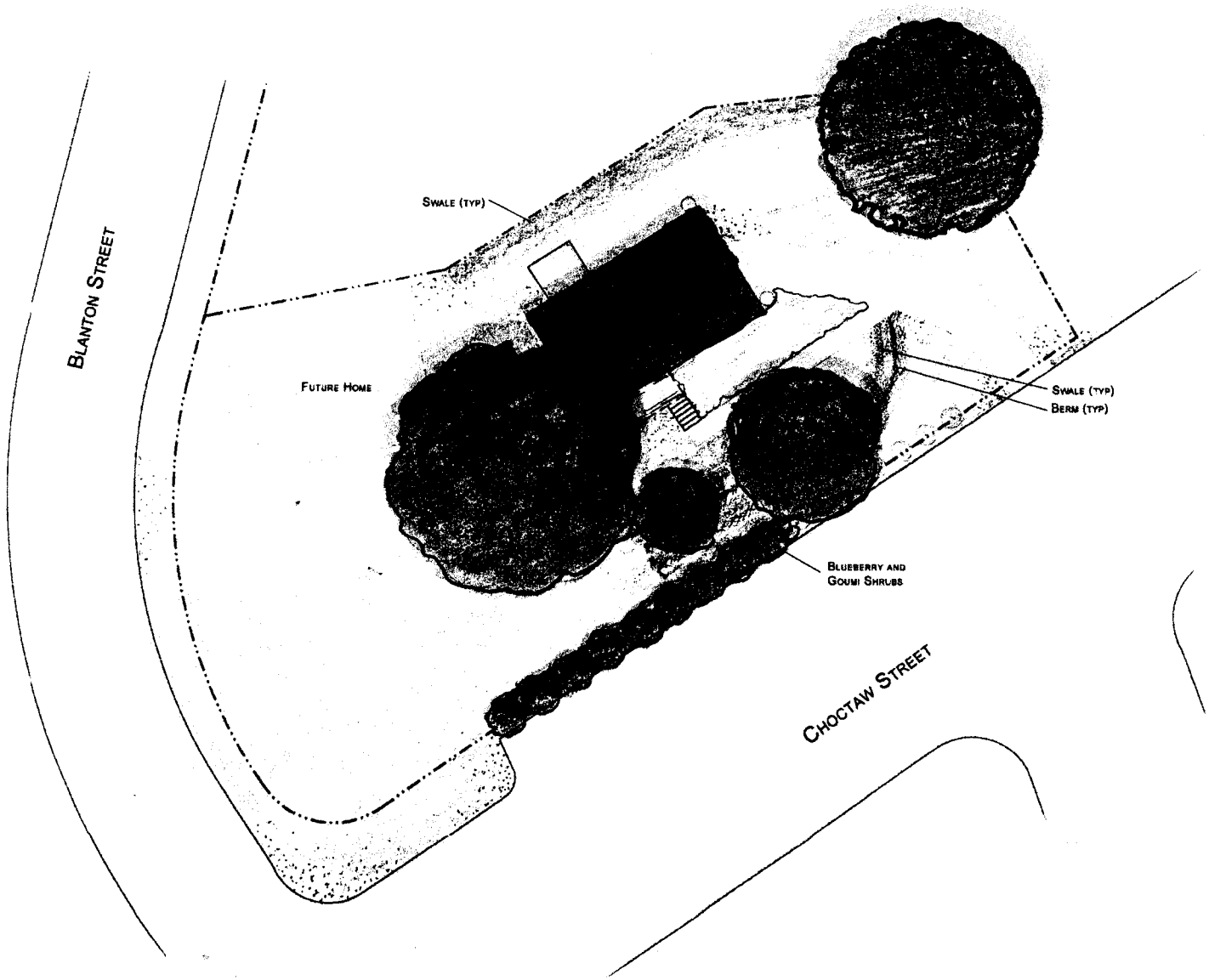

RIVER LINK

LinkingWaters
Phase 1

North

09/08/2010
Drawn By:
Nancy Hodges

Materials and Tool

A-Frame Level

1. Determine which end of the swale or berm has the most specific location needs (i.e., one end needs to end above a certain tree or rock, or below a sidewalk), and choose the exact point that you want the swale to start at on that end. Don't just randomly start on one end without considering this factor. Think about whether the line you are drawing is the bottom of the berm or the top of the swale, and plan this point accordingly.
2. Use that point for a starting location, and mark it with a **flag** or **chalkdust**.
3. Place one leg of the **A-frame level** on that point. Swivel the other leg until the weight in the center hangs exactly over the line in the middle of the level, indicating that the two legs are now exactly level with each other. Mark the second leg's position with a flag.
4. Now, don't lift the entire A-frame level up and move it. Instead, swivel it using the second leg as the pivot point, so the first leg now advances to the next point. Repeat #3 to find a level point.
5. Repeat steps #3 and #4 until a line covering the required distance is staked out.

Sheet Mulch

1. Using a weedeater, lawnmower, tractor or scythe, cut grass or vegetation where sheet mulching will be done.
2. If soil is extremely compacted, or inhabited by root systems of extremely hardy plants, consider to break up the soil. If you do use machines to break up soil, tilling or using other machines consider mixing in amendments such as lime, greensand, compost and rotting organic matter (leaves, mulch, straw) at that time.
3. Spray ground down with water until it's very wet, or at least somewhat wet depending on water availability.
4. If trying to kill existing vegetation, lay down 1-2" of fresh, high nitrogen animal manure. If not needing to kill existing vegetation, lay down 2-4" of well composted manure.
5. Lay down tightly overlapping cardboard, shingled going downhill like shingles on the roof of a house. Cardboard should be free of colored ink, and have minimal staples or tape. Large sheets are best. Cardboard can be sourced at bicycle stores, furniture stores, and cardboard recycling facilities. A truck is usually needed for getting cardboard. Overlap cardboard so any holes or gaps are covered and over-lapped by at least 6" horizontal inches of unbroken cardboard. If on a significant slope, shingle two rows like a house roof and the third row in the opposite fashion, with the downhill layer on top of the uphill layer, so as to allow water draining downhill to go under the cardboard and get to the ground.

Materials and Tools

6. Now, lay mulch on top of the cardboard. If planting trees and shrubs, use wood-based mulch or tree leaves. If planting vegetables, use a straw or hay mulch. Lay at least 2" but no more than 8" mulch.
7. Finally, spray the mulch with water to hold it into, settle down dust and wet the cardboard, which will then dry conformed to the shape of the ground underneath it.

Typical Tool List:

Hand rake
Machete
Japanese sickle
Hand pruner
Pruning saw
Line lever
A-frame level
Edging spade
Trench spade
Round shovel
Pulaski
Mattocks
Hard rake
Loppers
Tarp
Flags/chalk/marking paint

Water Infiltration Methods

inch wide by 4-inch deep trench that is sloping 2.5 percent, and the drop will be connected to the collection bin. An access grate will be positioned over the hole for pumping, and the gutters will be filled with pebbles for support, porosity, and aesthetic appeal. After a rain event, the bin will be pumped into a calibrated container, and water volumes will be measured and recorded. Sediment in each calibrated container will be allowed to settle until the container is needed again for the next measurement, at which time the amount of sediment will be recorded.

Procedures for collection drains

1. Cut holes in collection bin tops for drainpipes and pump
2. Mark locations for bins and trenches
3. Dig holes for collection bins 25"Lx20"Dx18"W
4. Dig 5"x4"x120" trench with 2.5% slope (3-inch drop in 120-inch length)
5. Insert collection bins
6. Attach drops from gutters to collection bins
7. Install the gutters
8. Install the access grates
9. Fill gutters with gravel for support

Soaker works:

Soaker works consist of a series of porous impediments positioned along the contours down a slope to slow the water and encourage infiltration. Two of these series will be implemented using different materials, locally milled black locust planks and kudzu bundles. In addition, an area without impediments will serve as a control area and have its runoff and sediment captured and measured, too. Each area to be drained is 10 feet long and 12 horizontal feet wide, which will be equally divided with three levels of the porous impediments for the soaker works. All three areas will have similar vegetative cover when the soaker works are installed: seeded with winter rye and covered with straw. The soaker works and control area will be installed in the eastern portion of the Site, north of the parking area and assigned an infiltration factor of 0.6 and a runoff factor of 0.4. The area is close to the SINMAP stability designation for Lower Threshold, and to maintain a conservative interpretation, its Stability Factor of 0.65 has been used for the calculations.

Procedures for soaker works:

1. Prepare 9 kudzu bundles by folding lengths of the vine back and forth on itself, making each bundle about 6 feet long with a diameter of 8-10 inches. When formed, use additional vine to tighten and wrap the bundle, using half-hitch knots along the length of the bundle until it holds together well.
2. Divide the areas for the soaker works into three levels.
3. Hammer in stakes at the same elevation to act as anchors for the locust planks and kudzu bundles. Two stakes may be enough for the locust planks, but the kudzu bundles will probably need four at each level.
4. Place the locust planks just above the stakes angled so that they can be hammered in to be well secured.
5. Place the kudzu bundles just above the stakes, with three bundles overlapping at each level.

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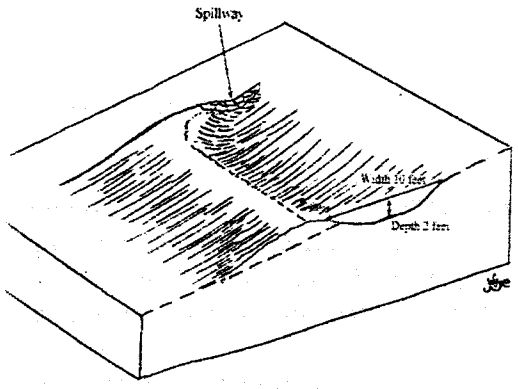
Water Infiltration Methods



6. We want the lowest point of the U-shaped swale to be 10-12" deep. Dig down with the mattock, and coming behind scraping the loose soil with a round spade, until swale is 10-12" deep in the middle, and begins angling back up towards the berm at that point.
7. Continue this process until the swale is a nice U-shape, 10-12" deep at the bottom, with no steep walls.
8. Rake the berm out smoothly with a hard rake, and compress it by repeatedly walking on it. You can stage a dance party on the berm to get it compressed.
9. Take sod and place it, roots facing up, just on the curve where the swale begins turning it into berm. This is the place where water does the most damage and the sod will help protect the berm from erosion.

Diversion Swale

1. A diversion swale is like a drainage ditch, except it uses a U-shaped profile rather than a sharply angled profile, which allows it to function longer and carry more water with less maintenance than a sharply cut ditch.
2. Assess size of swale needed to carry expected runoff load; assess exactly where the water needs to get to (point B), and where the swale needs to start (point A) to catch the water it needs to catch.
3. Using a line level or a transit, make sure that it's downhill from point A to point B. If there are any short sections in between point A and point B that have any appearance of being uphill instead of downhill, note them as you will need to dig them deeper to accomplish the overall downhill slope inside the swale.
4. Dig the swale using guidelines from the infiltration berm n'swale keeping a sloped wall at about 45 degrees.
5. In this case, you will not be creating a berm downhill of the swale. Bring soil to selected location.
6. Test swale with water to make sure the water runs where it should.
7. Seed swale with cover-crop seed appropriate to soil and light availability

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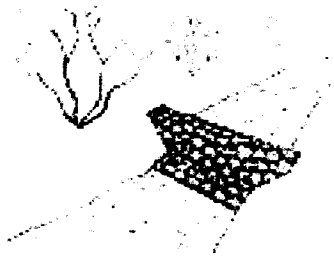
Curb Restoration

1. Removal any existing shrubs and/or trees within 2' of the curb
2. Flag or mark out a line 12" in from the curb.
3. Using an edging spade, connect the dots on that line with a 4-6" deep line cut in the grass, angling slightly (20-30 degrees) towards the curb rather than straight down.
4. Using a pick-mattock, go back along that line, digging and loosening the section of turf between the line and the curb, in an angled cut towards the bottom of the poured cement of the curb.
5. Using round spades, come behind the pick-mattocks scooping the soil out of the loosened area and placing it 12-24" uphill of the cut.
6. Separate turf (grass with roots and soil attached) from loose soil, placing turf even further uphill than loose soil.
7. Repeat #4 and #5 until the trench roughly creates a triangle, with an even slope proceeding from the cut-line on the uphill side of the trench to the bottom of the cement curb.
8. Once the trench is roughly the correct shape, come behind with an edging spade to sculpt it into a very even slope that looks good.
9. Using a hard rake and round spade, rake the soil that was dug out of the trench into a gently curved berm continuing the angle created by the sloped wall of the trench. Lay the chunks of turf upside down on the uphill side of the berm.

Infiltration Berm n' Swale

1. First stake out the location of the berm and swale as described in "D" with an A-frame level, making sure to think about exactly which part of the feature is the swale and which part is the berm, and what sizes you want them to be. Never try to design a swale and berm with total width less than 4', with 2' for the swale and 2' for the berm. 5-6' total width is a more realistic footprint for a mid-grade slope in a small urban yard, and it can get much larger depending on circumstances.
2. Now, using an edging spade dig a line connecting the points along the top of the swale. The line should be 4-6" deep, and sloping downhill at a 45 degree angle. Make sure not to dig straight down which would create a sheer wall to the swale, but instead dig at a 45 degree angle.
3. Come behind the edging spade with pick-mattocks, or pulaskis if the soil is very rooty, digging the 45 degree angle deeper.
4. Take sod and flip it uphill out of the way for the time being.
5. Take loose soil and move it downhill to where the berm will be located.

Myco-Filtration Gabion



1. Select exact location for myco-filtration device, ensuring that it is an appropriate use of this technique. See "Mycelium Running" by Paul Stamets.
2. Determine size of gabion needed by calculation of flow, pollutants and dimensions of flow area.
3. Calculate volume of wood chips, burlap sacks and mycelial inoculant needed.
4. Acquire freshly chipped tulip poplar woodchips, or other hardwood chips if poplar chips are unavailable.
5. In an appropriately sized **tarp-pit**, mix **woodchips** with **mycelial inoculant**, and moisten to the moisture level of a lightly dressed salad.
6. Stuff **burlap sacks** full of mixture, and seal burlap sacks with **twine** or old **baling twine**.
7. Using **standard digging tools**, dig a trench wide enough to lay the sacks longwise (long sides parallel to the length of the trench), and 1-2 sacks deep (depending on effluent flow).
8. Lay sacks in trench and stack up to 3 sacks high.
9. Pin sacks down using **rebar** or **bamboo stakes,** hammered with a **sledge hammer.**

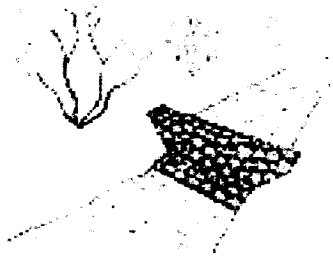
Crescent Berms

1. A Crescent berm is a level space, shelf, or raised barrier separating two areas with a curved shape where the end points are pointing in towards the center of a circle. The ends of the crescent should be tapered to blend in with the level of the soil just as you do for the rest of the berm. These often are located on slopes below the drip line of a tree.
2. First stake out the location of the berm as described in "D" with an A-frame level, making sure to think about exactly what size you want the berm to be at its widest point. 3-5' width is a realistic footprint for a high-grade slope in a small urban yard, and it can get much larger depending on circumstances.
3. Take loose soil and mound it in the shape, width and height desired for the berm.
4. Rake the berm out smoothly with a hard rake, and compress it by repeatedly walking on it. You can stage a dance party on the berm to get it compressed.
5. Cover bern with 4" of single ground hardwood mulch or other mulch of choice.

Collection drains with water/sediment collection bins:

A collection drain is a lined trench that directs water and sediment into a collection bin from which it will be pumped for measuring. Three collection drains will be installed for measuring and comparing water and sediment volumes captured from the base of each soaker work and from the associated undisturbed area. The water/sediment collection bins will consist of a 20-gallon storage container with holes cut into the top for water to be drained into or pumped out of the container. The bins will be installed sloping slightly towards the hole for pumping and positioned at the low end of a 10-foot section of aluminum rain gutter connected to a piece with a drop. The rain gutter will be placed in a 5-

Myco-Filtration Gabion



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Vegetation Removal

Kudzu

1. Cut vines back to ground using a **machete** or **Japanese sickle**, or a **hand pruner**. Two people work together so as to trace the vines back to the roots, and then mark the roots with **flags** or **chalk**. One person holds the vines up and uses a **hard rake** to scratch around on the ground ensuring the base of the root has been found; the other person cuts the vines. Vines are piled for composting and later use as high-nitrogen mulch, or for fiber extraction.
2. Using a **"trench" spade**, dig a conical hole around the root, widening the hole as necessary to continue exposing the root more deeply, without scarring or breaking the root itself. Continue until the root is followed down to a point at which the root is 1" or less thick.
3. Cut the root cleanly with a sharp spade or a hand pruner.
4. Pile roots in a shady spot on a **tarp**, waiting processing or disposal.
5. Fill hole back in and rake to smoothness.
6. Use a **cover-crop** area where roots have been removed. In spring or summer, use buckwheat. In fall or winter, use annual rye and Austrian Winter Peas. Mulch lightly with **straw**.

To process roots for medicinal use:

1. Thoroughly clean soil off roots, using buckets of water and old toothbrushes or larger dish brushes.
2. For food, store roots whole in a refrigerator or root cellar. Can be baked and eaten kind of like sweet potatoes.
3. For medicine, cut roots into chunks about ¼" by ¼". Dry in paper bags in the sun, or in a food dehydrator.

Shrub

1. Using **loppers,** cut one or two main branches of the shrub off at the bottom, allowing access to the main trunk.
2. With a **pruning saw**, cut the shrub's trunk at the base.
3. Using a **trench spade** and a **pick-mattock**, dig the root ball of the plant out of the ground.
4. Thoroughly shake and bang soil out of root ball of shrub, depositing soil in the hole that the shrub came out of. Bang the root ball against a metal tool like a spade or pick-mattock for better effect.
5. Pile root balls in one pile, and tree branches in another pile.
6. For use of juniper as smudge wood, cut into branches no longer than 12". Put those branches in paper shopping bags to dry in the sun.

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Possible economic niches related to Linking Waters Project
September 22, 2010

A. **On-site physical services**
1) Roof surface repair and replacement (replace asphalt shingles with enameled metal or split shakes)
2) Micro-keylining with Yeoman plow
3) Pond building
4) Gutter replacement/ rainwater diverters
5) Terracing and rock work
6) Mini-trackhoe operators
7) Yard maintenance (pruning, raking, mowing)
8) Food harvesting, processing for individual property owners
9) Sheep and goat rental
10) Fence and outbuilding construction
11) Wetland construction
12) Graywater system design and construction
13) Rain garden design and construction
14) Drip irrigation
15) Solar hot water
16) Rooftop gardens
17) Mushroom gardening
18) Composting and mulch management
19) Site evaluation for BMP's
20) Installation of permeable pavement
21) Bioremediation (phyto, myco, microbial)
22) Integrated pest management systems
23) Composting toilet design and construction.

B. Physical Products
1) Tool making
2) Mushroom innoculant production and retail
3) Nurseries of useful plants
4) Preparation and marketing of fish-based fertilizer
5) Building ferrocement cisterns, installing plastic cisterns
6) Salvage materials acquisition, sorting, storing and retail
7) Urban farm animal breeding and selling
8) Retail of solar dehydrators and ovens, Biopods, rocket stoves etc.
9) Water purification systems: local to industrial
10) Specialized compost tea preparation and marketing

C. Off-site services
1) Urban farm co-ordinator, harvester, marketer
2) Urban micro-hydro
3) City liason for stormwater regulations, help to find win-win solutions
4) Medicinal plant and herbalism consultant
5) Interfacing with MSD on legal level
6) Elder care and networking of elders to find multi-generational communities for elderly people to live and get involved with gardening
7) Activism changing regulations and incentives at state and local levels around urban water management and agriculture.
8) Land surveying, mapping, GIS work
9) Child care and education in gardens, outdoor education
10) Breeding useful plant cultivars
11) Municipal development and planning to incorporate urban food production

D. Informational services
1) Permaculture designers
2) City liason who knows codes, city regulations for "green streets", helps property owners to design to meet codes
3) Consultants of many types
4) Trainer for other municipalities doing same thing as model city of Asheville.
5) Developing permaculture curriculum for different audiences, especially public schools
6) Monitoring and data collection
7) Creation of specialty maps

E. Financial
1) Community investment co-ops, credit unions
2) Micro-venture capital co-ordination for all of these enterprises.

SEDIMENTS
Particles of soils, sand, silt, clay and minerals wash from land and paved areas into creeks and tributaries. In large unnatural quantities, these natural materials can be considered a pollutant. Construction projects often contribute large amounts of sediment. Certain lumbering practices affect sediments in runoff. Sediments may fill stream channels and harbors that later require dredging. Sediments suffocate fish and shellfish populations by covering fish nests and clogging the gills of bottom fish and shellfish.

PETROLEUM PRODUCTS
Oil and other petroleum products like gasoline and kerosene can find their way into water from ships, oil drilling rigs, oil refineries, automobile service stations and streets. Oil spills kill aquatic life (fish, birds, shellfish and vegetation). Birds are unable to fly when oil loads the feathers. Shellfish and small fish are poisoned. If it is washed on the beach, the oil requires much labor to clean up. Fuel oil, gasoline and kerosene may leak into ground water through damaged underground storage tanks.

ANIMAL WASTE
Human wastes that are not properly treated at a waste treatment plant and then released to water may contain harmful bacteria and viruses. Typhoid fever, polio, cholera, dysentery (diarrhea), hepatitis, flu and common cold germs are examples of diseases caused by bacteria and viruses in contaminated water. The main source of this problem is sewage getting into the water. People can come into contact with these microorganisms by drinking the polluted water or through swimming, fishing, or eating shellfish in polluted waters. Often unexpected flooding of barnyards or stock pens can suddenly increase the toxic effects of animal waste in water. Animal waste can also act as a fertilizer and create damage by increasing nutrients. (see Fertilizers)

ORGANIC WASTES
Domestic sewage treatment plants, food processing plants, paper mill plants and leather tanning factories release organic wastes that bacteria consume. If too much waste is released, the bacterial populations increase and use up the oxygen in the water. Fish die if too much oxygen is consumed by decomposing organic matter.

INORGANIC CHEMICALS
Inorganic chemicals and mineral substances, solid matter and metal salts commonly dissolve into water. They often come from mining and manufacturing industries, oil field operations, agriculture, and natural sources. These chemicals interfere with natural stream purification; they destroy fish and other aquatic life. They also corrode expensive water treatment equipment; and increase the cost of boat maintenance.

DETERGENTS, PESTICIDES AND FERTILIZERS
Many of these substances are toxic to fish and harmful to humans. They cause taste and odor problems and often cannot be treated effectively. Some are very poisonous at low concentrations. The major source of pollution from agriculture comes from surplus fertilizers in the runoff. Fertilizers contain nitrogen and phosphorous that can cause large amounts of algae to grow. The large algae blooms cover the water's surface. The algae die after they have used all of the nutrients. Once dead, they sink to the bottom where bacteria feed on them. The bacterial populations increase and use up most of the oxygen in the water. Once the free oxygen is gone, many aquatic animals die. This process is called eutrophication.

HEATED OR COOLED WATER
Heat reduces the ability of water to dissolve oxygen. Electric power plants use large quantities of water in their steam turbines. The heated water is often returned to streams, lagoons, or reservoirs. With less oxygen in the water, fish and other aquatic life can be harmed. Water temperatures that are much lower than normal can also cause habitat damage. Deep dams often let extra water flow downstream. When the water comes from the bottom of the dam, it is much colder than normal.

ACID PRECIPITATION
Aquatic animals and plants are adjusted to a rather narrow range of pH levels. pH is a measure of the acidity of a solution. When water becomes too acid, due to inorganic chemical pollution or from acid rain, fish and other organisms die.

PESTICIDES, HERBICIDES, FUNGICIDES
Agricultural chemicals designed to kill or limit the growth of life forms are a common form of pollution. This pollution results from attempts to limit the negative effects of undesirable species on agricultural crop production. Irrigation, groundwater flow and natural runoff brings these toxic substances to rivers, streams, lakes and oceans.