

An aerial photograph of a landscape featuring a prominent, winding river or stream that meanders through a patchwork of agricultural fields. The fields are in various shades of brown and tan, suggesting different crops or stages of cultivation. The river is a deep, dark green color. In the upper right corner, a small cluster of buildings and trees is visible, possibly a farmstead or a small village. The overall scene is a mix of natural and human-made elements.

Lines on the Land



United States Department of Agriculture
Natural Resources Conservation Service

www.ia.nrcs.usda.gov

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Look for the lines

Lines are all around us—lines made by nature and lines made by people. If you take time to look at those lines, they can tell you much about the way we live.

Our travel paths, homes, offices, and schools all form lines that help define our existence.

On the land, lines are a record of land ownership, field boundaries, cropping patterns, and natural forces. The lines we see on the land tell us whether it is being well cared for or if wind and water erosion are being accelerated by the actions of people.

This booklet is intended to help you become familiar with the lines and patterns you see on the land. It will help you understand which lines are a result of neglect and which are created by conservation farmers who care for the land.



Contour stripcropping adds graceful and colorful lines to the land.

*Lines on the land will tell you
much about the way we live...*

Crop lines



(L to R) Iowa's major row crop is corn, followed by soybeans, and then hay and oats.

Soil erosion lines



Sheet and rill erosion

Sheet and rill erosion occurs when water begins to flow off the land. Sheet erosion is difficult to see because the soil is lost in a way similar to a few sheets of paper being peeled from a tablet. Rill erosion leaves definite marks where the soil has been washed away.



Ephemeral erosion

Runoff water flowing from uneven landscapes tends to concentrate in natural, depressional channels. These channels can be reshaped and farmed across, but continued, concentrated flow takes away the soil. Eventually, a gully will form.



Gully erosion

Over time, heavy rains with gushing, concentrated runoff can seriously erode soil and create very large ditches or gullies on the land—thus, the term “gully washer” for a heavy rain.

Sediment trail



Sediment problems begin when raindrops dislodge bare soil...



...and complicate life downstream. Everyone is affected by mud in streams, lakes and reservoirs.

What causes soil erosion?

Soil erosion by water

How much soil is carried away by water depends on these factors that influence erosion:

- » Rainfall—more rainfall means more erosion.
- » Soil type—some soils erode more easily than others.
- » Length of slope—the longer a slope, the more erosion you can expect.
- » Steepness of slope—steep slopes erode more easily than gradual slopes.
- » Ground cover—the more completely your soil is covered with protective grasses, legumes, or crop residues, the better the erosion control.
- » Soil disturbance—even with ground cover, “fluffing” the soil underneath with tillage can lead to erosion.
- » Erosion control—practices such as contouring slow water runoff.



Long, steep hills with no ground cover in areas with heavy rainfall are highly susceptible to soil erosion by water.

Soil erosion by wind

Loose, bare, and dry soils are especially vulnerable to wind erosion. A wind as gentle as 13 miles per hour one foot above the ground can lift soil particles. The wind lifts particles off the ground and carries them a short distance, then they fall back to the ground and dislodge more soil particles. This process accounts for 50 to 80 percent of wind erosion.

The amount of soil erosion by wind can be estimated by these factors:

- » climate
- » how easily the wind can lift certain soil types
- » roughness of a soil ridge
- » distance across a field with no barriers
- » types and amounts of vegetative cover



Soil blown by wind is often dropped into road ditches.

RUSLE2

A formula known as the **Revised Universal Soil Loss Equation 2 (RUSLE2)** helps land users and conservationists estimate the average amount of annual soil loss. RUSLE2 estimates soil loss from sheet and rill erosion caused by rainfall on cropland. From this estimate, current soil loss conditions and plan prevention practices can be assessed.

RUSLE2

Revised Universal Soil Loss Equation 2

$$A = RKLSCP$$

A = average annual soil loss from rill and interrill erosion caused by rainfall and its associated overland flow expressed in tons/acre/year

R = climate erodibility

K = soil erodibility measured under a standard condition

L = slope length

S = slope steepness

C = cover management

P = support practices

How to slow erosion

The basics— slowing erosion

Covering the ground prevents raindrops from bombarding the soil and dislodging soil particles. Grasses, legumes, crop residues, and trees and shrubs are most often used by farmers to protect the soil.

The other basic way is to slow the water's path down a hillside. If water is caught and detained on a hillside, such as it is with contoured and terraced fields, erosion will be reduced.

Covering the ground is also a very effective way to control erosion by wind. It is the most commonly used method.

Another way to reduce erosion by wind is with wind barriers. The barriers – most often natural windbreaks of planted trees and shrubs – break the wind.

These barriers may be around farmsteads, as farmstead windbreaks, or in long rows as field windbreaks.



A windbreak can protect the area behind it for a distance up to 10 times the height of the tree.



Crop residue protects the soil against both wind and water erosion.



Live plants protect the soil.



A combination of ground cover—crop residue and hayland in this case—and terraces offer excellent erosion control.

Residue management

Properly managing the amount, orientation and distribution of crop and other plant residue on the soil surface will help significantly reduce soil erosion.

Reducing tillage helps farmers save soil, time, and energy. A high residue system also helps build soil organic matter over time.

Three common types of residue management practices in Iowa include no-till, vertical tillage, and strip-till. **No-till** prepares a seedbed and plants with 10 percent or less of the ground surface disturbed. **Vertical tillage** involves lightly tilling the soil and cutting up residue. With **strip-till**, residue-free strips of soil are tilled ahead of planting using a knife apparatus, such as a fertilizer injection shank.



Comparison to the familiar

Crop residues spread across the surface of a field could be compared to the cheese sprinkled over a pizza.



No-till corn-on-corn (top); corn residue is still protecting the soil while a farmer prepares to harvest the next year's soybeans (left); a north central Iowa farmer prepares strips before spring planting (right).

Contour farming



Both soil and energy can be saved with contour farming.

Comparison to the familiar

If you've ever put a coin into a funnel-type wishing well and watched the coin go around and around the funnel, you know the concept of contouring.

Contour farming is farming with row patterns nearly level around the hill. Each crop row serves as a small dam to hold water on a slope.

In contrast, crops planted in rows up and down a hill make water run off the slope faster; this leads to soil erosion.

Compared to up and down hill farming, contour farming can cut soil losses by as much as 50 percent on long, gentle slopes.

Contour stripcropping



Contour stripcropping combines the soil savings of contouring and crop rotations. Planting alternating contoured strips of row crops, small grains, and hay on a hillside can reduce soil losses up to 75 percent from those on hillsides farmed up and down hill with continuous row crops.

Stripcropping is an excellent conservation choice for a farmer who needs small grains and hay.

The bands of hay or small grain in stripcropping slow runoff and trap sediment from row crop strips above them.

Comparison to the familiar

The stripes on a waving American flag and contour stripcropping have a similar appearance.



Crop rotation

Since row crops are most likely to expose barren topsoil, continuous row cropping on soils prone to erosion by water or wind can create soil erosion problems.

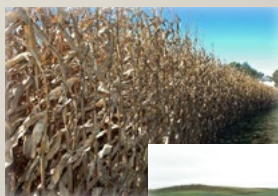
To hold soil on row cropped land, conservation farmers often rotate their crops. For example, on a steep slope planted to corn or soybeans, a farmer might choose to alternately grow small grains and hay in later plantings.

Legumes, such as alfalfa and clover hay, in the rotation improve the tilth of the soil and make it more fertile. The length of time any one crop is in rotation can vary widely.

To keep each field in a crop rotation, the year one field is growing alfalfa, an adjoining field may be growing oats.



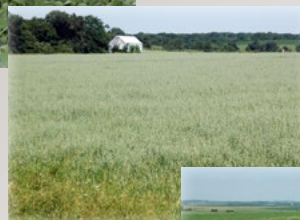
Legumes in a crop rotation give the soil a rest from row crops; this builds the soil and protects it from erosion.



*Year 1
Corn*



*Year 2
Soybeans*



*Year 3
Oats*



*Year 4, 5, 6
Alfalfa*

Comparison to the familiar

A farm with crop rotations looks like a quilt; each patch of the quilt represents a different crop.

Field borders



Field borders – strips of grass at the edge of a field – are also called grass headlands and grass turn strips.



Comparison to the familiar

A field border used on all sides of a field looks like a picture frame.

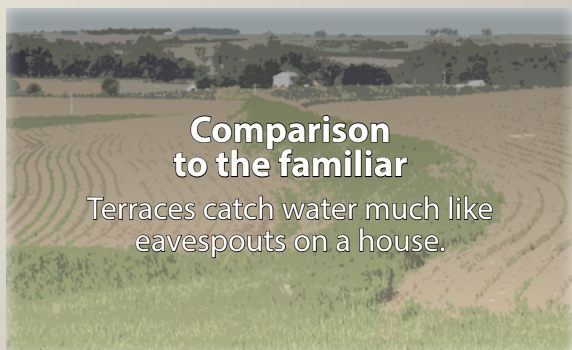
A field border is a strip of perennial grass, legumes, or a mixture of the two established at the edge of a field used in place of end rows.

The grass or legume strips on the edges of fields can be used as a turn strip for farm machinery. They eliminate up and down hill end rows that could cause soil erosion, and provide wildlife habitat.

Terraces



Terraces are mounds of soil built around a hillside. The entire surface of a broadbase terrace is farmed (left); only the front or uphill side of a grassed backslope terrace is farmed (center); and none of the narrow-based terrace is farmed (right)



Comparison to the familiar

Terraces catch water much like eavespouts on a house.

Terraces reduce soil erosion by breaking long slopes into a series of shorter slopes. On shorter slopes, water doesn't build up as much speed and has less power to tear away soil particles. Terraces catch water at intervals down the slope and temporarily store it before delivering it through underground tile or a grassed waterway to the bottom of a slope. Combined with no-till or another high residue system, terraces give excellent soil protection on most slopes.

Grassed waterways



Grassed waterways carry concentrated runoff water from hillsides without causing soil erosion.

Comparison to the familiar

A grassed waterway works like a water slide to safely carry concentrated flowing water from a field.

Grassed waterways are areas planted to grass or other perennial vegetative cover where water usually concentrates as it runs off a field.

Runoff water from heavy rains does not flow evenly off a field; it works its way to the bottom of a slope through natural depressions, or channels, that have formed over time.

If these natural drainage ways are continually cultivated, the

soil within them becomes bare, loose, and vulnerable to erosion –gullies usually form.

However, if the watercourses are shaped into a parabolic form and seeded to a grass cover, the grass will lay down like a carpet as water flows over it. The soil is undisturbed, and cleaner water is delivered to streams, lakes, and reservoirs.

Contour buffer strips



Strips of grass on a contoured field break up a long slope of newly planted row crops.

Comparison to the familiar

Contour buffer strips look like the narrow rings of a dart board or the white strips on a football field.

Farming on the contour keeps topsoil in place. But longer slopes may also need to be broken up from row crops to slow the flow of water. An excellent way to do this is with wide strips of grass or legumes that alternate with row crops.

However, when a farmer wants more row crop acres than contour stripcropping allows, contour buffer strips may be used. These narrow strips of grass trap sediment that move down the hillside with runoff.

Grass buffer strips help establish contour farming patterns and their grass offers habitat for wildlife. Wider grass strips provide better protection from erosion.

Contour buffers strips can also provide needed forage for livestock.

Filter strips



Filter strips are bands of vegetation along streams or other bodies of water. They filter sediment and other pollutants from runoff water before the water enters streams, lakes, rivers, and reservoirs.

The vegetation is most often grass but in some cases trees are also planted to work with the grass. Their roots can absorb nutrients that might otherwise enter the water.

The most effective filter strips are those established at the bases of gentle, even slopes that have

fairly uniform, non-concentrated runoff from the slope. The filter strip, if wide enough, will slow runoff water enough that sediments settle out.

Filter strips do not take the place of upland soil conservation practices; they are the last line of defense to prevent contamination of water bodies. These areas of vegetation alongside watercourses also mean farming operations are kept farther away from water, which slows stream bank erosion and distances any chemicals from the water body.

Comparison to the familiar

Filter strips filter sediment and other contaminants from water like the lint filter in a clothes dryer.



Cover crops



A cereal rye cover crop is planted temporarily to protect the soil after harvest through the spring planting season..

Cover crops, such as cereal rye, oats and winter wheat, are planted temporarily to protect the soil from wind and water erosion. They hold nutrients in the field with a living crop during times when row crops are not growing.

Planted in the fall, cover crops help reduce erosion, limit nitrogen leaching, suppress weeds, increase soil organic matter, and improve overall soil quality. Small grain cover crops increase

surface cover, anchor corn and soybean residues, increase water infiltration and reduce erosion.

Timing is critical for cover crop management. They must be planted early in the fall to allow for good establishment before winter, but also must kill winter hardy cover crops soon enough to prevent yield losses in the following crop.

Comparison to the familiar

Cover crops hold nutrients and soil in place with a live growing plant similar to grass on a lawn.

Tree and shrub plantings



Trees offer protection for wildlife, and the fruit of shrubs is an attractive food for birds. Tree and shrub planting is encouraged by a number of government programs that offer technical and financial assistance.

Comparison to the familiar

In a sea of corn and soybeans, tree and shrub plantings are an island of food and shelter for wildlife.

Most farmland has odd areas, erodible steep hills, wet soils, or other areas suitable for trees and shrubs. Tree and shrub plantings cover the ground, add variety to the landscape and are among the best sources of food and cover available to many species of wildlife.

The trees may be managed as forest for commercial harvest, or simply as a natural area.

Windbreaks



Comparison to the familiar

Windbreaks work like any barrier to block the wind. Multiple rows of trees are as effective as buildings or other man-made barriers.

Trees planted in rows at right angles to prevailing winds can block the wind enough to control wind erosion. Rows of trees planted in crop fields are called field windbreaks.

Multiple rows of trees and shrubs planted on two or more sides of farmsteads are called farmstead or feedlot windbreaks. They lower energy costs at the farmstead, increase livestock gains, beautify the farmstead, and offer food and shelter for wildlife.

Farmstead windbreaks can also control snowdrifts at a farmstead in the winter.

Farmstead windbreaks control drifting snow and attract wildlife to a farmstead. Trees are planted in windbreaks by hand or with mechanical tree planters.

Better land...better water



Land that is well cared for results in better groundwater and surface water.

It's been said that what goes on the land goes into the water. Indeed, most contamination of ground and surface water is a direct result of actions on the land.

Those lines on the land that are good for the soil, such as those used to prevent erosion, are also good for the water. Sediment, along with a certain number of chemicals carried with sediment particles, are major water contaminants. As soil conservation practices keep topsoil in place, they also prevent sedimentation and pollution of streams, lakes, and water supplies.

Farmers are seeking ways to farm with fewer chemicals, and to use only the amounts they need. For instance, where farmers once used maximum amounts of nitrogen fertilizer, many are grid testing their soil to determine whether to apply more. Their intent is to apply only what the crop can use, where it is needed.

There is an increased sensitivity to how contaminants reach groundwater, as well. Abandoned well plugging program, proper handling of livestock wastes, alternative methods to control pests, and careful calibration of farm chemical machinery are ways farmers control potential groundwater contaminants.



Clearer, cleaner water is a goal of soil and water conservation programs.



It's common to see farmers testing their soils for nutrients to avoid over-applying. It's important to test soils for P&K levels to reduce the risk of surface water impairment.



More livestock producers are building concrete waste storage facilities to reduce manure runoff, which keeps Iowa water bodies cleaner and safer.

Flooding impacts

Agricultural flooding and untimely heavy rain events over the past decade are putting an even bigger emphasis on where we farm, how we use land, and how we protect the soil.

Where we farm

Planting row crops along stream and river banks (right), for instance, can have detrimental effects to crop performance, future land use, water quality, wildlife, and people living downstream.



Land Use

All across the state land is being converted to row crops from pasture, hay, CRP, and forested areas. This type of land is often susceptible to erosion, causing the most havoc in times of flooding and heavy rains. The photo at right is an example cropland, despite being terraced, still incurs soil erosion. This land is better suited for grassland.



Soil Protection

A high residue system will dramatically reduce the amount of soil that runs off your farm. Cover crops can also provide adequate protection during the fall and winter months. Many of the practices detailed in this brochure protect the soil best when working in combination with other practices. At right, a farmer combines no-till, terraces and contour farming to protect against soil erosion after spring planting.



Operation & maintenance

Another key component to reducing soil erosion is properly maintaining conservation practices. All standardized practices include an Operation and Maintenance section that is included in the conservation plan.

When practices are poorly maintained, it becomes most apparent during heavy rain events. That's when neglected conservation practices are the most susceptible to damage.

Grassed waterways (top right) are a very common practice in Iowa to prevent gully erosion. During heavy rains it is not uncommon to see water running down the side of a waterway, instead of into it. Proper practice is to plant into the waterway and lift the implement over the waterway, instead of planting parallel to the grassed waterway, to allow water to flow into it.

Terraces (middle right) can also fail during heavy rains. It is important to remove sediment build-up in the terrace channel and around the intake, repair sections which have eroded, and control rodents and burrowing animals.

With livestock waste storage facilities (right), it is important to have a plan for removing water and waste during heavy rains to prevent overtopping or spills. Keeping pickets cleaned out is also necessary to allow the facility to work properly.



Conservation by design

A conservation plan is a critical document for farmers; many of their U.S. Department of Agriculture (USDA) program benefits are tied to how they care for the land.

The best conservation plan is one that has been designed especially for a specific farm. A farmer consults with soil conservationists, foresters, agricultural engineers, economists, soil scientists and other specialists to develop options about possible conservation practices. Among their considerations are soil types, erosion potentials, nearby water bodies, and farming goals.

After examining the options, the plan is developed. It lists which conservation practices will be used and where they will be applied. The plan also includes a schedule of when each practice will be applied.

It is farmers, the people closest to the land, who ultimately make the decisions that affect everyone who depends on the land. Conservation lines on the land result from their decisions.



Conservation help nearby

Conservation— a cooperative effort

Anyone who wants help or advice on soil and water conservation practices doesn't have far to go to find it. Every county in Iowa has a soil and water conservation district and a local NRCS field office located at USDA Service Centers. To find your local USDA Service Center, visit <http://offices.sc.egov.usda.gov/locator/app?state=ia>.

A unique working arrangement allows local, State, and Federal governments to share office space and coordinate soil and water conservation programs and water quality improvement programs in Iowa.

Soil and water conservation districts (SWCD) – subdivisions of State government – serve as local coordinators for several local, State and Federal programs. Each district is guided by locally elected commissioners.

The State Technical Committee and the Iowa Department of Agriculture and Land Stewardship's Division of Soil Conservation (IDALS-DSC) guide State programs, including financial assistance, for most conservation practices. State programs also fund secretarial and technician positions in local USDA Service Centers.



USDA provides technical and financial help

USDA offers technical and financial assistance through the Natural Resources Conservation Service (NRCS).

We help land users plan for and apply soil and water conservation practices. Technical help is available at no cost. Other NRCS activities, done in cooperation with the other conservation agencies, include making soil surveys, monitoring soil and water resources, and controlling upstream flooding.

Local NRCS field offices are located in every county. We are listed in the telephone directories in the United States Govern-

ment section under the Department of Agriculture. Iowa NRCS information is available online at www.ia.nrcs.usda.gov.

Services available to everyone

All programs and services of these conservation agencies are offered to everyone on a non-discriminatory basis without regard to race, color, national origin, religion, sex, age, marital status, or handicap.



Natural Resources Conservation Service

Des Moines, Iowa

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