lowland peat / good structure

Peaty loam

Rough and coarse seedbeds are at less risk to wind erosion (although these are still vulnerable when the wind speed is greater than 20 mph).

Skirtland soils, where the peat has degraded (due to ' wastage'), and where peat has been mixed with the mineral clay subsoil, are more stable and are at less risk to wind erosion.

lowland peat / poor structure

Peaty loam

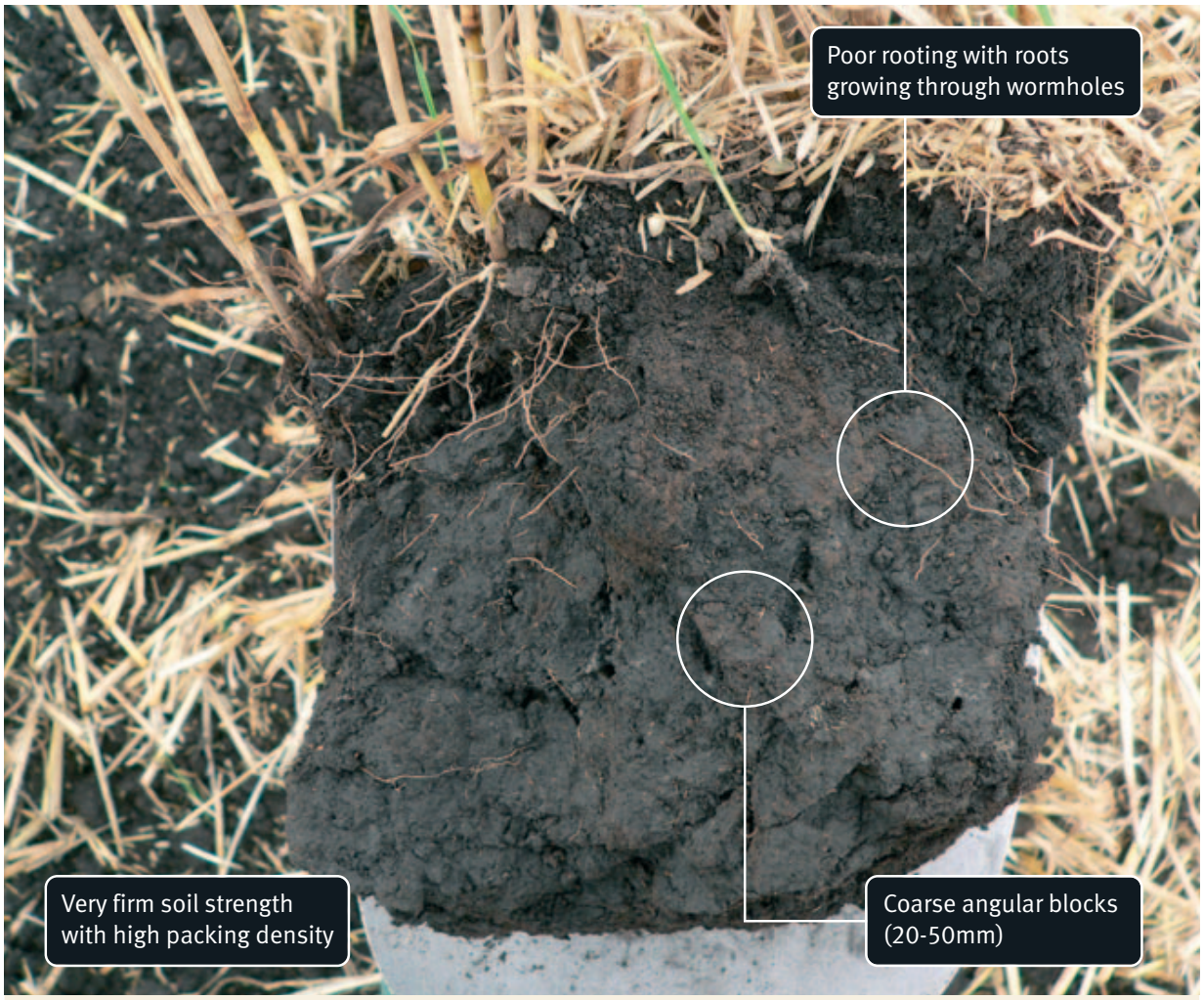
Bare peaty fenland soils are at risk to wind erosion where the soil is dry and soil particles are less than 1mm diameter.

lowland peat / good structure

Peaty loam

Peay loam topsoil with good soil structure. The large organic matter content produces a stable structure.

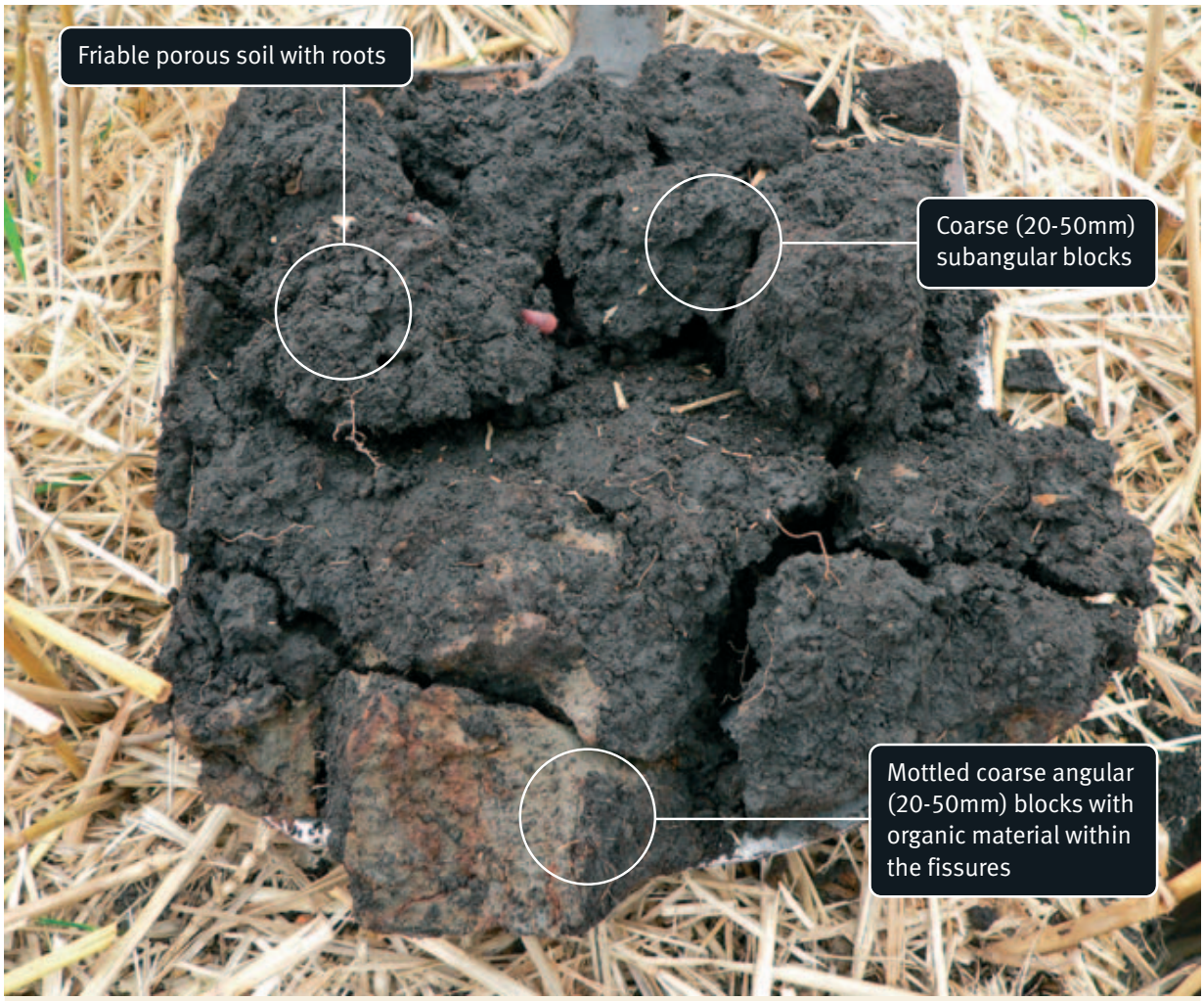
lowland peat / poor structure



Peaty loam

Peaty loam topsoil with poor soil structure along compacted wheelings.

lowland peat / good structure

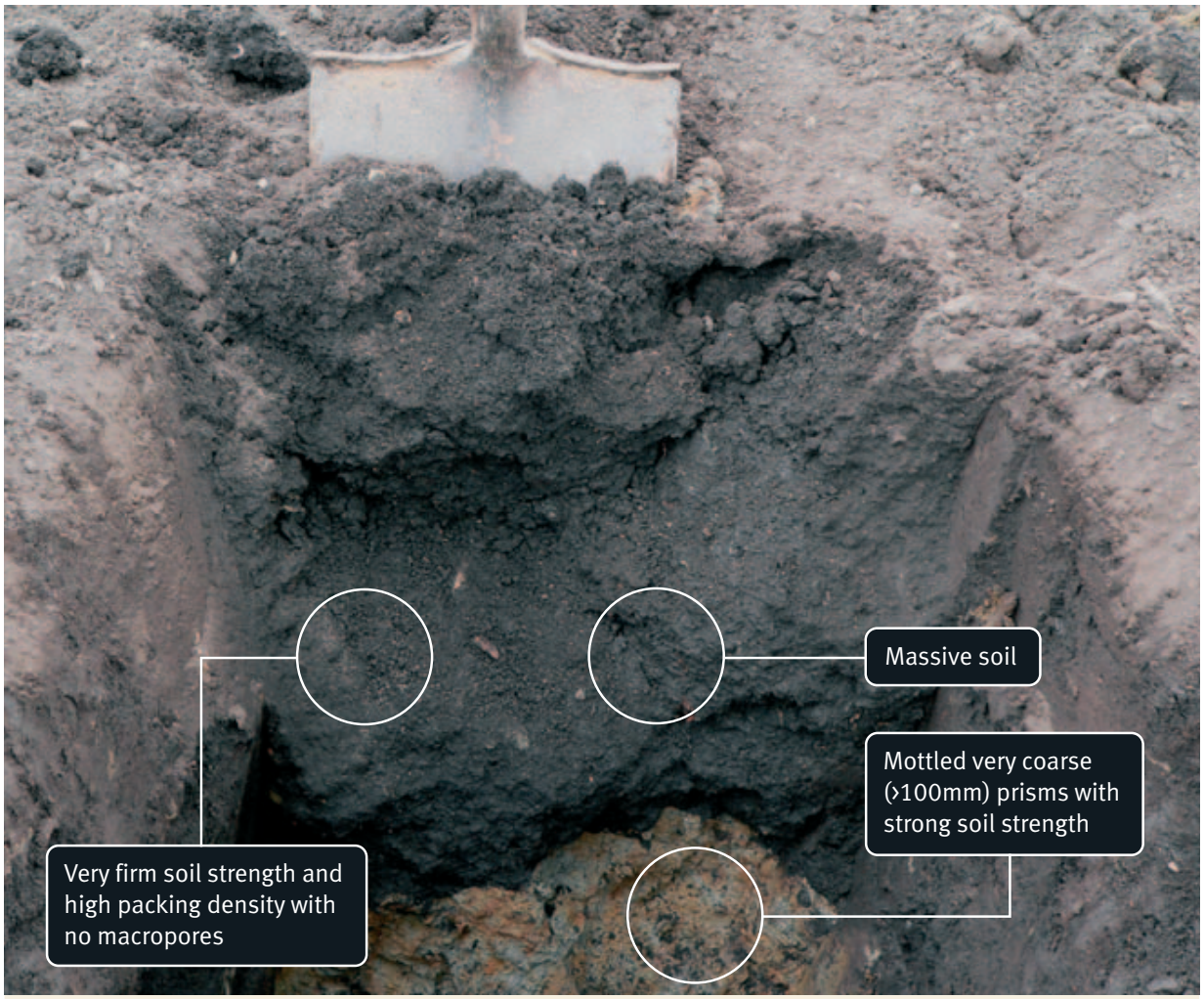


Peaty loam over silty clay

Well-structured peaty loam overlying a silty clay mineral subsoil.

Agricultural land is highly dependent on artificial drainage to lower the water table. A low water table and good soil structure accelerate peat wastage due to oxidation, shrinkage and consolidation.

lowland peat / poor structure



Peaty loam over silty clay

Poorly structured peaty loam overlying silty clay.

Farm traffic in wet conditions can damage the soil. Poorly structured soils have poor drainage which can lead to ponding and reduced crop yields. However, runoff is unlikely on flat fields.

Deep cultivation and subsoiling can correct poor soil structure, provided the soil is dry enough and there is an economic need.

thinksoils

Appendix I
General principles to avoid erosion and runoff

general principles to avoid erosion and runoff

Soil

Know the soil types on the farm, their inherent risks and capability, particularly in relation to wetness and stability.

Regularly dig to assess soil structure to aid decisions on any necessary remediation.

Weather

Use crop cover to protect unstable soils against the battering action of rain and erosive power of wind.

For example:

- drill winter cereal crops early in September to ensure good crop cover before the onset of winter rain.
- plant nurse crops to prevent wind blow.

general principles to avoid erosion and runoff

Landscape

Avoid steep slopes and channelling water onto roads and into watercourses when growing high-risk row crops.

Plant grass strips in natural drainage pathways (prone to gulley erosion) to help stabilise the soil and to act as a soakaway.

Plant shelterbelts of hedgerows and rows of trees to prevent wind erosion.

Land use

Timeliness of landwork is essential to avoid unnecessary damage to soil structure.

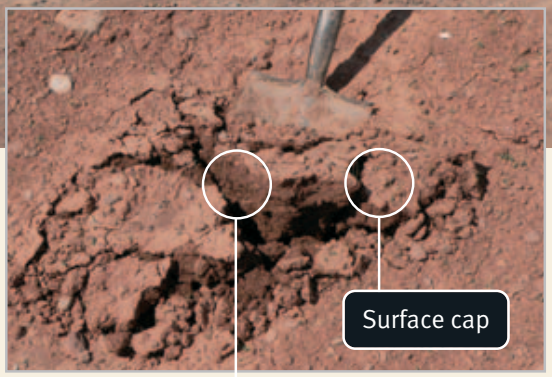
Remove compaction by cultivating and subsoiling at the correct depth when the soil is suitably dry.

Aim for a high level of organic matter.

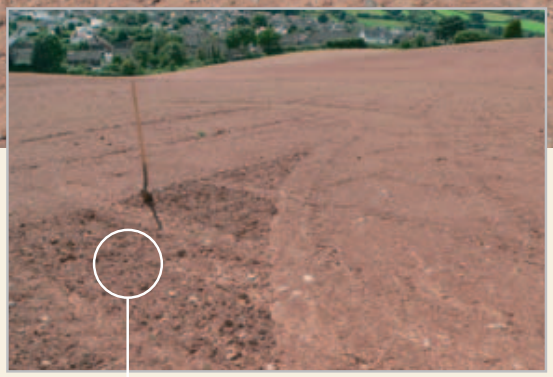
thinksoils

Appendix II
Case studies
Further information

runoff and soil erosion from seeding of grass



Soil surface with massive soil structure in the top 5cm of soil



Small section of soil that had not been rolled where there were no signs of runoff, capping or poor soil structure.

A storm event during the spring caused runoff, soil erosion and flooding of roads and nearby property. A 9 ha field with long steep slopes (›7°) had been seeded with grass. The soil had been rolled to conserve moisture.

Soil assessment

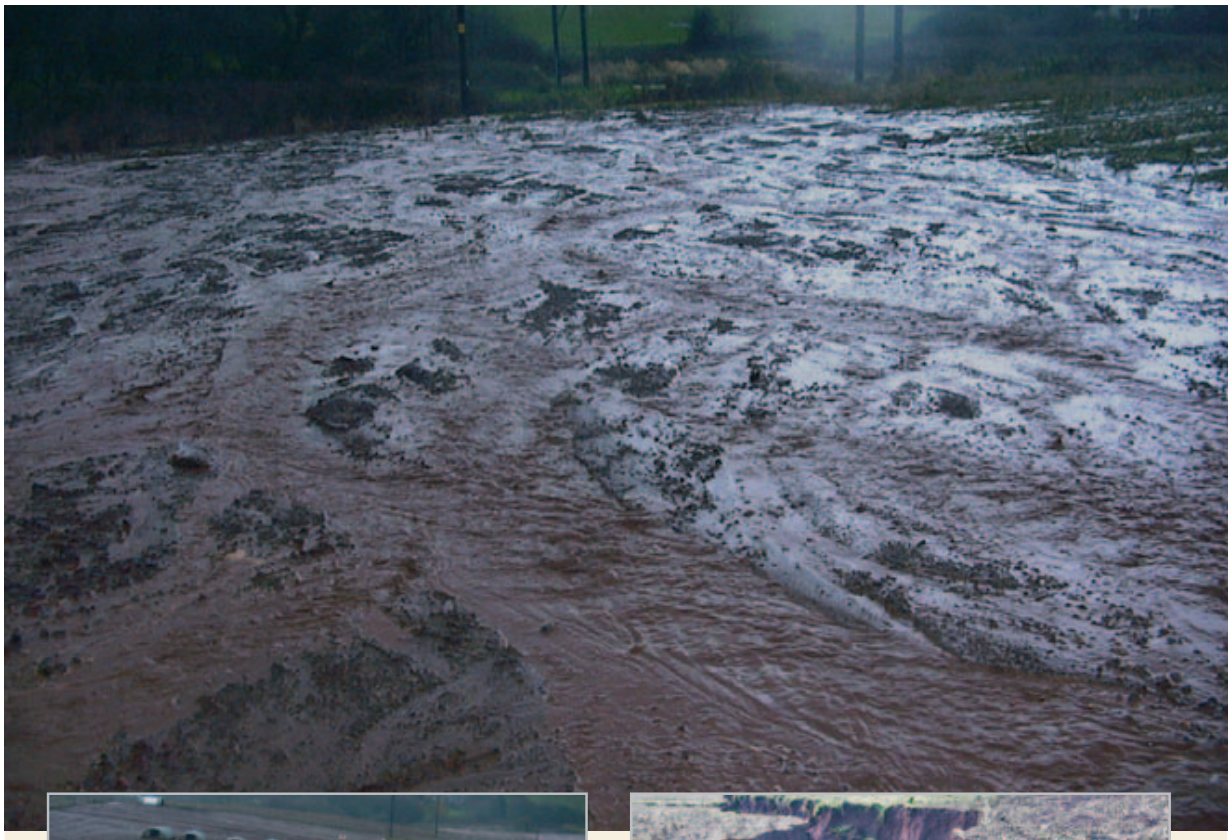
Examination of the topsoil revealed poor soil structure in the top 5cm of soil. The surface was also capped. Water had washed along wheel marks down the slope. Rolling of moist soil together with the battering action of heavy rain is likely to have caused poor soil structure.

The reduced permeability of the topsoil probably exacerbated runoff and soil erosion. A small section of soil that had not been rolled had better soil structure in the topsoil, with no signs of runoff.

Remedial options

- Lightly cultivate field in the short term to remove compacted surface layer to prevent further runoff, re-sow with grass if necessary.
- In future, consider creating soil surface roughness and/or sowing into loosened stubble on high risk fields.

serious soil erosion from fields with outdoor pigs



Ponded water and runoff

Serious gulley erosion

Moderate rainfall caused excessive runoff and serious soil erosion from fields with outdoor pigs. Large amounts of sediment entered a nearby stream.

Soil assessment

Soil structure in the topsoil was very poor. Trampling by outdoor pigs had sealed the soil so that even under moderate rain there was excessive runoff. The catchment area was large (›20ha) with steep slopes (›7^0) and flow was concentrated in a valley causing a 3m deep gulley.

Remedial options

- Cultivate paddocks under suitable conditions to remove compacted surface layer and to improve infiltration of rainwater in the short term.
- Move pigs to shallower slopes away from nearby watercourses.
- Fill in the gulley and plant with grass to stablise the soil and to enable runoff to soakaway.

runoff from a field with out-wintered cattle

Intense rainfall caused excessive runoff from a 5 ha field with moderate slopes (3-7^0). The field was used for out-wintered cattle being strip grazed on kale. Runoff from the field caused flooding of the adjacent road.

Soil assessment

Examination of the topsoil revealed poor soil structure in the top 5cm. Soil texture was sandy loam. Trampling of the soil by cattle and farm traffic in wet conditions caused poor soil structure. This in turn reduced the ability of the soil to accept heavy rain, causing runoff. Water had also washed along wheelings to the gateway. There was no runoff from similar soils in adjacent fields that had better soil structure.

Remedial options

- Back-fence the cows, and cultivate the field under suitable conditions to remove compacted surface layer and to improve infiltration of rainwater in the short term.
- Out-winter cattle in fields away from roads and watercourses.
- Consider alternative field access so that water is not channelled onto the nearby road.

soil erosion from a field of parsnips

Headland and tramlines that have been cultivated to remove surface compaction

Heavy rainfall caused soil erosion from a field that was used for growing parsnips. This resulted in a large amount of soil deposited on the road, and sediment in the adjacent stream.

Soil assessment

The field had a soil texture of sandy loam with a moderate slope (3-7^0). The main source of runoff was from wheelings between the vegetable beds. Poor soil structure was found in topsoil and subsoil in the headlands, which were acting as a source and conduit for runoff. The soil had capped although there was little sign of runoff from the parsnip beds.

Remedial options

- Cultivate soil along the wheelings between vegetable beds and along headlands to remove the compacted surface layer and to improve infiltration of rainwater.
- After winter harvesting, cultivate the field as soon as weather permits to remove surface compaction and the risk of further soil erosion. Subsoil if necessary, at a later date when the soil is sufficiently dry.
- Lay out vegetable beds and move gateway so water is not channelled onto nearby roads and watercourses.

wind and water erosion from a potato field

A field with a moderate slope (3-7^0) was used for growing potatoes. The soil was fumigated and rolled, leaving a fine smooth surface. In the spring a strong wind blew across the field causing fine sand to blow onto a neighbouring road. The wind erosion resulted in an approximate loss of 10 t/ha of topsoil. This was followed by heavy rain, causing further erosion and an approximate topsoil loss of over 60 t/ha.

Soil assessment

Examination of the topsoil revealed poor soil structure. Soil texture was sandy loam, and heavy rain had also caused the soil to run together to form a surface cap.

Remedial options

- Lightly cultivate the field along strips to loosen the soil at strategic places following fumigation in order to intercept runoff and to reduce wind erosion.
- Carry out fumigation on fields away from roads and watercourses.
- Increase the soil organic matter content in the long term by applying manures to improve soil structural stability.

wind erosion from fields of sugar beet and vegetables

Rough seedbeds help reduced the risk of wind erosion

Imported compost used to improve soil stability

Fields with shallow slopes (2-3^{0}) used for growing sugar beet, carrots and onions had problems of wind erosion. Wind erosion caused soil to blow into ditches.

Soil assessment

Wind erosion was at most risk on large flat fields with fine sand and loamy sand soil textures.

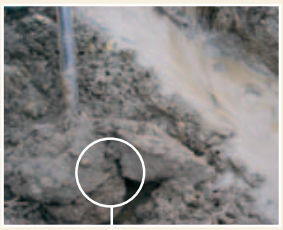
Remedial options

- Organic matter is imported onto the farm including poultry manure and compost.
- Coarse seedbeds are used where possible.
- Non-inversion tillage is used to establish cereals (to help build up organic matter on the soil surface), and is being tried on some beet land.
- Fields are split so that a range of crops are grown to reduce the risk of wind erosion.
- Onions are planted on the highest risk fields as sets rather than seed because they have a better ability to withstand and limit wind blow.
- Nurse crops of barley are used with sugar beet.
- Fleece and polythene used on the farm has an added benefit of preventing wind erosion.

Case study: Farmacy plc

excessive runoff from fields with maize stubble

Waterlogged topsoil over relatively dry structureless subsoil



Structureless clayey subsoil

Sediment pollution of nearby river

Excessive runoff occurred during the winter from fields with maize stubble, causing sediment pollution of an adjacent river. The field had been chisel ploughed following harvest.

Soil assessment

Soil texture was clay loam overlying slightly mottled clay in the subsoil. Examination of the soil revealed poor structure below the cultivated layer. The subsoil was much drier than the topsoil. Slow drainage due to poor soil structure was causing waterlogging in the topsoil, and subsequent runoff on steep slopes (›7°).

Remedial options

- Subsoil the field when the soil is dry enough to achieve shattering.
- Aim for early harvesting of maize in dry conditions, by planting early in the spring and choosing early-maturing maize varieties.

runoff from a field with a cereal crop

Chisel ploughing in part of the field to remove compacted layer

Good soil structure following chisel ploughing with improved crop yield

Continuous direct drilling of cereal crops and grass leys had been carried out on a field for 13 years. The soil surface was regularly waterlogged during winter, causing runoff onto the road which then drained to the nearby watercourse.

Soil assessment

The soil was a clay loam over a clayey subsoil, and parts of the field had steep slopes (>7^0). Soil examination revealed a layer of soil with high packing density and slight porosity at 5cm depth that was causing waterlogging at the soil surface. Organic matter content in the topsoil was relatively high (5.4%) probably due to minimal cultivation over 13 years. There were few earthworms (that are normally abundant with minimum tillage), probably because of the long periods of waterlogging.

Remedial options

Part of the field was chisel ploughed (to a depth of 20cm) to loosen the topsoil. A strip was left uncultivated so that crop performance could be compared between the two areas. Yield of whole crop silage was increased by 27% in the chisel ploughed area, and this part of the field had better soil structure with no runoff onto the road during the winter.

poor drainage and runoff from grassland

Poor soil structure

Subsoiling to improve soil structure

A field of permanent grassland with shallow slopes (<3^0) had runoff during the winter. The field was used for silage, grazing and spreading of manures. The nearby river had problems of nuisance algae smothering river gravels, probably due to nutrients being washed from the land.

Soil assessment

Examination of the soil revealed poor structure in the subsoil. The subsoil was a slowly permeable non-calcareous clay with a naturally poorly structured subsoil and a high water-table. The field was regularly travelled on during winter and wet spring conditions which is likely to have further degraded soil structure.

Remedial options

- A trial was carried out where an area of grassland was subsoiled (at 35cm depth) during late summer. During the following winter, runoff was reduced compared to the area not subsoiled.
- An improved land drainage system was considered to be necessary to further reduce waterlogging and to help maintain soil structure.

runoff from cereal stubble

Poor soil structure in the topsoil and subsoil

Deep cultivation to improve soil structure

Slurry had been regularly spread onto steep (>7^0) stubble fields during winter. Rainfall often caused runoff rich in nutrients to wash from the fields into adjacent ditches.

Soil assessment
Examination of the soil revealed poor structure, both in the topsoil and subsoil. The soil was a slowly draining silty clay that lies wet for long periods.

Remedial options
A trial was carried out where part of a field was cultivated (at 35cm depth) to improve soil structure. The remaining area was left as cereal stubble, and slurry was spread as usual. Runoff from the cultivated area was much less than that from the stubble, and the cultivated soil was able to absorb the spread slurry, thereby reducing the risk of water pollution.

runoff from tramlines, headlands and farm tracks

Poor soil structure in a field headland

Runoff onto adjacent road

Muddy runoff from tramlines, headlands and farm tracks was polluting a chalk stream with soil sediment. The salmon and trout fishery was being affected because sediment smothers spawning gravels where fish bury their eggs.

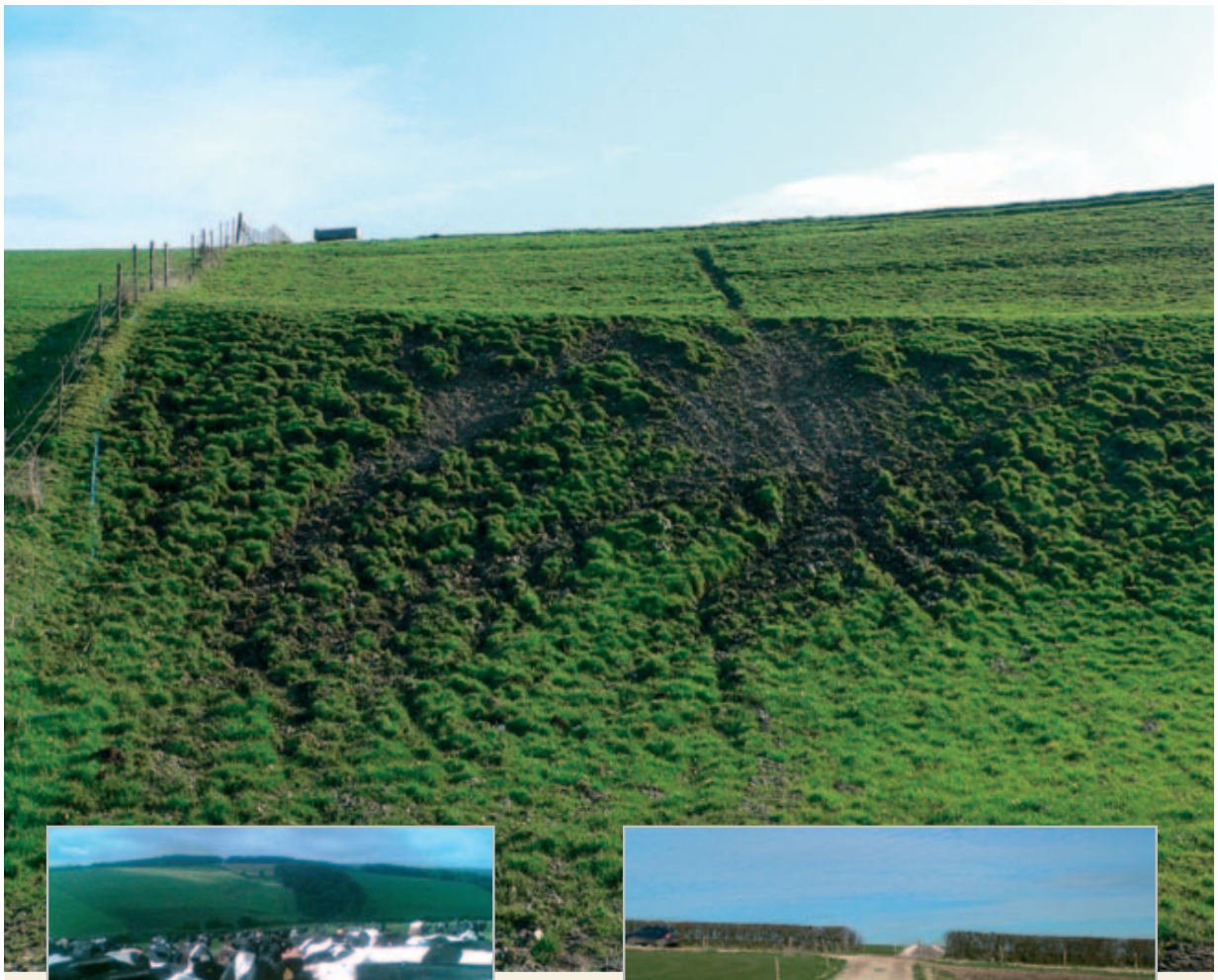
Soil assessment

Soils in the area were mainly shallow, overlying chalk with silty clay loam textures. These soils are normally freely draining, where winter rain is readily absorbed. However, poor soil structure along tramlines and headlands was causing water to runoff down slopes. Farm tracks in the area were also acting as a source and conduit for runoff.

Remedial options

- Subsoil tramlines and headlands to improve soil structure and reduce runoff.
- Divert runoff from farm tracks at regular intervals to grassed soakaways.

soil erosion in grassland



Recently installed cow track

Soil erosion was occurring in a field of permanent grassland on steep slopes (›7^0). This resulted in eroded soil being washed into a nearby stream during heavy rainfall.

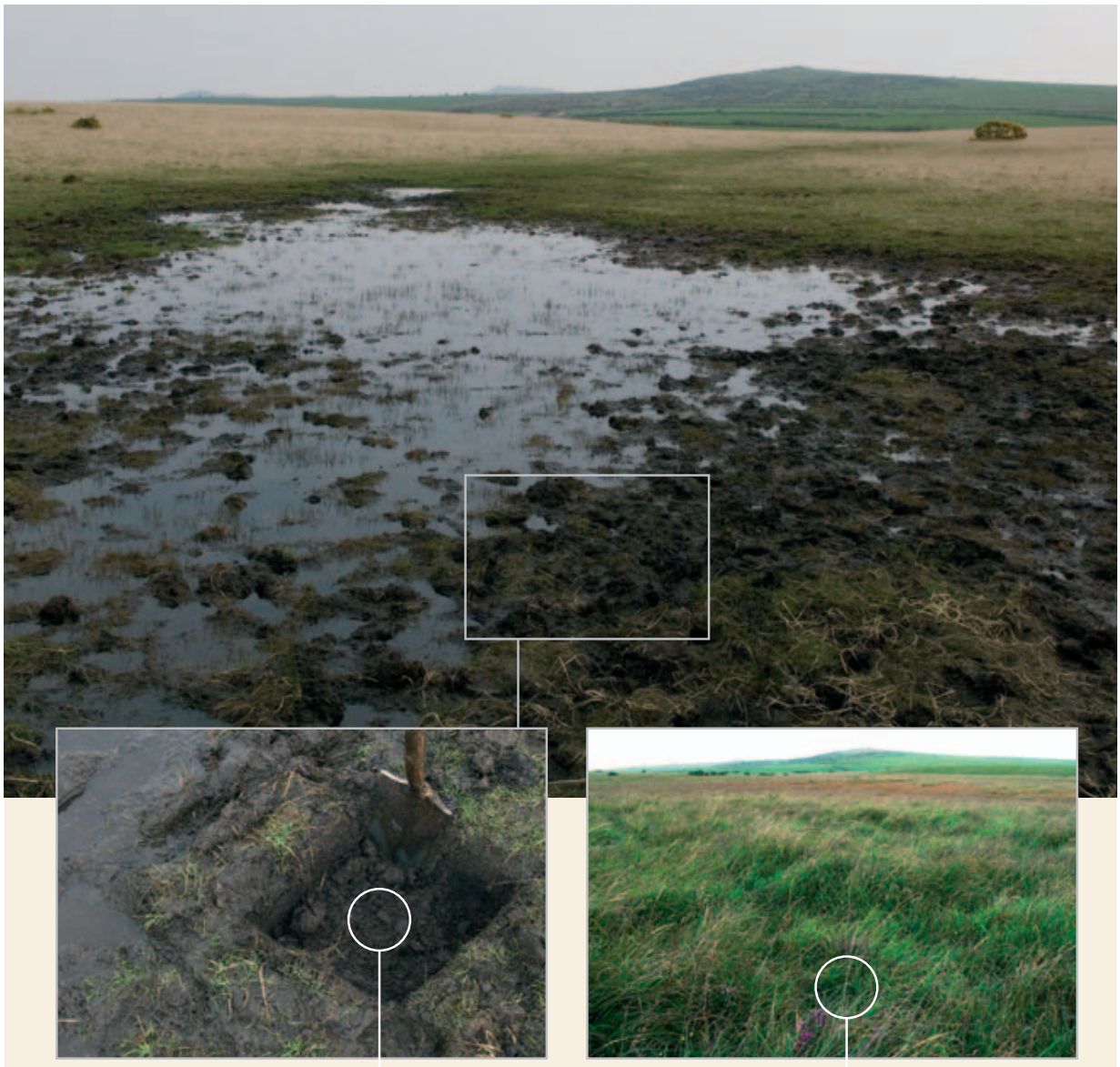
Soil assessment

The soil was a shallow, silty clay loam over chalk. An area of the field was heavily used by a large herd of cows. Treading by cows had broken the soil surface, causing the soil to slump and slip down the slope. The topsoil had poor soil structure and reduced porosity, particularly at the base of hoof marks. Heavy rainfall was also washing soil and flints down the slope.

Remedial options

- Fence the trampled area to exclude cows, to help the soil structure naturally recover.
- Install cow tracks to protect soils.

runoff and soil erosion on peaty upland soils



Dry subsoil with poor soil structure

Reduced grazing pressure to help regeneration of heather moorland

Large areas of moorland were trampled by livestock, causing soil erosion and runoff. This caused sediment pollution in nearby watercourses. Enhanced runoff increased the risk of localised flooding.

Soil assessment
The soil had a peaty topsoil overlying sandy loam. Although these soils are naturally waterlogged, examination of the soil revealed a very dry subsoil despite a saturated soil surface.

Water did not soak into the soil pit. Soil structure in the subsoil was poor due to trampling by cattle in wet conditions and vehicles used to feed stock during the winter.

Remedial options
The land was entered into an environmental scheme where payment is given to reduce grazing pressure and to encourage regeneration of heather moorland. It is expected that the soils will naturally restructure, although this may not occur for many years.