Welcome to the Trollberget Demonstration Area

Within the Trollberget Demonstration Area, practical examples are shown of how to rewet a previously ditched unproductive wetland as well as how a ditch cleaning operation on productive forestland should be carried out with consideration for the environment.

The measures were carried out within the Grip on Life project in collaboration with the landowner Holmen. SLU has monitored the effects of the measures and conducts extensive research in the area. The aim of the measures and monitoring is to contribute new knowledge so that the right measure is carried out in the right place.

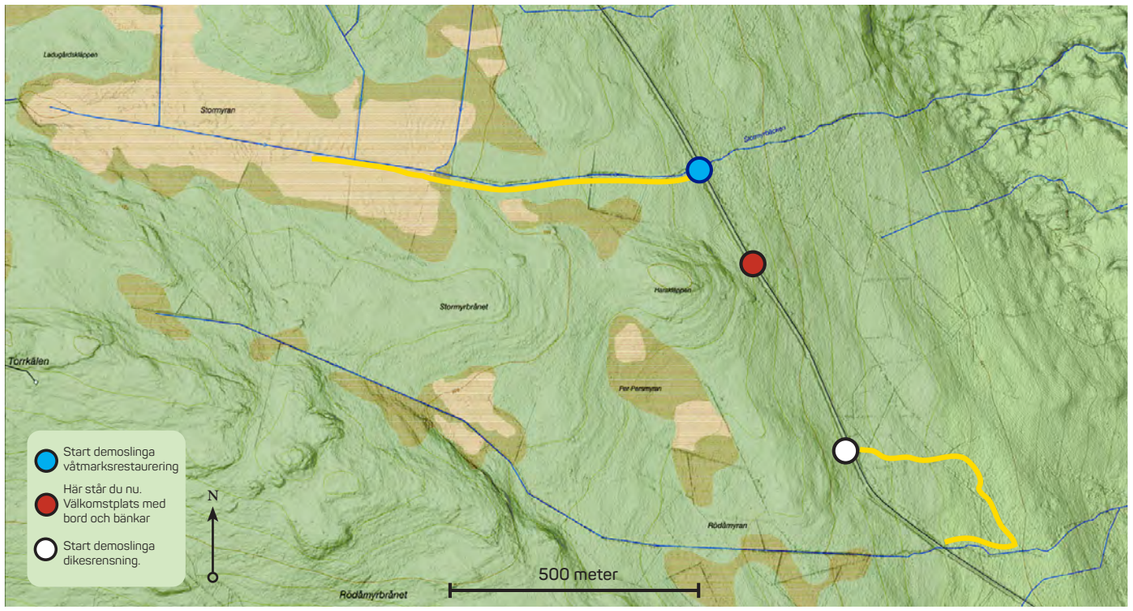
VINDEL RIVER AND NATURA 2000

The surface and ground water from the area flows into the Vindel River, which together with its tributaries is part of the EU Natura 2000 network. Natura 2000 is a network of valuable natural areas, that includes species or nature types particularly worthy of protection from a European perspective. To preserve these values, a permit is required for actions or activities that can significantly affect protected species or habitats in Natura 2000 areas.

DEMONSTRATION LOOPS

The demonstration area includes two loops with information signs. One loop concerns wetland rewetting of the unproductive peatland named Stormyran and the other shows ditch cleaning on forestland and precautionary measures to mitigate environmental effects. Here, at the welcome point, it is possible to take a break between visits to the loops. Just make sure to leave it in better condition than you found it.

We hope that the area provokes thoughts and contributes new knowledge about both wetland restoration and ditch cleaning on forestland!



Overview map of the demonstration area with welcome area (red circle) and the trailheads for the two demonstration loop trails (blue circle for rewetting, white circle for ditch cleaning).

Blocking and filling in a ditch during the wetland restoration at Stormyran in November 2020. Trees from the peatland were cut to reduce evapotranspiration and then used as material to block the ditches. Photo: Tobias Eriksson

An excavator preforming ditch-cleaning. Note that soil mounding had already been performed as a soil preparation method when this photo was taken. Photo Ragna Lestander

V-notch flow measuring stations are located by the outlets of all the catchments to monitor effects on water quality and quantity. Photo Tobias Eriksson

THIS IS GRIP ON LIFE

In the project, authorities, forest owner associations and interest organizations work together to combine modern forestry with consideration for the forest's valuable waterways and wetlands.

Grip on Life is much about developing new and better methods for, for example, collaboration, forestry, forest management and restoration of waterways and wetlands. By contributing with new knowledge and new methods, we want to secure a sustainable future for streams, rivers, lake systems and wetlands across the country.

The goal is to improve the environment and the conditions for animals and plants that live in waterways and wetlands in the forest landscape, and at the same time continue to use our natural resources in a sustainable way.

Grip on Life IP runs from the year 2018 until the year 2025. The project has received funding from the EU's environmental program LIFE IP.

www.griponlife.se

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Ditches — clean, leave alone or fill them in?

HISTORY OF DITCHING

During the 1800s, ditches were first dug to create farmland for Sweden's growing population. Gradually, the ditch network was expanded to promote better conditions for haymaking in peatlands and eventually, to increase forest production.

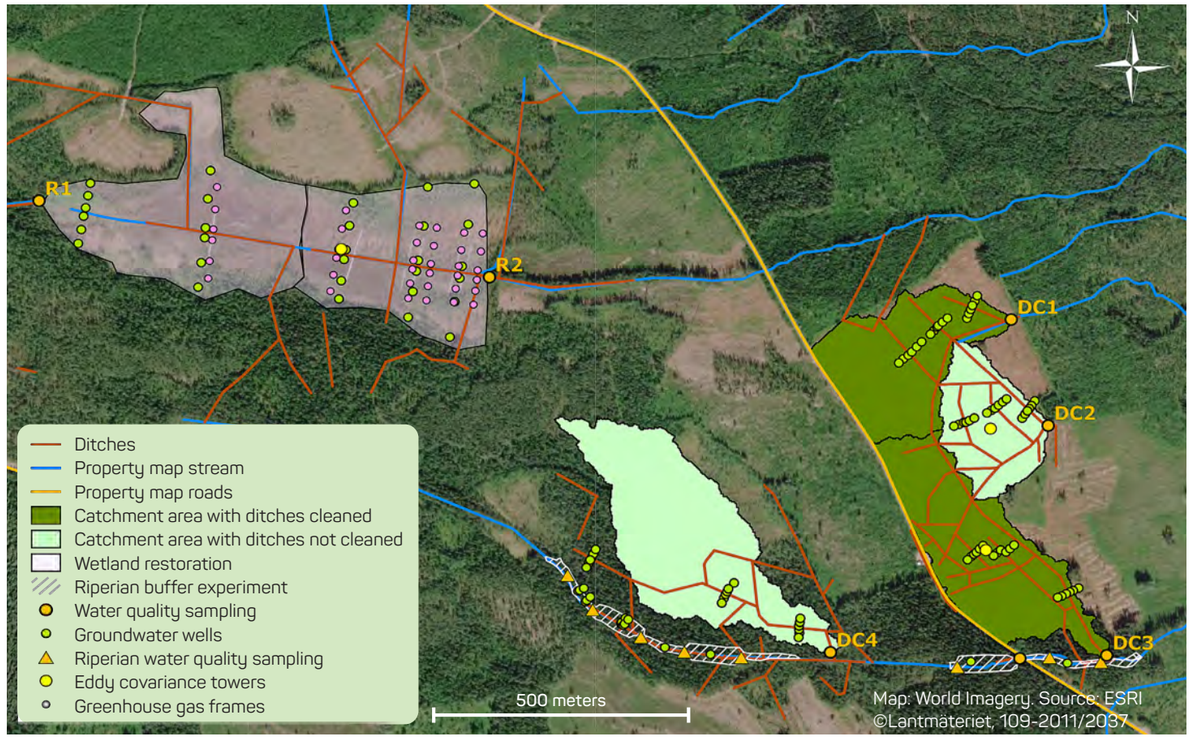
In the 1900s, ditching in wet forestland increased and the activity reached its peak in the 1930s. During the Great Depression, state-funded grants were used to dig ditches to alleviate unemployment. In the beginning, ditches were dug by hand before newer methods of ploughing, machine digging and dynamite took over. Since 1986, land drainage (new ditching) requires a permit.

Altogether, millions of hectares of wetlands were drained in Sweden. In many of these areas tree growth has increased, but not in all.

MAINTAIN, LEAVE OR BLOCK THE DITCH?

Forest ditches gradually degrade, and it can be difficult to assess whether and how a ditch should be managed. Cleaning of forest ditches is typically carried out to maintain forest production benefits. At the same time, ditch cleaning can negatively affect aquatic organisms by causing increased turbidity and transport sediments downstream to lakes and waterways.

Letting ditches fill in themselves naturally or by actively blocking them (rewetting or ecologically restoring) can improve water quality and increase water-holding capacity of the landscape, but knowledge of the effects of wetland restoration is needed.



Map of the infrastructure within Trollberget Experimental Area with three different catchment-scale treatments —wetland restoration (R1 & R2), cleaning ditches after final felling (dark green areas) and leaving ditches unmanaged after final felling (light green areas). In each catchment area, a measuring station is located at the outlet of each ditch network (yellow circles). Additionally, a riparian buffer width experiment is located along the southern boundary of the map (white hashed area).

MONITORING OF ACTIONS

Better information for decision-making is needed to determine which action should be carried out where. The area you are standing in is part of the Trollberget Experimental Area where various research projects are monitoring effects after three different management treatments: blocking and filling-in ditches, cleaning ditches after clear-cut harvest, as well as leaving ditches unmanaged after clear-cut harvest. In fall 2018, measuring stations were installed to monitor effects of water quality, water levels and mercury before and after the different treatments. Many other research projects have subsequently started in the area, including monitoring effects on greenhouse gas emissions and biodiversity.

Krycklan Catchment Study

Trollberget Experimental Area

KRYCKLAN CATCHMENT STUDY

The measuring stations at Trollberget are also part of the Krycklan Catchment Study. The research infrastructure consists of the 68 km2 Krycklan Catchment, which is one of the most instrumented and monitored catchment areas in the world. Research has been conducted in the catchment since the 1920s.

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Information in English

Welcome to the demonstration loop for ditch cleaning

This demonstration loop is part of a larger demonstration area developed within the GRIP on LIFE project and which includes both blocking and filling in as well as cleaning of ditches. You are now at the ditch cleaning demonstration loop trail.

On the map you see eight information sites based on the forest sector´s Strategic Management Objectives for good environmental consideration when cleaning ditches and delimiting riparian buffer zones prior final felling. The loop trail is about 600 meters long and there are trail markings in the terrain to help you find your way. More information about the Trollberget Demonstration Area in general is found at the welcome point.

ACTIONS IN THE AREA

The forest in the area you are standing by was harvested in 2020 and ditches were cleaned in fall of 2021. The ditches were cleaned according to the methodology used at Holmen Skog and was performed following the Swedish Strategic Management Objectives for good environmental consideration when cleaning ditches, as described further down on the following pages.

MONITORING OF DITCH CLEANING EFFECTS

The environmental effects of the ditch cleaning are monitored by SLU. Research equipment may therefore be located in the area. Please show consideration of the equipment when you walk around the area so we can continue to gather more valuable information on how to limit negative effects on the environment when cleaning ditches.

Photo : Ragna Lestander

2018 Monitoring stations were installed

2019 Notification of harvest and ditch cleaning

2020 Harvest

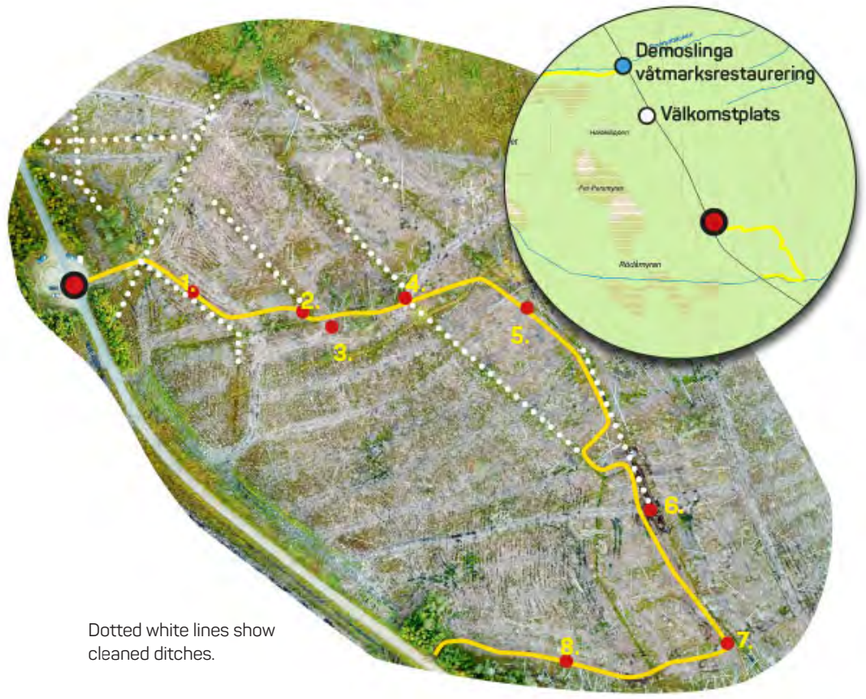
2021 Ditch cleaning

2024 Sampling within the GRIP on Life project is completed

2025 Project completion and compilation of results

You are here on the map

1. Planning, execution and growth effect ditch cleaning
2. Sedimentation pits
3. Water protection measures
4. Crossing ditches and waterways
5. Natural and cultural environmental values
6. Protection measures before the outlet to a lake or stream
7. Monitoring ditch cleaning
8. Riparian buffer zones: function, research and delimitation



Dotted white lines show cleaned ditches.

SOME CONCEPTS

First-time drainage (new ditching): Ditching whose purpose is to increase the suitability of the property for a certain reason, in this case, to increase forest production.

Ditch cleaning: Action that may be carried out to maintain the depth and location of the ditch as it was after the last legal ditching.

New natural state: The state that occurs after a ditch naturally degrades over a long period of time and has lost its ability to divert water.

Protective ditching: Action carried out in connection with planting after clear-cut harvesting. The protective ditches are shallow and divert water for a limited time.

These measures may be subject to notification, require notification of consultation or permission to be carried out.

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GRIP on LIFE

Strategic Management Objectives for ditch cleaning

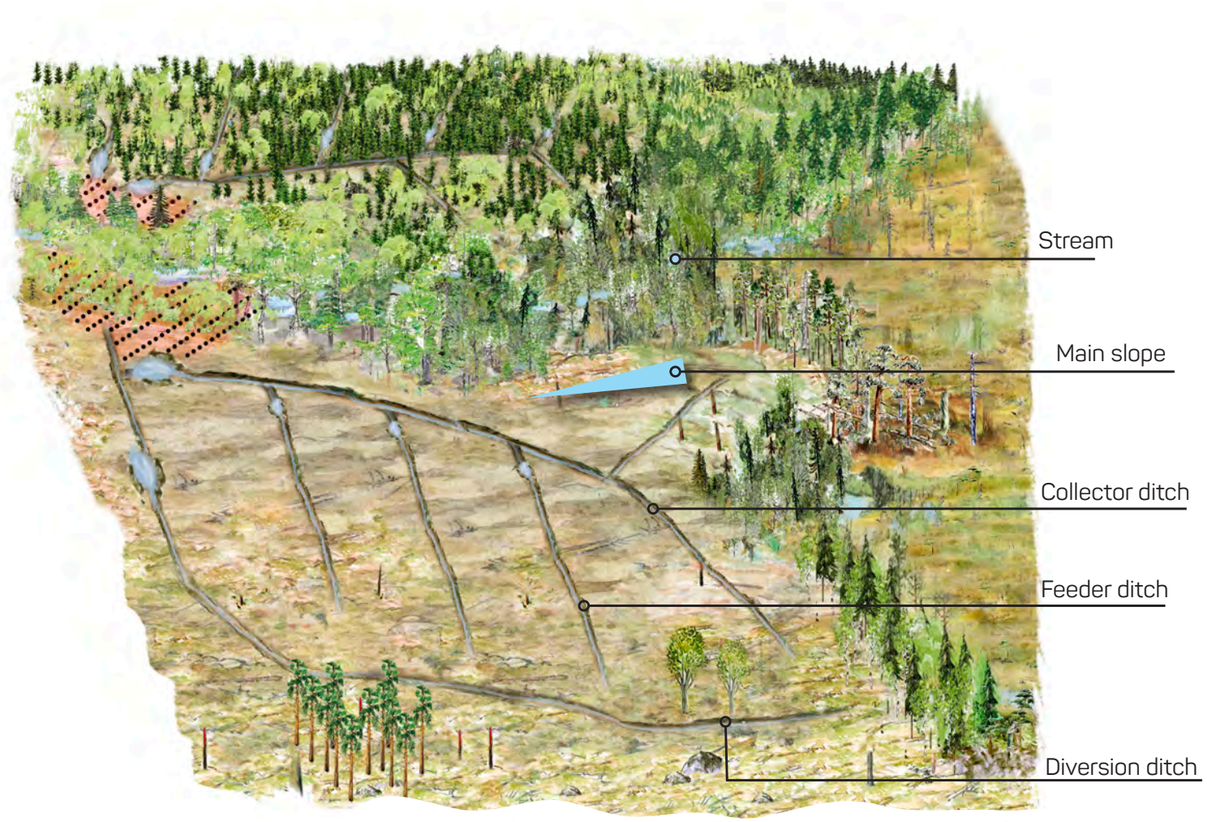
The forestry sector's Strategic Management Objectives for good environmental consideration provide guidance on how environmental consideration should be carried out in various forestry measures. The Strategic Management Objectives are produced in broad collaboration within the forestry sector, based on current forest policy and best available knowledge.

+ POSITIVE EFFECTS DITCH CLEANING

- Can maintain tree growth or improve conditions for regeneration. Which provides material and bioenergy to society and improves the forest owner's economy.
- Can result in better soil bearing capacity on mineral soils and some peat soils when driving.
- Reduced need for protective ditching as drainage is improved.
- Reduced risk of windthrow in storms as the roots of the trees can grow deeper into the ground.

- NEGATIVE EFFECTS DITCH CLEANING

- Increased stress and mortality of aquatic organisms due to turbidity and transportation of sediments to lakes and streams downstream of the ditch system.
- Increased export of phosphorus to lakes and waterways due to increased supply of eroded material.
- Changed biodiversity and occurrences of species dependent on wet ground or high humidity.
- Can cause increased emissions of greenhouse gases from peatlands.



Example showing a completed ditch cleaning operation. Feeder ditches have been carefully cleaned and ends with a sedimentation pit followed by a short overflow area before draining into the collector ditch. The collector ditch has not been cleaned. A sedimentation pond is constructed at the end of the collector ditch. In the ditch that previously ran straight out into the stream, the last section has been filled in and the area is used for filtering.
Illustration: Bo Persson

STRATEGIC MANAGEMENT OBJECTIVES FOR DITCH CLEANING

- Every ditch cleaning operation is preceded by 1) a calculation of the balance between production benefit and negative environmental impact locally and on neighboring water environments and 2) planning of performance.
- Ditch cleaning is only carried out where maintained tree growth can be expected.
- Stretches of ditches that do not contribute to sustained growth are left unmanaged or filled in.
- Stretches of ditches with stream-like features as well as stretches through valuable swamp forests and other valuable wetland environme-nts are left unmanaged.
- Sediment transport is prevented to lakes, waterways and valuable wetlands. Methods such as building sedimentation pits, sedimentation ponds and overflow areas of sufficient dimensi-ons and by leaving a good buffer next to lakes and watercourses might help reduce sediment transport.
- Management of ditches with historic and cultural artifacts must not damage the artifacts.

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Information in English

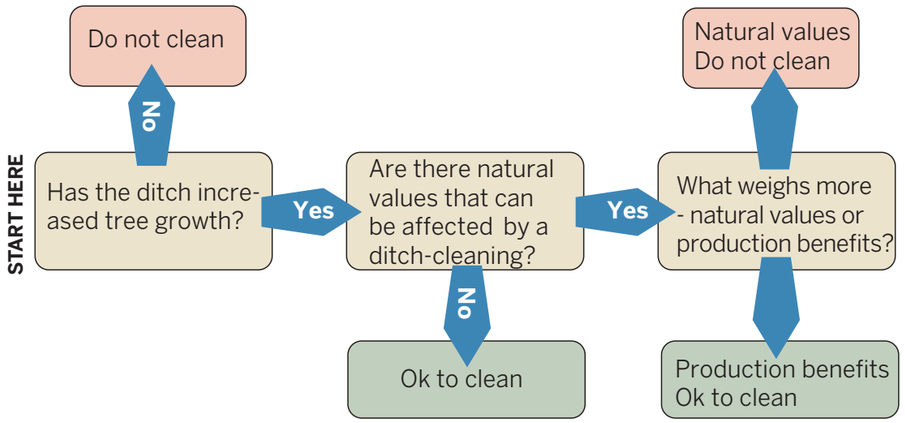
1. Planning and performance of ditch network maintenance

When cleaning ditches, it is important to balance production benefits and environmental impact. If a ditch cleaning would not improve forest production, cleaning anyway not only entails a financial cost but also has a negative impact on the environment.

EXAMPLES OF GOOD PRACTICE WHEN CLEANING FOREST DITCHES

- Make an initial selection according to the sketch below.
- Is the flow of ditch water blocked by, for example, a plug? In that case, cleaning can be done as a targeted effort.
- Information regarding the original depth and location in ditching plans gives guidance of the maximum depth the ditch may be cleaned to. If there is no plan, an assessment can be made using, for example, a soil probe.
- On flat ground, excavated debris are distributed evenly on both sides of the ditch, otherwise they should be placed downslope of the ditch.
- Avoid ditch cleaning measures in acid sulphate soil.

Instead of ditch cleaning, alternatives such as planting with deciduous trees after final felling or continuous cover forestry can be considered.



Principle sketch and workflow for planning if ditches should be cleaned or not. Natural values refer to both land and water environments.

CUSTOM MACHINES AND BUCKETS

The person who performs ditch cleaning must have the appropriate education. Ditch cleaning can be carried out with a crawler excavator or more specialized machines. There are also different kinds of buckets. Machine and bucket should be adapted to the needs and conditions during the cleaning. The choice of machine affects the number of trees that need to be felled for accessibility. A low soil pressure is important in order to avoid packing of ditch embankments and impair the ditch's function.

In the photo to the left, a profile bucket is used to remove accumulated debris in a ditch. In the photo to the right, a specialized machine with a cutting bucket is shown.
Photo: Anja Lomander

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Tree growth effect of ditch cleaning

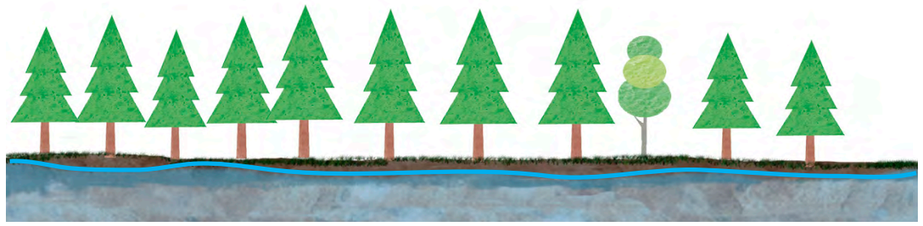
An important principle when cleaning ditches is to only clean those ditches that contribute to maintaining tree growth obtained after the first-time drainage. As a basic rule, the ditch's effect on tree growth should therefore be assessed before the need of cleaning is estimated.

GUIDE TO ASSESS TREE GROWTH EFFECT AND NEED FOR DITCH NETWORK MAINTAINANCE:

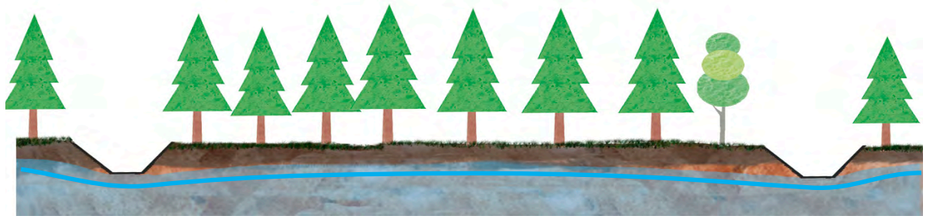
- The drainage capacity of ditches is considered to be most important in young stands and on land with a tree stand volume lower than 150-200 m3/ha.
- Examine the width of the annual rings in tree core samples to determine the response from previous ditching or cleaning.
- The groundwater level should not be deeper than 25-30 cm from the ground surface. If the groundwater level is already deeper, a cleaning will probably not have a desired effect on tree growth.
- Consider how the forest is doing in general. Look at the length of annual shoots. Stalled top shoot development may indicate poorer growth and thus indicate ditch cleaning could help.
- Is the soil nutritious enough? A reduced growth effect may be due to a decrease in ditch function, but it could also be a result of insufficient nutrients.
- Assess the location of the individual ditch in the terrain. Improperly dug or too sparsely dug ditches do not drain the area efficiently.

DITCH CLEANING AND TREE GROWTH

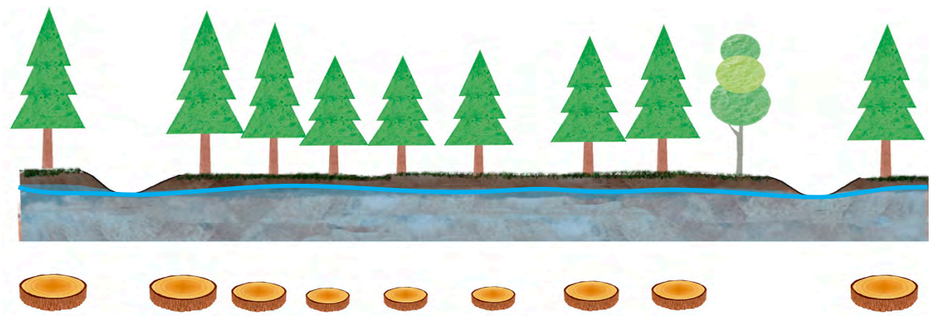
The purpose of ditch cleaning is primarily to sustain the tree growth obtained after the ditches were dug (first-time drainage). According to studies, tree growth after ditch cleaning can increase, but the knowledge in this area is limited. In more highly stocked stands groundwater level is kept down through evaporation and trees taking up water.



1. The condition before soil drainage (new ditching).



2. The condition after ditches are dug. The groundwater level has been lowered. Drainage effect decreases with distance from ditches.



3. After 20-30 years ditches start to degrade and the water transportation capacity can decline. The groundwater level has risen again. Cross section of the tree trunks shown in the figures above indicates tree growth in relation to distance from ditches. Illustrations: Bo Persson

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2. Sedimentation pits

Sedimentation pits or ponds can reduce the transport of coarser particles into streams or lakes. They work best in combination with overland flow areas, which can also retain finer particles.

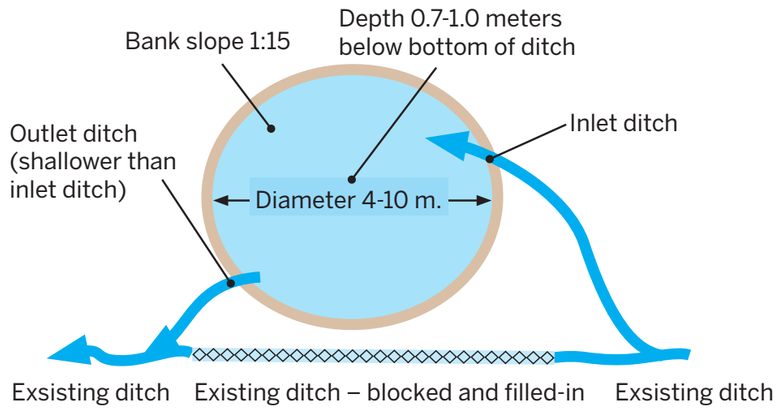
FUNCTION OF A SEDIMENT PIT

A sedimentation pit is a widened section of 1-3 m3 in the ditch. A sedimentation pit works best on coarse-grained soils as mainly coarser particles are captured. On soils with smaller particles, sedimentation pits should not be used as there is a significant risk of increased erosion.

DIMENSIONING AND LOCATION

Place sedimentation pits every 100-200 meters. Dimensioning and placement of the sedimentation pit is important for them to be effective. A sedimentation pit can be placed just before the outlet to another ditch or just before an overland flow area or an uncleaned stretch. For particles to have time to deposit, the water-velocity into the sediment pit must not be too high.

Example of a sedimentation pit. The inlet and outlet ditch are laterally offset from each other to slow down the water velocity and extend the retention time. The outlet ditch is also shallower than the inlet ditch. Photo: Daniel Palm



The illustration shows an example of a sedimentation pond. In larger ditch networks, particles can settle by directing the ditchwater into sedimentation ponds and then returning it again. Illustration Bo Persson

KEEP IN MIND THAT:

- Placement of major protection measures is planned in advance and communicated to contractors. Detailed environmental consideration can be planned by the contractor performing the work.
- Build sedimentation pits and ponds before the ditch cleaning starts. Deposited sediments are emptied during the ditch cleaning.
- Sedimentation ponds should be emptied on several occasions in the first years after cleaning. Maintenance is made easier if they are placed close to a road.

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3. Protection measures when cleaning ditches

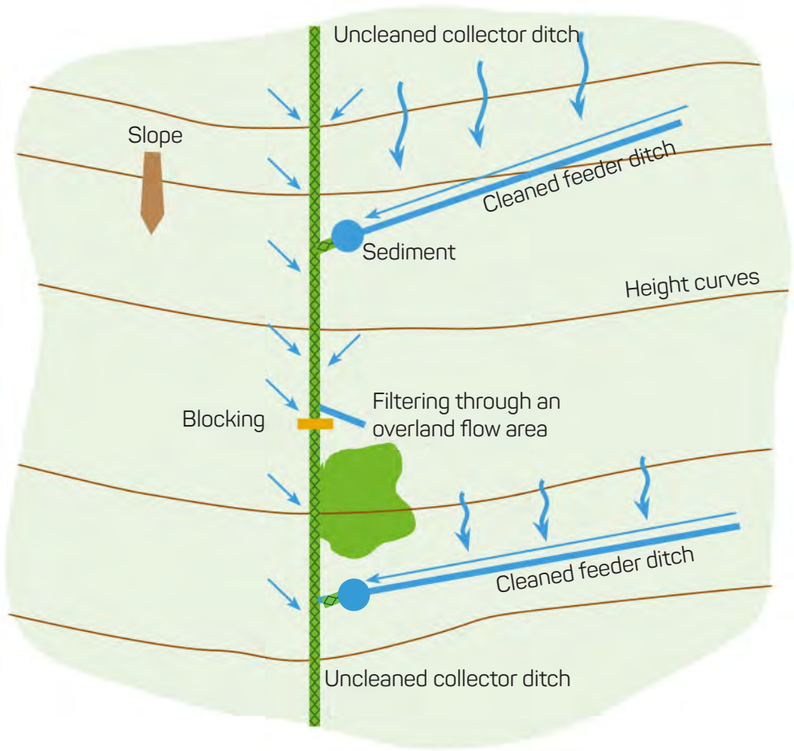
Different protection measures can be taken to prevent increased turbidity and transportation of sediments during ditch cleaning. To reduce risk of erosion the water velocity should be slow, which also increase the probability for particles to settle on the way.

TURBIDITY AND SEDIMENT TRANSPORT

Work with the local conditions in the terrain and combine different protection measures to prevent turbidity and sediment transport. The level of turbidity and sedimentation transport caused by a ditch cleaning is controlled not only by the performance but also by the:

- **Water velocity in the ditch network**
- **Amount of erodible material**
- **Amount of water transported in the ditch network**

The photo shows a threshold that can be built in ditches with a steeper slope. The water velocity slows down and reduces the risk of erosion. Photo: Mikael Sandberg



The illustration shows how the location of an individual ditch needs to be considered during ditch cleaning. The collector ditch you are standing by has a steep slope, which affects the water velocity. A cleaning of the ditch would have a very small effect on the drainage capacity while increasing the risk of erosion. Filtering through an overland flow area would be possible along the way. Illustration Bo Persson.

EXAMPLES OF PROTECTION MEASURES WHICH CAN BE COMBINED:

- Perform the cleaning at low water levels.
- Leave breaks of uncleaned stretches interspersed with cleaned sections.
- Save vegetation in the collector ditches. Vegetation slows down the water velocity and can filter both nutrients and sediments.
- If the soil is easily eroded the ditch banks should not be too steep. Vegetation on the slopes increases stability and prevents erosion.
- Use sections on a slope as overland flow areas by directing the ditch water through uncultivated land.
- Stop the cleaning with a good buffer to lakes and watercourses.
- Construct thresholds, sedimentation pits, sedimentation ponds and overland flow areas where appropriate.
- Avoid exposed mineral soil when cleaning ditches.

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4. Crossing ditches and streams

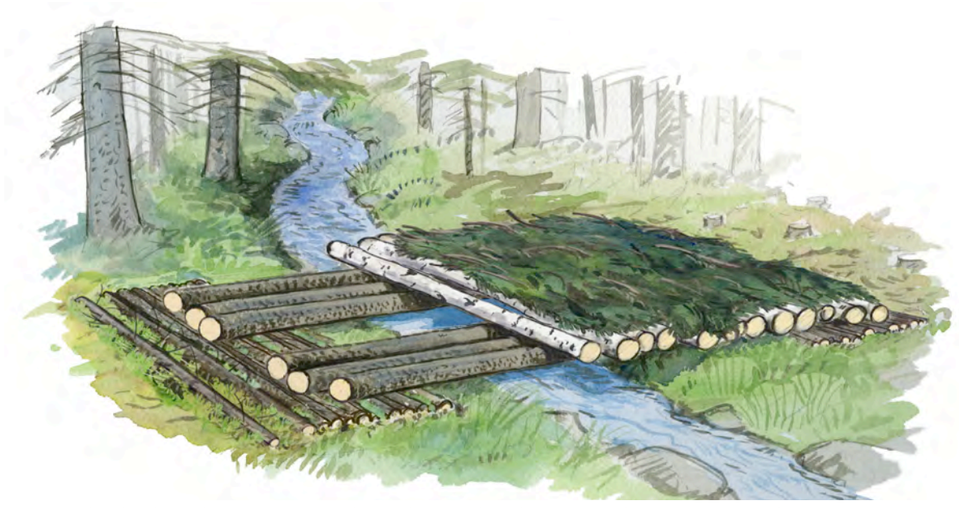
Forestry operations near water require caution, regardless of whether they occur next to a natural stream or a dug ditch. The forest sector's Strategic Management Objectives for good environmental consideration provide guidance of important steps to consider when crossing streams and ditches with forest machines.

PREVENT DAMAGE

When crossing a stream or a ditch with a forest machine it is important to prevent soil damage caused by rutting and compaction. Well-taken protective measures such as bridge constructions and adding branches, thinner logs and treetops in driving routs will considerably reduce the risk of damage.

PLANNING CROSSINGS

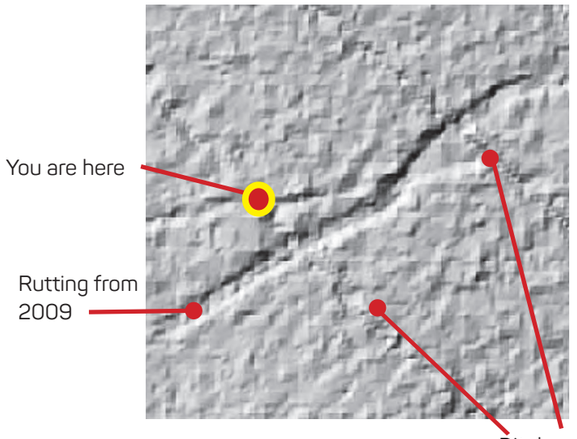
- Primarily, seek for an alternative drive route.
- If a crossing is necessary, choose the most suitable location and mark the crossing clearly in the field and on maps for the contractor.
- Build a bridge or use technical aids.
- Protect the driveway and exit of the crossing, by placing branches, treetops and thin logs in the driving route, before passing the waterway
- Leave the bridge for following actions before it can be removed.



A wooden bridge. The same principle applies to the planning and construction of crossings over streams as over ditches. Illustration: Martin Holmner

KEEP IN MIND THAT:

- All ditches lead somewhere! The ditch can connect to a watercourse or a lake further downstream.
- Do not drive in streams or ditches and do not damage the bottom of waterways.
- Beware of ditch edges and surrounding land when driving. Rutting can impair the function of the ditch and cause erosion and harmful sediment transport to lakes and streams.
- Plan and execute crossings so the flow paths of the water do not change or cause damming in streams or ditches.



The picture shows a terrain model with visible ditches and a deep rutting caused by a forest machine.

HAS THE RUTTING AFFECTED THE FUNCTION OF THE DITCH?
COULD THE RUTTING HAVE NEGATIVELY AFFECTED THE DOWNSTREAM WATERWAY?

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5. Natural and cultural environmental values

When cleaning ditches, consideration must be taken to natural and cultural environments both on land and in water.

HABITATS IN DITCHES

Sections of ditches that begin to have meandering routes, patches of dead wood and a creek-like structure should be left unmanaged. These sections can act as areas where organisms can survive and spread from.

ENVIRONMENTS IN STREAMS AND LAKES

Sediments reaching natural streams and lakes can negatively affect insect and fish life far down in the downstream water. Take various protection measures when cleaning ditches to prevent sediment transportation. The cleaning should stop with a good buffer to lakes and streams.

ANCIENT AND CULTURAL ENVIRONMENTS

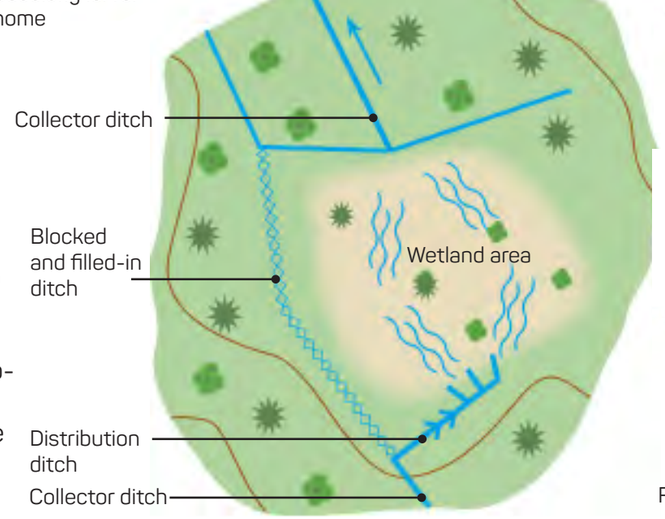
Cultural environments next to water can be found in the form of, among other things, dams, embankments, irrigation ditches or building remains. Ancient and cultural remains must not be damaged by forestry and ditching measures.

Mayfly larvae

Mayfly

Dragonfly

Caddisfly larval home



Trout

Weevil larvae

River pearl mussel

Sediments reaching lakes and streams can fill spawning beds for fish and impair living conditions for aquatic organisms. Illustrations: Bo Persson

NOTIFICATION OBLIGATION

In many cases, a consultation with the Swedish Forest Agency is required at least six weeks before ditch cleaning. This applies, for example, cleaning of ditches that flow directly into lakes and waterways and cleaning of ditches with extensive degradation. If there is a risk that fishing may be affected, a notification must be made to the County Administrative Board.

VALUABLE SWAMP FORESTS AND WETLAND ENVIRONMENTS

Nature values in areas of consideration, valuable swamp forests and other wetland environments can be negatively affected if the groundwater level changes during ditch cleaning. Sections through these areas are therefore left unmanaged. If appropriate, the wetland areas can instead be used as buffer (overland flow area), where the ditch-water can filter through the vegetation (see illustration).

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6. Protection measures before the outlet into a lake or a stream

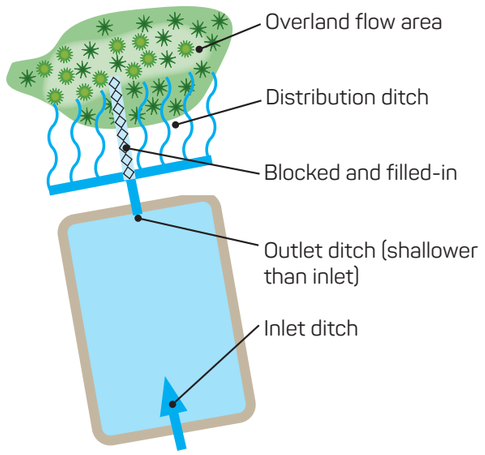
A ditch cleaning should stop with a good buffer to lakes and streams. Suspended solids released from the ditch network needs to be retained before the outlet. Here, a sedimentation pit was dug and a stretch of approximately 70 meters was left unmanaged before the outlet ditch enters the stream.

SEDIMENTATION PONDS

A sedimentation pit or pond in the outlet ditch can capture coarser particles before the water is released further into an overland flow area.

The size of a sedimentation pond is adapted to the size of the catchment area. The surface should be 3-8 m2 per hectare catchment area and have a volume of 2-5 m3 per hectare catchment area.

Photo and illustration of a sedimentation pond with a distribution ditch before an overland flow area. Sedimentation ponds are built in larger ditch networks.
Photo: Sixten Karlsson.
Illustration: Bo Persson



OVERLAND FLOW AREAS

Overland flow means that the water from the ditch is spread out through an undrained area, where the water-velocity is slowed down and smaller particles and nutrients are retained. For most efficiency, the overland flow area should have dense vegetation. Tracks or channels through the area should be avoided.

The dimensions of an overland flow area depend on the area's conditions. The slope of the area should be less than 10 degrees. The length of the overland flow area is adjusted according to the table below but should be at least 1% of the catchment area.

What is located downstream of the ditch network?	Dominating size of particles/soil type along the ditch network	Length of overland flow area (if the slope of the area > 10 ° the length is doubled)		
		20-50 m.	50-100 m.	>100 m.
Stream or lake	Sand	x		
	Coarse mineral soil		x	
	Fine-textured mineral			x
	Peat			x
Valuable stream or lake*	Sand		x	
	Coarse mineral soil			x
	Fine-textured mineral			x
	Peat			x

Table with recommendations for the dimension of overland flow areas. * Valuable streams and lakes designated by the County Administration Boards.

WHAT ARE THE LOCAL CONDITIONS FOR PROTECTION MEASU-RES AT THIS SITE BEFORE THE OUTLET INTO THE STREAM? COULD SOMETHING BE DONE DIFFERENTLY? HAVE THE STRATEGIC MANAGEMENT OBJECTIVES FOR GOOD ENVIRONMENTAL CONSIDERATION DURING DITCH CLEANING BEEN FULFILLED?

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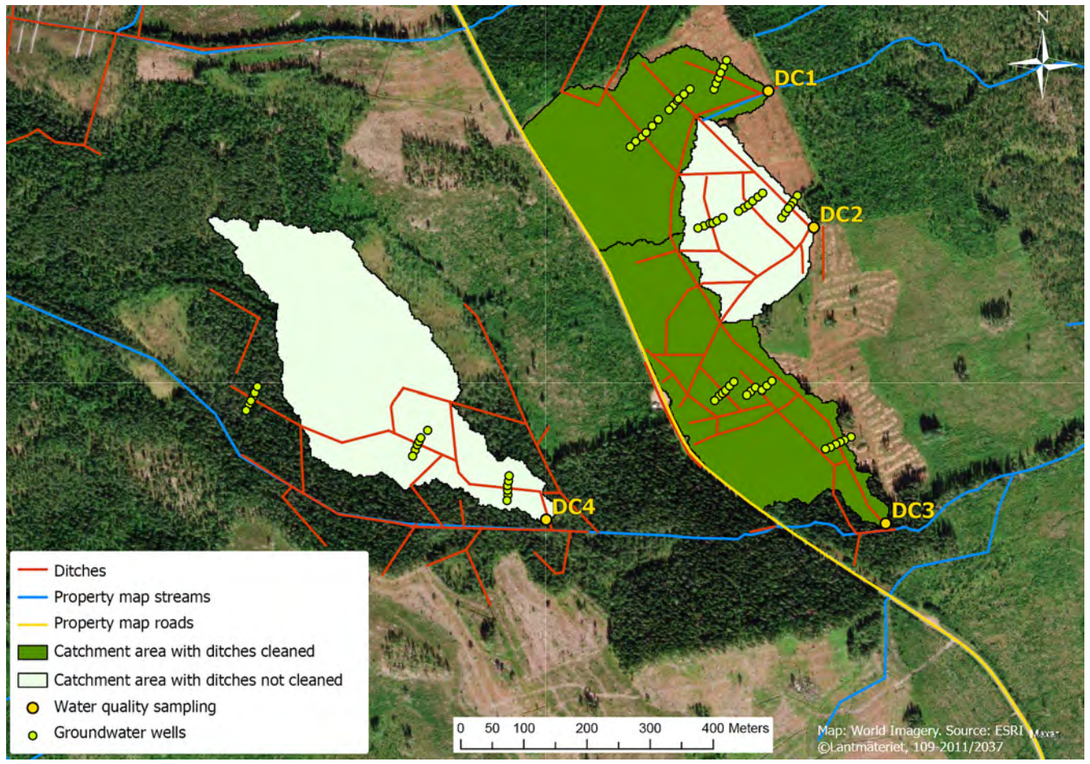
7. Monitoring ditch cleaning

To increase knowledge of where and how ditch cleaning can be done while mitigating negative effects on the environment, more research is needed. Within the GRIP on Life project, SLU monitors the environmental effects of ditch cleaning through sampling before and after the cleaning. Sampling within the project occurs from 2018 to 2024.

ENVIRONMENTAL EFFECTS DURING DITCH CLEANING

Generally, digging in aquatic environments causes turbidity and sediment transport, which can have negative effects on aquatic organisms. Erosion and sediment transport can occur during high flows in a ditch network long after the ditch cleaning has been carried out. Nutrients and heavy metals can also be transported with the sediments.



Map of the treatment areas for ditch cleaning. Effects on water quality, discharge and groundwater levels are monitored in ditch-cleaned areas and compared to areas where degraded ditches were left unmanaged. A measuring station is located at the outlet of each ditch network. Transects with groundwater pipes are located over selected ditches.

QUESTIONS THE MONITORING ATTEMPTS TO ANSWER:

- What effects does ditch cleaning have on the water quality? Will the ditch cleaning lead to increased nutrient leakage and higher levels of organic material in the ditch water?
- What impact does ditch cleaning have on sediment transport and turbidity?
- Will the concentrations and amount of mercury and methylmercury increase after the ditch cleaning?
- How long-lasting are the potential effects on the water quality?
- Is discharge and the groundwater level in the areas affected by the ditch cleaning?

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8. Buffer zones: functions, research and design

A functional forested riparian buffer zone provides conditions for healthy waters with varied habitats and high biodiversity. Illustration: Bo Persson

Riparian zones adjacent to waterbodies are an important part of a functioning freshwater ecosystem. Forested riparian buffers are therefore retained around the water environment when, for example, the adjacent forest is harvested. These buffers help maintain the ecological functions of the riparian zone, preserve water quality and biodiversity found in the riparian zone and in the water.

EXPERIMENT WITH BUFFER ZONE WIDTH

The riparian buffer zone you are standing by is part of a research experiment. Here, SLU is studying how different widths of forested riparian buffers retained after final felling affect ecological functions of the riparian and stream ecosystem. One hundred meter stretches alongside the stream received either a forested buffer zone of five or 15 meters width when the adjacent forest was harvested. The research compares the stretches and investigates to what extent the ecological functions of the buffer zone can be maintained by the two different widths.

ECOLOGICAL FUNCTIONS OF FORESTED RIPARIAN BUFFER ZONES:

- Maintain important biogeochemical cycling
- Prevent sediment transport and stabilize the shoreline
- Provide food for aquatic organisms
- Provide shade
- Provide dead wood
- Protect biodiversity

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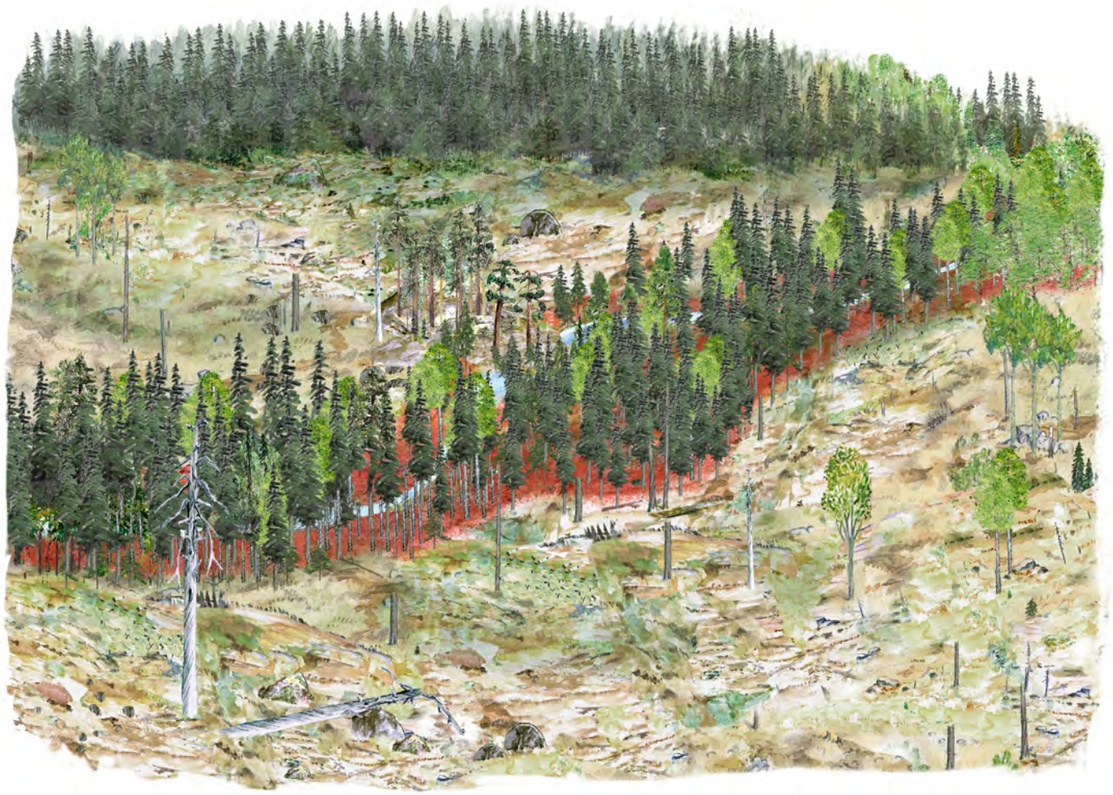
Design of the buffer zone before felling

The width of the forested buffer zone retained after felling varies based on the local condi-tions along the waterbody. In the forest se-ctor's Strategic Management Objectives for good environmental consideration, a guideline is presented for how to design a buffer zone.

GUIDELINE TO DESIGN OF BUFFER ZONES

Step 1. Identify discharge areas alongside the waterbody, where the groundwater flows upward or is very close to the ground surface. Riparian forests, springs and other biotopes that require consideration are generally sensi-tive environments and often holds high natu-ral values. Include these environments when designing a buffer zone.

Step 2. If the shading is not sufficient after step 1, the buffer zone is further widened. A forest with an even aged or single-layered structure may need to be made wider than a multi-layered zone to achieve the equivalent function.



Example of a riparian buffer zone after final felling designed based on local conditions. The groundwater discharge area alongside the stream is marked in red. Illustration: Bo Persson

RISK FOR WIND-FELLING

In some cases, forested riparian buffer zones are not stormproof and in wind-exposed locations there is a risk of extensive wind-felling. Riparian buffer zones are designed according to the guideline described above, but in exceptional cases the design can be adapted to limit the risk for wind-felling in the retained buffer.

Keep in mind that no logging should occur in riparian zones with high nature values and that extended consideration may be needed alongside waterbodies with particularly high values.

HOW CAN A FORESTED RIPARIAN BUFFER ZONE BE DESIGNED TO MAINTAIN ECOLOGICAL FUNCTIONS WHEN THERE IS A HIGH RISK FOR WIND-FELLING?
WHAT IS IMPORTANT TO CONSIDER DURING THE FOLLOWING STEPS OF SOIL PREPARATION AND PLANTING?

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