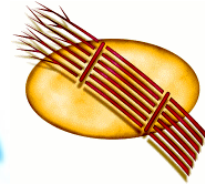


# *Live Rock Revetment*



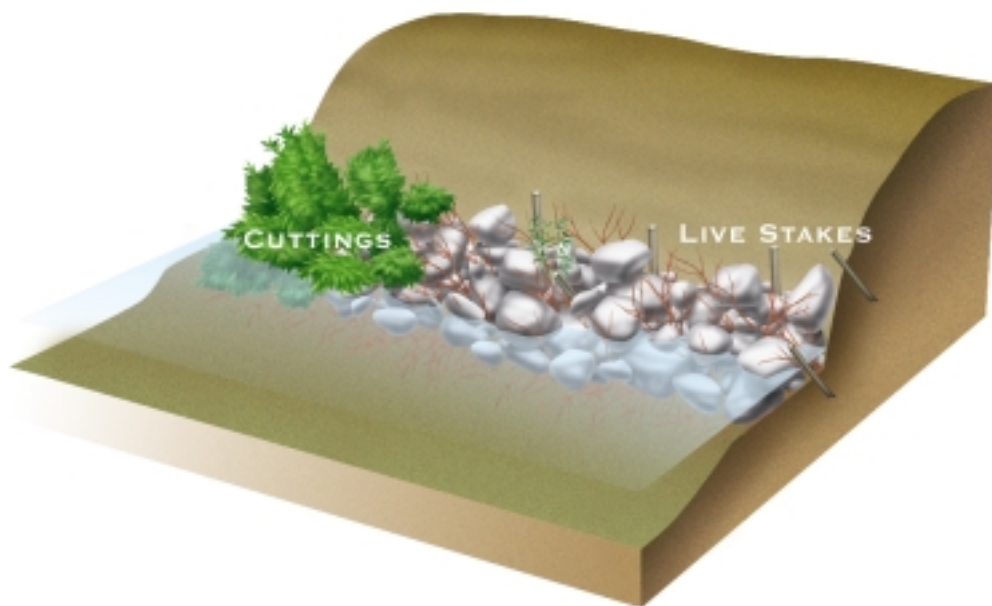
## **Description**

A live rock revetment is the combination of live dormant cuttings with field or armour stone. The live cuttings are placed in the openings between the rock, during or after rock placement. The rock holds the cuttings in place, and as the cuttings grow the roots hold the rock in place and help to stabilize the site. This method has also been referred to as a joint planting, vegetated rip-rap, and rock fill with branch layering.

## **Purpose**

While a live rock revetment provides immediate protection after installation, it should be used sparingly. In this bioengineering technique, preference is placed on improving past installations.

The extensive use of rock or armourstone (blankets of quarried limestone) by itself as a means of stabilizing stream banks can have a negative affect on both the stream's physical and ecological stability. The relatively smooth surface of a streambank covered in rock provides less resistance to the flow of current than a similar streambank covered in vegetation. The widespread use of rip-rap or rock can actually have the effect of gradually accelerating the streams current, increasing the occurrence and severity of erosion



**LIVE ROCK REVETMENT**

downstream. Large amounts of rock can also reduce the amount and complexity of riparian growth. This can have a cumulative negative impact on both wildlife and fish habitat.

However, where it is appropriate, there are many advantages in combining live cuttings with stone. They include the creation of diverse riparian habitats; the roughening of the surface of the rock treatment which can slow current velocities and trap sediment; the presence of roots which help to hold the rock in place; and a more natural appearance. A live rock revetment is also efficient in dealing with high volumes of bank seepage.

While it is best to combine live cuttings with rock when the rock is placed, this method can also be effectively used to improve existing rip-rap or armourstone structures. This "improving" feature is important to note since the use of purely rip-rap or armourstone is still common.

## Application

A live rock revetment can be a cost effective means of dealing with erosion in situations where there are high current velocities, wave action, steep banks that cannot be graded, or where there are small breaks in the streambank. This method is simple to use, and can lend itself to the private landowner or volunteer group faced with severe erosion problems.

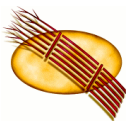
A live rock revetment can be placed on a wide range of slopes, as long as the finished slope is approximately 2:1. Placement on slopes from 1:1 to vertical require the use of stone sized 1.5 to 2 times greater than recommended by looking at velocity alone.

The size of rock to be used depends on stream velocity, gradient or slope, and the weight of the stone. The following table gives a general guide to size stone:

<b><u>Stream Flow Velocity (m/sec)</u></b>	<b><u>Mean Stone Diameter (cm)</u></b>
less than or equal to 2.0	8 - 11
2.0 - 2.5	11 - 18
2.5 - 3.0	18 - 22
3.0 - 3.5	22 - 23
3.5 +	requires a more thorough design

Those interested in building a live rock revetment are urged to contact their local Conservation Authority or get the help of a Water Resources Engineer to ensure the appropriate sizing of stone. The stone does not need to be uniform in size, but should have an average diameter that matches the recommended diameter.

Most literature detailing the construction of a standard rip-rap structure recommend the use of angular quarried stone. This is so that the individual rocks "knit" together, making it more difficult for the structure to be washed away over time. Fieldstone, if found in sufficient quantities and sizes, works just as well as quarried stone. The growing cuttings help to hold rocks in place, allowing for the use of rounded stone.



Standard rip-rap also demands the use of a filter fabric or gravel to be placed at the rock/soil interface. This is to prevent the erosion of the finer soil through the rip-rap. In the case of a live rock revetment this is not required; as a brushlayer or willow bundles act as a filter material.

The thickness of a live rock revetment can vary, but should be sufficient to hold the cuttings in place. In a live rock revetment, long-term protection is provided by the growing cuttings, not the stone. A live rock revetment should extend up the streambank to a point close to the bankfull stage.

Care should be taken to ensure both the up and downstream ends of the structure are returned into the streambank. The toe of the live rock revetment should be slightly lower than the streambed to prevent early undercutting. This is because the structure requires substantial quantities of rock, therefore, a live rock revetment can only be used on sites that are accessible to machinery. Site disturbance can be quite high.

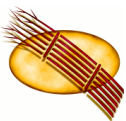
## **Construction Guidelines**

To construct a live rock revetment in existing rip-rap or armour stone, follow these steps:

- Collect a supply of fresh, live, dormant cuttings. Mature stems in all shapes and sizes can be used. Any of the species listed in the appendix will work, as long as the chosen species match the site conditions. Willow posts are also effective. Cut live stakes, following the recommendations in the live stake factsheet. Keep in mind that the proportion of materials used should be ½ live cuttings, ½ stone.
- Pry up or dislodge the rock in the area you want to plant. Try to reach the underlying native soil. If there is a layer of filter fabric, you will need to cut a small hole in it to give the cuttings access to the soil.
- Install the live stakes, willow posts, or bundles of cuttings. Make sure they have penetrated the filter fabric, and the underlying soil. Place soil around the cuttings, while carefully replacing the rock.
- If the rock layer is too thick and the underlying soil cannot be easily reached, place the cuttings as close to the underlying soil as possible and pack with soil while replacing the rock.

To construct a complete live rock revetment, follow these steps:

- Prepare the bank by making sure that it is free of debris. The live rock revetment should (like a brushmattress) have complete contact with the ground. Excavate a shallow trench the thickness of the revetment, and



slightly below the streambed. Make sure this trench is returned into the streambank at both the up and downstream ends.

- Starting at the upstream end, place a layer of live cuttings at the bottom of the trench and along the bank. This layer of cuttings should be at least 5 cm thick, and should be placed so the growing tips are at an upward angle. The cuttings should protrude from the rocks at least 50 cm.
- Place a load of stone on top of the cuttings. This should be done carefully to minimize damage to the cuttings.
- Add live stakes and/or willow posts. Make sure they have penetrated the underlying soil.
- Place more stone, continually mixing in cuttings, move up the slope until you have reached the desired height. The revetment should have live cuttings placed throughout.
- If you are working on a site where high current velocities make it difficult to place the live cuttings, move downstream in short increments, completing the entire revetment as you go.

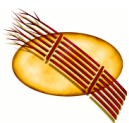
## Materials

Here's a list of what you will need:

- a ready supply of fresh, dormant cuttings. Availability, size, and species similar to that of live stakes. Willow posts can also be installed.
- sharp pruning shears.
- chainsaw and appropriate safety equipment.
- sledgehammer, deadblow hammer.
- shovels, rakes.
- earth moving machinery.
- a sufficient quantity of appropriately sized stone.

## Cost and Maintenance Needs

The costs of creating a live rock revetment out of existing rip-rap is minimal if live cuttings and labor are provided by volunteers. Costs will rise dramatically when building a complete revetment. The use of machinery to transport stone, to grade or prepare the site, and to place the stone can be substantial. Cost per linear metre can run from \$100-200/m. Maintenance of an established live rock revetment is minimal.



## **Integration**

A live rock revetment can be used in conjunction with:

- fascines
- vortex weirs
- live stakes

## **Demonstrations**

This type of habitat structure has been applied in the following demonstration projects:

- Project #15, Black Ash Creek Rehabilitation Project
- Project #92, Baxter Bridge CP Rail
- Project #119, Rouge River Restoration - Redstone Road Bridge

## **For More Information**

Please refer to the following authors and their respective publications located in the bibliography:

Schiechl and Stern, 1996.  
Schiechl, 1980  
Gray and Sotir, 1996

