The damage done by rodents is just part of the whole riparian planting experience. The best way to deal with it is to remove thoughts of the damage from your mind and continue to forge ahead with the planting program. When working in a natural eco-system, there will always be disappointment involved when you are trying to meet specific goals. You had best realize this early on, and continue with your mission, regardless.

Persistence is something that I will mention more than once in this paper. The more you plant, the better at it you will get. Just like everything else you do.

Above: *The push planting method requires that you handle the plant at the transition point between what stays above ground and what is plunge beneath the earth. Right photo shows how you clear a small spot in the grass, to expose the soil, before you push the cutting firmly into the ground. Sometimes the roots are already sheared off when you pull them out of the rolled rooting medium.*

Above: *Push the plant right down to the transition spot on the cutting shaft. Then firmly tamp the soil around the base to ensure that no air gets at the roots, which are alread growing.*

On rainy days, I use rubber gloves for planting, but if the weather is nice, apair of gardening gloves will do the job. The rubber palm and finger area on the gloves keeps the soil from jaming under your finger nails. The plants will not suffer any planting shock, if there is enough moisture in the soil when planted. The planting shown in the previous photo is from the first batch of the bunch, for the 2020 planting season. The date was April 07, and the frost was still in the ground, except for right next to the water's edge, on Nose Creek.

2.6 Hole Punch Method Photo Guide

The hole punch method is best used when planting with volunteers, so that the planting procedure stays consistent and the plants have a good handful of peat moss and soil surrounding the rooted part of the cuttings. It also provides the opportunity to work in teams, which is a good practice for corporate groups and students alike. This is when working as a team can really get the gang organized and off to a good start. Lots of plants can be planted if the small teams get their rhythm and really start getting the job done efficiently.

I always start the groups off with a bit of a talk about the program and the first thing in the planting process, which is safety. Packing around heavy pointed, and somewhat sharp tools like the hole punches must be done by responsible hands. There are plenty of people to remind anyone that is getting too complacent in the job.

The point of the hole punch can be used to clear a small spot in the grass, for the hole to be punched into the ground. As mentioned, be careful not to take any blades of grass down into the earth with your punched hole.

Above: *First you clear the grass to expose the soil underneath. Secondly, you drive the hole punch tool into the ground up to the foot peg, which marks the appropriet depth. Now enlarge the hold using a circular motion, the width of your shoulders will guide you on how much you should make your circle. This will increase the size of the planting hole and make removal of your tool easier.*

The movement of the handle on the hole punch tool in a circular motion, at shoulders width, will enlarge the hole and also make it easier to remove the tool. Please use your legs when you lift the tool, this will save your back and make the job easier.

It is hard work, so you should spell off the person on the hole punch tool, it would be a nice gesture and also give the person a bit of a break. This way everyone can have a hand at doing some of the different duties involved in planting the pre-grown cuttings.

Use your legs and keep your back straight, when lifting the hole punch tool out of the ground. Then place the pre-grown cutting into the hole, holding it on the rooted part of the plant, as you push it into the hole. The depth should be perfect every time, thanks to the tools pointed end. I always mention the use of your legs rather than back, when I do a safety talk, before each planting event.

The space around the roots needs to be filled with the soil mix of peat moss and compost. Use your hand to fill the hole. Remember to wiggle the cutting from side to side.

You can wiggle the plant shaft from side to side, to help fill the hole with the soil mix.

The plant is now ready for watering, and filling the hole with more soil. Then, the top of the hole needs to be sealed so that air does not get at the roots. You can use your hands or feet to gently compact the soil at the base of the cutting shaft. Too much compaction on wet soil can impede the growth of the plant, so be careful. The over compaction of soil will hinder growth, especially if the soil has a high clay content.

Water will come out of the hole when you compact the soil, but the air will not get at the roots and the peat moss will help hold moisture in the soil. around the cutting, promoting fast root recovery.

You can tell from this photo, there is a high clay content in the soil, so be careful not to compact the ground around the plant too much. The moist ground will get the plant off to a good start.

Above: *We planted these willows along the Bighill Creek in Cochrane, Alberta.*

I don't like to bend over more than I have to during a planting, so using my boots to compact the soil and seal the base of the plant works just fine in some applications. Just my weight per square inch, is adequate for good compaction.

After the watering of plants, I little time is allowed to let the water soak into the soil around the plant. I usually plant 10 plants, and then go back and water them, from the first planted cuttings onto the last. This allows the water to soak into the ground, before tamping.

The moisture in the peat moss, will last for a long period of time. This can sustain the plant between rains.

These stage one pre-grown cuttings are ready for either push planting or hole punch planting. The roots will be preserved in hole punch planting, while the push planting will shear them off. Either way, the plants will survive the planting in good condition at this stage of growth. Remember, the stage two plants need to be planted using the hole punch method only.

2.6.1 Stream Bank Stabilization

By far, the most visually rewarding results from our planting program are the stream bank erosion sites that we have planted with willows, to stabilize. The stream bank stabilization plantings have one of the most rewarding results; cleaning stream beds of silt and improving water quality, over time. Once Soil, Clay and Silt are prevented from entering a stream channel annually, the velocity of flow of the stream channel will eventually flush out all of the silt in the stream bed, downstream. This mainly occurs annually, in the spring months. The long-term result will mean more aquatic invertebrates in the creek and more food for the wild trout that live in the streams.

For years now, volunteers have been planting native willows and tree cuttings that were grown from stock that was collected in the watershed, and then planted in the spring and fall. A percentage of those cuttings were utilized in plantings on eroding stream banks along a few local streams. Some of the eroding stream banks were quite steep, and potentially dangerous, so I completed all of these types of plantings myself. By keeping photographic records of the stream banks recovery, I can share some of this information with you.

Above: *This eroding stream bank stabilization project was completed entirely by using Stage One, push plantings in the applications. The photos are five years apart.*

The dangerous planting environment shown above is why only a trained professional should attempt to plant on such a site. My methods include knowing when to access a dangerous steep eroding bank, to plant willows.

There are some simple rules to follow:

- Never plant in early spring, when the frost is coming out of the ground.
- Never plant just after a rain, or when the soil on the exposed slope is showing heavy moisture in its clay and soil.

- I try and do most of the planting on these exposed erosion sites, post flood, when spring melt blows out the stream channel with high volumes of flow. Planting these sites is best done after the spring flooding period.

If the plants survive the first season, by next spring they will have established a root network that will help keep the toe of the slope more stable. The plants will usually grow faster, with no competing plants to suck up the moisture or crowd them out.

Above: *The extreme erosion sites are the most challenging, but the photos above show newly push planted cuttings on the* ***Left,*** *and plants that have made it thru their first winter, on the* ***Right****. The right photo shows the ice is still melting on the stream channel, in the early spring.*

It has surprized me how well new Salix willows will grow in rather dense clay, when planted on stream banks that consist of mainly exposed clay. This was a major advantage in using pre-grown cuttings for a planting program that would focus on erosion sites, as well as normal stream bank plantings. These erosion sites are all planted by push planting. The hole punch method would just be too ackward and dangerous.

As I previously mentioned, the Stage Two plants are always planted with a hole punch tool method. These Stage Two can be a lot more advanced in growth than the Stage One.

The Stage Two has been grown in the rolled rooting medium for a longer period of time, and the tops and roots are more developed or advanced in growth. The best time to plant these advanced plants is in the the cool of the early morning or evening. The plants need to be kept in the bags or black plastic bags in pails, so that less air and sun can get at the roots.

I always encourage volunteers not to carry too many plants in their planting bags, at one time, so that plants are not exposed to the air for too long. Before each corporate or NGO volunteer planting program, a safety meeting is held and also a brief training program, so that the groups members are all on the same level as novice planters. Some corporate groups and volunteers can gain experience over the years and do a fantastic job of planting.

Above: *These cuttings were planted a few years earlier, in this eroding stream bank, with clay and gravel in the soil, yet they still grow.*

3.0 Discussion:

It is important to discuss some of the variables involved in the planting of not only cuttings by other planting applications of trees or willows close to a flowing stream. The different applications, using pre-grown cuttings will also be covered in this section of the manual.

In cities and towns, this Head Start System of planting can be carried out with volunteer groups, corporate groups and students, annually. There are benefits that you will be witness to over time, if you are not in a big hurry. More wildlife habitat and improved water quality are high on the list of benefits. Below the surface, the aquatic life can benefit as well, but this is usually harder to see, unless you witness rising trout, pike or even minnows and suckers, breaking the surface of the water to take a meal. In the spring planting season, it is also spawning season for the common suckers in our local flowing waters. These large fish group up in shallow, gravel laden areas on all three streams in our program, so you should be mindful of such things, so that you can show and share the experience of witnessing this.

This type of riparian planting program is very worthwhile and you can do a lot of planting every year, with volunteers, for minimal cost. If you can find someone who is willing to do part of the cutting collection and growning of the plants. Having the local schools involved is also a big plus, for participating in the entire process from collection to planting.

West Nose Creek in the City of Calgary has surprizing high populations of beavers, considering the limited supply of willows and trees. The bank dens are the most common type of habitat that the beavers use on this stream. Planted trees from development are the primary target in some areas, despite heavy tree wrapping. If the tree wrapping is done incorrectly, and the wrapped wire is not attached to the tree, the beavers learn to lift the wire mesh to get at the base.

The hunt for any available forage keeps a population of beavers in constant movement, up and down the creek, looking for a quick meal or supplies for their winter food cache. Sometimes our young willows are targeted as a quick snack, but sometimes the young cuttings will continue to grow, even after being made a meal of. There will be loss, but the riparian planting program must go on, accepting the loss as part of the natural process. It really is quite different than our world, so for some it takes a while to get use to.

The young people of today, especially the really young elementary school kids, are real keeners, and I love to work with them. Middle school students are just as enthusiastic, so both of these age groups would be high on my list of favorite groups to plant with.

When I talk about the beaver's hunt for food, I am also including the planted trees in developments that are located close to streams like the West Nose Creek. The developers will sometimes wrap their planted trees, and some will not. Even those that are wrapped, are done so in an amateur manor. Sometimes wrapped trees are not wrapped high and the beavers don't waste any time getting after them. Tree wrappers may not realize how tall beavers are, when they are standing on the upslope side of the tree, on their back feet and tail.

Above: *Sometimes the wire is too short and sometimes it is not tall enough. If the mesh is not attached to the tree, the beaver can lift the mesh and get at it.*

This harvesting of a developers planted trees is why there are more beavers on West Nose Creek, in Calgary, more than the stream would support, when compared to a stream once a healthy riparian zone is established. There is a direct relationship between the size of a beaver population and the recovery time of a healthy riparian zone. This should be considered, when beaver management issues arize. Beaver management is always going to be a requirement at some point in time. If you are striving for a healthy riparian zone along a creek, in a residential and commercially developed area like the West Nose Creek in the City of Calgary.

The newly planted willows will eventually provide the beaver population with an adequate supply of food and habitat. The beavers will still build dams on the creek, and cache their winter supply of food in the deep water, close to the lodge or bank den. Beavers store large quantities of willows and poplar in soft muddy bottoms of the creek. The beavers will push the limbs of trees and willows into the soft mud botton, or wedge the branches under the stream bank to keep things submerged. This woody debris adds nutrient to the stream's aquatic life cycle, so it is all good.

Submerged willows and limbs of trees will stay preserved all winter, making a vaualbe cache of food for the beavers winter survival. In the early spring you will see the light colored limbs, now stripped of their bark, exposing the light color of the inner core.

Lots of Pails Around the Yard

Above: *There is just over 6,000 plants in this photo. At least100 cuttings per bundle, plus a few extra thin diameter cuttings as well. The thin diameter plants are* ***not*** *included in the planting totals. I have grown and supplied over 14,000 plants in one planting season in 2015. The most developed plants are always planted first. Large quantities are grown at different time windows.*

What I like about growing large quantities of willows and poplars in 5 Gal. buckets, you can fit a lot of willows in your back yard. I have grown over 16 thousand for one season's planting. Over 14,000 in the spring and a few thousand more in the fall. It was necessary to grow batches to rotate the ready plants out of my yard. It was pretty cautic for a few seasons, but nowadays, I am down to just 3,300 in the year 2020, with maybe half of that in the 2021 season.

It took a number of years to finally discover that you can grow willow and poplar tree cuttings in 20L pails, thru the entire willow growth operation. Prior to using the pails, I would roll growth mediums and stack them in tight groups on a plastic barrier, watering them regularly to keep them moist. The pail method just cut a corner in my operation and allowed me to reduce tending time, and make the whole operation more efficient. Which has been the plant since day one, to make the system more efficient.

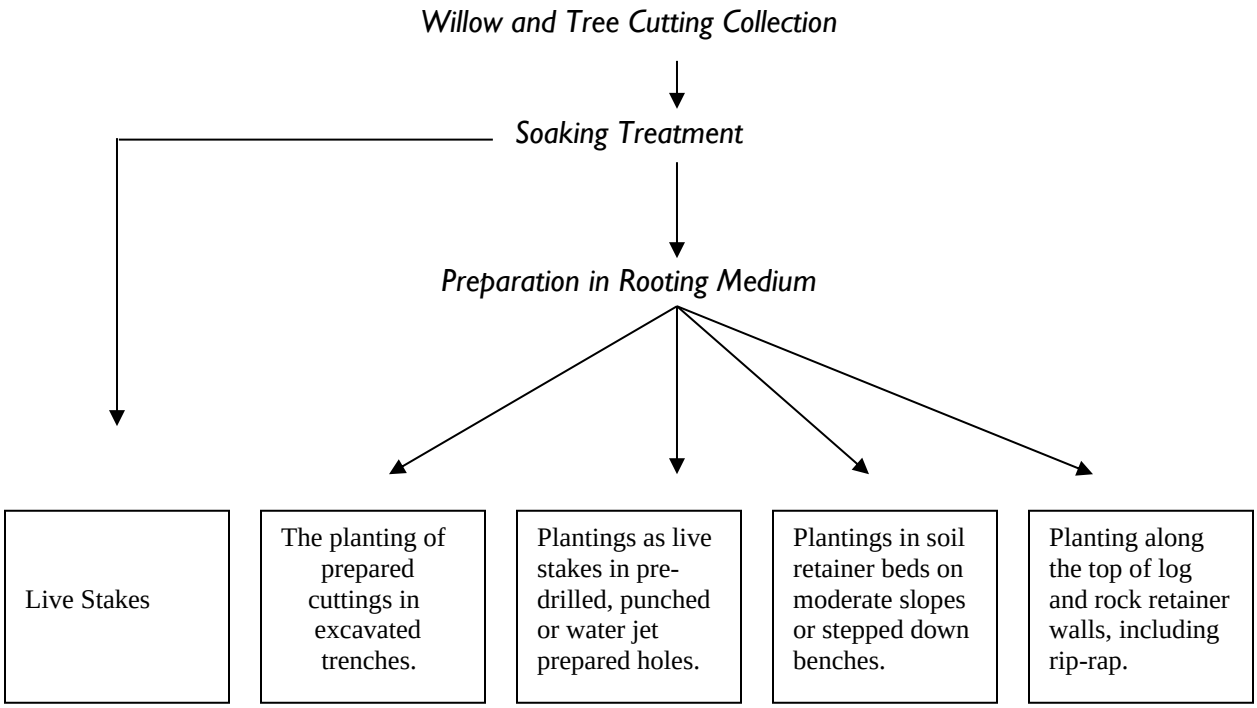
Initially, I grew plants by starting them indoors, and later on using a green house, but now the entire operation is conducted outdoors in the backyard, without the major expenditures of indoor or green house operations. My goal was to make a system that was easy and simple to follow for the small volunteer groups or large ones. Making everything simple and more easily undertaken, if riparian planting is in your project's program.

My backyard landscaping and maintenance has been put on hold for the "Bow Valley Riparian Recovery and Enhancement Program", which is the planting program title for the project that I am involved with presently. It feels good to utilize the space for a worthwhile cause. The plants that are most developed, or further advanced in growth stage are selected for planting first, in the early spring, as soon as the frost is out starting in early March and going on into April, to at all times in the spring, keep large numbers of plants in the growing process. I call the early development plants "Stage One" and the further developed plants are titled "Stage Two" plants.

After this paper is published, there will be small modifications made to improve the system over time, but this will most likely be carried out by someone else, with some new fresh ideas on how to further improve the methodology. Eventually, my equipment will be passed on to the next person interested in continuing with this type of work.

My first paper that I published was for a Riparian Restoration Workshop, held on May 10th and 12th of 2011, in Standoff, Alberta. The workshop was sponsored by the Alberta Government's TSAG, Technical Services Advisory Group, First Nations and The Department of Fisheries and Oceans Canada. The Blood Tribe and a few different consulting firms helped to organize this event for First Nations managers from across Canada. However, tremendous improvements have been made to the planting system, since that first publication, a decade ago. This latest version of this published methodology is much more simplified for those interested in riparian restoration planting and to encourage more planting in similar programs to the ones I have carried out. It also opens up opportunities for volunteer organizations to get involved in a large project to improve the riparian zones along flowing streams, in cities and towns.

In the diagram below, it shows how you can jump from soaking the cuttings, straight into live stakes. Just soaked cuttings can still be used as a planting application as well, rather than preparing them in rooting mediums, but the soaking process is important to get them off to a good start. The survival will not be as high as well, when just planting cuttings.

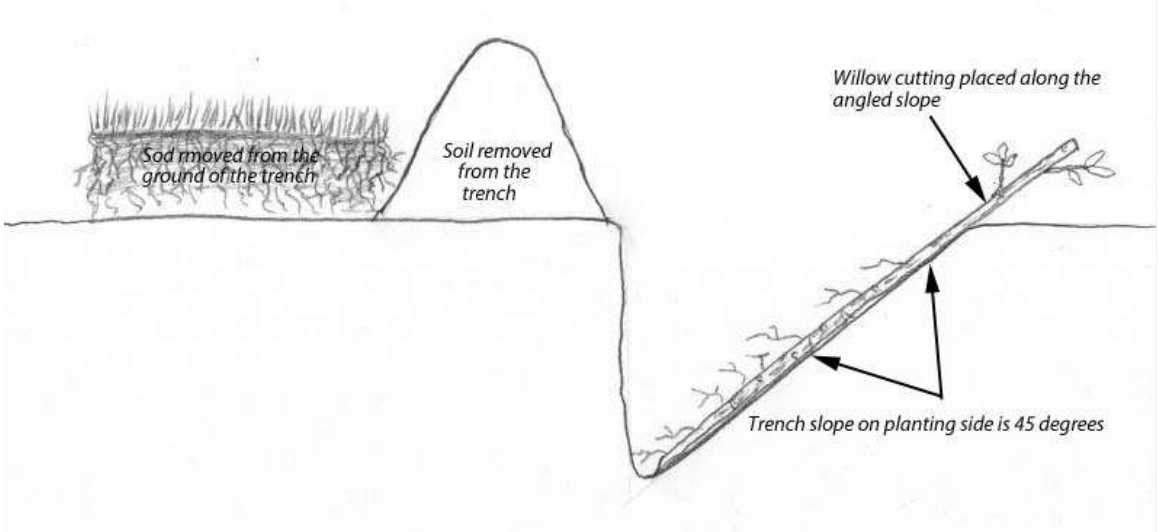


Above: *This shows a break down of how the planting program fits into the use of prepared cuttings. You can see that rooting medium grown plants can be used for a variety of applications.*

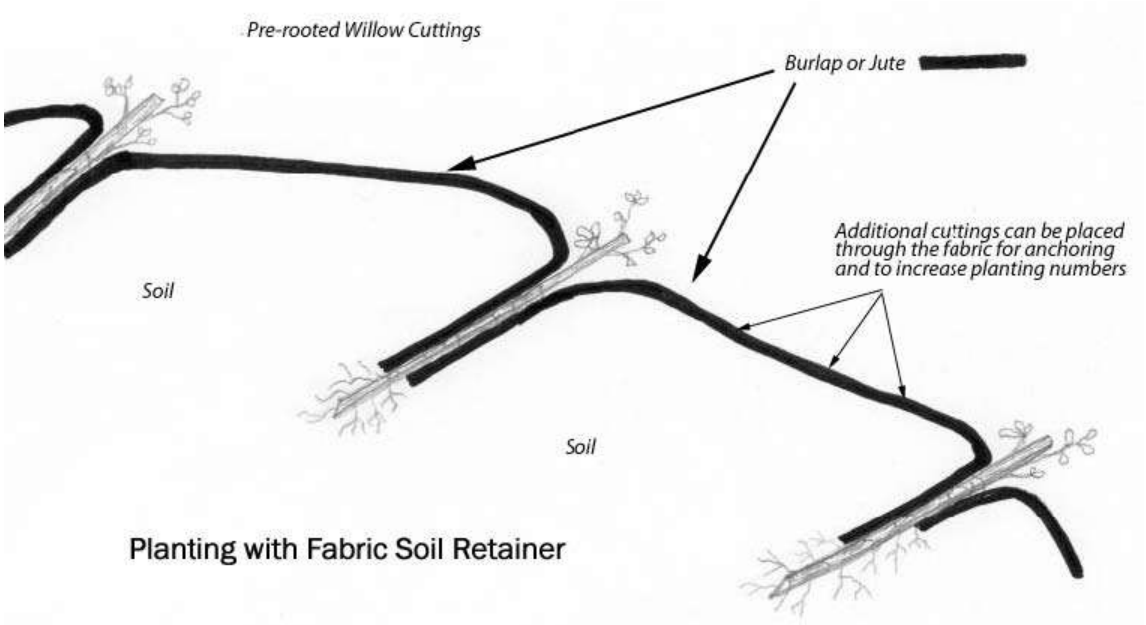
3.1 Other Planting Applications

We have already covered the push planting and hole punched methods in this manual, but there are some other applications that require some review. The trench planting method and the planting with soil retainers. In these and other applications, you can use the pre-grown cuttings for a Head Start. The trench planting method is pretty straight forward, so we can look at this approach first. Simply put, you just dig a trench with a 45^0 slope. You can place the cuttings on this slope, spaced apart a few inches, and then cover the trench and bottom of the cuttings with soil.

Planting with soil retainers is a little more involved, so this is how to start. First you use burlap as a growing medium and soil retainer. It will break down and bio-degrade in a few years when buried, but if left exposed, it can last for 4 or 5 years. Review the following diagrams for a primer in a few different applications.



Above: *This illustration shows how to plant using the trench method. The sod is first removed and placed off to the left in this drawing. Cuttings can either be left in the rolled burlap rooting medium or removed and placed individually in the trench. A mix of soil and sand can be used in the rolled rooting medium for better root development, but the rolls will be heavier than with the peat moss.*



Above: *This sketch shows how the burlap retainer is used with rows of planted willow and tree cuttings. The burlap soil retainer will also help maintain good moisture content below its covering. Additional live stakes can be used to anchor the fabric and add extra plants to the site. This application is good for the top of areas rip-rapped with large class boulders. Vegetation on top will eventually spread down into the rip-rap.*

The following photos show how a burlap soil retainer is used, when planting the top of rip-rap armouring. The Application site is in the Hinton area of the province of Alberta.

Above: *Rolled rooting mediums can be used with burlap soil retainers to establish a willow and tree crop. The plants can be spread out during the planting process, to allow for less congestion during the first few years of growth. You can achieve this by unrolling a bundle of plants and picking out the rooted cuttings for planting. The cuttings were then planted at random.*

The live stakes on the left side of the planting are for holding the burlap in place, along with some rocks. The live stakes will also grow, so this is a perfect anchoring system for the burlap fabric.

This application was used on the top of rip-rap at a new culvert site. Both sides of the road received plantings. The silt fence would stay in place until the willows have taken, and also native grasses are growing on the site.

All of the cuttings used for this project were collected from the area surrounding the project site. I grew them in Cochrane, until the main project was ready to move ahead with. This growing system allows you to plan on when the plants will be available, but you have the option of keeping them alive for a longer time, or even an earlier planting date.

On this Hinton Project, I had to have all of the equipment and plants ready to go, when the contractor that installed the culvert was making his move on doing the crossing. An engineer from ATCO Pipelines was also required on site, along with another consulting firm that I had already completed some work for.

The planting on this site was completed in 2007 and the after photos, on the next page, were taken in 2010 on a follow up trip. I had returned to the surrounding area for another project, so I stopped by the 2007 project site and took a few of these photos. The plants were doing great and I repaired the silt fence so that it would last a few more years before removal. It was great to see how well the plants had grown and I also took some photos

of our instream fish habitat enhancement work, which included some constructed log pool habitats, boulder runs, spawning habitat and cover habitats, including planted willows.

Above: *This is the planting site, three years after it was completed. You can see that the live stakes have grown as well, but they are not as far ahead as the plantings from the rolled rooting medium. The rolled mediums already had new long new limbs growing, when planted.*

Above: *These are the plants on the other side of the road. The burlap has just about bio-degraded away. There are also poplar trees growing in the mix.*

The use of burlap in rolled rooting mediums, is for those applications where the plants will be densely planted, when the plants can be unrolled and covered with soil.

Above: *This is how you prepare a rolled rooting medium with burlap. This roll is used in either trench planting or a soil retainer bank.*

The rolls should fit inside a 20 L pail, so a tight rolling is required. I have grown these rolls without the pail, you just have to water them more often. They can also be grown on bare ground, so this will help you out in certain circumstances. Either dense tops for cuttings or the standard live stake size, in a small or large diameter, will work with this

method. This was the technique used on the Canmore Creek log wall planting, which was featured in the first pages of this manual.

Burlap can be purchased in 1 X 3-meter sections, in hardware store, which is just perfect for this application. You can also buy the product in bulk, but this is going to be costly, so make sure you have a guaranteed use for the material, if you buy a lot of it.

It is important to note that after a rolled rooting medium is unrolled, you can remove cutting from the roll and spread them out over a greater spacing. This spreading out of the pre-grown cuttings, is used with trench planting and also with a burlap soil retainer planting. It extends the area of planting and insures a good survival rate, in the end.

I always give the site a very large watering, if I will be leaving the site. This will pay off big time, if you're looking to ensure a good survival rate, when you leave. The soil will stay moist for a long time, with the fabric helping to hold in the moisture. The roots will grow right thru the burlap and in a few years the fabric will break down and become a fibrous loam.

All of the planting technology used, is designed to let the plant grow on its own, to let nature do the rest, after the planting job is completed. However, with the hole punch method of planting, heavy watering just after planting can make a big difference, because you are usually planting a little further back from the edge of the stream. This is where some planters make their mistakes, by not giving there planted crop a good saturation of water, right after planting. If you wet the ground in the surrounding area, the water will stay in the ground around the plants for a longer period of time, with less evaporation. If a rain comes within a few weeks after planting, the plants will be ok, once a really good watering is completed.

Some volunteer groups were interested in returning to water the plants, in the weeks after the first day of planting, so that is what they did. Additional watering can always help the plants out, but be prepared to sometimes loose more plants to trampling by foot traffic along the stream banks, over plants that are pretty hard to see in the tall grass. This is the only draw back in having volunteers watering. As novices, they cannot spot small plantings as easily as a train set of eyes can. The preferred approach is to be honest with the volunteers is the best way of communicating the message.

Damage done by humans is something we have control over, but there are other more pressing concerns. Loss of plants by rodents is a heart-breaking sight for the volunteer planters, and this can be very disappointing to experience, take my word for it. I have witness too much of this in my own planting career. This is why I like to make a point of giving advanced warning about rodent damage on a planting site. Remember that once the willow has survived into the second year, its chance of survival due to beaver grazing, is increased.

If there is more plant showing, the more interest from passing beavers, swimming by in the stream. Slowly, the plant grows into maturity.

The way I look at it, if you experience a lot of loss in riparian planting, it helps shape your character. This philosophy is what helps me cope with some of the disappointment.

Above: *This photo shows what the early buds look like, after being covered and in the dark for approximately 15 days. The coverings over the plants also insulates the cuttings, which promotes early growth. It is still too early in the growth stage for any type of pest or leaf mold to start, if the plants are well covered and the air can circulate thru the cutting's tops. Later on, in growth, any infected leaves should be removed from the bundles, when you notice any.*

Disease, mold or mites are a concern when you are planting so many plants, so close together. I have had problems with a black mold or similar blights in the past. This was soon resolved by collection of the cuttings being carried out in the late winter, rather than in the early or mid winter period. The storage of cuttings indoors or in temperatures too warm, without good circulation, will result in potential problems arising, from a collection of bad storage or growing conditions, usually indoors.

When you are planting large quantities of pre-grown cuttings, and planting with the push planting method, you should have the right equipment to transport your pails around the creeks that you are planting on. With lots of good trail pathways near my planting sites, in Airdrie, Calgary and Cochrane, it is easier to get your plants close to where they are going in the ground. I use a game cart and pails to transport the bulk of my plants, and then planting bags can be used for the actual planting. The whole process of transporting and planting is a rather fast operation, so one trained individual can plant hundreds of plants in a morning's outing, using the push plant method. Check out a few pointers ahead.

Placing the cuttings in the pails and bags requires a little care and caution. Just follow these guidelines. Carefully, grasp the cuttings near the transition spot on the base of the terrestrial side of the plant. Pull up, and the pre-grown cutting will follow. The cuttings will come out a little easier if you unwrap the top wrap of wire around the bundle or roll.

The plants can be carried along the stream by putting the cuttings in a plastic bag, carried in a 20L pail. If you wrap the plastic around the rooted part of the bundle of cuttings, less air will get at the roots. I can use one or two 20L pails for a day of planting. This is a quick way of getting the cuttings to the stream bank.

In this photo, you can see two 20L pails of cuttings and two bags with cuttings. This is an entire pail of cuttings, which is a little over 100 plants. All of these can be carried along the stream. When you need to refill your belt carried bags, you can do so from the plants in the pails. If the bags and pails are used, the plants will last approximately an hour out of the pails that they were growing in. I can plant approximately 100 plants in one hour of planting. Some areas will be slower to plant, while other areas can be planted quickly.

When you plant with the hole punch method, the soil mix for filling in the hole should be light and full of nutrient. The lightness makes a big difference when you are carrying the soil with you, when planting. Peat moss is the key ingredient, this is what I use to grow the plants, so it is also perfect for planting day. For the ingredient that boosts nutrient, a compost mix will do the job. A very small amount, mixed in with the peat moss, is a great soil enricher. The peat and compost will sustain the plant for a longer period of time,

when it is in its first season of growth. Peat moss also absorbs water and holds it for a long time, so roots can drink their fill. The peat moss will quickly turn into dark black loam, within a year or so, after the planting.

A premium quality peat moss which is fine and has very little wood mixed in, will be better for pouring down the narrow space around the planted cutting. By moving the cutting from side to side in the hole, the peat moss will fall further down into the hold. You can use water to help wash the peat down the hole as well. I like to tamp the top of the hole closed before a heavy watering. This can be accomplished by a firm tamp of the toe, on the ground around the cutting. I have also used just my hands with gloves to tamp a hole, if the gloves are rubber.

You can also tamp the hole after a watering, but this is something that the planter can decide when they try a few different methods in different ground. The ground conditions vary, so must the techniques for closing the ground around the stem of the cutting. It is really important to seal the hole well when planting with the hole punch method.

Remember that too much compaction of the ground around the plant will impede growth, especially when there is lots of clay in the soil. There are small things that you learn over time, but this is where experience guides you on your journey. I may mention some things that you may consider insignificant, but you will understand well once you have planting a few thousand plants.

4.0 Results

Now that the planting technics are clear, we can turn our attention to some of the results and a primer on how this method of planting willows can enhance fish habitat both above and below the water level. Willows and other woody mass create lateral margin habitat on both sides of a trout stream. The growth, over time, will help to constrict the flow in the main channel and create an increase in flow velocity and scour. This will result in the cleaning of the natural stream bed, down to the gravel, cobble and boulders that enhance both aquatic invertebrate populations and trout populations.

The cleaner and more abundant gravels provide spawning habitat for trout, so this is where the real benefit to the trout populations come to play. The increase in aquatic invertebrate habitat will also boost up the populations as well, and this abundance of food for trout will provide healthier and more numerous trout. These benefits are what I look for in the riparian planting programs that I have been involved in. My focus is to understand how the plantings shape the trout habitat in the stream, as they grow over time.

The plantings right along the water's edge are the ones that are most significant in creating trout and invertebrate habitat. The submerged lateral habitat of willow branches that have entered the creek are particularly significant in their benefit to both aquatic invertebrate and trout habitat. I have called this type of habitat "Suspended Lateral Margin Habitat", and one of the main advantages for this type of submerged habitat, is that it does not get

buried in silt or muck, during high flows of turbid water with suspended fines or silt, being flushed down the system.

This makes willow plants a vital part of the natural stream habitat on certain types of streams, in our area. These local streams are spring creeks with lots of agricultural activities, altering the natural stream bed substrate. Suspended lateral margin habitat provides significant habitat for the life cycle of a trout stream. The newly planted willows also provide a natural bio-filtration system for the creek, filtering surface ground water entering the stream.

When I got into the planting of native willows and trees on streams, it first started out as a component of the fish habitat enhancement work that I was doing, in the past. Over time, I began to realize how significant a riparian planting program could be for some of our local trout streams, if it was carried out on a large scale, with many thousands of plants being planted every spring.

The benefits of growing willows and trees that we plant would be amazing on some reaches of streams that were then, pretty much void of the natural riparian cover, which was once historically present. The recovery from years of abusive livestock grazing is possible, in cities and towns that now own the property surrounding the streams, and they are interested in seeing these streams recovery as well. This makes the task of organizing a planting program so much easier. Provided you make contact with the right people, also eager to witness some positive change.

Above: *The willows shown in this photo were all planted along West Nose Creek in Calgary. They are still pretty small in the tall grass, but they were planted in 2016, so they haven't been growing along the creek for that long. There were plantings, both on top of the stream bank and right along the water's edge. In a few more years, they will be standing a lot taller.*

Above: *These willows were planted along the Bighill Creek in Cochrane, they also are still pretty small, but growing higher every year.*

Above: *These are willows planted along West Nose Creek in Calgary. The plantings are being grazed upon by beavers, but they are now numerous enough to handle the foraging rodents.*

Above: *This is one of our planting sites along the Nose Creek in Airdrie.*

Above: *This is the same site in Airdrie, back when we started planting on this same reach of the Nose Creek. The lady in the stripped coveralls is Crystal Bazar, of the City of Airdrie, a key player in our program's success in that city.*

Above: *These willows growing right along the water's edge, were all planted in our program.*

Above: *This photo shows the relatively evenly spaced willows that we planted. Growing well!*

Above: *We planted these willows along the Bighill Creek in Cochrane. When I say we, I mean all of the volunteers in the "Bow Valley Riparian Recovery and Enhancement Program". As I write this, we have planted over 75,000 native willows and tree plants, along over 30 km. of stream bank, on three different local trout streams. The plants have been completed on Nose Creek, West Nose Creek and Bighill Creek. In the city of Airdrie, Calgary and the town of Cochrane, Alberta.*

The willows surrounding this pool habitat were all planted in the BVRR&E Program. You will see some dramatic results on location like this one, in the near future. The trout numbers in the creek will increase significantly. Some of these willows are Salix Exigua, which will sucker up all over the area. The willow is a great streambank stabilizer and it can withstand heavy beaver grazing. A great primary recruitment plant and nitrogen fixer.

Above: *The willows on the left-hand side of the stream channel were all plantings from the BVRR&E Program. There are willows growing in the tall canary grass on the right-hand side of the stream channel, but they are growing slow, due to their competition with the tall grass.*

Above: *These willows were bent over in a flood event on the creek, but they are showing some great fish habitat benefits already, only a few years after our plantings.*

Above: *All of the willows shown in this photo were planted in our program along the Bighill Creek in Cochrane. They are already a part of the new look the stream is taking on. Amazing what a few willows can do to beautify a stream in need.*

Above: *We planted these willows along the Bighill Creek in Cochrane. They are now providing plenty of additional shade and cover for resident trout in the creek.*

Above: *An eroding stream bank that has just been planted. Check out the follow-up photo below. You will see quite a dramatic result after only a few years of growth.*

Above: *This is the same eroding stream bank, 5 years after we completed the first planting.*

Above: *An early morning view of our willows planted along and now over the Bighill Creek, in Glenbow Park, in Cochrane.*

Above: *When planting a large quantity in the spring, you may need to have multiple batches of willows that were collected and started at different times. For quantities over 14,000 plants in one spring planting program, you have to maximize your production. Fortunately, I have a big back yard and it is exposed to good south facing sunlight.*

Above: *These Stage two bundles were grown without pails; the medium is burlap and black plastic. These willows were planted in a soil retainer, on a project site.*

Above: *It is migrating beavers like this one, that stop to snack on our willow plants.*