A Simplified Technical Manual for the Propagation and Planting of Native Willow and Tree Cuttings for Riparian Restoration

2021

The Head Start Planting System

Bow valley Habitat Development

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1/6/2021

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1.0 Introduction:

The first time that I was introduced to planting cuttings along a trout stream, was back in the late 1980's. I was planting with Ray Sloan, an environmental instructor at Mount Royal College. Ray and his class of future environmental scientists were volunteers in the planting. The planting was on Dogpound Creek and it was organized by Trout Unlimited, Canada. My first use of cuttings on one of my own projects was in 1998, on Canmore Creek, in the Town of Canmore, Alberta.

The ease of planting these cuttings drew my interest into the method. The use of native indigenous plants collected from the same watershed, in my mind, was the best approach to riparian recovery work. They were mostly willows, but a few aspens and balsam poplar were also included in all of the plantings. Just like what had existed historically, along the trout streams. This was before agriculture, livestock and development of the land had decimated much of the natural riparian cover along some of our area streams.

Above: This before and after shows how an unstable mining site was sliding into Canmore Creek. A log wall was built and planted with local native cuttings. The Trans Alta Corporation provided the funding for Bow Valley Habitat Development to successfully complete the reclamation project. A log wall was constructed to create a bench that would help stabilize a 60^0 slope that was left by previous coal mining operations. The streambed had become smothered in old mine tailings.

Above: This is a photo from the upstream end of the log wall, just after construction and 15 years later. You can see the planted willows and trees have grown very fast in this particular environment. All of the coal mine tailings have been washed downstream, when the bank was stabilized.

The process of growing and planting that I used on Canmore Creek was totally experimental, but it worked so well, I decided to study the study the technique further. Since that first planting experiment, I have been continuing to develop the methodology for pre-growing and planting of native deciduous cuttings. In the last 23 years, the methodology has slowly developed to a point where I feel satisfied that the technique is very efficient and it doesn't cost much to carry out. Every year, the planting technology improved in both time, efficiency, and expense.

1.1 Why Plant Cuttings

When planting cuttings, it is **not** necessary to dig a hole. You can punch a hole into the stream bank, using a special tool, and then plant your cutting. If you are a trained experienced planter, you can push the cutting into the stream bank by hand. In either case, the cutting should grow good until it encounters dry weather, flood or rodent damage. If the plant survives the various deadly conditions, it will grow into the second season. After surviving the first season, the plant has a much better chance of growing into maturity. By the third year, one can feel pretty confident that the new plant has a good foothold.

The fact that you don't have to dig a hole close to the water's edge is very important, and this makes the "pre-grown cutting planting system" a much more environmentally friendly methodology. There will be no loose soil left from digging with shovels and planting potted plants. The existing plants and their root systems are not affected, so none of the stream banks stability is lost by using this planting method and system.

With shovel planting, that excess soil will end up washing into the stream channel. In Canada, it is illegal to carry out any type of excavation, on or close to the stream banks, without an of the necessary permits and authorizations and silt containment measures. There are special procedures and operational guidelines attached to any activity on streambanks, especially when silt containment and preventative measures are involved. When you dig along creeks you also risk the introduction of evasive plants, and destabilizing the stream banks.

Planting density is a big factor in success as well, by planting thousands of plants or saturation planting, your survival number will systematically be increased. After all, it doesn't matter what type of planting system that you use, the plants are left to manage on their own, even during the first weeks after planting. If the planter is not watering, fertilizing, the plant is going to struggle for that first few weeks, but it will grow. Overall survival will be realized at the end of the growing season.

The survival after planting is generally pretty good, if the plants were planted with care, and the instructions are followed closely. It will be known that you have a good planting system, if your survival after the first few weeks is in the high 90% range! That is what my technique has shown this success through results, time after time. After that initial result, the natural environment will take its' toll, however. The climate, rodent damage, flood damage and so on will take its toll, but in the end, the surviving plants will establish a foot hold in the area and seed propagation will spread the willows around.

The end of the summer is when most of the lost usually occurs, so at that time of the season, you can get an idea of how successful the spring planting was. If the plants can survive until the frost is in the ground, you are in good shape for the following spring growing season.

Now, after many years of improvements and changes, it is a good time to share some of what I have learned over the years!

1.2 Background

Over the years, I have been perfecting the "Head Start" planting system, making it more cost effective and easier for volunteer planters to carry out, with minimal training involved. Once the equipment is acquired, there is little overhead and having the basic equipment will keep you going for years to come.

Now that I have the equipment, and the newer methods of growing are well established, the costs are even lower than when I first started. There will be some different options open for the new willow grower, if they are interested. These options will be mentioned in this manual, so expect to read them further on.

The first use of growing mediums to get collected cuttings growing, was pretty basic, but it worked well and the job was always completed successfully. It involved the use of woven burlap or jute' as part of the growing medium. A perfect biodegradable fabric like burlap was ideal for starting native cuttings from both poplar and willow.

The burlap has a surface life of approximately 3 to 4 years, but if buried with soil, it biodegrades in one or two years. This leaves no trace of any man-made materials or human involvement, once the plants have taken to the soil, the natural process takes over. Importantly, the fabric also retains soil and helps hold moisture just below the surface. Keeping the soil out of streams is a priority, so the added expense of using burlap is not a factor.

The photo below shows what some of my first rolled burlap bundles looked like, when they were unrolled during a planting project on Canmore Creek, in 1998.

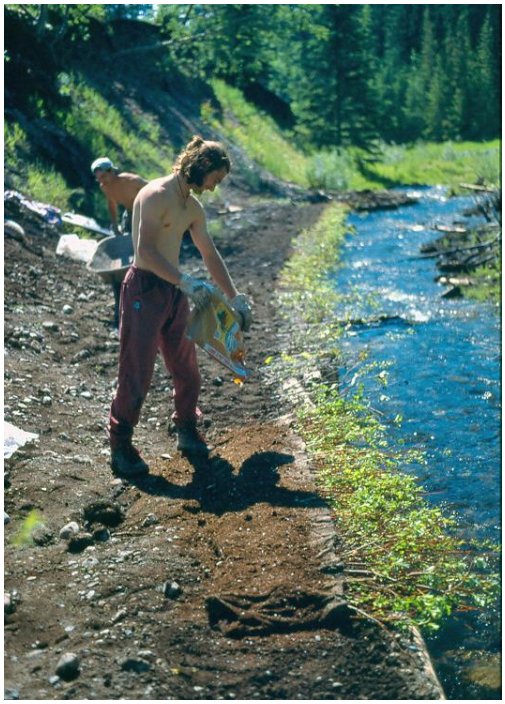
This photo shows one of my first prepared burlap rooting mediums. You will notice that I used plenty of smaller diameter cuttings back in those days. On the fabric, you can see that the burlap is already biodegrading, after a few months of growth. The root system is woven into the fabric, but the burlap is planted along with the native willows and poplars, complete in the rolls. The rolled bundles are unrolled and covered with soil. These willows and poplar cuttings were started in a sand, pea gravel mix. Which made constant daily watering a necessity. This was my first attempt at using this system!

This roll shows a mix of different small diameter willow and tree cuttings, densely grown and planted. The burlap stays on the roll, soil is spread over the unrolled burlap and roots. The use of sand as a growing mix was successful, but my soil mix has since changed. As a result of using a sand mix, the process was more costly to carry out, because the person hour time was extensive. However, this was my first attempt at applying this methodology, so the process was improved over time. It was an experiment that worked out quite well!

The growing process slowly evolved over time and today it is very efficient. Nowadays, I don't use as many cuttings in a bundle, as I did back in the day, but I felt it was important to give you an idea of how it all started for this process of growing and planting native deciduous plants, from cuttings. Nowadays, I use 20L buckets to raise the crop, and the need for constant watering is a thing of the past. I will get into this a little later-on.

During that Canmore Creek application, a few extra dollars were spent to ensure a high survival rate, and this included soil store bought potting soil added over the top of the unrolled willows. Peat moss was also added to help hold water in the soil for a longer period-of-time. I had a great crew working on that Canmore Creek Project, so everything went really-well. The team liked doing what we were doing, so extra care was provided when it came to growing any plants that we used in the program.

The photo sequences that I took during the project and for some time after, help to show you all about that first time, using the Head Start Planting System.



This photo shows the first time that the Head Start Planting System was used on Canmore Creek, at a stream bank and slope stabilization project. My crew and I just unrolled the bundles of native willows and poplars onto a constructed log wall, and then covered the plants with some peat moss and soil.

The log wall was 150 feet in length, and approximately 50 to 70 CM above the surface of the creek. The new plants would eventually help prevent old mine tailings from sliding into the creek. The growing system for the willows and poplars was just starting to unfold, so my methods were primitive back then.

The plants had been growing for a few months, before they were needed on the log wall site. This made this type of planting quite unique for that time, as a tool in stream bank stabilization work.

This photo shows the log wall a few years later. You can see the willows and poplars are growing over the top of the wall and out over the creek. Now you can see the first signs of cobble showing on the streambed.
This log wall completely resolved the issue of mine tailings sliding down into the stream channel and today the stie is totally covered with mature native willows and trees.

The planting method shown above is quite simple. You just unroll the plants and cover them with a little potting soil and what ever other soil you have available on site. This is not a garden, so rocks in your planting soil are not a problem. The burlap rolls will bio-degrade over time, leaving no sign of the rolled mediums. Alfalfa was seeded on the disturbed slope, back from the plantings, until native grasses could take root. Alfalfa is a great nitrogen fixer and it eventually gets crowded out, by native plants.

The following photo will show you just how great the site looks, after years of growth.

This photo shows the log wall in 2013, 15 years after completion. You can see that the native willows and poplar trees are now dominating the base of the slope and almost entirely hiding the constructed log wall. The native plants were all grown from cuttings that were collected in the immediate area of the project site, so the willows and trees grew very well in that environment and maintained the historic riparian habitat that grows along the creek. This is very important in preserving the natural biodiversity of your site.

Hinton Project

This planting method technology still has a very important roll to play in stream bank and slope revegetation along streams, at construction sites or restoration projects. The next application for this particular-style of planting pre-grown cuttings was in 2008, on a rip rap and culvert replacement and installation site, near Hinton, Alberta.

The Head Start growing procedure had been used for other projects, since the first time on Canmore project, but not this particular-rip-rap and roadside type of planting application that was completed in Hinton. The Hinton project involved a similar growing process, but the planting was entirely different. The grown cuttings were removed from the rolls and spread out on a planting site, instead of just unrolling the bundles and covering them with soil.

The grown bundles of willows work great very well for late season plantings and-also the simple transportation of large numbers of plants. For the Hinton are project, thousands of plants were transported by pick-up truck to the site. Once their, there were watered and left until they were needed on the project site. A planter can remove the willows from the bundles as needed or in sections, whatever the particular-application required, the willows are there for your use.

An important note is that you should make sure the bundles of plants are covered with plastic and a tarp, during transportation. Young plants are always very fragile so extra care is needed when handling them. A healthier plant suffers less planting shock than one that is already been disturbed to much and is wilted over. It is a high priority to take care of your plants!

The willows shown above were planted on the top of rip rap, armouring a culvert on a small creek near Hinton, Alberta. This is what they looked like three years after planting. Growth was very fast, due to the relatively high amount of precipitation that the area gets every year, at least in recent years. These plants, once grown, will provide a nice buffer between the road and the creek.

The last two examples mentioned are only one type of planting method that is used with pre-grown cuttings for a crop. In other applications, the pre-grown cuttings are planted individually, along local streams which are presently void of any woody riparian growth, or to enhance the existing sparse growth of native willows and trees that have managed to survive into modern times. Smaller trench plantings can also be done with this technique of propagation, but first we should look at how the cuttings are collected, stored, and grown.

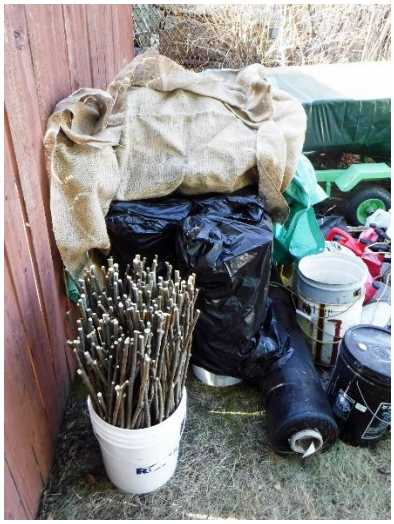
2.0 Methods:

The methodology used in the "Head Start Planting System" covers the collection, storage, growing process, and finally the planting applications. Make sure you have all-of the necessary provincial and federal permits in place to carry out a planting program on any local streams. A detailed plan, including varieties of plants that you will be planting, is required. As well as location maps. The collection and growth of cuttings is really-easy, if you have some of these effective guidelines to follow. The first thing to do is make-a-plan on when to start collecting your cuttings, but also how and where you plan on storing the cuttings for later planting. Storage is really-important, so it will be the first thing that is discussed, before collection.

2.1 Storage of Cuttings

It is important that you maintain moisture in the stalks and keep them frozen until they are ready to start the growing process. When collecting in late winter, you need to try and freeze the cuttings right away and keep them in a place where they will stay frozen.

The north facing areas of a house, garage, or fence, are good locations to store cuttings, or if it is still late enough in the winter, I will just make sure they are well covered to maintain a frozen state. The frozen ground can be your freezer if you have a good plan for storing them. The cuttings are stored in the buckets, with good insulating covers to keep the light out and ensure the plants stay dormant, until they growing process starts.



The cuttings can be stored on the north facing side of a fence, garage, or house. As - long - as they are well covered to keep out the light and provide insulation on the warmer days of late winter.

When the time to start growing arrives, the buckets of cuttings will be moved to a different location, where they can start to grow roots and buds. If you are ready to start growing the cuttings, the buckets can be placed close to the wall of a house, or any building with a south facing location. These areas receive the most sunlight and the warm rays will help melt the ice and get the cuttings started in their growth cycle.

The plants are still covered in their buckets, to keep the light out, and the frozen ground underneath will help keep the cuttings cool enough to be in ideal rooting conditions. When the ice starts to melt in the buckets later-on, the plants will start to grow. They need to be left in darkness for this stage of growth. The reflective warmth from south facing buildings is like a heated green house, if you position the cuttings so they can take advantage of this heat.

Just remember, cool is good for growth. The plants should not be overheated or left to go dormant again from freezing on and off. The heat from a building can keep the plants just right, but this is where your experience will pay off, as you learn to use this system of growing roots and tops on your cuttings, for the spring planting.

The plants can take a little cold, especially the roots, which are known to grow in temperatures just below freezing, as-long-as the root development is below the surface of the ground, where the temperatures are still above freezing.

The cuttings are covered with plastic and fabric covers to maintain the maximum warmth of the house. This will get the plants growing in the late part of the winter. As soon as the ice melts in the bottom of the buckets, the cuttings will start their growth process. Sometime the roots and new buds are already developing, by the time you are ready to start to prepare them in a growing medium.

The reason planning is so important in the early growing process, is that you need to have a good location for your operation and you need to figure out when to move the plants around to improve growth according to the time of the late winter and early spring. Before you start collecting lots of cuttings, having the plan in place will allow a smooth flow of your operation.

If you are not in a situation where you can use a building, the cuttings can just be covered with tarps and plastic and left in an exposed sunny area, to get the growing process started.

The ambient temperature is what will get the plants growing in the late winter. There may still be frost in the ground, but above ground the plants sense the warmer growing conditions of spring and the roots and buds will start to develop.

2.2 Collecting Cuttings

All the cuttings for the normal planting process can be collected and stored in 20 litre plastic pails, during the month of February and March, prior to when you start to grow them. The maximum capacity for what a bucket will hold can vary, but usually approximately 160 cuttings can be fit into a bucket easily. I like to use a little water in the bottom of the pails, when collecting, approximately 5 cm. When storing the cuttings, you can add approximately 12 to 15 cm of water at the bottom of each bucket full of willow cuttings. The water will freeze, but that small amount at the bottom of the bucket will not break your plastic pails. Once covered with plastic, evaporation will be delayed.

The most common length of cutting that I like to collect is approximately 22 to 28 inches in length. Approximately eighty percent of the cutting will be below the ground, when planted. This will help maintain stability of the young plant, thru its first season of growth. You can also use a 60% below ground approach, but this depends on where the plants are planted and how. I like to have a lot of the cutting below ground, to ensure plenty of live mass to feed the sprouting tops of the plant.

Collection Sites

The collection sites for your cuttings are going to be on private properties that you will have to search out yourself. They must be in the same watershed, close to your planting sites. Identification of the varieties of willows, native poplar and aspen trees can be completed in advance. I like to make maps showing what varieties of different Salix willow are in the collection site, so when there is no leaves or catkins on the willows in the winter, you will still know, from your maps, what is available to harvest.

By pre-identifying the types of Salix willow, you can do so during the spring, when both the leaves and catkins are on the willows, making them easier to map. During the winter, identifying willows is very difficult with some varieties which are quite similar to each other in some ways, that only when in spring bloom that can be differentiated. Knowing what is present on a particular property in advance of a collection trip will be worth your while. You can also bring in an expert to help you out with the id process.

Permissions to collect cuttings should be obtained in advance as well. Once you earn the respect of the landowner, your collection activities can continue for years to come, on the same properties. I have used approximately 26 different collection sites over the past 7 years. Some of the sites will produce two years in a row and then they can be rested for a year. Other sites should be rested for a few years, just to make sure that the number of cuttings available, when you go to collect, will be well worth your while.

A good management plan for how you collect your cuttings is a good idea. The management plan will determine whether your collection of cuttings on a particular property is done with conservation in mind and a respect for the natural ecosystem. The annual collection can impact the health of an existing willow stand, if you are not careful and harvest on tight guidelines that will ensure continued growth in the willow stand.

Harvesting of straight cuttings will always leave a certain number of cuttings that are not straight, on the plant. This will ensure future growth on that year class of cutting. I collect cuttings that range in age from one year to 4 years in growth.

Collecting Cuttings for Spring Planting - A Few Pointers

Every winter, I will collect cuttings from native willows and a few trees, to grow for a spring planting. I have many collection sites, which I keep to myself, because they are all on private land and I can manage the collection process as I see fit. It is important to have a good management strategy right up front, so you don't damage any of the existing willow crop, due to over harvest and leaving a mess behind. If you manage your collection program properly, you will have a place to collect cuttings from, for many years to come.

It is really upsetting when you discover an area along the river or creek that has been clear cut for a planting program. This is not necessary and when the cuttings collected are larger diameter cuttings, the damage to a site can be significant. A real eye sorer for anyone that likes the riparian zones to be left natural in appearance. Let the beavers do the harvesting, as this is what nature had modified the growth of native willows and trees for in the first place, and we all seem to accept this as a natural process.

My target diameter is relatively small-in-size and my cuttings are straight shafts, so only the straight willow shafts get collected. This is a limiting factor to begin with, so it insures that only a few of the limbs of a mother plant are removed from the plant. When you make a clean cut, with sharp shears, in the winter months, the plant does not suffer any significant shock from this natural process for the willow. Remember, the beavers have already grazed heavily on willows forever, so not to worry about the mother plant, if you do it right.

Only the straight shafts or limbs will be collected. This particular-photo shows a number of straight shafts on this mother plant. The photo also reveals a lot more information, so take a good look and then check out the photos below. One good limb from a willow can provide multiple cuttings of the desired length.

Multiple cuttings from a single mother plant are mixed in a huge batch of cuttings, so that clones of the same plant are not planted along the creek in a straight line or sequence. You should always mix the different varieties of cuttings, so that come planting time, you will have a good diverse batch of plants ready for the particular-stream that you are restoring.

Some varieties of Salix willow will have numerous straight shafts to collect as cuttings, but don’t let this guide you in your selection choice.

You can see in the enlarged section of this photo, there is the top of a previously made cut, when I was collecting willow cuttings a-number-of years earlier. In the photo, you can see that the new growth exploded with new limbs, just below where the cutting was removed from the mother plant.

This after growth demonstrates how well the willow copes with any pruning or grazing by beavers. There were multiple stumps on this plant, I have added a pointer to a few in the photo that you can see in this enlargement.

The sights that I have collected many thousands of willow cuttings from, are actually providing more ground cover habitat, due to being properly pruned for so many years. It can enhance the growth of the plant.

People accessing the same collection sites as I use, are not going to notice any signs of disturbance or that someone has been collecting cuttings, unless they notice some small twigs left over on the ground. These winter trimmings will be covered by grass in the late spring, and slowly bio-degrade, enriching the soil at the base of the plant, with added organics.

The collection process follows guidelines set forth by DFO and other agencies that understand the need for proper management in a collection site. Remember, the landowner will always be the final critic in your operations.

The red arrows point to the top of the cutting stumps left over from previous collections.

This Stage One cutting shows the length of the plant and how much of it is rooted and how much is above ground. I rinsed this plant off to take this photo. The wet part will be below ground or slightly above. Eight inches to ten inches above ground is the norm. It depends on how long your cuttings are. The Stage One plants are those that I just push into the ground. Other types of cuttings will be explained in more detail, further on in this manual. The plant in this photo is approximately 24 inches in length.

Most of the roots will be sheared off when this cutting is planted, but if the ground is moist, the plants roots will continue to grow. The advantage is that you get the roots started and then they will take to the planted ground quicker. The cuttings are planted in the capillary fringe, along the water's edge, so the soil is always moist.

The photos in this manual will be the best guide to what size of cutting that you collect. Remember, approximately 160 cuttings should fit in a pail, along with some really small diameter cuttings to fill the gaps.

Above: *These cuttings are grouped and covered with an insulating fabric to allow them to start their growing phase. These cuttings average 26 inches in length, with an average ½ inch diameter. This size range is easy to push into soft stream bank soil, in the spring planting. These lengths are planted at a 60% underground and the top 40% exposed above ground or 80% and 20%. Different lengths can be used for different applications.*

In the late winter, when cuttings are normally collected, you can prepare the cuttings in their rooting mediums when ever you wish. This can be done in a garage or on a warm day. It takes approximately one hour to prepare new rooting mediums, but if you are reusing old ones, you can prepare approximately 3 per hour. This will all be covered in the preparation of the rolled mediums, with photos to help give a clear picture of how the rolled rooting mediums are prepared.

2.3 Preparing Rooting Mediums

Preparing the rooting mediums is where the real innovation for this planting program comes to light. There are a few different preparation options that will be covered in this manual, but the most well used is the one most-commonly used for both volunteer and contract plantings, so this is what I will cover first off. The materials used to prepare a rolled medium also come with different options, first we will look at the use of geo-textile, peat moss, plastic pails and wire. With these four things you can start growing willow and deciduous tree plants. The 20L plastic pails can be found in any major supplies store, the geo-textile will also be easy to find, because it is commonly called silt fence.

The geo-textile is commonly called silt fence, but without the posts already attached. You can order just the rolls from a supplier. The rolled fabric will have to be cut using a hot knife or something similar. This will prevent your fabric from fraying over time, with heavy use. The fabric is one metre in width and one roll can provide lots of growing mediums. The fabric also has a permeable weave, so water will easily pass thru it. In this photo you can also see what the 20L plastic pails are used for.

Most of the 20L pails were purchased, but I did manage to make an-arrangement to recover some used paint pails from a recycling facility, to reduce project costs. It took a lot of time cleaning out the used paint pails, but the labour was all volunteer, so it was time well spent. This has been mentioned in group plantings, with students and corporate groups, just to pass on the message that we can make use of what we already have on hand, with just a little more effort. Besides, volunteers do this type of think, and it is an enjoyable task, when you know that we are all making a major environmental contribution.

A respirator is a must, when cutting the fabric with the tool that is shown. The tool is a solder tool, with a fine point that will easily melt thru the fabric, when it is up to temperature. A long straight edge is used to make line for a clean accurate cut.

Once you have a really-hot cutting tool, you can cut many lengths of fabric in a shorter period of time. I use an 11 feet length of fabric (335cm). This allows a little extra light penetration protection.

The use of burlap and black plastic is also covered later-on in this manual, but let me explain why black plastic can be used in place of the geo-textile, if you are planning a less expensive expenditure on materials. Black plastic that is cut to a width of 110 cm can be used in place of the geo-textile, at a cheaper cost. The prepared rolls will be grown in a plastic 20L pail, so a roll of cuttings with black plastic can be strong enough to stay together for the growing process. I use a heavy 4mil thickness of black plastic. A standard 3 metre width for either the black plastic or burlap, with the standard 11-foot length will do the job.

The heavy black plastic can be reused for years and it doesn't take up much space. The burlap and black plastic are also used to grow rolls where the burlap will be planted along with the cuttings. In other words, you just unroll the cuttings into a trench, slide out the plastic with a quick jerking motion, and then just cover the burlap fabric with soil. The burlap bio-degrades rapidly when underground.

2.4 Standard Cutting Preparation

The standard cutting, rooting medium, is what I use most of the time, so this is where I will start. Once the lengths of fabric are cut to size, you will need to have a good supply of some galvanized wire, to wrap the rolls with. An 18-gauge wire is just about right for this task. It can be reused for future applications. Premium peat moss is what you require to spread under and on top of the cuttings. A clean, fine powdery peat most is the best. Cheaper brands sometimes have a lot of wood chips in the bale, which is an annoying to the consumer, when you have-to stop and clean all of the chips out of the roll. The fine peat moss must be powdery dry and clean of anything that might add bult to your prepared rolls.

Some of the peat moss that I have purchased in the past was so bad, I had to take the time to strain it thru a ¼ inch square mesh straining screen. Best buy wisely!

Above: *The fabric is laid out on flat ground and a thin covering of peat moss is spread over one half side of the width. You don't have to go right to the end, but you will know how far when the cuttings are spread on top of the peat moss. It is easy to add or remove peat moss, so be generous with the peat moss to start with. Spread the peat moss to a thickness of 2 cm or there abouts.*

I like to use knee pads for this preparation work. Also, a nice pair of gardening gloves with the rubber hand coating, so the moist peat moss doesn't stick to your gloves, when you spread the moss over the section. The palm of the hand, with fingers spread apart, works great for spreading the peat most to a level coating on top and bottom of the spread cuttings that you will place over the first layer.

If you are preparing rolls on snowy ground, you can lay down a large tarp to work on. I have lots of larger geo-textile fabric that I use for covering plants, and also as a work tarp for cold snowy ground, in my back yard. Heavy warm coveralls work great for the winter preparation projects. In the photos shown, the ground is pretty much dry and there is no snow, but it is still March or April in some photos.

The 18-gauge wire that you are using must be cut to the proper length for wrapping the rolls. I use three lengths and place them in position, on the end of the fabric, so I can roll up the medium and the wire is already in place to tie the roll snug. Cut your wire to 40-inch lengths (101cm). I have a marker on my shed to guide the lengths of each cut, and

this allows some fast wire cutting. The next photo will show what the wire looks like, when it is laid out and ready for preparing the roll.

Above: *This photo shows the three lengths of wire, placed under the far end of the fabric. The piece of wood is just used to help show the wire in this photo. The ends of the wire are tucked under the fabric. I folded the end of the fabric to make this shot work.*

Now you are ready to place the cuttings on the peat moss that you have spread thinly on the fabric. When you place your first cutting on the peat moss, it should be seated into the peat moss, lightly apply pressure when placing each cutting firmly on top of the peat moss. You may have to redo your rolls until you get an idea of how much peat moss to use. A quick guide would be to put your peat moss in a 20L pail, so that it is half full, this should be enough to complete the entire roll. First, place down half of the pail's contents on the fabric, then spread out your cuttings so they are almost touching. Then spread the other half of the moss over the top, using your hand to sprinkle and then spread an even thin coat.

The best approach is to take your time and do the best that you can, then the speed will come with experience. On new rooting mediums that have just been cut from a roll of geotextile, you can make up approximately three per hour. Newly cut rolls will require more time to assemble than those that have been previously used, and already have some peat moss in place, along with the wires. The already used rolls are quick to prepare for reuse.

Above: *This is what the cuttings will look like once they are spread over the peat moss. About 60 to 70 % of the cuttings will be underground on this application.*

Above: *A thin covering of peat is placed over the top of the cuttings. Notice how thin the coating appears in this photo. There is a total of 100 cuttings in this roll. The peat moss is about to be covered with the bottom half of the fabric and then the entire medium can be rolled and wired tight. The extra fabric length in the roll allows a full wrap of fabric on the outside of the roll.*

Above: *The wood blocks are used to keep the fabric in place while you complete the rolling of the medium. The blocks work good with any sort of annoying wind blowing, while you work.*

Above: *Firs you fold the end of the fabric over and then start rolling. I constantly pull the top of the fabric snug, as I roll, to make sure that the bottom and top stay even. There is also a video that comes along with this manual, you can pick up some pointers from the video, which will make the job a lot easier.*

Before the roll gets to the end, make sure that you fold the end, where the wires are placed, so that no soil will escape, when the roll is watered. This will also ensure that there are no frayed ends of the fabric. This will also be demonstrated in the video.

This is what the roll looks like after it is snugly wrapped with the 18-gauge galvanized wire wrapped around the roll. The uneven bottom will straighten out when you place the roll right side up. Give is a firm drop on the ground to help achieve the uniform bottom. When the roll is placed in the pail and watered, the roll bottom will flatten out a bit more.

After the roll is positioned upright, you can add extra peat moss by letting it fall out of your hand, over the top. A watering by hose or bucket will even out the peat moss on the top of the roll. This also takes some practice, but you will learn quickly.

The tops of the cuttings may not be even, but this is just the way it works out in the end. When collecting cuttings, they are never even and the same length, so this is not important.

This shows what the top looks like, after a sprinkling of peat moss to fill gaps on the top of the roll. A firm bump on the ground, when the roll is in the pail will also help to settle things in the roll.

The watering will soak down the top peat moss and prevent light and air from getting at the rooting area of the cuttings. It may look darker for plants in the centre, but please consider that during the day each cutting will get adequate sunlight to grow.

***Above:** A top view of the prepared roll, in a bucket.*

The prepared rolls of rooting mediums are ideal for growing large numbers of plants, in a relatively small growing area outdoors. The pails can easily be moved around without harming the growing plants inside. Each roll has at least 100 plants, so you can transport

a large-number of plants to a project site, with ease. I always add some extra small diameter cuttings to the rolls to further increase the size of the crop.

It seems a waste to leave growable size cuttings on the collection sights, when you can treat them as an extra for your project planting. The small diameter cuttings are never counted in the totals, so they end up as beneficial bonus. The photo above shows only 100 plants though, because this is the norm for planting and it will be used in this manual, basing everything on units of 100 plants.

Once the peat has been added to the top of the bundle, you can water the bundles of cuttings. Slowly, using numerous pouring's, pour over the top of the cuttings, filling the bottom of the pail with ¼ depth of water. The water will help level the top of the roll and settle down the peat in the roll. For novice planters, you may have to add additional peat to fill any holes in the top. The pail of cuttings is now ready for darkness.

This is what the final product looks like. In the background, you can see that a large-number of cuttings can be grown in close courters. The rolls get enough sun and the area that they take up is minimal.

Depending on what time of the late winter or early spring that it is, you will need to start the cuttings growing with fabric and plastic covers, so that no light enters the multiple pails.

The cuttings may have already started to grow, while they were in storage, but this is something that you will have to learn, over time. There are always tell-tale signs of new growth, both the roots and new buds, which will appear pale light in color, when started to grow in the darkness.

I first cover the rooting mediums with plastic, so that the cloth fabric covers that are used to keep the plants warmer and in darkness, can then be applied and removed without

damaging the growth on top of the cuttings. New buds, leaves and branches on new plants are very fragile and you need to be careful how you handle and plant them. Never touch them by hand or fingers. It is very important to remember this, and always handle the new plants right at the transition area of the cutting limb or shaft. It is the space between top growth and the rooted part of the cutting. The bottom goes into the ground and the top is exposed, so grabbing the plants right were damp turns to dry, is the best spot to hold. However, it will be a while before you need to worry about this. The plants now start to grow.

First, the plants need to grow a bit, and this is where some knowledge of the time that the plant spends in darkness and its exposure to the sun. In the growing process, this needs to be understood. Remember that the dark part of the growing process is primarily to get the plant into the first stage of the growth process. This is when the cutting first starts to develop both roots and tops on the shaft. Sometimes, you will be preparing rolled rooting mediums when there is already some root and top growth. This is ok, the plants will grow, it is like I have previously mentioned, you just have-to be a little more careful when handling plants in the advance state of growth.

Sometimes, when you are preparing lots of plants, you may get a bit behind and find some of the cuttings that were in the dark are now in an advanced state of growth. These cuttings have pale color tops and roots near the bottom, and sometimes all over the cutting. Just plant them with the tops carefully positioned on the ground, move slowly, and you will avoid damage to the plant.

The pale cuttings will turn green on top and survive, you just have-to be very gentle with them. You may lose the odd limb, but there are usually multiple buds on the tops of these cuttings, by this time, so the plant will still survive.

After preparing the late advanced growth cuttings in a roll, they can be watered with a sprinkle, until there is ¼ of a bucket showing in the bottom, around the roll, just like the others are. The pails and plants can then be covered with plastic, which will allow them to be protected and get plenty of sunlight, during the daylight only. At night the plastic must be covered with an insulating fabric. I use burlap and cotton drop sheets, used for painting. Every morning, when the sun or warmth is right, I remove the drop sheets and burlap, to let the sunlight in. The following is an excerpt from my notes:

"This morning, it is April 27th. At 8:00 am, I removed the covers off of the plants. It has been nice during the days and at night, below zero but the plants are doing just fine. The plants have developed

both some roots and tops in recent days. I will continue to cover the plants at night, until some of the surrounding trees and willows start to show some green on there buds. Shortly after this, I can remove the covers, and just let the natural conditions toughen up the plants, for planting. When native willow leaves break into green, you know that they have developed some resistance to morning frost and some sub-zero weather."

When you start planting, you always plant the most developed plants, so some sorting and organizing of the plants and pails is required. It is important to keep an eye on the water levels in the pails, especially when you take the covers off, including the clear plastic. Maintaining ¼ pail depth is important for good growth. When planting time nears, you can cut back on the watering, a bit. This will make the buckets of plants easier to transport to the planting sites. At the location of planting, you can water the plants good, so they are ready for the moist ground.

Above: *Willow and tree cuttings rooting in mediums are positioned on the south facing side of the house, close to the basement for added heat. They are then covered first with plastic and at night with an insulating fabric.*

Above: *the covers can include a black tarp to draw in some heat for the plants.*

The plants will start growing in the collection pails, when the air and pail warmth of being above the frozen ground, triggers circulatory life in the cutting. The development of both roots and buds from existing bud nodes, plus the opening of existing buds that were on the cuttings, will develop over a few weeks in the above zero temperatures. Basically, you can learn this thru your own growing process, just keep an eye on the plants over time. You can easily see the roots start, when you checkup on the plants from time to time, with white delicate roots revealing themselves in the dark. The buds and new buds will also be a white, light, greenish color.

This is where the heat from a house of just the sunny side of a building will do the job. The buildings conduct enough heat to transmit thru to the cuttings. Both the south facing and the lesser east facing side of my house generates some heat. In late March, my collected cuttings can sometimes be triggered for growth, but this is just one of the many important variables that come to play, when growing cuttings.

In most years, it is April when you are confident that growth has just started. I will add a black tarp to the covered plants to generate more heat during the day, in April. This will also help initiate growth, for enough earlier developed cuttings. The thawed water in the pails gives you the first clue to when the plants are starting to grow outdoors, in their covered groupings. The pails closest to the house will always start to grow earlier. The cuttings on the east facing end of the group of covered pails, will also start rooting and developing tops earlier as well. These covered pails get sun from the morning on to evening, so they will receive more heat during the day and grow faster.

This is what the early-stage development of willows will look like, after a few days of exposure to the sun. These cuttings were already exposed to the sunlight for one week when this photo was taken. The covered growing cuttings had budding leaves that were light in color when they felt the first rays of sunlight on themselves.

After the cover was removed, photosynthesis has now been occurring in the plants. Most of the willows shown in this photo were Salix Exigua or sandbar, coyote and narrow leaf willow. The common names are many, so pick your choice, I just call them Exigua.

The dense growth on the top of the cutting is a sign that you are growing the cuttings correctly, an developing them for a good, early start. This is where the idea of calling the planting system the "Head Start Planting System". I have grown to like this name and I have used it in a Workshop manual in the past, in 2011 to be precise.

This is what another week of growth will look like, when the plants are exposed to the sunlight of your back yard. When the weather is warm enough to allow the wild willows to start to bud and expose some green leaves, you can remove the covering of clear plastic for night time, and just leave the plants uncovered from this point on. By this time the willows can withstand a few frosty mornings.

Coverings of a 4 mil. polyethylene plastic has the same effect as a green house would have, but it is much cheaper and easier to use the coverings than expend funds for a greenhouse. I have grown cuttings in a greenhouse earlier on, but when hail destroyed the structure, I switched to using just clear plastic for the same purpose. You can move pails of plants around, with the mobility of having a poly cover that can also be easily moved as well.

The covering of plastic sheeting does not damage the new sprouts on the tops, if you are careful handling the plastic and make sure that the covering is well anchored under the buckets or pails and using weight of 2 X 4's or some other side of milled wood as a weight for the outer edges. I even place small blocks of flat wood over the plastic and covers at night, if need be. However, if the wind cannot get into the plastic covers, you are in good shape for such conditions. My back yard is pretty-well sheltered from the main blasts of wind gusts that we experience in this country.

The following is a note from my planting records.

"May 02, 2020

I have been covering the prepared rooting mediums with clear 4mil plastic and a burlap cloth tarp during the nights, one week ago I had been using an additional cotton tarp as well. On some nicer days I remove the plastic and let the sun bath the plants with its warmth. Last night was the first night that I just used only the clear plastic cover overnight. It is time to start to toughen up the plants a bit.
I took a photo in the morning, with the cover and without. You can see from the following photos that the plants are already off to a good start, for the 2nd of May."

I even use some lengths of aluminium to keep the plastic in place. Throwing a canvas sheet or burlap fabric over the plastic at night will ensure protection from any night time frosts that we experience.

These photos were from the first night that just clear 4 mil plastic was used to cover the plants.

This is a close up of some of the plants growing on May 2, 2020.

These plants shown above are ready for push planting as soon as the ground frost leaves the soil along the stream banks. It is necessary to get the cuttings in the ground before too much top growth increases the chances of planting shock and reduced survival, but there is still plenty of time left for the plants like those shown above.

Above: *This cutting has new root development occurring. The cutting had only been soaked in a pail with water, for approximately 15 days. It was now being prepared in one of the rolled rooting mediums.*

The cuttings will now be ready for the planting season, and the planting season begins for native willows and trees as soon as the frost is out of the ground. On streams where there is no willow or tree cover, the stream banks are exposed to more heat during the day, and-also the warmer water of the stream has now started to melt the ice into the stream banks. I use a hand planting tool that I have, to check and see if the frost is still in the ground. Always check well exposed areas first.

Above*: This is the hand tool that I use to both plant cuttings and check for ground frost.*

Areas with good exposure to the warmth of the sun, will be ready to plant earlier, so this tool is a must for planting with this method. If you can push this tool into the ground, all the way, you can also push a cutting into the ground all the way. The tool is used mainly

for pilot holes into really heavily graveled stream banks, paved hard, and other harder ground. The diameter of the steel rod is 1/2 of an inch, the hole will make it easier to push in the cuttings. Sometimes it also pays to add a little water on the end of the cutting or in the hole.

The two larger planting tools shown are samples of the 6 of the planting tools that I use for volunteer plantings. They are heavy, so I always encouraged volunteers to take turns at the hole punching task. There are foot assist brackets on the tools that are positioned at the right depth for the standard cutting length, or the part which is to be underground.

The tools are used to punch a hole in the ground so that the cutting can be placed in the hole and a peat moss soil mix is added around the cuttings. The fine powdery peat moss works the best. Then water is added, then more peat moss and a final watering, followed by a light tamping around the cutting's base. The hand tool shown is smaller for planting on the water's edge on the stream bank.

The planting tools shown were built by me, using steel pipe and steel bar stock. The pipe is schedule 40, so it will withstand the rigors of volunteer planters. Despite the heavy pipe, my tools have been bent and welds have broken by a few over zealous planters. This is the main reason I built them so heavy. They are a heavy tool, but they do work well in soft soil along most of our local spring creeks. This system of planting is very fast, if you have a trained planter on the team. Remember that volunteers may be pretty sloppy workers while learning, so make sure you are watching them closely to help out. Experienced planters are what I always hope for.

A really-good system for planting with a group, is too have one person punching a hole and at the same time, placing the cutting down the hole. The other volunteers can add the soil mixture of peat moss, and complete the watering and tamping around the base of the cuttings. I like to mix in some compost or rich powdery soil, with the peat moss, to make a good mix. The soil mix should be powdery or fine, in-order-for it to easily fall down the sides of the hole around the cutting, before watering. I always tell and show the volunteers that they can move the planted cutting from side to side, to assist in getting the dry soil mix down around the cutting's roots. The water will do the rest, by settling down the mix.

A small patch of soil should be exposed in the grass covered ground, before you use the hole punch, otherwise, some grass may be pushed down into the hole when you force the point down thru the surface of the soil. The grass would create a path for air to travel

down into the hole and dry out the roots out, so it is important to watch out for this when using the hole punch tools. Just a little extra care when planting, can determine whether the plant survives or not, so if you have already invested some time, you might as well go a little extra distance in doing a good job.

When the cuttings are ready to plant, you can use a wheeler truck with air filled tires for moving the plants around, both from your growing operation, to the stream bank where you plan on planting. I also have a game wheeler cart that I use to haul three pails of plants at a time, down the many path systems that border creeks in cities and towns.

This photo shows the wheeler trucks and cart that are used to transport pails of plants to a planting site. The plastic bag has watering buckets a soil mix for planting and other things like a garbage bag for clean up and personal field work supplies.

The game cart is the one that has the black pail on it. I can load three pails on this cart and easily transport the three buckets to my destination, along the creek.

This group of ATCO planters are participating in a planting event on West Nose Creek, in Calgary. The plants are ready for the ground. After a quick photo, the planters got to work and planted all 500 plants in a few hours of work.

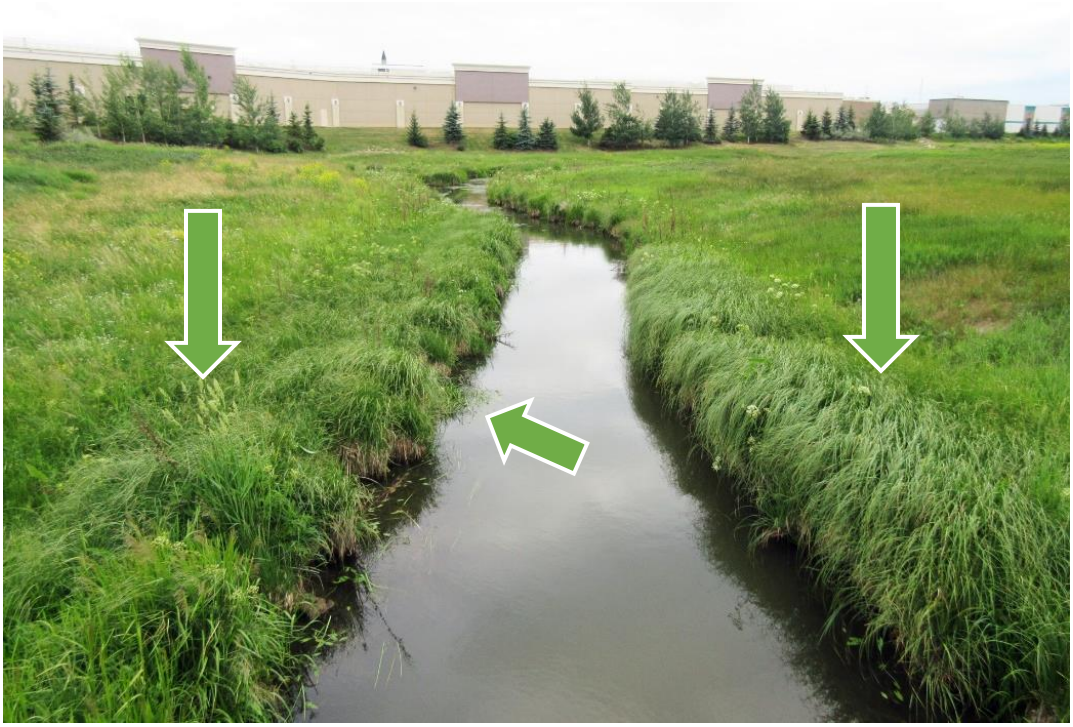
This was the sixth year that ATCO participated in our planting program. The plants were Stage One grown cuttings.

The air-filled tires on the wheeler make it a good tool for moving the pails from the path system to the creek bank.

2.5 Planting Techniques

There are a few different planting methods, with the two most-commonly used methods that are cover first, in the planting methods discussed. They are the hole punch method and push plant method. I use the hole punch method with most of the volunteer groups. The ATCO team has participated on six different plantings, I did allow that group to experience a push plant method, but in most cases, it is safer for the plants if we use the hole punch method, when volunteers are involved.

With the hole punch method, a hole is punch into the soil and the cutting is placed down the hole, followed by the addition of soil and water. This has just been covered on page 23 of this manual, so other important information shall be added in this section. Things like where to plant along streams. My approach is to use the push plant method right along the water's edge and use the hole punch method, a littler further back from the stream bank.



Above: *The green arrows show an area of the stream that would be planted. The two vertical arrows show where the hole punch method would be applied. The arrow on the water shows where push planting would occur, right along the water's edge, where trout habitat is created.*

By far the most valuable plantings for fish habitat will be those that are carried out on the water's edge of small spring creeks. Woody bio-mass is the best for both shade and stream bank stability. The branches, limbs and trunks that end up in the stream's channel, both above and below the surface of the water, are premium habitat units. The wood below the surface enhances not only habitat for trout, but for aquatic invertebrates as well. The addition of nutrient to the water accelerates the rich microbial life of the water and benefits other life, like trout. The more natural nutrient from our planted willows and trees, the more food for trout and other fresh water life.

From a fish habitat perspective, natural native willows and trees are the most beneficial for creating submerged and over-head cover for wild trout. The growth above water will enhance other wildlife habitat and create a game corridor for native animal life. Plants are so inexpensive if grown by volunteers or private sector staff, so the costs are kept low. All we are doing essentially is just helping mother nature with her own recovery, by speeding things up a bit.

By growing the plants from cuttings, you can keep the costs down and also provide thousands of plants in a small grow area, like a back yard, and everything will be transported from the grow area to the planting site, with minimal effort. I just load the cuttings into my truck with a topper, to keep them safe in transportation to the planting sites. This simplicity has long been the goal of development this method of planting, from growth to ground or should I say stream bank.

This method of planting cuttings in the spring is advantageous for the planters too. The easy remove of the cuttings from the rooting medium, and then transport them in plastic pails with black plastic liners, to keep the roots covered, is what makes this system so attractive to those participating. I also have belt bags for carrying plants on both sides of my hips to make a good supply right handy for planting. The bags are easily moved around the belt for comfort.

This photo shows the belt and cutting bags that I use for push planting and-also for volunteer events, where the roots need to be protected from both the air and sun. Fifteen minutes in the bag is a rule to remember. I used plastic fabric, a glue gun and geo-textile to build these bags.

Everything was hot glued with a flexible glue. The seams are on the inside, and I also hemmed the top of the bags using the hot glue. Metal grommets were added to the bags for the nylon rope.

This newly planted willow was planted just back from the water's edge, on West Nose Creek. The new growth comes from right near the top of the cutting, which is always the best. As the surrounding grass grows, the plant will need to compete for sunlight. The roots also must compete for moisture.

If rodents don't nibble off the new growth on the end, the top may survive. Sometimes the tops will be harvested by mice, vole, muskrats or even water foul. There are plants that will immediately start growing new buds and branches, after being grazed upon, but some loss will occur. There is nothing you can do about this, as it is natures way.
The long cutting shaft is well anchored into the stream bank, which will reduce damage by floods. Typical high flow events are common on most spring creeks, but there are usually not as severe as a mountain stream's sudden rage of high volumes from the steep valleys of the east slopes of the Rockies.

I generally use two hands to plant a growing cutting. My right hand is firmly gripped on the transition point of the shaft, where rooting area is divided by the rest that is above ground. I use my left hand's thumb and fore finger to grip a point near the tip of the cuttings angle cut end. The left hand helps get the momentum of the plunge into the soft ground, in one motion. Remember, we are planting on the capillary fringe, so the soil is always wet or moist. When I push the cutting in up to the transition spot, I will use my hand to tamp the soil firmly around the ground at the base of the plant. Don't worry about root shearing, because the cutting will continue to grow and produce the same roots, from where they are cut off.

The tamping is carried out just to ensure that no air gets to the roots. Make sure no grass is pulled into the hole caused by the cutting being plunged into the ground with a piece of grass trapped on the end. No watering is required when you are push planting, because you are only planting in moist, soft soil. The initial survival rate is really-good. After a few weeks, most of the plants are still alive, indicating that they have taken to their new environment. The true test will be in late summer, when moisture levels can drop and rodent damage is a consistent problem for the new plants.

Above: *This planted cutting has survived constant rodent damage, yet it continues to grow. The green at the base of this cutting are the leaves from new willow buds. The plant will eventually thicken with multiple branches. I am pretty sure it will survive the damage.*

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.*

Above: *These are some of the oldest willows that I have planted, on a nearby spring creek.*

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 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.

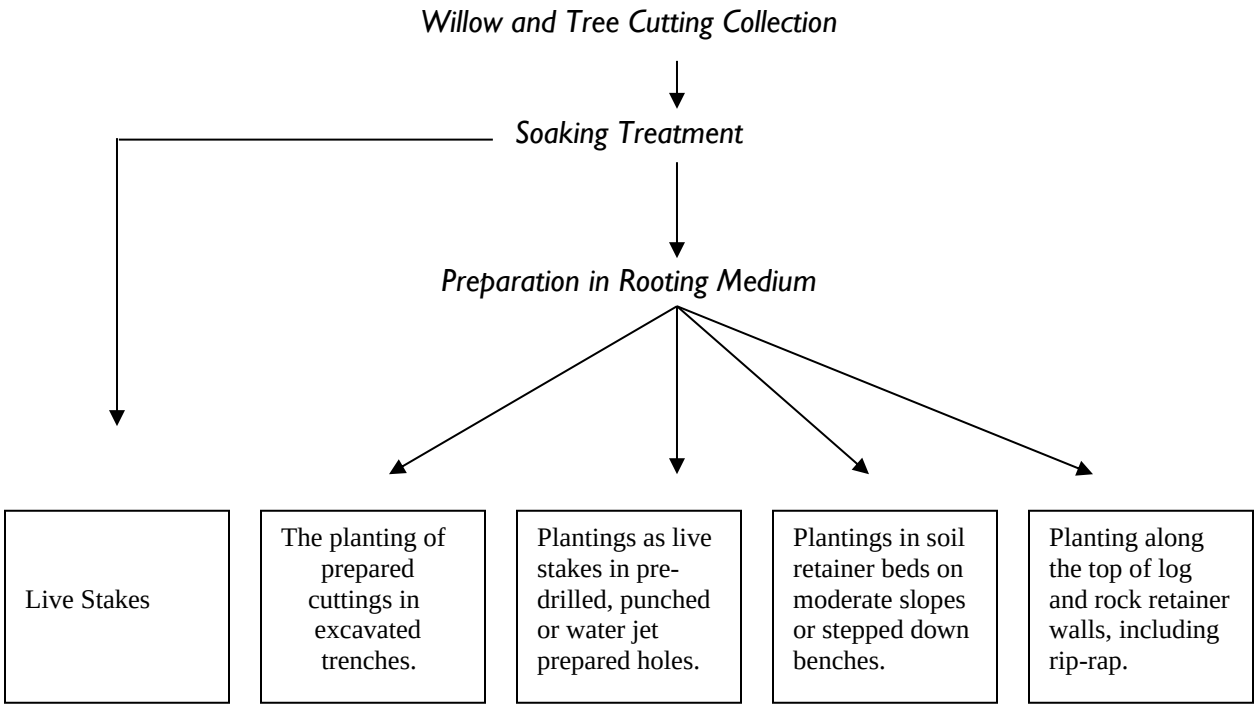
Initially, I grew plants by starting them indoors, and later-on using a green house, but now the entire operation is conducted outdoors in the backyard, without the major expenditures of indoor or green house operations. My goal was to make a system that was easy and simple to follow for the small volunteer 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, and 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.

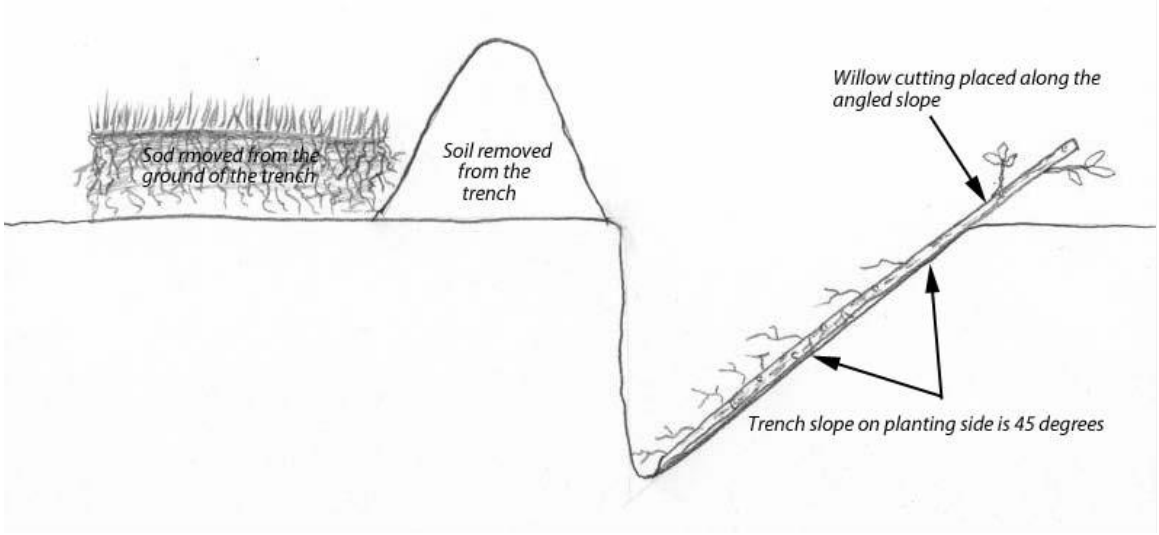


Above: *This shows a break down of how the planting program fits into the use of prepared cuttings. You can see that rooting medium grown plants can be used for a variety of applications.*

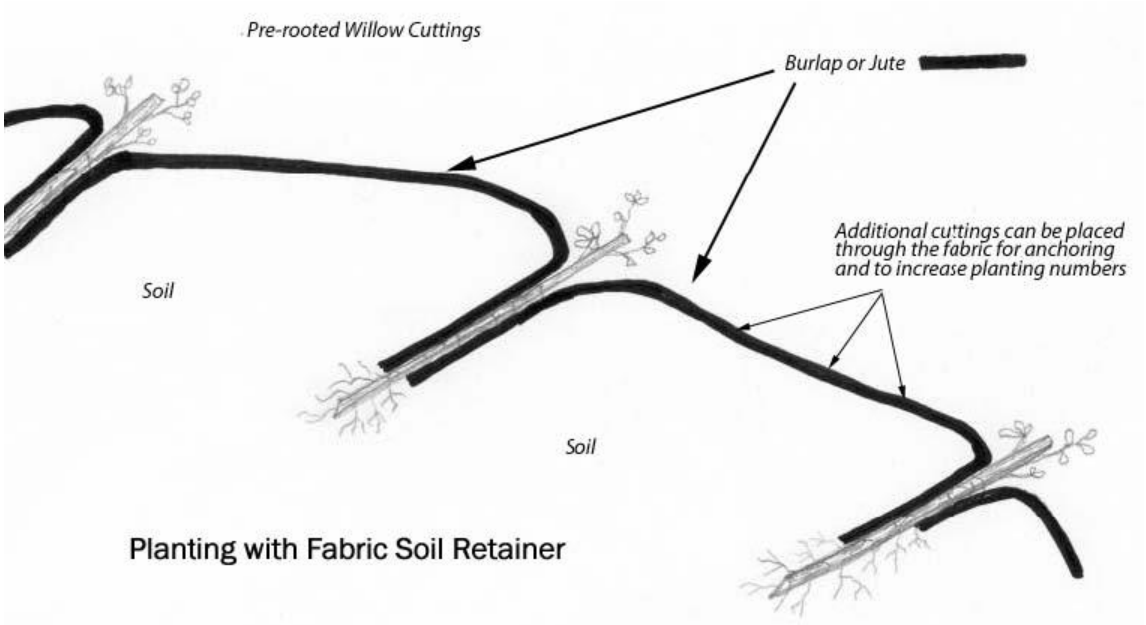
3.1 Other Planting Applications

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.

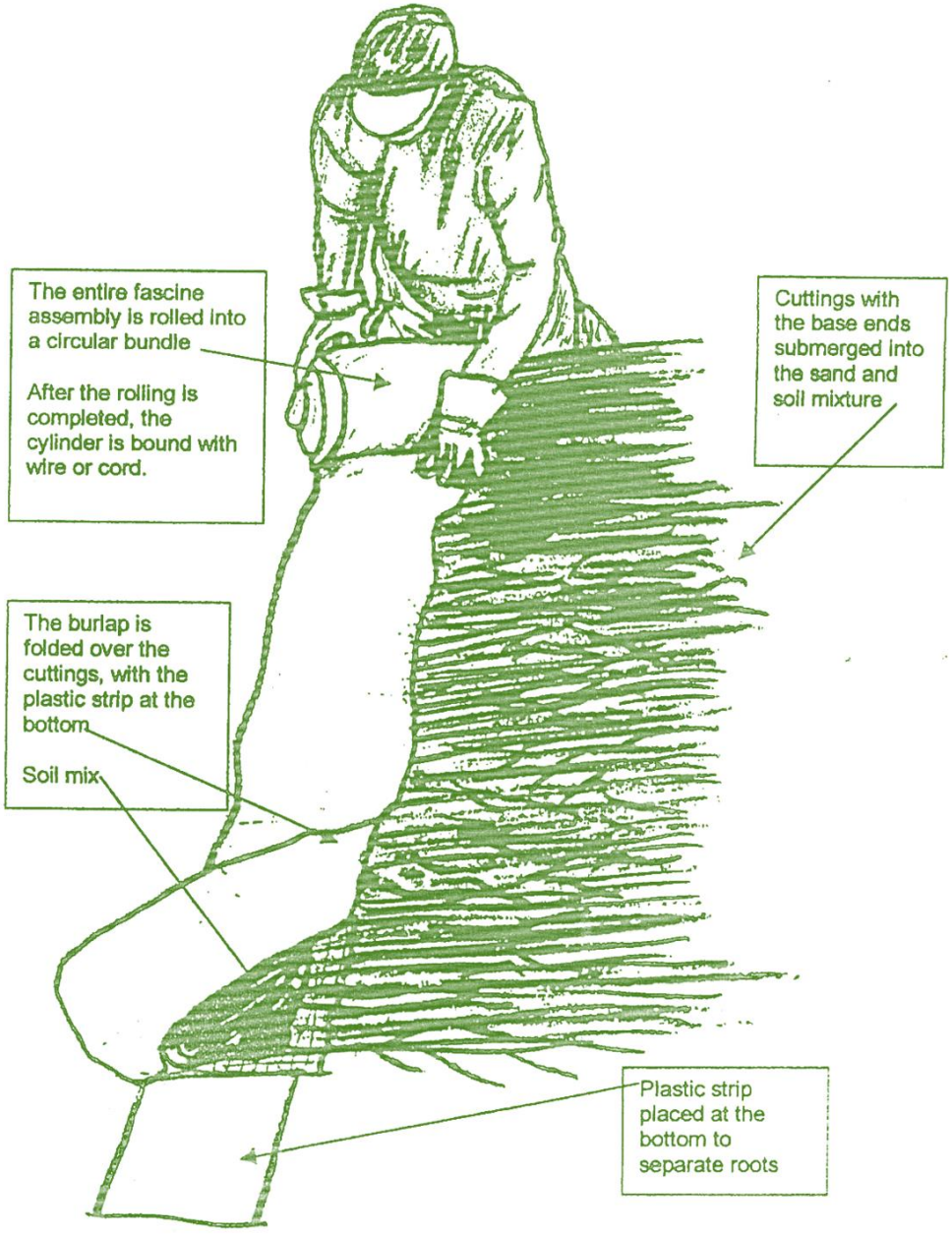
The planting on this site was completed in 2007 and the after photos, on the next page, were taken in 2010 on a follow up trip. I had returned to the surrounding area for another project, so I stopped by the 2007 project site and took a few of these photos. The plants were doing great and I repaired 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.*

What Rodent Damage Looks like?

Just to give you an idea of what sort of damage our plants face, I will include a few photos that demonstrate what hazards exist along the streams that we plant on.

A flood covered this pre-rooted willow cutting that we planted, leaving grass that had been washed down the torrent and wrapped around our plants. The plant is minus a few limbs from grazing rodents, but new growth is showing on the shaft. In the winter, when snow covered the ground, the voles or mice stripped bark off of the top part of the cutting shaft. This is a common occurrence, the small rodents use the bark for food and nesting material.

Rodents have stripped the bark off of this planted cutting, but the plant struggles on to survive.

The stripping of bark on planted cuttings can be very bad on certain areas of the stream, yet on a different year it is not much of a problem. In cities and towns, the predators that keep the muskrat, mouse, vole and other rodent populations in check, are not present.

You can see the original top of the planted cutting on the lower right-hand side of the base of this plant. The beaver has bitten off the shaft of the main limb that grew off of the cutting, but despite this, the plant is producing new blooming buds new the top. Se the photo below for a photo weeks later.

This is the same willow plant, weeks later.

The plants do well in certain areas of the creeks, despite the beaver population. Here, we see the planted willows are growing good on both sides of the stream bank.

Once native willows are established along the creeks, they can withstand the pressure from rodents, but if a beaver dam floods the willows out in a dammed section of creek, the willows will take years to recover. This is just part of the normal natural process, so treat it like a matter-of-fact natural occurrence. There is nothing else you can do about it.

These planted native willows, which are growing right along the edge of the stream bank, are true survivors. They have survived floods and rodents. The willows planted along both sides of the stream are off to a good start and if you use your imagination, you can envision what the stream will look like in the future. The resident trout in this creek will utilize the new habitat created by our riparian planting program.

A Look at The Growing Plants

The whole idea of the Head Start System of Planting is to prepare the plants for growth early and get them started growing before the normal growing season begins. There are weeks of growth above ground that can get the plants ready for planting as soon as the frost leaves the ground. Along the creeks, the stream banks thaw out early, and the ground is really soft during the weeks right after the frost thaws. This is the best time to get at it.

The growing conditions are manipulated for an early start, so you will have green tops and roots on the cuttings, before the frost is gone. The fabric cloth covers and clear plastic are the only expense involved in this method of growing and planting. If the entire planting crop is located in your backyard, you can easily keep things in order, with minimal effort. The reduced need to water and tend plants has helped to keep the costs down and the plants growing. Many thousands so far!

These batches of willow rooting mediums are growing in different stages, to insure an extended planting season. This photo was taken in April, before the frost has left the ground. The plants already have roots and top development. New buds are also forming, due to the growing process method. These will be planted as Stage One class, pre-grown cuttings.

This photo of Stage One plants being readied for planting, was taken in May, just after the frost has come out of the ground along the stream. The plants are pulled out of the rolled rooting medium from the outside in, on the rolls. The plants are transported along the creek by using buckets with garbage bags to cover the roots with.

On a cool morning the plants will stay shock free for an extended period of time. Just keep them in the dark and reduce the air circulation on the roots. I do all of my planting in the early morning hours. Volunteer groups are sometimes only active in the late morning hours, so on warm days, the plants exposure needs to be reduced. Watering the rolls in the pails, as soon as you get to site, is recommended.

The Stage One pre-grown cuttings are easily handled, if you know how to do it properly. The roots can be touched or removed, but the tops are left untouched. These cuttings are simply pushed into the ground by hand. The soft moist soil, just after the frost is gone, stays wet for some time. This is a good time window to plant in. The advanced growth on the cuttings gives the plant an extended growing season, which increases the chances of survival during that first season in the ground. If the plants are a little more advanced by the late fall, they will have a better shot at surviving the winter months.

About Watering

I have mentioned that just by keeping the buckets a quarter full will keep the plants alive and growing fast, but there are times when the rains will fill the buckets and this is not good for growth. You can simply lift the buckets by the handle and pour the excess water into any spare containers, such as a rain barrel or extra pails. Sometimes, the water in the pails will get a little smelly, so this is the time to circulate the water, by emptying out the pails and pouring in fresh water. If you don't mind the smell, the stagnant water can be reused, after you aerate the water to recharge it with oxygen.

Remember that the capillary reaction of the water creeping up the peat moss, will keep the part of the roll that is above water level, in the buckets, still wet or moist at all times. Willows and Poplar tree cuttings can withstand a lot of water in their early stage of growth, so keep this in mind. I have found that drying out the soil a bit every now and then can enhance the root development. Every time you water, the oxygenated water also aerates the roots, so frequent small watering's are actually beneficial.

Having so many plants crammed into such a small area, reduces the need for lots of water, and the design of using pails always partially filled keeps the surface area of exposure to the air, at minimum. The peat moss is excellent at holding water for an extended period of time, and also a perfect medium for rooting. Willow emits a natural rooting hormone, so having all of the willows dipped in the same reservoir of water results is some hormonal leaching which will promote root development.

In the beginning, I played around with different rooting starters, stimulators and treatments, but soon discovered that the natural hormones in the buckets are quite adequate.

Transporting Plants in Rolled Rooting Mediums

Another winning attribute to the use of rolled rooting mediums for growing native willow and tree stock is the easy mobility of the pails, with the mediums. Transporting large quantities of live plants in a truck or on a trailer is easy and doesn't take up much space. When wet, the pails weight in at a whopping 30 to 40. lbs, depending on how much water is in the pails and rolls. You can actually empty the pails if your journey is not more that a day long. Make sure the plants are well covered and the tarp is tied down good. If the package is snug and no wind can get inside, the plants will fair well.

Above: *I took the tarp off of the plants to take this photo, my crew and I had stopped for gas at the half way point on a 500 miles journey to the project site. There is 1,200 native willows and poplar trees in the back of my pickup truck.*

The plants in the back of the truck in the photo above are Stage Two Plants, which were grown late into June for the particular project that we were working on. I used corrugated cardboard to wrap around the pails and plants, ensuring that there was no inter action between the pails, on the long trip. With the tarp covering the willows and poplar tops. they are bent over when the tarp is cinched down, but this is not a problem for the plants, they will quickly spring back into shape when the cover is removed.

This particular bundle of plants was used for hole punch planting, trench planting and soil retainer planting on a major fish habitat enhancement project. The survival rate for all of these plants turned out to be in the 80% range, which is about as good as it gets. The Stage two plants had extra long tops in the bundles, when it finally came around to planting them. The plants were simply watered when they arrived at the site and stayed there until they were ready for planting, in a week's time, after arrival.

What Do the New Roots Look Like?

Above: *This is what the first root development looks like. These new roots formed when the cutting was soaking in the dark, and now the cutting is ready to be prepared in the rooting medium. The longest roots are those that were not submerged, but right near the surface of the water in the pails.*

Above: *Before I started to use pails, this is how I grew large batches of native willows and trees. The burlap rolled rooting mediums were just placed on some geo-textile and watered regularly. Now with the pails being used, the watering is reduced significantly.*

Rooting Hormones

The photo of the root systems developing on soaking cuttings, which you just reviewed in the photo above, shows how the new roots will bust right thru the outer circulatory system and bark of the cutting, anywhere on the shaft. This brings me to the topic of natural rooting hormones. You don't need to add any rooting stimulators, hormones or acids to the cuttings to get them to produce roots.

When collecting cuttings, I will add either creek water or snow to the bottom of the pails, to keep the exposed, cut ends from drying out. This water stays in the pails, as the cuttings soak and develop new roots and buds on the shafts. When you cram a lot of freshly cut shafts into a pail, with a little water, the natural growth hormones from the willows will leech out into the water. This provides all the natural hormones that you need to get the cuttings off to a great start. I always water the prepared rooting mediums with the same water that I used for soaking the cuttings.

This is important to know, because the simpler methods are usually the best, with no outside chemical additives involved in your growing operations. Remember that when the soaked cuttings are prepared in rolls, with enough mineral nutrient in the peat moss, this will get the plants started. Also, the soil where the willows are planted maybe pretty poor, so this will be the determining factor in whether the planting will survive. Survival rates can be as high as 90%, in the first weeks and months of the plants new creek side environment, then the other variables will start to wear on the plant, and cause a deadly stress. And then of course there are the rodents.

Survival in the rolls, until planting day arrives, is really great, and I would estimate it in the 98% range, so growing a health crop is a pretty reliable venture. Willows are great nitrogen fixers, so if the plants survive along the stream banks, they will naturally enrich the soil over time, and enhance further growth in the riparian zone.

Growing Mediums Without Pails

As just previously mentioned, you can grow plants in rolls, without using pails. The technique will require a little more watering and time, but the results are just as rewarding as those plants grown in pails. The larger Stage Two native willows and tree cuttings can be used in trench and soil retainer plantings, so the burlap method is used most often for these applications. When planning on using a larger Stage Two plant, you will need to grow the cuttings with the tops closer to ground level, so that all of the plants can get the same share of sunlight when they grow.

If you prepare the rolled rooting mediums in the correct manor, your loss of plants stays significantly low. The loss would be due to sunlight deprivation, because the plants are growing for a longer period of time in the rolls. It is a good idea to have the bud nodes close to the top of the cutting, this way you can get new growth near the top.

Above: *These burlap rolls have been growing without pails, but rather with a geo-textile fabric base and an outer 2x6 border frame. These will be planted right away, so no need to keep the tops close to the soil in the rolls. This photo shows approximately how far along you can grow willows with longer tops.*

An important bit of knowledge is that you should keep the outer area of the rolls from exposure to both wind and sun. I like to wrap my plants outer area with tarps and fabric sheets, including burlap, to protect the growing root systems. Some lumber planks help hold the perimeter of the grouping of rolled mediums covered around the outside during windy days. Any excess water will still drain from the bottom side of the sloped ground of your grouping, unlike using the pail method of growing.

Any rolled rooting mediums that are not grown in pails, can still be moved to the planting site, in pails, for safe transporting. As long as the rolls are groupings of one hundred plants, and they are not prepared in too fat a roll, to fit in the pails. I have successfully moved burlap rolled mediums around using a plywood base and rope slings, and this works just fine. The prepared rolls can even be placed on the rubber tire wheeler that I use to move rolls around on.

The ability to move large numbers of plants around easily on a wheeler truck or cart is a real advantage with any riparian planting project. Being mobile with lots of plants and just a few basic planting tools and equipment is important in operating efficiently.

The use of rubber air filled tires on your wheeler cart is an advantage on rough terrain. The plywood bases, with slings worked very well in making a the carrying of the mediums a lot easier as well.

The rolled medium shown in this photo was for shorter cuttings, grown for a soil retainer planting. The top growth would be much more advanced than with a normal spring planting roll. The rolls are easily moved around when new or when the plants are growing high.

The End.