

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

2021

The Head Start Planting System



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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 aspen 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° 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, floods 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. All of 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 all of 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 foothold in the area and seed propagation will spread the willows around.

The end of the summer is when most of the loss 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 all of 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.

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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.

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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 pretty 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.

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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 all of 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.

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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.

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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 all of 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 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 all of 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 all of 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.

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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.

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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.

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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 thereabouts.

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 moss 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

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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.

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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.

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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: First 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.

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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 it 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

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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 $\frac{1}{4}$ 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

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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 where 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 $\frac{1}{4}$ 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

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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 $\frac{1}{4}$ 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.

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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 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.

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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.

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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

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for pilot holes in really gravelly stream banks and 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 to 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

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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.

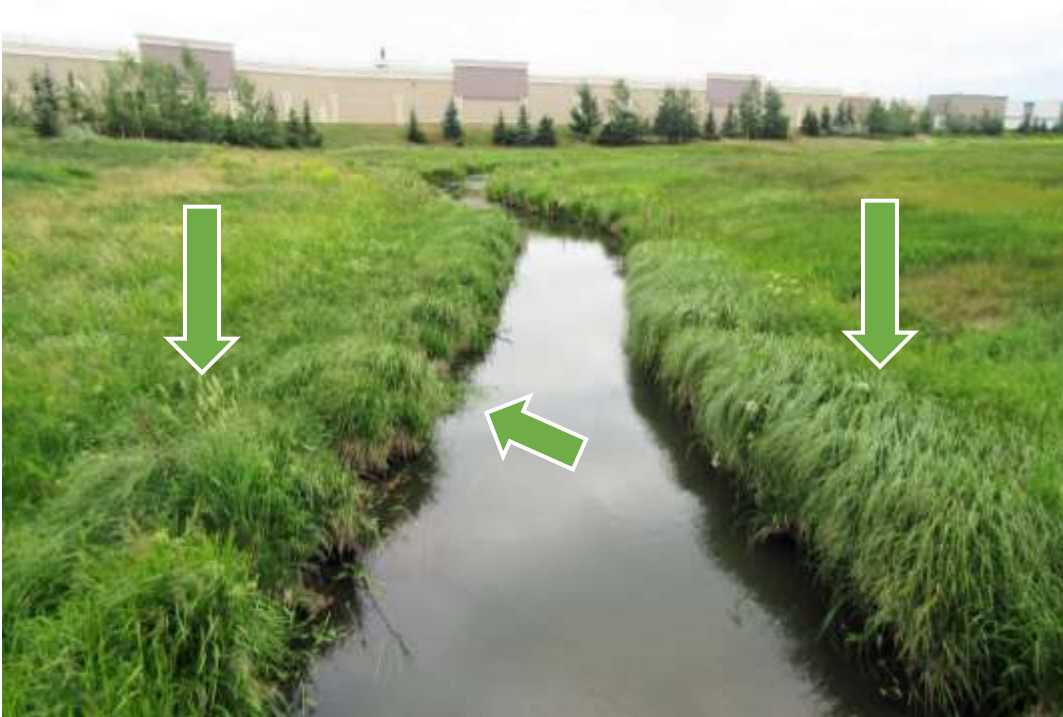
2.5 Planting Techniques

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

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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

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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 have to 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 fowl. 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 nature's way.

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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.