Stump Removal Methods

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Decisions, Decisions

Stumps can be eliminated from the landscape in a number of ways. A major decision point is whether to completely extract and remove the stump, or leave some portion or all of the stump in-place in the soil. One low impact alternative includes cutting the stump low and level so a mower or other vehicle can drive over. Another low impact alternative is leaving a high stump for use as a weathered planter, temporary seat or table.

If a stump will be removed from a landscape, the next decision point is whether to extract the stump whole or in large pieces, or to break the stump apart into small pieces where it sits. In-place stump removal usually does not pose an equipment intensive demand on landowners, nor risk extensive landscape disruption as extraction. Stump extraction usually requires plenty of space because of the power requirement of the equipment used and the physical size of the stump to be transported off-site.

What's Best?

Stump removal processes can be generically described as: dig, push up or yank stump out of the ground; break the stump up into various sized pieces; burn what wood you can; accelerate the chemical (~25% faster) or ecological (~50% faster) degradation and decay process; or, do nothing. Stump removal techniques covered here are:

Hand or machine digging.
Mechanically pushing or pulling.
Trenching and soil saws.
Grinders and chippers.
Water and air excavation.
Blasting.
Burning.
Accelerate chemical degradation.
Accelerate ecological decay.
Do nothing.

Digging

One means of removing stumps is to hand dig around the stump, cutting any large diameter roots. This job is hard and tedious. As soil is removal and large roots cut, the stump may be extracted with a lever bar or a hand winch and chain. Once you complete this process on a small stump, you may decide other means of stump extraction is highly preferable to using a shovel and your own energy. Hand digging is strenuous work and can be dangerous when using associated equipment which may be under-powered, under-sized for the loads, or designed for another purpose. An example of inappropriate tool use is using a small soil auger for excavation. Leaving the stump high can give you additional leverage to pull and push on the stump.

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Digging stumps with a backhoe, excavator or loader can be fast and effective. Digging does disrupt and disturb an established landscape. Machine extraction requires good access to the site for the equipment and for debris removal and transport. The foot print on the landscape of stump removal using mechanical extraction can be large.

Pushing

Sites where heavy equipment can be used and not compact the soil or damage the landscape features, can have stumps physically pushed out of the ground. Stump pushing or clearance is a process used in initial development clearance of forested sites and on commercial campuses where no landscape work has commenced but large equipment is available. Whole tree take-down with stump extraction can be done effectively at the same time. A blade on a heavy tractor can be elevated and used to push a tree or tall stump until the lean from broken roots is clear. The next step is to drop the blade and push under the root ball while lifting with the blade until the tree topples exposing the woody roots and root collar.

Two stump removal procedures associated with heavy equipment use and serious site disruption are root raking and stump splitting. Root raking uses a heavy piece of equipment for pushing or pulling a heavy steel blade or rake with tines. The tines allow most of the soil to drop away but gathers and breaks large roots and stumps. Stump splitting uses an excavator with a heavy steel hooked point to pierce and yank upward on stumps. The intent of stump splitting is to break the stump into several pieces by separating and splitting the wood between major roots.

Pulling

Equipment with cables, winches, and pulley systems can be used to drag the stump out of the ground. Both vibratory and steady pull systems are available. Deeply soaking the soil with water hours before can greatly reduce extraction power requirements. A cable, chain, or grapple is affixed to the stump and a winch is used to pull the stump. Either straight horizontal pulling, or using a lifting stand or tripod to elevate the chain or cable (adding a vertical component to pulling) can be used, although the power requirements are similar.

Usually a soil saw, trencher, or other means of excavation or root severing are used to reduce the force needed for extraction. Great forces can be generated in stump pulling and it is critical all load bearing components of any set of cables, chains, pulleys, anchor lines, or connectors be designed for the forces generated plus a safety factor. Figure 1 was developed from reanalyzing a number of studies dealing with the pounds of force needed to extract stumps of a given diameter. Figure 1 provides a rough estimate of forces and their variation caused by different stump and soil conditions. Because of the power requirements involved, most pulling systems require large equipment and a large setup area. Customized smaller pulling systems can be designed for unique situations.

For effective pulling of stumps, the mechanics of how a stump is locked into the soil should be reviewed. Trees can have many small diameter roots or a few large diameter roots -- highly branched woody roots or long unbranched roots -- large angles between roots or roots closely packed together. Rooting systems are highly variable in life, and so stumps structure is highly variable in death. The most critical feature of a stump being pulled (to minimize force exerted) are the large diameter roots on the same side as the pulling action – toward the winch cable.

The more roots branch on the pulling side of the stump, the less stiff the stump / soil system and the nearer to the stump will be the extraction fulcrum. Root branching points close to the stump will be the location of bending and breaking failures. Root branch points are places where large changes (abrupt reductions) in root stiffness occur. A stump with a few large diameter, unbranched roots on the pulling side will be very stiff and hard to pull. Stiffness and pulling force required will fall dramatically as the angle between neighboring large roots on the pulling side reach and exceed 60^{o} of horizontal separation.

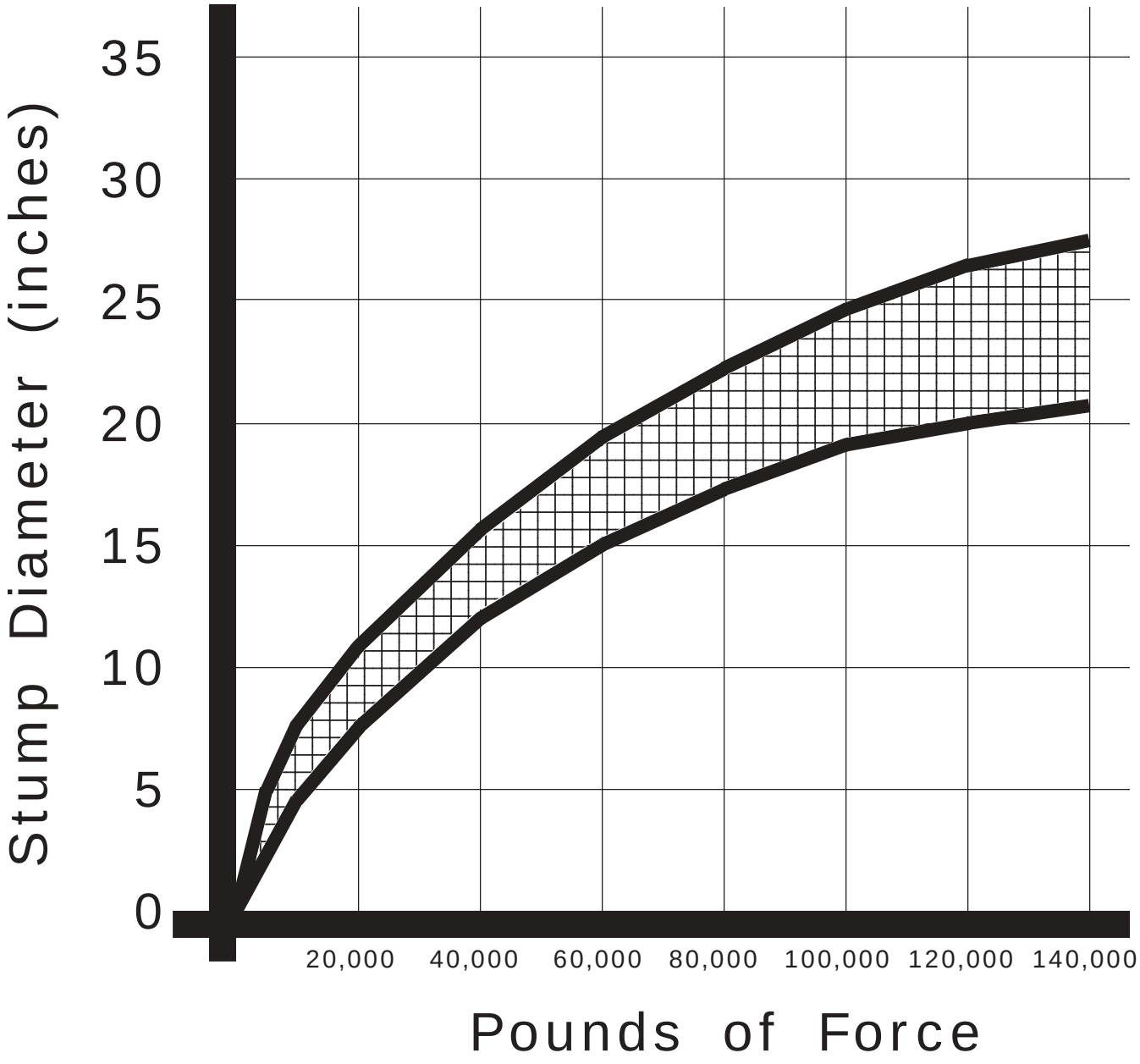

Figure 1: Rough estimate of pounds of force, and force variability, required to extract a stump of a given diameter. Note every stump has different soil-root mechanical interactions, different levels of damage and decay, and different site constraints. These differences lead to great variability in extraction force. This figure was generated by reanalyzing a number of studies in order to provide a basic level of information regarding extraction forces. This figure was derived from information presented in Biller & Baumgras (1987) and Golob et.al. (1976).

Along with the stiffness of the roots, decreasing the holding interface between soil and root surface is critical for pulling. Saturating the soil with water before pulling will decrease soil strength and root holding capacity by as much as four times (4X). Under saturated soil conditions, roots are more likely to slip rather than break. Use a trencher or soil saw to loosen the stump by severing roots, reducing root length, and reducing root holding capacity. For extracting the main stump mass only, roots should be severed close (no more than stump diameter) from the stump on the pull side. Roots on the opposite side of the pulling force can be severed between two and four times (2-4X) stump diameter measured from the stump center. In essence, you are trying to roll the stump up and out of the ground while minimizing force expended.

Trenchers & Soil Saws

Soil trenchers and saws can be used to cut, at some distance from the stump, roots and soil. Trenching around the stump can eliminate most of the root-soil contacts and make it easier to extract the stump whole or in large pieces. Soil saws are large circular wheels with soil teeth used for cutting down through soils. Soil saws can be used to rapidly sever small roots and separate the stump from surrounding soil. Note trenchers and soil saws are designed for soil excavation, not cutting or chipping wood. Damage to equipment and dangerous conditions for the operator can arise from misuse or exceeding design specifications. Trenchers and soil saws can be effectively employed to isolate the stump from the mass of soil roots occupy.

Grinders

There are four primary types of stump grinders: hand manipulated handlebar machines; self-propelled machines; tow-behind machines; and, truck / tractor mount machines. Stump grinders pushed by hand can fit into small areas but may take a long time to grind. Small machines may also be limited by the depth of grinding. On the other hand, some small stump grinders can be pushed or walked through areas less than 29 inches wide. The larger the machine, usually the larger the engine and grinding head or wheel. Note stump grinders can be rented, but are powerful specialized equipment which can be dangerous. Seeking professional assistance is recommended for most people and landscape situations.

Stump grinding should always include a skirt or fencing around the stump to control flying debris and limit where stray pieces of stump and soil may end-up. Allow enough room inside the skirting for wood chip build-up. The chips produced will amount to approximately four times the volume as solid stump wood.

Stump grinding is usually sold by the diameter of the stump at the widest point. Additional fees are assigned for the depth to which the stump is to be ground (4 to 36 inch depth) and how tall the stump is above the ground. There are specialized stump grinders used under specific conditions, like stumps under six feet of water in lakes. When contracting with a stump grinder, be sure to explain the access width and heights, and the open space available around the stump, to assure the best choice of equipment. Extremely large stumps are difficult to cost effectively grind with some types of equipment.

For any stump grinding / chipping job a number of specifications should be outlined. The depth of stump removal below grade, the extent around the stump to remove large roots, clean up procedures and chip removal, and residual damage repair to the landscape and hardscape are a few of the items to be agreed upon before accepting a service. Chip disposal is critical in any specification set. Chips can be: left where they fall, leveled, spread, moved elsewhere on-site, removed from site, or dumped back into the stump excavation hole. The stump excavation hole can have chips only deposited or the chips can be mixed at some concentration with clean soil or other materials. The excavation hole can be cleaned out

completely and backfilled with clean soil. The decisions regarding material deposition are important for the future use of the stump site, for the values of the surrounding landscape, and for the cost alternatives for off-site disposal.

Soft Excavation

Removing soil from around a stump (including beneath the stump) can be accomplished using jets of water or air. A high pressure water jet can be used to separate the stump and large roots from the soil. The roots can then be cut and the stump extracted. The water jet process is more effective when the water used and the soil it carries can be vacuumed-up immediately. If a vacuum truck is not used, temporary trenches, slope dams, ditches, and water control barriers can be installed to collect all water and soil eroded from the site and to keep the stump area drained. Using a water based excavation system can be fast and effective on many soil types but is extremely messy with off-site impacts possible from water and displaced soil. Soil saturation can reduce soil bearing strength, accelerating site damage from equipment ruts and poor traction, but easing stump extraction.

A high velocity air jet can be used in the same way as a water jet in order to excavate a stump. Air jet products have a number of advantages over water jet products in ease of use, equipment requirements, and potential residual mess. A stump shroud or netting is usually required in established landscapes to control soil and dust. A commercial sized air compressor can be setup at some distance from the stump area. The air nozzle and hose can be snaked through small spaces. The whole stump and major roots can be exposed using soft excavation and then some means of extraction used.

Blast From The Past

Blasting or blowing stumps was a standard practice for stump extraction in the past. In rural areas and on large sites disrupted by construction, blasting can still be used under carefully controlled conditions. Usually a hole is bored or dug beneath a stump and the blasting charge inserted. In areas away from underground utilities, wells, foundations, and buildings, charges can be set. In the past there was a tendency to use an over-charge of explosives, spewing wood, rocks, and soil many yards. In the blast, the shockwave of the explosion and rapidly expanding gases shear off roots and elevate the stump and soil. The blast heavily compacts the soil below the charge.

Carefully controlled and directed explosive charges can be successfully used by certified explosive experts in concert with stump removal specialists. Special training and permits are required to purchase, transport, and use the explosives traditionally used to blow stumps. The extent of clean-up after the explosion can be controlled by using blast mats (like a mat of interconnected old tires) to cover and hold down flying debris.

Burning

Another traditional means of stump reduction was to set it ablaze, usually using petroleum-based accelerants or charcoal briquets. Stumps must be dried before they will sustain ignition. Other woody parts of the tree which are already dry can be used to burn for heating the stump, driving off the water, and igniting the stump. Stumps are in contact with moist soil, have limited surface area open to the air, and are covered with bark, all of which slows drying. Petroleum products, resin soaked wood, torches, charcoal briquets, or other external heat sources can be used to ignite and sustain stump burning. Partial excavation or extraction can aid in drying the stump and allow enough oxygen to reach applied fuels to burn the stump. Extensive large-bore drilling into stumps is cited as essential by many stump removal products.

Burning rapidly breaks apart wood bonds, releasing energy. The parts of the stump which do not burn will be covered with a charred layer, or be partially burned to charcoal, which slows the decay of

these residual parts. Burning can be assisted by products which either kill and dry the stump faster (salts), or make the wood more flammable (diffusible chemical fire accelerant). There have been a number of stump removal products marketed that are a burning pre-treatment. Note in many parts of the nation burning stumps, smoke generation, and accelerant products are not allowed for stump removal.

Accelerate Chemical Degradation

Many traditional products used to accelerate the degradation and decay of stumps contain concentrated salts to dry the stump for burning, attempt to infuse the stumps with potassium nitrate (saltpeter) to assist with burning, contain alkalis or sulfiting agents used to break down lignin, or contain exzymes which weaken wood cell walls. Many of these materials or formulations have been used in one form or another over many years. Few show any acceleration of decay in the short term. At the recommended application rates, many products are damaging to decay fungi. Over the long run, most products which increase nitrogen in the wood and decrease the C:N ratio around the stump will accelerate the wood decay process.

Accelerate Natural Decay Processes

Knowing the important components of stump decay allows for optimization of a decay environment. Providing more of whatever component is limiting decay rates, while not interfering with other soil resources, can push the decay process along. By carefully enriching resources on the site around a stump, decay conditions and organisms can be facilitated. For most stumps, aeration of the soil and stump, increasing the surface area of the stump open to the air but shielded from the sun, assuring moist not wet conditions, and addition of nitrogen fertilizer all provide conditions accentuating wood decay. There are a number of products available, from specialized stump removal compounds to general fertilizers, which can be added to the stump or site. Stump decay remains a long-term soil mediated process, not stumps melting away quickly. Expectations for stump decay should be centered upon climatic conditions and soil temperatures stretched over several years.

Doing Zip

Leaving a stump in the soil and forgetting it is easy. Forgetting a stump and trusting nature to act alone in removing assocaited problems may seem like an ecologically viable means to treat a site. Resource constraints, site liabilities, and forgone site usage all can haunt non-action. There are locations and circumstances when doing nothing is a real option, but in established landscapes, prompt stump removal is an important part of good management.

Ecological Values

Stumps are a food source and a habitat which is difficult to find in many community landscapes. The creatures which inhabit and use the decaying stump change as the stump changes. Energy concentration in a decaying stump represents a rare and essential resource to a number of animals and micro / meso-organisms. If a stump can be simply left in-place and not disturbed, interesting things can happen, especially when the stump is surrounded by a healthy soil. The pieces and chips of a stump can also be used to enrich the site and provide unique, wood centered habitats.

Soil Subsidence

However a stump is removed from a site, the space it occupied will be left behind -- the stump hole excavation (calera) and root channels of various sizes and lengths. As soil subsides, new mineral

soil will need to be applied to the site. Small layers of soil can be applied and then washed into the soil openings or depressions. Be careful to not use water or tamping to compact new soil into old positions. Because the stump and roots will take many years to finally decay away, many years of vigilance will be needed to fill-in areas. Stump and root decay near structures or pavements may require soil stabilization to prevent damage. If roots or stumps were pushing damaging structures when alive, wood decay will lead to additional damage. After you have declared victory on a stump and walked away, periodic visits to minimize liability risks and repair unexpected problems will still be required.

Future Site Use

The site which remains after stump removal will be dominated by decay processes for a number of years. Once the decay process is functioning well, a new tree can be planted near the site. Planting should be completed outside the area impacted byb the removal treatment. The cause of death, or need for removal of the original tree, needs to be considered in both species and site selection for a new tree. The same resource limitations (including pest problems) can impact the new tree as they constrained the old tree, unless changes are made. Planting back into the identical location as the original tree is possible if the old stump is broken and shattered enough to allow the new tree to colonize the native soil. New soil can be used for fill in the stump excavation or caldera, but multiple openings or connections to the surrounding native soil through the old stump site are essential. Usually several years are allowed to pass, with rapid decay progression, before a new tree is planted in the same location. Do not plant in only the wood chips from a stump pushed back into the caldera, as resource fluctuations can be severe for a new tree, as will access to the new roots by pests.

Conclusions

There are many ways to deal with stumps in a landscape. The techniques involved are centered around soil weakening or loosening, excavation, extraction, and/or reduction. Reducing the stump through grinding or chipping is the most prevalent technique used in a well managed, modern landscape operation. Other means of mechanical or natural reduction can be used. For most landscape systems and objectives, quickly recycling the resources and space occupied by a dead stump is critical.