Roadside Vegetation Management Project

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Date: October 5, 2016

Mike Heitzenrater, District Roadside Development Specialist
PA Department of Transportation
Engineering District 2-0
70 PennDOT Drive; PO Box 342
Clearfield, PA 16830

We are writing to provide details on our findings and offer suggestions on grounds improvements from our visit to the District 2-0 office building. The visit occurred on Tuesday, July 19, 2016. On that date we met with the following personnel: Mike Heitzenrater (District Roadside Specialist 2), Greg Sayers (Maintenance Operations Manager), Sharon Hay (Management Analysis 2), Mark Coudriet (Custodial Worker 1), Mike Dinant (Maintenance Repairman 2). After touring the grounds we collected images and soil samples (Appendix I) from throughout the site. The recommendations provided are divided into four separate categories including “Trees”, “Lawn”, “Vinca minor”, and “living snow fence”.

The suggested maintenance activities require professional experience in and understanding of tree and lawn care. A certified arborist would be best suited to complete the pruning practices and cuts necessary to create the proper structure and regain tree health on the property. Similarly, an outside lawn care specialist with experience would be a practical investment for implementing the fertilizer and weed control operations outlined in this letter. The mowing and lawn renovation are items that may be suited to in-house personnel or contracted out.

Trees

Our site visit on Tuesday July 19, 2016 occurred during the 3rd growing season after planting. The trees on this site suffered from poor vigor likely due to difficulty with establishment expressed as short growth increments, dieback of branches, and development of early fall coloration with premature leaf loss. We were told that the trees had not been outfitted with gators (i.e., devices to store and supply water slowly to an individual tree) or otherwise supplied with supplemental water. A rule of thumb for an establishment period is one year per caliper inch of the tree. The trees to be planted were specified as 2.5 to 3 inch caliper, so the establishment period should be 3 years. During this time, supplemental water is necessary to encourage proper root development in combination with monitoring rainfall. The pH of soil collected from the base of several trees was 7.4 (Appendix I, Soil Test 1).

The tree species planted according to the planting plan with their preferred pH range are:*

Tree Species	PH range
Acer rubrum 'Red Sunset'	5.0 to 5.8 (higher may cause Manganese deficiency)
Ginkgo biloba	tolerant up to 8.2
Quercus prinus	5.0 to 6.0 but adaptable
Quercus bicolor	prefers acid soil
Ulmus americana 'Valley Forge'	adaptable
Zelkova serrata	tolerant

**Quercus bicolor* was not specified on plan but appears to be what was planted.

A quick overview of tree condition by species follows:

Oaks: The planting plan shows the oak species as *Quercus prinus*, chestnut oak; however, the trees on the site appear to be *Quercus bicolor*, swamp white oak. Swamp white oak is a great tree for harsh sites, with either wet or dry soils, but it does prefer acidic soil conditions. The oak trees appeared to have dieback from the first or second year on the site. By the time of our visit, there was vigorous branching from the trunk and larger branches. In our experience, pruning out dead wood and allowing oak trees of this size to continue to develop new branches will produce satisfactory tree form in most cases (Image 1).

Image 1: Shows tree with dead wood that can be removed and, likely promote acceptable tree form.

Red Maple: *Acer rubrum* 'Red Sunset' were experiencing premature fall coloration and defoliation that often indicates stress and low energy. They did not show the dieback like the oaks; however the stress response is indicative of slow decline. We did not notice the kind of chlorosis or yellowing that would indicate manganese deficiency, but the tree canopies were not full and leaves did not have a good functional green color (Image 2).

Image 2: Red maple displaying premature fall coloration and defoliation.

Valley Forge Elm: The outer foliage seemed somewhat dry from water stress, but otherwise deep green color and little evidence of dieback and defoliation. The elms on this site appeared to be in the best condition of any of the trees that we saw (Image 3).

Image 3: Valley Forge Elm displaying healthy growth.

Ginkgo biloba: These trees seemed to have a full canopy of foliage. The foliage may have been a bit yellow, but considering the soil pH and the lack of watering during establishment, it is difficult to determine if this was caused by the high soil pH, moisture stress, or is normal for the genetic makeup of the trees planted (Image 4).

Image 4: Ginkgo trees appeared normal and healthy on the site.

Zelkova serrata: The color of the foliage appeared to be normal. The biggest problem appeared to be that some of these trees had extensive dieback. In several instances 1/3 to 2/3 of the canopy was dead – often on one side of the tree. Poor growth of roots into the backfill soil and water stress would seem to be the likely cause of the dieback (Image 5).

Image 5: Canopy loss and dieback likely due to lack of water resulting in poor root development.

Overall, the trees appear to show enough promise to save as many as possible. Only where dieback is extreme do we suggest removing them.

Trees in the narrow tree lawn in the parking lot to the left of the main entrance could be removed if safety or maintenance concerns dictate that decision. One of them is a zelkova, which appears to have about a 75% dieback (Image 6).

Image 6: Trees in this island could be removed if safety or maintenance concerns dictate.

Suggestions for improving tree health

- The elm and ginkgo trees were in the best shape of any tree species on the site. They would benefit from application of mulch to the soil around them and from supplementary watering. Do not place mulch up against the trunk of the tree.
- Oaks should be pruned to remove deadwood and allow sprouts to develop from the trunk and branches to form new scaffold limbs. Scaffold limbs are the primary branches that emerge from the trunk and carry the smaller limbs and foliage of the tree. Vigorous growth such as sprouting is a positive sign, as long as we can identify what caused the dieback. In this case the dieback was likely due to moisture stress. A handout with pruning guidelines is included with this report (Appendix II).
- The best treatment for the red maple trees would be anything that reduces the stress. Adding mulch to the soil around the base of the trees and watering would be beneficial. Avoid pruning except to remove deadwood until these trees begin to exhibit some vigor.
- The zelkova trees will require pruning to remove deadwood. In some cases the dieback is so extensive that the trees should be removed and replaced.
- Trees should be evaluated on an individual basis to determine which should be removed. This could be done by a qualified individual such as an ISA certified arborist who is familiar with establishing and maintaining young landscape trees.
- Covering the soil around the base of trees with mulch and supplemental watering would benefit all of the trees to be retained on the site. A suggestion for supplemental watering is to install a 20-gallon tree gator on each tree and fill each gator a minimum of one time each week during the growing season. It would be beneficial to begin this process in the spring of 2017 and continue through the growing season. The process should be repeated again in 2018. The 2016 growing season is essentially over at this point.
- Acidifying soil pH to improve tree growth would require annual soil testing and inputs, and may be too time consuming to be worthwhile. Soil pH should become more acid over time (which would be favorable to tree health) as the limestone used to remediate the site reacts with the soil and becomes depleted.

Lawn

The lawn areas described are divided here into four separate and distinct parcels. Each will be discussed individually. These include: Front/Back Lawn, Entrance Loop, Swale, and Traffic Islands. Most areas would benefit from an overseeding of turfgrass to improve turf density. Seeding can be done April, May, or September of 2017. A walk behind or tractor mounted overseeding unit would be best suited for accomplishing this operation; however, where organic matter is needed the seeding can be done in conjunction with the incorporation of organic matter as described later. Suggested seed mixes and rates, where recommended, can be found within the description for each parcel. When mowing turfgrass areas keep in mind to

target a height of 3 inches. This will allow the grasses to develop and be more competitive while reducing stress on the desirable turf stand. An irrigation system would greatly enhance the ability to maintain a luxurious lawn throughout the growing season, but it would require extensive inputs and cost for installation and maintenance. In our view, this would not be practical for this site and facility.

Front/Back Lawn (Image 7)

The soil test shows pH and nutrient levels for this area are above optimum and no additional organic matter are needed (Appendix I, Soil Test 2). The only nutrient currently required is nitrogen. Despite the soil test suggesting fertilizer applications three times per year, we would recommend an application twice per season (May and September) from the list of fertilizers shown on the soil test result. This would provide 1 lb N/1000 sq ft. during each application. Additionally, a broadleaf herbicide treatment should be made during the May and September fertilizer applications. The fertilizer treatment will enhance the existing turf stand, while the broadleaf treatment will eliminate competition for the grasses and ensure a neater appearance. The areas closest to the building appeared to have sufficient turf density. The steps mentioned will enhance and improve the vigor, health, and appearance at these locations.

Image 7: Back Lawn of PennDOT District 2-0 office building.

Entrance Loop (Image 8)

This soil test revealed another high pH value (i.e., 8.1) (Appendix I, Soil Test 3). Items required within this area include fertilizer, organic matter, and broadleaf weed control. A fertilizer that provides added phosphorus (P_2O_5) is required. Therefore, choose a fertilizer combination that will provide 1 lb N/1000 sq ft. plus 5 lb P_2O_5/1000 sq.ft. applied in May and 1 lb N/1000 sq ft. plus 4 lb P_2O_5/1000 sq ft. applied in September the first year. A soil test is recommended in spring 2018 to determine future fertilizer amounts needed in spring and fall of subsequent years. Organic matter should be applied at a depth of ¼ to ½ inch across the entire surface in spring 2017 and blended into the existing soil using a core aerator travelling over the area eight to ten times, followed by a broadcast overseeding of grass seed (see next paragraph), and then incorporated using a drag mat. Additionally, a broadleaf herbicide should be applied during the spring and fall fertilizer treatments. Avoid any herbicide treatments during the establishment phase of the grass waiting until at least two mowing operations have occurred for the newly established grasses. The fertilizer treatment and added organic matter will enhance the existing turf stand, while the broadleaf treatment will eliminate competition for the grasses and ensure a neater appearance.

A seed mix including turf-type tall fescue, Kentucky bluegrass, and perennial ryegrass at 80/10/10 percent by weight would provide a durable turf stand once established. An overseeding rate of 3 lb/1000 sq ft. is suggested.

Image 8: Lawn within circle at entrance to PennDOT District 2-0 office building.

Swale

The pH value for soil sampled from this area was optimal (i.e., 7.5), while phosphate (P_2O_5) and organic matter levels were low (Appendix I, Soil Test 4). Items required within this area include fertilizer, organic matter, and broadleaf weed control. A fertilizer that provides added phosphorus (P_2O_5) is required. Therefore, choose a fertilizer combination that will provide 1 lb N/1000 sq ft. plus 5 lb P_2O_5/1000 sq.ft. applied in May and 1 lb N/1000 sq ft. plus 4 lb P_2O_5/1000 sq ft. applied in September the first year. A soil test is recommended in spring 2018 to determine future fertilizer amounts needed in spring and fall of subsequent years. Organic matter should be applied at a depth of ¼ to ½ inch across the entire surface in spring 2017 and blended into the existing soil using a core aerator travelling over the area eight to ten times, followed by a broadcast overseeding of grass seed (see next paragraph), and then incorporated using a drag mat. Additionally, a broadleaf herbicide should be applied during the spring and fall fertilizer treatments. The fertilizer treatment and added organic matter will enhance the existing turf stand, while the broadleaf treatment will eliminate competition for the grasses and ensure a neater appearance.

A seed mix including turf-type tall fescue, Kentucky bluegrass, and perennial ryegrass at 80/10/10 percent by weight would provide a durable turf stand once established. An overseeding rate of 3 lb/1000 sq ft. is suggested.

Traffic Islands (Image 9)

The pH value of soil in the traffic islands was elevated (i.e., 8.4), while phosphate (P_2O_5) and organic matter levels were low (Appendix I, Soil Test 5). These areas would require an application of 1 lb N/1000 sq ft. plus 5 lb P_2O_5/1000 sq ft. applied in May and 1 lb N/1000 sq ft. plus 2 lb P_2O_5/1000 sq ft. applied in September the first year. A soil test is recommended in spring 2018 to determine future fertilizer amounts needed in spring and fall of subsequent years. Organic matter should be applied at a depth of ¼ to ½ inch across the entire surface in spring 2017 and blended into the existing soil using a walk behind core aerator travelling over the area eight to ten times, followed by a broadcast overseeding of grass seed (see next paragraph), and then incorporated using a drag mat. Additionally, a broadleaf herbicide should be applied during the spring and fall fertilizer treatments. The fertilizer treatment and added organic matter will enhance the existing turf stand, while the broadleaf treatment will eliminate competition for the grasses and ensure a neater appearance.

A seed mix including turf-type tall fescue, Kentucky bluegrass, and perennial ryegrass at 80/10/10 percent by weight would provide a durable turf stand once established. An overseeding rate of 3 lb/1000 sq ft. is suggested.

Image 9: Example of lawn within traffic island at PennDOT District 2-0 office building.

Vinca mInor

There were some questions concerning maintaining *Vinca minor* (and whether it is worth maintaining) that is planted as a ground cover in the foundation plantings on the northeast side of the building and in larger beds adjacent to the pedestrian entrance and loading dock on the northwest side of the building (Image 10). *Vinca minor* or periwinkle is a short evergreen groundcover (up to 6 inches tall) with a medium growth rate. It performs best in partial to full shade and when grown on evenly moist but well drained soil. *Vinca* Stem Blight *(Phomopsis livella*) is a disease that causes brown patches of dead plant material.

Image 10: *Vinca minor* as a groundcover within the ornamental landscape beds.

There are two options available for the areas planted to *Vinca minor*. Either option could be applied independently to the various beds on the site. A weed control program will need to be implemented on the beds whether the *Vinca* is removed or retained.

Option 1 is to remove the *Vinca* in certain areas where the cover is poor and weeds tend to be a problem. Anywhere the *Vinca* is removed, more ground surface will be exposed and available for weed germination and growth. The advantage to removing the *Vinca* is that the ornamental beds can be more readily treated with glyphosate (as long as desirable shrubs are avoided) to remove weeds that escape control by preemergent herbicides. The disadvantage is that less plant material is available to provide interest and texture to the landscape as well as compete with weeds.

Option 2 is to retain the *Vinca* groundcover and plant some additional *Vinca* plugs where coverage is thin. The plugs were originally planted at 12 inches on center. Fertilizer and supplementary water could be supplied for several years to encourage establishment. The advantage of having ornamental beds covered with dense groundcover such as *Vinca* is that weed growth is reduced by competition and the groundcover can provide an attractive addition to the landscape. The disadvantage is that fewer herbicides are available for post emergent weed control and in some cases hand-pulling weeds may be required. For this reason, adopting a maintenance program to encourage dense growth of the *Vinca* that includes an application of a preemergent herbicide such as Snapshot is essential.

Whichever option is chosen, a weed control program is needed. Snapshot 2.5 TG granular herbicide can be applied to bare beds and *Vinca minor* groundcover at 150 lbs/acre in the spring (April). Bare beds can be spot treated with glyphosate to control weeds that escape at any time during the season. *Vinca minor* beds will require hand pulling of weeds that escape or possibly the use a selective herbicide, depending on the weed species that develop. Remember to always read and follow label directions when using pesticides.

Living Snow Fence

A pressing concern of the property is the forceful winter winds and accompanying snow drifts that accumulate in the parking lot. The property boundary does not allow sufficient distance to install either snow fencing or a living snow fence using a border(s) of shrubs on PennDOT's property. Typically setbacks of 75 to 250 ft or greater are needed. The adjoining property is currently vacant and new vegetative growth is offering an opportunity to capture some of the drifting snow. It would be advised to communicate to the owner of the adjoining property located on the westerly side of the office building to leave rows of vegetation if brush is removed in the future. Two or three rows offset from 75 to 250 feet from the parking lot would help to capture drifting snow. The use of snow fence would be another option at similar setbacks. The lot will likely be developed in the future and the problem with drifting snow reduced by newly installed obstacles and structures.

Appendix I

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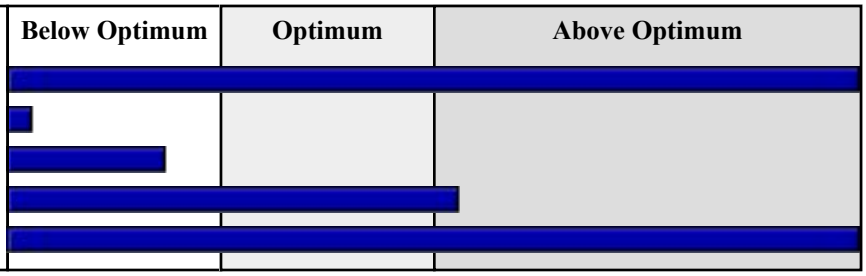
SOIL TEST REPORT FOR:	ADDITIONAL COPY TO:
JON JOHNSON ROADSIDE VEGETATION MGMT PROGRAM 102 TYSON BLDG UNIVERSITY PARK PA 16802	DAVID DESPOT ROADSIDE VEGETATION MGMT PROGRAM 102 TYSON BUILDING UNIVERSITY PARK PA 16802

DATE	LAB #	SERIAL #	COUNTY	ACRES	FIELD ID	SOIL
07/28/2016	S16-35060	30410	Clearfield		D2 Tree Dirt	

SOIL NUTRIENT LEVELS



RECOMMENDATIONS FOR: *Landscape, Maint, pH 5.5*

Limestone, Calcium And Magnesium Recommendations

Apply the following quantities of limestone, epsom salts and/or gypsum to the soil to correct soil pH, calcium and magnesium levels.

Calcitic Limestone: NONE
(0-3 % Mg)

Magnesium: NONE

Gypsum ($CaSO_4$): NONE

Nitrogen, Phosphate And Potash Recommendations

Apply 3.5 lbs per 100 square feet of 5-10-5 and 0.75 lbs per 100 square feet of 0-46-0.

MESSAGES

The above lime and fertilizer recommendations are for this soil sample and this season only. Nitrogen, phosphate and potash recommendations are for fertilizers containing specific ratios of nitrogen (N), phosphate (P2O5) and potash (K2O). As an example 5-10-10 contains 5 % N, 10 % P2O5, and 10 % K2O. If fertilizers with the ratio(s) shown are not available, contact your local garden center or fertilizer supplier for the appropriate substitution.

pH is high. Use sulfur (see Table on back of report) to lower pH to optimum level of 5.5

LABORATORY RESULTS:

[1]pH	[2]P lb/A	Exchangeable Cations (meq/100g)					% Saturation of the CEC			Optional Tests:		
		[3]Acidity	[2]K	[2]Mg	[2]Ca	[4]CEC	K	Mg	Ca	Organic Matter %	Nitrate-N ppm	Soluble salts mmhos/cm
7.4	44	0.0	0.4	1.6	19.6	17.0	2.2	9.5	88.4	5.5		

Test Methods: [1]1:1 soil:water pH, [2]Mehlich 3 (ICP), [3]Mehlich Buffer pH, [4]Summation of Cations

The high calcium level in this sample indicates the probable presence of soluble calcium. Therefore the CEC and the percent saturations were calculated using a maximum exchangeable calcium level of 15 meq/100 g.

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COMMENTS

1. To be most effective, all recommended limestone and/or fertilizer should be incorporated 6 to 8 inches into the soil prior to planting. If plants or crop is established, apply recommended materials to the surface and water area well.

Use a high quality agricultural ground limestone product to meet the limestone recommendation on this report. Manufacturers of agricultural ground limestone products provide a number called the calcium carbonate equivalent, or CCE, on the label. CCEs with high numerical values (close to 100 or above) indicate a pure lime source (greater ability to neutralize soil acidity). The amount of lime recommended on this report is based on an agricultural ground limestone with a CCE of 100. If your lime source is close to or equal to 100, you don't need to adjust the recommended amount. In the event that you use a lime source with a CCE well below 100, use the following formula to adjust the required amount.

$$\text{Actual liming material required} = \frac{\text{(Soil test recommendation in lbs of lime/1000 square feet)}}{\text{CCE of liming material}} \times 100$$

Example Only:
Soil Test Recommendation: 5 lbs limestone /100 square feet
CCE on label: 70 percent

$$\text{Actual liming material required} = \frac{\text{(5 lb of limestone/100 square feet)}}{70} \times 100$$

= 7 lbs liming material/100 square feet

2. If 11 to 20 pounds of limestone are recommended, divide the amount by two and apply in two applications six months apart. If 21 or more pounds are recommended, divide the amount by three and make three applications at six month intervals.

3. If 3 or more pounds of MgSO4 (Epsom salts) are recommended, divide the amount by two and make separate applications at four month intervals. If an alternative magnesium source is used, apply an amount equal to the equivalent of 10.5% Mg in MgSO4; ONLY ONE APPLICATION should be needed.

4. Lime and fertilizer recommended in pounds of material per each 100 square feet of area to be treated. Use the following conversions to convert from pounds per 100 square feet to other units or area sizes:
   Pounds per 100 sq. ft. x 10 = pounds per 1000 sq. ft.
   Pounds per 100 sq. ft. x 435 = pounds per acre:

5. Amount of sulfur needed to lower soil pH to optimum level.
   (See Laboratory Results on front of report for soil pH)

From Current Soil pH	To Optimum Soil pH	Sulfur (lb/100 sq ft)	From Current Soil pH	To Optimum Soil pH	Sulfur (lb/100 sq ft)
8.0	7.5	0.50	7.0	6.5	0.75
	7.0	1.00		6.0	1.25
	6.5	2.00		5.5	2.50
	6.0	3.00			
	5.5	4.00			
7.5	7.0	0.75	6.5	6.0	1.00
	6.5	1.25		5.5	1.75
	6.0	2.50			
	5.5	3.50	6.0	5.5	1.50

Apply sulfur at the above rates for a loam soil. On heavier soil (silt loams) use one third more than the Amount shown. On lighter soils (sandy loams) use one-half of the amounts shown.
If aluminum or ferrous sulfate is used to lower pH, multiply the above amounts by 2.5. Follow the same suggestions as above for soil types. If 4 or more pounds are needed, divide the amount in half and make two applications six months apart.

6. There is no reliable test for evaluating the amount of nitrogen (N) in soils that is available to crops over the growing season. The N recommended is based on the actual N that needs to be supplied annually to ensure optimum plant growth.

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DATE	LAB #	SERIAL #	COUNTY	ACRES	FIELD ID	SOIL
07/28/2016	S16-35058	30406	Clearfield		D2 Frt Lawn	

SOIL NUTRIENT LEVELS			Below Optimum	Optimum	Above Optimum
Soil pH	8.1				
Phosphorus	100	ppm			
Potassium	282	ppm			

RECOMMENDATIONS FOR: ***Home Lawn to Maintain*** ***Kentucky Bluegrass***

Limestone Needs:

Limestone: NONE
Apply the quantity of limestone recommended above to your soil in a single application unless it exceeds 100 lb/1000 square feet. If the recommendation exceeds 100 lb/1000 square feet, split the recommended amount into 2 or more separate applications 4 to 6 months apart.

Fertilizer Needs:

Fertilizer*	Rate: lb per 1000 square feet**
33-3-4	2.75
34-3-3	3
31-0-0	3.25
30-3-3	3.25
32-3-10	3.33
28-6-6	3.5
27-3-8	3.7
27-5-12	3.75
27-2-11	3.75
26-2-6	3.75
26-3-3	3.75
25-4-4	4
21-5-7	4.8
20-0-0	5

For a simple fertilizer program that will provide adquate quantities of nitrogen, phosphate and potash to turf based on your soil test results, apply <u>one</u> of the fertilizers listed on the left at the rates specified three times during the growing season for a three-year period. Apply once in mid-spring (May), once in late summer (September), and once in the late fall (November) each year. If you can not find any of the fertilizers listed below, select a fertilizer with an analysis close to one of those listed.

*Select only one
**Apply three times during the growing season.

Nutrient Needs (lb/1000 sq ft):

N	P_2O_5	K_2O
3-4	NONE	NONE

The individual nutrient needs for optimum turf growth are listed to the left. These needs will be met by applying the fertilizer materials listed in the above table three times per year for a three-year period.

LABORATORY RESULTS:

[1]pH	[2]P lb/A	Exchangeable Cations (meq/100g)					% Saturation of the CEC			Optional Tests:		
		[3]Acidity	[2]K	[2]Mg	[2]Ca	[4]CEC	K	Mg	Ca	Organic Matter %	Nitrate-N ppm	Soluble salts mmhos/cm
8.1	200	0.00	0.72	3.11	21.61	18.8	3.8	16.5	79.7	5.9		

Test Methods: [1]1:1 soil:water pH, [2]Mehlich 3 (ICP), [3]Mehlich Buffer pH, [4]Summation of Cations

The high calcium level in this sample indicates the probable presence of soluble calcium. Therefore the CEC and the percent saturations were calculated using a maximum exchangeable calcium level of 15 meq/100 g.

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Home Lawn Maintain

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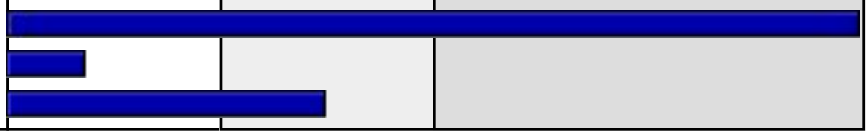
DATE	LAB #	SERIAL #	COUNTY	ACRES	FIELD ID	SOIL
07/28/2016	S16-35061	30409	Clearfield		D2 Ent Loop	

SOIL NUTRIENT LEVELS			Below Optimum	Optimum	Above Optimum
Soil pH	8.1				
Phosphorus	28	ppm			
Potassium	164	ppm			



RECOMMENDATIONS FOR: ***Park Area-To Plant*** ***Tall Fescue***

Prior to planting, incorporate the following into the top 4 to 6 inches of soil.

Limestone: NONE

Phosphate (P_2O_5): 9 lb/1000 square feet

Potash (K_2O): NONE

Organic Matter: 2 cu yard/1000 square feet

Apply a starter fertilizer just prior to seeding and work lightly into the soil

Apply a starter fertilizer at approximate rate of 1 lb of nitrogen per 1000 square feet, 0.5 to 1.0 lb of P_2O_5 per 1000 square feet, and 0.5 to 1.0 lb of K_2O per 1000 square feet using a fertilizer with approximate 1:1:1 or 2:1:1 ratio of N:P_2O_5:K_2O.

MESSAGES

The above recommendations are for a new establishment that will be tilled 4 to 6 inches in depth prior to planting. In some cases, turfgrass seed is planted into soils that have not been tilled. In such cases, incorporating large amounts of lime, fertilizer, and organic matter into soil 4 to 6 inches in depth is not possible. When planting into soils that have not been tilled, do not exceed 100 lb lime/1000 square feet; 5 lb P2O5/1000 square feet; or 2.0 lb K2O/1000 square feet. Do not apply organic matter unless a core aerator is used to incorporate into the soil surface. If attempting to incorporate organic matter with a core aerator, apply 1/4 to 1/2 inch of organic matter to the turf/soil surface and make 8 to 10 passes with the aerator.

LABORATORY RESULTS:										Optional Tests:		
[1]pH	[2]P lb/A	Exchangeable Cations (meq/100g)					% Saturation of the CEC			Organic Matter %	Nitrate-N ppm	Soluble salts mmhos/cm
		[3]Acidity	[2]K	[2]Mg	[2]Ca	[4]CEC	K	Mg	Ca			
8.1	56	0.00	0.42	2.43	11.16	14.0	3.0	17.4	79.6	2.4		

Test Methods: [1]1:1 soil:water pH, [2]Mehlich 3 (ICP), [3]Mehlich Buffer pH, [4]Summation of Cations

Turf-To Plant

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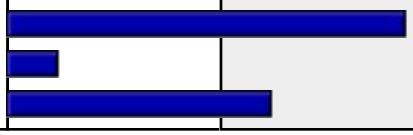
DATE	LAB #	SERIAL #	COUNTY	ACRES	FIELD ID	SOIL
07/28/2016	S16-35057	30408	Clearfield		D2 Swale	

SOIL NUTRIENT LEVELS			Below Optimum	Optimum	Above Optimum
Soil pH	7.5				
Phosphorus	21	ppm			
Potassium	153	ppm			



RECOMMENDATIONS FOR: ***Park Area-To Plant*** ***Fine Fescues***

Prior to planting, incorporate the following into the top 4 to 6 inches of soil.

Limestone: NONE

Phosphate (P_2O_5): 9 lb/1000 square feet

Potash (K_2O): NONE

Organic Matter: 2 cu yard/1000 square feet

Apply a starter fertilizer just prior to seeding and work lightly into the soil

Apply a starter fertilizer at approximate rate of 1 lb of nitrogen per 1000 square feet, 0.5 to 1.0 lb of P_2O_5 per 1000 square feet, and 0.5 to 1.0 lb of K_2O per 1000 square feet using a fertilizer with approximate 1:1:1 or 2:1:1 ratio of N:P_2O_5:K_2O.

MESSAGES

The above recommendations are for a new establishment that will be tilled 4 to 6 inches in depth prior to planting. In some cases, turfgrass seed is planted into soils that have not been tilled. In such cases, incorporating large amounts of lime, fertilizer, and organic matter into soil 4 to 6 inches in depth is not possible. When planting into soils that have not been tilled, do not exceed 100 lb lime/1000 square feet; 5 lb P2O5/1000 square feet; or 2.0 lb K2O/1000 square feet. Do not apply organic matter unless a core aerator is used to incorporate into the soil surface. If attempting to incorporate organic matter with a core aerator, apply 1/4 to 1/2 inch of organic matter to the turf/soil surface and make 8 to 10 passes with the aerator.

LABORATORY RESULTS:										Optional Tests:		
[1]pH	[2]P lb/A	Exchangeable Cations (meq/100g)					% Saturation of the CEC			Organic Matter %	Nitrate-N ppm	Soluble salts mmhos/cm
		[3]Acidity	[2]K	[2]Mg	[2]Ca	[4]CEC	K	Mg	Ca			
7.5	42	0.00	0.39	1.50	12.97	14.9	2.6	10.1	87.3	2.8		

Test Methods: [1]1:1 soil:water pH, [2]Mehlich 3 (ICP), [3]Mehlich Buffer pH, [4]Summation of Cations

Turf-To Plant

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1855
(814) 863-0841 Fax: (814) 863-4540
Agricultural Analytical Services Laboratory
The Pennsylvania State University
University Park, PA 16802
www.aasl.psu.edu

SOIL TEST REPORT FOR:	ADDITIONAL COPY TO:
JON JOHNSON ROADSIDE VEGETATION MGMT PROGRAM 102 TYSON BLDG UNIVERSITY PARK PA 16802	DAVID DESPOT ROADSIDE VEGETATION MGMT PROGRAM 102 TYSON BUILDING UNIVERSITY PARK PA 16802

DATE	LAB #	SERIAL #	COUNTY	ACRES	FIELD ID	SOIL
07/28/2016	S16-35059	30407	Clearfield		D2 Islands	

SOIL NUTRIENT LEVELS			Below Optimum	Optimum	Above Optimum
Soil pH	8.4				
Phosphorus	42	ppm			
Potassium	166	ppm			

RECOMMENDATIONS FOR: ***Park Area-To Plant*** ***Tall Fescue***

Prior to planting, incorporate the following into the top 4 to 6 inches of soil.

Limestone: NONE

Phosphate (P_2O_5): 7 lb/1000 square feet

Potash (K_2O): NONE

Organic Matter: 3 cu yard/1000 square feet

Apply a starter fertilizer just prior to seeding and work lightly into the soil

Apply a starter fertilizer at approximate rate of 1 lb of nitrogen per 1000 square feet, 0.5 to 1.0 lb of P_2O_5 per 1000 square feet, and 0.5 to 1.0 lb of K_2O per 1000 square feet using a fertilizer with approximate 1:1:1 or 2:1:1 ratio of N:P_2O_5:K_2O.

MESSAGES

The above recommendations are for a new establishment that will be tilled 4 to 6 inches in depth prior to planting. In some cases, turfgrass seed is planted into soils that have not been tilled. In such cases, incorporating large amounts of lime, fertilizer, and organic matter into soil 4 to 6 inches in depth is not possible. When planting into soils that have not been tilled, do not exceed 100 lb lime/1000 square feet; 5 lb P2O5/1000 square feet; or 2.0 lb K2O/1000 square feet. Do not apply organic matter unless a core aerator is used to incorporate into the soil surface. If attempting to incorporate organic matter with a core aerator, apply 1/4 to 1/2 inch of organic matter to the turf/soil surface and make 8 to 10 passes with the aerator.

LABORATORY RESULTS:

[1]pH	[2]P lb/A	Exchangeable Cations (meq/100g)					% Saturation of the CEC			Optional Tests:		
		[3]Acidity	[2]K	[2]Mg	[2]Ca	[4]CEC	K	Mg	Ca	Organic Matter %	Nitrate-N ppm	Soluble salts mmhos/cm
8.4	84	0.00	0.43	1.28	11.52	13.2	3.2	9.7	87.1	2.0		

Test Methods: [1]1:1 soil:water pH, [2]Mehlich 3 (ICP), [3]Mehlich Buffer pH, [4]Summation of Cations

Turf-To Plant

Appendix II

Pruning Landscape Trees

Contents

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Types of Pruning Cuts 2
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PENNSTATE
Cooperative Extension
College of Agricultural Sciences

Why Should Trees Be Pruned?

Proper pruning of landscape trees improves their structural strength, maintains their health, enhances their beauty, and increases their value. Pruning is advisable if:

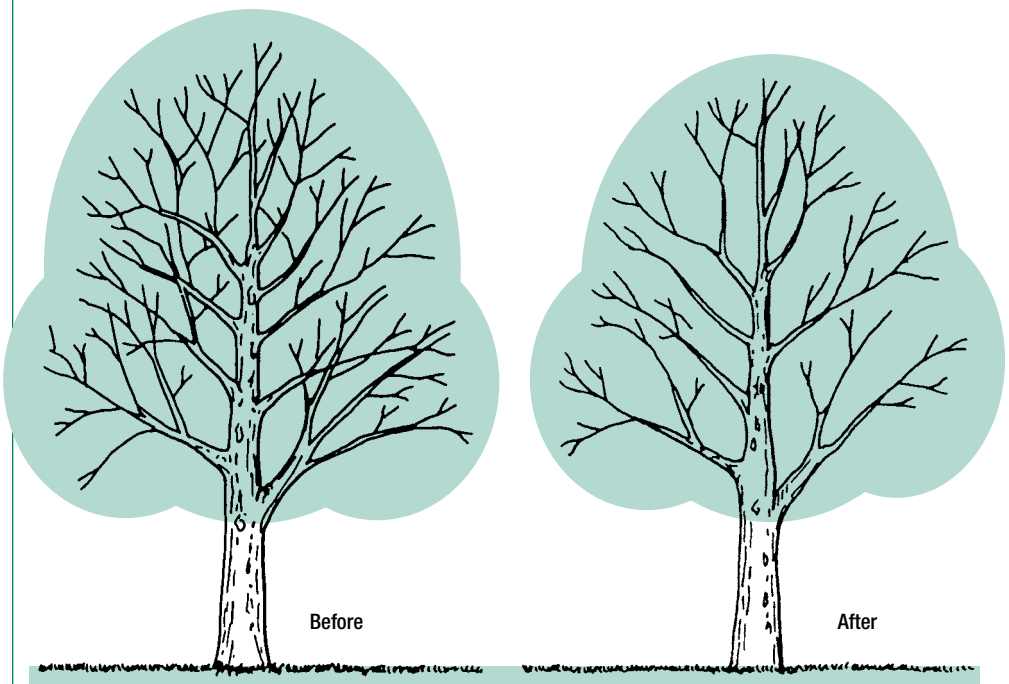
- trees have crossing branches, weak branch unions, or other defects
- branches are dead, dying, decayed, or hazardous
- lower branches interfere with people or vehicles, or block visibility of signs
- branches are growing into buildings or utility wires
- limbs have been broken by storms
- trees have grown too large and might injure people or damage property

Landscape trees not only make homes and communities more beautiful, but they also improve our environment and can increase the value of a property up to 20 percent. Trees are truly assets that need to be enhanced and protected. Proper pruning is definitely a worthwhile investment!

Who Is Qualified to Prune Trees?

Simple types of pruning, such as cutting lower branches from small trees, can be done by anyone who understands plants and has the proper tools. But only qualified arborists should train young trees or climb into trees to prune them. That type of tree work requires knowledge of scientifically based pruning techniques, tree physiology, and safety practices, as well as working experience with various tools and tree species. Because proper pruning is complicated and examples of shoddy and unsafe work abound, national standards have been developed for the best methods and safety. Any potentially hazardous activity associated with climbing trees, using power tools, and especially working near electric lines should be left to qualified professionals who follow the national tree safety standards.

This circular offers guidance for those who want to prune young trees. It also can help you find a qualified tree professional, understand proper pruning practices, and recognize work that is damaging to trees.



Crown thinning a tree removes unwanted branches, reduces weight, and allows light and air penetration. If properly done, thinning increases a canopy's photosynthetic area.

Types of Pruning Cuts

—A *thinning cut* removes a branch at its point of origin on the trunk. A reduction cut shortens a limb to a lateral branch large enough to resume the growth of the pruned limb (Fig. 1). Thinning and reduction cuts leave no stubs. They are used to remove damaged, dead, or weak branches, reduce the length and weight of heavy limbs, or reduce the height of a tree. Reduction cuts are placed so as to distribute ensuing growth throughout a tree and retain or enhance a tree's natural shape. Reduction and thinning cuts are the proper type of cut to use in pruning a live tree. Reduction cuts on larger branches can be referred to as drop crotch pruning.

—A *heading cut* trims a branch back to a bud, or trims a branch or leader back to a small branch not large enough to assume the growth of the pruned branch. Heading cuts should only be used when pollarding trees or shaping terminal flowering plants such as roses; they should not be used for topping trees. Topping has been described as the "ultimate in destructive practices," and in almost all cases it permanently damages a tree's health, structure, and appearance.

—A *stub cut* is like a heading cut but is made indiscriminately to a point on a branch or leader where no bud or branch exists. A stub cut, like a heading cut, is used when a tree is topped. Topping is only appropriate when sections of limbs are cut off during the removal of a tree.

Tree Topping

Topping of trees using stub cuts and heading cuts should not be done for several reasons. Topping reduces the ability of a tree to produce food. Shock and long-term declining health resulting from topping can make a tree more susceptible to insect and disease problems and can lead to its death. By removing the branches that protect a tree's crown, topping can lead to sun scalding of remaining branches. The stubs and sun scalds resulting from topping cuts are highly vulnerable to insect invasion and the spores and actions of decay fungi. Numerous water sprouts resulting from topping are weakly attached and grow so rapidly that a tree can regain its original height in a short time with a more dense and unwieldy crown. With their natural form and beauty disfigured, topped trees are ugly to most people. Topping can reduce the value of a large ornamental tree by thousands of dollars. Although tree topping may cost less and take less time and knowledge than using reduction cuts (the proper pruning technique), you would be paying for an inferior service.

Training Young Trees

Before pruning a young tree, it is important to consider the natural form and desired future growth of the tree. Some trees like pines and sycamores have strong central trunks and require little pruning. Others, such as oaks and maples, branch out more. Pruning should accentuate the natural branching habit of a tree and should also correct structural problems. By correcting any defect in the structure of a young tree, pruning helps develop a mechanically stronger and healthier tree.

A few minutes of thoughtful pruning spent on a young tree can eliminate hours of costly future pruning on mature trees. Ideally, pruning should be done over several years, whether it is to provide clearance or to train a young tree. Prune as little as possible in the first two years after a tree has been planted, so there will be enough temporary branches and leaves to produce food for the growth of roots, trunk, and branches. Newly planted trees will gradually restore the balance between roots and branches; excessive pruning can be detrimental and delay normal growth. When a tree is planted, prune only broken, malformed, or diseased branches. Remove any double leader so that one dominant trunk is maintained. Removing branches

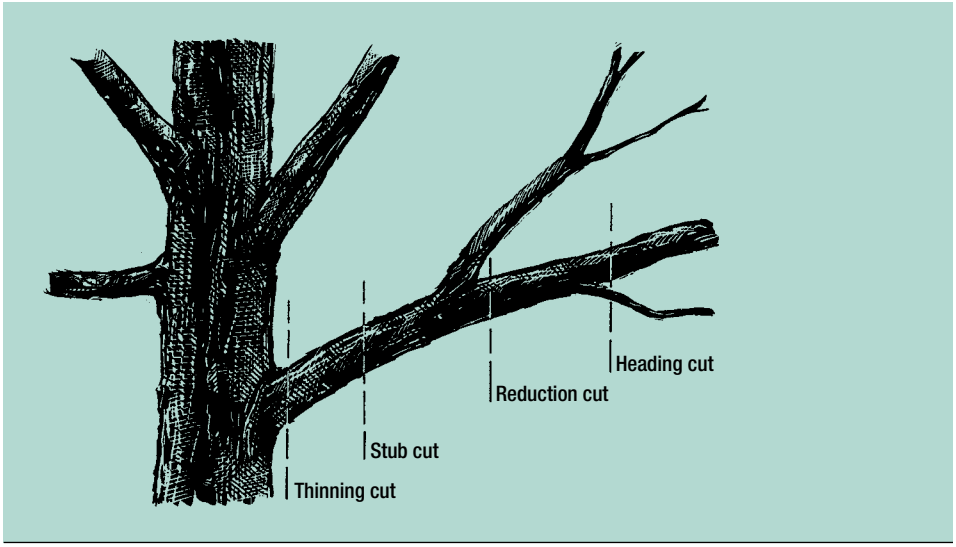


Fig. 1. When using reduction cuts, always remove or shorten a branch to a side branch that is at least one-third the size of the one being cut. A branch that is 3 inches in diameter would be pruned back to a side branch that is at least 1 inch in diameter. Do not remove more than 25 percent of a mature tree's foliage in any year.

before they exceed 1 inch in diameter will keep pruning wounds small.

Clearance requirements are an important consideration. Street trees or trees along walkways and driveways must have limbs high enough to safely accommodate pedestrians and vehicular traffic, signs, and lights. Trees grow from the tips and the tops, not from the bottom. Branches that grow 6 feet off the ground will always remain at that height and may droop as they grow longer. If clearance is not a problem, keep branches on the tree to help the tree grow. The need to prune for clearance can be minimized by purchasing trees that have been nursery grown to street tree specifications.

About two or three years after planting a tree, examine it closely again and prune any broken, malformed, or diseased branches. Also, remove any suckers from the base of the tree. Step back and look at the tree from all sides to select the permanent branches and branch structure that the tree will have for its lifetime. When deciding which branches to remove, consider the following (see Fig. 2):

- Thin or prune back any unusually long branch that competes with the leader for dominance.
- Remove any branch that crosses or rubs another, keeping the branch that conforms to the natural form of the tree. Thin out excessively crowded branches.
- Wide angles between the limb and trunk are stronger than narrower ones. Remove branches that have much narrower angles between branch and trunk than are typical for the species.
- Remove the lower branches to provide safe clearance and visibility, gradually over several years.
- Branches should be well spaced along and around the trunk of a tree.
- To correct defects or to thin out an overly dense crown, a young, vigorous tree can have as much as 35 percent of its foliage removed while the tree's structure is being established.
- Avoid pruning trees from the time of bud break until leaves have grown to full size.
- Prune hawthorns, crabapples, pears, and other flowering trees immediately after flowering, thus allowing a tree to develop flower buds for next spring.

The ideal mature tree will have lateral branches that are 18 to 24 inches apart on the trunk and one strong leader. However, some trees differ, such as Japanese maple and other ornamentals, which are meant to have a more bushy appearance. It may take repeated pruning efforts over a number of years to attain an ideal structure. Remember to retain enough branches on the tree to keep it healthy and vigorous.

Some types of trees have better branching habits than others. Branching also can be affected by nursery pruning practices. Many problems can be avoided by

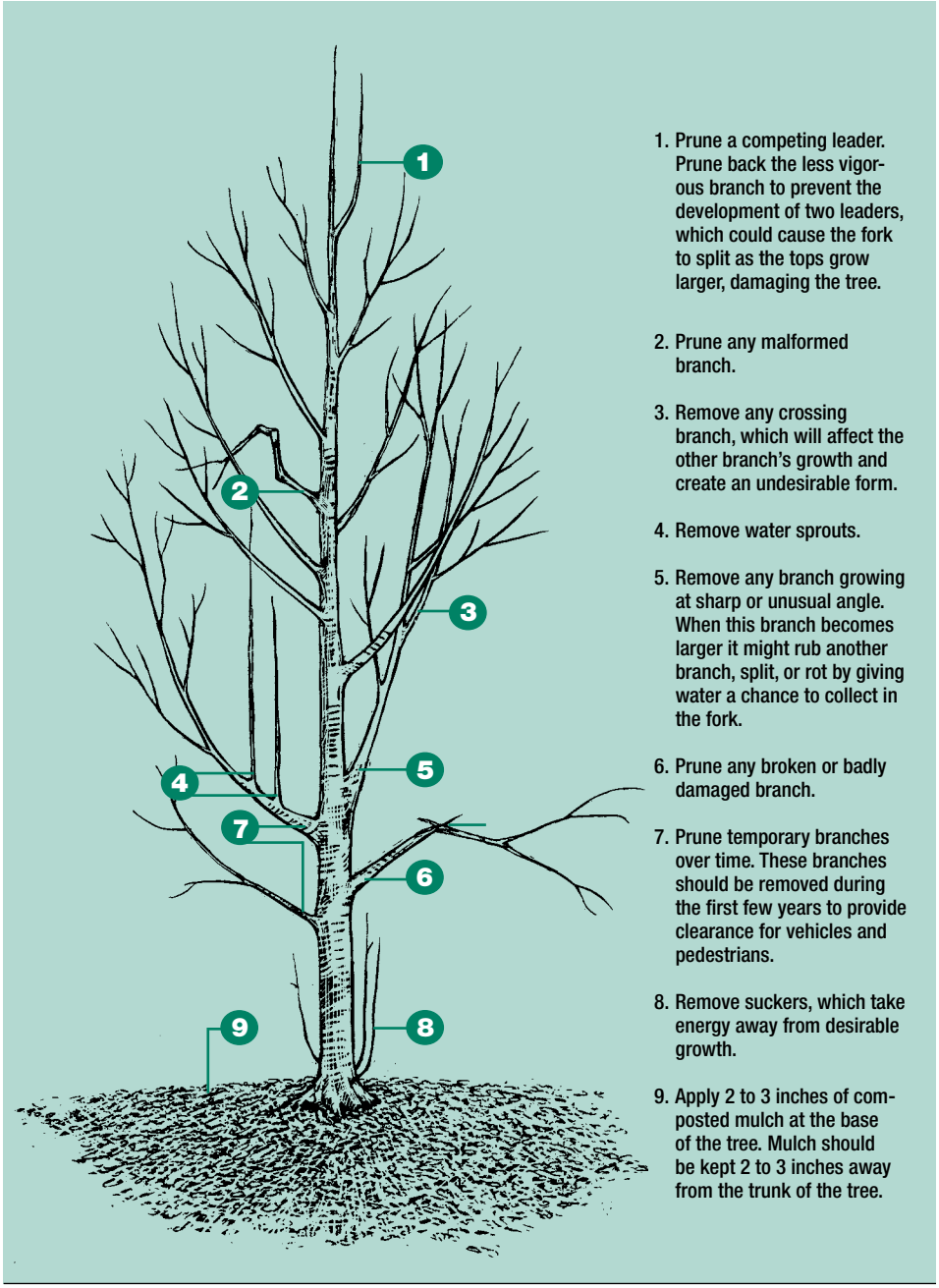


Fig. 2. This figure shows examples of branches that should be pruned from newly planted trees. To promote good structure and lessen the need for future pruning, trees should be properly pruned during the first one to five years. Balance between roots and branching will be restored naturally, which is preferable to compensatory pruning. To promote root establishment and growth, as many branches as possible should remain.

purchasing a high-quality tree of the right species that is suited to its purpose and to the site where it is to be planted. Properly prune your young tree to lower future maintenance costs and to create a beautiful and safe mature tree.

Pruning Mature Trees

Not all mature trees need to be pruned. Some only require pruning every 5 to 10 years. The need for pruning can be reduced by planting the right type of tree in the proper place and by properly pruning a tree when it is young. Pruning a mature tree excessively or incorrectly causes more damage than good. When a vigorous branch is cut from a tree, part of the tree's ability to produce food is removed and a wound is created where decay organisms may enter.

When you prune a branch, do not leave a stub or cut flush against the trunk. To remove a branch, make a slanting cut just outside the branch collar (the swollen area at the base of the branch next to the trunk depicted in Fig. 3).

Mature trees should only be pruned for specific purposes and in a manner that protects and preserves the tree's natural form.

Pruning should focus on maintaining tree structure, shape, health, and safety. Types of pruning recommended by the American National Standards Institute and the International Society of Arboriculture are described below:

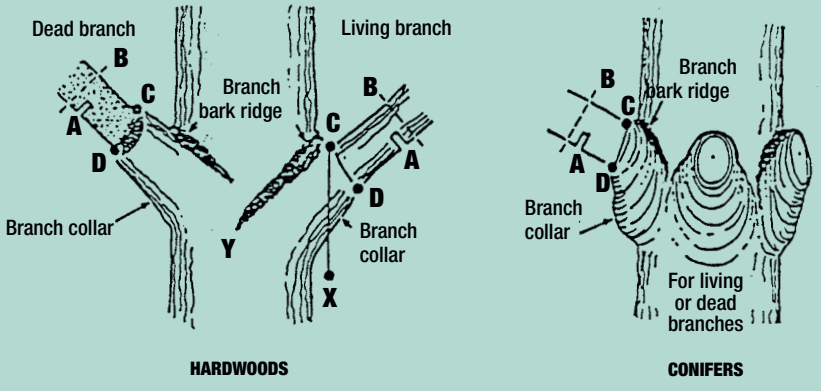
Crown cleaning—removes dead, dying, diseased, crowded, weakly attached, or low-vigor branches and water sprouts.

Crown thinning—selectively removes branches to increase light penetration and air movement and reduce the weight of heavy limbs.

Crown raising—removes lower branches to provide clearance for buildings, vehicles, pedestrians, and signs.

Crown reduction—reduces the size and spread of crowns using reduction and thinning cuts, resulting in fewer sprouts than heading or stub cuts, and maintaining the structural integrity and natural form of the tree (Fig. 4).

Crown restoration—improves the structure and appearance of trees that have been storm-damaged or deformed by heading or stub cuts.



Natural target pruning properly removes a branch while protecting the branch collar, which is essential for wounds to heal. First cut A, second cut B, and third cut C–D.

Fig. 3. To promote closing of a pruning wound by wound wood, always use the three-step or natural target pruning method when removing a branch. This pruning method protects the branch collar (the shoulder rings and swollen base of a branch) and prevents the tearing of bark. Do not leave a stub when you prune a branch, and do not cut flush against a trunk. Thinning cuts should be made with sharp tools and should be kept as small as possible, clean and smooth.

Selecting a Tree Care Professional

A qualified and reputable person or company should be hired to perform tree work, not an individual with a chain saw trying to make a fast buck. It is very difficult, if not impossible, to repair damage that has been done by poor pruning. In tree work, the old adage "you get what you pay for" is usually true. Tree care practices change based on the latest research, and will continue to change. It is important to hire a qualified arborist, preferably a Certified Arborist, who keeps up with proper, safe tree care techniques and will provide high-quality work at a fair price. The following guidelines can help you to select a qualified arborist and ensure proper tree care.

Always have at least two or three tree care firms examine and bid on your tree work. Usually, these firms will do so at no cost. For referrals, contact a local municipal arborist, the cooperative extension office in your county, or the International Society of Arboriculture (ISA). Tree care professionals are members of professional organizations such as the ISA. Reputable tree service companies generally do not solicit door to door, as they rely mainly on repeat customers. If possible, include a certified arborist among those whom you contact to examine your trees. Arborists certified by the ISA have passed a test of their knowledge and must continue their education to maintain competency.

Ask for a written estimate detailing the work to be done from everyone who examines your trees. Terminology used on bids should match the tree pruning guidelines and standards explained in this publication. If terms like topping or rounding-over are used, consider another firm. Do not blindly accept the lowest bid. Remember, in tree work a good job can be slightly more expensive. Try to schedule work in fall or winter, when rates may be lower. Ask to be shown proof of liability insurance and worker's compensation insurance.

Ask the bidders where you can see trees they have pruned and examine their work firsthand. The following are indicators that proper pruning has been done:

- use of reduction and thinning cuts, rather than topping, heading, or stub cuts, so that the natural form and branching habit of the species is preserved
- cuts placed just outside the branch collar, not flush cuts
- absence of torn bark where branches have been cut, and no sign of bark punctured by climbing spurs
- no "lion-tailing," or clumps of foliage at the ends of branches caused by removing all or most of the inner foliage
- cut surfaces untreated with wound dressing or tree paint, which can injure trees

Once you have decided on an arborist, demand a written contract that briefly but clearly states all of the following:

- type and amount of work to be completed and the techniques to be used, with reference to the *ANSI A 300 Tree Pruning Standards* or *International Society of Arboriculture Tree Pruning Guidelines*
- total cost of work to be done, not just total cost per tree
- who will be responsible for clean-up work and to what extent
- who will receive any firewood or other products
- starting and completion dates

Do not pay in advance, but wait until all terms of your contract have been fulfilled.

Use the following information to ensure that your trees will be pruned in the proper manner and for the right reasons. Familiarity with pruning methods will help you hire a qualified arborist who will do the job right.

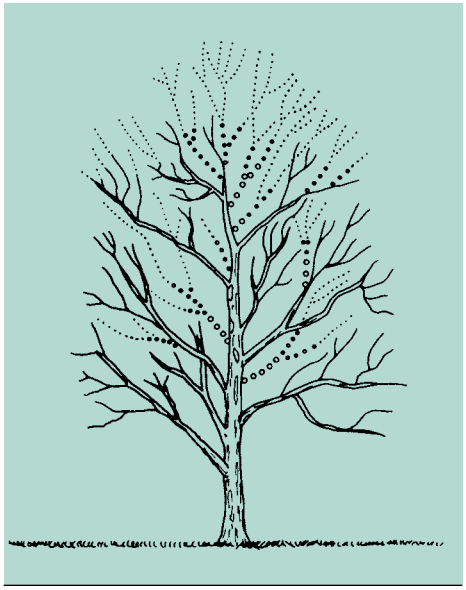


Fig. 4. The method for reducing the size of a crown is the use of small reduction cuts. Using larger reduction cuts that remove a large branch or leader to a large branch is commonly called crotching or drop-crotching. Even though large wounds may result from drop-crotching, this method of pruning is preferable to heading or stub cuts.

Utility Pruning

Trees that can grow or fall into utility wires require special pruning practices. Utility pruning is designed to prevent interruption of electric service, improve public safety, and protect utility workers. Only specially trained line clearance tree trimmers are permitted to prune trees close to electrified lines that carry more than 750 volts, according to regulations of the U.S. Department of Labor Occupational Safety and Health Administration and the American National Standards Institute. If you plan to prune or remove a tree requiring a person, tool, equipment, or any part of the tree to reach within 10 feet of an electrified line exceeding 750 watts, the work must be performed by a qualified line clearance tree trimmer, or the utility company must be notified several days in advance so that proper safety precautions can be arranged.

Wires leading from a pole-mounted transformer to a residential electrical meter generally carry less than 750 volts, but to be safe, check with your local utility company.

Utility companies determine the amount of clearance that is needed between trees and electric lines to maintain reliable and safe service. Clearances between trees and wires depend on voltages that vary among primary and secondary conductors, and growth rates that differ among tree species. Professional tree service contractors are employed by utilities to prune periodically to specific clearances.

Utility pruning practices changed greatly during the 1990s. Research has shown that tree wounds do not heal, but are compartmentalized both physically and chemically to prevent the spread of decay and closed by wound wood. Accordingly, utilities specify the placement of pruning cuts to utilize natural defense mechanisms of trees and promote faster closure of pruning wounds. Directional pruning, using thinning and reduction cuts, is used because it is better for tree health and structure than topping trees or leaving branch stubs (Fig. 4). In directional pruning, growth of branches is directed away from wires by pruning those that can grow too close, while allowing extension of branches that will not interfere with electric lines. Topping of trees with heading cuts is avoided, as it damages tree health and encourages vigorous sprouting that increases the frequency of pruning cycles. Also, the tunnel or side-wall effect of clearing a row of trees to a uniform distance sometimes can be softened by pruning some branches back various distances, even to the trunk.

Some trees will appear to be disfigured by the pruning practices of utility companies (Fig. 5 and Fig. 6). In particular, trees that previously were topped or rounded-over will be difficult to reshape with directional pruning. Any tall-growing tree that is under or close to electric wires cannot retain a completely natural shape and should be considered for removal if severe pruning is required or has been done in the past.

Two alternatives can be used to reduce unattractive aspects of utility pruning and to lower line clearance costs. Both involve the replacement of large trees, either gradually or in groups, depending on the circumstances and preferences of people in the neighborhood. A formal street tree design with uniformly spaced trees of the same kind and size requires removal and planting all at the same time. An informal planting design can be implemented over several years, with less disruption in the appearance of the neighborhood.

Trees that are replanted should be smaller species that will not grow into wires at maturity. The right tree for planting under utility wires should be no taller than 20 to 30 feet at maturity. Adequate space for root growth also is an important consideration in relation to tree size and placement. Low-growing trees are most appropriate if the space for roots between a sidewalk and the street is less than 4 feet wide. Medium-size trees, up to 45 feet at maturity, can be planted near utility lines (such as the other side of a street) if they are offset at least 15 feet from the nearest wire. Consider other open spaces away from utility lines for the placement of larger trees, being careful to plant them far enough away from buildings. *Street Tree Factsheets*, a publication available from Penn State, can help you choose the right tree to plant near or beneath utility lines.

Many communities have developed constructive relationships with their utility company to optimize pruning practices and tree removals. Good communication between communities and utility companies will help reduce any problems, and a notification requirement in a municipal street tree ordinance can alert an official, tree commissioner, or municipal arborist of impending tree pruning or removal. A municipal representative then can talk with the utility forester to address any concerns, and thus improve pruning quality that meets community standards.

PHOTO COURTESY GEOFF KEMPTER, ASPLUNDH TREE EXPERT CO.

Fig. 5. Trees under these wires were topped improperly several years ago. Vigorous regrowth of slender branches from the stubs of thicker branches grew into the wires, requiring pruning for clearance.

PHOTO COURTESY GEOFF KEMPTER, ASPLUNDH TREE EXPERT CO.

Fig. 6. After directional pruning of the same trees, branches directed away from the wires were retained, instead of removing all of these branches according to previous practices. Much of the regrowth will now occur on those retained branches, without interfering with the wires. Although the shape of the trees appears unnatural in the winter, they will be more normal in appearance when covered with foliage and will be healthier throughout the year.

For More Information

Arboriculture: Care of Trees Shrubs, and Vines. Hall, Inc., Englewood Cliffs, NJ 07632.

Modern Arboriculture. Shigo and Trees, Associates, 4 Denbow Road, Durham, NH 03824-3105.

How to Prune Young Shade Trees. (Other publications on tree care and maintenance are also available.) The National Arbor Day Foundation, 100 Arbor Avenue, Nebraska City, NE 68410. Phone: 402-474-5655.

Standard Practices for Trees, Shrubs, and Other Woody Plant Maintenance. (ANSI A300) International Society of Arboriculture, PO Box GG, Savoy, IL 61874. Phone: 217-355-9411.

Standard Practices for Tree Care Operations—Pruning, Trimming, Repairing, Maintaining, Removing Trees, and Cutting Brush—Safety Requirements. (ANSI Z133.1-1994) International Society of Arboriculture, PO Box GG, Savoy, IL 61874. Phone: 217-355-9411.

Street Tree Fact Sheets. Publications Distribution Center, 112 Agricultural Administration Building, The Pennsylvania State University, University Park, PA 16802-2602.

Tree-Pruning Guidelines. (Other publications on tree care and maintenance are also available.) International Society of Arboriculture, PO Box GG, Savoy, IL 61874. Phone: 217-355-9411.

Trees Are Good. Created by the International Society of Agriculture to provide the general public with quality tree care information. www.treesaregood.com

International Society of Agriculture. A worldwide organization dedicated to fostering a greater appreciation of trees and their care. www.isa-arbor.com

Prepared by William Elmendorf, assistant professor of community forestry, and Henry Gerhold, professor of forest resources. Illustrations on pages 1, 4, and 5 provided courtesy of the International Society of Arboriculture. Illustrations on pages 2 and 3 by Jeffery Mathison. Prepared by Penn State with guidance from the Pennsylvania Urban and Community Forestry Council and support from the Pennsylvania DCNR Bureau of Forestry. For more information, contact the Pennsylvania Urban and Community Forestry Program, School of Forest Resources, The Pennsylvania State University, 334 Forest Resources Building, University Park, PA 16802; 814-863-7941.

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