Office of State Lands and Investments

Wyoming State Forestry Division

Community Tree Assessment

Laramie, Wyoming

October 2007

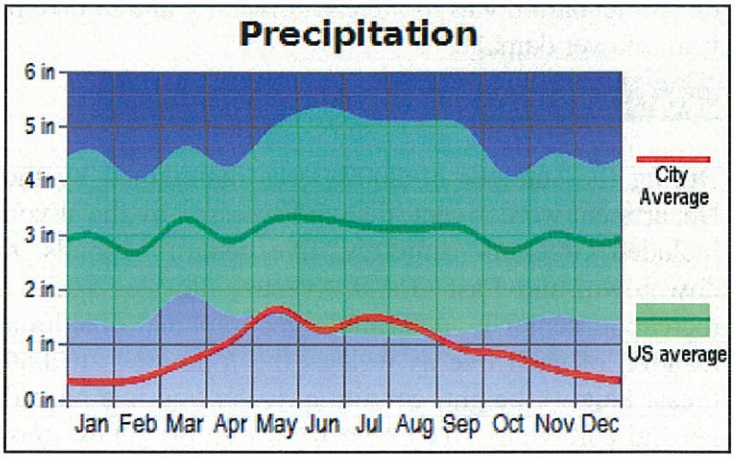
Table of Contents

Introduction

Covering an area of approximately 11.1square miles; Laramie, Wyoming is located in Albany County on a high plain between two mountain ranges: the Laramie Range to the east and to the west the Snowy Range. Laramie's elevation is approximately 7,165 feet above sea level. As a result of the high elevation, winters are long and summers are relatively cool with an average high and low temperature of 80° F and 37° F. Laramie receives only ten to fifteen inches of precipitation annually, placing it in the aridic soil moisture regime. The short growing season, cool temperatures, reduced precipitation, and frequent intense wind result in a challenging environment to grow healthy urban trees.

Benefits of Trees

Since the settlement of Laramie in 1868, the residents have recognized the benefits of planting trees in an urban environment. From the beautiful fall colors they produce to the protection they provide from harsh winter winds, trees are not often taken for granted. With proper tree species selection, placement and maintenance the trees in Laramie can:



Average monthly precipitation for Laramie compared to the U.S. average.
http://www.city-data.com/city/Laramie-Wyoming.html

- **Improve Air Quality** – Trees improve air quality by lowering air temperatures, absorbing gases, and by releasing oxygen into the atmosphere.
- **Reduce Stormwater Runoff and Erosion** – Tree leaves intercept rainfall and filter the amount that reaches the ground. Some of the water is absorbed, some is evaporated, and the rest falls to the ground. Tree roots also help to hold the soil in place.
- **Conserve Energy** – Trees placed on the sunny side of a house can reduce air conditioning costs by up to 30 percent. Conifers placed in the windward side of a home can help to block the harsh winter winds.
- **Trees Boost Local Economy** – Studies have shown that planting trees makes good financial sense. On average, for every dollar spent on planting and maintaining trees in Wyoming, the town will see approximately two dollars in returns by encouraging economic development and tourism. In addition, trees increase real estate value by up to 15%.
- **Increased Wildlife Habitat** – Tree canopies are homes to a variety of types of wildlife such as birds and small animals.
- **Trees Reduce Stress** – Trees not only improve our physical health by cleaning the air and moderating temperatures, but they also contribute to our mental well being as well. Trees provide a sense of calm.

Summary of Past Conditions

It was through the recognition of these benefits that lead the City of Laramie to conduct their first tree inventory in 1993. At this time 100 percent of the public trees in the City of Laramie were inventoried by the Wyoming State Forestry Division. This inventory included street trees but for the sake of this report, the street tree data has been removed. There were sixteen different public areas included in the inventory for a total of 2,110 trees. The estimated value was $2,238,501. At that time, spruce and cottonwood dominated the population in most parks, averaging 67 percent of all park trees. The trees were generally in fair to good condition however; problems as the result of improper pruning, planting too close together, and old age were noted. Mower damage was mentioned as the most common problem. The overall recommendation was to increase diversity and to take precautionary measures to protect the trees from mower damage.

Assessment Procedures

During the summer of 2007, trees maintained by the City of Laramie Parks and Recreation Department were inventoried and assessed by the Wyoming State Forestry Division. These areas included Greenhill cemetery, five detention ponds, three beautification areas (Spring Creek, downtown, and East Grand Avenue), thirteen parks and two recreation areas (the ice arena, recreation center,). A Trimble geographical positioning system (GPS) was used to record the location of each tree as well as the following attributes: species, placement, Dbh (diameter at breast height), height, condition, if the tree is a hazard, location or management unit, need and general comments. The objectives were to (1) establish a status of Laramie's tree resources (2) make recommendations on long-term program needs and (3) to examine and rate trees for removal. Each of these objectives will be discussed as needed in the sections that follow with all recommendations being summarized in the Recommendations section at the end of the paper. The survey is a reflection of the tree population at a given time. The condition, needs and numbers of trees is constantly changing, making it necessary to update tree information on a regular basis.

A tree recommended for priority 1 pruning due to the large dead limb over the walk.

Management Needs

For this inventory trees were classified based on seven management needs: none, mulch, water, priority one, two, or three prune, or removal. The recommendations for pruning were based on theses guidelines:

- **Priority 3 Prune** – Trees that needed to be pruned for form or structure, to promote a leader, to clean up one small dead or broken limb, or to provide clearance.
- **Priority 2 Prune** – Trees that need pruned due to several small dead, broken, or diseased limbs. These are limbs that if they fall as a result of weather conditions, will not cause major property damage or risk injury to a bystander (no more then a couple of inches in diameter).

- **Priority 1 Prune** – Trees that need immediate attention were recommended for priority one prune. These are trees that have large dead or hanging limbs in the canopy that could cause injury or property damage.

Survey Results

Surveying 100% of all trees maintained by the city park and recreation department, a total of 3,504 trees were assessed with 42 different species identified. For a complete list of the public trees in Laramie by species see Appendix A. When a tree clumps into two or more trunks at or near the ground level, each trunk was counted as an individual tree. The exception to this was trees growing with multiple stems (ten or more) averaging two inches in diameter or less such as chokecherry or boxelder.

Species

The most dominant species in Laramie were spruce with 1,259 trees and cottonwood with 1,165 trees. Crab apple and chokecherry were the next two most common species with 272 and 118 trees respectively. The remaining 38 species only totaled 14 percent of the population. Twenty-nine species totaled six percent of the total population, equaling less than one percent each.

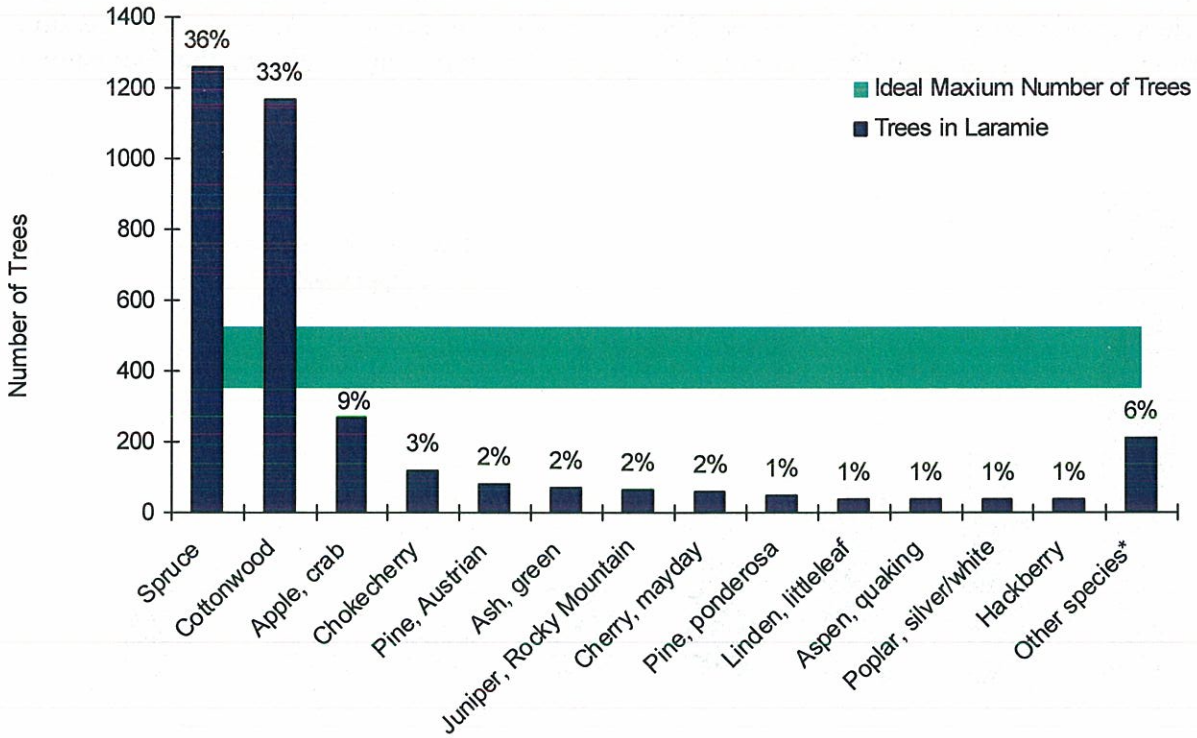


Figure 1. Number of Trees by Species in Laramie, WY compared to the ideal maximum range for a single species that should be found in a community. No species should command more than 10 to 15% of the tree population.

*Other species is the combined total of 29 different species, all of which equal less than one percent of the population.

When a single species represents a large percent of the population, there can be devastating losses as a result of insect or disease infestation. One example of this is in Evanston, WY where hundreds of cottonwood trees were lost over a period of two to three years as a result of Cytospora canker. In general, no single species should command more than 10% of the population to prevent catastrophic losses from an insect or disease outbreak. In Laramie where there is a limited number of species that will thrive, no single tree species should comprise more than 10 to 15 percent of the population. Currently with a total population of 3,504 trees, this means that there should be no more than 350 to 526 trees of a given species. This maximum ideal range is represented in Figure 1. Colorado blue spruce and cottonwood trees both comprised more than 10% of the population, at 36 and 33 percent respectively. The City of Laramie needs to refrain from planting these species for five to ten years in public areas. Future planting efforts should focus on other tree species that can thrive in Laramie's harsh climate but do not currently represent a large percentage of the population. Green ash, sensation boxelder, Manchurian apricot, white fir, honeylocust, larch and mountain ash are just a few species that can be planted in greater number. For a list of trees that can grow in Laramie, see Appendix B. Choosing to plant hardier trees, which grow slower and may require more care when they are young, will require less water, structural maintenance and preventative care once established.

Size

Figure 2 demonstrates the size class distribution of the public trees. The average diameter of Laramie's public trees was nine inches Dbh. The City of Laramie Parks and Recreation Department, with assistance from committed groups of individuals such as the Downtown

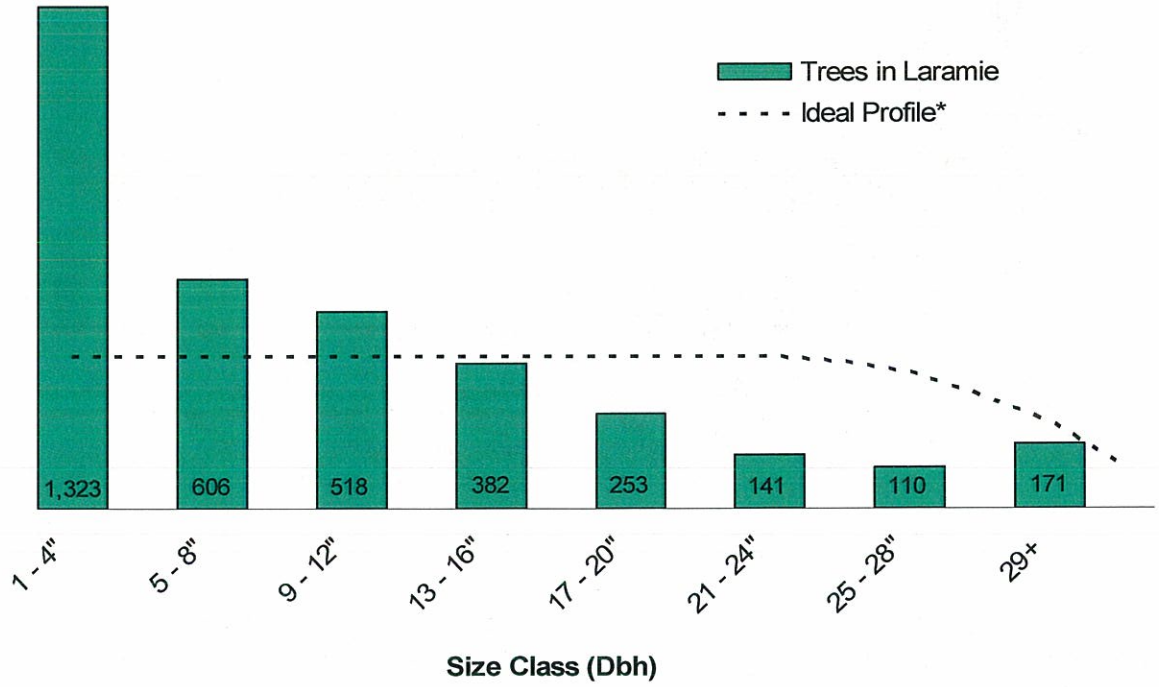


Figure 2. Size class distribution of 3,504 public trees in Laramie compared to an ideal profile. This ideal profile would total 5,790 trees.

Beautification Committee, has done an outstanding job of planting new trees in Laramie over the last five years. This is evident with the high number of trees that fall within the 1 – 4 inch size class, 23 percent of the total population. However, the focus now needs to be on maintaining the investment that the city has made by ensuring that there are adequate resources to conduct regular pruning and maintenance. With a relatively small maintenance division under Parks and Recreation and a limited number of personnel compared to the amount of work that needs to be done, routine preventative maintenance is not a high priority. However, it is through activities such as mulching, providing the appropriate amount of water, and structural pruning, that the condition of the trees will be maintained and the city's investment protected. While the energy that was put into the planting efforts needs to be preserved, the City needs to determine how many trees it can care for and plant trees annually based on this number. This will help the City attain the "ideal" size distribution profile, while being able to care for the trees it currently has.

There were 171 trees that were 29 inches or more in diameter. Five different species make up this mature to over-mature size class: spruce, cottonwood, silver poplar, willow, and Douglas-fir. Cottonwood, silver poplar, and willow are all fast growing weak wooded species that are prone to dieback and decay. They should be checked on a regular interval for dead limbs, stubs, cracks in the trunk, mushrooms or conks growing at the surface, or discolored bark. If decay is caught early enough, there is the potential of pruning it out and stopping the spread. Take particular care to check these trees and other mature trees after major storm and wind events to ensure that no damage has occurred.

Condition and Management Recommendation

In 2007, the majority of the trees were in good or fair condition. Of the 2,145 trees rated in good condition, 96 percent required no maintenance or needed only the routine maintenance mentioned above: mulching, water, or priority 3 prune. Although there were fewer trees rated in fair condition, 1,061 total; a higher percentage of these trees need priority 1 and 2 pruning.

Only a small percent of the public trees in Laramie, WY were rated in poor condition. Greenhill Cemetery (34 trees), Washington Park (29 trees), and Kiwanis Park (23 trees) had the highest number of trees rated in poor condition. However, two of the smallest parks, Kiowa and Harbon Park, had the highest percentage of trees in poor condition.

With consideration to all condition classes, the most common recommendation was priority three pruning. As already mentioned, the number of trees the city maintains compared to the work load the Parks and Recreation Department faces, pruning trees in good to fair condition are not a priority. However, establishing a routine pruning program can greatly benefit the community forest by developing trees with a strong structure and desirable form. One of the most important components of this program is training. This type of pruning focuses on removing dead, dying, diseased,

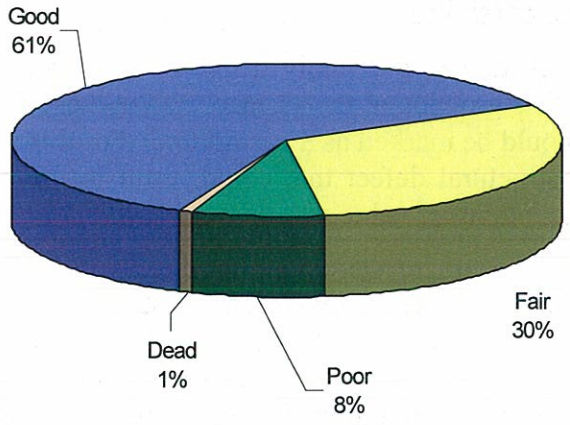


Figure 3. Condition of Trees in Laramie, WY.

interfering, conflicting, and weak branches with the goal of directing future branch growth and shaping the tree to develop a strong structural form. This type of pruning is essential for trees less than twenty feet tall with all trees receiving there first training three years after planting. This type of pruning does require a comment of time and resources in order to take a proactive approach as opposed to being reactive. There are many reasons for pruning a young tree. First this type of pruning can be done on the ground, is less expensive and requires less equipment. The structural strength of the tree can be improved by removing branches that will be more prone to breakage as the tree grows and when done properly, the tree receives a smaller wound that takes less time and energy to heal. In addition, because a tree is less likely to suffer breakage, pruning can increase tree health and longevity. Finally, trees that receive the appropriate pruning measures when young will develop fewer hazards and require less future maintenance.

A total of 233 trees were recommended for removal. Almost half of these were in poor condition and not surprisingly, a large number were spruce and cottonwood trees. In many areas around Laramie, the spruce trees were planted in rows with inadequate space allowed for each tree once they reached maturity. These trees are now crowded, drought stressed, and several have been naturally "topped" during storm and high wind events. Other common problems noticed on trees in poor condition included: canker, rot, trunk damage, a high number of scale insects, and dieback. Several of these problems will be discussed in further detail under the section *Common Problems*. Trees recommended for removal provide an excellent opportunity to replant and increase species diversity.

Table 1. The number of trees and average diameter by management need for public trees in Laramie, WY (2007).

Management Need	Number of Trees	Percent of Population	Average Condition	Average Diameter
Mulch	298	8.5	Good	5
Water	718	20.5	Good	8
None	990	28.3	Good	8
Priority 1 Prune	96	2.7	Fair	30
Priority 2 Prune	221	6.3	Fair	17
Priority 3 Prune	948	27.1	Good	9
Removal	233	6.6	Poor	10

Hazard Trees

Each tree was visually inspected for large cracks, areas of decay, dead limbs, mushrooms or conks growing at the surface. When these were found, it was determined whether or not the tree should be marked as a hazard tree. For this inventory a hazard tree is defined as a tree containing a structural defect that could result in the tree or a portion of the tree falling on someone or something of value.

In 2007, there were 55 hazard trees identified on property maintained by the City of Laramie Parks and Recreation Department: 27 trees in Washington Park, 12 in Undine, six downtown, four at the Depot, two each at LaPrelle and Optimist Park, and one each at Greenhill Cemetery and Labonte Park. Appendix C shows the hazard trees by location. Thirty-seven of the hazard trees were recommended for priority one pruning. All of them were mature to over-mature cottonwood trees with two in good condition and 27 in fair. These trees contained large dead limbs that if pruned out, could remove the hazard and prolong the life of the tree. Eight were

considered to be in poor condition. Although the hazard can be pruned out, the City needs to determine if considering the condition and size of the tree, it is more cost effective to prune the tree or remove and replant. There were eighteen recommended for removal. These were all listed in poor condition and with the exception of three, were mature to over-mature trees.

Table 2. Hazard Trees by Species and Management Recommendation.

Species	Priority One Prune	Remove	Average Dbh
Cottonwood	37	14	32
Willow	-	2	24
Spruce	-	2	32
Total	**37**	**18**	**31**

It is important to note that while the personnel who conducted the inventory are trained, they are not certified arborists. Identifying a tree as a hazard can be subjective. The trees should be re-evaluated by a certified arborists before action is taken. The City of Laramie is privileged enough to have four certified arborists on staff to conduct these follow-up inspections. All hazard trees should be rated in order of priority and put on a time line established by the Parks and Recreation Department. For example, all hazard trees will be taken care of over a two year period with the highest priorities occurring in year one. Because of the difficulty involved with safely removing large trees, this job requires a certified arborist with experience. In addition to the trees identified as hazards, all of the mature to over-mature trees should be carefully inspected following all major storm events or at least on a semi-annual basis to catch defects as they occur and not after they have caused damage or cost in clean-up.

Concerns

There were several problems that were noticed frequently throughout all of the areas included in the inventory. Some of these problems were due to insects and disease while others were environmental factors. It is important to note that many of the trees are impacted by more than one of these problems and that often, they are interrelated. For example, a tree that is already stressed from drought conditions will be more susceptible to attack by an insect infestation. It is through this interaction of both the environmental stress and the biological stress, that the tree's health is seriously impacted. The best preventative measure that can be taken is to maintain adequate environmental conditions for the tree, ensuring that it has the right amount of water, is protected by mulch, and that regular corrective pruning occurs during the fall or winter months.

Insects and Disease

Some of the insects and diseases that were noticed frequently include: bacterial wetwood, cytospora canker, scale insects on conifers, oyster scale on aspen, and tent caterpillars on chokecherry trees. Fact sheets are included in Appendix D – Common Community Tree Problems Occurring in Laramie, WY.

- Many of the cottonwood and willow trees in Laramie were affected by **bacterial wetwood**. This disease affects the central core of the tree, causing a yellow-brown discoloration of the wood. Where this occurs, the wood is wetter than the surrounding area and high internal gas pressure builds that can cause foul smelling slime to ooze from the tree. This slime is toxic to the cambium and can alter the trees ability to develop

calluses when wounded. Currently, there is no method of eliminating wetwood. However, the best prevention is to prevent stress to the tree through adequate water and protection of the roots and stem. For more information see Colorado State University Cooperative Extension Fact Sheet: Bacterial Wetwood, no. 2.910 by W.R. Jacobi (1998) in Appendix D.

- There are various species of the Cytospora fungus that causes **Cytospora canker**. This canker was commonly found in Laramie on cottonwood trees. The fungus causes yellow or orange-brown to black discolored areas on the bark of the trunk or branches. Other symptoms may include liquid ooze, sunken dead areas of bark, black pinhead-sized pimples, masses of spores, and reddish brown discoloration of the wood and inner bark. The fungus attacks trees in a weak or stressed condition and can lead to death. Similar to wetwood, the best defense is to prevent the tree from becoming stressed or injured. Both drought and over watering are the two most common stresses that lead to Cytospora infection. Wounds caused by lawn care equipment are prime targets for the fungus. Properly mulching the tree will help prevent these types of injuries and minimize drought stress. Trees that are also heavily affected by insects are predisposed to the disease. Some resistant tree species and cultivars include: ash (all cultivars), Noreaster cottonwood, Platte cottonwood, elms, hackberry, honeylocust, big and little leaf linden, pines, and most maples. For more information on preventing and removing infected areas from a tree refer to Colorado State University Cooperative Extension Fact Sheet: Cytospora Canker, no. 2.937 by W.R. Jacobi (1999) in Appendix D.

- Many of the conifer trees in Laramie, particularly the spruce trees, were heavily infected with scale insects. There are many species of scale insects but **Chionaspis pinifoliae** (pine needle scale) attacks most species of pine, spruce, and fir. Protected beneath a covering, scale insects attach to the bark or needles of the tree and feed on the sap. Although no one scale causes extensive damage, when heavily infested or stressed from other factors, scales can lead to decreased vigor, needle drop and dieback, and increased susceptibility to other insects and diseases. There are several natural enemies to pine needle scale like specific species of lady beetles and chalcid wasp. However, these natural enemies are not always successful in keeping a population under control. Other methods include horticultural oils and insecticides applied during the vulnerable crawler stage of the insect. The crawler stage is the brief period in the insect's life where it is mobile and unprotected by a covering. This occurs just after it is hatched. For more information on other types of scale insects that affect confers and control methods see Colorado State University Cooperative Extension Fact Sheet: Scale Insects Affecting Conifers, no. 5.514 by W.S. Cranshaw (2000) in Appendix D.

Popular bore damage on a cottonwood tree at the Laramie Recreation Center.

- **Poplar bore** was noticed on numerous hybrid cottonwood trees such as lanceleaf cottonwood. This roundheaded borer is the larva of Saperda calcarata, a long horned beetle. The larva predominantly

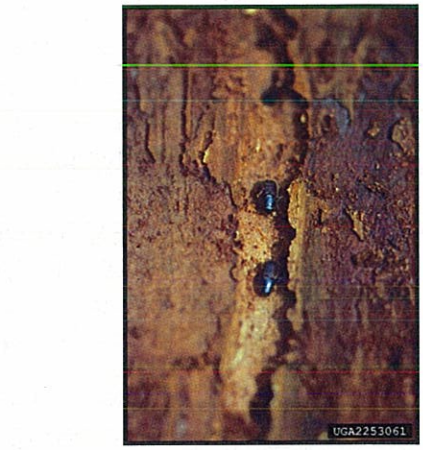
attacks aspen trees but can also infest cottonwood, poplar, and willow trees. The females emerge from June until August to lay their eggs. They prefer trees that are open grown, in partial to full sun, and over-mature, stressed trees. They lay their eggs in small slits near the middle of the tree. Damage appears as swollen areas on trunks and larger branches. Signs of attack include exit holes where adults emerge, woodpecker activity, a varnish-like stain on the bark below the points of attack, and reddish sap running down the trunk. Although poplar bores tend not to kill larger trees, they do weaken the tree making it more susceptible to damage from wind, other insects, and diseases. If the infestation is large enough, the bores can girdle and kill a smaller tree. Because popular bores have a long life cycle, they are difficult to control. The best practice is preventative by maintaining the trees in good condition. For other information on chemical controls of popular bore refer to http://coopext.colostate.edu/4dmg/Pests/popborer.htm/.

- **Oystershell scale** is a specific type of scale insect that was noticed on many of the aspen trees in Laramie during the summer of 2007. Oystershell scale attaches to the twigs and branches of the tree and feeds on the sap. Like pine needle scale, only when the population is large enough will they kill the tree. The full-grown female scale is about 1/8th inch long, brown or gray, slightly banded, and is shaded like an oyster shell. The eggs over winter underneath the old scale covering of the mother. Because they are so well protected, oystershell scale can be difficult to control. Depending on the size of the infestation, one control method is to remove over wintering scales by scrubbing them off of small trees and shrubs. Like the pine needle scale, if insecticides or horticultural oils are applied during the vulnerable crawler stage, they can be affective. This usually occurs from late May until early June, but can vary greatly depending on location. The egg hatch may last a couple of weeks so regular inspections are necessary. For more information see Colorado State University Cooperative Extension Fact Sheet: Oystershell Scale, no. 5.513 by W.S. Cranshaw (2003) in Appendix D.

An aspen tree infected with both oystershell scale and canker.

- Several chokecherry trees were heavily infested with **tent caterpillars**, particularly in LaPrelle and Undine Park. There are several species of caterpillars that produce very visible silken tents. Most of the caterpillars use the tents for shelter during the day, leaving at night to feed on the foliage. Although visually unappealing, they general do not cause significant injury to a tree unless the tree is already stressed from other factors. Tent caterpillars can be controlled with natural enemies, such as birds, predacious bugs, hunting wasps, parasitic wasps, and tachinid flies. With all of these natural controls, heavy infestations rarely last more then one season, but there are also microbial insecticides and contact insecticides available. More information is available on tent caterpillars in Appendix D. - Colorado State University Cooperative Extension Fact Sheet: Tent-Making Caterpillars, no. 5.583 by W.S. Cranshaw (1997).
- There was only one spruce tree located in Depot Park that was infested with spruce beetles, Dendroctonus rufipenni. This tree was removed just after being included in the

inventory. Spruce beetle is noted not because it is a common problem within the town limits, but because bark beetles have infected the surrounding forests with devastating affects. There are many types of bark beetles causing this mortality throughout the Intermountain West and they are all native to the area. For numerous reasons, they have reached epidemic populations and attack not only stressed trees but also large healthy trees. These beetles are small, about the size of a grain of rice, brown and hard to see. The first sign that a spruce tree has been attacked is boring dust on the tree or around the base. If the tree is not stressed by drought, pitch tubes may appear around the entrance holes. Once the beetles have bored through the tree's protective bark, females create egg galleries in the underlying phloem tissue and deposit their eggs. The beetles and the larvae feed off of this living tissue and cut off the trees ability to transport water. Unlike other types of bark beetles, spruce beetles can have up to two life cycles and the trees often do not show the characteristic red-brown needles until one or two years after the attack has occurred. The best preventative measuring from protecting Laramie's large population of spruce trees is to ensure that the trees get adequate water. If the spruce beetle population reaches epidemic levels within the city limits, it could have a devastating effect on the community forest. There are several valuable sites that provide more information on bark beetles including:



Spruce beetle and boring dust. http://cals.arizona.edu/extension/fh/bark_beetle.html

- Wyoming State Forestry website – under Forest Health ***http://slf-web.state.wy.us/forestry/health2.aspx***
- The USFS Insect and Disease Leaflet (number 127) available on-line at ***http://www.barkbeetles.org/spruce/SBFIDL127.htm***

As already mentioned, when a community forest has a large percentage of only one or two species, there can be devastating affects from an insect or disease outbreak. Many of the problems noticed in Laramie do not typically cause tree mortality. However, Cytospora canker and spruce beetles have both been identified in Laramie and have the ability to cause tree mortality. With a starting 69 percent of the community forest being spruce and cottonwood trees, these are problems that must be taken seriously.

Environmental Factors resulting in Common Problems

Other than the common biological problems, there were a number of other factors that resulted in problems with the community trees in Laramie. Drought is one of the common environmental disorders affecting community trees, especially in a dry climate like Laramie. Water was recommended for twenty percent of the trees inventoried. Although drought can affect all species of trees; of the 718 trees in Laramie needing more water, 486 were spruce trees. There are three reasons for this high number of spruce trees. First, as already discussed spruce trees

comprise a large percentage of the population. Second, many of the areas included in this inventory have a sprinkler or drip system installed to make sure that the trees receive adequate water during the summer months. At some point during the fall, this system is turned off. Unlike deciduous trees that become dormant in the fall, conifers still conduct photosynthesis throughout the winter. When the sprinklers are turned off, they may not be getting sufficient water. The third reason that many of the spruce trees are in need of additional water is competition. In many areas the spruce trees were planted too close together.

Damage from drought conditions and winter drying can not be reversed. However, one way to lessen the impact is to get in the practice of watering conifer trees when the air and soil temperatures reach 45 degrees or above for a sustained period of time. Colorado State University recommends deeply watering the soil from the surface to a depth of 12 to 18 inches once a month for all trees in the summer and once every two months in the winter for conifers. Another beneficial practice is to mulch all trees.

One problem that was already briefly mentioned is that several spruce trees have been naturally topped during past storm events. This seems to have occurred in areas where the spruce trees were planted close together in rows. One theory is that in such a competitive environment, the trees have focused their resources into height growth. As a result, the trees have relatively small diameters for the height of the tree and are more easily broken as a result of heavy snow loads or high winds. One possible solution would be to remove some the crowded spruce trees to help encourage diameter growth. This would also help alleviate water competition. However, caution should be taken in choosing which trees to remove. These trees have adapted to there location and are dependant on the neighboring trees for wind protection. With this in mind, and because spruce trees are shallow rooted species, without proper consideration for wind direction, removing trees could result in other trees being blown down during the next wind event. If the Parks and Recreation Department chooses to remove some of the spruce trees, pay careful attention to the direction the high winds come from and how removing a tree will affect the surrounding spruce.

Problems with these trees include insufficient water and broken tops during storm events

Another common problem noticed during the inventory was damage to the base of the tree by lawn care equipment. The best way to prevent this type of injury is to apply mulch around the tree. The area should extend three to six feet out from the base of the tree and be two to four inches deep after settling. Keep the mulch an inch or two from the base of the tree to prevent bark decay. While mulch can be applied at any time of the year, it is best to avoid early spring application.

Mulch was recommended for 298 trees. Although the City of Laramie Parks and Recreation Department does an excellent job of applying mulch to newly planted trees; on average the trees recommended for mulch were smaller trees ranging from one to nine inches in diameter. Mulch can also benefit trees that are already established. In fact, there are so many benefits to mulching it is hard to over emphasis the value, particularly in a dry climate. The benefits of mulch include:

- Conserve soil moisture with a 10 to 25 percent reduction in loss from evaporation
- Protect trunk from mowers and weed whackers
- Impede weed growth
- Reduce soil erosion
- Protect roots from traffic
- Cut down soil compaction
- Improve soil fertility and structure
- Moderate soil temperatures (www.umass.edu/urbantree/factsheets/9mulchingtrees.html; http://www.ces.ncsu.edu/depts/hort/consumer/factsheets/trees-new/text/muching.html)

Tree Value

The value of each tree was determined based on the species, Dbh, and condition. Based on the Council of Tree and Landscape Appraisers formula and the Colorado State Forest Service tree values, each species was assigned a specific value and species factor and the following equation was used to determine tree value:

$$\textit{Tree Value Formula} = \textit{Species Value} * (.785 * (Dbh^2)) * \textit{Species Factor} * \textit{Condition Factor}$$

The formula breaks the trees down into six condition classes: excellent, good, fair, poor, very poor, and dead. For the Laramie Tree inventory only four condition classes were used. As a result, when trees were rated in good condition with no management need recommended, the excellent condition class factor was used in the tree value equation (1.0). For the trees rated in good condition but included a management need, the good condition class factor was used to calculate tree value (0.8).

The trees that were included in this inventory were valued at a total of $11,673,554. This is a valuable resource for the City of Laramie. However, with just the slightest improvements, the projected value of these trees shows a minimum five percent increase. This was determined by raising the condition value of trees in need of priority three pruning, water, or mulch rated in fair condition (0.6) to a condition value of a good tree still in need of some care (0.8); and those in poor condition (0.4) to fair condition (0.6). Table 3 shows the value of the trees by condition class and the projected value.

Table 3. Current Value of Public Trees Compared to a Projected Value

Condition Class	Current Value	Projected Value
Good	$6,874,320	$8,916,559
Fair	$4,094,852	$2,772,846
Poor	$704,383	$564,600
Total	**$11,673,554**	**$12,254,005**

As indicated by the equation, tree value is directly related to size. As a tree grows the benefits provided to the environment increase. This includes rainfall interception, absorption of greenhouse gases, carbon dioxide sequestration, and lower air temperatures during the summer. The value of these trees is a paradox. Even though the mature trees have the most value, over mature trees have the potential to cause the most damage during storm events and can be the most expensive to maintain. The Parks and Recreation Department will need to evaluate the cost of maintaining these trees verses the estimated value and projected number of years that they will remain an asset.

Table 4 lists the top four most valuable trees in Laramie and Figure 4 shows their location in Greenhill Cemetery. This method of evaluating tree value tries to remove the subjective element of evaluating a tree and keep it purely quantitative. Although this method is appropriate for looking at overall values to guarantee that adequate monetary resources are allocated for care and maintenance; the emotional attachment by the community can not be overlooked.

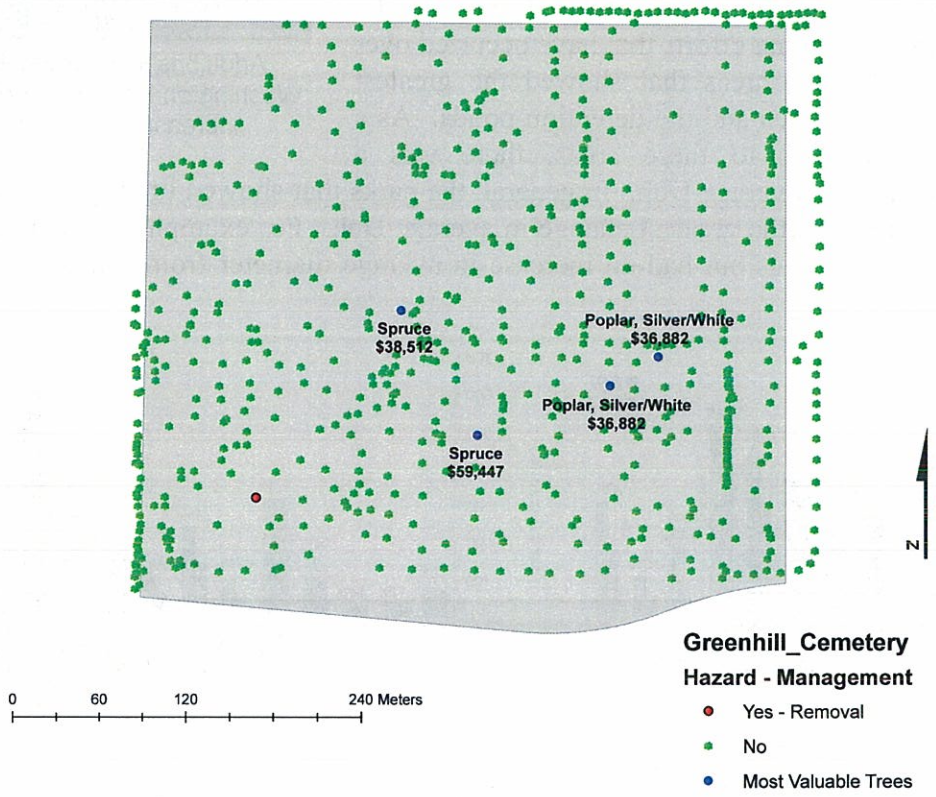


Figure 4. The Four Most Valuable* Trees in Laramie are Located in Greenhill Cemetery.
*Tree Value is based solely on species, size, and condition.

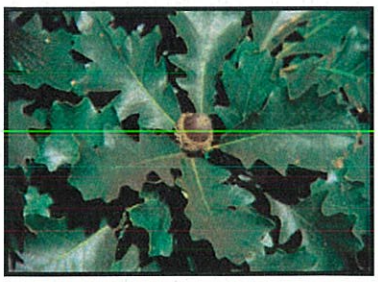
Table 4. The four most valuable trees in Laramie.

Species	Dbh	Condition	Management	Location	Value
Spruce	41	Good	None	Cemetery	$59,447
Spruce	33	Good	None	Cemetery	$38,512
Poplar, Silver/White	41	Good	None	Cemetery	$36,882
Poplar, Silver/White	41	Good	None	Cemetery	$36,882

Changes in the Community Forest

Figure 5 shows the percent change in species diversity, number of trees and average Dbh by location from the 1993 inventory to the 2007 inventory for the locations that were included in both. The Parks and Recreation Department has made great strides to increase diversity in some locations. The downtown area has the most dramatic improvement, with a 450% increase from the two species represented in 1993 to eleven species in 2007. Depot and Washington Park also showed a remarkable increase in diversity with additions like mountain ash, bur oak, and hawthorn. Despite this, overall species diversity has not improved. In 1993,

67 percent of all public and street trees were spruce and cottonwood. Not including street trees, in 2007 a shocking 69 percent of all public trees were spruce and cottonwood. This reinforces the recommendation that the City refrains from planting additional cottonwood and spruce trees.



Additions like bur oak to Washington Park have helped increased diversity.

The fourteen locations included in the comparison data showed a 22 percent increase in the number of trees from 1993 to 2007. This reflects the dramatic planting efforts that have occurred over the last five years. The two areas that showed the greatest increase were the downtown area and the detention ponds. As a result of the additional trees to these areas, there was a corresponding decrease in the average Dbh. In general, the parks that showed little to no change in the number of trees showed the greatest change in average Dbh. For example, LaBonte Park went from 316 trees to 314 trees but had an increase in average diameter from 5 inches to 11 inches.

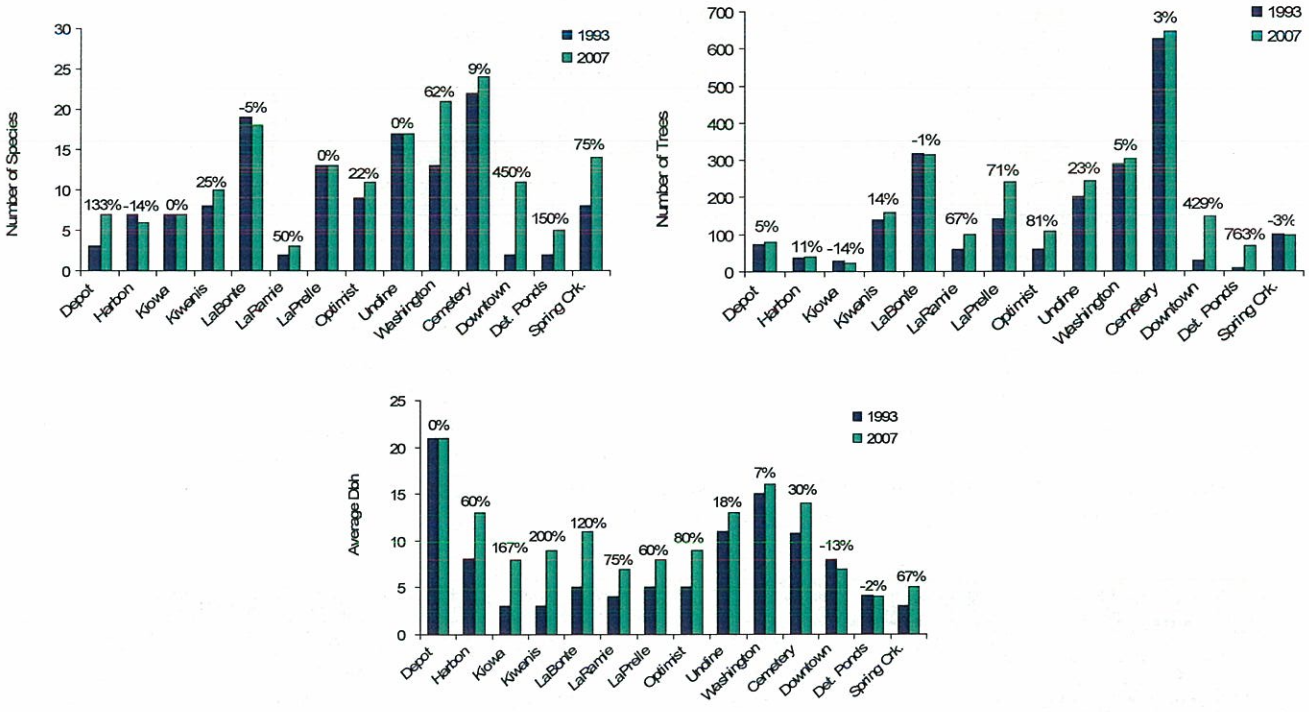


Figure 5. Percent Change by Location.

Involvement and Funding

A commitment from the residents is essential to maintain a healthy, beautiful community forest in Laramie. There are many ways to build this relationship through education and opportunities for involvement. Already established is a day each fall where volunteers are requested to help plant or mulch trees. This has been successfully run and participated in for at least the last three years. These types of activities help the residents establish ownership and increase their desire to

see public trees thrive. Be creative when considering other ways to encourage community involvement such as:

- Offer free trees to volunteers who help with community tree planting projects, including instructions for proper planting and care. Or continue to offer private homeowners a bareroot tree or containerized tree at modest cost each spring. This is a great way to encourage species diversity and could be coupled with information about the trees and a tree planting class.
- School planting programs where local businesses and utility companies share the cost of purchasing trees, while the Parks and Recreation Department provide the knowledge and direction to help the students plant trees around their facility. Getting the students involved with the planting and general tree care will give them ownership. When students are involved with tree planting projects it is important that there is an adult with each group that is adequately trained on proper tree planting methods. In addition, in order to develop good stewards of the community, couple the planting with education classes about the benefits of trees in the urban environment.
- Keep the public well informed about the condition and status of the community forest through regular tree care classes, newspaper articles, door hangers in neighborhoods where tree work is going to be conducted, and information on the benefits of community trees. The City of Laramie has already shown tremendous dedication to the community forest but through education, the value that the trees provide to the public will become recognized.

The City of Laramie has been fortunate to receive grant money from the State of Wyoming, the Laramie Rivers Conservation District and other sources to conduct tree plantings. There are several other possible sources of funding that can be pursued. Some sources are listed below.

- Frito Lay Free Tree Opportunity - Last fall, Frito Lay gave 25,000 seedlings to nonprofit organizations such as schools, clubs, and communities. This year they are giving away 50,000 more. (http://www.arborday.org/makingamericagreener/)
- American Forests - Funding for quality tree-planting projects through the Global ReLeaf Forests ecosystem restoration program. This organization is particularly interested in partnering with private and public sector organizations and agencies to plant trees and improve the environment in projects that would otherwise not be feasible. (http://www.americanforests.org/global%5Freleaf/grants/)
- Lowe*s Outdoor Classroom – The grants can be used to build a new outdoor classroom or to enhance a current outdoor classroom at the school. (http://www.lowes.com/lowes/lkn?action=pg&p=AboutLowes/outdoor/index.html)
- Lowe's Charitable and Educational Foundation - The Lowe's Charitable and Educational Foundation (LCEF) has a long history of contributing to grassroots community projects. (http://www.lowes.com/lowes/lkn?action=frameSet&url=apps.bridgetree.com/funding/default.asp)

Other funding opportunities may be found at the United States Department of Agriculture - A Guide to Grants, Fellowships, and Scholarships in International Forestry and Natural Resources website available at http://www.fs.fed.us/people/gf/gf00.htm.

Laramie Parks

Corner Park

There was one tree at Corner Park, a cottonwood. The tree was in good condition, approximately thirteen inches in diameter and sixty feet tall. It was in need of pruning for maintenance and form and was valued at $3,195.

Depot Park

There were seven different species identified at Depot Park and a total of seventy-nine trees. They were valued at $778,910. Forty-eight percent of the trees were cottonwood and 37 percent were spruce (see appendix A for a complete list of species). Unlike many areas in Laramie, on average this was a mature to over-mature population of trees, indicated by an average diameter of 21 inches Dbh. Forty-nine percent of the trees were 21 inches or larger in diameter. Although fifteen percent of the population falls within the 1 to 4 inch size class, new plantings need to continue at this location. These plantings need to focus on increasing species diversity with additions such as bur oak or black walnut and should not include cottonwood or spruce trees.

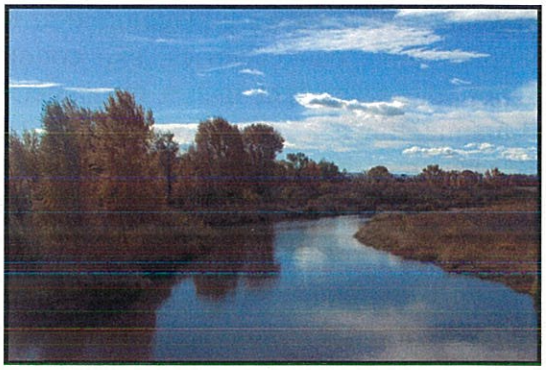
Despite the older population at Depot Park, the trees were in good to fair condition, 53 and 32 percent respectively. As shown in Table 5, 27 trees needed no to minimal care, simply mulch or water. Twenty-one of the trees were recommended for priority three pruning. Structural pruning needs begin to at a young age to assure that the trees grow with good form and to avoid problems such as V intersections, included bark, multiple leaders, or crossed branches. Although the trees recommended for priority three pruning already average 14 inches in diameter, they have not yet reached maturity and some of these types of problems can be corrected. Even though this recommendation was only applied to 27 percent of the population, all the trees in the park should be checked and pruned on a three to five year cycle so in order to develop into strong, healthy trees.

Priority two pruning was recommended for 18 of the trees and priority one pruning for five trees. Nineteen of these trees were cottonwoods and two were willows. Both species are fast growing, weak wooded species that are easily damaged during strong wind and storm events. In general, these trees were mature to over-mature. At the time of the inventory eight trees were recommended for removal: four cottonwoods, two spruce, and two willows. Since the time of the inventory at least one of the beetle killed spruce trees has been removed. This tree was identified as a hazard. The priority for this location is the removal of the remaining hazard trees, two willows and one cottonwood (see map in Appendix C).

Table 5. The number of trees and average diameter by management need for Depot Park.

Management Need	Number of Trees	Percent of Population	Average Condition	Average Diameter
Mulch	5	6	Good	3
Water	10	13	Good	17
None	12	15	Good	18
Priority 1 Prune	5	6	Poor	31
Priority 2 Prune	18	23	Fair	33
Priority 3 Prune	21	27	Good	14
Removal	8	10	Poor	26

Greenbelt Park



The greenbelt path follows along the Laramie River with a right of way that extends 35 feet from the center of the path on both sides. Within this right of way, 163 trees were inventoried, 162 cottonwoods and one Russian olive. The trees averaged eight inches Dbh and 39 feet high. They were in fair condition with a total value of $167,252. Many of the cottonwoods along the greenbelt had canker.

Trees with multipliable trunks are structurally weak and should be pruned to one trunk if they are within the right of way.

The greenbelt is a wonderful asset to the people of Laramie, providing an ecosystem for native plants and riparian wildlife. Although the goal is to maintain it in as natural a state as possible, pruning the trees within the right of way will help ensure the safety of those who use the trail system, as well as provide preventative versus reactionary maintenance. Eighty-nine of the trees were recommended for priority three pruning. Many of these trees had two or more trunks and included bark. When trees are allowed to grow in this form it weakens the structure of the tree, increasing the possibility of damage in a severe storm, both to the tree and property or individuals. Trees within the right of way should be correctively pruned to one stem. One tree was recommended for priority two pruning and three trees as priority one. These trees had dead limbs hanging over the path. Thirty-six trees were recommended for removal due to crowding or growing with more than one trunk. When possible, remove the trunks in the poorest condition or with the highest amount of lean, leaving the best trunk.

The Russian olive was also recommended for removal. Russian-olive trees are an exotic species first introduced in the 1800's for use in wind breaks and erosion control. Because they are so hardy and self-sustaining, in many areas of the country, such as Wyoming, they have gained in popularity. They are a very aggressive species that has overtaken native species, such as cottonwood, along streams and rivers. They are no longer for sale in Wyoming and there is a statewide banned from planting as in an effort towards eliminating Russian-olives from the landscape.

Harbon Park

There were 40 trees in Harbon Park at the time of the inventory: 19 spruce, nine cottonwood, five chokecherry, four crab apple, two quaking aspen, and one limber pine. They averaged thirteen inches Dbh, with 36 of the trees twenty inches or below in diameter, and were 49 feet high. The majority were in good or fair condition, 16 and 15 trees respectively. Girdling roots, competition, and trunk damage were common problems at this location. Seven of the trees were recommended for removal. They were valued at $22,963.

Kiowa Park

Twenty-four trees were inventoried at Kiowa Park: eight spruce, six quaking aspen, three crab apples, three chokecherries, two cottonwood, one mayday cherry, and one bristlecone pine. They averaged eight inches in diameter and were 25 feet tall. Like many of the areas in Laramie, this is a young population of trees. Only one of the 24 trees in the park had a diameter greater than thirteen inches. Because of such a young population, sixteen of the trees were in good condition with only three in fair, and five in poor. Watering and priority three pruning (pruning for form, clearance, or structure) were the most frequent recommendations. The total value was $44,476.

Kiwanis Park

There were 159 trees at Kiwanis Park, ninety percent being spruce (44%), cottonwood (35%), and crab apple (12%). The trees averaged nine inches in diameter and 41 feet high. Just like Kiowa Park, only one of the trees at this location had a Dbh greater than twenty inches. As evident from Figure 6, the trees were mainly in good to fair condition. The trees that were rated in poor condition were stressed, with discolored foliage, and a high amount of scales on the spruce trees. Management was recommended for eighty percent of the trees with the most common recommendations being priority three prune (52 trees) and water (47 trees). Removal was recommended for ten trees in poor condition due to the highly stressed environment and drought conditions. Replanting in these locations is an opportunity to increase species diversity. The value of these trees was estimated at $362,821.

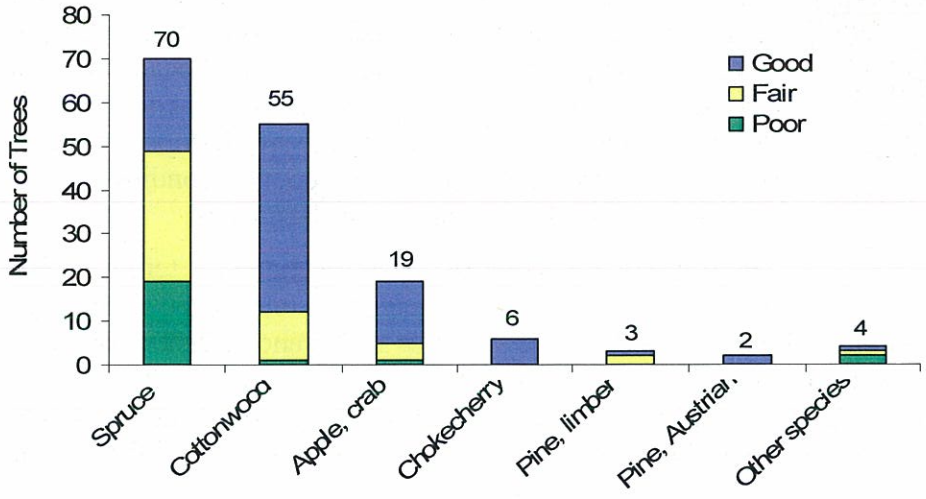
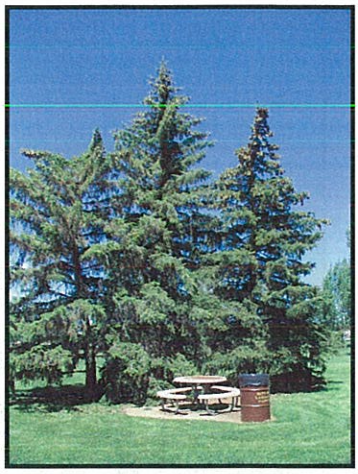


Figure 6. Number of trees in Kiwanis Park by species and condition class.

LaBonte Park

LaBonte Park had 314 trees; ninety-three percent were four species: spruce (45%), cottonwood (31%), crab apple (10%), and chokecherry (6%). A complete summary of the trees in LaBonte Park is included in Appendix A. Trees in LaBonte Park averaged 11 inches Dbh and 38 feet high. This park had a young population of trees with 61 percent having a Dbh of twelve inches or below and only eight percent having a Dbh of above twenty inches. Table 6 sorts the trees by management need, including average condition and diameter. As is apparent, the majority of the trees in LaBonte Park needed no to minor management. The most common suggested maintenance was priority three pruning. Although there was only one hazard tree identified in LaBonte Park, listed as a priority one prune, there were thirteen recommended for removal. Primarily these trees had numerous dead branches, trunk wounds, broken tops and/or were dying.



The spruce tree on the left has a broken top due to a storm event.

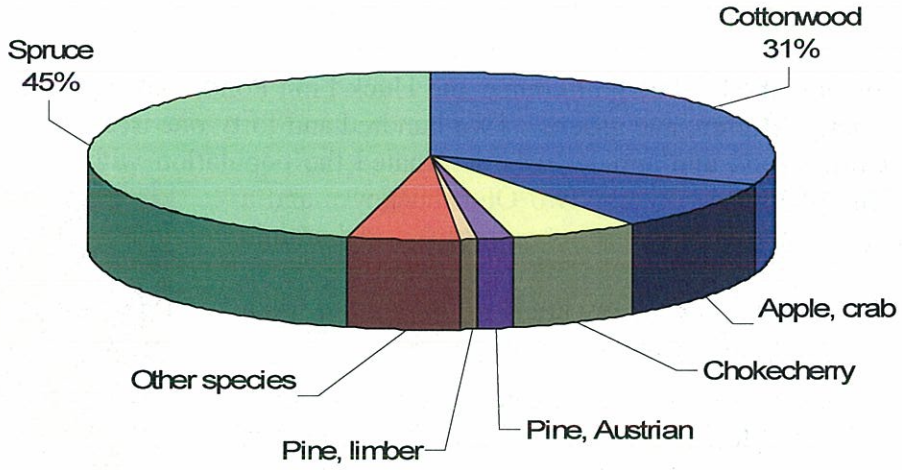


Figure 7. Species distribution for LaBonte Park.

Table 6. The number of trees and average diameter by management need for LaBonte Park.

Management Need	Number of Trees	Percent of Population	Average Condition	Average Diameter
Mulch	10	3	Good	8
Water	88	28	Fair	12
None	84	27	Good	11
Priority 1 Prune	5	2	Fair	19
Priority 2 Prune	25	8	Good	12
Priority 3 Prune	89	28	Good	10
Removal	13	4	Poor	9

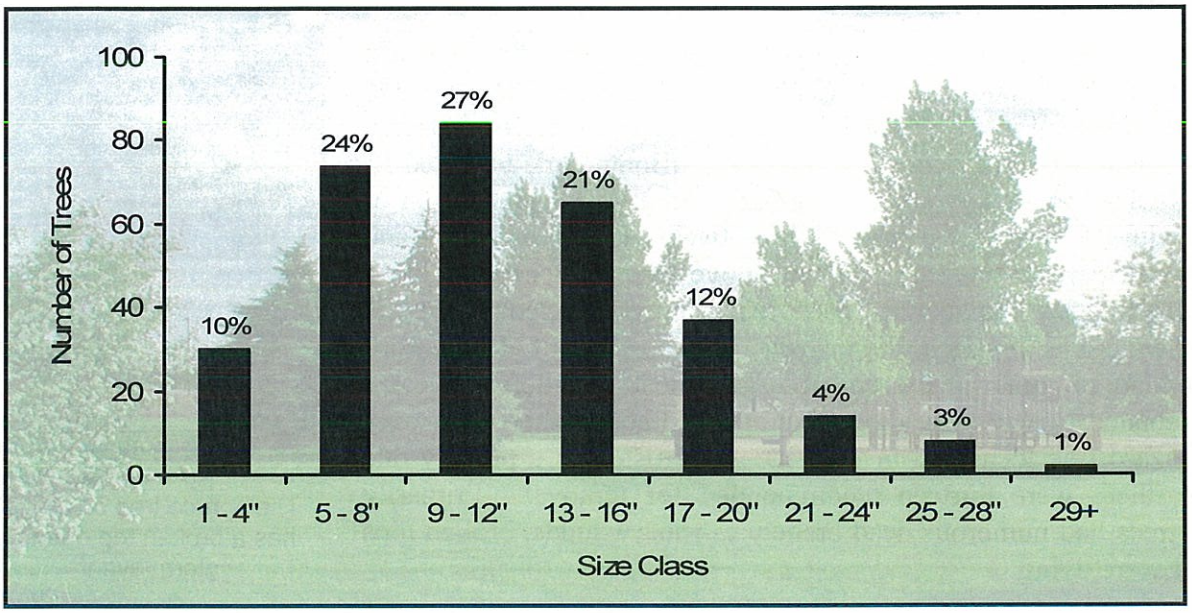


Figure 8. Size distribution for trees in LaBonte Park.

LaPrelle Park

LaPrelle Park contains the Frisbee golf course and Huck Finn Pond, making it a popular spot in the summer for many different age groups. Two hundred and forty-one trees were inventoried at this location. Cottonwood and spruce trees dominated the population with 42 and 36 percent respectively. This park also contains two Ohio buckeyes and a bristlecone pine, two species that are recommended in Laramie to help increase diversity. The trees averaged eight inches in diameter and 28 feet high. Like many areas in Laramie, it has a high population of young to maturing trees (Figure 9).

Ohio buckeyes add diversity to the Laramie Community Forest.

Figure 10 illustrates that regardless of species, most of the trees in this park were in good to fair condition. Thirty-five percent of the trees required no management. These were mostly trees in good condition. The most common recommendation for this park was priority three prune (28% of the trees) and water (15% of the trees). The trees would benefit from pruning to thin the canopy, help establish a central leader, or train the tree to establish a stronger structure as it grows. Two trees were identified as hazardous, these should either be improved though immediate pruning or removed (map included in Appendix C). In all, seven trees were recommended for removal.

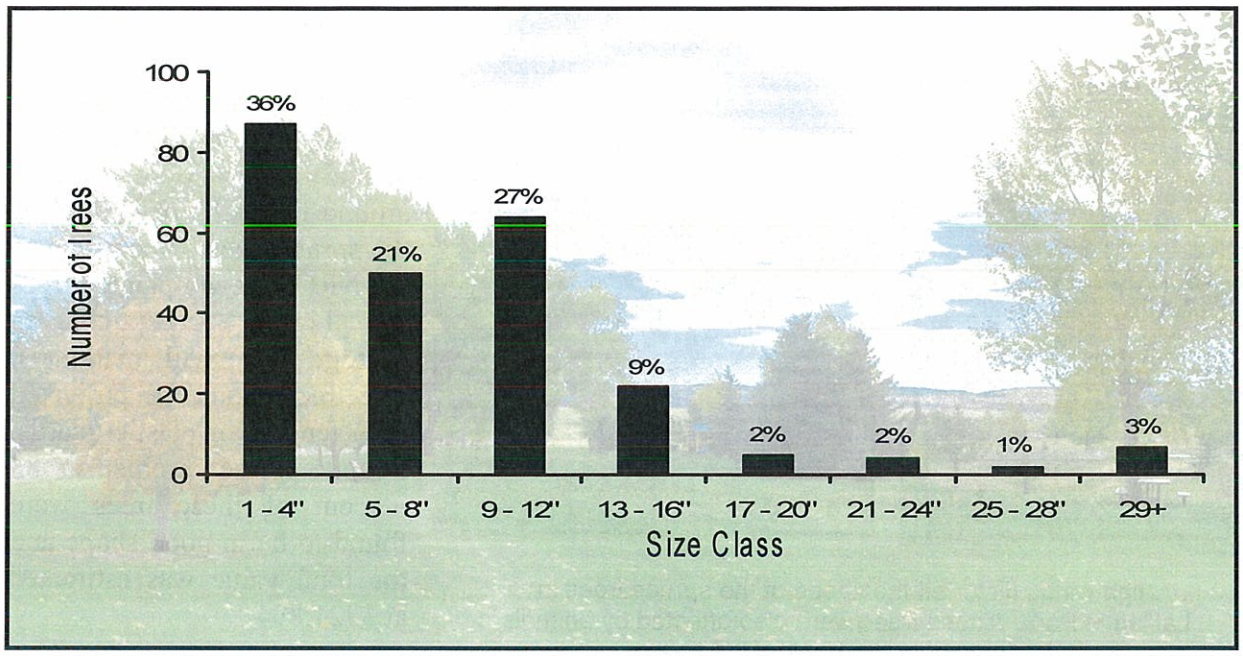


Figure 9. Size distribution for trees in LaPrelle Park.

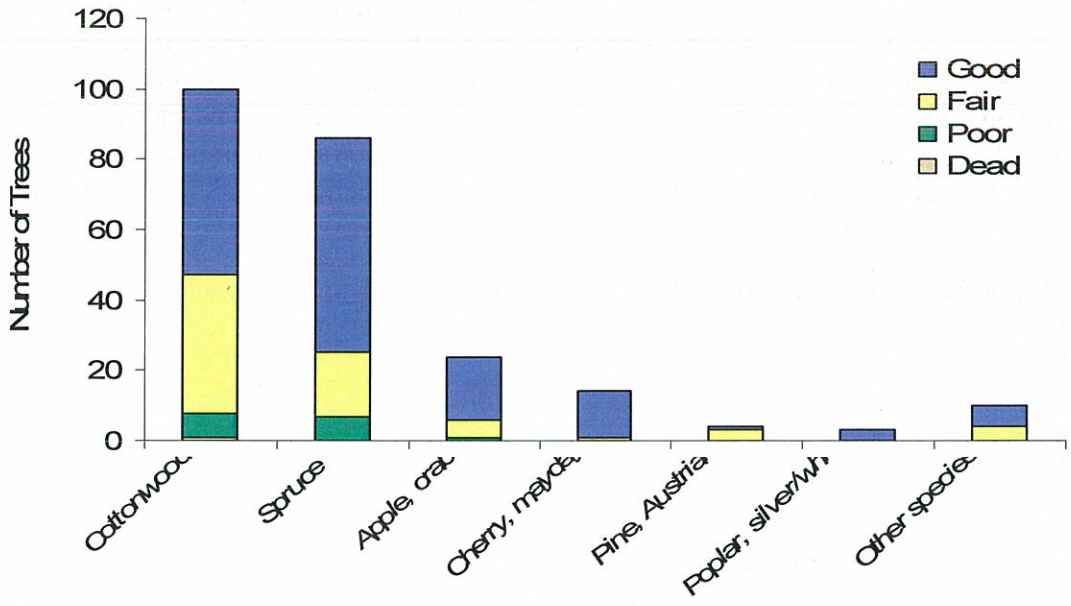


Figure 10. Number of trees in LaPrelle Park by species and condition class.

LaRamie Park

There were 100 trees planted at LaRamie Park: 90 spruce, nine cottonwood, and one bristlecone pine. They averaged seven inches in diameter and 27 feet high. The most common recommendation was water. There were two unique problems noted at this location compared to the other sites around Laramie. First, this park is used for sporting events and is a relatively open area. Due to this, the growth of some trees has been distorted by the high winds in the area. If room allows, adding an additional row of shrubs or junipers will help diffuse the wind and allow

High winds distorted the shape of the spruce trees in LaRamie Park. These trees were also affected by animals digging near the trunk of the tree.

the spruce to grow vertically. Second, fresh digging and animal holes were noticed around the trunk of several of the spruce trees. According to the NRCS, newly planted trees are highly susceptible to damage by small mammals. The trees should be protected with fencing or plastic guards. Despite these problems, 83 percent of these trees were found to be in good shape and the total value was estimated at $221,894.

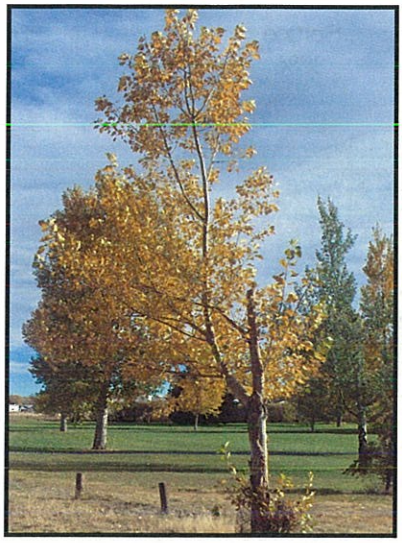
Optimist Park

There were nine different species represented at Optimist Park and 105 trees total. Seventy-four percent of the trees were spruce (41 trees) and cottonwood (37 trees). There were also ten crab apples, seven Rocky Mountain Juniper, four chokecherries, three bristlecone pine, and one each of Austrian pine, silver popular, and Russian olive. The trees averaged nine inches in diameter and 33 feet high. Like many other public areas in Laramie, there was a high percentage of young trees in this park. Seventy-six percent of the trees were twelve inches or smaller in diameter.

Table 7. Number of Trees by Size Class in Optimist Park

Size Class	Number of Trees	Percentage
1 - 4"	28	26.7
5 - 8"	33	31.4
9 - 12"	19	18.10
13 - 16"	5	4.8
17 - 20"	12	11.4
21 - 24"	7	6.7
25 - 28"	1	1.0
Total	**105**	**100.0**

The majority of these trees were in good condition with only eight trees in poor condition. However, 86 percent of the trees were recommended for some level of management. Four trees were recommended for removal. Three of these, pictured below, were in poor condition. The fourth was a Russian olive in good condition. As already stated, Russian olives are aggressive exotic species banned from planting statewide, particularly this close to the Laramie River. These trees were valued at $281,882.



Examples of trees in Optimist Park that were recommended for removal.

Scout Park

Scout Park is a recreation field containing 86 trees: 39 cottonwood, 27 spruce, twelve chokecherry, five crab apples, two hawthorn, and one Austrian pine. The trees average two inches in diameter and thirteen feet tall. Many of these trees have been recently planted and overall they are in good condition. Thirty-two of these trees required no maintenance at the time of the inventory. The most common suggestion included mulch and water. There was trunk damage on several of the trees either from a mower or weed whacker. These trees were valued at $18,397.

Undine Park

Seventy-six percent of the 245 trees at Undine Park are spruce and cottonwood. Other species included crab apple (15 trees), ponderosa pine (10 trees), Austrian pine (7 trees), and Rocky Mountain juniper (7 trees). There has been an effort made to increase diversity at this park by planting trees such as Ohio buckeye, western larch, and hawthorn. This needs to be continued. The trees averaged thirteen inches in diameter, 42 feet tall and were in good condition valued at $1,075,807. However, as shown in the chart below, the percentage of trees in good condition went down as the trees increased in age.

The growth of this western larch is suppressed by the mature cottonwoods above.

Forty-four percent of the trees required no immediate management. Of the remaining trees, priority three pruning was recommended for 41 trees; priority two pruning, 29 trees; water, 24 trees, and fifteen trees needed mulch. Priority one prune was recommended for thirteen trees. These were all cottonwoods, averaging 33 inches in diameter, eight of which were considered a hazard. Fourteen trees were recommended for removal. Four of the trees for removal were listed as hazardous; all over-mature cottonwoods in poor condition. The remaining ten were either listed in poor condition, crowded or had broken tops.

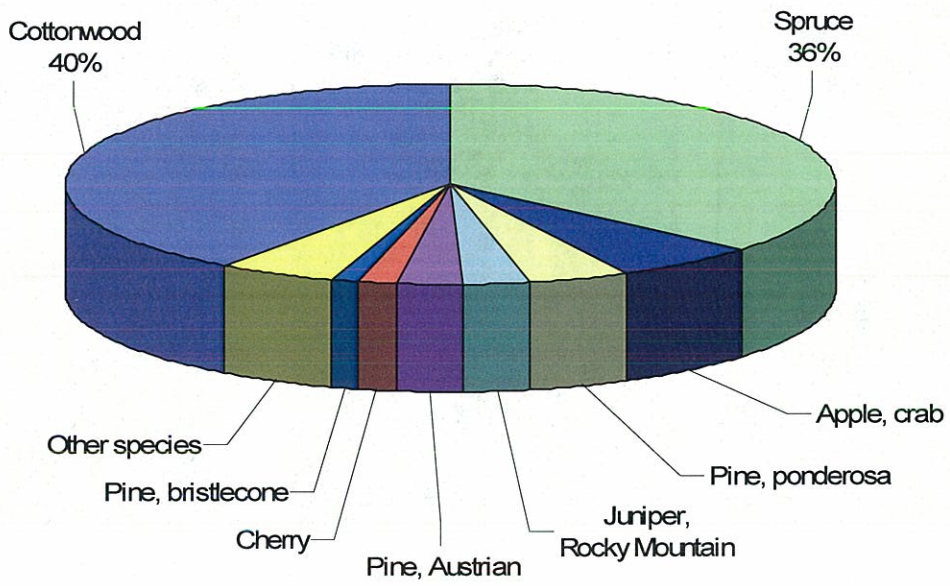


Figure 11. Species distribution for Undine Park.

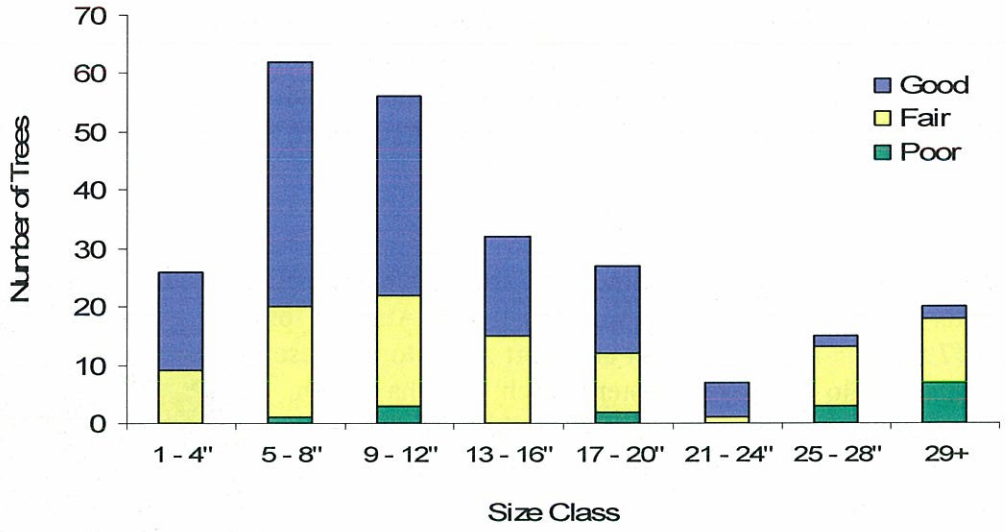


Figure 12. Number of trees by size class and condition in Undine Park.

Washington Park

There were 304 trees in Washington Park. Ninety-four percent of the population consisted of eleven species: cottonwood (40%), spruce (36%), crab apple (6%), ponderosa pine (5%), Rocky Mountain juniper (3%), quaking aspen (2%), golden willow, hawthorn, and bur oak (1% each). For a complete summary of trees in Washington Park see Appendix A. Washington Park trees averaged 16 inches in diameter and approximately 50 feet high. Figure 14 illustrates the number of trees by age class for Washington Park. Over fifty percent of the trees (173) were 16 inches or

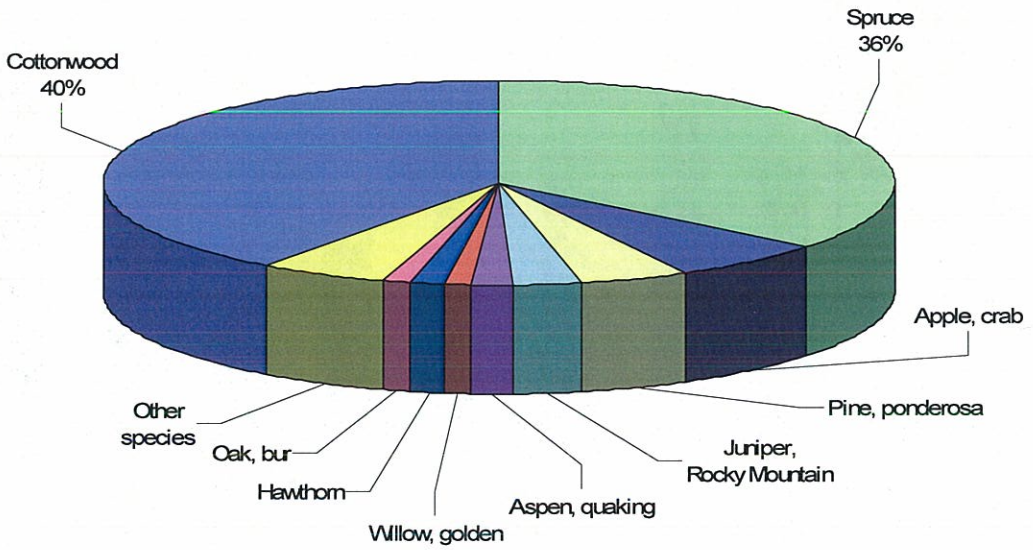
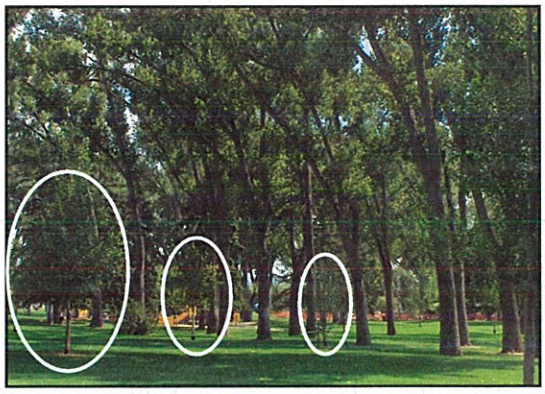


Figure 13. Species distribution for Washington Park.

less in diameter. Twenty-six percent (79 trees) were mature to over-mature and the majority of these (74 trees) were cottonwood trees.

Table 8 shows the number of trees by management need, the percent of the population and the average diameter. Not surprisingly, smaller trees were recommended for additional mulch. Although mulch will benefit trees of all size, the thin bark on young trees makes them more susceptible to damage from lawn care equipment. Trees averaged thirteen inches Dbh for priority 3 pruning, 28 inches for priority 2, and 32 inches for priority 1. Twenty-seven hazard trees were identified; all of them cottonwood trees (Appendix C). Only seven of the hazard trees were recommended for removal. The remaining were primarily in fair condition but have large hazardous limbs over play areas, sidewalks, power lines or the street. While pruning will help prolong the future of these trees within the park, it is important to recognize that over-mature trees are declining. The Parks and Recreation Department has done an excellent job over the last ten to fifteen years in foreseeing the future of the park by planting new trees under the current canopy. The next step is to set up a removal plan for over-mature and/or hazardous trees. This would involve prioritizing the trees based on condition and establishing a plan for removing one or two trees on a scheduled basis. With each removal, the remaining trees should be checked for dead limbs, stubs, cracks in the trunk, mushrooms or conks, or discolored bark. If decay is caught early enough, there is the potential of pruning it out and stopping the spread. Take particular care to check these trees and other mature trees after major storm and wind events to insure that no damage has occurred.



Small cottonwoods planted underneath the established canopy.

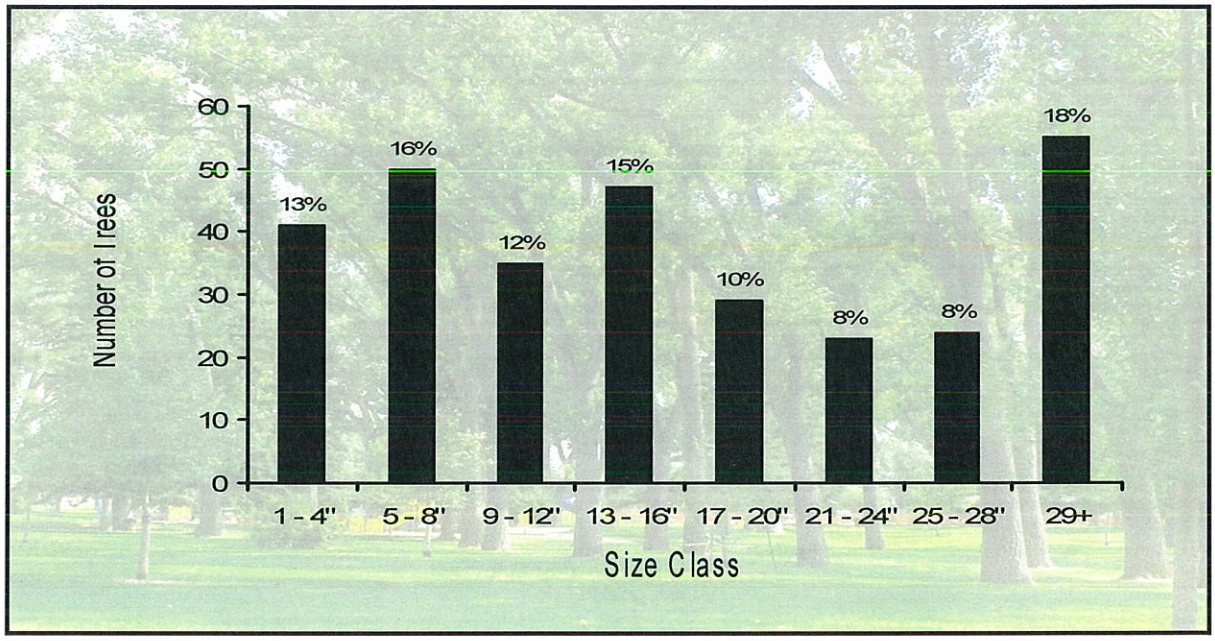


Figure 14. Number of trees by size class in Washington Park.

Table 8. Number of trees and average diameter by management need for Washington Park.

Management Need	Number of Trees	Percent of Population	Average Condition	Average Diameter
Mulch	6	2	Good	2
Water	87	28	Good - Fair	13
None	69	23	Good	9
Priority 1 Prune	45	15	Fair	32
Priority 2 Prune	27	9	Fair	28
Priority 3 Prune	56	18	Good	13
Removal	14	5	Poor	21

Beautification Areas

The City of Laramie has been privileged to have such a dedicated beautification committee to plant trees, shrubs and flowers to enhance the city. Over the years, the committee's progress has made a mark of greenery in the city.

Downtown

There were 160 trees included in the downtown area of Laramie. This part of town offered some of the most diverse trees, with no one species dominating more than twenty percent of the population. The top eight species (98% of the population) included: 31 green ash, 24 mayday cherries, 24 cottonwood, 23 crab apples, 23 linden, 17 spruce, nine chokecherries, and five honeylocust. On average the trees were seven inches in diameter, 23 feet tall and in good condition. The trees were valued at $418,245.

The City of Laramie was awarded a grant for the downtown beautification project and at the time of the inventory had planted 57 trees. This recent tree planting effort is evident in the size class distribution. Seventy-one percent of the trees were in the one to four inch size class. The most common management recommendations for this young population included priority three

pruning and water. Many of the trees have low branches that are rubbing against the protective fencing that is around the tree. This type of injury can be prevented with proper pruning.

All of the trees 23 inches or larger in diameter were cottonwoods. These mature to over-mature trees need observation and pruning. All twelve trees recommended for priority 1 pruning were cottonwoods, this includes the six trees identified as hazardous (map included in Appendix C). Four trees were recommended for removal; two linden, one mayday cherry, and one crab apple. These are small trees that were probably damaged when planted, did not get adequate water, or were vandalized.

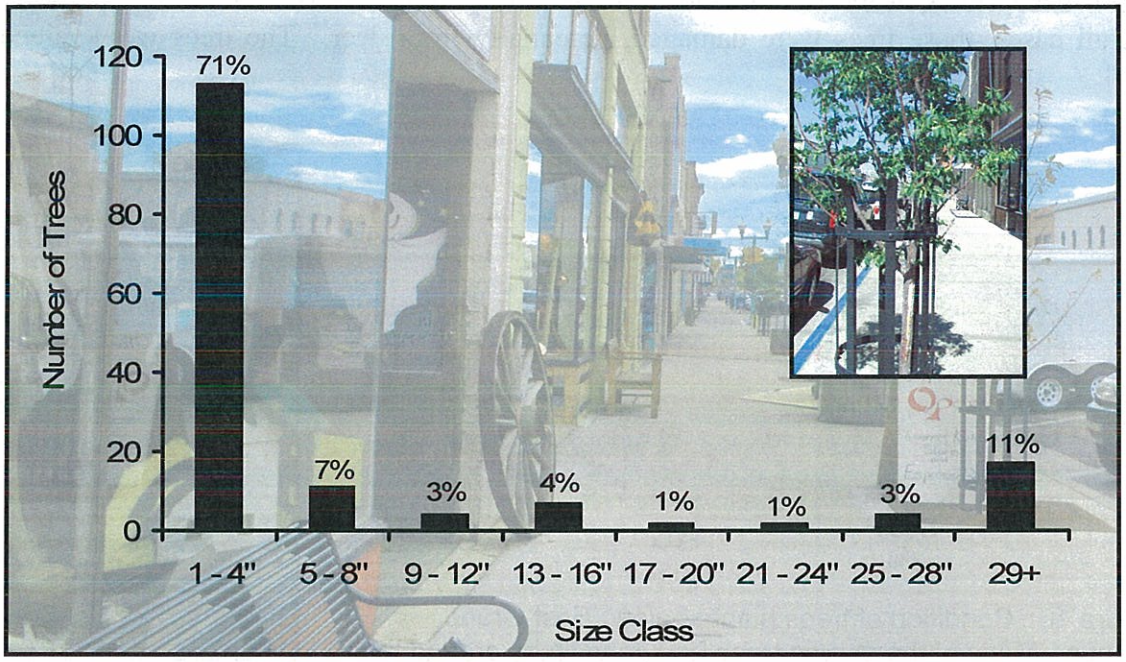


Figure 15. Size distribution for the trees in downtown Laramie. Many of the trees have low branches that should be pruned away from the fencing.

Table 9. The number of trees and average diameter by management need for downtown Laramie.

Management Need[A]	Number of Trees	Percent of Population	Average Condition	Average Diameter
Water	32	20	Good	4
None	40	25	Good	3
Priority 1 Prune	12	8	Fair	37
Priority 2 Prune	17	11	Fair	16
Priority 3 Prune	55	34	Good	3
Removal	4	3	Dead	2

A. Mulch was not recommended at this site.

East Grand Avenue

East Grand Avenue is a harsh environment for trees to thrive in. The trees planted along East Grand Avenue, East of Boulder Drive, are subject to poor soil conditions, temperature extremes, high winds, and pollutants from the busy traffic coming on and off of Interstate 80. It is understandable that in this location, the city would plant tree species that have the greatest

chance for survival while requiring the least amount of care. Therefore, the East Grand Avenue beautification project included 81 cottonwood trees and 74 spruce trees. The wide right of way also provides enough space for the cottonwoods to develop into mature trees without the future risk of hazardous limbs over the busy street.

Because this is a recent planting, the trees averaged 2 inches in diameter and 14 feet high. Despite the young population, fifty-nine of the trees were already rated in fair, poor, or dead condition. The most common management recommendation for this site was water. It appeared as if the water line for many of the trees was broken. Fifteen of the trees, all in poor or dead condition except one, were recommended for removal. These trees should be replaced. In almost all cases, these trees were damaged, potentially from deer. The trees were valued at $21,434.

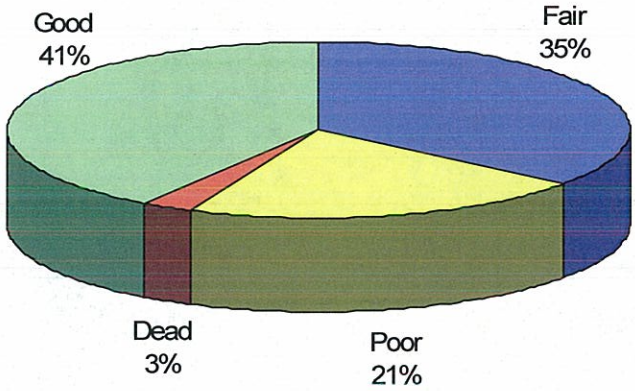


Figure 16. Condition of trees planted along East Grand Avenue. Many of the spruce trees had dead limbs around the bottom half of the tree, while canker, sunscald and/or chlorosis were noticed on the cottonwood trees.

Highway 287

Entering Laramie from the south along Highway 287 is a recently completed beautification area with 166 trees: 77 spruce, 52 Austrian pine, 19 crab apples, eleven cottonwood, and seven green ash. These trees averaged one inch in diameter and seven feet tall. These trees were in good condition and over all no management recommendations were made. However, giving them the time and care that they need now to become established will result in strong, healthy trees in the future. With the mulching and staking done, the most important thing that can be done now is to insure that they receive adequate water. The general rule of thumb is ten gallons of water for each 1 inch of trunk diameter. Because conifers still conduct photosynthesis during the winter, on days when the air and soil temperatures reach 45 degrees or above for a sustained period of time, winter watering can be beneficial.

Community volunteers helping with the Highway 287 tree planting.

Snowy Range Road Beautification

There were 55 trees planted in the fall of 2007 along Snowy Range road, west of the exit from Highway 80. There was a nice distribution of plant species at this location with no single species comprising more than 18 percent of the population. These trees averaged one inch Dbh, were ten feet tall and in good condition. At the time of the inventory, they did not have mulch. This was the only recommendation for this site. The trees were valued at a total of $3,547.

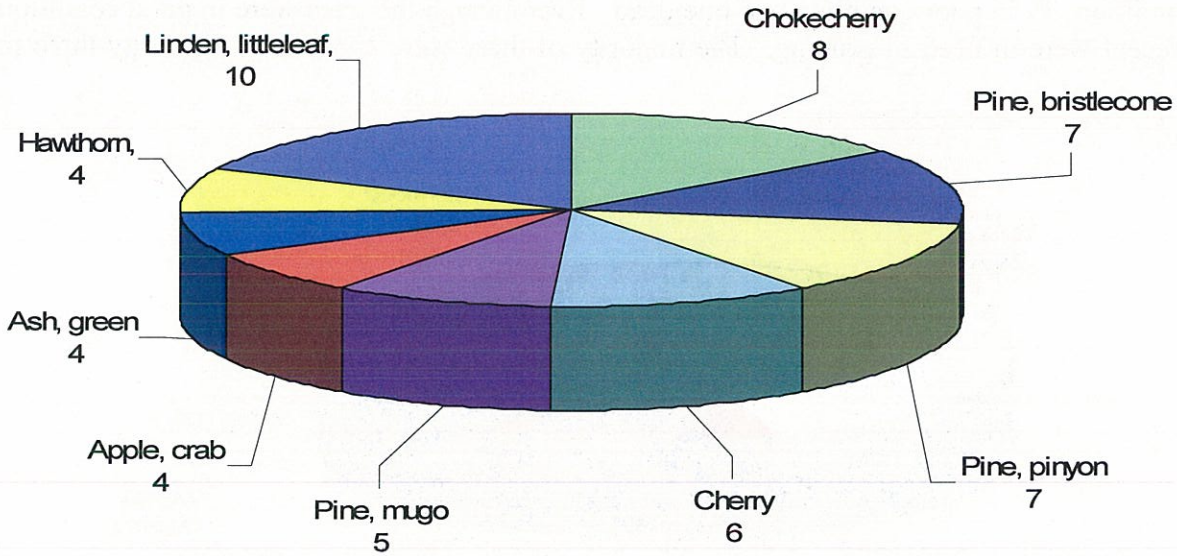
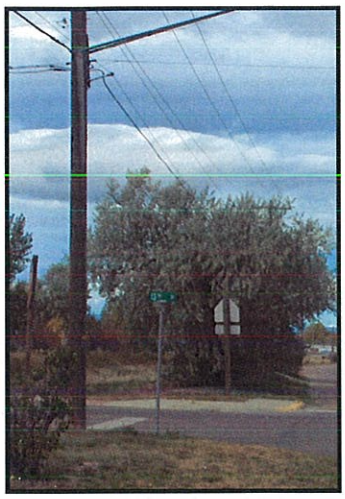


Figure 17. Species distribution for Snowy Range Road Beautification Area.

Spring Creek Beautification

There were 77 trees within the Spring Creek beautification area. Although these trees were older and probably include some volunteers, this area also has a nice distribution of tree species. Similar to the Snowy Range exit, no single species equaled greater than seventeen percent of the population, with quaking aspen (twelve trees), Russian olive (eleven), cottonwood (ten), and crab

apple (eight) being the dominate species. These trees averaged five inches in diameter and 20 feet tall. Sixty-eight percent of the trees planted along Spring Creek were in good condition; however, only sixteen percent required no maintenance. Priority three pruning and water were the most common recommendations. Eight trees were recommended for removal: five Russian-olives growing under power lines; two dead trees, a cherry and green ash; and one was a small cottonwood growing as a shrub. The total value of these trees was estimated at $67,148.



Volunteer Russian olive with poor placement under telephone wires.

Other Public Areas

Greenhill Cemetery

Greenhill cemetery contained 646 trees at the time of the inventory. The most dominant tree species were spruce and cottonwood. Together these two species totaled 67 percent of the population in the cemetery. As illustrated below, the eleven most common species total 95 percent of the population. For a complete summary of trees in the cemetery see Appendix A. The average size was 14 inches Dbh and 51 feet tall. Only fifteen percent of the cemetery trees fell within the mature to over-mature size classes (25" or larger). There was a relatively uniform distribution of trees between one inch and twenty inches in diameter.

On average the trees in the cemetery were in good condition (399 trees). There were 211 in fair condition, 35 in poor condition and one dead. Even though the trees were in good condition, 46 precent were in need of pruning. The majority of these were considered a priority three prune

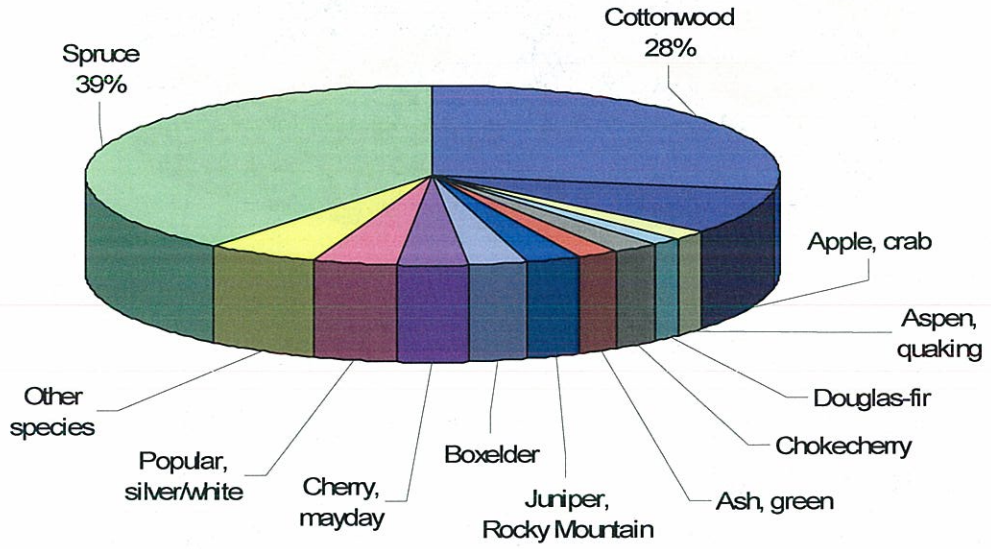


Figure 18. Species distribution for trees in Greenhill cemetery.

(256 trees). Sixty-five of the trees in the cemetery were recommended for removal; predominantly larger spruce trees, averaging seventeen inches in diameter and 60 feet tall, that were crowded on two sides by other large spruce trees. Although removing these trees is not a high priority, doing so would increase the neighboring spruce trees water uptake and allow greater diameter growth. A number of spruce trees in Laramie were topped by a heavy snow storm in the summer of 2005. Encouraging diameter growth over height growth will strengthen the trees and make them less prone to this type of damage. Mower damage was observed on only five percent of the trees in the cemetery.

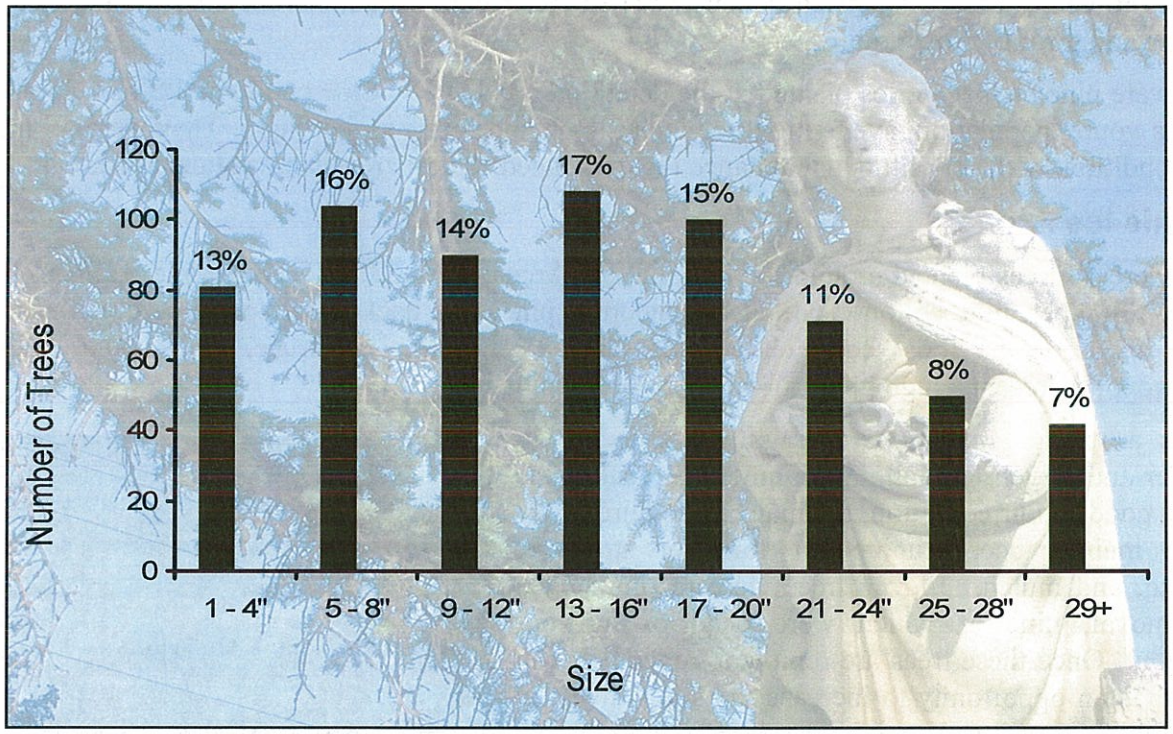


Figure 19. Size distribution for trees in Greenhill cemetery.

Detention Ponds

There were 69 trees planted around five of the detention ponds in Laramie.

The detention pond at 10th Street and Beaufort Street had eight spruce trees and six cottonwoods. They averaged three inches Dbh and nineteen feet high. Eight of the trees were in good condition, five in fair, and one in poor. At this size and level of condition, the trees were valued at $3,130. The recommended management for this site included priority three pruning and water on a regular schedule. Several of these trees had wetwood, canker, and/or frost cracks.

The detention pond on Reynolds Street had two cottonwoods, two ponderosa pine, one big tooth aspen, and one spruce tree. These trees averaged nine inches Dbh and 31 feet tall. Only one of the cottonwood trees was in good condition, the remaining five in fair. These trees were valued at $13,249. Three of the trees were recommended for priority two pruning due to small dead or broken limbs. Mulch would help prevent the mower damage noticed on two of trees as well as minimize the risk of frost cracks.

There were seventeen trees at the detention pond on the corner of Reynolds Street and 22nd Street, four spruce and thirteen cottonwood. These trees averaged seven inches Dbh and 31 feet high. Overall, they were in good condition and were valued at $21,254. Very little maintenance was recommended for these trees, five were listed as priority three prune, and two as priority two. Decay or a frost crack was noticed on seven of the trees.

There were twelve cottonwood and eleven spruce trees at the detention pond on the corner of Nighthawk Drive and 22nd Street. This is a young population, averaging 2 inches Dbh and 12 feet high. Twenty trees were rated in good condition and three in fair. They were valued at $2,622. Fifteen of the trees needed mulched. The other recommendations for this site included watering and priority three pruning.

There were nine chokecherries planted at the detention pond at 18th Street and Pearl Street. This is also a young population, averaging three inches Dbh and fourteen feet high. They were all in good condition, with very little maintenance recommended. These trees were valued at $2,594.

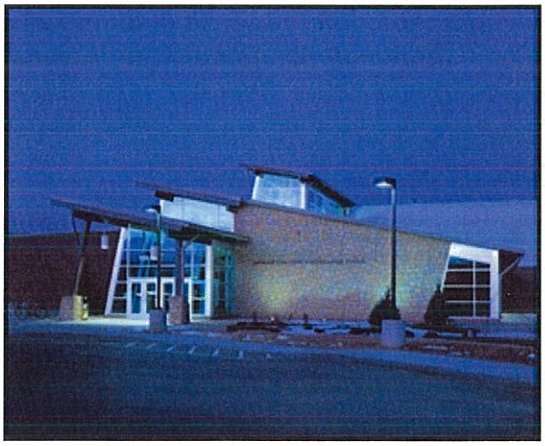
Laramie Ice Arena

There were 98 trees planted around the Laramie Ice Arena: 40 spruce, 17 crab apple, 16 Rocky Mountain juniper, nine cottonwood, eight ponderosa pine, five hackberry, and three green ash. Again, some of the most common species planted in Laramie; spruce, crab apple, and cottonwood, represent a high proportion of this tree population.

This is a young population, averaging two inches in diameter and eleven feet tall. With ninety percent of the trees in good to fair condition, the majority required only routine maintenance, pruning for form or structure, watering, and mulch. Eleven trees were recommended for removal, nine of which were dead or in poor condition. Once these trees are removed, replanting can be used as an opportunity to increase the site's diversity by adding trees such as honey locust, linden or hawthron. The trees at the Laramie Ice Arena are valued at just under $11,000.

Thornless honey locust cultivars offer brilliant yellow fall color.

Laramie Recreation Center



The Laramie Recreation Center has 188 trees planted around the perimeter. Although there were fifteen different species at this location, spruce and cottonwood still dominate the population (see Figure 20). This is a young population averaging two inches in diameter and eleven feet tall. At the time of the inventory 28 percent were in fair condition and seven percent were in poor. However, these trees were inventoried in the early summer, shortly after a cold spell, and their condition was base on the foliage. Later in the summer, these trees had recovered and the hackberry showed excellent growth. If these trees were re-inventoried they could probably be listed in

good condition. Only six percent of the trees required no maintenance. Water was recommended for 102 trees, priority three pruning for 61 trees, and mulch for eight. Six trees were recommended for removal. One was dead and five in poor condition with dieback. These trees should be re-evaluated and if removal is still recommended, they should be replaced. Manchurian apricot, oakleaf mountainash, and Norway maples would be nice additions to this location. At the time of the inventory, the trees were valued at $13,978.

Summary of Recommendations

In an urban environment trees are subjected to poor soil, temperature extremes, pollutants, and competition from turf and invasive species. In response to this environment, the tree is stressed and more predisposed to insect and disease problems. Community trees are also held to a higher standard than forest trees for appearance and safety. That's why community trees need regular inspections followed by the appropriate arboricultural treatment(s). Numerous recommendations for the City of Laramie have been made throughout this report and are summarized below.

- The first priority is to assess the trees identified as hazard trees. These trees should be prioritized as to their need and a two or three year plan established for pruning and removals. All removals should be done within the first year with replanting occurring as soon as possible. For pruning, the trees may need to be evaluated in the summer to correctly identify all the dead limbs. However, winter is the ideal time for large limb pruning. When the trees are dormant they are better able to withstand this type of stress
  - In addition, establish a plan for checking mature and over-mature trees at regular intervals and after severe storm events for signs of damage and decay. When trees develop hazards continue to prune and when needed remove and replant.
  - Be sure to educate the public about the reasons these trees were identified as hazards and that when trees are removed, replanting will occur. This may minimize the negative impacts that can result from removing large mature to over-mature trees, as well as provide the residents with some information that could be applied to their own trees.
  - Use replanting as an opportunity to increase species diversity.
- Before any new plantings occur, the City of Laramie must assess how many trees it can adequately care for with the current level of staff and volunteers. If the Parks and Recreation Department wants to continue planting at such high numbers, they should consider hiring a full time City Forester and/or a City Arborist whose sole responsibilities would include the care of the community forest (pruning, mulching, insect and disease, removal, and planting) and educating the public. Keep in mind that this is a valuable resource, estimated at over $11 million dollars, and should be viewed and cared for as an investment.
- Increasing species diversity is an absolute essential for Laramie, WY. At all public locations within the city, there should be no additional spruce or cottonwoods planted for a five to ten year period. Future plantings should focus on the other species listed in Appendix B.

- In regards to planting areas on the outer edge of Laramie, such as the East Grand Avenue and Hwy 287 plantings, where the goal is to have the planting help blend the town into the natural surroundings and trees are subject to poor growing condition; it is understandable that the city would select species that have the greatest chance for survival such as spruce and cottonwood. However, after investing the time and money into these trees, it is vital that they receive adequate water and care.
- Encourage the public to include more diverse species in their plantings by educating them on the benefits of having a diverse community forest, the numerous species that have the potential to grow in Laramie, and offering these trees at the annual Arbor Day tree sale and give away.

- Conduct a thorough pruning of all community trees to improve form, remove dead branches, and reduce crowding. This level of pruning should be done when the trees are small, with only minimal follow-up pruning needed once the trees approach maturity. However, because this has not been a priority for the City of Laramie, trees in all size classes are now in need of this priority three pruning. Start with all trees that were planted three years ago and prune other larger trees as time and resources permit.
  - The City of Laramie can easily set-up a pruning schedule by using the AcrMap program to mark which trees are pruned each year and when new trees are planted. Pruning should be done on a three to five year cycle.
- Establish a winter watering schedule for conifers when the air and soil temperatures reach 45 degrees or above for a sustained period of time; or as Colorado State University recommends with deeply watering the soil from the surface to a depth of 12 to 18 inches once a month for all trees in the summer and once every two months in the winter for conifers.
- Properly mulch and stake new trees. The area should extend three to six feet out from the base of the tree and be two to four inches deep after settling. Keep the mulch an inch or two from the base of the tree to prevent bark decay. Considering Laramie's dry climate, mulch is recommended for all trees regardless of size where the location permits.
- Build awareness of the many benefits trees provide the community through education.
  - The City of Laramie is fortunate to have four certified arborists on staff. These individuals need to be encouraged to maintain their certification by attending classes offered by the Wyoming State Forestry Division or the International Society of Arboriculture, Rocky Mountain Chapter.
  - Tree City USA produces educational bulletins available through the Wyoming State Forestry Division or at http://www.arborday.org/programs/treecitybulletins.cfm.
  - Consider additional approaches to educate the public on the community forest such as periodic articles in the Laramie Boomerang, door hangers in neighborhoods where tree work will be done, and tree care classes offered to the public.
- Be creative both in funding opportunities and with community involvement and partnerships.

- Keep the database as up to date as possible and conduct another tree inventory in ten years.

Laramie's community forest is in fair to good condition with a lot of positive energy being put into planting and beautification efforts. Now routine maintenance needs to be established in order to maintain or improve the condition of the trees. Additionally, the community forest is in critical need of diversification. Encourage education and partnerships to promote more involvement from citizens and build a commitment from the entire town. By acknowledging the importance of a healthy community forest, Laramie is already off to a great start.

Appendix A – *Summary Tables of Trees by Location*

Appendix B – *Possible Trees for Laramie, WY*

Appendix C – *Hazard Trees*

Appendix D – *Fact Sheets on Insects and Diseases*

Average size indicates diameter at 4½ feet above the ground. Average condition indicates the following visual observations: Good - no visual problems, Fair - average tree needs if one or two minor problems, and Poor - tree declining in vigor, visual problem noted.

Trees in Laramie, Wyoming managed by the Park and Recreation Department (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Spruce	1,259	35.9	10	36	Fair	$4,548	$5,725,670
Cottonwood	1,165	33.2	13	45	Fair	$4,112	$4,790,891
Apple, Crab	272	7.8	3	13	Fair	$506	$137,648
Chokecherry	118	3.4	4	17	Fair	$553	$65,283
Pine, Austrian	80	2.3	4	12	Fair	$604	$48,302
Ash, Green	72	2.1	3	19	Fair	$335	$24,118
Juniper, RM	64	1.8	5	18	Fair	$980	$62,751
Cherry, Mayday	62	1.8	2	13	Fair	$269	$16,659
Pine, Ponderosa	48	1.4	8	31	Fair - Poor	$1,755	$84,216
Linden, Littleleaf	40	1.1	3	13	Good - Fair	$304	$12,162
Aspen, Quaking	40	1.1	4	21	Good - Fair	$331	$13,236
Poplar, Silver/White	37	1.1	19	54	Good - Fair	$8,235	$304,691
Hackberry, Common	36	1.0	1	11	Fair	$18	$651
Hawthorn	23	< 1%	3	13	Good - Fair	$392	$9,018
Russian Olive	23	< 1%	8	27	Fair	$1,407	$32,372
Boxelder	21	< 1%	9	34	Fair - Poor	$1,355	$28,452
Pine, Bristlecone	17	< 1%	3	11	Good	$539	$9,163
Willow	11	< 1%	21	44	Fair - Poor	$5,038	$55,418
Douglas-Fir	11	< 1%	21	65	Good	$15,256	$167,811
Pine, Pinyon	11	< 1%	2	9	Poor	$145	$1,593
Oak, Bur	10	< 1%	2	16	Good - Fair	$182	$1,816
Cherry	9	< 1%	2	15	Good	$177	$1,589
Pine, Limber	9	< 1%	5	22	Good - Fair	$819	$7,372
Buckeye, Ohio	8	< 1%	4	12	Good - Fair	$361	$2,886
Maple, Other	7	< 1%	1	6	Good - Fair	$28	$194
Pine, Mugo	6	< 1%	2	6	Fair	$111	$664
Fir, Other	5	< 1%	15	70	Good - Fair	$5,783	$28,917
Birch	5	< 1%	6	29	Good - Fair	$684	$3,419
Pine, Other	5	< 1%	8	25	Good	$1,943	$9,715
Honeylocust, Common	5	< 1%	1	10	Good - Fair	$18	$90

Trees in Laramie, Wyoming managed by the Park and Recreation Department Cont. (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Sumac	5	< 1%	1	4	Good	$27	$137
Other	4	< 1%	2	14	Fair	$43	$171
Elm, Siberian	3	< 1%	25	63	Fair - Poor	$7,392	$22,175
Apple, Other	2	< 1%	6	18	Good	$913	$1,825
Larch	2	< 1%	3	25	Fair	$154	$309
Mountain-ash	2	< 1%	3	13	Good	$257	$514
Poplar, Hybrid	2	< 1%	4	13	Good	$298	$597
Ash, White	1	< 1%	3	35	Fair	$183	$183
Plum	1	< 1%	1	5	Good	$27	$27
Alder	1	< 1%	3	10	Good	$257	$257
Aspen, big tooth	1	< 1%	5	35	Good	$571	$571
Elm, Other	1	< 1%	1	10	Good	$20	$20
Total	**3,504**	**100.0**	**9**	**34**	**Fair**	**$3,331**	**$11,673,554**

Greenbelt Trees (September, 2007)

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Cottonwood	162	99.0	8	40	Fair	$1,022	$165,617
Russian Olive	1	1.0	5	25	Good	$418	$418
Total	**163**	**100.0**	**8**	**39**	**Fair**	**$1,019**	**$166,035**

Depot Park Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Cottonwood	38	48.1	26	56	Good - Fair	$12,346	$469,149
Spruce	29	36.7	18	62	Good	$9,434	$273,578
Apple, Crab	4	5.1	3	13	Good	$319	$1,277
Willow	4	5.1	31	44	Poor	$8,545	$34,180
Hawthorn	2	2.5	3	20	Good	$273	$546
Chokecherry	1	1.3	1	15	Good	$27	$27
Other	1	1.3	3	25	Fair	$154	$154
Total	**79**	**100.0**	**21**	**54**	**Good - Fair**	**$9,860**	**$778,910**

Harbon Park Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Spruce	19	47.5	16	63	Fair	$6,853	$130,211
Cottonwood	9	22.5	15	58	Good	$7,260	$65,338
Chokecherry	5	12.5	4	14	Fair	$598	$2,990
Apple, Crab	4	10.0	5	18	Fair	$415	$1,661
Aspen, Quaking	2	5	6	30	Fair	$566	$1,133
Pine, Limber	1	2.5	9	20	Poor	$1,133	$1,133
Total	**40**	**100.0**	**13**	**49**	**Good - Fair**	**$6,853**	**$130,211**

Kiowa Park Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Spruce	8	33.3	9	26	Good	$2,490	$19,917
Aspen, Quaking	6	25.0	6	22	Poor	$461	$2,766
Apple, Crab	3	12.5	3	12	Good	$317	$950
Chokecherry	3	12.5	8	25	Good	$1,600	$4,800
Cottonwood	2	8.3	19	63	Good	$7,504	$15,009
Cherry, Mayday	1	4.2	5	20	Poor	$335	$335
Pine, Bristlecone	1	4.2	5	15	Good	$699	$699
Total	**24**	**100.0**	**8**	**25**	**Good**	**$1,853**	**$44,476**

Kiwanis Park Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Spruce	70	44.0	10	34	Fair	$2,393	$167,542
Cottonwood	55	34.6	12	63	Good	$3,104	$170,721
Apple, Crab	19	11.9	3	15	Good	$383	$7,268
Chokecherry	6	3.8	2	13	Good	$217	$1,301
Pine, Limber	3	1.8	4	17	Fair	$322	$965
Pine, Austrian	2	1.3	9	23	Good	$2,286	$4,572
Birch	1	0.6	1	10	Poor	$9	$9
Pine, Ponderosa	1	0.6	5	15	Fair	$470	$470
Poplar, Silver/White	1	0.6	7	40	Good	$860	$860
Willow, Golden	1	0.6	33	70	Poor	$9,113	$9,113
Total	**159**	**100.0**	**9**	**41**	**Good - Fair**	**$2,282**	**$362,821**

LaBonte Park Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Spruce	145	46.2	12	39	Good	$4,729	$685,635
Cottonwood	96	30.6	14	52	Good	$4,043	$388,145
Apple, Crab	30	9.6	5	15	Good	$751	$22,536
Chokecherry	19	6.1	6	20	Good	$1,012	$19,233
Pine, Austrian	5	1.6	7	20	Fair	$1,216	$6,078
Pine, Limber	3	1.0	4	18	Fair	$471	$1,413
Hawthorn	2	0.6	3	13	Good - Fair	$239	$478
Birch	2	0.6	10	45	Fair	$1,427	$2,854
Buckeye, Ohio	2	0.6	5	13	Good	$643	$1,286
Oak, Bur	2	0.6	2	18	Good - Fair	$178	$356
Aspen, Quaking	1	0.3	7	25	Good	$1,000	$1,000
Cherry, Mayday	1	0.3	3	15	Good	$241	$241
Apple, Other	1	0.3	7	20	Good	$1,320	$1,320
Ash, Green	1	0.3	3	15	Good	$305	$305
Elm, Siberian	1	0.3	27	50	Poor	$7,142	$7,142
Juniper, RM	1	0.3	5	30	Good	$520	$520
Pine, Pinyon	1	0.3	7	30	Poor	$510	$510
Poplar, Silver/White	1	0.3	9	30	Fair	$1,066	$1,066
Total	**314**	**100.0**	**11**	**38**	**Good**	**$3,631**	**$1,140,120**

LaPrelle Park Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Cottonwood	100	41.5	10	39	Good	$2,601	$260,088
Spruce	86	35.7	6	23	Good	$1,893	$162,782
Apple, Crab	24	10.0	4	13	Good	$403	$9,683
Cherry, Mayday	14	5.8	4	16	Good	$532	$7,448
Pine, Austrian	4	1.7	9	24	Fair	$1,488	$5,952
Poplar, Silver/White	3	1.2	7	33	Good	$1,214	$3,642
Pine, Ponderosa	2	0.8	9	25	Fair	$1,599	$3,199
Buckeye, Ohio	2	0.8	5	15	Good	$571	$1,143
Aspen, Quaking	2	0.8	4	20	Good	$411	$822
Pine, Bristlecone	1	0.4	5	20	Good	$699	$699

LaPrelle Park Trees Cont. (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Pine, Pinyon	1	0.4	5	10	Good	$651	$651
Boxelder	1	0.4	5	20	Fair	$343	$343
Chokecherry	1	0.4	1	10	Fair	$20	$20
Total	241	100.0	8	28	Good	$241	$456,472

LaRamie Park Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Spruce	90	90.0	8	27	Good	$2,299	$ 206,937
Cottonwood	9	9.0	6	27	Good	$1,659	$ 14,928
Pine, Bristlecone	1	1.0	1	5	Good	$ 28	$ 28
Total	**100**	**100.0**	**7**	**27**	**Good**	**$2,219**	**$ 221,894**

Optimist Park Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Spruce	41	38.3	11	35	Good	$4,397	$180,287
Cottonwood	37	34.6	9	42	Good	$2,282	$84,420
Apple, Crab	10	9.3	3	12	Good	$311	$3,112
Juniper, RM	7	6.5	6	21	Good	$717	$5,017
Chokecherry	5	4.7	5	18	Fair - Poor	$566	$2,829
Pine, Bristlecone	2	1.9	6	15	Good	$1,035	$2,070
Pine, Austrian	1	0.9	9	25	Fair	$1,524	$1,524
Poplar, Silver/White	1	0.9	9	40	Fair	$1,066	$1,066
Aspen, Quaking	1	0.9	1	5	Fair	$15	$15
Pine, Other	1	0.9	7	25	Good	$1,371	$1,371
Russian Olive	1	0.9	3	15	Good	$151	$151
Total	**107**	**100.0**	**9**	**32**	**Good**	**$2,634**	**$281,862**

Scout Park Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Cottonwood	39	45.3	3	19	Good	$261	$10,193
Spruce	27	31.4	1	7	Good	$49	$1,316
Chokecherry	12	14	2	12	Good	$179	$2,152
Apple, Crab	5	5.8	2	11	Fair	$118	$588
Hawthorn	2	2.3	3	10	Good	$273	$546
Pine, Austrian	1	1.2	3	10	Good	$226	$226
Total	**86**	**100.0**	**2**	**13**	**Good**	**$175**	**$15,020**

Undine Park Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Cottonwood	98	40.0	18	55	Fair	$6,195	$607,130
Spruce	89	36.3	10	37	Good	$4,195	$373,390
Apple, Crab	15	6.1	4	13	Fair	$516	$7,739
Pine, Ponderosa	10	4.1	13	50	Fair	$3,337	$33,368
Juniper, RM	7	2.9	7	27	Good	$1,320	$9,243
Pine, Austrian	7	2.9	9	25	Fair	$1,908	$13,353
Cherry	4	1.6	7	23	Fair	$1,140	$4,559
Pine, Bristlecone	3	1.2	7	22	Good	$1,807	$5,421
Poplar, Silver/White	2	0.8	9	40	Good	$1,422	$2,844
Pine, Limber	2	0.8	8	38	Good	$1,930	$3,861
Fir, Other	2	0.8	16	70	Fair	$5,326	$10,652
Chokecherry	1	0.4	3	15	Good	$302	$302
Buckeye, Ohio	1	0.4	3	10	Good	$257	$257
Hawthorn	1	0.4	7	25	Good	$1,486	$1,486
Other	1	0.4	3	25	Fair	$154	$154
Pine, Other	1	0.4	7	15	Good	$1,371	$1,371
Willow, Other	1	0.4	9	40	Poor	$678	$678
Total	**245**	**100.0**	**13**	**42**	**Good**	**$4,391**	**$1,075,807**

Washington Park Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Cottonwood	122	40.1	24	58	Fair	$10,458	$1,275,906
Spruce	109	35.9	15	57	Good	$6,977	$760,522
Apple, Crab	19	6.3	4	13	Good	$689	$13,085
Pine, Ponderosa	14	4.6	11	45	Fair	$2,501	$35,017
Juniper, RM	8	2.6	7	24	Good	$1,090	$8,723
Aspen, Quaking	5	1.6	5	31	Good	$650	$3,250
Willow	4	1.3	14	43	Fair	$2,356	$9,422
Hawthorn	4	1.3	2	10	Good	$84	$336
Chokecherry	3	1.0	6	20	Good	$1,066	$3,198
Oak, Bur	3	1.0	2	17	Good	$190	$571
Pine, Austrian	2	0.7	7	25	Good	$1,076	$2,151
Cherry, Mayday	2	0.7	5	18	Fair	$778	$1,555
Poplar, Silver/White	1	0.3	9	50	Good	$1,422	$1,422
Pine, Other	1	0.3	5	25	Good	$874	$874
Pine, Pinyon	1	0.3	1	5	Good	$26	$26
Boxelder	1	0.3	7	25	Good	$1,121	$1,121
Ash, Green	1	0.3	5	25	Good	$509	$509
Alder	1	0.3	3	10	Fair	$257	$257
Aspen, big tooth	1	0.3	5	35	Good	$571	$571
Douglas-Fir	1	0.3	3	15	Good	$180	$180
Mountain-ash	1	0.3	3	15	Fair	$257	$257
Total	304	100.0	16	50	Good	$6,970	$2,118,955

Beautification Areas

Downtown Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Ash, Green	31	20.9	2	18	Good	$269	$8,349
Cherry, Mayday	25	16.9	1	11	Good	$27	$677
Cottonwood	24	16.2	31	63	Fair	$13,688	$328,507
Apple, Crab	24	16.2	4	14	Good	$841	$20,179
Linden, Littleleaf	23	15.5	3	13	Good	$398	$9,160
Chokecherry	11	7.4	2	16	Good	$166	$1,830

Downtown Trees Cont. (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Honeylocust, Common	5	3.4	1	10	Good	$18	$90
Poplar, Hybrid	2	1.4	4	13	Good	$298	$597
Hawthorn	1	0.7	1	10	Good	$38	$38
Pine, Pinyon	1	0.7	5	15	Good	$260	$260
Elm, Other	1	0.7	1	10	Good	$20	$20
Total	**148**	**100.0**	**7**	**22**	**Good**	**$2,498**	**$369,707**

East Grand Avenue Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Cottonwood	84	54.2	3	19	Fair	$221	$18,534
Spruce	71	45.8	1	8	Fair	$41	$2,900
Total	**155**	**100.0**	**2**	**14**	**Fair**	**$138**	**$21,434**

Highway 287 Beautification Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Spruce	77	46.4	1	5	Good	$60	$4,633
Pine, Austrian	52	31.3	1	7	Good	$65	$3,368
Apple, Crab	19	11.4	1	9	Good	$36	$675
Cottonwood	11	6.6	1	10	Fair	$16	$175
Ash, Green	7	4.2	1	15	Good	$28	$197
Total	**166**	**100**	**1**	**7**	**Good**	$54	$9,047

Snowy Range Exit Beautification Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Linden, Littleleaf	10	18.2	2	13	Good	$170	$1,695
Chokecherry	8	14.5	1	10	Good	$27	$215
Pine, Bristlecone	7	12.7	1	5	Good	$28	$196
Pine, Pinyon	7	12.7	1	6	Good	$21	$146
Cherry	6	10.9	1	14	Good	$63	$375
Pine, Mugo	5	9.1	1	3	Good	$28	$140

Snowy Range Exit Beautification Trees Cont. (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Apple, Crab	4	7.3	1	9	Good	$29	$116
Ash, Green	4	7.3	2	16	Good	$136	$543
Hawthorn	4	7.3	1	10	Good	$30	$121
Total	**55**	**100.0**	**1**	**10**	**Good**	**$64**	**$3,547**

Spring Creek Beautification Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Russian Olive	16	16.5	10	28	Good	$1,867	$29,874
Cottonwood	14	14.4	9	35	Good	$2,245	$31,435
Aspen, Quaking	12	12.4	3	14	Good	$166	$1,995
Apple, Crab	11	11.3	4	13	Good	$584	$6,427
Chokecherry	10	10.3	2	11	Good	$117	$1,173
Juniper, RM	10	10.3	2	10	Good	$93	$932
Spruce	9	9.3	6	25	Good	$933	$8,395
Cherry, Mayday	5	5.2	3	14	Good	$318	$1,589
Ash, Green	3	3.1	2	13	Good	$163	$488
Other	2	2.1	2	10	Dead	$0	$0
Poplar, Silver/White	2	2.1	12	48	Fair	$1,909	$3,818
Boxelder	1	1.0	5	25	Good	$458	$458
Plum	1	1.0	1	5	Good	$27	$27
Willow	1	1.0	11	25	Good	$2,025	$2,025
Total	**97**	**100.0**	**5**	**20**	**Good**	**$914**	**$88,636**

Other Public Areas

Detention Pond Trees (August, 2007).

Location	Species	Number of Trees	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
10th and Beaufort St.	Spruce	8	3	13	Fair	$173	$1,386
10th and Beaufort St.	Cottonwood	6	4	27	Good	$291	$1,744
Total		14	3	19	Fair	$224	$3,130
Reynolds	Cottonwood	2	17	58	Fair	$5,007	$10,014
Reynolds	Aspen, Big Tooth	1	1	10	Fair	$15	$15
Reynolds	Pine, Ponderosa	2	9	28	Fair	$1,599	$3,199
Reynolds	Spruce	1	1	5	Fair	$21	$21
Total		6	9	31	Fair	$2,208	$13,249
Reynolds and 22nd St.	Spruce	4	6	23	Good	$1,308	$5,234
Reynolds and 22nd St.	Cottonwood	13	8	42	Good	$1,232	$16,020
Total		17	7	37	Good	$1,250	$21,254
Nighthawk and 22nd St.	Spruce	11	2	8	Good	$113	$1,238
Nighthawk and 22nd St.	Cottonwood	12	2	15	Good	$115	$1,385
Total		23	2	12	Good	$114	$2,622
18th and Pearl	Chokecherry	9	3	14	Good	$288	$2,594
	Total	**69**	**4**	**22**	**Good**	**$671**	**$42,850**

Ice Arena Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Spruce	40	40.8	2	11	Fair	$164	$6,564
Apple, Crab	17	17.3	1	10	Good	$41	$704
Juniper, RM	16	16.3	1	5	Good	$21	$338
Cottonwood	9	9.2	3	19	Fair	$162	$1,460
Pine, Ponderosa	8	8.2	3	11	Fair	$146	$1,167
Hackberry, Common	5	5.1	1	15	Dead	$5	$27
Ash, Green	3	3.1	3	17	Good	$224	$671
Total	**98**	**100**	**2**	**11**	**Fair**	**$112**	**$10,931**

Laramie Recreation Center Trees (September, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Spruce	49	26.1	1	9	Good	$42	$2,065
Cottonwood	43	22.9	3	15	Good	$155	$6,673
Hackberry, Common	31	16.5	1	10	Fair	$20	$624
Apple, Crab	11	5.9	1	10	Good	$29	$319
Cherry	10	5.3	1	10	Good	$25	$255
Pine, Ponderosa	9	4.8	2	10	Good	$113	$1,016
Ash, Green	8	4.3	2	14	Fair	$86	$692
Linden	7	3.7	2	12	Good	$187	$1,306
Maple, Other	7	3.7	1	6	Good	$28	$194
Buckeye, Ohio	3	1.6	2	10	Good	$67	$200
Oak, Bur	3	1.6	2	13	Fair	$141	$422
Chokecherry	2	1.1	1	5	Good	$27	$54
Pine, Bristlecone	2	1.1	1	8	Fair	$24	$49
Pine, Austrian	2	1.1	2	10	Fair	$94	$188
Other	1	0.5	1	10	Fair	$17	$17
Total	**188**	**100.0**	**2**	**11**	**Good**	**$74**	**$14,074**

Greenhill Cemetery Trees (August, 2007).

Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Spruce	253	39.2	19	62	Good	$10,575	$2,675,433
Cottonwood	179	27.7	15	59	Good	$4,721	$845,106
Apple, Crab	53	8.2	5	16	Good	$780	$41,330
Chokecherry	34	5.3	4	21	Good	$776	$26,373
Poplar, Silver/White	26	4.0	23	60	Good	$11,153	$289,973
Boxelder	18	2.8	9	36	Fair	$1,474	$26,530
Juniper, RM	15	2.3	9	29	Good	$2,532	$37,978
Ash, Green	14	2.2	6	26	Fair	$883	$12,364
Aspen, Quaking	10	1.5	3	26	Good	$224	$2,240
Douglas-Fir	10	1.5	23	70	Good	$16,763	$167,632
Hawthorn	7	1.1	5	14	Good	$781	$5,467
Russian Olive	5	0.8	6	28	Fair	$386	$1,929

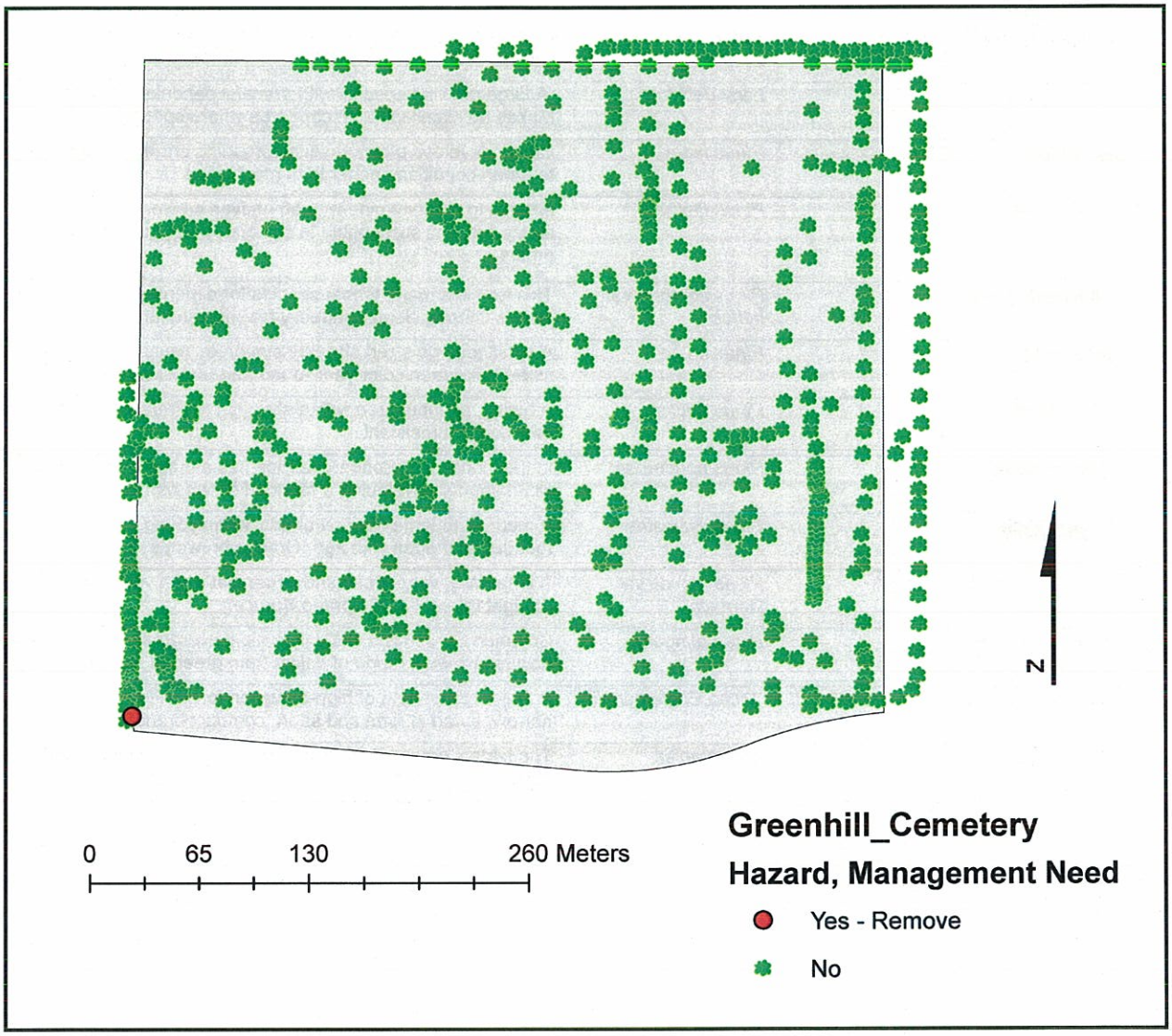
Greenhill Cemetery Trees (August, 2007).

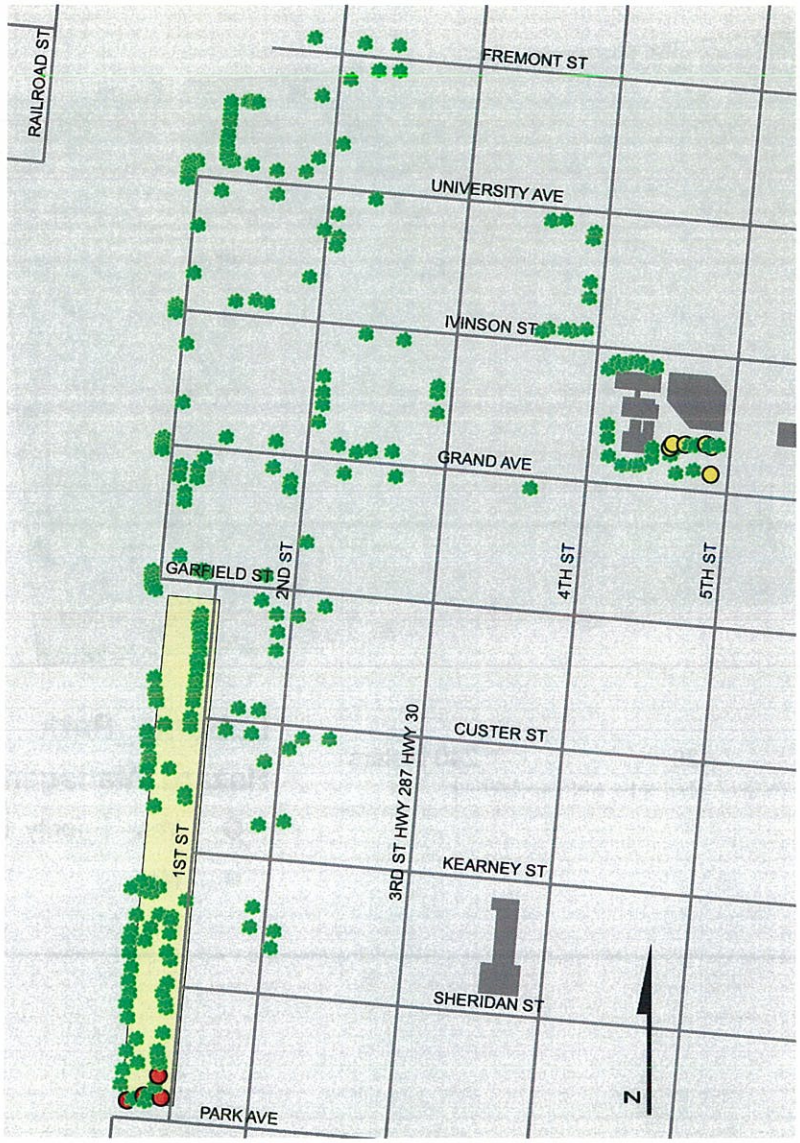
Species	Number of Trees	Percentage of Total	Ave. Dbh (in.)	Ave. height (ft.)	Ave. Condition	Ave. Value	Total Value
Pine, Austrian	4	0.6	11	30	Good	$2,722	$10,888
Fir, Other	3	0.5	14	70	Good	$6,088	$18,265
Birch	2	0.3	4	23	Fair	$278	$556
Elm, Siberian	2	0.3	24	70	Fair - Poor	$7,517	$15,033
Oak, Bur	2	0.3	3	15	Good - Fair	$233	$467
Pine, Other	2	0.3	10	30	Good	$3,050	$6,099
Pine, Ponderosa	2	0.3	11	35	Good	$3,390	$6,780
Apple, Other	1	0.2	5	15	Fair	$505	$505
Ash, White	1	0.2	3	35	Fair	$183	$183
Larch	1	0.2	3	25	Fair	$154	$154
Mountain-ash	1	0.2	3	10	Good	$257	$257
Pine, Mugo	1	0.2	5	20	Fair	$525	$525
Total	**646**	**100.0**	**14**	**51**	**Good**	**$6,488**	**$4,191,434**

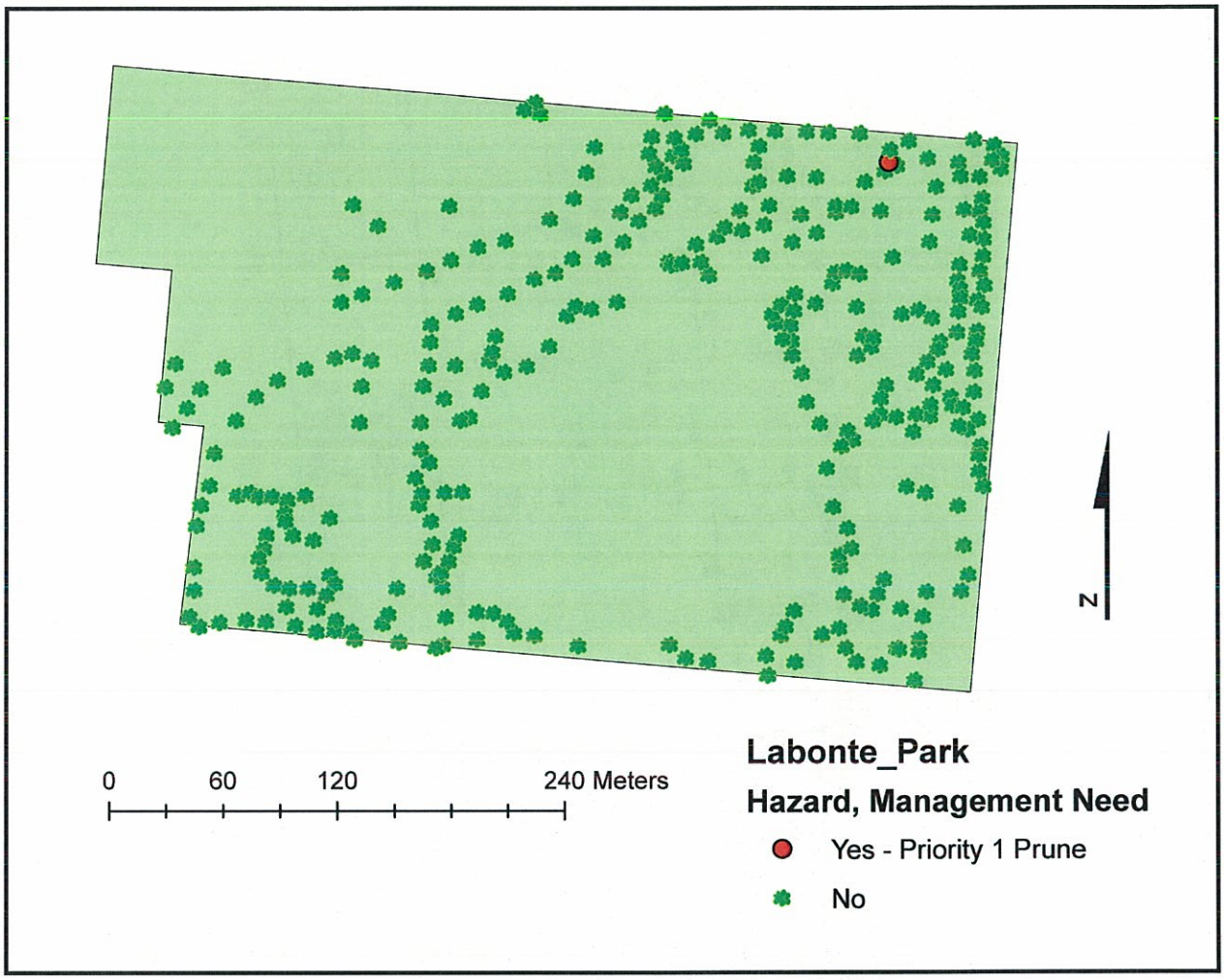
Common Name	Latin Name	Description
Small Trees		
Apple, Common	*Malus pumila*	Most cultivated apples are hybrids of M. pumila and are distinguished primarily by their fruit characteristics.
Apricot, Manchurian	*Prunus armeniaca var. mandshurica*	Small fast-growing tree. Rounded, spreading form, winterhardy, and drought resistant. Attractive white flowers, golden orange fall color and edible fruit.
Cherry, Flowering	*Prunus spp*	There are many varieties of flowering cherry that produce beautiful spring colors and attract birds.
Chokecherry, Amur	*Prunus maackii*	A small to medium upright tree with white flowers. The distinctive bark provides year-round accent to any landscape.
Crabapple, Flowering	*Malus* hybrids	Ornamental crabapples are a group of small flowering trees used for landscape plantings.
Crabapple, Siberian	*Malus baccata*	Siberian crabapple is the hardiest species of the Malus genus and produces white flowers.
Hawthorn, Toba	*Crataegus x Mordenensis 'Toba'*	Broadly rounded, low-branched tree with wide-spreading. Attractive white flowers and red fruit, thorny stems.
Hawthorn, Russian	*Crataegus ambigua*	A small ornamental tree that will grow 15 to 20 feet in height. Resists cedar apple rust and has low to very low water needs.
Hawthorn, Thornless Cockspur	*Crataegus crus-galli*	An excellent small tree with a widespreading plant form. Foliage is dark green and very glossy.
Hawthorn, Downy	*Crataegus mollis*	Planted as an ornamental because of the large white flowers in the spring and crimson fruit in the fall. Fall color is yellow.
Ironwood (American Hop-hornbeam)	*Ostrya virginiana*	Also known as American Hop-hornbeam. A small, slow growing tree. Leaves resemble elm but it is in the Birch family.
Lilac, Japanese Tree	*Syringa reticulata*	A very large shrub or small tree with stiff, spreading branches. Large showy flowers. Attractive winter fruit display.
Maple, Amur	*Acer ginnala*	A tall shrub or small tree native to northern Asia. Outstanding bright reddish fall colors.
Maple, Bigtooth	*Acer grandidentatum*	Also known as western sugar maple. It is desirable for its beautiful red fall color and good drought tolerance.
Maple, Tatarian	*Acer tataricum*	A very tall shrub to small tree, slightly larger in stature than Amur maple. Duller foliage and yellowish fall color.
Mayday Tree	*Prunus padus*	One of the first trees to leaf out and bloom in spring. Has low to moderate water needs and is drought resistant.
Mountain-ash, Oakleaf	*Sorbus x hybirdia*	Slow growing, compact and upright with grayish-green, oak-like foliage. Resistant to fireblight.
Pear, Ussurian (Harbin)	*Pyrus ussuriensis*	The hardiest of all pears, introduced from northeastern Asia. White flowers and semi-glossy foliage.
Plum, Princess Kay	*Prunus nigra`Princess Kay'*	Fast growing small- to medium-sized flowering tree. Spectacular red fall color and winter form.
Plum, Stanley	*Prunus domestica `Stanley'*	The Stanley is by far the most popular plum variety. Late blooming, extremely cold hardy and reliable.
Serviceberry (tree form varieties)	*Amelanchier* spp.	Serviceberry species are excellent large shrubs or small trees that are well adapted to this area. Beautiful white flowers.
Medium and Large Trees		
Ash, Green	*Franxinus pennsylvanica*	A popular medium sized tree that tends to have good form and be resistant to disease.
Ash, White	*Fraxinus americana*	An excellent landscape tree in sites where it is adapted. Fall color develops early and ranges from yellow to redpurple.
Aspen, Quaking	*Populus tremuloides*	Aspen trees grow fairly straight and become clear of lower limbs over time. Rapidly recolonizes disturbed sites. Does better when planted in groups or clusters.

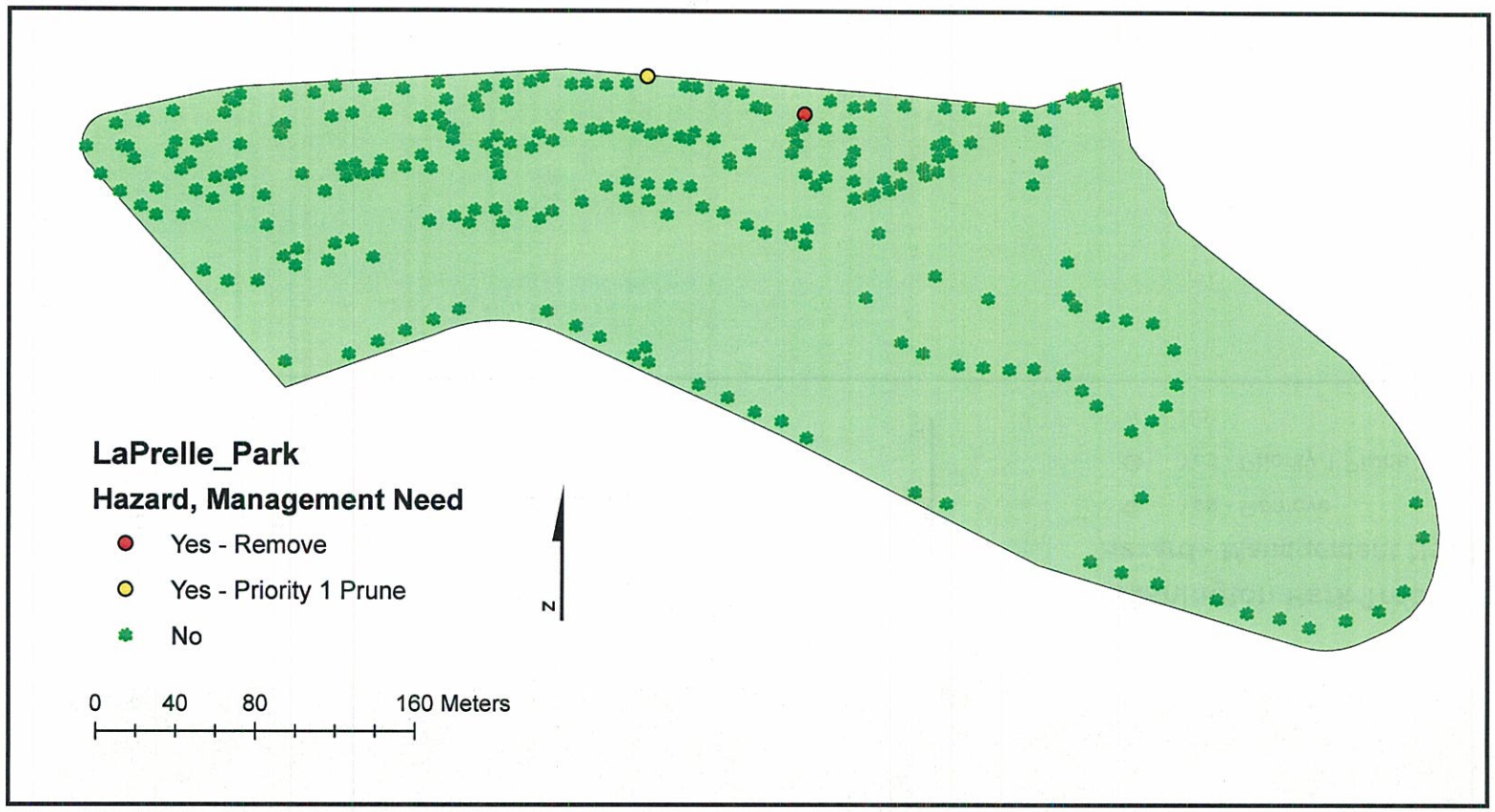
Common Name	Latin Name	Description
Medium and Large Trees		
Birch, Paper	*Betula papyrifera*	Paper Birch is noted for its thin, white papery bark which is very noticeable and attractive. Nice yellow color in the fall. Needs winter watering
Birch, Western Water	*Betula occidentalis*	This smaller tree of many stems prefers wet stream beds. It has smooth reddish-brown bark with horizontal lenticles.
Boxelder, Sensation	*Acer negundo 'Sensation'*	A relatively fast-growing, short-lived, medium to tall tree of irregular form. Stronger wood, red fall color.
Buckeye, Ohio	*Aesculus glabra*	It has a dense oval to round form, branching quite low. The leaves are palmately compound with large globose fruits.
Cottonwood, Highland	*Populus acuminata x sarg.*	An upright oval tree with good disease resistance. Good for smaller spaces compared to other larger varieties.
Cottonwood, Lanceleaf	*Populus x acuminata*	These tree has tear drop shaped. It is native along streams and produces numerous root suckers.
Cottonwood, Narrowleaf	*Populus angustifolia*	The narrowest leaf of the cottonwoods with a somewhat narrow crown. Needs abundant water and has weak wood and/or branch structure.
Cottonwood	*Populus deltoides*	Native throughout the west in moist soils along streams and wetlands. Branches have a tendency to break during storms.
Elm, American	*Ulmus americana*	A large, fast growing tree with a broad vase shape. Leaves are medium green, turning yellow in the fall.
Elm, Hybrid	*Ulmus x spp.*	A disease resistant variety of elm that resembles American elm. It it tolerant of most urban conditions.
Elm, Japanese	*Ulmus davidiana* var. *japonica*	Has a form more similar to the American Elm than most other species. Resistant to Dutch Elm Disease.
Hackberry, Common	*Celtis occidentalis*	A good replacement tree for the American Elm because of its similar form. The bark is gray and has a warty texture.
Honeylocust, Common	*Gleditsia triacanthos*	A fast-growing medium-sized tree adapted to a wide variety of soils. Seedlings are very susceptible to winter dieback.
Horsechestnut	*Aesculus hippocastanum*	Horsechestnut is very adaptable to a wide range of favorable or harsh environmental conditions.
Linden, American (Basswood)	*Tilia americana*	An excellent landscape tree for large scale sites. Desirable for its large stature, shade and aromatic flowers.
Linden, Littleleaf	*Tilia cordata*	Desirable specimen tree in the landscape. The flowers are highly fragrant. Widely used as a street tree and for landscaping.
Maple, Autumn Blaze	*Acer x freemanii*	A hybrid between Silver and Red Maple. Combines the aesthetic qualities of Red with the tolerance of Silver.
Maple, Norway	*Acer platanoides*	An attractive landscape tree that is tolerant of urban conditions. Has a dense, round to broad oval crown.
Oak, Bur	*Quercus macrocarpa*	Bur Oak is a large, rugged tree. It is extremely adaptable to a wide range of environmental conditions.
Oak, Gambel	*Quercus gambellii*	A shrub or small tree growing 6 to 30 feet tall. The Gambel oak is used by deer and elk as browse.
Oak, Northern Red	*Quercus rubra*	A handsome large tree. Leaves are dark green and develop excellent fall colors. One of the faster growing oaks.
Walnut, Black	*Juglans nigra*	Considered the most valuable timber tree. The tree is borderline hardy and seedlings may experience some winter dieback.
Conifers		
Douglas-Fir, Rocky Mountain	*Pseudotsuga menziesii* var. *glauca*	A large forest tree native to the Rocky Mountains. Very important tree in the lumber industry.
Fir, White (Concolor)	*Abies concolor*	An attractive conifer and outstanding landscape plant. It has a formal pyramidal shape. Excellent as accent plant in landscape.

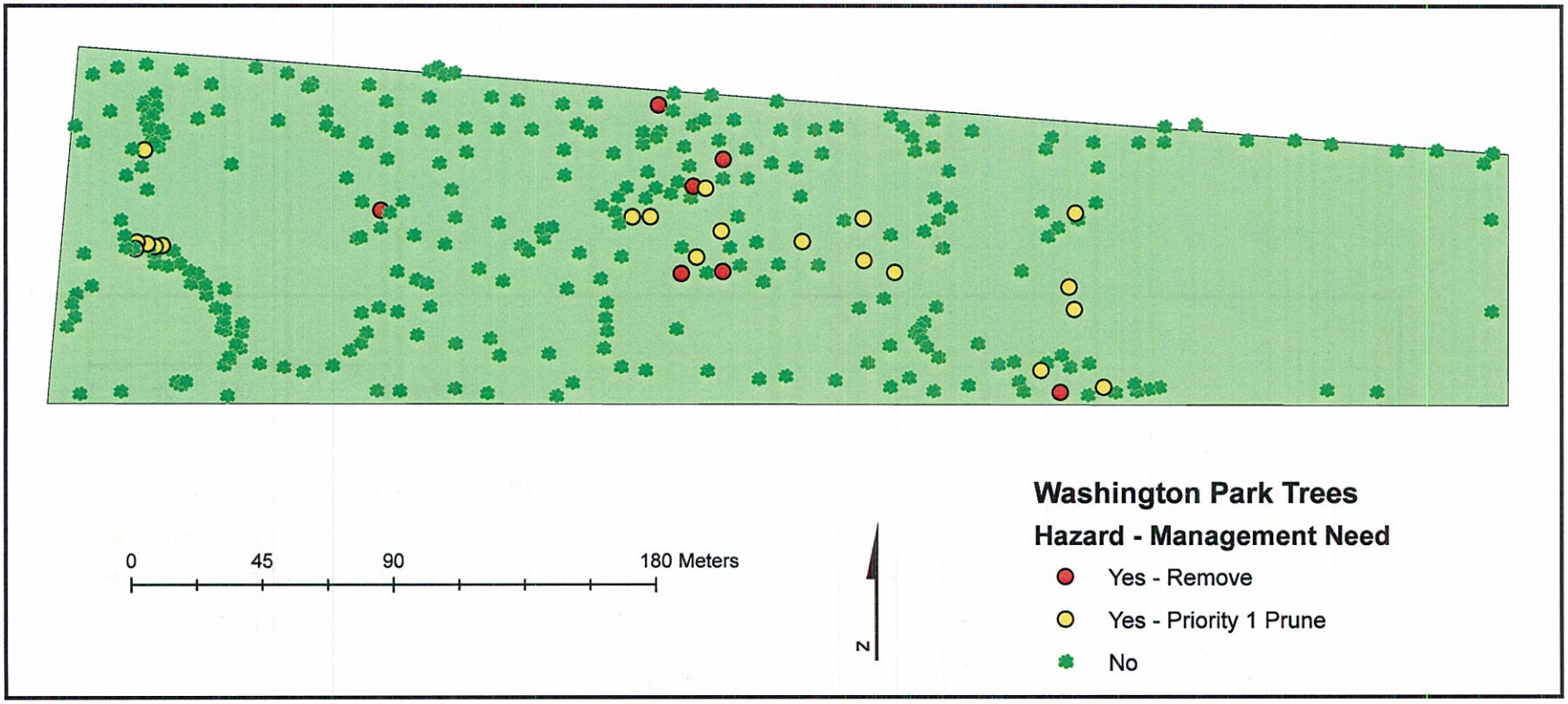
Common Name	Latin Name	Description
Conifers		
Juniper, Rocky Mountain	*Juniperus scopulorum*	A small to medium tree, typically with a dense pyramidal crown. Can be used effectively for screens or hedges.
Larch, European	*Larix decidua*	A large growing species with graceful pendulous branchlets. Makes an excellent landscape tree where space permits.
Pine, Austrian	*Pinus nigra*	Crown develops a picturesque spreading crown with age. Adapts to urban conditions better than most pines.
Pine, Limber	*Pinus flexilis*	A small to medium pine with an uneven crown. Often multi-stemmed. less susceptible to salt and winter burn injury than others.
Pine, Lodgepole	*Pinus contorta* var. *latifolia*	This tree is a major timber species for dimension lumber. In dense stands it forms clean, gradually tapering shafts
Pine, Mugo	*Pinus mugo*	A small to large sized shrubby evergreen which varies in form and size. Dark green color year-round and resists winter burn.
Pine, Pinyon	*Pinus edulis*	A bushy, resinous tree with a short trunk. Prefers full sun and is very drought resistant.
Pine, Ponderosa	*Pinus ponderosa*	In the landscape, Ponderosa Pine has a broad pyramidal form when young, developing a rounded crown with age.
Pine, Scotch	*Pinus sylvestris*	A medium to large tree, pyramidal when young, becoming more rounded and open with age. Orange brown peeling bark.
Spruce, Black Hills	*Picea glauca* var. *Densata*	A large tree, very dense and pyramidal when young. Not as drought tolerant as Colorado Spruce.
Spruce, Colorado (Blue)	*Picea pungens*	Colorado Spruce is a stiffly pyramidal evergreen conifer. Foliage occurs in a wide range of colors from green to silver blue.
Spruce, Englemann	*Picea Englemannii*	A major component of high-elevation forests. Mature trees have a narrow, pyramid form and short, compact branches.
Spruce, Norway	*Picea abies*	The fastest growing of the spruces. It has a pyramidal form, developing long, pendulous branchlets with age.


N
0
65
130
260 Meters
Greenhill_Cemetery
Hazard, Management Need
Yes - Remove
No


RAILROAD ST
FREMONT ST
UNIVERSITY AVE
IVINSON ST
GRAND AVE
GARFIELD ST
2ND ST
4TH ST
5TH ST
CUSTER ST
3RD ST HWY 287 HWY 30
1ST ST
KEARNEY ST
SHERIDAN ST
PARK AVE
N
0
80
160
320 Meters
Downtown
Hazard, Management Need
Yes - Priority 1 Prune
No
Depot Park
Hazard, Management Need
Yes - Remove
No


N
0
60
120
240 Meters
Labonte_Park
Hazard, Management Need
Yes - Priority 1 Prune
No


LaPrelle_Park
Hazard, Management Need
Yes - Remove
Yes - Priority 1 Prune
No
N
0
40
80
160 Meters


0
45
90
180 Meters
N
Washington Park Trees
Hazard - Management Need
Yes - Remove
Yes - Priority 1 Prune
No

How to Recognize - and Prevent - Hazard Trees

When damage, injury or death occurs because of a defective tree, the law usually holds the tree's owner responsible. (In a public place such as a park, this responsibility shifts to the managers of the tree.) Under the law, it is your duty to exercise care, good judgment, caution and foresight by inspecting your trees regularly and recognizing situations that may cause them to break or fall.

What is a Hazard Tree?

A hazard tree has a structural defect that may cause the tree or a portion of the tree to fall on someone or something else of value. This is a legal gray area, but for a tree to be a hazard, a target must be within the falling distance of the tree or the part that fails. A target means people, vehicles and structures. Therefore, a defective tree in the woods or an open field, or away from paths in an arboretum need not necessarily be considered a hazard. To look for hazardous conditions, inspect each tree systematically. Start by scanning the top, using binoculars if necessary. After reviewing the crown, look downward along the trunk, then carefully examine the root zone.

- **Examine the Top and Crown** - Some species are simply more brittle than others. This is one reason why city ordinances sometimes prohibit or discourage trees such as willows, box elders and silver maple. Plant these trees only in open areas. If they already exist on your property, a minimum precaution would be to avoid locating play areas or patios beneath these trees.
- **Know the Tree's History** - Sometimes past events warn of potential trouble. For example, previous topping will almost invariably result in weakly attached regrowth. Similarly, broken branches with stubs not pruned, or sprout-like regrowth after storm damage, set the stage for breakage. Recent, seemingly unexplained loss of large limbs may also be a sign of internal problems.
- **Determine if the Tree is Dead or Dying** - With the exception of trees for wildlife where structures or human traffic are absent or rare, dead and dying trees should be promptly removed. Felling a large tree is extremely dangerous. Call an expert to do the job.
- **Check for Dead Branches** - Loggers call dead branches widowmakers and treat them with great respect. Homeowners should do likewise. Dead limbs are an accident waiting to happen. They can fall in the slightest breeze, when a mower bumps the tree, or a child climbs in it. They sometimes give way even on a calm day. Dead limbs are a red-flag signal for prompt action.
- **Check for Branches that Cross or Rub** - Branches that cross or rub invariably lead to weak spots. These should be pruned off as soon as they are spotted, and the smaller the better.
- **Determine the Tree's Vigor** - Evaluating a tree's vigor is somewhat subjective. However, experts say it is the surest early warning that there is a serious health problem in a tree. Vigor is reflected in the amount of leaf cover, and leaf size, color and condition. By comparing your tree with others of like size, you will be able to detect a less vigorous crown.

Examine the Trunk

- **Watch for Forked Trunks** - Forked trunks are signals of potential weakness, especially if one side of the fork has grown outward instead of upward like the other. Narrow-angled forks are also prone to infection, often indicated by sap or pitch being exuded. Early pruning of one side of the fork can prevent these problems; cables or braces are corrective actions taken by arborists to strengthen the fork in trees of higher value.
- **Look for Tree Balance** - Leaning or lopsided trees present more of a hazard than those growing vertically, but if a tree has always grown off center, it generally is not an undue risk. However, any sudden lean indicates breakage or weakening of support roots and should be cause for alarm and immediate action.
- **Look for Signs of Decay** - Clues to internal decay of the trunk or large branches are cavities, disfiguration (cankers) and the fruiting bodies of fungi (conks). Sometimes there are no outward indications. Arborists then use one of the methods shown below to check for decay.
- **Examine Wounds and Cracks** - Any trunk wound is an opening for decay. Wounds extending into the ground, including lightning scars, should be of particular concern and examined regularly. Some cracks, such as frost cracks, have little effect on the strength of a trunk. However if two vertical cracks appear on opposite sides of the tree, it can be a sign of root injury or breakage. It is usually associated with a circumferential separation of wood internally and is extremely dangerous.

Don't Forget the Roots

Root decay is often insidious and difficult to detect. Noted tree expert Dr. Alex L. Shigo calls the organisms that cause root problems "the sneaky fungi." Sometimes their work in weakening support roots goes completely unnoticed because the smaller feeder roots may go right on absorbing water and lawn fertilizer. Then, suddenly, one day the tree falls over. To detect root decay, look carefully for "mushrooms" on or near the base of the tree. If found, or if root trouble is suspected, have an arborist dig up some roots to sample for decay organisms. Trenching or construction within the root zone is a major cause of hazard trees. The problem is two- pronged. First, severed roots lose their ability to support the trunk and crown, especially if located on the windward side of the tree. Second, severed roots are open wound that invite decay organisms.

Checklist for Preventing Hazard Trees

- Inspect your trees carefully several times each year and in all seasons. Annually, have a qualified arborist inspect your trees and provide you with a written report.
- Avoid planting brittle species where falling limbs could injure people or property.
- Prune trees when they are young and regularly thereafter.
- Use correct pruning methods, always making the pruning cut outside the branch collar.
- Don't allow trees to be topped.
- Always plant the right tree in the right place. For example, avoid planting large-growing trees under power lines, or too close to your house, and make sure the species selected matches the soil and other site characteristics.
- Water deeply during dry periods, slowly applying at least 1" of water.
- Erect barriers around or slightly beyond the dripline of trees during construction. Insist that these root protection zones be honored by construction workers.

- Consider cabling or bracing weak forks or branches in older trees of high value. This is work or a professional arborist.
- Do not plant trees with narrowly-forked stems.
- Where a high value tree may be suspected of developing into a hazard, use landscaping to keep people at a safe distance. This may require techniques such a re-routing walks, moving patio furniture, or planting shrubs and hedges as barriers to foot traffic.
- **Remember:** a heathy, vigorous tree that receives regular care is less likely to become a hazard than one that is ignored. Prevention is the best solution to the tree hazard problem.

1. *This document is Fact Sheet DH 102, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611. Publication date: June 1993. It was originally published by the National Arbor Day Foundation.*

Pruning

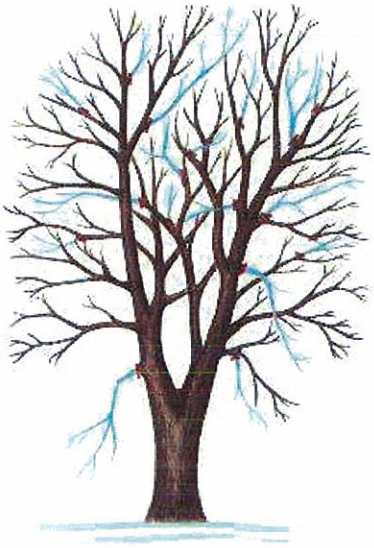
Developing, mature, and over mature trees in the parks may be recommended for one or more of the following pruning activities:

Cleaning – shall consist of the selective removal of one or more of the following parts: dead, diseased and broken branches, water sprouts, root suckers, crossing and poorly attached branches

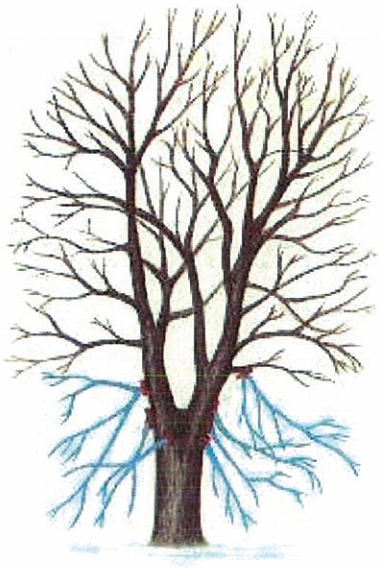
Thinning - shall consist of the selective removal of all parts listed in cleaning plus selective pruning to increase light penetration, air movement and/or to reduce weight in the crown. Thinning should result in an even distribution of branches on individual limbs and throughout the crown.

Raising – shall consist of the selective pruning to provide vertical clearance.

No more than 25% of the crown should be removed within an annual growing season for any of the above pruning activities.



Crown Thinning



Crown Raising

Once the majority of the recommended pruning has been completed, a pruning rotation should be developed for the public trees. Developing trees should be pruned on 12-15 year rotation. Mature trees should be pruned on a 3-10 year rotation. Within the mature category, trees in good condition should be pruned every 8-10 years. Trees in fair condition should be pruned every 5-8 years and trees in poor condition and trees within the over mature category should be pruned every 3-5 year.

Appendix D – Fact Sheets on Insects and Diseases

DISEASES

Bacterial Wetwood

no. 2.910

by W.R. Jacobi [1]

Quick Facts...

Bacterial wetwood is a common disease that affects the central core or bark of many shade and forest trees.

Slime is the exudate generated from wetwood and is toxic to growing areas of the tree.

Several insects commonly feed on this slime.

Wetwood-infected tissue does not greatly alter the wood strength of most trees.

Prevention of tree stress is the best management approach. Effective control measures do not exist.

Bacterial wetwood is a common disease that affects the central core of many shade and forest trees. In Colorado, the disease is most prevalent in elm, cottonwood, aspen and willow. The disease also affects species of ash, fir, maple, birch, hickory, beech, apple, mulberry, oak, sycamore, poplar, cherry, plum and linden.

Figure 1: Wetwood slime.

Causal Organism

Several bacteria, including species of *Enterobacter*, *Klebsiella* and *Pseudomonas*, often are associated with wetwood. It has not been conclusively demonstrated that these bacteria cause the disease, but they are directly involved.

Symptoms

Symptoms of this disorder include a yellow-brown discoloration of the wood, generally confined to the central core of the tree. This affected wood is wetter than surrounding wood and is under high internal gas pressure. The gas pressure and high moisture content cause an oozing or bleeding of slime from wood and branch crotches. The ooze often is foul-smelling, slimy, and colonized by yeast organisms when exposed to air (Figure 1). When the slime dries, it leaves a light gray to white crust on the bark (Figure 2). Orange shinny ooze on aspens is usually from insect borer damage not wetwood.

Wetwood slime is toxic to the cambium, the tissue between the inner bark and wood that produces new cells. It can prevent or retard callus formation when the tree has been wounded or destroy the cambium at the base of a pruning cut (Figure 3). Foliage, young shoots and grass die if slime flux drips on them.

Wetwood also can be found just under the bark as dark streaks in the current season's wood or as a discoloration in several annual rings within the spring wood. This cambial or "surface"wetwood is common on drought-stressed cottonwoods and globe willows. Root tissue also can exhibit wetwood symptoms as brown streaks extending from the diseased trunk into the center core and sometimes the outer wood of roots. On globe willows, white foam commonly is seen in affected areas.

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Figure 2: Dried slime.

Figure 3: Retarded callus formation.

Radial cracks may also occur in wetwood-affected trees (Figure 1). These cracks probably develop during winter months. If the cracks extend to the cambium, they serve as avenues for slime and gas to escape. The slime also will kill the surrounding cambium.

The buildup of gas pressure is a by-product of bacterial activity. In elms, it consists mainly of methane and nitrogen. Recent studies show the highest gas pressure occurs in elms from May through August.

Wetwood-infected tissue slightly alters the strength properties of the wood. However, it inhibits the development of wood-rotting fungi, which are unable to grow in the affected wood because of lower oxygen content. Wetwood also causes warpage and splitting problems when boards cut from affected trees are dried.

Transmission

Bacteria associated with wetwood are common in soil and water and probably enter trees through root wounds. Where oozing occurs, the bacteria could be transferred to a new stem or branch wounds. Wetwood also may occur in seedlings that develop from infected seeds or from infected parent material in vegetatively propagated plants.

Management

No effective methods exist to eliminate wetwood disease. Preventing damage and stress to a tree's roots and stem is the best way to avoid a serious wetwood problem. Drought conditions increase wetwood problems, so it is important that the tree receives adequate water, especially during spring and summer months.

Recently transplanted trees may ooze slime if roots are not established and cannot supply adequate water. Fertilizing wetwood-infected trees is recommended if the tree shows nutrient deficiencies.

To help prevent disease spread within an infected tree, keep any injection holes shallow so they do not reach the inner wetwood core. If they do reach this core, the bacteria can spread outward. Drain tubes can help release pressure in those trees where wetwood is confined to inner cores — the slime oozes out the tube instead of somewhere else. However, this creates another wound that allows the bacteria to spread outward. This practice also introduces more oxygen into the tree's system and can possibly allow wood decay. Thus, drain tubes are not recommended.

In trees affected with cambial wetwood just below the bark, cut away the dead bark areas to allow for better wound closure. Remove discolored bark down to the wood and margins of the healthy yellow-green cambium. If this area exceeds 30 percent to 50 percent of the trunk circumference, the tree may not close the wound or be an aesthetically pleasing tree. If, however, the area is small, shape with clean, smooth edges.

Associated Insects

Several insects commonly visit the oozing slime and feed on it. Various flies and sap beetles often are seen on the slime. Larval stages of these insects may develop within the wounded area. Among the most striking insects that visit oozing slime are bumble flower beetles, a hairy species of June beetle that sometimes clusters in large numbers. None of the insects that visit slime flux wounds are known to transmit the bacteria and there is no need to control them.

[1]*Colorado State University professor, bioagricultural sciences and pest management.*

G A R D E N I N G S E R I E S

DISEASES

Cytospora Canker

no. 2.937

by W.R. Jacobi [1]

Quick Facts...

Cytospora canker occurs on woody plants or parts of plants that are weak or stressed.

Many trees are affected by this disease, including aspen, birch, cottonwood, poplar, spruce, willow, ash, maple, elm, peach and apple.

To manage the disease, reduce stress on trees, use resistant plants, remove infected limbs, clean wounds and prune properly.

Cytospora canker is caused by various species of the fungus *Cytospora*. These pathogens affect many species of trees in Colorado, including aspen, cottonwood, lombardy and other poplars, apple, cherry, peach, plum, birch, willow, honeylocust, mountain ash, silver maple, spruce and Siberian elm. Based on recent studies at Colorado State University, some *Cytospora* species are host specific and will not spread to other tree species. Aspen and cottonwoods are attacked by the same fungus. Willow, green ash, alder and elm, however, are attacked by fungi that seem host specific.

The fungus attacks trees or parts of trees that are injured or in a weak or stressed condition. It can cause their death. Trees affected by drought, insects, defoliation by fungi, sunscald, herbicides, or mechanical injury are susceptible to cytospora infection.

The disease especially affects trees with root damage, which are often found in areas under construction, or trees that have been recently transplanted. Stands of aspen that have been thinned and young aspen sprout stands may suffer from cytospora canker.

Symptoms

The symptoms of this disease are yellow or orange-brown to black discolored areas on the bark of the trunk and branches (Figure 1). Liquid ooze on aspen and gummy ooze on peach and cherry are common. Cankers, sunken dead areas of bark with black pinhead-sized speckling or pimples, may be evident (Figure 2). The pimples are the reproductive structures of the fungus. Under moist conditions, masses of spores (seeds) may ooze out of the pimples in long, orange, coiled, thread-like spore tendrils (Figure 3). Reddish brown discoloration of the wood and inner bark also may be evident. Dead bark may remain attached to the tree for several years, then fall off in large pieces.

On spruce trees, the disease appears as sunken areas surrounded by swollen callus giving a gall-like appearance. Small black fruiting bodies may occur on the canker. Once the branch is girdled, needles may yellow or redden. The branch eventually dies. Large amounts of resin flow from infected areas, coating branches and stems. Unless you see sunken areas surrounded by swollen callus, resin flow on spruce may indicate that other stresses, diseases or insects are affecting the tree.

Control

Because this canker usually occurs on a weakened host, the first and foremost method of control is to prevent infection by preventing stress on the tree. Drought and flooding soil with water are the two most common stresses that predispose trees to cytospora infection.

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Figure 1: Orange discoloration found in spring and early summer associated with cytospora canker.

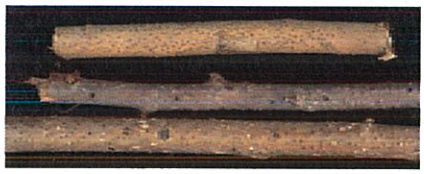

Figure 2: Cytospora canker on three branches, each with scattered pycnidia.

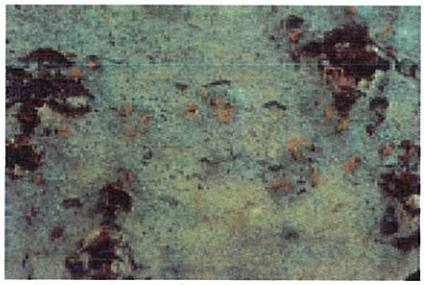

Figure 3: Orange spores oozing from pycnidia.

To help a tree resist infection, prepare soil before planting, fertilize, water properly for winter and summer, prune, and avoid injury to the trunk and limbs. Proper care of recently transplanted trees also is essential to avoid stress and infection. See fact sheets 2.932, *Environmental Disorders of Woody Plants*, and 7.833, *The Science of Planting Trees.*

Wounds caused by lawnmowers and weed trimmers are prime targets for infection on trees in landscaped areas. Insects, such as oystershell scale, stress the tree and predispose it to cytospora infection. They should be controlled.

Help prevent cankers at pruning wounds on peach and cherry trees by applying labeled fungicides as wound dressings. The effectiveness of fungicides on other trees is not known. Research on other diseases indicates effectiveness is probably limited.

Another way to prevent cytospora damage is to use resistant species or varieties in new plantings (Table 1). Remember, resistant does not mean the plant is immune, just better able to defend itself against the pathogen than some other tree. It is still important to keep all trees healthy. Purchasing healthy nursery stock will decrease the possibility of infection.

Once infection occurs, the best treatment is to increase plant vigor and sanitation. Remove all infected limbs and other areas. When removing branches, make a smooth cut at the base of the limb, as near the trunk as possible, without damaging the branch collar (swollen area at base of branch). Jagged and rough cut surfaces promote infection.

Clean wounds to avoid further spread of infection. Remove dead bark to dry out the diseased area and help the tree defend itself against insect and fungal attacks on the cankered area. Directions for proper wound and canker treatment are as follows:

- Prune or cut trees only during dry weather.
- Clean tools and wipe them with ethyl alcohol, Lysol or other disinfectant. Clorox may be used at a concentration of one part Clorox to nine parts water.
- If a wound is fresh (one month old or less), use a sharp knife to carefully cut and remove all injured or diseased bark back to live, healthy tissue. If the wound is older, just remove loose bark pieces. It is important not to cut, remove or damage callus that may be forming at the canker edge. Callus will look like swollen bark growing across the dead area. Scrape the wound surface clean of loose bark.
- Clean tools and disinfect after each cut.
- Cleaned wounds should not have any sharp angles.
- Do not apply any tar, oil-based paint or other wound dressing. The best method to prevent infection or decay is to allow the cleaned tissue to dry out.

Table 1: Some resistant species and cultivars.

Ash	All cultivars.
Aspen	Resistant cultivars not commercially available.
Cottonwood	Cultivars Noreaster, Platte, Mighty Mo, Ohio Red. Avoid Lombardy, Bolleana, Sioux Land.
Elms	
Hackberry	
Honeylocust	All cultivars.
Junipers	
Lindens	Big and little leaf.
Maples	Most species and cultivars.
Pines	

[1] *Colorado State University professor, bioagricultural sciences and pest management.*

Quick Facts...

Aphids occur on almost all types of trees and shrubs. They usually do not damage plants and are controlled by natural enemies such as lady beetles.

Problems most commonly occur where aphids produce leaf curls, such as on ash, plum, honeysuckle and snowball viburnum.

Check for natural enemies before treating with insecticides.

Systemic insecticides are particularly effective when aphids have curled the leaves.

Contact insecticides and soaps are useful when aphids are exposed on leaves.

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Putting Knowledge to Work

TREES & SHRUBS

Aphids on Shade Trees and Ornamentals no. 5.511

by W.S. Cranshaw [1]

Dozens of species of aphids (plant lice) may be found on shade trees and woody ornamental plants in Colorado. Aphids are small insects, typically less than 1/8 inch, although some may be almost 1/4 inch long. Colors range from bright orange or red to dull gray. One common group, woolly aphids, produces an abundance of flossy, waxy threads that cover their bodies. Winged and wingless forms can be produced by all Colorado aphid species (Figure 1).

Aphids feed on plants by sucking plant sap from the leaves, twigs or stems. When abundant, aphids remove large quantities of sap, reducing plant growth and vigor. This injury is most common with stem- or trunk-infesting aphids, such as the woolly apple aphid and juniper aphid. Aphids feeding on developing leaves also can produce leaf curl injuries. This is most frequently observed on snowball viburnum, honeysuckle, plum and ash.

Most aphids excrete large quantities of a sweet, sticky substance called honeydew. At times, excessive honeydew dropping from trees can be an extreme nuisance. Also, sooty mold fungus may grow on the honeydew, producing a gray, unattractive covering of the leaves. Sooty mold is not damaging to the trees except when it covers leaves and temporarily reduces photosynthesis.

Ants often are attracted to honeydew and feed on it. Ants may even tend aphids and other honeydew-producing insects (certain scales, leafhoppers, treehoppers), protecting them from natural enemies such as lady beetles and lacewings. (See fact sheet 5.550, *Beneficial Insects and Other Arthropods.*) Often the presence of ants crawling up trees or on foliage indicates that large numbers of aphids or other honeydew producers also are on the plants.

Typical Aphid Life History

Most species of Colorado aphids overwinter as eggs on specific types of woody plants. Eggs hatch in the spring. The following spring and summer, forms of the aphid sometimes move from overwintering plants to other plant species. Summer aphids consist entirely of females that give birth to live young at a rate of one to 20 per day.

The newly hatched aphids can complete their development within one to two weeks, after which they begin to produce more aphids. Consequently, aphid populations may increase rapidly, with several generations occurring during the growing season. At the end of the summer, both male and female aphids are produced. They mate on the overwintering host plant, and females lay eggs.

Control

Many kinds of insects naturally prey upon aphids. Most common are various species of lady beetles (ladybugs), green lacewings, syrphid flies and small parasitic wasps. Under many conditions, these beneficial insects provide effective control of aphids. Before applying any insecticide, check the plants to

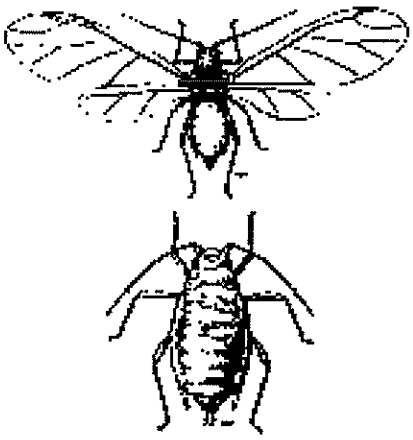

Figure 1: Adult aphids — winged and wingless.

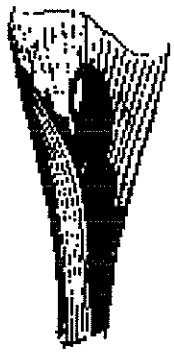

Figure 2: Aphid eggs deposited on a leaf (enlarged).

Table 2: Insecticides for control of aphids on shade trees and ornamentals.

Soil-applied systemic insecticides
imidacloprid
disulfoton
Foliar-applied systemic insecticides
acephate
dimethoate
Contact foliar-applied insecticides
insecticidal soaps
malathion
esfenvalerate
Dormant season applications
horticultural oils

Always carefully read and follow all label instructions. Failure to do so can result in excessive exposure to people, pets and wildlife and leave damaging residue on plants.

[1]Colorado State University Cooperative Extension entomologist and professor, bioagricultural sciences and pest management.

make sure these natural controls are not already reducing aphid numbers. Sometimes ants interfere with these natural controls. Excluding ants with sprays, sticky bands, etc., can allow biological controls to be effective.

When natural enemies are not abundant enough to provide aphid control, insecticides sometimes are needed to prevent plant injury. For most aphid problems, particularly those associated with leaf curls, insecticides that move systemically within the leaf or plant provide the best control. The most common systemic insecticide available to homeowners is Orthene (acephate). Cygon (dimethoate) also may be available as a spray for use on evergreens.

Some insecticides can be applied to the soil and taken up by the roots of the plants. These are called *systemic* insecticides. The most recent, Imidacloprid, is sold under the trade name Bayer Advanced Garden Tree & Shrub Killer Concentrate. (Merit is the trade name of imidacloprid used by professional tree care companies.) It is applied as a drench over the root zone. An older—and much more toxic—soil systemic insecticide that is still available for some ornamental plant uses is DiSyston (disulfoton). DiSyston is sold as granules or in plant food mixtures for soil application.

There are several insecticides effective for aphid control when sprayed on plants. Perhaps most effective are those with systemic activity that allows them to move through the plant. Acephate (Isotox, Orthene) is the most widely available systemic insecticide. Dimethoate (Cygon) is less commonly available and is mostly used for aphids on evergreens. Other insecticides used as sprays that have activity against aphids include insecticidal soaps (see fact sheet 5.547, *Insect Control with Soaps and Detergents*) malathion, and esfenvalerate.

Many of the aphids that curl leaves and produce problems in spring originate from eggs that remained on the plants during winter. Before bud break and egg hatch these eggs can be killed with sprays of horticultural oils (see fact sheet 5.569, *Insect and Mite Control: Spray Oils*). Such a use of oils is often described as a 'dormant oil' application, since it is applied before the plants produce new growth in spring.

On smaller trees aphids may be controlled by use of high pressure sprays of water. Hosing plants can also remove the sticky honeydew that aphids excrete.

Table 1: Some common species of aphids in Colorado.

Common name	Scientific name	Hosts
American walnut aphid	*Monellia caryae*	Walnut
Ash leafcurl aphid	*Prociphilus fraxinifolii*	Ash
Birch aphids	Various	Birch
Elm leaf aphid	*Tinocallis ulmifolii*	American elm
Giant conifer aphid	*Cinara* spp.	Conifers
Giant willow aphid	*Lachnus salignus*	Willow
Green peach aphid	*Myzus persicae*	Peach, plum
Honeysuckle witches' broom aphid*	*Hyadaphis tartaricae*	Honeysuckle
Leafcurl plum aphid	*Hyalopterus arundinis*	Plum
Oak aphids	*Tinocallis* sp.	Oak
Rose aphid	*Macrosiphum rosae*	Rose
Snowball aphid	*Neoceruraphis viburnicola*	Snowball viburnum
Woolly aphid (various)	*Adelges* spp., *Pineus* spp.	Conifers
Woolly apple aphid	*Eriosoma lanigerum*	Apple, elm

*Discussed in 5.546, *Honeysuckle Witches' Broom Aphid.*

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INSECT SERIES

TREES & SHRUBS

Tent-Making Caterpillars no. 5.583

by W.S. Cranshaw [1]

Quick Facts...

Several species of caterpillars construct a silken shelter or tent.

In spring, tent caterpillars are common. After midsummer, the most common tent-making caterpillar is the fall webworm.

These insects attract attention due to the conspicuous tents. However, they rarely cause any significant injury. Greatest injury occurs from early season defoliation, particularly on stressed plants.

Many biological controls naturally regulate populations of these insects.

Several kinds of caterpillars feed in groups or colonies on trees and shrubs and produce a silken shelter or tent. Most common in spring are various types of tent caterpillars (*Malacosoma* species). During summer, large loose tents produced by the fall webworm (*Hyphantria cunea*) are seen on the branches of cottonwoods, chokecherry, and many other plants. Occasionally early spring outbreaks of caterpillars of the tiger moth (*Lophocampa* species) attract attention.

Tent Caterpillars

Four species of tent caterpillars occur in Colorado. The western tent caterpillar (*M. californicum*) most often is seen infesting aspen and mountain-mahogany during May and early June. Many other plants, particularly fruit trees may also be infested. Western tent caterpillar is the most common and damaging tent caterpillar, sometimes producing widespread outbreaks that have killed large areas of aspen.

In stands of gambel oak, the sonoran tent caterpillar (*M. tigris*) occurs and the *M. incurvatum discoloratum* can be found feeding on cottonwoods and related trees during April and early May in the Tri River area of western Colorado. In northeastern Colorado, the eastern tent caterpillar (*M. americanum*) can occasionally be found on fruit trees.

These tent caterpillars spend the winter in egg masses glued to twigs of the host plant (Figure 1). Prior to winter the insects transform to caterpillars and emerge from the eggs shortly after bud break. The newly emerged caterpillars move to crotches of branches and begin to produce a mass of dense silk.

This silken tent (Figure 2) is used by the developing insects for rest and shelter during the day. They also molt (shed their skins) while on the silk mats. Most often the caterpillars leave the silk shelter to feed at night, returning by daylight, although they sometimes feed during daylight hours as well. The tent is gradually enlarged as the caterpillars grow.

The caterpillars become full grown in late spring. Most wander from the area of the tent and spin a white cocoon of silk, within which they pupate. The adult moths, which are light brown with faint light wavy bands on the wings emerge about two weeks later. The moths mate and the females then lay a single egg mass. Tent caterpillars produce only one generation per year.

The most common and damaging tent caterpillar found in urban areas is the forest tent caterpillar, *M. disstria* (Figure 3). Although its life history is similar to other tent caterpillars, the forest tent caterpillar does not produce a permanent tent as do the other species. Instead, they make light mats of silk on trunks and branches that are used as temporary resting areas during the day. Forest tent caterpillars feed on a wide variety of plants including aspen, ash and various fruit trees. Occasionally they produce outbreaks that can damage plants.

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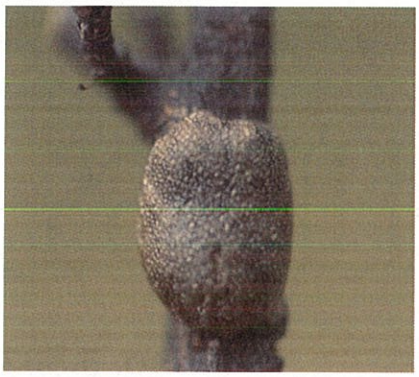

Figure 1: Egg mass of western tent caterpillar.

Figure 2: Tent of western tent caterpillar.

Figure 3: Forest tent caterpillar.

Fall Webworm

Fall webworm (Figure 4) is the most common tent caterpillar observed during midsummer. It is found on a many different plants, although chokecherry and cottonwood are the most common hosts. Winter is spent as a pupa, loosely buried under protective debris in the vicinity of previously infested trees. The adults, a nearly pure white moth, emerge in June and July, mate and lay eggs in masses on the leaves of trees and shrubs. Eggs hatch shortly afterwards. The young caterpillars feed as group, covering the few leaves on which they feed. As they get older, fall webworms progressively cover larger areas of the plant with loose silk, and generally feed within the loose tent that they produce (Figure 5). When full grown, the caterpillars disperse and sometimes create a nuisance as they crawl over fences and sides of homes.

There is only one generation of fall webworm known to occur in Colorado, although two or more generations are produced in parts of Kansas, Oklahoma, Texas and other nearby states.

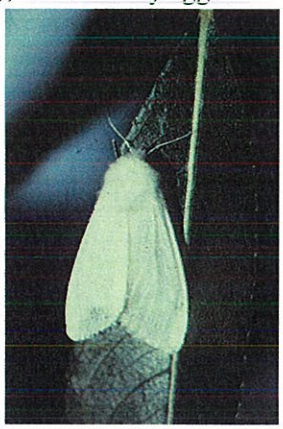

Figure 4: Fall webworm adult moth.

Tiger Moth

Caterpillars of tiger moths (*L. ingens, L. argentata*) make a dense mat of silk on the terminal growth of ponderosa pine, lodgepole pine, pinyon, Douglas-fir, white fir and juniper (Figure 6). They are one of the few caterpillars that continue to feed and develop during winter. They produce and occupy tents through early spring. By June, they complete their development and pupate. The adult moths emerge and fly during July and August, laying masses of eggs that hatch before fall.

Historically, outbreaks of tiger moths occur most commonly in the Black Forest area near Colorado Springs and in West Slope pinyon-juniper stands. Top-kill of damaged trees commonly results from these injuries.

Minor Tent-Producing Insects

A few other insects are found in Colorado that produce silken tents. Pine webworms (*Tetralopha* sp.) can be found tying together foliage of ponderosa pine in areas along the Front Range. Uglynest caterpillars (*Archips cerasivornana*) (Figure 9) can be found on chokecherry, where they produce a messy nest of silk mixed with bits of leaves and insect frass. Outbreaks of the rabbitbrush webbing moth (*Synnoma lynsyrana*) occasionally damage rabbitbrush (Figure 7). There also is an uncommon group of sawflies, known as web-spinning sawflies, that produce mats of silk on spruce, pines or plum.

Control

Many natural enemies attack all of the tent-making caterpillars. Birds, predaceous bugs and various hunting wasps prey on the caterpillars. Tachinid flies and parasitic wasps are important parasites. Tent caterpillars also are susceptible to a virus disease that can devastate populations. Because of these biological controls, serious outbreaks rarely last more than a single season. An exception is found in some communities where fall webworm is an annual problem. One reason for these sustained outbreaks may be the loss of biological controls due to aerial mosquito spraying.

The microbial insecticide *Bacillus thuringiensis* (Dipel, Thuricide, etc.) can be an effective and selective control of all the tent-making caterpillars.

Figure 5: Tent produced by fall webworm.

Figure 6: Tiger moth tent in top of pine.

However, to control fall webworm, Bt must be eaten by the insect. Therefore, it must be applied before the colony covers all of the leaves.

Several contact insecticides also are effective for tent-making caterpillars. Sevin (carbaryl) has long been available. More recently various pyrethroids such as permethrin, cyfluthrin and esfenvalerate are available for homeowner application and are highly effective. Spinosad, a naturally-derived product (sold as Conserve to commercial applicators) is very selective in its effects of species other than caterpillars.

If accessible, tents may also be pulled out and removed. More severe measures, such as pruning or burning, are not recommended because they can cause more injury than the insects.

Often, there is no need to control these insects. This is particularly true for fall webworm, which feeds late in the season. Such late season injuries can be well tolerated by plants. Control normally is warranted only where there is sustained, high levels of defoliation over several years.

Figure 7: Colony of rabbitbrush webbing moth..

Figure 8: Tents of the western tent caterpillar.

Figure 9: Uglynest caterpillar.

[1]*Colorado State University Cooperative Extension entomologist and professor, bioagricultural sciences and pest management.*

INSECT SERIES

TREES & SHRUBS

Oystershell Scale

no. 5.513

by W.S. Cranshaw [1]

Quick Facts...

Oystershell scale is a common insect pest of many woody plants in Colorado.

Oystershell scales feed on the plant by sucking plant sap. Heavy infestations can kill branches and even cause the decline and death of the tree.

In most areas of Colorado, there is only one generation per year.

Oystershell scales overwinter in the egg stage.

The eggs hatch in the spring and the newly emerged insects quickly attach themselves to the plant.

Oystershell scale can be controlled in the winter by using a dormant oil.

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More than 50 plant species in Colorado are attacked by the oystershell scale. Of these, ash, cotoneaster, dogwood, lilac, poplar and willow are most commonly infested.

Oystershell scales attach themselves to the bark of twigs and branches. They feed on the plant by sucking out plant sap and can weaken and even kill the plant when the infestations are abundant.

Description and Life Cycle

The most familiar stage of the oystershell scale is the covering of the full-grown female scale that overwinters attached to the bark (Figure 1). The mother scale is about 1/8-inch long, brown or gray, slightly banded, and the general shape of an oyster shell. The overall appearance of the scale often is similar to that of the underlying bark and these insects are easily overlooked. Old scales can stay attached to the tree for several years before falling off.

The oystershell scale overwinters in Colorado only in the egg stage. Eggs are underneath the old scale covering of the mother. At lower elevations, eggs typically hatch in late May or early June. At higher elevations, egg hatch may be delayed into mid-June.

Eggs from all the scale insects do not hatch at the same time, and egg hatch may last a couple of weeks. Eggs of oystershell scale with two generations per year are reported to hatch earlier than one-generation scales. In most areas of the state, there is only one generation of the insect per year. Where two-generation races exist, second generation egg hatch occurs in July and August.

The newly hatched scale insects are called crawlers. The crawlers are pale and smaller than a pinhead. This is the only mobile stage in the life history of the oystershell scale.

After a few hours, the crawlers find a suitable location, usually on a shaded area of the tree. They insert their mouthparts into the plant, begin to feed and soon molt. They remain in this location for the rest of their lives. Within a week they are covered with a waxy scale that protects them from most insecticides.

Control

Overintering scales can be scrubbed off of small trees and shrubs with a plastic scrub pad. Avoid vigorous scrubbing on thin-barked trees which can be injured.

Where heavy infestations are present but limited to single branches, consider pruning. The scales and eggs on pruned wood should die within a few weeks but some precaution should be made to remove prunings from the vicinity of host trees to prevent possible infestation by crawlers.

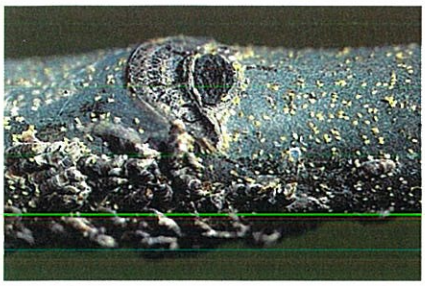

Figure 1: Oystershell scale adults and crawlers.

Oystershell scales can be difficult to control because they are well protected with a thick waxy covering for most of their lives. One popular method for assisting in control is to use a horticultural oil (see fact sheet 5.569, *Insect Control: Horticultural Oils*) before bud break in spring—a 'dormant oil' application. Oils applied during the dormant season can kill many oystershell scales before eggs hatch. However, the wax covering of oystershell scale is a barrier to effective use of horticultural oils during the dormant season and may result in erratic control.

Most horticultural oils can also be used after leaves have emerged. Young oystershell scales—crawlers and newly settled scales—can be killed by oils applied in late spring.

After leaves have emerged oystershell scale is particularly vulnerable during the crawler stage. After this time the waxy cover prevents most insecticides (except oils) from being effective. However, the crawler stage is highly susceptible to almost all insecticides (Table 1).

The occurrence of the crawlers usually occurs in late May or early June, but may vary considerably due to plant location and weather. Weekly examinations of infested plants can detect when the tiny yellow first stages of the oystershell scale have hatched from eggs and move about the plants. Close inspection can detect them, although some magnification is useful. Crawlers can be dislodged for easier view by shaking infested branches over a sheet of paper or tray. Double-sided sticky tape on branches can be used to capture crawlers for inspection.

Several insecticides that have some residual activity can be used to control crawlers during the period they are present (Table 1). Usually a single application applied to coincide with the beginning of the crawler period can kill crawlers for the subsequent few weeks that they are present.

Soil-applied or trunk injected systemic insecticides (e.g., Acecaps, imidacloprid/Merit) are sometimes promoted for control of oystershell scale. Because these materials fail to move in high concentration to the areas of the plant where oystershell scale feeds, control is often poor. Systemic insecticides are not recommended for control of oystershell scale.

Always read and follow label instructions for mixing, usage and application safety.

Table 1: Active ingredients of some insecticides used to control oystershell scale crawlers.

acephate (Orthene)[1]	bifenthrin
carbaryl (Sevin)	cyfluthrin
horticultural oils[2]	permethrin

[1]Acephate may injury foliage of aspen, cottonwood and some flowering crabapples.
[2]Horticultural oils do not have any residual activity and have to be reapplied to control crawlers. However, it can also control stages of oystershell scale after the crawler stage by smothering the young scales that have settled on the bark and begun to feed.

[1]Colorado State University Cooperative Extension entomologist and professor, bioagricultural sciences and pest management.

INSECT SERIES

TREES & SHRUBS

Scale Insects Affecting Conifers no. 5.514

by W.S. Cranshaw [1]

Quick Facts...

Several species of scale insects develop on conifers in Colorado. Pine needle scale and striped pine scale are particularly damaging.

The most vulnerable stage of the scale insect's life cycle is the crawler stage, an active unarmored stage that occurs after egg hatch.

If insecticide applications are made for control, proper timing is important in their success.

Scales are some of the most important insect pests affecting conifer trees and shrubs in Colorado. As scales feed on bark and needles, they remove sap and may damage cells. This can lead to decreased vigor, needle drop and dieback, and increased susceptibility to other insects or disease. Some scales also excrete sticky honeydew, which further detracts from plant appearance and attracts nuisance bees and wasps.

There are several important scale insect pests in urban Colorado. Pine needle scale has long been the most damaging species. However, the striped pine and pine tortoise scales have also become pests along much of the Front Range. Several additional species are of minor or occasional importance to pines and spruce.

Pine Needle Scale

The pine needle scale (*Chionaspis pinifoliae*) feeds on the needles of most species of pines, spruce and fir. During outbreaks, needles may be nearly covered with the bodies of the scales, giving an appearance that the plant is spattered with white paint. Heavily infested needles drop prematurely. Sustained outbreaks cause needle loss and sometimes twig dieback.

The adult (mother) pine needle scale is about 1/8 inch long, white to grayish-white, and is always found attached to evergreen needles. Many of the scales overwinter in the egg stage beneath the covering and body of the mother scale. Pine needle scale eggs are tiny and a rosy-purple color. Some mother scales survive the winter, especially during a mild season, and can continue laying eggs into the spring. This can greatly extend the period of egg hatch.

Additionally, egg hatch dates vary with elevation and seasonal temperatures. An early hatch, sometimes beginning in late April, can occur following periods of warm weather in late winter and early spring. Under cooler conditions, initial egg hatch can be delayed until as late as the first week of June. If cooler weather persists all spring, hatching can continue for a month or more.

Newly hatched scales are called crawlers. They are minute in size, a similar rosy-purple color as the eggs, and somewhat resemble tiny aphids. This is the only active period in the life cycle of the pine needle scale. Individual crawlers move about for hours to days before inserting their mouthparts into the needles. Populations can be active for up to three weeks. Shortly after settling, the scales molt (shed) their covering and produce a golden brown form. Once these insects produce their protective waxy covering (armor), chemical control can be difficult. The female scales remain stationary throughout the rest of their lives; male scales feed for a period of a few weeks and emerge as winged adults.

At higher elevations, pine needle scale produces only one generation per year. However, at lower elevations a second generation is common in mid- to

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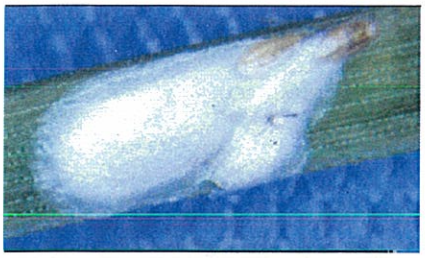


Figure 1: Pine needle scale.

Figure 2: Pine needle scale exposed from cover while laying eggs.

Figure 3: Striped pine scale.

late summer. Because egg hatch may be extended, a distinct second generation does not always occur. These later-emerging young primarily settle on the current season needles.

Pine Needle Scale Control

Several natural enemies are associated with pine needle scale colonies in Colorado. A minute lady beetle (*Coccidophilus atronitens*) is commonly found feeding on eggs and developing scales in the spring and summer. Several species of chalcid (parasitic) wasps also are common. To see if these beneficial insects are present, examinine the white, waxy cover of the scale. Parasitic wasps produce small, round emergence holes near the center of the cover. Predatory lady beetles chew more irregular holes. Unfortunately, natural enemies of pine needle scale are not always sufficient to prevent damaging outbreaks.

Pine needle scale is more readily controlled with horticultural oils than are some other armored scales, such as oystershell scale. Oils applied during the dormant season (dormant oils) are recommended for pines. Spruce may temporarily discolor at the rates used for these treatments (about 2 percent concentration). Alternatively, oils that can be used during the growing season can be very effective. These summer oil applications can kill young, settled scales, as well as crawlers and eggs. Do not apply horticultural oils when new growth emerges or if plants are under stress from drought. Summer applications also can discolor spruce.

Often, the most effective controls of pine needle scale are "crawler sprays," insecticides applied to coincide with the vulnerable crawler stage of the insect. Many yard and garden insecticides are labeled for this purpose, including insecticidal soaps, Sevin, Permethrin, Orthene, cyfluthrin and various oils.

Apply crawler sprays shortly after egg hatch, which can be determined by monitoring. The small, rosy-colored crawlers are detected by shaking a branch over a piece of white paper. Try this survey when crawlers are expected to first appear, from late April to late May. If egg laying and crawler activity occurs over a period of several weeks, repeat applications of insecticides, particularly if short-lived residual treatments (soaps, oils) are used. To conserve natural enemies, avoid insecticides at other times in the life cycle of the scale.

On many plants, infestations are localized and can be controlled with spot sprays.

Striped Pine Scale

Striped pine scale (*Toumeyella pini*) has greatly increased in importance along the Front Range. It is a soft scale (Coccidae) that is primarily damaging to Scotch pine. Pinyon, Austrian and lodgepole pine also have been affected. Infested trees can decline rapidly in vigor. An increase in bark-infesting woolly aphids (*Pineus* spp.) also appears to be associated with striped pine scale infestation. Striped pine scale excretes large amounts of honeydew as it feeds, which results in a sticky covering on twigs and needles. Dark gray sooty mold fungi grow on the honeydew, further degrading the appearance of infested trees. Nuisance bees and wasps are attracted to the honeydew.

Striped pine scales spend the winter as fertilized, immature females attached to the twigs of the current season's growth. Some mature females may also overwinter. Adult females are somewhat round, wrinkled, and have tortoise-shell coloration (light brown to reddish brown with dark brown to black markings). In addition to the black markings, one or more cream-colored stripes occur down the center of their dorsal surface. Females begin to mature eggs in May and early June, at which time they have grown to about 1/4 inch in diameter. Eggs hatch under the covering of the mother and crawlers begin to emerge by early June. A single female can lay hundreds of eggs that hatch over a period of several weeks.

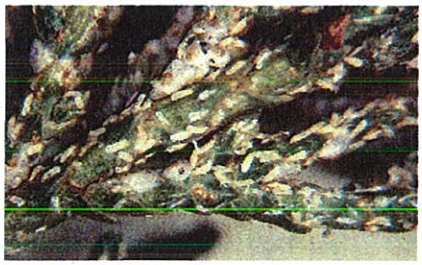


Figure 4: Juniper scale.

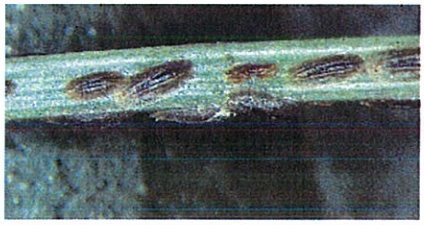


Figure 5: Pinyon-needle scale, "bean stage" nymphs on needles. Photo courtesy of USDA Forest Service.

Striped pine scale nymphs are generally orange to brown. Female scales remain on the twigs while males migrate to the needles. Males become enclosed in a papery covering as they mature. They emerge to mate with the females in late summer. There is one generation per year.

Striped Pine Scale Control

Several common birds, including house finches and yellow-rumped warblers, feed on striped pine scale adults. Larvae of green lacewings and brown lacewings feed on crawlers and small females. However, no highly effective natural enemies of striped pine scale have been identified in Colorado.

Controls for striped pine scale are generally similar to those for pine needle scale. Horticultural oils used both in the dormant season or in the summer can be effective. Insecticides that can be applied to crawler stages include Sevin, malathion, and Orthene. Optimal timing to spray for crawler emergence typically occurs around mid-June. In addition, striped pine scale can be controlled with soil applications of the systemic insecticide imidacloprid (Bayer Advanced Garden Tree & Shrub Insect Concentrate).

Minor Scale Pests Affecting Conifers

Several additional scale species occur. However, most are uncommon. They often exist as isolated infestations and rarely cause significant injury.

Black pineleaf scale (*Nuclaspis californica*). This scale is rare in the state but is found on ponderosa pine and blue spruce. Adult females are less than 1/8 inch long and have a circular, brown to black, waxy covering with lighter margins. Published information suggests that black pineleaf scale usually is associated with stressful growing conditions.

Juniper scale (*Carulaspis juniperi*). The juniper scale sometimes attacks the needles of juniper, particularly Pfitzer juniper, and is associated with dieback during outbreaks. This scale is generally creamy white, with females more elongated and larger than males. It overwinters as eggs under the covering of the mother scale.

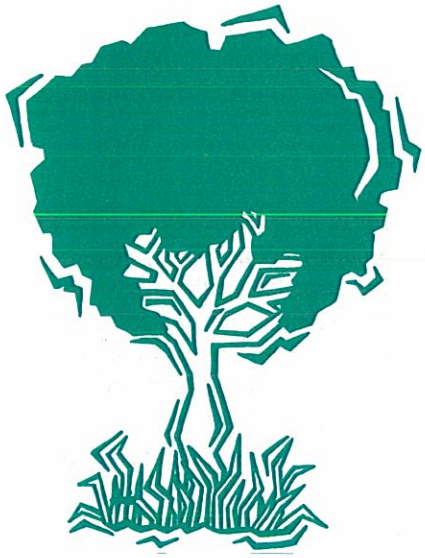
Spruce-bud scale (*Physokermes piceae*). The spruce-bud scale also rarely occurs in the state and is associated with spruce. Adult females are nearly spherical and dark brown, with older adults closely resembling undeveloped buds. This is a soft scale that produces honeydew.

Pine tortoise scale (*Toumeyella parvicornis*). This scale is closely related to the striped pine scale, with which it is commonly confused. Life histories, host ranges and control methods appear to be similar for both species.

Fletcher scale (*Parthenolecanium fletcheri*). All stages of this scale feed on stems and branches of juniper and yew. Adult females are 1/8 to 1/4 inch long. Flattened in the early stages, they later swell to a hemispherical shape. Young females are brown with yellow stripes and a yellow border; older females darken to a solid medium brown. The closely related European fruit lecanium, *Parthenolecanium corni*, also is reported to occur on juniper.

Pinyon needle scale (*Matsucoccus acalyptus*). The pinyon needle scale occasionally causes significant damage to pinyon in the form of older needle loss. Outbreaks occur in native stands and ornamental plantings, particularly in the southwestern part of the state. The life cycle and habits of this species differ from the other conifer scales in that the developing nymphs (second instar) resemble small (1/16 inch) black beans that are attached to the needles throughout the winter. By early spring, the nymphs resume development and move to the trunk and larger branches, where adults lay cottony egg masses in March or April. Insecticides applied for control of this insect are recommended when egg masses are first observed on trunks.

[1]W.S. Cranshaw, Cooperative Extension entomologist and professor; bioagricultural sciences and pest management.



G A R D E N I N G S E R I E S

DISEASES

Environmental Disorders of Woody Plants no. 2.932

by C.E. Swift, W.R. Jacobi, M. Schomaker and D.A. Leatherman [1]

Quick Facts...

Sunscald occurs during cold, bright days in midwinter. It occurs more frequently on thin-barked trees. Wrap trees in winter to help prevent sunscald.

Drought and overwatering injuries occur in deciduous and evergreen trees.

Plant woody plants where they can adapt to climate and soil conditions.

Woody plants have to harden off properly to prevent fall frost damage.

Temperature extremes and rapid fluctuations can harm most plants. Because many shade trees and woody ornamentals planted in Colorado are not native, they often are injured by temperature extremes, or temperature extremes coupled with moisture stress. The five most common temperature and moisture related problems in woody plants are sunscald, drought injuries, drowning of roots, frost damage and winter (cold) damage.

Sunscald

Sunscald occurs during cold, bright days in midwinter. Direct sun rays heat south-facing branches and southwest sides of tree trunks. This raises bark temperatures above freezing and causes some cells to become active. Reflection off snow will increase this problem. After sunset or with changing weather conditions, the bark experiences a sudden temperature drop, killing the activated tissue. Sunscald can occur on the north side of trees and shrubs due to reflection off white or light-colored structures immediately adjacent to susceptible woody plants.

Bark in the affected area may initially turn red, orange, yellow or some other hue not consistent with normal bark color. The bark then may crack, become mushy, or slough off in patches revealing dead tissue underneath. These symptoms usually occur on the tree's southwest side. Various fungi and insects may attack the damaged areas, intensifying the problem by forming cankers and borer injury.

Sunscald occurs more frequently on thin-barked trees such as aspen, birch, cottonwood, fruit trees, honeylocust, mountain ash, maple and willow. The problem usually is the most severe on newly planted trees. Sunscald is less likely on older established trees because the bark is thicker and roots are better developed. Protect young trees to prevent severe sunscald injury or death.

To prevent sunscald, plant susceptible trees on the east side of buildings or otherwise protect them from late afternoon (southwest) sun. Adjacent plantings or temporary fencing will help shade the bark. Drought-stressed trees are more susceptible to sunscald, so watering adequately in the fall and winter is important.

Commercial tree wraps can prevent sunscald damage. Start at the trunk's base and wrap in an overlapping upward spiral to a point above the second branch. Attach the wrap at top and bottom. Apply the tape to the wrap only. Direct contact of the tape with bark may cause injury.

Wrap the tree in October or November and remove the wrap in April. Leaving the wrap on all year restricts tree growth and results in girdling injury. Also, during the summer, damaging insects and disease organisms often take up residence under the wrap. Wrap new plantings for two consecutive years.

Protect commercial fruit or nursery plantings by painting tree trunks with an interior white latex paint (diluted one part paint to two parts water). While this method is not aesthetically pleasing, it is less expensive, quick and lasts for several years.

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Remove bark damaged by sunscald back to healthy tissue without damaging the healthy tissue. Wrap the tree from November to April to prevent sunscald problems to the developing callus tissue in the sunscald area.

Drought Injury

Drought injury is a dehydration of leaf or branch tissue that occurs when more water is lost through leaves than can be replaced through the roots. Environmental factors include prolonged hot, dry summer weather; dry winters; low relative humidity; wind; soil with high salt concentrations; and restricted root growth from too much water and compacted soil. Other factors that induce injury are new construction near the tree (sidewalks, driveways, buildings); landscaping practices that use plastic as weed barriers; and soil grade changes.

Environmental factors that cause or contribute to drought injury include:
- *prolonged hot, dry summer weather;*
- *dry winters;*
- *low relative humidity;*
- *wind;*
- *soil with high salt concentrations; and*
- *restricted root growth from too much water and compacted soil.*

Drought injury in deciduous trees most often appears as leaf scorch: areas of discolored tissue between leaf veins or along leaf margins. These irregularly shaped, discolored areas can be light tan to dark brown. Winter freezing of deciduous tree roots can result in leaf scorch the following summer.

Leaf scorch is most severe on the side exposed to the contributing factor. For example, hot, dry winds cause most symptoms to appear on the side exposed to prevailing winds. However, in some cases, heat reflected from white or light-colored siding can cause scorch, especially to conifers, even on the north side of trees. In advanced cases the entire tree appears dry and scorched. Severe scorch can result in complete defoliation because leaves dry up and fall prematurely. Trees defoliated before midsummer often form new leaves. Those defoliated in late summer may not grow new leaves until the following spring.

Winter drying of evergreens results when water lost through the needles can not be replaced by roots because the soil is dry. It often results from rapid temperature changes associated with warm, dry winds (chinooks) in late winter. Symptoms usually appear first on the south or southwest side but can develop throughout the tree. Needles of affected fir trees most often turn a yellowish color but can turn red. Spruce and pine needles turn yellow to yellow-brown and then red to reddish purple in advanced cases. Discoloration occurs first in outer branches and progresses from the needle tip to its base. In severe cases discoloration occurs rapidly and uniformly along the entire needle. A red color change on needles in early spring may indicate winter drying injury; new spring growth usually is not affected. This can be determined by checking the buds. A red color change also may indicate bark beetle or a root disease problem. If the buds are alive they will be soft and pliable.

Drought injury also occurs in evergreens during summer months. Symptoms of summer drought are evident following hot, dry weather in late summer. They include tip dieback of needles, progressing from the tree's top downward and from outer branches inward. A severe case appears as a sudden browning of all needles. Browning and dehydration of older needles (those nearest the tree's interior) most often is caused by a chronic drought problem but can be from natural needle drop.

Damage from leaf scorch, winter drying and drought injury cannot be reversed. Their impact on tree health, however, can be lessened or prevented by cultural practices that provide favorable growing conditions for the roots. (See fact sheet 2.926, *Healthy Roots and Healthy Trees*). One such practice is deeply watering the soil from the surface to a depth of 12 to 18 inches once a month in summer and once every two months in winter.

Damage from leaf scorch, winter drying and drought injury cannot be reversed.

Organic mulch under trees helps reduce moisture loss and competition from turf and improves moisture penetration into the soil. Do not overwater trees and avoid polyethylene plastic under mulches. Use porous weed control fabrics instead. Polyethylene plastics and overwatering

contribute to oxygen starvation that results in root death. A gradual yellowing of foliage that develops first on the tree's interior and progresses outward indicates oxygen starvation.

These practices are not a guarantee against drought injury. Hot, dry summer or cold winter weather may result in excessive moisture loss regardless of how much water is provided. However, these practices help ensure a healthy tree that can better recover from drought injury.

Overwatering

Ash, aspen, honeylocust, birch and maples are the most susceptible to drowning or wet soil conditions.

Overwatering woody plants is a common problem in Colorado, particularly in irrigated turfgrass areas. Trees do not show symptoms of damaged roots from water logged soils until some time after overwatering occurs.

The most common symptom in broad-leaved trees is leaf fall in midsummer with some interveinal discoloration of the leaves. There usually is little marginal leaf scorching, since this indicates possible drought stress. The symptoms of leaf discoloration due to excess soil moisture usually start at the bottom and inside of the tree and work up, rather than from the top down as with drought stress trees. Ash, aspen, honeylocust, birch and maples are the most susceptible to drowning or wet soil conditions.

To determine how much and how often water should be applied, use a shovel to check soil moisture to a depth of 10 to 12 inches. The soil should not be crumbly or dry. If the soil feels wet or forms and holds a ball when squeezed in the hand, the soil does not need to be irrigated. If water can be squeezed from the soil or it has a sewer-gas-like odor, the soil is excessively wet.

Trees do best when there is time for the soil to drain and dry slightly between irrigations. They also do better if the soil is wetted deeply (2 feet) rather than shallowly (6 inches).

Frost Injury

Woody plants prepare for winter as fall approaches through a process called "hardening-off", and reach a peak of cold hardiness in midwinter.

Many woody plants are damaged by early fall and late spring frosts. Depending on the time of year, frost injury is characterized by blackening or browning of foliage or newly emerged shoots and flowers all over the plant. In areas where frost pockets develop, only the lower plant parts may be affected.

Plants are most susceptible to frost injury during the spring flush of growth. Spring frost injury often is more noticeable than fall injury, especially when new shoots of spruce droop and redden or fir shoots droop and turn light brown. Flowers also are damaged or killed on plants such as lilac and crabapple. Spring frost damage to evergreens is characterized by a downward curling of shoot tips. Affected tips may turn red or brown within one or two weeks. A severe fall frost can cause serious damage or death to parts of trees that have not hardened off.

Woody plants prepare for winter as fall approaches through a process called hardening off. They reach their peak cold hardiness in midwinter. Avoid overwatering trees from mid-August until after fall leaf drop. Do not apply nitrogen fertilizer after mid-July. This will allow plants to harden off for winter and help prevent frost damage in early fall.

Once frost injury has occurred, nothing can be done, but frost damage can be prevented. Plant woody plants only in climates where they can adapt. For sensitive plants, avoid low areas where frosts are more prevalent. Recommendations on specific trees and shrubs suitable for Colorado's climate are available from your Colorado State University Cooperative Extension county office or a Colorado State Forest Service district forester.

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