Town of Paonia
Street Inventory Report

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Colorado State Forest Service

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Town of Paonia
2020 Street Tree Inventory

2020 Inventory Background

In 2020, Corinne Ferguson, Town Administrator/Clerk for the Town of Paonia, approached the Colorado State Forest Service about conducting a general tree inventory and a tree risk assessment for the trees that the Town is responsible for managing, also called the right-of-way trees. After several discussions, a proposal and agreement were accepted in September 2020 (Appendix A) between the Colorado State Forest Service (CSFS) and the Town of Paonia (Town), the key elements are listed below. The inventory data was collected in September and October of 2020. The process, results, and recommendations of the 2020 inventory are presented in this report.

- The inventory is a stand-alone product based in the Geographical Information System (GIS) software program ArcGIS, version 10.4. GIS software captures, stores, analyzes, manages, and presents data linked to a location and includes mapping capability.

- Trees in Town managed areas and along street rights-of-way were inventoried. If the tree was larger than 20 inches in diameter at breast height or the tree had an obvious defect it also received a tree risk assessment.

Inventory Process

Details regarding the process of collecting data for the tree inventory are described below:

- A Trimble Juno (a hand-held computer) or an Asus computer tablet with Global Positioning Software (GPS) capability was used to record data for each inventoried tree in the Town.

- Using ArcGIS (GIS software), the CSFS created a customized geodatabase for the Town's tree inventory. The units were loaded with ArcPad v. 10 software to facilitate data collection with aerial photos.

- Aerial photography acquired by the CSFS from Delta County was used to determine tree positions on the map and in the ArcGIS software program.

- After tree information was collected, it was imported from the data collection units into the ArcMap 10.4 software program on a CSFS computer.

- Using the Town's tree inventory data records CSFS was able to:
    - Query data,
    - Generate reports/spreadsheets within ArcMap and in Microsoft Excel,
    - Create maps.
    -

This inventory is intended to be a living document. It requires maintenance and updating as tree work is completed on the Town's trees (e.g., removals, plantings, and pruning), this can be done in Excel spreadsheets or in the GIS software.

2020 Inventory Data Fields

The following data fields represent the tree inventory observations that were recorded. These questions are also found in Appendix B.

Tree ID

- Each tree within the Town was given a unique identification number.

Data Collector

- Name of the person who collected the inventory data for that tree.

Date Inventoried

- Date of data collection.

Tree Location

- This field was used to identify where the tree is located in Town with a street address.

Tree Species

- The tree species list was based on known native and non-native trees planted in the area.

Tree Species Secondary – write in

- If the tree species was not listed, the data collector could enter the species name.
- If the species was listed in the previous question but was a known variety/cultivar, that information was collected.

Diameter at Breast Height (DBH)

- Tree diameter was measured in two-inch size classes: 1.0-2.9, 3.0-4.9, 5.0-6.9, etc. up to a maximum of 73.0 inches.
- Every tree was assigned a size class based on the tree's diameter at breast height (DBH).

Tree Space

- Options include: Small, a tree that at maturity is smaller than 25 feet tall or wide; Medium, a tree that at maturity is between 25-35 feet tall or wide; or Large, a tree that at maturity is larger than 35 feet tall or wide.
- A planting space was considered if a 1½-inch caliper tree could be planted at the location. Caliper is the diameter of a tree trunk six inches above the ground or at the base of the tree at the root collar; this measurement is used on young, small trees from a nursery.
- The location must be rated as good or excellent to qualify as a tree space.
- The location of a space must be 25 feet from a stop sign or intersection to prevent issues with line of sight.

Condition

- Options include: Excellent, Good, Fair, Poor, Very Poor, or Dead.
- The condition categories are slightly subjective, depending on the person observing the tree regarding the condition. Generally, most data collectors avoid using the excellent category. Most trees were placed in the good category unless the tree's condition was truly superior to the other trees of the same species they had inventoried.
    - Trees rated as fair would have some of the following issues: stagnant or uneven growth pattern, poor vigor, minor trunk damage, deadwood, etc.
    - Trees rated as poor would exhibit some of the same issues as above, but the problem or condition was more advanced than a tree with a fair rating.
    - Trees rated as very poor trees would exhibit some or all the following issues: have minimal live branches, be heavily damaged from wildlife, or were being severely impacted by insects or disease. These trees are normally recommended for removal.

Placement

- Options include: Excellent, Good, Fair, Poor, or Liability.
- The placement categories are slightly subjective, depending on the person observing the tree regarding the placement. Generally, most data collectors avoid using the excellent category. Most trees were placed in the good category unless the tree's placement was truly superior to the other trees of the same species they have inventoried.
    - Trees rated as fair would have some of the following issues: close to other vegetation or structures that impede normal growth habits, have the potential to affect sidewalk pathways in the future, or are growing beneath an overhead line but have not yet made contact.
    - Trees rated as poor would exhibit some of the same issues as above, but the problem or placement was worse than a tree having a fair rating.
    - Liability trees are located where they were currently creating problems for infrastructure items such as sidewalks or overhead lines. These trees may also negatively impact pedestrian or vehicle safety. These trees were usually recommended for removal.

Number of Stems

- Options include: 1, 2, 3, 4+, or N/A. N/A was used if it was a tree planting space.
- Purpose of the question- help determine management needs and overall condition of the structure. One stem is preferred over multiple stems.

Condition of Leaf

- Options include: Good, Fair, Poor, N/A. N/A was used if it was a tree planting space.
- Purpose of the question- indicated tree health based on the quality of leaves (leaf size and color).

Percent Dieback

- Options include: None, <25%, 25-50%, 50-75%, >75%, or N/A. N/A was used if it was a tree planting space.
- Purpose of the question- help determine if the tree is having health issues. Dieback in tree crowns can be an indicator that significant insect or disease damage was occurring.

Surface Type

- Options include: Bare Ground, Cutout, Mulch, Native Vegetation, Rock, Un-watered Grass, Watered Grass, Weeds, or Other.
- Purpose of the question- to assist the staff to determine which trees need mitigation. This could include pulling back grass to reduce damage by string trimmers or mowers, remove weeds, or adding mulch.

Water Quantity

- Options include: Excessive, Adequate, Inadequate, Unknown, or None.
- Purpose of the question- This is to indicate if the tree is receiving the appropriate amount of water. It is especially easy to over or under water trees when they are growing in the grass.
    - None is different than inadequate, as inadequate indicates the tree is receiving some amount of water (but not enough) while none indicates the tree is not receiving any supplemental water.

Growth Obstructions

- Options include: Adjacent vegetation, Curb/pavement, Guards/fencing, Overhead wires, Sidewalk, Signs/Signals, Street light, Structures, Vehicle, Other, or None.
- Purpose of the question- to make the staff aware of any physical obstructions that were or will affect the tree's normal growth habit.

Pest on Tree

- Pest choices include: Aphids, Bark beetles, Blights, Borers, Cankers, Decay, Girdling roots, Mites, Root disease, Scales, Weevils, or Other.
- These options were pests known to impact the tree species in Paonia. Girdling roots were placed in this section and it is important to take management actions when it was observed on a tree.
    - **Girdling Root:** There were girdling roots visible around the trunk flare/ root collar of the tree. This is a root that is growing across the trunk instead of out into the soil. These roots should be cut as soon as possible to prevent the root from growing larger and causing further damage. This need may also be selected if there was no visible trunk flare and girdling roots were suspected and further investigation is suggested.
- The term pest was used to describe an issue the tree was experiencing that is causing harm.
- Purpose of the question- to identify what pest was affecting the tree.

Pest Other

- If the pest was not listed in the above list, the pest species was documented here.

Management Need

- All urban forest trees need management as they establish and mature. The management need observation was used to report the most pressing needs the tree had at the time of the inventory. In some cases, the tree may be doing well and did not need a specific management action but would benefit from being put on a pruning rotation for future management. Some trees had more than one management need, that information was collected in the second management need field.

- Each tree was assigned one to two management needs from the following categories:

    - **Clearance Prune:** This need was chosen to address public safety. It was used on trees that had the potential to damage personal property or cause injury to people. The standard branch height over streets is 13-14 feet and a branch height of 8 feet over sidewalks. Trees or branches must not block public safety signs.

- **Cultural Treatment:** This need was chosen when tree's health would be improved by adding fertilizer or if the growing site needed to be mitigated (e.g., soil compaction). Although the need was not immediate, the tree would benefit from further inspection to determine how to improve the existing situation.

- **Defective Prune:** The tree required a one-time corrective action to eliminate a serious problem(s). The recommendation for a defective prune was usually instigated by the presence of a nearby target. Targets include benches, playgrounds, sidewalks, streets, etc. Some examples of defective pruning include hanging dead branches two inches or larger in diameter, cracked branches, extreme trunk lean, large deadwood, and/or co-dominant trunks that could fail. Immediate action to mitigate the defect is recommended.

- **Do Nothing:** The tree was in good health and condition. In its present state, the tree was a good example of the species for that site. No immediate action was required at the time.

- **Inspect**: If the tree had a risk rating of moderate or high, it would require a licensed/certified arborist to complete a more in-depth assessment to determine its condition and overall health. If the tree does not have a risk rating or a low-risk rating associated with the tree, it requires Town staff to assess the tree for issues and correct or mitigate them if possible.

- **Mitigate Space:** An object was in close proximity or in the tree's growth path and was interfering with the tree's current or future health. This object can be either man-made or natural and either the tree or the object should be removed or relocated.
  - **Excessive soil and/or grass over root ball:** This was identified on container and ball and burlap (B&B) planted trees in the Town. This indicates either the tree was planted incorrectly or had soil or grass placed over the root flare after planting. The recommendations are that the root flare of a tree is located at or above soil grade. Trees that are too deep in the soil suffer from a lack of oxygen to the roots and show stress by having minimal growth, poor leaf health, dieback, and more.
  - **Weed barrier fabric:** Weed barrier fabric does not readily break down in Colorado due to our low humidity. As trees grow in diameter, the fabric can press into the delicate basal bark and constrict the growth on the tree, potentially creating wounds that insects and diseases will attack. If the fabric is placed around a tree, it is important to monitor and cut back the fabric as the tree grows. Also, do not place additional soil on top of the fabric; this can restrict air/oxygen movement into the soil that the tree roots require.

- **Mitigate Water:** This need was chosen when the tree needs more or less water.

- **Monitor:** The tree was in overall good condition. However, the tree had an issue that was specifically documented in the inventory and should be watched to ensure the concerned area does not worsen causing the tree to decline rapidly or fail.

- **Other**: The issue did not fit into the other categories; details were given in the comments field.

- **Plant / Space:** A planting space has been identified as suitable based on the existing site conditions and the horizontal and vertical space available.

- **Protect:** The tree was being damaged by existing external factors; examples can include lawnmower damage, grass trimmers, weed barrier fabric cutting into the tree, or caging. If grass were growing against a tree trunk, the tree would benefit from grass removal within a three-foot

radius. Deer or other animal damage would also fall into this management need. Action is needed to mitigate and/or prevent further damage.

- **Remove:** This tree was either dead or in very poor health due to damage to the tree, overall tree health, improper planting, over-crowding, pests, or people abuse. It would be prudent to remove it from the growing site. Trees harboring aggressive or nuisance pests or pose a hazard to the public should be removed as soon as possible.

- **Rotation Prune:** Normal periodic pruning was suggested to maintain scaffold branching, eliminate conflicting branches, pruning stubs, remove small deadwood, trunk sprouts, or root collar suckers. No major structural issues were identified on the tree.

- **Sidewalk Damage:** The root or trunk flare of the tree was impacting the sidewalk in some way; this includes lifting and/or cracking. The extent of the damage to the sidewalk was not assessed.

- **Structure Prune:** Pruning was needed to correct a structural, aesthetic, or a tree health problem. The problem does not pose an immediate threat to the public or personal property, however, if left alone the problem will not resolve itself. Examples include crossing branches, included bark, scaffold (permanent) branches too close to each other, no central leader, and/or an unbalanced growth pattern.

- **Treat Disease:** There was physical evidence of a disease at the time the tree was inventoried (for example, fire blight, canker, or decay).

- **Treat Insects:** There was physical evidence of an insect at the time the tree was inventoried (for example, scale, borer, or aphids).

Management Need Comments

- Space to write additional comments about the management need.

Management Need 2 and Comments

- Same question and options as Management Need 1.
- Used if the tree had more than one management need but they are not listed in priority of tree need.

Comment

- This was an open-ended field where the inventory data collector could enter any additional information. This field was used to give supplemental details regarding the tree.

Risk Assessment

- All trees 20 inches in diameter and greater were assessed for risk to determine the priority management action for that tree in the Town. Some trees below the size threshold were assessed for hazards if a defect was observed.
- This inventory utilized the Colorado Tree Coalition (CTC) Tree Risk Assessment 14.2 protocol, a more in-depth description of the criteria can be found in Appendix E.
- This protocol is based on the International Society of Arboriculture Tree Risk Assessment Best Management Practice, 2011.

Tree Species and Value

The data collected during the tree inventory was compiled and used to determine a tree's overall value to the Town and the environment. This is done primarily to show the tree's caretakers that their trees are just as valuable as street paving, internal infrastructure, or other hardscape items. The Town understands how much it costs to build a bathroom or picnic structure and that this infrastructure periodically needs maintenance. An urban tree population has a monetary value, but this can be overlooked, and while they do require maintenance, a tree's value increases as it gets older and larger when well cared for.

The formula used by the CSFS to determine tree value is based on dollar figures and percentages obtained from the ninth edition of the Species Rating and Appraisal Factors Guide, which is produced by the Rocky Mountain Chapter of the International Society of Arboriculture. The formula takes into account the tree's species, diameter, condition, and placement. A tree with a good condition or a good placement will have a higher value than a tree in poor condition or with poor placement. See Appendix F for more detailed information.

The Town of Paonia has a wonderful and valuable urban forest; the following table, Table 1, shows the top ten most valuable trees. Two trees tied for the most valuable tree, both are silver maples and are 73 inches in diameter located on Oak Avenue. To see the value and all other associated data collected for individual trees, see Appendix G. The database is very large, and the spreadsheet will only be available electronically and not included in the appendix of the printed report.

Town of Paonia - Street Tree Inventory - Top 10 Most Valuable Trees					
Tree Species	**Tree Value**	**DBH**	**Condition**	**Placement**	**Address**
Maple, silver	$ 76,135.42	73.0	Fair	Good	338 Oak Ave
Maple, silver	$ 76,135.42	73.0	Fair	Good	316 Oak Ave
Elm, Siberian	$ 55,603.42	58.0	Good	Good	221 Orchard Ave
Maple, silver	$ 54,919.23	62.0	Good	Fair	703 4th St
Elm, Siberian	$ 45,355.47	56.0	Good	Fair	318 3rd St
Elm, Siberian	$ 44,694.31	52.0	Good	Good	435 Box Elder Ave
Elm, American	$ 41,779.58	48.0	Good	Fair	104 Main St
Maple, silver	$ 41,660.89	54.0	Fair	Good	318 3rd St
Maple, silver	$ 41,660.89	54.0	Good	Fair	310 Poplar Ave
Maple, silver	$ 40,820.00	50.0	Good	Good	333 Onarga Ave

Table 1. Top ten most valuable Town trees.

In total 435 trees were inventoried in the Town of Paonia and the value of these trees is approximately $4.1 million. While a slight majority of the trees are less than 20 inches in diameter, the bulk of the value of Paonia's urban forest is found in the larger diameter trees.

Town of Paonia - Street Tree Inventory - Tree Size Breakout			
Tree Size	**Total**	**Percent**	**Value**
Less than 20 inches	236	54.25%	$ 441,025.53
Greater than 20 inches	199	45.75%	$ 3,695,046.67
Total	**435**	**100.00%**	**$ 4,136,072.20**

Table 2. A breakout of tree value based on tree size

Current Tree Situation

Tree Inventory Data

The purpose of the 2020 Town of Paonia Street tree inventory was to determine the health of the trees in the community, conduct risk assessments of large trees, and identify individual tree's management needs. Foresters from the CSFS collected data on the town trees and Table 3 shows the summary of the tree inventory. Data was collected on 512 trees and planting spaces. In total there were 435 trees and 77 planting spaces. See Appendix I for maps of the Town and the tree locations.

Norway maple is the dominant tree species in Town, followed by the silver maple. Between these two tree species, they make up 32.6 percent of the total number of trees in Town. It is recommended to not have any one tree species or tree genera make up more than 10 percent of the total forest canopy. *Acer* (Maple) is a genus and is comprised of all maple trees. Norway maple (*Acer platanoides*) or Silver maple (*Acer saccharinum*) are considered individual tree species within the *Acer* genus.

The purpose of this standard is to reduce the potential for an insect or disease outbreak to kill the majority of trees in an area. Most insects and diseases are host specific and usually attack one or two specific tree species or genera, such as the lilac ash borer only attacks ash (*Fraxinus*) trees or lilacs (*Syringa*). Without a variety of tree species and genera, an outbreak could wipe out an entire park or street. An appropriate amount of species diversity can be achieved in the Town, and a list of suggested tree species that have the potential to thrive is found in Appendix C. Some trees on the list have not been planted in Town previously and may not succeed; however, it is worth the effort and time to attempt to plant new plant genus, species, and varieties/cultivars to determine if they will thrive.

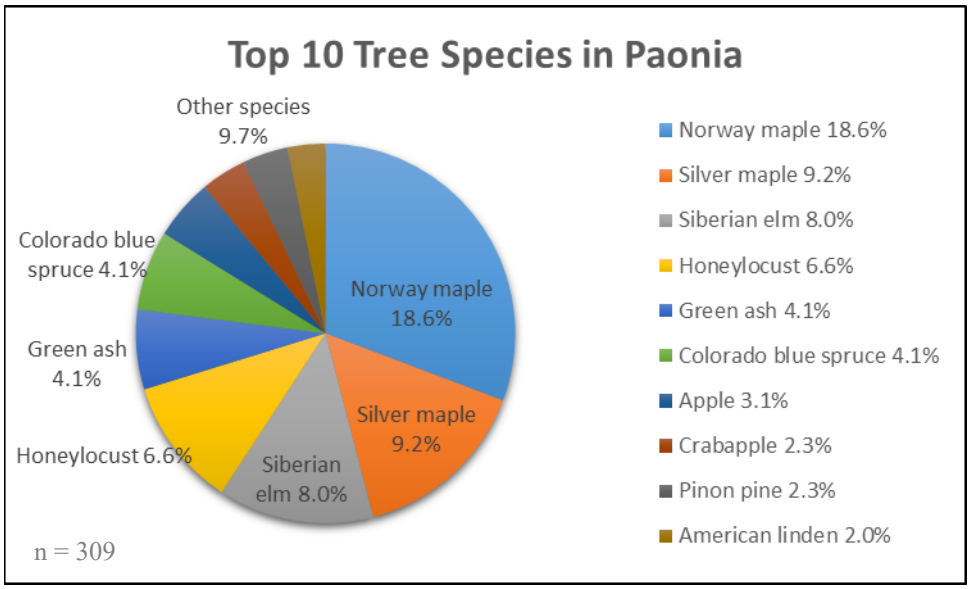


Figure 1. The top ten tree species in Town.

Town of Paonia - Street Tree Inventory - Value by Species					
Tree Species	**Total**	**Percent of Total**	**Average DBH**	**Average Value**	**Total Value**
Maple, Norway	95	21.84%	20.90	$ 9,830.41	$ 933,889.00
Maple, Silver	47	10.80%	31.30	$ 17,661.79	$ 830,104.29
Elm, Siberian	41	9.43%	36.60	$ 21,749.92	$ 891,746.69
Honeylocust	34	7.82%	13.60	$ 4,309.58	$ 146,525.84
Ash, Green	21	4.83%	24.90	$ 8,550.26	$ 179,555.37
Spruce, Colorado Blue	21	4.83%	21.30	$ 10,976.45	$ 230,505.52
Apple	16	3.68%	4.60	$ 775.78	$ 12,412.55
Crabapple	12	2.76%	5.30	$ 772.82	$ 9,273.80
Pine, Pinon	12	2.76%	7.80	$ 937.94	$ 11,255.30
Linden, American	10	2.30%	19.20	$ 8,392.63	$ 83,926.27
Other, Conifer	10	2.30%	10.40	$ 2,931.14	$ 32,242.49
Cherry	9	2.07%	11.30	$ 4,109.25	$ 36,983.22
Cottonwood, Carolina	9	2.07%	31.30	$ 9,580.06	$ 86,220.59
Willow, Globe	8	1.84%	34.40	$ 15,958.55	$ 127,668.40
Other, Shade	7	1.61%	10.00	$ 2,367.32	$ 16,571.27
Plum	7	1.61%	4.00	$ 274.36	$ 1,920.50
Catalpa	6	1.38%	12.00	$ 2,802.13	$ 16,812.78
Cottonwood, Rio Grande	6	1.38%	45.30	$ 21,606.69	$ 129,640.15
Linden, Littleleaf	6	1.38%	14.00	$ 4,403.03	$ 26,418.20
Redbud	5	1.15%	2.80	$ 190.95	$ 954.77
Ash, White	4	0.92%	9.00	$ 1,437.19	$ 5,748.76
Birch, Weeping	4	0.92%	23.50	$ 9,804.43	$ 39,217.71
Cottonwood, Hybrid	4	0.92%	15.50	$ 3,494.52	$ 13,978.07
Elm, American	4	0.92%	38.00	$ 27,881.55	$ 111,526.21
Hackberry	4	0.92%	10.50	$ 1,995.98	$ 7,983.94
Juniper	4	0.92%	5.30	$ 624.06	$ 1,872.17
Peach	4	0.92%	4.00	$ 201.80	$ 807.22
Poplar, Other	4	0.92%	28.50	$ 12,696.68	$ 50,786.72
Walnut, English	4	0.92%	19.00	$ 8,968.00	$ 35,872.00
Other, Fruit	3	0.69%	3.30	$ 274.31	$ 822.93
Other, Ornamental	3	0.69%	5.30	$ 685.19	$ 2,055.57
Boxelder	2	0.46%	38.00	$ 15,376.38	$ 30,752.77
Maple, Other	2	0.46%	4.00	$ 203.86	$ 407.73
Oak, Other	2	0.46%	4.00	$ 361.73	$ 723.46
Pine, Austrian	2	0.46%	24.00	$ 10,683.03	$ 21,366.07
Willow, Other	2	0.46%	12.00	$ 3,355.03	$ 6,710.05
Oak, Bur	1	0.23%	6.00	$ 813.89	$ 813.89
Total	**435**	**100.00%**	**16.5 inches**	**$ 9,378.85**	**$ 4,136,072.27**

Table 3. Summary of tree species, diameter at breast height, and value of the Town trees.

Tree Condition

Tree condition is used to describe the overall health of the tree at the time of the inventory and is an important component of determining tree value. A tree in good health exhibits the following characteristics: good growth pattern, strong vigor, no trunk damage, and/or deadwood. A tree in good condition will have a higher value than a tree in poor condition. This field is also used to indicate if a tree is standing dead so Town staff can determine if it poses a safety risk and needs to be removed.

In Town, the trees are mostly in good condition, with over 54 percent of the population. For the remaining trees, 38 percent of the trees are in fair condition, and 8.3 percent are in poor or very poor condition (see Figure 2). Trees in the fair condition category mostly require defective pruning, structure pruning, or need further inspection. This will be discussed further in the Management Priorities section.

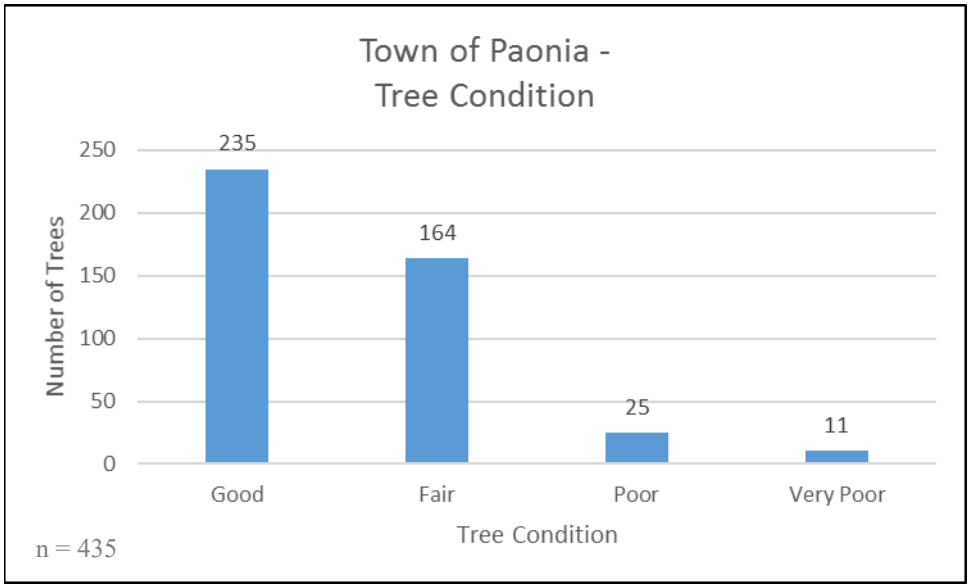


Figure 2. Tree conditions for all trees in the Town.

Tree Placement

Tree placement is used to describe the quality of the location the tree is planted in and is also an important component of determining the tree's value. A tree with a good placement is in a location that exhibits the following characteristics: adequate growing space; available water; no growth conflicts with buildings, other vegetation, or power lines. A tree with good placement will have a higher value than a tree with poor placement. This field is also used to indicate if a tree has issues with liability so Town staff can either mitigate the safety risk or remove the tree, this could include conflicts with line-of-site at intersections or sign visibility.

Almost 60 percent of the trees in Town have good placement, with 36.5 percent in the fair category. Trees in the fair category were usually identified as fair due to their impact on the sidewalk or due to water concerns.

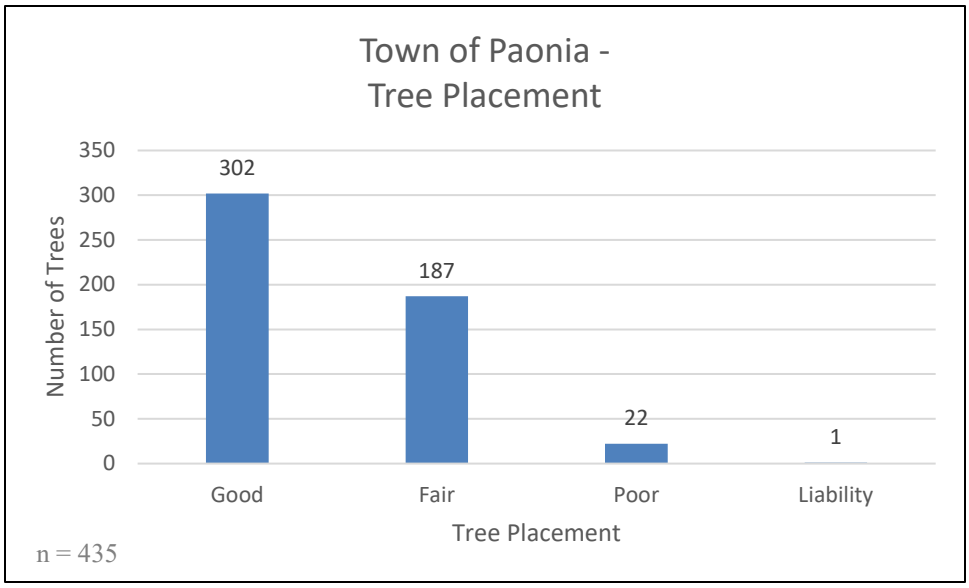


Figure 3. Tree placement ratings for all trees in the Town.

Other Data

Additional data was collected for each tree and tree planting space including the surface type around the tree and if there is adequate water available to the tree. The dominant surface type in Town was watered grass, followed distantly by bare ground. Bare ground may indicate a very dense tree crown canopy and the difficulty of growing plants in the shade. Most trees have adequate water available to them, either by landscape irrigation or by hand application (water hose). Trees with inadequate water show signs of water stress in the form of stunted growth, dieback, and increased susceptibility to insects and diseases. Proper summer and winter watering is important for urban trees, especially newly planted trees and conifer trees. Appendix K has information on proper water recommendations for both newly planted trees and winter watering. See Figures 4 and 5 for additional information.

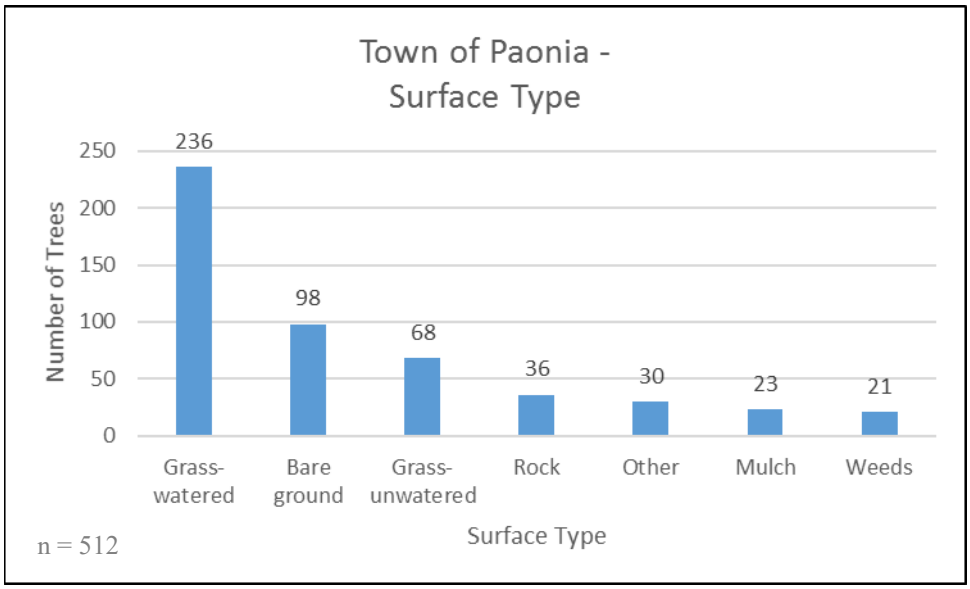


Figure 4. The type of surface was identified for all trees and planting spaces in the Town.

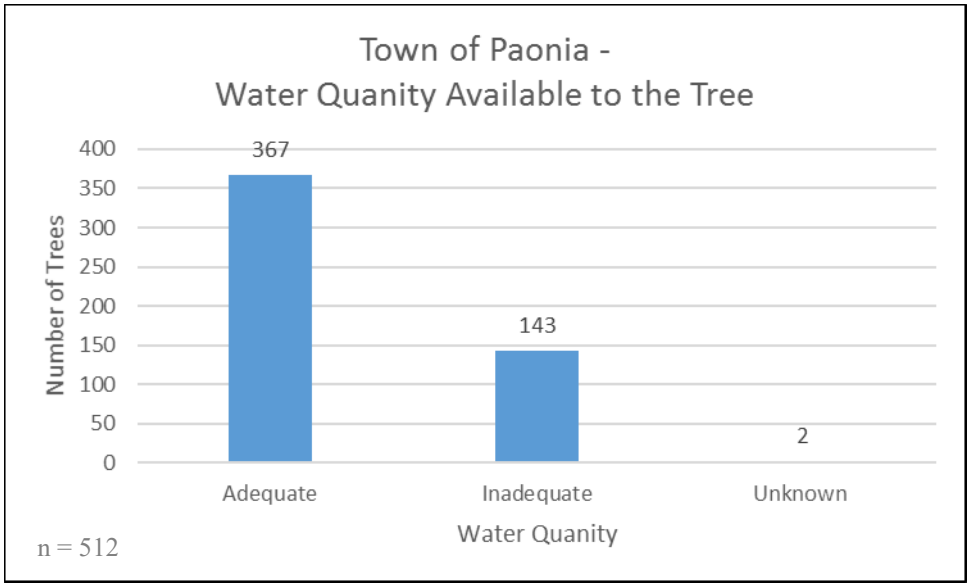


Figure 5. Water quantity available to trees and planting spaces

Top Tree Management Needs

All urban forest trees require management as they establish and mature in the landscape. The 'management need' observation was used to report the most pressing needs the tree had at the time of the inventory. Up to two needs could be selected per tree. For all trees inventoried, 782 management needs were identified, with 31 trees not needing any immediate management. These selections are to assist the tree manager in identifying current needs the tree has that could be addressed with management actions.

The primary management need identified was defective prune. This indicates that the data collector observed one or more of the following conditions: hanging dead branches two inches or larger in diameter, cracked branches, large deadwood, and/or co-dominant trunks that could fail. Defective pruning is a one-time corrective action to eliminate a serious problem(s). The recommendation for a defective prune was usually instigated by the presence of a nearby target. Targets include sidewalks, homes, vehicles, fences, etc. Immediate action to mitigate these defects is recommended.

The second most common management need identified was structure prune. This management need was selected when pruning is desired to correct a structural, aesthetic, or a tree health problem. The problem does not pose an immediate threat to the public or personal property, however, if left alone the problem will not resolve itself. Examples include crossing branches, included bark, scaffold (permanent) branches too close to each other, no central leader, and/or an unbalanced growth pattern.

The third and fourth most common management needs identified were also related to pruning. Clearance pruning was selected when addressing public safety. It was used on trees that had the potential to damage personal property or cause injury to people. The standard branch height over streets is 13-14 feet and a branch height of 8 feet over sidewalks. Trees or branches must not block public safety signs. Rotation prune was selected to indicate that a normal periodic pruning is suggested to maintain healthy scaffold branching, eliminate conflicting branches, pruning stubs, remove small deadwood, trunk sprouts, or root collar suckers. No major structural issues were identified on the trees with this need. Some trees did not have a management need at the time of the inventory (31 trees) but would benefit from being placed on a pruning rotation schedule. See Figure 6 for the top 10 management needs selected during the inventory.

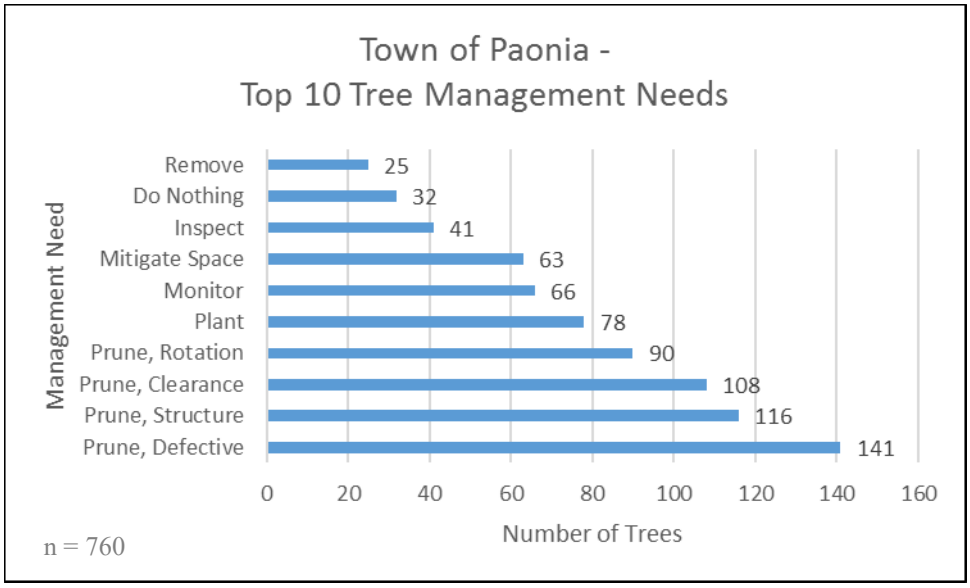


Figure 6. Top 10 Management needs for the trees in the Town.

Plant Diversity

Plant diversity is extremely important to the overall health and quality of the urban forest. The CSFS recommends that no tree genus exceed five percent of the total tree population as plant diversity is a mechanism that helps to keep insect and disease outbreaks from destroying an entire tree species population in a community. Most insects and diseases are host specific, meaning they will only attack specific tree species. John Ball, a Forestry Specialist for the South Dakota State University states that "What we need is more genera." He proposes that no more than five percent of a community's trees be in one genus. Ball continues with "this, in itself, may not reduce the possibility of an exotic threat, but will limit its impact. If only five percent of a community's trees were ash, emerald ash borer would be a more manageable problem and would not be draining the resources to the degree it is in cities where ash was 25 to 30 percent of the population. The five percent rule will be tough to achieve, and may not always be possible, but there are some genera for which you might want to follow the rule as closely as possible. These include ash (*Fraxinus*), elm (*Ulnus*), linden (*Tilia*), oak (*Quercus*), maple (*Acer*), pine (*Pinus*), poplar (*Populus*), and spruce (*Picea*)." The reason for limiting these specific genera it that "they all have many species spread across the three northern continents- Asia, Europe, and North America. Some, such as oak, even reach into Africa and South America. Geographical barriers, such as oceans, mountains and deserts, have isolated species in these genera into distinct populations within their own continents, each contending, and co-evolving with their own unique pests. We already have experienced the repercussions of this pattern with ash and elm; the rest may follow, as this pattern of isolated populations is the set-up for lethal exotic pests." (Ball, John. January 21, 2015. AmeriNursery.com).

There are multiple examples of tree populations being severely impacted. Two recent examples are a couple of infectious fungal diseases and one recent insect outbreak that has wiped out the American elm, American chestnut, and the ash tree populations in the United States. The two diseases are the chestnut blight on American chestnut and the Dutch elm disease in American elm. The emerald ash borer, an insect, is currently killing all ash trees on the Front Range of Colorado and in the Midwest and the Northeast. This insect was found in Boulder County, Colorado in 2013 and has continued to be discovered around the Denver Metro area. These pests are exotic and have been introduced to our native tree populations and they have no natural defenses to fight off the attacks.

There are at least 25 tree genera and over 40 tree species planted in Town, see Table 4 for specifics. This is an encouraging number, although there are many trees with less than five trees representing a genus. The most common tree genus in Town is maples (*Acer*), including Norway, silver, and boxelder, making up over 30 percent of the genus composition (see Table 5 for a list of the top 10 species in Town). This is followed by elm (*Ulnus*) trees, both American and Siberian, making up 10 percent of the population. However, when looking deeper into the maple species data, the percentage of trees over 20 inches in diameter is 19.5%, and trees less than 20 inches in diameter is 14 percent. Both of these numbers are still much higher than the preferred five percent per genera limit but noting the aging population versus the upcoming population is important when planning for the future. See Table 3 for the tree species breakout.

It is very important to continue to diversify the genus and species of trees planted in Town to increase the percentage of less commonly planted trees. Refer to the suggested species section and Appendix C for recommended species to plant.

Town of Paonia - Tree Genus by Percentage		
Tree Genus	**Total #**	**Percentage**
Acer (Maple)	146	33.56%
Ulnus (Elm)	45	10.34%
Gleditsia (Honeylocust)	34	7.82%
Malas (Apple, Crabapple)	28	6.44%
Fraxinus (Ash)	26	5.98%
Populus (Cottonwood, Aspen)	23	5.29%
Prunus (Cherry, Peach, Plum)	22	5.06%
Picea (Spruce)	21	4.83%
Pinus (Pine)	19	4.37%
Tilia (Linden)	16	3.68%
Salix (Willow)	10	2.30%
Catalpa (Catalpa)	6	1.38%
Cercis (Redbud)	5	1.15%
Betula (Birch)	5	1.15%
Celtis (Hackberry)	4	0.92%
Juniperus (Juniper)	4	0.92%
Juglans (Walnut)	4	0.92%
Pyrus (Pear)	4	0.92%
Quercus (Oak)	3	0.69%
Thuja (Arborvitae)	2	0.46%
Abies (Fir)	2	0.46%
Other, ornamental	2	0.46%
Sorbus (Mountain ash)	2	0.46%
Pseudostuga (Douglas-fir)	1	0.22%
Gymnocladus (KY Coffeetree)	1	0.22%
Total	**435**	**100.00%**

Table 4. Tree genus diversity breakdown for the Town.

Town of Paonia - Street Tree Inventory - Top 10 Species					
Tree Species	**Total**	**Percent of Total**	**Average DBH**	**Average Value**	**Total Value**
Norway maple	95	18.55%	20.90	$ 9,830.41	$ 933,889.00
Silver maple	47	9.18%	31.30	$ 17,661.79	$ 830,104.29
Siberian elm	41	8.01%	36.60	$ 21,749.92	$ 891,746.69
Honeylocust	34	6.64%	13.60	$ 4,309.58	$ 146,525.84
Green ash	21	4.10%	24.90	$ 8,550.26	$ 179,555.37
Colorado blue spruce	21	4.10%	21.30	$ 10,976.45	$ 230,505.52
Apple	16	3.13%	4.60	$ 775.78	$ 12,412.55
Crabapple	12	2.34%	5.30	$ 772.82	$ 9,273.80
Pinon pine	12	2.34%	7.80	$ 937.94	$ 11,255.30
American linden	10	1.95%	19.20	$ 8,392.63	$ 83,926.27

Table 5. Top 10 tree species growing in the Town.

Suggested Species

The Town of Paonia should continue to diversify the urban forest by selecting tree species that are hardy from Zone 4a (-30°F to -25°F) to Zone 5a (-20°F to -15°F). The USDA Plant Hardiness Zone is the standard used to determine which plants are most likely to thrive in a location. The zone information is based on the average annual minimum winter temperature. A list of suggested tree species based on what is growing in the Town, the surrounding communities, and what could do well based on tree characteristics can be found in Appendix C). This list includes many species that have not been planted before, but it is worth trying these trees to see how well they do.

The CSFS strongly recommends that the Town does not plant any ash trees (*Fraxinus* species) as they have no defense mechanisms against the emerald ash borer (EAB). The EAB has been identified in multiple Front Range communities and it has the potential to devastate the ash population when it arrives on the western slope. There were 26 ash trees inventoried in Town.

Species diversity is a key component to the health of the Town of Paonia's urban community forest. As tree spaces become available within parks and the rights-of-way in the community in general, the Town should choose trees from Appendix C or other species that may do well and are currently underutilized or have not been planted in the community.

Proper Tree Planting

To have more tree diversity in the Town, the new trees must be properly planted and cared for. Trees will have a much better chance of success if basic rules are followed by either by Town staff or a contractor. Tree planting guides produced by the Colorado State University and the Colorado Tree Coalition can be found in Appendix K.

Keep in mind, planting replacement trees is recommended when a tree removal occurs and the location is appropriate. If stump grinding is completed, then a tree may be planted in the same spot.

Planting issues were identified in the Town during the inventory. The main concern was that both container and ball and burlap trees are being planted too deep in the ground and in holes that are too small. Education of the proper planting steps to staff and contractors will minimize the issue in the future. Additionally, it is

recommended that the Town insert wording in future planting contracts that require the landscaping company to follow proper planting standards. The existing planted trees with these issues will need to be addressed as time and money allow for it. The CSFS is willing to conduct training for Town staff and contractors and review contract wording to ensure proper planting is done in future planting projects.

Image 1. A recently planted tree, it was planted too deep in the soil. No root flare is visible.

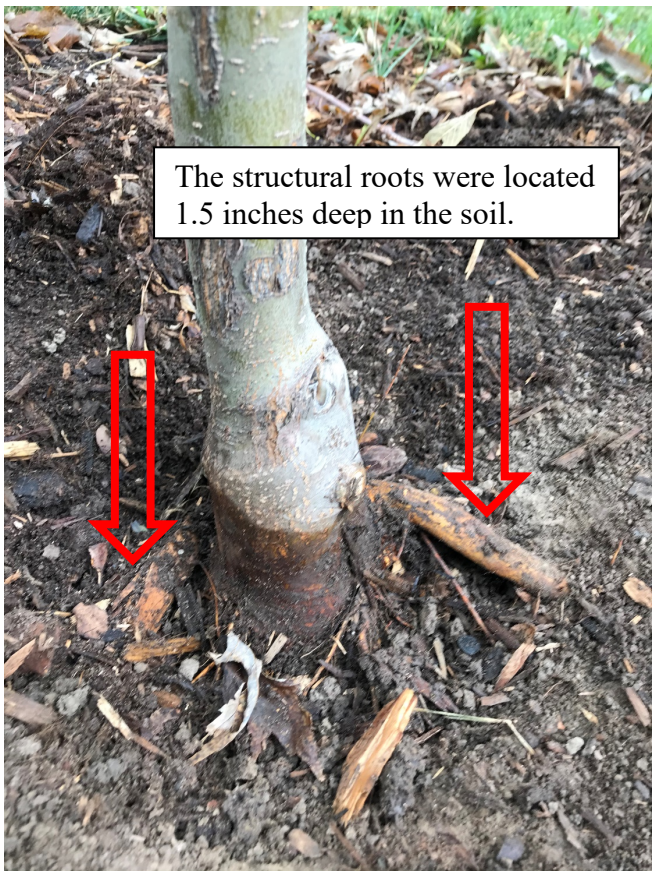


Image 2. The root flare was excavated and was found approximately 1.5 inches deep.

In general, a planting plan should consider the following:

- Whenever possible, plant trees in places where they will receive good east and/or west sun for most of the day. Trees planted in full shade struggle unless they are a very shade-tolerant species.

- Plant in the early spring after the soil thaws to take advantage of cooler temperatures, spring moisture, and available staffing. An alternative planting time is to plant in the fall after the leaves have dropped off but while the soil temperatures are still warm enough to facilitate root growth (i.e., above 40 degrees Fahrenheit). A tree is never completely dormant until freezing temperatures arrive.

- Select the best planting site and if desired, amend the backfill soils with organic matter but no more than five percent.

- Plant Material Type -
  - Bareroot plant material, in various sizes, is a good option because you acquire more plants per dollar however, they are usually only available in the spring.

- Container plants can be installed anytime in the growing season but will require irrigation that is more frequent while they become established as they are used to daily watering at the nursery in the summer.
- Ball and burlap (B&B) trees are usually larger and require machinery to facilitate planting. If purchasing B&B deciduous trees, they should be at least a two to three-inch caliper diameter or be 8 to 12 feet in height. Conifers should be five feet or greater in height. Larger tree sizes discourage vandalism, but they will usually require staking.

- Remove competing vegetation at least four feet in diameter (more if possible) away from the planting site and mulch with three inches of wood chips. Make sure the chips are not in contact with the root collar/stem. By removing competition for water and minerals, you increase a plant's chances for establishment.

- If staking a tree, it should only be left on for one growing season. This helps maximize root establishment and minimize vandalism. It is particularly important in high wind areas and for conifer trees.

- Deer/beaver protection should be in place until trees are established (i.e., at least 15 feet tall and/or three inches in diameter).

- Watering is critical to the success of all newly planted trees.

- Provide supplemental water during the growing season for the first three to five years.

- Determining a watering schedule for newly planted trees depends on the soil type. The goal is to water deep, approximately 10 to 12 inches down, as this is where the roots are growing.
  - The first step is to determine how quickly the soil dries out after watering by using a long probe (long screwdriver, piece of rebar, etc.). The depth the probe can be pushed into the soil indicates the level of soil moisture.
  - After watering, use this method every couple of days to check how quickly the soil dries out. Once the soil is dry within one to two inches from the soil line, it is time to re-water.
  - This schedule will fluctuate as the temperature warms during the summer and cool toward fall, it is important to monitor the amount of water given based on the season.

- Winter watering is an important tool to ensuring a tree's success. Water one time per month in the dormant season unless there is snow on the ground or the temperature is below zero.

Insects and Diseases

Native insects and diseases are part of all plant ecosystems. In the forest, they are Mother Nature's way of removing poor and unhealthy specimens and ensuring the forest does not become too dense. In urban environments, they are Mother Nature's way of removing trees stressed by human or environmental factors, planted incorrectly, or are incompatible with the planting site.

Minimal insect and disease activity was observed during the inventory as 65 percent of trees showed no pest activity. **Decay** was the most commonly identified disease with 52 trees (10% of trees) showing signs of compromised wood integrity. According to the Morton Arboretum, "once a wound occurs, decay-causing fungi can enter the heartwood and the decay process begins. Trees have a unique defense. The wood around the wound begins to produce special compounds in the wood cells that set up a wall or barrier to isolate the

infected area. This is called compartmentalization. In a vigorous tree, new growth continues to form and add to the sound wood. Once compartmentalized, discoloration and decay will spread no further unless one of the barriers is broken." (www.mortonarb.org) In older or stressed trees, compartmentalization may not occur or the decay organisms are too aggressive. Many of the trees in Town that exhibited signs of decay had been topped in the past. Topping is a pruning practice that is not recommended or utilized by certified arborists. This practice removes all the tips/leaders of branches and this was usually done to reduce the overall size of a tree. This type of pruning, especially in trees with poor compartmentalization abilities, can lead to decay in branches and the trunk as the tree grows. Signs of decay in Paonia street trees included large wounds on branches and trunks, cavities, and fruiting bodies (decay organisms). See Image 3 for an example.

The second most commonly observed pest was **bacterial wetwood** in both Siberian elm and various cottonwood species (34 trees, 6.6%). The Morton Arboretum states "wetwood, also known as slime flux, is a very common bacterial disease that occurs in many kinds of trees. Nearly all elm and poplar species are affected, as are numerous other trees including crabapple, birch, maple, horse chestnut, linden, oak, pine, redbud, and sycamore. Wetwood is normally not a serious disease. However, a tree with a chronic case of wetwood may decline in general vigor." (www.mortonarb.org) The outward signs of wetwood is a dark brown to black water-soaked area of wood, usually seen around cracks in the bark and old pruning cuts. The liquid itself is pale and when it dries it can leave a pale gray to white crust on the bark, see Image 4. There is no control for wetwood and it usually does not require management. If a high-quality tree is infected with wetwood and is showing signs of dieback or decline, a drainpipe for the fluid may be installed but this would only be done in extreme cases.

Girdling roots or the potential for girdling roots were observed on over 20 trees (4.5%). While a girdling root is not an insect or disease, the Pest category was used to describe an issue the tree was experiencing that was causing harm. A girdling root is a visible root around the trunk flare/ root collar of the tree (see Image 5). This is a root that is growing across the trunk instead of out into the soil. These roots should be cut as soon as possible to prevent the root from growing larger and causing further damage to the tree's xylem and phloem (the internal system that moves water up to the leaves and food down to the roots). This option was also selected if there was no visible trunk flare and girdling roots were suspected and further investigation is suggested (see Image 6). This issue can easily be addressed by Town staff but is most importantly addressed during the planting of new trees in the landscape. Following proper planting procedures will significantly reduce the possibility of a girdling root occurring.

The fourth most commonly observed pest was ***Cytospora* canker**. A canker describes an area of dead cambium (living cells just beneath the bark) and dead bark, usually on the tree's trunk but can be found on branches. Canker fungi travel from tree to tree by wind, rain, other insects, and humans. The fungus produces spores in the spring when the weather is moist. (Aspen: A Guide to Common Problems in Colorado, 1986). The primary tree species being impacted by cankers were cottonwood and fruit trees such as cherry, peach, and plum (see Image 7). There are multiple canker types that affect these species, however, the dominant canker observed was *Cytospora* canker (*Cytospora* spp.).

Cankers are tree killers and can create high-risk tree situations when deadwood and stem weakness begin to occur on the trunk or in large branches. It can kill individual twigs, branches, and portions of the trunk by girdling the bark (killing the bark around the circumference of the tree part). Cankers will affect trees of all sizes and ages but will have greater success in trees that are stressed from too much or too little water, soil compaction, other insects or diseases, and trees that have been improperly pruned. Often, infected trees will break at the canker site and can be hazardous.

Cankers usually occur on weakened host trees; therefore, the primary control method is to prevent tree stress. If the tree is already infected, the best treatment is to increase plant vigor and remove all of the

infected limbs. Proper tree pruning and making clean cuts are critical to preventing the initial infection and then preventing the spread of this disease. Pruning tools can spread the disease from branch to branch or tree to tree. Cleaning pruning tools between cuts when pruning trees with cankers (or fireblight on crabapples) can prevent the spread of the disease. The tools can be wiped or sprayed with ethyl alcohol, Lysol, or other disinfectants. It is recommended to prune trees during dry weather, as the cankers are more active during moist weather. (CSU Extension, 2.937 - *Cytospora* Canker fact sheet, 2013).

The most common insect issue identified during the inventory was **scale**. They were observed on both American elm (European elm scale) and pinon pine (pinon needle scale), see Image 8. Scales can be either soft-bodied or armored insects; they suck sap from the tree and can produce a substance called 'honeydew', which can allow sooty black mold to grow on tree surfaces. This can be especially obvious on American elm trees where the upper sides of branches turn black. Horticultural oil spray is the safest and most effective way to control scale, but the label directions must be followed. This oil coats the scale insects and clogs their breathing pores which will eventually kill them.

Using the tree inventory data, Town staff can make informed decisions on tree species selection, planting locations in relation to trees impacted by insects or diseases, and how to manage trees with current insect or disease issues based on the type, severity, and location. Management may include tree removal or a spraying regime to control or prevent the insect.

Most of the pests observed in the Town are not 'killers', but instead stress the tree by killing or damaging leaves, branches, or tree leaders. This can predispose the tree to 'killers' or create a poor tree structure that may require future pruning maintenance. These types of insects should be considered for management when creating a tree management plan.

In general, it is important to use good tree care practices for landscaped trees such as maintaining a regular watering schedule, with supplemental watering during dry and winter months, which will promote and maintain tree vigor. It is also important to schedule regular pruning of trees to remove hazards, promote good structure, health, vigor, and aesthetics. Regular pruning is an important measure the Town can take towards the prevention and control of insects and diseases. In some instances, if insect issues increase on a particular tree species, the Town may consider implementing pesticide applications as a measure of control. If trees succumb to an outbreak, they may need to be replaced with a different tree species that can thrive in that environment. However, the most effective preventative tool when it comes to pest management is to regularly visit the trees to view, inspect, and monitor tree health and conditions. Native pests naturally undergo a cyclic activity regime. Some years or seasons the population may explode, which would warrant action on the part of Town staff.

There is a non-native insect currently decimating deciduous trees in the Midwest: the Emerald Ash Borer, see Image 9, affects all species of ash (*Fraxinus*). Most likely, this insect will need a human vector to get into the urban forests of Western Colorado. It was originally detected in Boulder, Colorado and is now found in other towns and cities on the Front Range. There is no way of predicting when or if this insect will arrive in Western Colorado but because this tree species is presently growing in the Town proper, management must plan for their arrival by making the tree population as diverse as possible, as soon as possible. Mountain ash trees are not at risk, as they are in the *Sorbus* family, not in the *Fraxinus* family.

Additional information on these and other insects and diseases described above and listed below can be found in "*Insects and Diseases of Woody Plants in Colorado*" from the Colorado State University Extension office. This book is a great resource and should be in the reference library for the Town. See Appendix L for additional information on all insects, diseases, and pests described in this section.

Image 3. Decay in trunk from an old pruning wound.

Image 4. Bacterial wetwood visible on a poor pruning cut on a Siberian elm.

Image 5. Girdling root that should be removed.

Image 6. Tree with no root flare, excavate to locate and expose root flare.

Image 7. Cherry tree with Cytospora canker resin.

Image 8. European elm scale on an American elm.

Image 9. Photo of an emerald ash borer. This insect will attack all species of ash.

Tree Risk Assessment and Methods

The goal of the tree risk evaluation portion of the tree inventory is to provide the Town staff with information on trees with risk to create a strategy to reduce tree risk while working within budgetary limitations. Corrective actions should be completed as soon as is feasible and should be prioritized according to the tree risk analysis and priority ratings. Once high-risk trees have been identified and management actions prioritized, the inventory data should be updated as tree risk management occurs. Bi-annual monitoring and inspection of trees with moderate, low, and lowest ratings should be scheduled (all high-risk trees having been mitigated first).

For this evaluation, all trees 20 inches in diameter at breast height (DBH) and greater and smaller trees that exhibited signs of risk were assessed. This information was used to determine the priority management action for that tree. This inventory employed the Colorado Tree Coalition (CTC) Tree Risk Assessment 14.2 protocol, a more in-depth description of the criteria can be found in Appendix E. This protocol is based on the International Society of Arboriculture Tree Risk Assessment Best Management Practice, 2011.

The protocol's factors are divided into risk values (Tables 6 and 7). For example, tree species (Table 7) is divided into four risk values based upon a tree species' inherent characteristics. Values range from one (low-risk) through four (high-risk). While rating the tree, the inspector evaluated all situations that were applicable to each factor and recorded their respective risk values.

Trees 20 inches in diameter or larger, or with an obvious defect, were evaluated with the following criteria and given a value between 1 and 4 (see Table 6) for each class: Likelihood of Failure, Likelihood of Target Impact, and Consequences of Failure and Impact. These three classes were then added together to give a Subtotal 1, with values ranging between 3 and 12.

Classes	Risk Value	Rating Criteria	Rating
A - Likelihood of Failure	1	Improbable	(1-4)
	2	Possible	
	3	Probable	
	4	Imminent	
B - Likelihood of Target Impact	1	Very Low	(1-4)
	2	Low	
	3	Medium	
	4	High	
C - Consequences of Failure and Impact	1	Low	(1-4)
	2	Moderate	
	3	High	
	4	Very High	
Subtotal 1 – Risk Assessment	**-**	**Add A + B + C**	**Risk value (3-12)**

Table 6. Trees with potential risk were assessed using this criterion.

The next criteria to be evaluated (Table 7) and given a value between 1 and 4 for each class was the Target Use, Tree Species (this was based on a previously determined list), and Action Recommended. These three classes were added together to give a Subtotal 2, with values ranging between 3 and 12.

Classes	Risk Value	Rating Criteria	Rating
D - Target Use	1	Low Use	(1-4)
	2	Moderate Use	
	3	High Use	
	4	Very High Use	
E - Tree Species Rating	1	Low Risk	(1-4)
	2	Moderate Risk	
	3	High Risk	
	4	Very High Risk	
F - Action Recommended	1	Re-evaluate Next Inspection Cycle	(1-4)
	2	Re-evaluate Next Growing Season	
	3	Mitigation	
	4	Removal	
Subtotal 2 – Risk	**-**	**Add D + E + F**	**Risk value (3-12)**

Table 7. Trees with potential risk were assessed using this criterion.

After Subtotal 1 and Subtotal 2 were determined, the numbers were multiplied together to give the tree its final risk rating which could range between 9 and 144. Table 8 shows the risk categories associated with the risk ratings.

Total Risk Rating	-	Subtotal 1 (x) Subtotal 2	Risk value (9-144)

Total Risk Rating	Risk Category
72-144	High Risk
36-71	Moderate Risk
9-35	Low Risk

Table 8. Based on the criteria in Tables 6 and 7, each tree was given a final risk.

Management Actions and Recommendations

Management actions were identified after the completion of the tree inventory for both regular trees and those that required a tree risk analysis. The management recommendations for risk-assessed trees are based on the final priority ratings. These ratings will help guide the Town staff in recognizing and prioritizing a work plan for each year. As in all management plans, the scheduling, and achievement of these management activities will depend upon the Town's resources, available grant assistance, and environmental conditions.

To understand the management actions recommended it is important to define what is considered a risk tree. A risk tree are those trees with a structural defect and in a location that increases the chance of failing and hitting a target. The combination of a defect and target can result in property damage or personal injury. A target may be a structure, vehicle, or person that could be struck by a falling tree or tree part. The value of a target has a direct bearing on the relative hazard a tree represents. A tree falling on a fence is less serious than one falling on a restroom facility. A tree that could injure or kill people, such as one leaning over a picnic table, is more hazardous than a tree leaning away from a trail. Liability from failure increases where people are present.

Many trees in the Town did not meet the requirements to receive a full risk analysis and a risk rating. However, many trees would benefit from management actions. This information was captured in the management need question. Appendix D provides photo examples of each of the management needs documented during the inventory.

The following list includes many of the most common types of tree risk conditions but not all were noted in the Paonia Inventory:

- Decay
- Cavities – in trunk or branches
- Dead limbs
- Splits/cracks in branches
- Heavily used areas with compacted soil and injured roots
- Heavy horizontal limbs
- Basal or crown rot; root decay
- Damage from wind and/or vehicles
- Construction damage
- Leaning trees, heaving soil
- Soil slippage areas
- Tree declines: insect and disease situations
- Weak branch or trunk unions

The following photos depict some of the management needs that were observed during the tree inventory. Management actions can prolong a tree's contribution to the tree canopy and improve its overall health.

Image 10. This tree on 2nd and Boxelder is beginning to block the yield sign and needs to have the crown lifted.

Image 11. This linden tree on 2nd and Grand needs to have its root collar excavated, and the suckers and fabric removed.

Image 12. This honeylocust needs to have structure pruning to restore its crown after being improperly pruned in the past. Also located on 2nd and Grand.

Image 13. This hackberry is located on 3rd and Grand. This will grow into a large mature tree, up to 40 ft wide by 40 ft tall. It is in the wrong location. Remove and replace with an appropriate tree species.

Risk Trees – Management Priorities

Tree risk assessments were a component of this tree inventory, and 196 trees received this higher level of assessment. The information in this section is a summary of the top priority management recommendations for trees that received a risk assessment rating of moderate or high. This data is found in Appendix H.

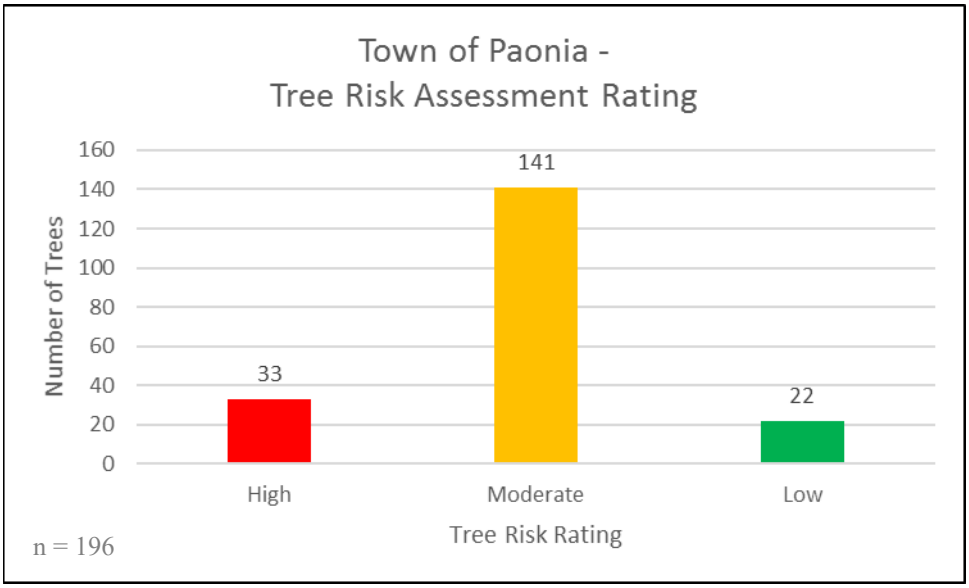


Figure 7. Risk assessment ratings for trees in Town.

Of the 196 trees identified, the Town has 174 trees that received a moderate or high-risk rating and 22 trees with a low rating. The importance of this inventory is it has narrowed down the trees that need mitigation or an in-depth assessment from the Town's general tree population. The Town should focus on the trees with a moderate or high-risk rating and ensure management is completed that reduces the tree's risk or removes the tree from the landscape.

The **number one management need** in the moderate and high category is that 32 trees require an in-depth assessment from a licensed/certified arborist to determine if the concerns noted during the inventory can be mitigated with management or if they need to be removed due to their potential impact on public safety or tree's overall health.

The **number two management need** for the moderate and high-risk trees is to defective prune. The priority is to have a certified/licensed arborist prune the trees to remove dead or dying branches, reduce the weight in co-dominant leaders, remove hangers (broken branches hung up in the tree's canopy), and/or conduct other needed pruning actions. While it is not uncommon for trees to have some deadwood in their crowns, the unpredictable timing of branch failure makes it imperative for those trees close to sidewalks, parking areas, picnic tables, playgrounds, or infrastructure to receive a higher priority for mitigation action. Based on the inventory comments, the concern is that if these trees with defective issues are not addressed, the risk will continue to increase and the likelihood of failure will increase.

The **third management need** is almost a tie between rotational prune and structure prune. The rotation pruning recommendation indicates there were no major structural or defective issues identified on the tree during the inventory but continued management to ensure healthy, safe trees is recommended. This is usually done on a rotation with all Town trees put on a rotational pruning schedule. This schedule depends on the budget, the number of large versus small trees, and the availability of arborists/staff.

When the management need structure prune is selected, it indicates the need to have a certified/licensed arborist prune the trees to improve their structure and that the current tree crown has major issues. Evaluator comments include previously topped, the tree has previous branch failures, has co-dominant leaders, and included bark. These comments indicate that if these trees' structural issues are not addressed, the risk will continue to increase and the likelihood of failure will increase.

In general, Town staff should be trained to monitor the status of the large trees in the Town, particularly the trees with moderate or high-risk ratings, as there are tree parts or features that would benefit from having staff monitor the trees in case of a change. Changes could be but are not limited to, new/increased amounts of branch dieback, dead limbs, presence of mushrooms, a change in the sound of the trunk when hit with a mallet, and/or an increase in trunk lean. Management needs for trees with a risk assessment are shown in Figure 8.

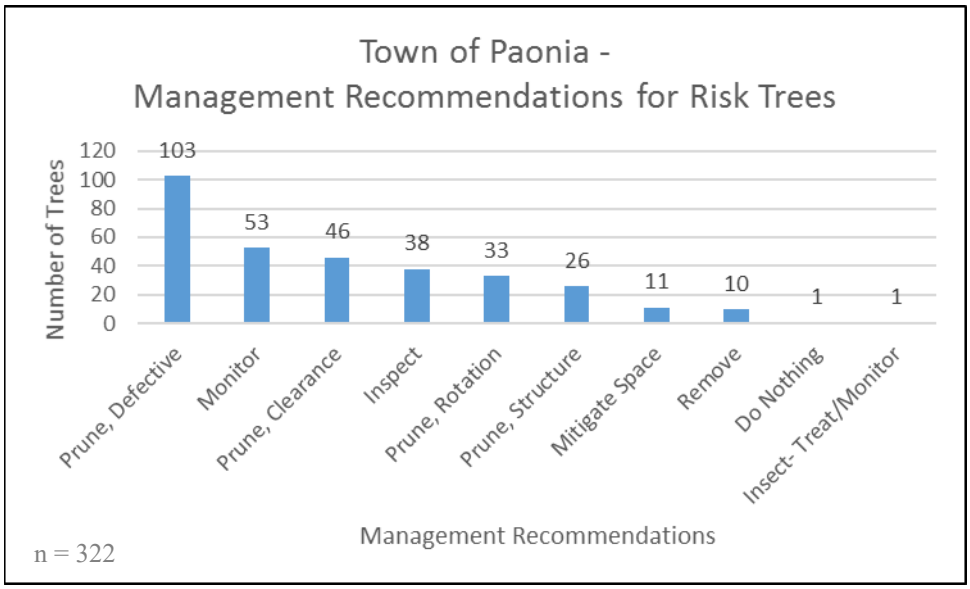


Figure 8. Management recommendations for trees with moderate or high risk.

All Trees - Management Priorities

The following recommendations are in order of priority and these are for all Town trees, not just trees with high or moderate risk. This list can be used to create an implementation schedule and to write a tree management plan. A management plan would include details on management activities for all trees in the Town.

The **first priority** for the Town is to establish a management and care plan for the large trees, 20 inches diameter or larger (or with a defect that needs to be monitored). A basic tree risk assessment was completed on 196 trees and this information will give staff data on the current health and management needs of each tree and a reference/base point for future assessments. The tree risk assessment spreadsheet can be found in Appendix H. By creating this plan, it will show the Town has taken the duty of care for these trees seriously and have steps to mitigate any risk issues identified by this inventory or future assessments.

Part of the management/care plan should include bi-annual assessments. A licensed/certified arborist or the Colorado State Forest Service- Grand Junction Field Office staff can conduct this assessment. A list of certified arborists can be found by searching the International Society of Arboriculture's 'find an arborist' webpage at: www.isa-arbor.com/findanarborist/findanarborist.aspx. A walkthrough of the areas where these trees are located, once in the spring to identify trees that need mitigation after leaf break and again in the

fall, will also assist the staff in monitoring the overall health of the urban forest and in caring for individual tree needs.

The **second priority** for the Town is for staff to visit trees that have the management need of remove (25 trees), have the condition rating of poor or very poor (36 trees), or the placement rating of poor or liability (23 trees). Once staff has assessed the tree(s), the appropriate management action(s) can be determined and put into the overall management plan.

The **third priority** is to have the 41 trees with the management need inspect assessed by a licensed/certified arborist or an experienced staff member. The tree may need additional information collected to determine the level of holding wood in the trunk or roots or it may need an aerial inspection if bird cavities or damaged canopy branches were identified. The main goal for the inspecting arborist is, can mitigation make this tree safe for the public, or does the tree need to be removed. The purpose of the in-depth assessment should determine this for each of the identified 'inspect' trees.

If there is a large basal wound or the tree's soundness is in question, the goal is to determine the amount of holding wood (sound wood) the tree has and if it meets minimum criteria for safety. As a rule, if the amount of sound wood in a tree is larger than 1/6th of the tree's diameter or 1/3rd of the tree's radius, there is sufficient wood to hold the tree or branch in place under normal weather conditions. That means for every 12 inches in diameter there must be at least two inches of sound wood completely encircling the decayed portion of the tree. The key to sound wood being an effective deterrent to tree failure is that it must completely encircle the decay. Additional information on holding wood and defect is in Appendix L.

The management need inspect was also selected if the inventory data collector felt the tree needed additional information or assessment before making a management recommendation. Cankers on the trunk or branches and holes in the trunk are comments made by evaluators.

The fourth priority is to have a licensed/certified arborist remove any defective tree parts identified during the inventory (141 trees). Nearly all the comments have either dead branches or deadwood as the problem needing attention. Also noted were to remove smaller stems (to remove co-dominant stems), or the leader died and it needs to be removed and the structure fixed. While it is not uncommon for trees to have some deadwood in their crowns, the unpredictable timing of branch failure makes it imperative for those trees close to sidewalks, parking areas, picnic tables, playgrounds, or infrastructure to receive a higher priority for mitigation action.

The **fifth priority** is to begin to address the trees with the management need Mitigate space or with a Growth Obstruction. These options were selected if the tree was experiencing conflicts with the ability to grow to its full potential in its growing space. This includes sidewalk conflicts with the root flare, adjacent vegetation growing too close to the tree, girdling roots (either observed or possible due to external signs), and overhead wires.

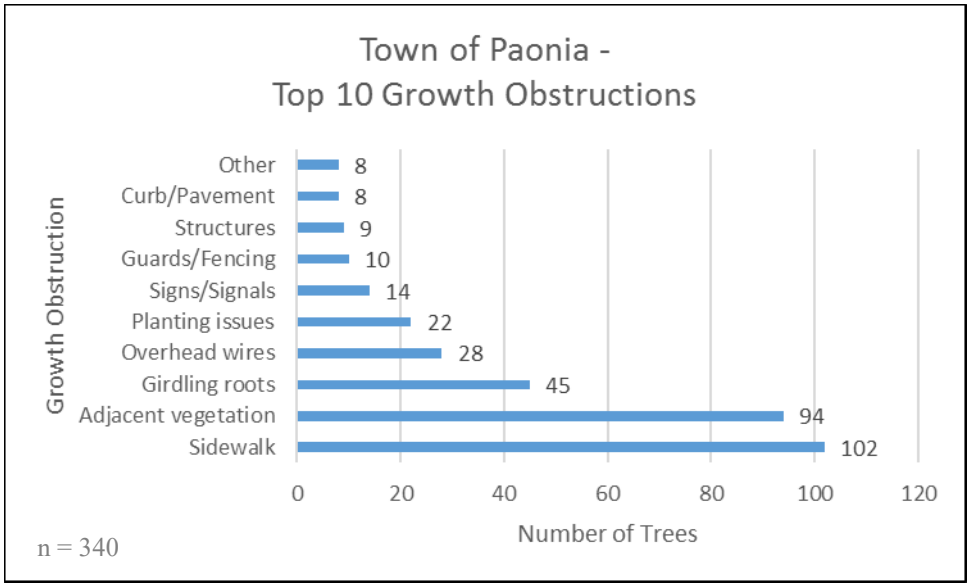


Figure 9. Management Need – Top 10 Tree Growth Obstructions.

Sidewalk conflicts

Street trees and sidewalks are important to the Town of Paonia and the goal is to not have to choose one over the other but to find a balance when conflicts arise, particularly in locations where large trees are growing. Sidewalk conflicts were noted when the sidewalk was beginning to show signs of damage from the tree's roots or trunk flare, this included cracking, lifting, or heaving of the concrete or ground. The level of damage done to the sidewalk was not identified, only that a conflict was occurring. This is a common issue when trees are planted between the street and sidewalk and outgrow the space. There were 102 conflicts noted during the inventory. See Appendix N for documents related to this topic.

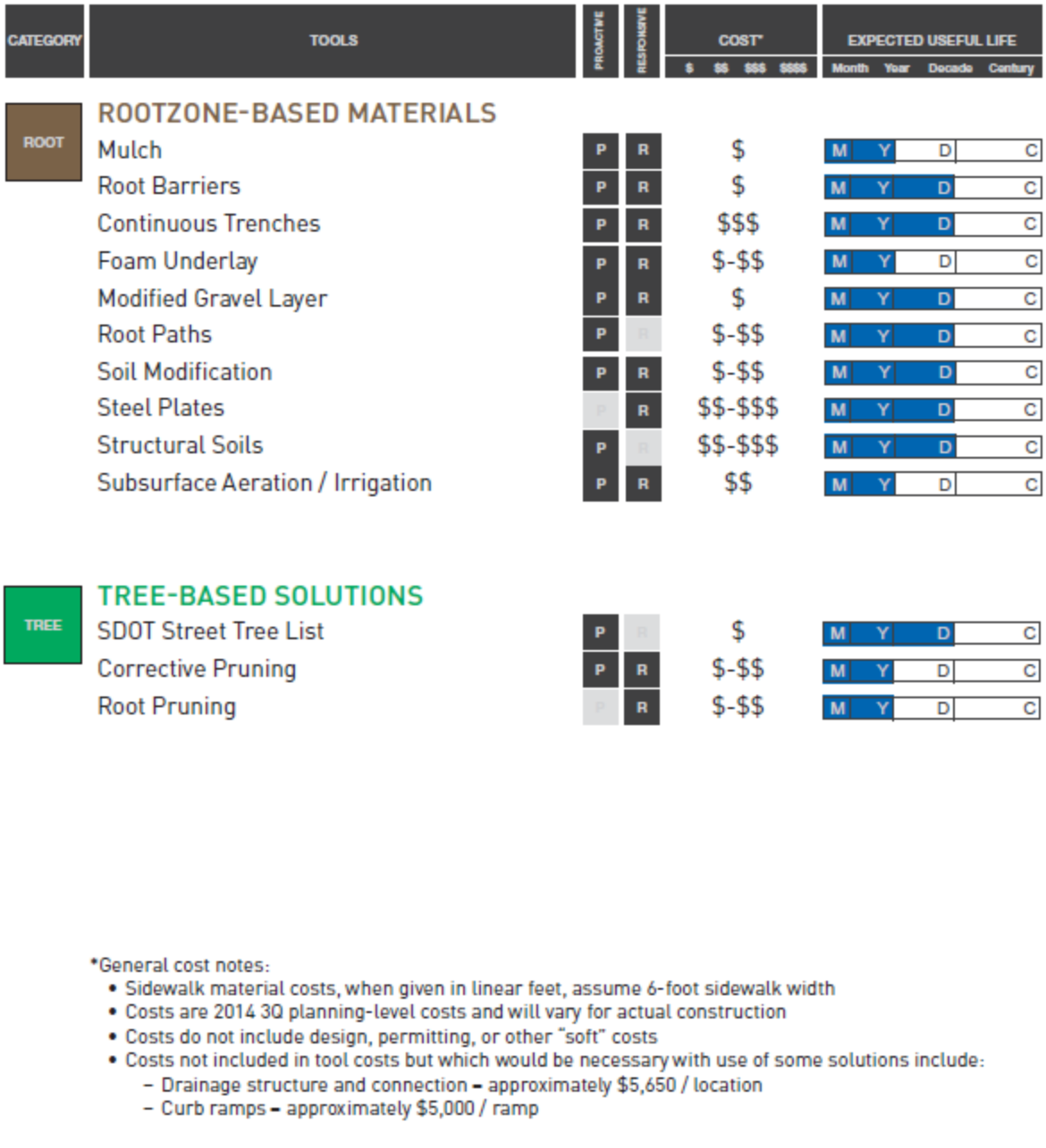
To manage this issue the Town must decide which trees to keep, which ones warrant removal, and where sidewalk replacement or repair can be conducted. If the determination is to keep the tree, there are solutions that the Town can use that will retain the tree and provide accessible, walkable surfaces. There are both tree-based and infrastructure-based techniques and material options, the Seattle Department of Transportation (SDOT) put together a plan that addresses many of these (see Appendix N).

Tables 9 and 10 are taken from the SDOT plan and is a useful list of paving and other surface material options, infrastructure-based design solutions, rootzone-based material, and tree-based solutions that the Town can consider. There will not be one solution that fits all situations and some trial and error will be involved as the Town decides which options work best in different areas. However, it is important to recognize that there are many options available that weren't available in the past thanks to advances in research and technology. It is also recommended to contact other towns and cities and talk to staff that is dealing with the same tree vs sidewalk issues.

TOOLKIT OVERVIEW

CATEGORY	TOOLS	PROACTIVE	RESPONSIVE	COST* $ $$ $$$ $$$$	EXPECTED USEFUL LIFE Month Year Decade Century
	PAVING AND OTHER SURFACE MATERIALS				
MATERIAL	Asphalt	P	R	$-$$$	M Y D C
	Expansion Joints	P	R	$	M Y D C
	Pavers	P	R	$$-$$$	M Y D C
	Pervious Concrete	P	R	$$$-$$$$	M Y D C
	Reinforced or Thicker Slab	P	R	$$-$$$	M Y D C
	Rockery / Wall	P		$$-$$$$	M Y D C
	Beveling		R	$-$$	M Y D C
	Porous Asphalt	P	R	$-$$$	M Y D C
	Shims		R	$	M Y D C
	Tree Guards and Tree Rails	P	R	$$-$$$	M Y D C
	Decomposed Granite	P	R	$-$$	M Y D C
	Mudjacking (Concrete Leveling)		R	$$-$$$$	M Y D C
	INFRASTRUCTURE-BASED DESIGN SOLUTIONS				
DESIGN	Monolithic Sidewalk	P	R	$$$	M Y D C
	Pavement Thickness		R	$$$	M Y D C
	Tree Pit Sizing	P	R	$	M Y D C
	Bridging		R	$$$$	M Y D C
	Curb Bulbs	P	R	$$$-$$$$	M Y D C
	Curb Realignment	P	R	$$$-$$$$	M Y D C
	Curving or Offset Sidewalk	P	R	$$-$$$	M Y D C
	Easement	P	R	$-$$$	M Y D C
	Suspended Pavement Systems	P		$$$-$$$$	M Y D C
	Lowered Sites	P		$$$-$$$$	M Y D C
	Soil Volume	P	R	$-$$$	M Y D C

Table 9. Toolkit overview from the Seattle Dept. of Transportation for managing sidewalk conflicts.



CATEGORY	TOOLS	PROACTIVE	RESPONSIVE	COST*	EXPECTED USEFUL LIFE
				$ $$ $$$ $$$$	Month Year Decade Century
ROOT	**ROOTZONE-BASED MATERIALS**				
	Mulch	P	R	$	M Y D C
	Root Barriers	P	R	$	M Y D C
	Continuous Trenches	P	R	$$$	M Y D C
	Foam Underlay	P	R	$-$$	M Y D C
	Modified Gravel Layer	P	R	$	M Y D C
	Root Paths	P		$-$$	M Y D C
	Soil Modification	P	R	$-$$	M Y D C
	Steel Plates		R	$$-$$$	M Y D C
	Structural Soils	P		$$-$$$	M Y D C
	Subsurface Aeration / Irrigation	P	R	$$	M Y D C
TREE	**TREE-BASED SOLUTIONS**				
	SDOT Street Tree List	P		$	M Y D C
	Corrective Pruning	P	R	$-$$	M Y D C
	Root Pruning		R	$-$$	M Y D C

*General cost notes:
- Sidewalk material costs, when given in linear feet, assume 6-foot sidewalk width
- Costs are 2014 3Q planning-level costs and will vary for actual construction
- Costs do not include design, permitting, or other "soft" costs
- Costs not included in tool costs but which would be necessary with use of some solutions include:
  - Drainage structure and connection – approximately $5,650 / location
  - Curb ramps – approximately $5,000 / ramp

Table 10. Cont. Toolkit overview from the Seattle Dept. of Transportation for managing sidewalk conflicts.

Creating policies around future construction and repair/maintenance of sidewalks and trees would be beneficial for the community and Town staff. Policies can include:

- Updating the Town's Tree Ordinance on how and when to protect and preserve existing trees and proper planting protocols for street tree plantings.
- Creating an Urban Forest Management Plan. This could be a comprehensive plan to manage all Town trees, this can include both public and privately owned trees. This plan can also tie into other existing or scheduled planning efforts such as stormwater planning or development planning.
- Maintenance of the Tree Inventory that was conducted in the fall of 2020. The inventory data was a snapshot in time. As trees are planted, pruned, removed, or receive other maintenance, the database should be kept up to date to make the inventory a living document. It is recommended to re-inventory the Town's trees approximately every five years.

- Maintain a Street Tree List of approved street tree species and cultivars. These lists should address the situations and/or settings that different species are approved for. For example, which trees can be planted under power lines or what the minimum planting area widths are for larger trees. The list would be specific to the Town and the suggested planting list in Appendix C is a good place to start. Usually, the list also includes species that are not suggested to be planted in town due to insect or disease issues or undesirable characteristics, such as Russian olive (invasive) or female boxelder trees (seeds attract boxelder bugs).
- If one has not been developed, create an ADA Transition Plan or conduct other mobility planning. This plan would bring the Town closer to being compliant with the Americans with Disabilities Act (ADA).
- Create Street Tree and Sidewalk Design Requirements. These are often established by zoning codes and as standard specification for general building codes. The requirements can include sidewalk material options, widths for sidewalks and planting areas, utility or other setbacks and clearances, and tree types and spacing (also referring to the approved tree list). Additional specifications can establish a minimum planting area and/or minimum soil volume per tree. This can be expressed in terms of usable soil volume, the current industry minimums are 300 cubic feet for small trees, 600 cubic feet for medium trees, and 1,000 cubic feet for large trees. See Appendix N for additional information.

Adjacent vegetation

Growth obstructions relating to adjacent vegetation indicates the tree is being impacted by another tree or possibly a shrub. The general recommendation is that most likely this is not a critical management need and when staff or an arborist is visiting the tree for other management issues, to take care of the adjacent vegetation issue. In some cases, an invasive or undesirable tree is growing too close to the desirable tree and removal would create a better growing environment for the inventoried tree.

Girdling roots

Girdling roots are a major issue for most urban communities. This topic was also addressed in the Insect and Disease section as it was categorized as a 'pest'. At least 45 trees were identified as having a girdling root or the potential of a girdling root due to high soil levels around the trunk/root flare. Girdling roots are silent tree killers, the root grows across the trunk, and as the root and trunk grow in size, the pressure of the root can strangle that part of the tree, cutting off the supply of water to the leaves and nutrients to the roots. Girdling roots can cause large trees to fail right at the soil level. This issue can be addressed by carefully removing the girdling root. See Appendix J for details on the management of girdling roots.

Overhead wires

Most of the overhead wires that were observed were in connection with potential planting spaces. This growth obstruction was selected to ensure the proper size tree was planted in the location so it didn't interfere with the lines in the future. However, some tree canopies are growing in or near overhead wires and Town staff should be aware of the trees that have this conflict. Tree limbs can conduct electricity if they have contact with energized wires.

Planting issues

A couple of major planting issues were observed during the inventory. The first is improper planting as many newly planted street trees were planted too deep in the soil. The second issue arises from the first,

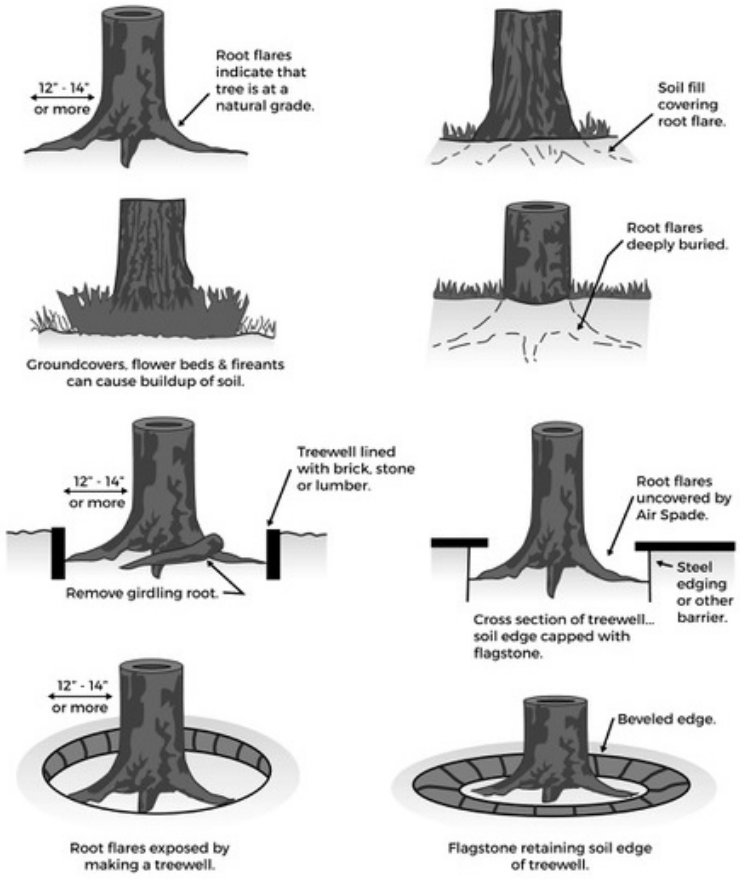


Image 14. Examples of good and bad root flares. Image found on dirtdoctor.com.

mature trees with no visible root flare, which stems from being planted too deeply in the soil. The third is to remove grass, mulch, soil, or weed barrier fabric that is too close to the trunk of the tree.

It is important to find the root flare when planting a tree and placing the flare at or above the soil line. If the flare was not located and then the tree was planted too deeply, the root flare could be five to eight inches below grade. Detailed planting information is located in Appendix K. These planting standards should be met by all Town staff who plant trees for in the Town or by contractors, adding this language and document to a planting contact would improve the future health of the trees.

The visible root flare is a sign of good tree health, this shows that the tree's roots are growing out into the soil and not creating girdling roots. Trees are designed to have a visible root flare; they should not look like telephone poles growing out of the ground. This flare and strong root system give them stability in windstorms and allows the roots to grow within 12-18 inches of the soil surface. If grass, mulch, soil, or weed barrier fabric is too close to the trunk, it could be hiding root issues or creating an environment that girdling roots can grow. Another issue is that the moisture from the soil (or mulch) can soften the tree's bark, which can allow pathogens and insects to penetrate the bark; this damage to the root flare is serious as it weakens a critical part of the tree. Additional information can be found in Appendix J and K.

Addition items of importance for the Town of Paonia:

Creating a Tree Management Plan

A Tree Management Plan establishes a clear set of priorities and objectives for the Town's urban forest. With a plan in place, the Town Manager and Public Works Director can use it as a guideline to maintain and create a healthy urban forest for all people to enjoy. The main components to a management plan include a vision of what the Town wants the urban forest to look like in the future, have a tree inventory and assessment completed to show what the urban forest is comprised of, determine a strategic plan of how to get to the vision based on what the inventory data identified, an implementation plan of what actions will be taken and when, and finally, a monitoring plan to make sure the Town is achieving the goals. See Appendix P for information on plan development.

Species diversity

This is an important component of all urban forests; Appendix C is a list of suggested tree species to plant that will provide diversity. As stated before, planting any ash species (*Fraxinus*) is no longer recommended. While there is a minimal number growing on Town property, there are additional ash trees in town on private properties thus increasing overall population and exposure. While there are preventative sprays that can be used on ash trees to prevent the emerald ash borer from killing the tree, however actions are NOT recommended until the borer has been confirmed within 10-15 miles of the Town. Increasing species diversity will lessen the impact of removing ash trees if the emerald ash borer does arrive on the western slope.

Proper Tree Pruning Education and Practices

Currently, there are no known International Society of Arboriculture (ISA), Certified Arborists working in town. This certification is an international standard and helps ensure that the arborist is following industry pruning and tree care standards. It is recommended to begin a training program that the local arborists can attend to improve their pruning skills to meet industry standards. The City of Grand Junction, for example, created an in-house forestry license that includes a written and field test that all arborists must pass in order to work within city limits. In 2021, the City will require all arborists working in city limits to have a Certified Arborist on staff. This license program is overseen by the City Forester and the Forestry Board. The test the City has used in the past can be found in Appendix O and the Town is welcome to use it as a template to create an in-house test.
Poor pruning was observed during the inventory. This includes flush cutting of branches, leaving of branch stubs, topping of trees, tipping of tree branches, and over-pruning (removal of too much material). All of these improper practices can be avoided with training and code enforcement. Improper pruning stresses the tree unnecessarily as the tree must now close a wound that is too large or was not needed which takes resources away from basic tree functions. If the tree was topped or over pruned, it will try to replace was what removed and this can cause additional structural issues. Poorly pruned trees can also lead to disease and insect infestations or decay in branches or trunks.

Local CSFS employees are available to do hands-on training with Town staff or contractors to facilitate learning to identify tree risk issues, proper pruning cuts, identification of insects and diseases, or other training needs that the Town would find

Image 15. An improper pruning cut. This cut removed the bark collar and make a large wound than needed.

Image 16. This is a tree on private property that has been topped. This is very difficult for the tree to close the wounds and decay in the branches is likely.

relevant. CSFS would need to charge for their time to conduct any training. Other local Certified Arborists in Carbondale, Grand Junction, or Montrose may also be willing to conduct trainings. The CSFS can assist with a list of potential companies if requested.

Conclusions and Recommendations

The Town of Paonia is a beautiful and well-loved community with an urban forest that will continue to mature and evolve over the coming years. As the Town continues to grow, having a street and park tree inventory with a tree risk component is an important part of the management process. With the information gathered during data collection, Town staff will be able to make informed decisions, put management actions in place, and create a Tree Management Plan that will benefit the community into the future. An urban forest is a living thing and it needs management to ensure that trees remain a viable part of the canopy and that they continue to grow strong and remain healthy.

This report provides a summary of the street trees inventoried and identifies the problematic trees in Town. This information will assist Town staff in deciding how to prioritize and mitigate the management needs of the Town trees. This report also provides an itemized list of all the large trees in Town: species, diameter, dollar value, condition, management need, and more. This inventory list is based in GIS software and in an excel spreadsheet (Appendix G, electronic only) and should be updated as work is completed.

The number one priority for the Town is public safety, but any tree management actions taken will also improve and maintain aesthetics, tree species diversity, wildlife habitat, and overall health of the Town's forest. These needs can be met with careful planning and budgeting.

Training of Town staff in proper hazard tree evaluations, pruning techniques, planting techniques, and insect and disease identification is an integral part in implementing these management actions and recommendations. The Colorado State Forest Service (CSFS) Urban and Community Forestry program hosts annual trainings/ conferences located on Colorado's Eastern and Western slopes, and it would benefit Town staff to attend these trainings. To be notified of the dates, contact the Colorado State Forest Service's Urban and Community Forestry Program Manager to be added to the email list. Other local trainings to increase staff's urban forestry education are conducted by the International Society of Arboriculture (ISA), Rocky Mountain chapter. They host many conferences and workshops during the year, visit www.isarmc.org to learn more about these local trainings. Another educational opportunity is for Town staff to become Master Gardeners through the Colorado State University Extension. The local office in Grand Junction hosts the Master Garden training sessions every January through March and a lot of content is online and virtual. For more information visit https://tra.extension.colostate.edu/gardening-hort/master-gardener-program/.

Local CSFS employees are available to do hands-on training (fees involved) with Town staff or volunteers to facilitate in learning to identify tree risk issues, proper pruning of younger trees, identification of insects and diseases, or any other training that staff would find relevant. Poorly pruned trees can lead to disease and insect infestations or decay in branches or trunks. To conduct tree pruning properly, quality pruning tools should be obtained by the Town. Handsaws, bypass hand pruners, pole pruners, and pole saws are the preferred tools for arborists. Loppers are not used to prune trees, they are used to cut up slash, and brush or cut down small seedlings or saplings. Tool brands CSFS employees regularly use are Felco, Corona, AM Leonard, and Silky.

Evaluating and treating hazard trees is complicated and requires certain knowledge and expertise. This report outlines some of the basic problems that may alert Town staff to a hazardous situation. Never hesitate if you think a tree might be hazardous. If you are not sure, have it evaluated by a professional. Remember, trees do not live forever. Design and follow a management plan and implementation schedule that includes a cycle of maintenance and replacement. This is the best way to preserve the health of the trees in the Town of Paonia and ensure a safe and enjoyable outdoor experience for its visitors.

Short and Long Term Recommendations

- **2021:**
  1. Have a Certified Arborist or qualified Town staff employee conduct a thorough inspection on the trees with a management need of Inspect.
  2. Take actions based on the in-depth assessment recommended by the arborist.
  3. Re-visit all trees that are recommended for removal, have a condition rating of poor, or have a placement rating of poor to determine the most appropriate management actions.
  4. Create fields in the database that will reflect work done on the trees.
  5. Begin updating the inventory database with work completed this year.
  6. Establish a pruning rotation for all Town trees, beginning with trees requiring defective and structure prune.
  7. Hire a licensed/certified arborist to prune the large trees.
  8. Begin to address trees with the management need mitigate space or with a growth obstruction. This will include removing excess soil/weed barrier fabric from around trees, identifying and removing girdling roots, and assessing sidewalk and tree conflict areas.
  9. Purchase quality pruning tools for staff to keep in their vehicles so they can address issues in the field.

- **2022:**
  1. Based on the current budget allocation:
     a. Continue pruning any remaining structural need or removing remaining removal trees.
     b. Prune all trees with routine prune as their management need.
     c. Continue all Town trees on a rotational pruning plan (e.g. every 5-7 years).
        i. Make sure all management work is updated in the database.
  2. Implement a process to keep the GIS software database updated and current on when management actions are taken.
  3. Start creating a Town Tree Management Plan which should include details on how to manage tree and sidewalk conflicts.
  4. Hire a licensed/certified arborist or the CSFS to conduct bi-annual assessments of trees with moderate or high-risk assessment levels (at a minimum).
  5. Start planting trees from the Suggested Planting list.

- **2023 and beyond:**
  1. Continue to update the tree inventory database as management actions are taken.
  2. Implement the Town Tree Management Plan.
  3. Have a complete tree inventory done for the Town managed areas.
  4. Begin to re-inventory trees in Town; this can be done in units to reduce the overall workload.

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Glossary of Terms:

Not all terms have been used in this report but are related to tree risk and general tree care and maintenance.

Backfill: soil and amendments placed/replaced around the root system in while filling the planting hole.

Bacterial wetwood: sapwood/heartwood disease caused by anaerobic bacteria.

Balled and burlapped (B&B): Shrubs and trees dug from fields with a ball of dirt around the roots. The solid ball is wrapped in burlap and set in a wire basket to hold it together. Usually dug in fall or early spring, during the dormant season.

Bareroot planting: installation of plants with naked/exposed roots.

Basal cavity: open hollow located at the base of the tree, usually initiated by wounding followed by internal fungal decay.

Branch collar: area where a branch joins another branch or trunk that is created by overlapping vascular tissues form both the branch and the trunk. Typically enlarged at the base of the branch.

Branch union: area where two branches meet.

Caliper diameter: nursery and landscape companies use this to determine tree size. Trunk diameter is measured six inches from the soil surface, if the diameter is great than four inches, it is measured 12 inches above the surface.

Canker: A canker is a localized area on the stem or branch of a tree, where the bark is sunken or missing. Cankers are caused by wounding or disease. The presence of a canker increases the chance of the stem breaking near the canker. A tree with a canker that encompasses more than half of the tree's circumference may be hazardous even if exposed wood appears sound.

Codominant stems: forked stems nearly the same size in diameter, arising from a common junction and lacking a normal branch union.

Conk: fruiting body or non-fruiting body (sterile conk) of a fungus. Often associated with decay.

Crack: separation of wood fibers; narrow breaks or fissures in stems or branches. If severe, may result in tree or branch failure.

Compartmentalize: natural defense process in trees by which chemical and physical barriers are created that act to limit the spread of disease and decay organisms

Compressed wood: wood that is being pushed in and/or impacted by another branch or girdling root. Wood is restricted by another growing part of the tree.

Critical root zone: also referred to as the **root protection zone** is defined as a circle on the ground corresponding to the dripline of a tree.

Crown: the branches, leaves, and reproductive structures extending from the trunk or main stems.

Cultural control: method of pest control through environmental changes.

Decay: process of degradation by microorganisms. Decaying trees can be prone to failure, but the presence of decay, by itself, does not indicate that the tree is a risk. Advanced decay (i.e., wood that is soft, punky, or crumbly, or a cavity where the wood is missing) can create a serious hazard. Evidence of fungal activity including mushrooms, conks, and brackets growing on root flares, stems, or branches are indicators of advanced decay.

Deadwood: any wood on woody plants, other than greenwood.

Defect: an imperfection, weakness, or lack of something necessary. In trees, defects are injuries, growth patterns, decay, or other conditions that reduces a tree's structural strength.

Diameter Breast Height (DBH): The diameter of a tree at 4½ feet above ground level.

Dieback: condition in which the branches in the tree crown die from the tips toward the center.

Dormant: A state of inactivity. Deciduous trees are dormant from the time the leaves fall until new ones appear.

Emerald Ash Borer: An exotic metallic green beetle about ½ inch long responsible for killing tens of millions of ash trees since being discovered near Detroit in the summer of 2002. First discovered and identified in Boulder CO in September 2013.

Girdling root: A root that has grown so that it encircles and constricts other roots or the main stem of a tree and may result in the decline or death of the tree.

Hanger: broken or cut branches remaining in the tree crown.

Hazard tree: situation or condition that is likely to lead to a loss, personal injury, property damage, or disruption of activities; a likely source of harm. In relation to trees, a hazard is the tree part(s) identified as a likely source of harm.

Included bark: bark that becomes embedded in crotch (union) between branch and trunk or between codominant stems. Causes a weak structure.

Leaning: tree that is not perpendicular to level ground.

Native: A species that naturally occurs in a particular region, ecosystem, and habitat. Species native to North America are generally recognized as those occurring on the continent prior to European settlement.

Non-native: A species that due to direct or indirect human activity occurs in locations beyond its known historical or potential natural range. Refers to species from another continent, region, ecosystem, or habitat.

Phototropism: influence of light on the direction of plant growth. Tendency of trees to grow toward light, which can cause the tree to be lean.

Poor Tree Architecture: Poor architecture is a growth pattern that indicates weakness or structural imbalance. Trees with strange shapes are interesting to look at, but may be structurally defective. Poor architecture often arises after many years of damage from storms, unusual growing conditions, improper pruning, topping, and other damage. A leaning tree may be a hazard. Because not all leaning trees are dangerous, a professional arborist or urban forester should examine any leaning tree of concern.

Pruning: Removing branches (or occasionally roots) from a tree or other plant using approved practices, to achieve a specified objective (e.g., visual appearance, clearance for pedestrians, strength of the tree in maturity, etc.).

Sound wood: Normal xylem tissue not affected by or infected with decay organisms.

Risk tree: For the purposes of this inventory, trees with a diameter of 20 inches or greater, or a tree with an obvious defect received a tree risk evaluation. A tree that receives a moderate to high rating indicates there are portions of the tree that are dying, failing, or otherwise posing a risk to the public and needs either remove or pruning management.

Target: people, property, or activity that can be injured, damaged or disrupted by a tree or tree part failure.

Tree Risk: The likelihood of a conflict or tree failure occurring and affecting a target, and the severity of the associated consequences (i.e., personal injury, property damage, or disruption of activities).

Root Problems: Trees with root problems may blow over in windstorms. They may even fall without warning in summer when burdened with the weight of the tree's leaves and water in the wood vascular system. There are many kinds of root problems to consider, e.g., severing or paving-over roots; raising or lowering the soil grade near the tree; parking or driving vehicles over the roots; or extensive root decay. Soil mounding, twig dieback, dead wood in the crown, and off-color or smaller Severing roots decreases support and increases the chance of failure or death of the tree than normal leaves are symptoms often associated with root problems. Because most defective roots are underground and out of sight, aboveground symptoms may serve as the best warning.

Sapling: young tree, larger than a seedling, smaller than a juvenile.

Stub: An undesirable short length of branch remaining after a break or incorrect pruning cut is made.

Weak Branch Unions: Weak branch unions are places where branches are not strongly attached to the tree. A weak union occurs when two or more similarly sized, usually upright branches grow so closely together that bark grows between the branches, inside the union. This ingrown bark does not have the structural strength of wood, and the union is much weaker than one that does not have included.

Xylem: Primary water and mineral conducting tissue in trees. Primarily composed of two cell-types; cellulose and lignin, which in addition to transport of water and minerals provide strength, stability, flexibility, and support.