
Butte-Silver Bow County, MT Urban Forest Management Plan

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Natural approaches to tree health



Urban Forest Management Plan for:
Butte-Silver Bow County, MT

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Executive Summary

An Urban Forest Management Plan (UFMP) is a document intended to provide direction, education and instruction on the current and future management of the community forest, and aspects of the privately owned urban forest. This UFMP is tailored specifically to the needs and goals of the community of Butte-Silver Bow (BSB), Montana; it encompasses the street trees, park trees, and in general terms, private trees. It is a guide for the BSB commissioners, tree board, care takers, developers and residents of BSB to effectively manage their urban forest. The plan provides short and long term goals and objectives for a healthy urban forest and a systematic, uniform approach to its care.

Work has been done to improve the BSB urban forest and attract attention to it. This report consolidates these previous efforts, and provides recommendations to produce a comprehensive, detailed outline to manage Butte-Silver Bow’s Urban Forest. Information was gathered from Stakeholders and caretakers of the community forest, the public of BSB, and the BSB Tree Board.

To accomplish the goal of having a healthy urban forest, a vision must be shared by the elected officials and BSB’s citizenry. The vision statement reads as follows:

Butte-Silver Bow County’s community forest is an equal part of the municipal infrastructure, thus creates efficiency and long term solutions. The community forest is cared for by the county and its citizens creating a high quality of life and considered essential to Butte-Silver Bow’s environmental and economic development.

The community forest is one of the city’s most valuable assets and the only type of infrastructure that will appreciate in value when managed correctly. The community forest increases the quality of life for the residents of Butte and provides many economic benefits. These benefits are calculated in the UFMP. While they are extensive, they also have the potential to greatly expand. For the urban forest, or green infrastructure, to remain the largest asset possible it must be managed in concert with other city infrastructure. The mission to have a safe, healthy, vigorous urban forest that is allowed to reach maturity, requires extensive planning and commitment to the process. The mission statement affirming this commitment states:

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Butte-Silver Bow County is committed to provide a healthy, safe and aesthetically pleasing community forest for its residents and visitors. This raises the standard of living and gives education and volunteer opportunities by maintaining, managing and preserving its trees.

The Butte-Silver Bow Urban Forest Management Plan (UFMP) analyzes the current urban forest and outlines its benefits. It clarifies the goals for the Butte community forest and organizes those goals into a systematic plan for implementation. Some goals can be accomplished immediately and some will take 10 years or longer. The goals of the BSB UFMP are listed in numbers with numbered objectives: Note: many objectives will apply to more than one goal.

1. Obtain adequate funding to implement The Butte-Silver Bow Urban Forest Management Plan and create an Urban Forestry Department within the county government of BSB.
 - 1.1 BSB county commission formally approve and adopt BSB UFMP
 - 1.2 Implement the first phase of the BSB UFMP by funding and removing high risk trees in the community forest.
2. Standardize maintenance of the Community Forest (publicly owned) and implement a systematic pruning and removal schedule
 - 2.1 Contract out work on trees that have high risk in “Phase One” and in full implementation of the UFMP, create an Urban Forestry department within BSB
 - 2.2 Implement program for annually monitoring trees presenting a high and medium level of risk
 - 2.3 Finalize and fund Risk Management Plan
3. Sustain and expand education programs to provide awareness on the importance and proper care of the Urban Forest (all urban trees)
 - 3.1 Promote awareness for updated tree ordinances to improve tree health and the care of trees in Butte’s Urban Forest
 - 3.2 Organize and implement annual Arbor Day tree planting events
4. Eliminate topping of trees
 - 4.1 Enforce rules for maintaining public trees.
 - 4.2 Educate public of the proper care of urban trees
5. Maintain and grow canopy cover to 25% over streets and sidewalks
 - 5.1 Partner with Planning Department to best utilize Butte Natural Resource Damage Restoration Council (BNRC) funds to plant urban trees
 - 5.2 Increase the use of large canopy trees where appropriate to maximize tree benefits relative to costs
 - 5.3 Implement program to plant three trees for every tree removed
 - 6.3 Irrigate newly planted trees for a minimum of three years
 - 6.4 Mulch young trees that have not already been mulched
 - 6.5 Increase stocking density levels to 60%

6. Urban Forestry Department is responsible for all tree related matters in the municipal forest and coordinating tree activities among county departments
 - 6.1 Facilitate collaboration between county departments and private entities related to tree planting and maintenance on public property
7. Finalize and enforce revised tree ordinances
8. Expand and manage tree inventory to greater detail
 - 8.1 Details will including documenting inspections, service requests, open planting spots and new tree plantings

The Butte-Silver Bow UFMP outlines two phases for the management of the urban forest: “Phase One” and “Full Implementation.” This two phase approach systematically implements the goals and objectives. The first phase utilizes the cost saving benefits of contracting tree services for pruning and removal of trees deemed to be hazardous. The development of an Urban Forestry Department and the hiring of an Urban Forester during full implementation will enhance BSB community pride and provide the necessary tailored care of the urban forest. With this approach BSB will receive the highest degree of care for the lowest amount of money, while also ensuring that Butte’s urban forest will continue to grow and thrive for future generations.

Management Recommendations

The BSB UFMP addresses several resource management aspects related to tree planting, pruning, removal plans, and operational targets. These are meant to provide realistic goals and targets for a sustainable urban forest program for years to come. The actions associated with the goals and objectives are detailed in the body of this report and briefly described here. Phase one is tailored for 2013 and full implementation of the Butte UFMP follows as soon as possible.

Phase One

Recommended Action	Action Description	Page Number
Removal of hazard trees	Removing trees that present a risk to the public	28
Pruning trees in poor condition	Pruning trees that present hazardous conditions	29
Choosing a contractor	Requirements of a qualified contractor	29

Full Implementation of UFMP

Creation of Urban Forestry Department	Job description for urban forester, arborist and laborer	30
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Administration of UF department	Asserting goals of UF department within count government	32
Coordinating tree related activities	The job of the urban forester is to oversee all tree related activities, essential to a urban forest in BSB	34
Pruning young trees	Establishing good branch structure	38
Pruning mature trees	Proper maintenance of mature trees, establishing a proactive management to municipal trees	39
Removal of hazard trees	Managing risk posed by tree, determining when the liability outweighs the benefits of a tree	40
Irrigation for young trees	Step for ensuring tree survival	41
Planting trees in reclaimed grassland areas	Restoration of reclaimed areas	42
Planting trees in uptown and corridor areas	Plan for uptown development	43
Planting trees in neighborhoods	Planting trees where residents will appreciate them and invest in them	45
Education	Creating a culture of proper tree maintenance, and ensuring support for the Urban Forestry Department	46
Five year work plan	Making goals and accomplishing goals	47
Annual work plan	Implementing the five year plan and planning for a budget	48

Update tree inventory	Proper tool to set goals, check to see goals are being accomplished and manage the community forest	49
Updated ordinances	Establishing consistency of maintenance of the community forest	50

Butte - Silver Bow UFMP Terms Defined

Street tree- A tree with-in the public right-of-way along a street, usually between the street and sidewalk

Community Forest- Publicly owned trees, trees on municipal land

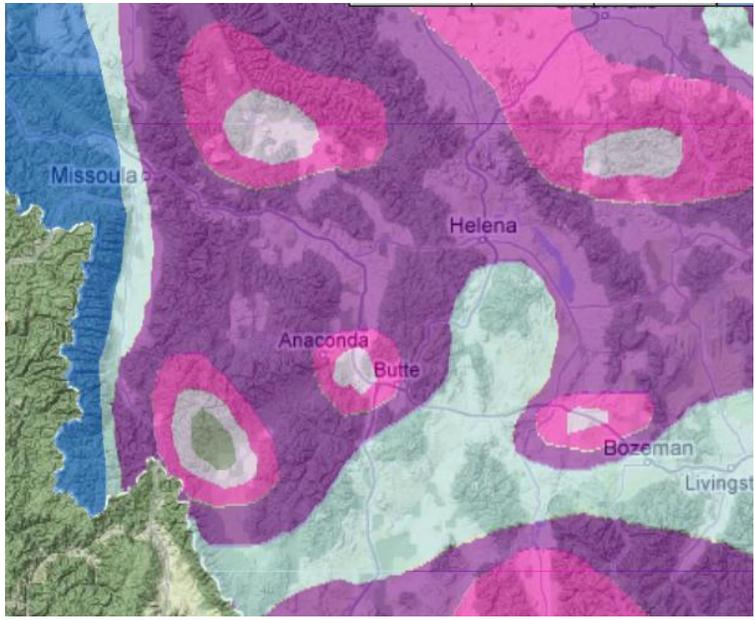
Urban forest- Entire tree population within city limits

Park tree- Tree inside a park

Pruning- Process of branch removal to achieve a specified goal in which the pruning cuts are made at nodes and in relation to the positions of the branch collar and branch bark ridge. (ISA website)

- ❖ This symbol marks Goals of the BSB UFMP throughout the document
- This symbol marks Management Recommendations throughout the UFMP

Introduction



- USDA Zone 4a**
 -30°F to -25°F
- USDA Zone 4b**
 -25°F to -20°F
- USDA Zone 5a**
 -20°F to -15°F
- USDA Zone 5b**
 -15°F to -10°F

The county of Butte-Silver Bow is a community of 34,200 people and is the fifth largest city in Montana. The county is at an elevation of 5,538 feet and has a particularly harsh climate, even by Montana’s standards, with an average temperature of 18F in January

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Figure 1 <http://www.plantmaps.com/interactive-montana-usda-plant-zone-hardiness-map.php>

and 63F in July. The plant Hardiness Zone Map indicates Butte is classified as zone 4a with a lower temperature range of -25 to -30 degrees F. However, it borders the 3b with a temperature range dipping to -35 degrees F. The climate is semi-arid and has 13 inches of annual precipitation. The city and county governments consolidated in 1977 to form Butte-Silver Bow.

In the late 19th century the hill Butte sat on was found to be rich in gold, silver, and copper, among other valuable metals, thus the mining history of Butte began. The area was known as “the richest hill on Earth.” Mining continued into the 20th century, but as the hills resources were depleted mining activities slowed, and eventually ceased. The economy of the town followed this rise and decline. The trees around Butte were all removed to support mining or killed from air pollution in the late 1800s. However, in the robust economic times of the 1940s and 50s many tree were planted in Butte. Butte was known as a town with an extensive green infrastructure and had 18 gardener clubs, the most of any town west of the Mississippi. Unfortunately, many of the trees planted at this time have been cut down for various reasons. The BSB UFMP intends to reinstate this culture of green infrastructure which will help beautify the city and change the aesthetically unpleasant perception of mining towns.

In the past 20 years, much reclamation work has been done to contain the poisonous contaminates left behind by the mining industry. The reclamation work is largely complete and now it is up to Butte-Silver Bow to beautify the reclamation and restore the natural landscape. The means to restore the reclaimed sites are in place and the BSB UFMP will aid in giving direction to this effort.

The people of Butte have a reputation of being rugged and individualistic. Along with these qualities a strong civic duty exists among the people with a belief in government and fair labor practices. A strong sense of community exists among the people of Butte and is a reason why visitors to Butte eventually make this place their home. The unique qualities of the people and history of the town helped shape the recommendations made in the Butte-Silver Bow



Urban Forest Management Plan. Combining this rich background with the implementation of the UFMP gives the urban forest a real chance to be the finest in the state. In the past decade, much investment has been made to preserve the historic qualities of Butte, and urban trees will be an essential aspect of the revitalization and economic growth in the historic district. This Historic District is the largest in America, encompassing some 6000 properties.

While Butte is the only of the seven larger cities in Montana to not have an Urban Forestry program or department, some work has been done to address the urban forest in recent years. Butte is at a critical period for implementing a city wide Urban Forest Program to avert costly liability issues and regain the benefits that the existing urban trees offer. Moreover, much money is available from outside sources to plant new trees, creating a pivotal opportunity for the citizenry of BSB to establish an outstanding community forest with essential community commitment and a reduced financial investment.

In 2011, the Montana Department of Natural Resources and Conservation (DNRC) produced a report outlining the benefits of the existing urban forest in Butte. The key finding of this report showed the largest margin of ‘green’ benefits was in “increasing property values” (up to 15%), followed by rainfall interception and reduction in stormwater runoff. These were followed by pollution reduction and energy conservation (Rodgers 2011). In the summer of 2012 an inventory of Butte’s municipally owned trees was conducted and identified some 4400 trees. With these inputs along with stakeholder meetings, public meetings, city documents and the resources of Gallatin Tree Care (GTC), this Urban forest Management Plan was crafted. This UFMP makes recommendations based on industry standards and ideals but also the practicalities, environment and people of Butte, MT. It proposes a realistic, workable plan that, when implemented, will create a model urban forest, one of which Butte can be proud, that will provide benefits far exceeding its costs, and one other cities can use as an example of good planning.

Current Management of Municipal Trees

The urban forest in Butte is addressed in a reactionary fashion. Money spent on the urban forest largely comes from the general fund. If a tree fails in a storm or the like it is cleaned-up by a city department assigned to the duty. The Parks and Recreation Department has been performing sanitation pruning on the golf course and park trees in the past years, spending approximately \$20,000 a year on that task. The Butte Tree Board has initiated a watering program for newly established trees that is contracted out for \$XXXXXXX a year. There are currently no International Society of Arboriculture certified arborists in Butte, either in private or public realms.

Many trees have been planted in recent years on corridor streets with money from various sources. Specifically, the Planning Department of Butte has 2 million dollars allocated in the

next ten years from the BNRC fund to spend on new tree plantings and soil modifications in Butte.

There is no income specifically allocated for the urban forest such as a fee for assessment. This prohibits any further maintenance or care to be done to the community forest and forces city employees to view municipal trees as a nuisance rather than an asset.

When a program that has many benefits (e.g. beautification, improved ecology and created monetary value) is implemented, it is viewed positively by the public and has a ripple effect of others investing in their community.

Intent of the Butte-Silver Bow Urban Forest Management Plan

The goal of an Urban Forest Management Plan (UFMP) is to give direction, motivation, vision, and instruction on how to further manage urban trees.

The Butte-Silver Bow (BSB) intends to create efficiency in the care for the city's trees, by decreasing liabilities and maximizing benefits. In doing so, it will bring BSB in line with national standards and norms for tree conditions and level of care.



The benefits realized from the investment will be exponential. This asset will grow in value over time.

The BSB UFMP ensures a healthy and safe urban forest for current and future generations. This is accomplished by having shared vision. The vision statement reads:

Butte-Silver Bow County's community forest is an equal part of the municipal infrastructure, thus creates efficiency and long term solutions. The community forest is cared for by the county and its citizens creating a high quality of life and considered essential to Butte-Silver Bow's environmental and economic development.

This plan provides an analysis on the benefits of the urban forest and a detailed description on how to manage the urban forest in BSB. The actions recommended are phased and culminate in a urban forestry department in Butte-Silver Bow. This plan details steps to be taken for each class of trees so that a Butte Urban Forester can be hired and systematically care for the urban forest in Butte on day one. Goal #1:

- ❖ Obtain adequate funding to implement The Butte-Silver Bow Urban Forest Management Plan and create an Urban Forestry Department with-in the county government of BSB.

The BSB UFMP is a living document meaning, objectives and goals are set according to the highest priority needs. As needs change and goals have been accomplished, new goals will be set and incorporated into this document. After implementing this UFMP the Urban Forester in Butte will take over the crafting of this management plan.

A study found that patients with views of trees, opposed to an unnatural view, recovered from surgeries faster than patients without (Unrich 1986). This recovery period from surgery was 8.5 percent faster. This aided in mental wellbeing as well as lower hospital costs.

Relationship to Other City Planning Documents

The BSB UFMP is an essential plan to grow the economy and infrastructure of the city. This document should be considered when other development plans are being drafted and/or executed. This UFMP is a piece of urban planning that fits into the greater plan of BSB urban development.

Urban trees are a major component of the green infrastructure. Considering this, the BSB UFMP will fit into the greater planning of the green infrastructure but does not comment on how to manage the hanging flower baskets, turf, etc. Attention has been given to the Vegetative Environment Enhancement Program (VEEP) but only advises on the management of the urban trees; this document should be a part of the VEEP planning.

Benefits of Trees

Urban trees increase human quality of life in many ways. Trees in the urban landscape have many economic benefits such as increased property values, reduction of demand on sewer systems by reduction of storm water runoff and erosion, reduced wear on city streets, enhanced air quality, carbon sequestration, energy conservation through shade and wind protection, and noise abatement. Other non-monetary yet also important benefits of urban trees include providing habitat for animals, especially birds. Also having trees in the viewshed can create and add to a healthier life and a quicker recovery from despondent periods.

Hydrology

Urban trees work symbiotically with other city infrastructure creating a synergy when all components are managed correctly. Urban trees reduce the demand on sewer systems during periods of storm water run-off. Tree's canopies absorb rain water lessening the amount of water

to enter the sewer system. Much of water that does run down the trunk of a tree is taken up by the roots. When a raindrop is intercepted by a tree's canopy it does not impact the soil, thus limiting erosion. These valuable soils are retained and the sewer system does not have to process the particulate matter. An average mature ash tree will intercept 1,209 gallons of water every year with an implied value of \$13/year/tree (McPherson et.al 2003). Also, trees increase the soil's capacity to store rainfall through transpiration and increasing soil organic matter.

“One acre of forest absorbs six tons of carbon dioxide and puts out four tons of oxygen” U.S. Department of Agriculture

Environmental Energy savings

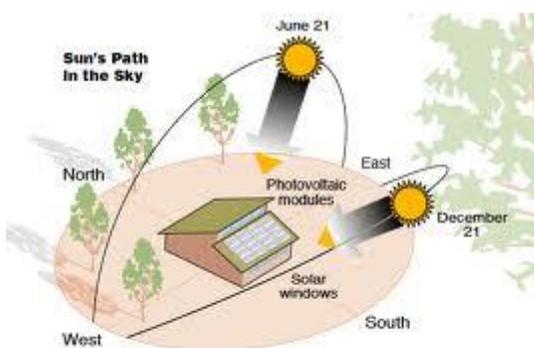


Figure 2 Greenpassivesolar.com

Trees can also aid an urban environment with the conservation of energy. This is done by shading buildings from the summer's sun and blocking them from the winter's wind. Radiant energy from the sun is absorbed by deciduous trees in the summer and is only filtered by branches of deciduous trees in winter. We are cooler when we stand in the shade of trees and are not exposed to direct sunlight. In winter, we value the sun's radiant energy and, because of this, we should plant only small or deciduous trees on the south side of homes (ISA Website). At latitudes higher than 30 degrees planting deciduous as well as coniferous trees

on the east and west sides of buildings provides summer shade while letting the winter's sun in to provide needed solar radiation (Matheny and Clark 2008). The trees planted on the west and north of buildings dissipate winter's wind coming from those directions. The air mass in a building with poor insulation can change 2-3 times every hour and even in well-sealed homes the air mass can change once every 2-3 hours. Trees that deflect winter's wind can reduce air infiltration by up to 50% resulting in a heating savings of 10-12% (Heisler 1986).

Air Quality

Trees improve air quality by absorbing gaseous pollutants such as sulfur dioxide, nitrogen dioxide, ozone and smog. Trees also intercept particulates in the air associated with soil tillage, construction and erosion. These air born contaminants have been associated with asthma, heart and lung disease, and cancer. Trees also sequester carbon, initially through photosynthesis, converting carbon into sugars. Over time these sugars are made into woody material, storing the carbon from the atmosphere. Trees release oxygen through photosynthesis and lower air

temperatures by shading services and transpiring water into the air. These trees can also block undesirable views while reducing noise, especially from vehicles and construction.

Economic value

A well maintained urban forest creates value. A survey by Arbor National Mortgage, INC found that “a lot with trees would be as much as 20 percent more saleable than a house on a lot without trees.” These investments in trees pay off in tax revenue from increased lot values and perceived values. Mature trees also reduce the temperatures of the streets below and in turn, decrease the need for street maintenance from 7 - 10 years to 20 - 25 years (Matheny and Clark 2008).

Consumers in shopping districts that are shaded by urban tend to linger and shop longer (Matheny and Clark 2008). These consumers are also willing to pay higher prices and have greater patronage for the good and services in these districts.

Landscaping with plants and trees positively influences businesses by: (Relf 1996)

- Increases workplace productivity and morale
- Helps recruit new employees
- Attracts new customers or new business tenants
- Can be used as an employee benefit
- Has a role in creating a corporate image
- Has value as a marketing tool

Montana DNRC conducted a green infrastructure analysis in 2010 and found Butte to have 9% canopy cover. The benefits from this canopy cover resulted in \$10 per person annually. If no greater investment is made these benefits will decrease and eventually be erased. If invested in, the benefits will increase to \$30 per person annually in 40

years' time. Butte's green infrastructure is an investment like other infrastructure, such as public buildings and sewer. This green infrastructure provides benefits both monetarily and intrinsically. For this reason, it must be cared for and invested in. **If the green infrastructure is left neglected it will become a liability, losing its benefits and costing more than if cared for properly. If invested in and maintained this asset over time can double, even triple its value and provide exponential benefits. The community forest is the only city infrastructure that can increase in value over time.**

A study conducted by the U.S. Forest Service in Amherst, Massachusetts, concluded that trees on a lot can raise a lot's value as much as 15 percent.

Urban Tree Benefits to Butte-Silver Bow

Implementing a community forest management plan is especially important at this time in Butte-Silver Bow. BSB specifically benefits from urban trees and those monetary benefits are outlined

in this section. In the uptown area, investments have not been as robust as it could have been. Maintaining and planting urban trees in this area will encourage economic development by beautifying this historic. Property values in the city portion of BSB will experience an increase with the addition of urban trees, some as much as 15%.

The tables and benefit prices are generated through i-Tree v5.0 inventory software program. This program was developed by the USDA and private tree corporations and the information produced is researched based.

Energy

As mentioned previously, trees provide shade from the summer's sun thus providing cooling effects on structures and prolonging the life of streets and other grey infrastructure. Annual energy savings can be observed in the following chart:

Annual Energy Benefits of All Trees By Species									
3/5/2013									
Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Common chokecherry	31.3	1,991	3,152.2	2,858	4,849 (N/A)		30.3	15.5	5.88
Crabapple	11.2	714	1,131.0	1,025	1,740 (N/A)		15.0	5.6	4.26
Green ash	63.8	4,056	5,189.2	4,705	8,760 (N/A)		14.3	28.0	22.52
Quaking aspen	33.5	2,131	2,934.3	2,660	4,791 (N/A)		11.9	15.3	14.83
Blue spruce	17.0	1,079	1,895.8	1,719	2,798 (N/A)		6.8	8.9	15.12
European mountain ash	6.1	389	595.7	540	929 (N/A)		4.6	3.0	7.37
Silver maple	11.7	743	872.4	791	1,534 (N/A)		2.4	4.9	23.25
Paper birch	12.0	766	980.1	889	1,654 (N/A)		2.3	5.3	26.69
Willow	6.6	421	583.8	529	950 (N/A)		2.2	3.0	15.57
Douglas fir	1.4	89	166.6	151	240 (N/A)		1.8	0.8	4.80
Littleleaf linden	3.7	233	359.9	326	560 (N/A)		1.8	1.8	11.66
Ponderosa pine	4.4	281	517.7	469	751 (N/A)		1.3	2.4	21.45
Bur oak	0.7	42	63.3	57	99 (N/A)		1.1	0.3	3.43
OTHER STREET TREES	11.3	721	1,009.9	916	1,636 (N/A)		4.2	5.2	14.35
Citywide total	214.7	13,656	19,451.9	17,635	31,291 (N/A)		100.0	100.0	11.50

The average tree in BSB provides \$11.50 in energy savings and a total of \$31,000 per year. This is calculated to include the energy demands to maintain the tree e.g. pruning and litter cleanup.

Stormwater

When a tree intercepts raindrops it reduces erosion. This is because it takes the momentum of the raindrop away which would otherwise have hit the soil and washed valuable organic matter away. The roots of the trees hold the soil together, resulting in much less erosion. The trees absorb sudden rain episodes and in turn lessen the load on grey infrastructure managing stormwater. Annual stormwater benefits can be seen in the following chart:

Annual Stormwater Benefits of All Trees by Species

3/5/2013

Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Common chokecherry	251,758	2,719	(N/A)	30.3	7.5	3.30
Crabapple	87,910	950	(N/A)	15.0	2.6	2.33
Green ash	955,399	10,319	(N/A)	14.3	28.4	26.53
Quaking aspen	494,243	5,338	(N/A)	11.9	14.7	16.53
Blue spruce	613,300	6,624	(N/A)	6.8	18.2	35.81
European mountain ash	53,713	580	(N/A)	4.6	1.6	4.60
Silver maple	180,622	1,951	(N/A)	2.4	5.4	29.56
Paper birch	176,016	1,901	(N/A)	2.3	5.2	30.66
Willow	93,860	1,014	(N/A)	2.2	2.8	16.62
Douglas fir	49,474	534	(N/A)	1.8	1.5	10.69
Littleleaf linden	64,666	698	(N/A)	1.8	1.9	14.55
Ponderosa pine	95,004	1,026	(N/A)	1.3	2.8	29.32
Bur oak	10,372	112	(N/A)	1.1	0.3	3.86
OTHER STREET TREES	240,354	2,596	(N/A)	4.2	7.1	22.77
Citywide total	3,366,691	36,363	(N/A)	100.0	100.0	13.36

The average tree in Butte is worth \$13 dollars in stormwater benefits and a total figure of \$36,000 annually.

Other Benefits

Additional monetary benefits are calculated including air quality, carbon dioxide (CO₂), and aesthetics. Air quality is improved by trees when they absorb CO₂ from the air. Also, particulates in the air are absorbed by the trees. When measuring CO₂ the amount of carbon sequestered is subtracted by decomposition rates and carbon released during maintenance. The following chart shows total benefits realized by BSB from its trees.

Total Annual Benefits of All Trees by Species (\$)

3/5/2013

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error	% of Total \$
Common chokecherry	4,849	833	1,008	2,719	29,125	38,534	(±0)	17.3
Crabapple	1,740	296	346	949	12,660	15,992	(±0)	7.2
Green ash	8,760	1,520	1,671	10,319	35,185	57,455	(±0)	25.7
Quaking aspen	4,791	791	647	5,338	23,543	35,110	(±0)	15.7
Blue spruce	2,798	349	-307	6,624	8,232	17,696	(±0)	7.9
European mountain ash	929	132	211	580	3,618	5,470	(±0)	2.5
Silver maple	1,534	348	227	1,951	8,494	12,554	(±0)	5.6
Paper birch	1,654	301	316	1,901	6,309	10,481	(±0)	4.7
Willow	950	172	154	1,014	5,868	8,157	(±0)	3.7
Douglas fir	240	35	-22	534	1,845	2,633	(±0)	1.2
Littleleaf linden	560	72	94	698	1,961	3,385	(±0)	1.5
Ponderosa pine	751	73	-44	1,026	1,178	2,984	(±0)	1.3
Bur oak	99	14	-3	112	540	762	(±0)	0.3
OTHER STREET TREE	1,636	265	190	2,596	7,364	12,052	(±0)	5.4
Citywide Total	31,291	5,201	4,489	36,363	145,921	223,264	(±0)	100.0

- Total annual benefits from city trees = \$223,000
- Average annual benefit per tree = \$52
- Average annual benefit per person = \$6.50

These are substantial figures and prove that trees are worth the investment.

Establishing priorities is difficult because all activities work towards the goal of a healthy community forest. A focus on planting is important because it promotes community involvement thus, stimulating more interest. On the other hand maintaining the community forest, mainly by pruning, is essential for public safety and the health of the existing trees. BSB is in the position of needing to address its mature trees that have not been maintained before planting new trees.

Essentially, the priorities are entirely dependent on level of funding. Money and time needs to be spent on addressing the mature trees and monitoring/ watering the young trees.

Assessment of the Tree Resource/Green Infrastructure

A tree inventory of county owned trees was completed in the summer of 2012. Trees were inventoried using Tree Works Software. This report uses this inventory to make recommendations and bases for calculations. 4,368 trees were inventoried marking their characteristics including species, diameter at 4.5 feet in height, location, health of the tree and management recommendations. Of those 4,368 trees, 294 had a condition value of 50% or less and are marked for removal, leaving 4074 trees.

The average urban tree in BSB provides \$52 dollars a year in benefits including energy conservation, improved air and water quality, stormwater runoff controls and

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March, 2013

Butte- Silver Bow, MT Urban Forest Management Plan

sequestering/storing carbon. This value is further explained in the section below, ‘Tree Benefits to BSB’ this figure illustrates the need to maintain the urban trees. When the tangible benefits of trees and the urban forest are quantified, BSB can then prioritize its need to maintain its “Green Infrastructure.” This green infrastructure can be defined as a network of natural ecosystems focusing on the trees and the systems they support including: clean water, healthy soils as well as shelter and recreation. The green infrastructure is a part of Butte-Silver Bow’s assets just as the gray infrastructure (e.g., sewers and roads). This green infrastructure works symbiotically with the grey infrastructure creating a synergy of the two networks.

The public trees in BSB are managed by several entities some of which include Parks and Recreation, the BSB Tree Board, private parties, Reclamation, and public works. All of which have different training and knowledge of tree care and the greater community forest. It is difficult to estimate how much is spent on the urban forest in any given year. Parks and Rec. spend approximately \$20,000 a year pruning dead wood out of the trees on the golf course, Reclamation spends \$10,000 a year on planting trees in the reclaimed grassland areas and several thousand is contracted out to private contractors. When storm cleanup is calculated and reactionary care of the municipal forest, \$40,000 is spent and the benefits of the urban forest increase negligibly.

Species Diversity

Species Diversity measures the range and frequency for each type of tree in a population.

No more than 30 percent of one tree family, 20 percent of one genus, and more than 10 percent of one species should compose the entire urban forest (Appleton, 2003). These targets are hard to attain in any city, especially Butte, because of the limited tree species that will grow because of the harsh climate let alone thrive. Nonetheless, guidelines should be adopted in BSB’s tree management program when deciding what trees to plant. These recommendations are important to limit potential monocultures and associated problems. A monoculture is a disadvantage because it makes a tree population more susceptible to being decimated. Trees with existing insect or disease problems, in close proximity to like species, can predispose healthy trees to continued health problems and premature mortality.

Twenty eight percent of BSB’s Urban forest is made up of Canada Cherries followed by Crabapples with 14% of the population and 13% are ash trees. Increasing species diversity is important because the ash trees are susceptible to the Emerald Ash Borer, and the crabapples can be diseased by fire blight putting BSB’s urban forest in a precarious position

Fortunately, green ash is a beautiful shade tree providing much shade in the summer while blocking minimal sun in the winter. All three of the most populous trees in BSB do well in the climate where relatively few other trees will thrive.

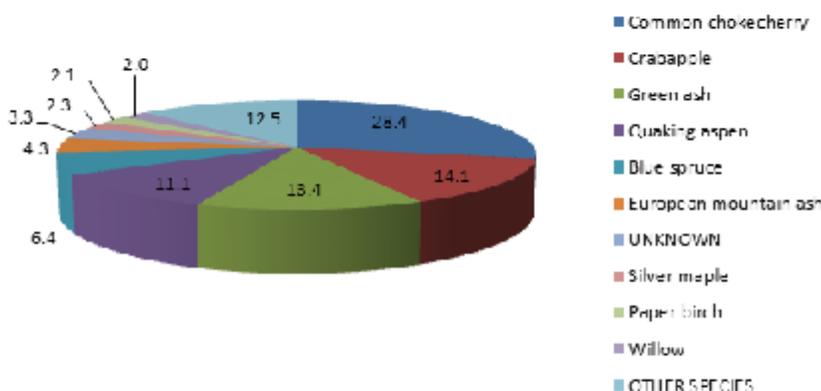
The Species distribution of the street trees is illustrated in the graph below.

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Butte-Silver Bow (balance)**Species Distribution of All Trees (%)**

3/5/2013



Species	Percent
Common chokecherry	28.4
Crabapple	14.1
Green ash	13.4
Quaking aspen	11.1
Blue spruce	6.4
European mountain ash	4.3
UNKNOWN	3.3
Silver maple	2.3
Paper birch	2.1
Willow	2.0
OTHER SPECIES	12.5
Total	100.0

Figure 3 Species Diversity BSB municipal Trees

The species distribution, as illustrated in the above pie chart, is weighted by Canada cherries. Future planting of this species should be limited. It is important to keep species, age and size distribution diversified to reduce tree mortality if a tree disease or insect were to invade Southwest Montana.

Age Diversity

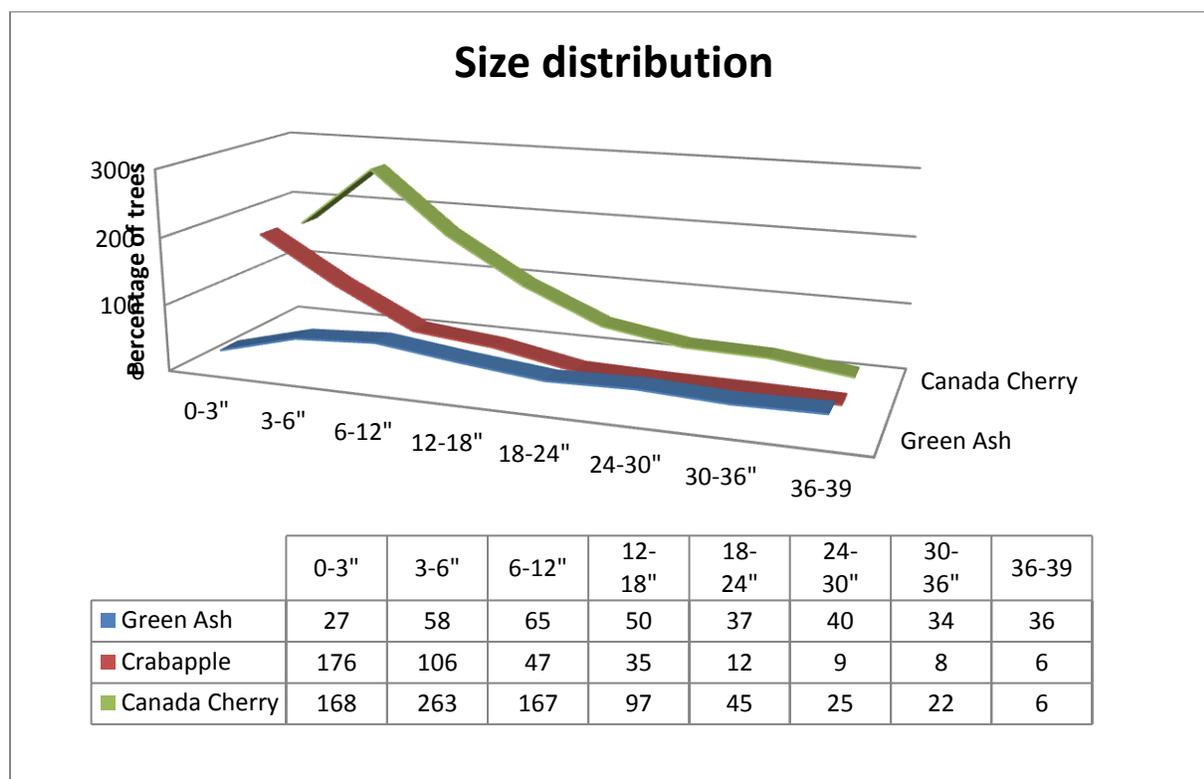
Age diversity is a measure of the frequency of similar sized trees of a particular species in a tree population.

For similar reasons, no more than 33 percent of one age class (young, medium or old) should comprise the urban forest. This rule provides the basic resource structure where a younger age class is always ready to replace the older age classes.

It is important that when an older tree dies, a younger tree is planted in its place. When an older tree is removed, there is a significant loss of benefit as a large tree provides 3 to 8 times the benefits that a small tree provides (Rogers, 2011).

Age and size distribution is an important statistic in managing BSB's urban forest. This information depicts how many new trees to plant as well as what size of trees are needed. If an urban forest's age class is heavily weighted to mature trees, it is important to plant new trees as well as facilitate good growing conditions for the established young trees. Age and size statistics reveal which trees provide the most benefits and which trees potentially need the most work to maintain. Again, if a tree population is mostly mature it dictates more willingness to remove trees that meet certain conditions in order to make new planting spots for the new generation. This information also helps identify which trees will need yearly monitoring.

Of green ash, crabapple and Canada cherry, the age and size distribution is illustrated in the graph below:



Size distribution for most common street trees in BSB. Numbers in data field are percentages

Figure 3 reflects the most abundant tree's species broken out by diameter. This is important information because it shows how old, or young, most of the trees in BSB. In reference to ash, the species offering the most benefits, most of the trees are entering maturity (6-12 inches in diameter). Over half of Butte's community forest has been planted in the last 5 years.

A tree with a larger canopy size, such as an ash or maple tree, offers more benefits over time. These trees can reach heights of 60 feet and life spans of 100 years, planting should be encouraged where root and canopy space is adequate. Trees with smaller canopies such as crabapples or Canada cherries are a wise choice where root development or overhead constraints exist.

Canopy Cover

One way to calculate benefits from trees is to determine the amount of shade they provide. This term can be described as “canopy cover.” This figure can also describe how much each tree improves quality of life. For example, a tree in a park setting with a large canopy improves the parks quality because it provides a spot to have a picnic or place to sit while taking a rest from summer activities. Similarly, trees over streets and sidewalk provide many benefits, from less resurfacing of streets to cooler temperatures in the vehicles parked under trees. The extent of community tree canopy cover is one indicator of urban forest sustainability (Clark et al. 1997). The percentage of canopy cover can be calculated for each species of tree.

BSB currently has 9 percent of its streets and sidewalks under the canopy of trees. BSB would greatly benefit from increasing this number to 25%. The goal Canopy cover targets are based on national averages and other city’s goals.

❖ UFMP Goal 5: Increase Canopy Cover in BSB to 25%

Ash trees provide 27% of the canopy cover in BSB even though they comprise 14% of the tree population. This further highlights the need to maintain these trees to protect them as a valuable asset.

Other cities have developed city ordinances requiring canopy cover to exist on newly formed parking lots. For example, the city of Sacramento, CA adopted an ordinance in 1983 that requires 50% shading coverage of the total paved area within 15 years of establishment, City Code 17.64.030(h) (Maco, McPherson 2002). Street tree regulations typically require one street tree for every 33 to 66 feet (Abby 1998). This requirement does not necessarily trend to canopy cover if the street tree planted is small in stature (Thompson and Ahren 2000).

Street tree stand age, meaning the age of a particular generation of trees, is typically 20 to 60 years (Maco, McPherson 2002). Thus, it is difficult to maintain a consistent maximized canopy cover because a stand will maximize its canopy and decline, reducing the total canopy cover. If trees are selectively removed and replaced with similar mature canopy attributes, a consistent canopy cover can be achieved.

Invasive Insects and Disease

Invasive species concerns will be an important issue for Butte-Silver Bow to keep in mind while moving forward. A historical example of an invasive species is the Dutch elm disease (DED).

DED has had devastating effects in many and cities throughout the United States that had a majority of elm trees lining their streets. DED was first detected in Ohio in the 1930's and spread throughout the United States systematically killing all American elm trees in its path. The disease was first detected in Montana about 1975 and is still infecting elm trees in Montana today. DED has currently spread north in to Alberta and Saskatchewan Canada and continues to affect American elms in its path. Fortunately, DED has not been detected in BSB, nor does BSB have many American elms (2% of total population) that could be affected. A more relevant invasive species that could affect the trees of BSB with devastating effects is the Emerald Ash borer (EAB).

EAB is an insect that bores into ash trees, cutting off translocation of water, starches and micro/macro nutrients, therefore killing them. The EAB has not yet entered Montana that we know of, however it is something for which to plan. This could decimate an entire tree species or age class of tree within a given region. The EAB is a serious enough concern that new plantings of ash trees should be limited to 1-2 percent until conditions change concerning the EAB.

Monetary Value of Existing Community Forest

BSB's trees provide incalculable benefits, especially when considering "quality of life benefits." There are many ways to calculate the benefits monetarily and aesthetically. It is important to remember that the benefits provided are coming from trees that have not been maintained at a level of industry standards.

The trees in BSB are valued at approximately \$5,000,000. Of the 4074 public trees, an average tree has a value of \$1,200. Values for the trees were calculated from the measurements and details from the field work performed by the MSU Extension office in Butte. Each size class of each species of tree was assigned a value. These values were obtained using the Council of Tree and Landscape Appraisers "trunk formula method". These values are an "as is" value, meaning the condition of each tree in its present state. This condition rating ranges from 0% for a dead tree to 100% for a perfectly healthy tree. The condition rating given to the trees in the urban forest is 50% for some of the poplars to 80% for many of the Canada cherries, the average condition for all of the trees is 71%. The values would rise as a function of this condition rating. With proper maintenance, the condition of the urban forest could be 85%, raising the total value some 15%.

The value of the publicly owned community forest represents the replacement value compounded by time it would take for the replacement trees reach the size of the trees currently present.

Target Program Outline

The mature trees in Butte-Silver Bow have not been cared for and are in a dilapidated state. Multiple departments use general funds to address safety concerns on trees that exist in their jurisdiction. The BSB UFMP outlines a program to consolidate all tree activities to be executed under one department that collaborates with the Reclamation Department in Butte to plant trees in the reclaimed grasslands and the Planning Department in Butte to plant street trees and park trees in designated areas.

Implementing this plan will take upwards of one to two years depending on when funds are made available. Unfortunately, hazard municipal trees will still be endangering the public while the creation of a Urban Forestry Department is being created in Butte. This is why The BSB UFMP recommends implementing a “phase one” component to start immediately addressing the trees that present hazardous conditions.

- ❖ UFMP Goal 1: Obtain adequate funding to implement The Butte-Silver Bow Urban Forest Management Plan and create an Urban Forestry Department with-in the county government of BSB.

Breaking the management of the urban forest into two categories of “phase one” and “full implementation” is an approach that utilizes the benefits of contracting out tree service and developing an Urban Forestry Department. BSB will realize the benefits of the cost savings and efficiency of contracting out the hazard removals and pruning and have the community pride and tailored care by hiring an Urban Forester. Put in another way: the highest degree of care for the lowest amount of money.

Phase One of Butte UFMP

Phase one of the BSB UFMP solely focuses on the safety of the public of Butte-Silver Bow. It does not grow the urban forest or increase the benefits provided by urban trees. In 2013 removing trees marked as hazardous and pruning trees in poor condition are a priority for public safety.

- Management recommendation: Begin removing hazardous trees in Butte

Currently, 294 trees in the BSB inventory have a condition rating of 50% or less and these trees are slated for removal. 39 of these trees have a diameter of 12 inches or greater and of those 39 trees 15 have a diameter of 30 inches or greater. The budget for removing these trees is **\$41,175** and 579 hours at \$75 an person hour. Each tree with a diameter is estimated at one hour/\$75 to remove, 12-29” is three estimated at 6 person hours/\$450 per tree and trees with a diameter of 30 inches or greater are estimated to take 12 person hours/900 per tree. This work can be spread out over three years, starting with the highest priority trees.

Number of removals	Diameter of <12”	Diameter between 12-29”	Diameter .>29”	Totals	3 year

					breakdown
294	255	24	15	294	98
Cost of removals \$	16,875	10,800	13,500	41,175	13,725
Hours allotted	255	144	180	579	193

Pruning trees that present hazardous conditions is also a priority in Butte.

- Management recommendation: Prune trees that present hazardous conditions.

Trees marked as in need of pruning have condition ratings of 51 to 69%. 581 of these trees exist 284 have a diameter of 12 inches or greater leaving 297 under 12 inches. Estimate 1.5 hours to prune the 12 inches and less at a cost of \$112.5 (\$75/hour) and 4 hours/\$300 a tree for the 12 inches and greater. The total cost for pruning these trees is **\$106,612.50**.

Number of trees to be pruned	Diameter less than 12"	Diameter 12" and over	Totals	3 year breakdown
581	297	284	581	194
Costs \$	33,412.50	73,200	106,612.50	35,573.50
Hours	445.5	1,136	1,581.5	527

Choosing a Contractor

Phase one of the management plan will most likely be contracted out because it will take some time to implement the full UFMP. While the funding is being secured the hazard trees will still exist and public safety is a top priority and concern. Choosing a qualified tree service from a surrounding area that has the ability to be flexible and can tailor its services to exactly what BSB's needs will be sufficient for phase one. This tree service should have a motivated work crew to perform at the highest possible level so BSB gets the most for the tax payer's dollar. Clarifying needs, goals and budgetary constraints are important topics to be articulated to the arborists or tree service performing the work.

The tree service to execute the bid must meet the following criteria when submitting a bid for the tree work:

- Meet the standards for tree care set in the updated BSB county ordinances. i.e. ISA certified arborist on-site and follow ANSI A-300 tree care standards and Z 1.33 safety standards
- Costs associated with completing the project
- Have proper liability and auto insurance
- Provide proof of workman's compensation or exemption and unemployment insurance

Desirably, the crew performing the tree work would be personable and articulate. Inevitably there will be interactions between this crew and the public. If the public has a good experience with a friendly, suitably dressed and competent arborist, the more likely they will be willing to fund their community forest. Similarly, the equipment should be well-maintained, and able to be identified by logos. This is also for public perception and understanding, as surely there will be interested community members.

BSB will want to consider the dates that the service will be performed and the work schedule. Also, the equipment the tree service plans on using should be known in advance to the work being done. BSB could identify a location for the wood chips which will save the county money. The wood from removed trees could be donated locally for firewood.

Contracting out this work has certain advantages because it work that is not specific to the BSB community, a removal is a removal. Much of this work will need specialized equipment such as a bucket truck, chipper and grapple truck. BSB does not currently own the equipment needed for this work. Advantages to contracting this work out include:

- Cost savings. It is established that tree care, for even very big cities, is less expensive. In Los Angeles, CA the cost of municipal tree care was 37% higher than privatization
- Funds are paid only if work is performed to specifications and satisfaction
- Labor is performed for peak demands
- Contractor provides all equipment, repair, maintenance and downtime of costs
- Insurance and workman's compensations is provided by the contractor
- Contractor provides all training, supervision and certifications
- Liability for damages is the contractor's responsibility

Writing Specifications for tree work

When BSB contracts with potential tree services, specifications will have to be set. Some pruning specifications will vary from genus to genus. Generally specification will state that pruning standards should meet or exceed ANSI A.300 specification s Best Management

Practices set by the Tree Care Industry Association. In general, where needed, key objectives should consider:

- Reduce limb failure risk by cleaning the dead, dying, diseased or structurally unsound branches.
- Create visual clearance to street signs, light and other visual obstructions.
- Create clearance for pedestrian and vehicular traffic at eight feet over sidewalks and 14 feet over streets.
- Reduce the risk of limb failure by reducing the length of long, heavy horizontal scaffold branches
- Develop good crown structure by helping the tree to establish one central leader
- Restore crown structure and shape to trees damaged by storms or other events
- Treating for pests or other growth abnormalities

Full Implementation of BSB UFMP

Full implementation of the BSB UFMP will bring Butte-Silver Bow in-line with industry standards, create safer public spaces and will provide Butte with all of the benefits that urban trees can offer. Implementing the UFMP creates an Urban Forestry Department in Butte-Silver Bow. A full implementation can be set into motion at any time after phase one has commenced.

Hiring an Urban Forester

Finding and hiring the correct person for the urban forestry position will be an important and possibly difficult task. When conducting the search, the International Society of Arborists and the American Society of Consulting Arborists have resources to assist in recruitment. Posting this job position on their websites will be a good place to start. It is possible if not likely that the correct person for this job will move to Butte for the position. Fortunately, this job could be a coveted job in the arboricultural world.

- Management recommendation – Creating an Urban Forestry Department

The benefits of this option include (Urban Forestry Best Management Practices, 2006):

- Deepen ties with the community
- Will build institutional knowledge
- Is always available, more flexible for other work assignment, can respond to emergencies
- Is directly responsible to citizens and their department
- Quality will improve over time with training to meet community standards
- Workforce is more stable
- Workforce is motivated by pride and residency and knowledgeable about the community
- More control over training and specializations
- Less administrative time is needed to write and oversee contracts

- It will take some responsibility off the shoulders of the BSB Tree Board such as preparation of budgets, enforcement of laws, preparation of planning documents, and analysis of programs and policies (Matheny, Clark 2008).

This person will possess a unique set of qualities and physical abilities; professionalism and laborer strengths. Some of the qualities to hire for will be: (Adapted from Indiana University Human Resources Services, 2005)

- **Leadership.** This person will communicate the vision and benefits of trees to stakeholders. Working with the planning and reclamation department will be a part of this job and cooperating with and obtaining commitment from these departments is crucial. Maintaining open lines of communication with stakeholders and the public is important to build relationships. This person will delegate responsibilities and provide motivation for subordinates to execute their jobs effectively.
- **Team Orientation.** This person will work effectively with others and actively contributes to the goals of groups and organizational goals. They will take ownership and share responsibility of projects and utilize strengths of individuals within the group they are working with.
- **Customer Service.** The public is ultimately who this person works for and when this person out in the community will provide as a useful resource to residents. This person will assume ownership for the municipal trees and respond to the public's concerns and the tree's needs. BSB's need will also be considered when the public raises concerns and balancing these needs will be important.
- **Problem Solving/Decision Making.** This person will make decisions using the information they have in a timely manner. They will use the resources they have and involve the appropriate people.
- **Interpersonal Communication.** This person will listen well to others and ask the appropriate questions when they need clarification. This person will be receptive to suggestions and give suggestions well. Butte has an eclectic citizenry and adapting to different communication styles will prove useful. This person will recognize and manage conflict as appropriate.
- **Flexibility.** This person will adjust their behavior when faced with different situations that are changing or uncertain. This person will still be effective when adapting to change dealing with ambiguity. They will acquire new information to meet changing demands.
- **Performance Management.** This person will distinguish between good and bad performances and adjust the plan going forward. Providing feedback and receiving feedback are important qualities in being an effective Urban Forester. This person will also acquire the appropriate help for each task.

- **Arboricultural Skills.** Just as important as managing the interests of the BSB UFMP is performing the actual care of the trees. Practicing arboriculture will occupy most of this person's time in the months of nice weather in Butte.
-

Duties of the Urban Forester

A unique set of skills is required to manage BSB's most valuable asset. This person's task is to implement the BSB UFMP. To do this, this person must work with other departments that have trees in their jurisdiction, influence planning of city infrastructure to accommodate the planting of trees and perform tree care activities.

- Management recommendation – Administration of the Urban Forestry Department

Ideally, the person BSB hires as their Urban Forester will possess many of the skills outlined above however, realistically the person hired will need to develop many of these traits and be trained to satisfy many of the demands. This person hired must be proficient in arboricultural operations. This person must be able to perform many, if not all, tree care activities without any training. If this person has other skills, great, however bureaucratic skills might need to be trained. A list of job duties will include the following, All are important while the first two are crucial:

- Arborist. Must be proficient in arboricultural duties such as, but not limited to: pruning techniques, removing trees, diagnosing disease and plant health care.
- Coordinate with other departments in BSB to direct all tree related activities
- Enforcement of laws, ordinance, rules and regulations
- Influencing the interests of the UF department and the expressing the benefits of urban trees
- Preparation and supervision of budgets
- Preparation and supervision of planning documents
- Analysis of programs and policies
- Employee selection and supervision; employee relations
- Agency operation and maintenance
- Maintenance of contracts with groups and people outside of the municipality
- Short-term planning of work plans that fit into the long term UFMP
- Maintenance of arboricultural tools such as chainsaws, safety gear and pruning devices

The goal of this person is to be an advocate for urban trees. This position will insert trees as a priority into city planning and activities and be "boots on the ground" performing tree care work.

Staffing the Urban Forestry Department

In addition to an Urban Forester BSB will need an arborist and a seasonal laborer to proficiently operate an Urban Forestry Department. The hiring of UF department staff will largely be conducted by the urban forester. This amount of personal will be needed to conduct arboricultural work in Butte. The Urban Forester will be involved in arboricultural work however their time will be best spent asserting the department's goals in county government.

Training of an urban forester and staff is an important component of a successful Urban Forestry Department. A list of trainings might include (Urban Forestry Best Management Practices, 2006):

- Tree identification and basic tree physiology
- ANSI A300 pruning, maintenance, and protection standards
- ANSI Z133.1 safety requirements
- ANSI Z60.1 standards for nursery stock
- Job site setup, flagging, and safety
- First Aid, CPR
- OSHA compliance
- Electrical Hazards Awareness Program
- ISA Certified Tree Worker and Certified Arborist Training

Equipment needs of the Urban Forestry Department

Arboricultural equipment is specialized and often is not shared between departments because of its specific uses. BSB does not currently own the equipment needed to perform arboricultural activities. Initially, BSB will have to invest in basic gear with an eye toward the big ticket items. Some of the basic items used regularly in arboriculture and their estimated prices are listed in the table below:

Tools	Initial investment \$
Chainsaws, one large and one arborist saw	1300
Rope for climbing	200
Harness	250
Pruning shears and hand saw	100
Personal protective gear. I.e. chaps, helmet, safety glasses.	150
Total initial investment	\$2000

With this basic equipment in place clean-up of debris and be hauled away in a pickup. Eventually, BSB will invest in bigger ticket items such as a bucket truck and chipper. The equipment listed here can be bought used and the prices given are in used condition with maximized value. This equipment will include:

Bucket Truck	15000
Chipper	6000
Pick up used for chipping or chip truck	7500
Total	28500

Coordinating Tree Related Activities in Butte-Silver Bow

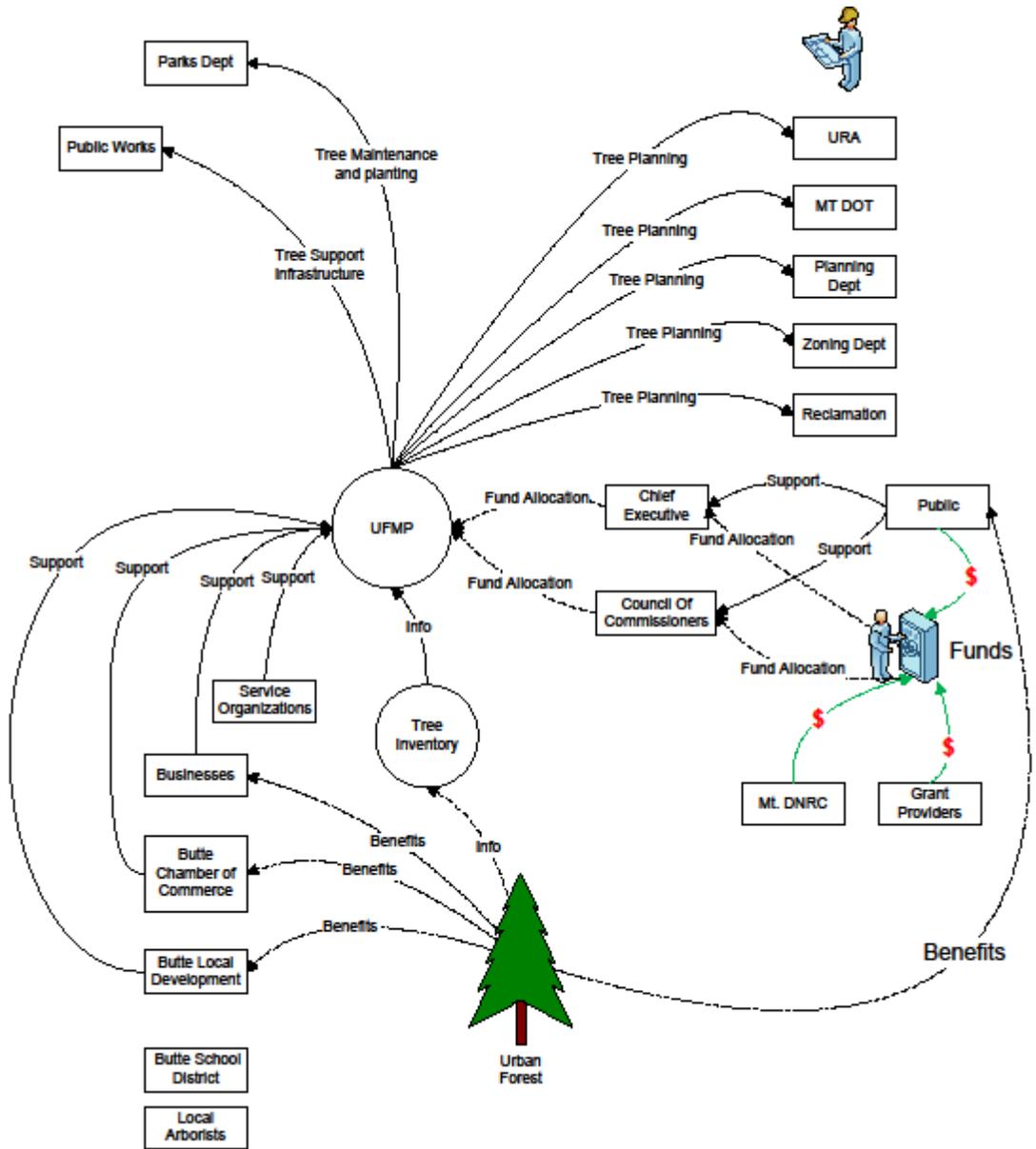
Coordinating different county departments and citizen groups to enhance the green infrastructure in Butte will be crucial to implementing the UFMP effectively. Currently, multiple entities manage different operations related to the urban forestry program. Tree planting on municipal land is carried out by the Planning Department, reclamation department, BSB tree board, and private citizens. Pruning is being done by Parks and Recreation, while storm clean-up is done by Public Works. The lack of coordination has paralyzed progress with related projects in the past. Implementing this UFMP, hiring an experienced Urban Forester, and giving this position the ability to influence and coordinate all tree activities will greatly help all stakeholders and green infrastructure within the BSB area..

In the 1940s and 50s Butte has a robust urban forest on municipal land. Many private groups planted these trees all to be cut down in the 60s by the city government. This is a prime example of what happens when there is not a coordinated effort to improve the urban forest. So much effort and resources were wasted and is what BSB will set it-self up for if an urban forestry position is not created in Butte.

The Planning Department currently anticipates spending \$500,000 a year for the next 10 years to launch a tree planting and care program. This money will be spent the most effectively if an Urban Forestry department is created in Butte-Silver Bow. Additionally, if a qualified urban forester does not oversee these efforts, this money could be largely wasted. Utilizing this BNRC money efficiently has the potential to help make Butte's urban forest among the nicest in Montana, compelling the county to execute this UFMP as soon as possible.

- ❖ UFMP Goal 6: Urban forestry department is responsible for all tree related matters in the municipal forest and coordinating tree activities among county departments.

The BSB UFMP will succeed with input from multiple stakeholders (see figure). This makes for a complicated process of organizing and executing, but also has the potential to help create a solid infrastructure, uniting these groups behind the common vision. The following diagram



represents the stakeholders, beneficiaries and the partnerships:

Figure 4 Olsen, Dan P. 2013

The Urban Forester in Butte will potentially interact with all of the parties represented above. What is important is that the UF will coordinate all tree related activities. By doing this:

- All trees planted by Reclamation and Planning departments will be planted properly
- All trees planted will be updated in the tree inventory
- All trees planted will be recorded and monitored to ensure proper watering and care.
- All trees pruned will be on a systematic cycle and updated in the inventory
- All trees removed will be recorded and the most hazardous trees will be addressed first
- Funds will be allocated in an efficient and effective manner
- The public and citizen groups will see visual progress and relieve frustration from not having a point person to facilitate green infrastructure projects
- The level of tree care in BSB urban forest will be professional and consistent

Actual planting of trees will still be done by citizen groups and Planning and Reclamation, but all plans to plant trees on county ground must be approved by the UF for the reasons stated above. All tree work will need to be done by certified arborists, limiting all municipal trees to be pruned within the Urban Forestry Department, or by an arborist approved by the urban forester.

Pruning

Maintenance for trees changes over time. Methodically approaching tree maintenance will result in saved time and money, increased benefits, lessened risk and healthier trees. Increased savings comes from a greater efficiency from reduced set-up time and travel time on an on call basis.



This tree should have been pruned at an early age to establish a dominant leader and eliminate weak branch attachments

When work is done it is important to document what has been done, not only for bookkeeping, but for possible legal implications.

The following list is expected work that might need to be considered for trees throughout their lifetime: (Clark, Matheny 2008)

- Irrigate
- Create and maintain distance from trunk for mowing
- Mulch
- Prune to develop good structure
- Maintain and remove stakes and tree ties
- Remove dropped leaves
- Survey and inspect for pests, defects, structure and other defects
- Prune to clean crown, maintain clearance and

meet other objectives as needed

- Install support systems (cabling, bracing)
- Manage pests
- Manage roots and pavement interactions
- Remove tree when time is appropriate
- Grind stump

Street trees must be pruned for a variety of reasons as compared to trees found in the forest which are largely un-pruned. The purpose of pruning trees in an urban forest are for aesthetics, risk management, functionality, and to improve the health of the investment.

Most mature trees in Butte have not been pruned or have been pruned incorrectly. This gives reason to establish a regular, planned pruning program. Pruning largely falls into five categories, listed below:

- Crown reduction in cases of branches over reaching their space or load limit.
- Crown cleaning, where dead branches need to be removed for ascetics or preventing them from breaking off.
- Crown Raising, for convenience of mowing and accessing yard space.
- Restoring, where branches have broken off and an irregular shape resulted
- Structure, for strong branch attachments and crossing or rubbing branches

Pruning trees addresses the second goal of the UFMP which states:

- ❖ Standardize maintenance of the Community Forest (publicly owned) and implement a systematic pruning and removal schedule

Also, pruning addresses the management recommendation:

- Pruning young and mature trees

Structurally pruning a young tree is much easier than a large tree that may have developed multiple problems since planting. When pruning a young tree many long term benefits are realized by eliminating potential weak branch attachments, rubbing or crossing branches or improving the general shape of the canopy. This task on young trees can take only 10 minutes while a large tree can take much longer and is more expensive. Trees should not be pruned at planting except for dead, damaged branches or serious structure problems. It is appropriate to prune for structure after the tree has established itself for a year. Pruning trees on a seven year rotation will be appropriate for BSB's needs.

In all cases no more than 25 percent of the foliage or crown should be removed in one growing season. Arborists performing the pruning should be certified by ISA and prune to minimum specifications set by ANSI A300 and Z1.33 safety standards.

Trees to be maintained by activities such as pruning can be prioritized. At the top of this priority list should be trees identified by:

- having been reported by the community or identified as high risk
- major streets
- park trees
- trees within right-of-way
- street trees

It is advised to systematically prune trees as opposed to an “on call basis.” This systematic approach is a proactive approach towards maintaining tree health. Operating on an “on-call” basis would classify as a reactionary care. The Tree Care Industry Association generally recommends pruning urban trees every five years. Considering the BSB community and its trees the community forest could be pruned on a seven year rotation. Preventative maintenance ensures a trained eye examines each tree thus creating a healthier urban forest. This is also known as a routine management approach where scheduled tree maintenance and requests drive workloads.

- Management Recommendation- Pruning mature trees

Trees can be divided into two broad categories; those needing a bucket truck for pruning and those not requiring a bucket truck. Pruning tree when they are young is vitally important to establish good branch structure. Being that 3200 of the 4070 trees in Butte are less than 12 inches in diameter, pruning the entire tree population in Butte is a smaller task than it could be in 10 years. By implementing a program immediately will save Butte \$375,000 as compared to waiting until the smaller trees have grown. Trees over 12” DBH typically need to be pruned using a bucket truck or by the use of climbers due to their size. 870 of Butte’s 4070 urban trees inventoried are 12” dbh or over and 3200 are smaller than 12”. The inventory indicated that there were 294 trees identified as being hazard trees or in such condition that they need to be removed. The trees over 12 inches dbh being pruned on a seven year rotation would equal 125 trees to be pruned each year. A crew of two will be able to prune/clean-up/document, on average, 4 of these trees a day. On a seven year rotation, this would be 13 days of work. The 3200 trees less than 12 inches DBH can easily be pruned without a bucket truck and many more of these will be able to be pruned each day. Approximately 8 trees can be pruned and cleaned up each day by one arborist; this would create 12 days of work on a 7 year rotation. On average the two person crew

will cost \$1000/day at a rate of \$65/hour for one person. At this rate, pruning the urban trees in Butte will cost \$60,500/year. This information is in the table below:

	# of trees	# to be pruned each year on a 7 year rotation	2 person crew for >12" 1 person for <12"	Cost per year in \$
>12 inches dbh	870	125 trees	4 trees/day = 32 days of work	32000
<12 inches dbh	3200	457 trees	8 trees/day = 57 days of work	28,500

Removals

Tree Removal is part of tree management. Reasons to remove a tree might include one or some of the following reasons: (Clark, Matheny 2008)

- Tree is dead
- Extensive decay, structure deficiencies caused by storms or other reasons
- Decline
- Infestation of pests or disease that might spread to other trees
- Impeding development
- Utility lines interfere and planting a smaller tree would be prudent
- Tree is a repeat offender of interfering with pavement and root pruning is not reasonable

On any given year in Butte, 1-2 percent of the tree could be removed to address risk and storm damaged trees. This would mean 45-90 trees a year could be removed costing The UF Department \$27,000-54,000.

- Management Recommendation- Removing trees hazard trees

Removals	# of trees	Price per removal \$	Total cost \$	2 person crew
	45-90	600	27,000-54,000	2 trees/day = 23-46 days of work

Knowing when to remove a tree can be difficult for many reasons. If it is not immediately obvious whether or not to remove a tree, an expert opinion can be obtained or even a second opinion. Arguments for removing or not removing trees are often influenced by the public. The danger arises when emotion overwhelms logic or there is a failure to accept the professional assessment.

Butte has a number of cottonwood street trees. Softwood trees such as these present a higher risk because of their weak wood. These trees that have defects or are in decline would be high on the list for removal.

Planting

Choosing the right tree for the right place is an important consideration when planting, especially with street trees. In Butte many medium stature trees have been planted along Montana and other corridor streets. This has been a good practice considering the limited space for roots to grow and limited nutrients available due to the planter size. It is important to remember planting a large tree can have as much as eight times the value as a small growing tree over a medium stature tree. On Butte's streets and in parks, understanding the site and how the tree will be maintained and then selecting the right tree is important. The following are considerations for choosing trees at specific locations: (Clark, Matheny 2008)

- Available growing space- above ground (horizontal and vertical), below ground (soil volume), and ground level (distance to pavement)
- Light- daily and seasonal
- Wind- daily and seasonal
- Soil- Structure and texture, drainage, ph, chemistry
- Surface cover- turf, mulch, herbaceous or wood plants
- Irrigation- quality and quantity
- Management-pest control
- Use- Litter, canopy (above street)

Irrigating newly planted trees is essential to their establishment. A tree in BSB will need irrigation for a minimum of three years after planting. After the irrigation period for newly planted trees, the trees need to be monitored to make sure there is not a loss on the investment.

A goal would be to plant three trees for every tree removed in Butte. This is to increase future canopy cover to 25% over streets and sidewalks, create species diversity, and raise the stocking density. The stocking density is the number of tree spots available compared to the number of spots that have trees.

- ❖ UFMP Goal 5. Maintain and grow canopy cover to 25% over streets and sidewalks

Planting trees in BSB is broken into three categories in the UFMP: Planting trees in the reclaimed grasslands, planting trees in the historic district and finally planting trees in the neighborhoods. Planting trees in the reclaimed grasslands are largely their own entity funded and executed by the Planning and Reclamation Department, while overseen by the Urban Forestry Department. Resources should be split evenly between the neighborhoods and the uptown area.

Five million dollars in BNRC are funds available to plant trees in the next ten years have a stipulation to plant only native trees. Unfortunately, trees native to this area do not make good street trees. These trees are juniper, aspen, Douglas fir and Canada cherry. These trees will make great trees in the reclaimed grassland areas and some in the parks but this money will not be spent on street trees.

Species diversity will largely dictate the health of the BSB urban forest. A high degree of species diversity is what the BSB urban forest has a potential for considering the age structure and where resources will be allocated in the full implementation of the UFMP. A high species diversity is what will make the BSB urban forest sustainable and is what will make this urban forest a model of other cities to follow. To achieve appropriate species diversity for BSB tree selection will not be available at the local nurseries. The urban forester will purchase trees from area wholesalers and possibly as many as 3-4 different wholesalers. A list of potential planting are available in the appendix. Specific recommendations include:

- Limit planting the three most populous trees in the current municipal forest to 1-2%. This includes limiting the planting of green ash, Canada cherry, and crabapples.
- Increase the planting of trees grow to have large canopies and are longer lived

Funding for planting street trees can be supplemented by continuing and bolstering the voucher program known as “tree-bates” This voucher program contributes \$50 to the purchase of a tree that will be planted on the public space adjacent of one’s house or business property This program will stretch this budget by encouraging the public to invest their money in planting street trees. The nursery can then plan for the increased demand for street trees by how many vouchers the city plans on distributing. These trees have a greater survival rates because the property owner has invested interest in the tree living and will often take care of their trees.

It is vital that one person, the urban forester, oversee all tree plantings in BSB. Many different groups are planting trees on public lands and money and effort will be wasted without one person to approve or reject the different group’s plans for planting trees.

Planting Trees in the Reclaimed Grasslands

The Reclamation Department has been planting groups of trees and plans to continue to so. The mining waste left behind in this area is toxic to the trees and if a tree’s roots encounter the waste the tree will suffer and most likely die. The reclamation process in this area that is largely complete capped the waste with a layer of limestone and 18 inches of clean soil. These areas have been seeded with native grasses and reclamation is finished. Planting trees in these areas starts the process of restoration. The areas that the Reclamation Department has planted trees have been excavated with planting spots large enough that trees roots should not encounter the toxic soils. The spots that have been excavated hold 10-20 native species trees and provide an aesthetically pleasing break of the grasslands, habitat for animals and recreation areas for people.

These trees will be watered for 3 years and then they are on their own. Continued planting of trees by the Reclamation Department should be encouraged because of their experiential knowledge of the area but again an urban forester could better coordinate this planting and ensure survival of these plantings. If Soil acidity levels (ph) are tested: lime and sulfur will alter the ph. Additions of mycorrhizal fungi have proved most effective in poor qualities such as mine spoils (Harris et al. 2004)

Additional planting spots should be in natural draws and low spots that naturally collect water and where wild trees would grow.

- Management Recommendation- Planting trees in the reclaimed grassland areas

A popular paved trail runs through this area for walking, running and biking. This makes an obvious area to focus tree planting and would provide many benefits to the people that use this trail. The species selection is limited to the native trees however these trees will still be quite valuable and provide enormous benefits.

When planting trees in this area the appropriate hole must be dug and soil must be brought in to allow for root expansion without growing into toxic soils. Exactly how big the hole should be and how much soil will need to be bought in will be dictated by reasonability, the size of the tree being planted and experimentation.

Planting Trees in the Historic District

Planting trees in the historic district will provide many benefits working symbiotically with the sewers, roads and buildings. Also, these trees will play a role in the economic development in Butte. One reason Butte has not seen more economic development and investment in the Uptown area is that the county has not invested into the beautification of it. Planting trees in this area address this issue and will play a role in revitalizing the uptown area.

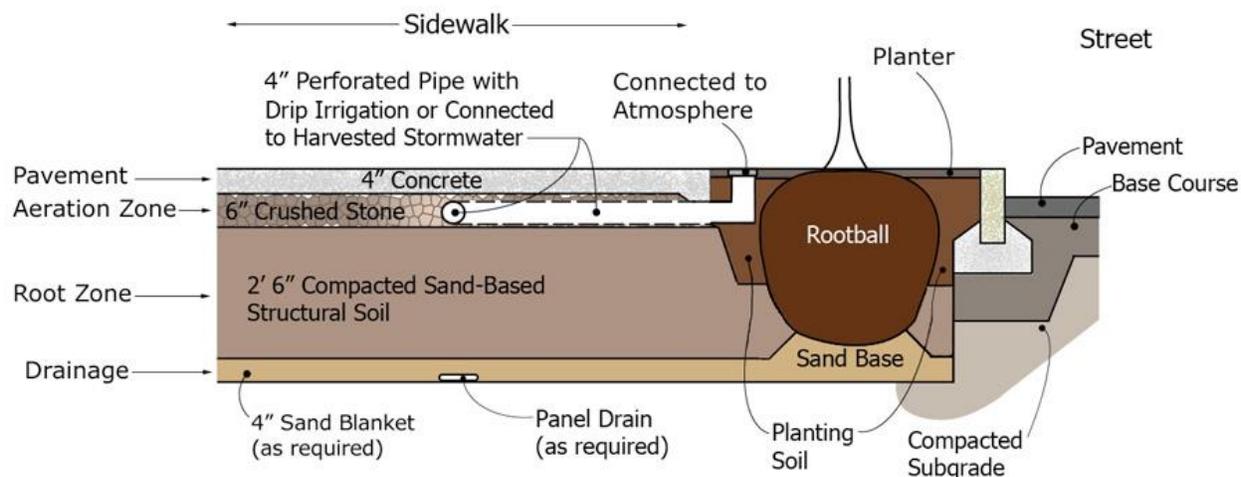
- Management Recommendation- Planting trees in uptown area

The climate is harsher in the uptown area than it is on the flats and the lower neighborhood areas. Species that will grow are even more limited because of this, refer to Appendix 1 for acceptable planting species in this area. In general, planting harvestable fruit trees on streets and boulevards is not advisable because of the messy fruit they create.

On the city streets in Butte it is appropriate to add additional trees, however appropriate planting locations are not currently available due to the existing planter spots which do not allow adequate space for growing trees. Many city streets do not have planting spots at all. If these streets were to be redone or upgraded, installing acceptable planting space for trees is advisable. An irrigated minimum of 100 cubic feet of soil is needed to sustain long term tree growth (DeGaetano 2000). In these planters, after two feet in depth is reached, an increase in soil surface

area is of greater benefit than greater depth. This would make a minimum realistic planter size of 2 feet deep, 3 feet wide and 16 feet long.

On a road that will be reconstructed in the future, reinforced “suspended pavement sidewalk” is an ideal way to provide planting spots. If a city street is ever reconstructed the city should consider suspended pavement which is an ideal way to provide future planting locations. This suspended pavement sidewalk does not bear extreme loads and is over non compacted soils in hardscapes. According to a study conducted by Bartlett Tree Research Lab (2006) trees with room to grow their roots under concrete in sidewalks were “larger, faster growing, had better color, and more root growth than most other treatments.” On these pavement plantings or any plantings in sidewalks, surrounding pavement should slope away from the planters, thus not sending contaminated water into the tree. The following is a description of what this might look like.



See Appendix # 4

Above ground planters are an option. Above ground planters are susceptible to greater temperature extremes and water stress. However, well designed planters with considerations given to size, insulation, waterproofing, irrigation, drainage, and soil mixes can be very attractive and trees can grow well in these planters. The 100 cubic feet size requirements will still apply to encourage root



Picture of an aboveground planter in Helena, MT

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development.

In the residential areas in the uptown area many of the sidewalks are connected to the sidewalks with no green area between the sidewalk and street. Again when these streets are reconstructed, space should be planned for a green area that will accommodate street trees.

Planting Trees in the Flats and in Neighborhoods

Planting trees in the neighborhoods and the flats should have equal attention and resources should be allocated. Trees planted in these areas will be greatly valued by the residents and the trees will be cared for by them. These areas have many families that will benefit from more urban trees and being out of the way of college rental units and bars, vandalism will be less of a concern. Public perception of the Urban Forestry Department will be higher because the people seeing direct benefits of municipal investment are residents and many are invested in their communities and neighborhoods. These people are the voting public and the UF program will reflect positively on the county commissioners. Planting trees near schools in these areas or on school property will aid in education of the benefits of urban trees and aid in building community.

- Management Recommendation- Planting trees in the neighborhoods and on the flats

Many of these areas do not have sidewalks or obvious areas for planting public trees. Again, as streets and grey infrastructure is improved trees should be considered and planting areas need to be part of the planning. The residents in these area will utilize the tree voucher program (tree-bates). This is good because the public funds are matched by private property owners and these trees have a greater survival rates because the residents have an invested interest in seeing the trees reach maturity.

Monitoring

Newly planted trees must be monitored annually to ensure proper establishment. Frequent care such as watering and inspecting for health should occur on a consistent basis. If health of the new trees is not meeting expectations the maintenance plan for these trees will have to be altered. The county will have to take a bigger role in maintaining these trees or the private parties responsible for their care will have to be consulted.

Trees exhibiting a high and medium level of risk also need annual monitoring. This is to address the priority of their maintenance or removal. If their risk level is unchanged, their maintenance can be left to the systematic routine pruning or schedule removal. If the condition of the tree has worsened in health or by a storm event, the monitoring process will address this accordingly and the action required could change.

Public Relations

It is important for the Urban Forester in Butte and the Butte Tree Board to communicate the benefits of the community forest to the public to ensure funding. The public's concerns must be heard by the Urban Forestry Department for funding but also to adjust to the needs of the public. Goals for the Urban Forester and Butte Tree Board are to communicate using the recommendations of the Western Forestry Leadership Coalition, which are to increase awareness and support for the community forest, foster a greater understanding of its importance, and engage a diverse group of people to support the program (Western Forestry Leadership Coalition). This can be done by communicating four main messages:

- Urban forests provide essential benefits we can't live without
- It is not by chance a healthy urban forest is maintained, community investment is essential
- Healthy community forests aid in a happier citizenry
- Community forests and rural forests are connected, they both can affect the other

The Butte Tree Board is fortunate that it has the members it currently does. Many backgrounds of professional expertise comprise the board. A mentoring program for new members is advised for maintaining the longevity of the board and its effectiveness.

At one of the public meetings a discussion came up that it would be beneficial if the Urban Forestry Department maintained a couple private properties a year of property owners that are in need. These people that benefit from the service would be in financial need and not be otherwise able to maintain their trees that are a part of the urban forest.

Volunteers

Fundraisers can also help to purchase trees furthering the scope of this budget. Planning events like the Arbor Day celebration can be continually planned at the tree board meetings. These events can be in conjunction with tree planting and pruning clinics

Education

Education is a key aspect to having a successful Urban Forestry Department. Education programs help build community help the public be informed of the benefits of the urban forest. The property owners in BSB own much of the urban forest and by education these people as to the proper care of urban trees the quality of care increases for the entire tree population. In-turn support is increased for the Urban Forest Department, creating a positive feedback loop. There are many programs and ways to educate the public, the following should be considered in BSB:

- Educational brochures of the proper care of trees in the urban forest for the public available at the courthouse, MSU extension office and other public places.

- The Urban Forestry Department webpage can be a good resource for the public as to the care of trees and recommended planting species.
- Volunteer opportunities such as pruning and planting clinics
- Workshops for pruning, planting and design of parks and street tree plantings
- Maintaining the “Tree City USA” distinction
- Continue to host Arbor Day and Earth Day events to recognize the work accomplished and volunteers
- Use signs in parks and around street trees to inform the public of the specs of tree and its growth habits
- Allow the public to adopt a tree, either financially or the care of while it is young
- Link the trees benefits to specific trees in high foot traffic areas such as “this tree provides Butte with \$13/year in stormwater reduction benefits” or “ this tree lessens the heating demands of the adjacent building by \$12/year”

These will accomplish the management goal of

- Management goal- Education

All of these objectives will lead to accomplishing the goal in the BSB UFMP of:

- ❖ BSB Goal #3. Sustain and expand education programs to provide awareness on the importance and proper care of the Urban Forest (all urban trees)

Work Schedules

Work schedules are a useful tool to in accomplishing goals of the UFMP and the community but also for setting benchmarks for performance of the Urban Forestry Department. When goal are set, both long term and short term, they can be checked to ensure they are being accomplished. If they are being accomplished, excellent, but if not adjustments can be made.

Five Year Plan

Implementing a five year plan is an important part of accomplishing key goals. Establishing a five year plan consists of setting goals and broadly describing the objectives to accomplish them. Five year plans will address three main goals: tree canopy cover, species diversity, and tree age distribution. For BSB, in the first five years ending January 2018 realistic goals could include:

- Urban tree population has been maintained to attain a reasonable level of risk.
- Tree canopy cover has been raised 5% from 9% to 14%
- Species diversity has been raised so that no one species occupies more than 15% of the total municipal forest and eventually so that one species occupies no more than 10% of the total population

- Increase age distribution by removing trees that present a high level of risk and are over mature and by planting new trees. The 10 year goal for age distribution is every age class is represented equally.

By incorporating this five year plan we can evaluate effectiveness of the department. When the period is complete BSB will incorporate changes in community values and respond to new information to develop the next five year plan. The public and the tree board can have good input in creation of the five year plans, tailoring them to what the communities need are.

Annual Work Plan

Annual work plans set out to accomplish the longer term planning. This done by setting specific operational objectives. These objectives will include the number and species of trees to be planted, the number of trees to be pruned and where these trees are and the number of removal and which trees to be removed. The following chart outlines when much of this work will be done:

Program Activity	J	F	M	A	M	J	J	A	S	O	N	D
Administration												
Work priorities												
Day to Day arboriculture planning												
Modification												
Tree Removals												
Inspections												
Remove trees												
Permit inspections												
Review Inventory												
Tree Pruning												

Review Inventory	[Redacted]											
Inspections	[Redacted]											
Prune trees	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
Permits inspections	[Redacted]											
	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
Tree Planting	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
Review inventory	[Redacted]											
Update open planting spots on inventory	[Redacted]											
Purchase trees	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
Plant trees	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
Water trees	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
Other Activities	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
Storm Cleanup	[Redacted]											
Major equipment maintenance/ repair	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
Education programs	[Redacted]											
Staff Training	[Redacted]											
Safety Training	[Redacted]											

When day to day planning occurs it will be guided by this annual work plan.

Inventory

Updating the street tree inventory should be done on a regular basis. This will now include what maintenance has been done on each tree in addition to any new plantings. Examples of work history include: (Clark, Matheny 2008)

- Planting date

- Pruning
- Root pruning
- Stake removal
- Adjustment of tree gates
- Pest management
- Other maintenance

The tree inventory will evolve into a tree by tree index. In addition to the information already tabulated, specific tree inventory will have a risk of failure and possible target, photograph and an appraised value for each tree. The appraised value can then be on a tree by tree basis rather than an overview given in this report.

Updating the list should be done in BSB in one of two ways. It can be done by whoever is conducting the tree work at the end of each day, or the inventory can remain separate from maintenance activities and be updated every few years by re-inventorying the city trees (Clark, Matheny 2008).

The current inventory does not include open planting spaces. When the inventory is updated it should be updated to reflect the open tree planting spots so planning can be done as to where the needs for new plantings are. This is a goal and a management recommendation:

- ❖ UFMP Goal 8. Expand and manage tree inventory to greater detail
 - Management Recommendation- Update tree inventory

Tree Ordinances

Tree ordinances provide authority with protecting the urban forest and the safety of the public. Enforcement of these laws reflect the importance of the urban forest to its citizens. Ordinances are also a part of comprehensive urban forest management plan.

- ❖ UFMP Goal 7: Finalize and enforce revised tree ordinances

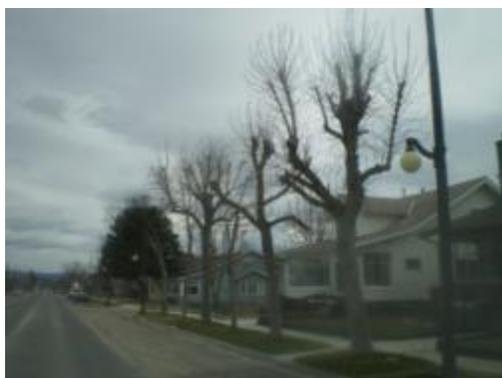
Butte-Silver Bow currently has a street tree ordinance #12.16 created in 1984. The ordinance recommendation written in the UFMP assumes an Urban Forester position has been created. If the ordinances have been updated and a UF position has not been filled the responsibility of enforcing the ordinances rests with the BSB tree board. This section helps to give suggestions for success of this ordinance. When writing an ordinance the following eight criteria for successful ordinances should be met (Swiecki and Bernhardt 2001).

1. Goals should be clearly stated and ordinance provisions should address the stated goals.
2. Responsibility should be designated, and authority granted commensurate with responsibility.
3. Basic performance standards should be set.

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4. Flexibility should be designed into the ordinance.
5. Enforcement methods should be specified.
6. The ordinance should be developed as part of a comprehensive management strategy.
7. The ordinance should be developed with community support.
8. Establishes a program independent of changing public opinion and finances (Urban Forestry Best Management Practices for Public Works Managers: Ordinances, Regulations, & Public Policies)



Poor pruning conducted by property owners or unqualified persons leads to an unsafe and an aesthetically unpleasing urban forest. Having a set of ordinances will address this issue.

BSB's ordinances fulfill numbers 1,2,5 and 8 of the criteria and the UFMP makes suggestions to fulfill the remaining criteria. Any statements or policies should be reviewed by the city attorney before being adopted into municipal code.

The process of frequently reviewing and monitoring the effectiveness of the existing ordinance and revising when necessary contributes to having a successful comprehensive community forest program.

Street tree ordinances primarily cover the planting and removal of trees within public rights-of-way. They often contain provisions governing maintenance or removal of private trees which pose a hazard to the traveling public.

Also included in this category are ordinances with tree planting requirements, such as those requiring tree planting in parking lots. These requirements act to preserve the urban forest. The following bullets are actions the ordinances should include: (Clark, Matheny 2008)

- Tree species to be planted
- Spacing between trees
- Line-of-site requirements with regard to planting and pruning
- Tree species and height requirements below utility lines
- Pruning standards
- Prohibition of topping
- Requirement of tree removal permits
- How many trees to be planted for every tree removed
- Qualifications of arborist conducting arborcare work

First, pruning standards are not addressed in the ordinances. This is important to have a point of reference for work to be done and for work that has been done. For example, if tree work has

been conducted on public trees to an unsatisfactory level, the pruning standards can be referenced to prove this and actions can be taken. In the existing municipal code 12.16. Recommendations include:

No. 12.16.060 Planting and Maintenance Requirements

- A. Trees planted within the public right of way or on publicly owned land shall meet the standards and minimum criteria set ANSI A.300 standard Practices (pruning).
- B. Stated ordinance is acceptable
- C. Any person pruning of street or park trees shall be certified by the International Society of Arborists.
- D. Any persons conducting work on municipally owned street or park trees shall obtain a permit from the Urban Forester.
- E. Topping of any tree in the urban forest is prohibited

No. 12.16.070 Maintenance of Street Trees

- A. Stated ordinance is acceptable
- B. Trees in the public right-of-way shall be pruned to allow a clear space over sidewalks of 12 feet, and a clear space over streets of 14 feet etc...

No. 12.16.080 required street tree work permit and license.

- A. Stated ordinance is acceptable. Change “Park Director” to “Urban Forester”
- B. Stated ordinance is acceptable
- C. Any persons conducting tree work on municipal trees shall be certified by the International Society of Arboriculture.

No. 12.16.090 Violation-Penalties.

- A. Stated ordinance is acceptable
- B. Penalties shall be the value of the tree destroyed or damaged commiserate with the Guide for Plant Appraisal 9th ed. And the 10th upon availability, cost of cure or appraised value, respectively.

The urban forest will suffer if the responsibilities are ill-defined or the authority to act is not granted. In Butte, The responsibility of the Urban Forester will be to enforce the 12.16 ordinances.

- ❖ UFMP Goal 4: Eliminate the topping of trees

As described in the “Species Diversity” section, a high species diversity is a key factor in the health of the urban forest. The list of Official Street Trees will need to be expanded to possibly include the tree mentioned in the “Expanded Street Tree List” appendix. The higher up the hill a tree is located, the harsher the climate is and more conservative plantings are advised. This means it is advised to not experiment with zone 4b or 4a in the uptown area while these tree might do quite well in the flats, around the airport or the lower neighborhoods

The city must raise public awareness for city ordinances; one way is to print them in the local newspaper, develop an interpretive brochure and/or conduct workshops when the ordinance 12.16 is approved. The target audience for this education should be:

- City Planners
- Building Inspectors
- City Advisory Commissions
- Contractors/Subcontractors
- Home/Property Owners
- Neighborhood Associations Developers
- Citizen Groups
- County Commissioners
- Utility Companies
- Realtors
- Architects/Landscape Architects

The ordinances do not include mandates for contractors to plant trees on street frontage or parking lots of new construction. Requirements could include

- All new parking lots must include 20 percent canopy cover when trees reach maturity
- New construction adjacent to city streets must include one street tree planted for every 33 feet of street.

Tree Permits

Tree protection ordinances are primarily directed at providing protection for public trees. The removal or pruning, both above and below ground, of any trees defined as public trees, street trees, and private trees on properties under development are subject to obtaining a permit before such activities commence. Permit application information may include the following information: (Clark, Matheny 2008)

- Name and contact information of applicant
- Location size and species and size of tree
- The reason for tree removal or work
- A description by a qualified arborist of what work is to be done, what condition the tree is in and why the work is needed

- A plan showing accurate tree location, drip line, existing structures planned construction and utility and drainage alignments
- The basis for permit requirement: Proposed Ordinance 12.16.100

Implementing tree permits into the construction process in BSB can be enforced by ordinances:

No. 12.16.100

- All construction that disturbs a municipally owned tree, above ground or below ground shall obtain a permit from the Urban Forester before construction commences.

The Urban Forester will need to visit the site after a permit is submitted for review. If this is a construction process approval will be contingent on the accuracy of the application, proper protection will be set up in the tree protection zones for trees being kept, and monitoring by the UF that and arborist is performing work done to the trees. The Butte Urban Forester will make an approval or reject the application based on its merits.

Byproducts from arboriculture and mulching trees

It is recommended to mulch trees especially newly planted trees. Mulch should be around the drip line, approximately three inches deep, and not in contact with the trunk of the tree. This practice will cut down on “Mower Blight”, temperate soil moisture and temperature, and reduce weed and grass competition (Ball 2003).

Mulch will not need to be purchased; rather chips can be obtained from the tree service activities of BSB. Wood chips can also be used for composting, or landscape applications. Logs from removals can be used for firewood or saw logs.

BSB can also provide these materials for free. For instance, logs from removal can be donated for firewood to people in need. This can be a valuable resource by increasing awareness for the tree program.

Risk Management

Risk Management is defined as follows: “Risk is simply a measurement of potential of deviation of an expected outcome, and the consequence of this deviation may either be good (resulting in opportunity) or bad (resulting in loss). The process of dealing with this uncertainty and trying to achieve the best outcome... in a changing environment is the essence of risk management.” (Reiss, 2004)

There is an inherent risk with ALL trees...we choose to live among trees because their benefits far outweigh their potential risk if managed appropriately (Rogers 2011). Obviously this is not an appropriate or realistic response; therefore some risk level must be acceptable. Controlling risk can be articulated in five ways according to Young (2002).

- Risk avoidance. Ex. Planting the right tree in the right spot, also to not put structures or people under a tree with structural defects.
- Loss prevention. Ex. Performing all regular maintenance and care such as pruning
- Loss reduction. Ex. Having a plan to deal with emergency situations such as in a storm or injuries
- Uncertainty reduction. Ex. Obtain risk evaluations from qualified risk assessors or remove tree if risk level is not tolerable.
- Risk transfer. Ex. Contracting with a tree risk consultant. (Clark, Matheny 2008)



A public tree showing a high degree of risk because of poor species selection and poor pruning

Qualified tree risk assessors are currently certified by the Pacific Northwest chapter of ISA. This certification is obtained by taking a course and successfully passing an exam.

Managing liability is of main concern. Acknowledging that it is the **duty** of the county to maintain the public trees, Butte-Silver Bow must maintain the trees to a reasonable **standard of care**. BSB is responsible for the hazardous tree conditions existing today or that may develop in the future. If the standard of care falls below what is reasonable and prudent, liability resulting from injuries or damages may result. The standard of care is one component of a risk management document.

When a tree is flagged as having a defect or hazard the influences that must be considered within the decision of removing the tree will include; accepting the public as a legitimate partner, planning/evaluating performance and collaborating with other credible sources(Covello and Allen, 1998).

Tree Characteristics Associated with Tree Failure



BSB has variable weather conditions making it a place where there is a potential for tree failure. Tree characteristics and weather to consider will include:

- Unusual storm with strong winds, snow
 - Winds or snow from an un-prevailing direction
 - Weak Branch attachment
 - Decay/ loss of structure
 - Crown decline or root decline.
- Diseases associated with either:
- Excessive end weight on branches
 - Excessive root loss when damaged or defects
 - Leaning trees
 - Cracks

There are many considerations for the BSB Urban Forester and Tree Board when deciding to remove a tree. Of the analytical process, the arborist's recommendations will first be considered. Next, site conditions and weather influence the likelihood of failure. These conditions include: (Clark, Matheny 2008)

- Climate and seasonal precipitation
- Site management history including changes in grade or root injury
- Soil drainage conditions
- History of other tree failures
- Obstructions to tree development such as pavement or structures

Lastly, the likelihood that a person or object could be injured is known as the target. Publicly owned trees are considered to have targets at all times in evaluating a target, again emotion can influence this decision making process. A public meeting can be held to get their comment to be taken into consideration for a final decision.

Butte-Silver Bow's Concerns Involving Risk

If hazard tree care services are contracted out, the risk is of performing the tree work is managed by the private contractor. The risk pertaining to the public still exists including:

- Tree Failure
- Grey infrastructure damage -including sidewalks and pavement, underground services, and overhead utilities
- Line of sight along streets
- Vehicle clearance over streets and sidewalks
- Fruit seed litter

- Emergency planning
- People in parks or community space

(Clark, Matheny 2008)

Risk Management Plan

Having a Risk Management Plan in place would greatly benefit the community of Butte-Silver Bow. A risk management plan in BSB should be developed by the BSB Tree Board and UF. Implementing the plan will be left up to the urban forester performing the tree work. Any statements or policies should be reviewed by the city attorney before being adopted. A policy statement concerning risk should include: (Young 2002)

- A statement of commitment by the top officials stating they believe risk management is important and identifies the overall purpose of risk management,
- Statement saying who is responsible for risk management and their authority
- A charge to select and implement risk control and how to finance
- A demand to audit and report on risk management efforts

The International Society of Arboriculture (Matheny and Clark, 1994) has quantified risk with a 12 point rating system, which could be used as part of the risk management plan. (See Appendix 4)

Proposed risk management policy statement for BSB:

Butte-Silver Bow has an active policy in mitigating the effects from potentially hazardous trees. The county will strive to eliminate, in a timely fashion any tree deemed hazardous. Being that budgets and human resources are limited, priority shall be placed on the highest risk trees. Identifying potential hazard trees will rely on any of the following: the public's concerns, the periodic updating of the tree inventory by the municipal Urban Forester, the recommendations of the contracted, credentialed "tree risk assessor", arborist performing work on municipally owned trees or the BSB tree Board. The BSB Urban Forester will facilitate the communication and documentation for the management of a particular tree marked as having a high degree of risk. The Urban Forester will have final judgment concerning mitigation measures taken for trees identified as hazardous.

In addition to the risk management policy statement, a standard-of-care must be established. The practice most likely will be carried out by the arborist conducting the pruning.

Proposed Standard-of-Care for Butte-Silver Bow:

Butte-Silver Bow will provide for a minimum standard of care for all trees residing on publicly owned spaces and adjacent vegetation that may impact safe public passage. This may occur through outsourcing contracts and/or through the development of in-house

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March, 2013

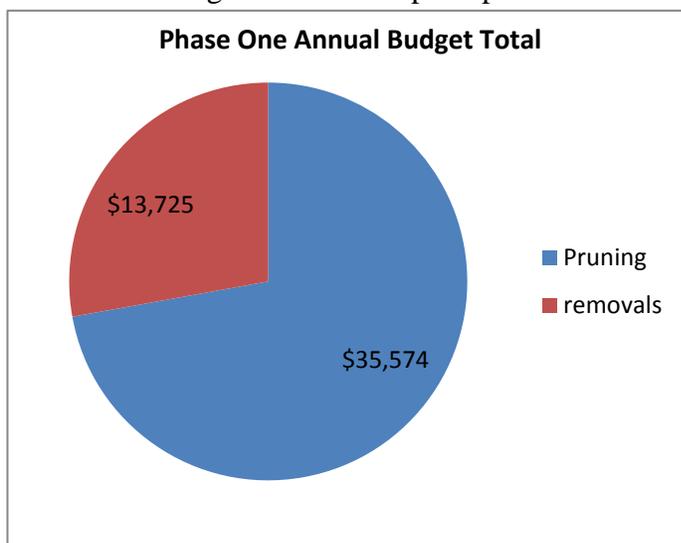
Butte- Silver Bow, MT Urban Forest Management Plan

expertise. The arborist performing the pruning will be technically proficient in current arboricultural techniques, recognized through International Society of Arboriculture (ISA) or comparable certifications. While treating the tree, a systematic inspection shall occur by examining the canopy of the tree and performing a vertical 360 degree inspection. The inspection shall be documented and captured in an inventory update and presented to the Urban Forester of Butte-Silver Bow. The BSB Urban Forester shall determine the risk of trees marked as hazardous based upon the arborist's observations and recommendations according to the Risk Policy Statement. The arborist's practices shall adhere to the industry standards according to International Society of Arboriculture's *best management practices* and adhere to the ANSI A300 pruning guide and the Z133.1 safety practices. Pruning goals should reduce failures of limbs based in problematic species. When an arborist is climbing a tree, a pre-inspection of the tree shall be performed.

Proactively addressing risk is imperative. Pruning a tree at a young age to develop good branch structure and planting the appropriate tree in the appropriate location is always good practice. Maintaining records of all treatments for the tree is in the best interest of the city as it demonstrates performance of duty and builds a history for each individual tree.

Budget/funding

There are many equations to consider when deciding on how much it will cost to fund the maintenance of the urban forest. A city can look at what other cities are spending relative to how many trees they have or how many people are in that city. A city can look at what is the maximum amount its citizenry will be comfortable spending on this asset or what it will cost to manage this municipal infrastructure. The BSB UFMP looks at all of these variables to recommend a budget that will keep the public safe and grow benefits provided by the urban



forest , while acknowledging the distaste for increasing taxes.

Budgeting for Phase One

Implementing “Phase One” of the BSB UFMP will cost \$49,298.50 for three years totaling \$147,895.50

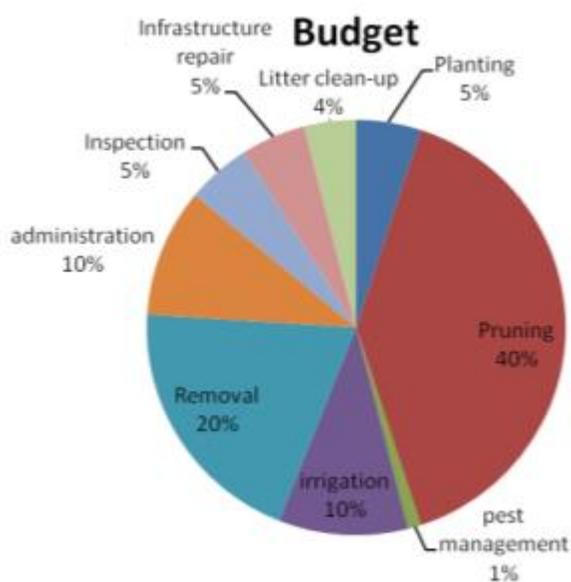
Again, spending addresses the safety of the public and does not grow the urban forest.

Budgeting for Full Implementation

Full implementation of the BSB UFMP will allow Butte to experience the

benefits of urban trees and will help give the next generation of Butte a town they can be proud of.

Full implantation of the Butte-Silver Bow Urban Forest Management Plan will require a \$205,500 annual investment. This \$205,500 level of spending is based on the costs explained in the Pruning and Removal sections and the other factors mentioned in the first paragraph under Budgeting/Funding. At this level of spending, BSB will have a safe and model urban forest with a lesser per capita amount of spending when compared to other cities nationally and in Montana. With this level of spending BSB will spend \$47 per inventoried tree and \$6.14 per capita. The cost per tree is normal when compared to national averages. Butte does not have many urban trees when compared to other cities of similar size. As more trees are planted, the per tree will decrease and spending will not have to increase because of the efficiency of the program. The per capita expenditure is much lower when compared to other cities in Montana and nationally. At this level of spending BSB will receive \$1.69 for every dollar it spends considering the benefits already discussed. This is a 60% return on its investment. This budget is a sustainable while providing an adequate level of service.



A typical Urban Forestry Department will spend the percentages in the pie chart to the left with-in their Urban Forest Department.

Equipment costs are figured into the costs of removals and pruning. BSB will initially allocate more money towards planting and less from pruning because of the age structure of the current urban forest. As trees reach maturity planting levels will decrease and pruning needs will increase. The initial numbers that BSB will spend in each category will be:

- Planting \$31,500- 15%
- Pruning. \$60,500 approximately 30% of budget
- Removals. \$40,000 approximately 20% of budget
- Infrastructure Repair. \$10,500 - 5%
- Administration. \$21,000 - 10%
- Irrigation \$ 21,000 - 10%
- Pest Management \$2,100 - 1%
- Inspection \$10,500 - 5%
- Liter Cleanup \$8,400 - 4%

These costs and percentages will vary year to year however in is likely all of these categories will be an active motion of the budget. Having a budget for trees and proactively maintaining them will improve efficiency, level of care, and safety for the public.

Financing Butte-Silver Bow's Urban Forestry Department

A \$10 fee per lot is recommended to finance the A Butte's urban forest. This is possible in accordance with MCA7-12 which states a city can establish a fee of this to supports its infrastructure. This level of funding is an adequate number to maintain and keep the community forest at an acceptable level of risk to the public. Tate (2007) states, **“Cost-efficiency in relation to benefits provided can make a difference.**

Maintaining program funding is intimately tied to demonstrating the importance of the urban forest to the health, safety and economic vitality of the community, and the effectiveness of the program in providing those goods and services.”

(Matheny, Clark 2008) Therefore it is very important to involve the community in care for the urban forest. This fee would look much like the assessment for sewer and water. This fee can also be levied as a per foot of right away frontage or a percentage of property value (Urban Forestry Best Management Practice, 2006).

The National Arbor Day Foundation surveyed 3,130 cities as to their spending on municipal tree programs. For cities that have a population of 0-9,999 the expenditures was \$10.58 per person.

Additional ways to implement funding for community trees include: (Urban Forestry Best Management Practice, 2006)

- General fund. The General fund and Parks and Recreation budget is where the funding comes from currently. The activities funded by these departments are tree planting in parks and storm clean-up.
- Grants. Grants currently play an important role in funding the current street tree planting program and will continue to do so in the future.
- Taxes, Special assessments and Tax Districts
- Capital Improvement Project Funds. This is assuming the trees are considered a capital Asset to BSB
- Tree work permits, Development and Inspection Fees. When a development occurs from private business or developers, the urban forest goals should be considered and fees assessed appropriately.
- Compensatory Payments. When a public tree is damaged by a car or by construction activity, BSB should be compensated just as it would if a streetlight or sign were

damaged. Trees have value as can be seen in Appendix 1 and the fine can be tied to these values.

- Utility Bill Donations. Residents could be encouraged to round up their utility bill to fund tree programs or a small fixed amount, such as 50 cents, could be added to each bill and the owner would have the option to voluntarily include it.
- Mill Levy(s)

Community members and organizations, both residential and private business, would be interested in investing in their community's forest. These organizations can be encouraged to participate in the "cost share program" or entirely funding projects in front of their businesses. This is a good way to develop relationships between the city and downtown businesses.

- Civic organizations will be an important source for labor hours and funding. A list of potential for-profit and non-profit organizations includes:
 - Banks
 - Hotels
 - Car dealers
 - Boy/girl Scouts & 4H
 - Gardeners club
 - Individuals

Conclusion

Butte-Silver Bow County has a rich history and is home to people very proud of their community. Implementing this UFMP will be a big financial commitment and sacrifice too many however if there is a community that a program like the one proposed here will work, Butte is the place. The Urban Forest is the part of city infrastructure that increases the quality of life for the citizenry and makes people happier. The people of Butte love their town and this is the ideal way for these people to invest in the community that they love. Butte has incredible, historic buildings and urban trees surrounding these buildings will compliment them aesthetically and bring more money towards their restoration. Butte is an unique town in all of Montana and this distinctive quality can only be enhanced by the addition of urban trees that are managed correctly.

The mature community forest planted by Butte's past generations has largely been neglected or mismanaged in recent history. It is now time to implement this Urban Forest Management Plan in concert with other infrastructure projects. This will greatly add to the beauty and lure of

downtown uptown Butte and bring benefits to the residents in the flats. Tree lined streets are a valuable asset to a community and leaves lasting impressions on both residents and visitors.

The investment in the trees is an investment for the future of BSB - paying off in the ecological benefits, tourism, and spurred economy in the uptown area. This Butte-Silver Bow Urban Forest Management Plan hopes to add to this wealth. To move forward with this BSB Urban Forest Management Plan the County Commission must adopt it in its entirety.

The trees are the city's only asset that grows in value over time; what we put in now will be worth many times its current value in one generation. Not to mention the money saved in reduced maintenance to the streets under the canopy of these trees. Investing in the urban forest is a worthwhile pursuit. In summary, investing in the community forest will result in a safer, healthier, and happier citizenry.

Appendix 1 S.W.O.T Analyses

Strengths

- Engaged public
- Citizenry passionate about their community and beautification
- BNRC funding for new plantings
- A young and relatively small urban forest that can easily be maintained and modified to a healthy species diversity
- Many open planting spaces
- Tree Board

Weaknesses

- Many entities managing the community forest both public and private
- Dilapidated state of many of the mature trees
- Harsh climate
- Inventory is dominated by small or medium stature trees
- 60% of the inventory has been planted in the past 5 years
- Ordinances do not protect the urban forest or give direction to the appropriate management
- Enforcement of ordinances
- Species list
- No certified arborist in Butte
- Hazard trees
- No planting spaces documentation in the tree inventory
- Budget/Lack of
- Tree Board

Opportunities

- Contracting risk tree pruning and removal to qualified tree services
- Hiring an Urban Forester
- Civic groups
- Big potential for economic boost resulting from uptown trees
- Partnering with the Planning and Reclamation Departments to plant a Urban Forest

- Grants
- Revitalization of uptown
- Improved air quality
- Beautification

Threats

- Emerald Ash Borer
- Vandalism to young trees in the uptown area
- Mower Blight
- Not funding the UF Dept.

Appendix 2 Recommended Planting Species

(Schutzki, Cregg 2006)

American hophornbeam *Ostrya virginiana*

Height: 40 ft.

Spread: 25 ft.

Site preferences: Zone 3b-9a. Prefers moist soil but will tolerate moderately dry soils once established. Very salt sensitive. pH: 5.0-8.2. Tolerates light shade.

Ornamental characteristics:

Shape: upright oval.

Foliage is dark green; fall color is yellow. Slow growing.

Insect/disease factors: None.

Additional: Slow to recover from transplanting. Transplant in spring.

‘Autumn blaze’ Freeman maple

Acer x freemanii

Height: 50-55 ft.

Spread: 30-40 ft.

Site preferences: Zone 4-7. Prefers moist soil but is drought tolerant.

pH: adaptable. Fast growing.

Ornamental characteristics: Shape: oval-rounded. Foliage has excellent orange-red fall color.

Insect/disease factors: None serious.

Cultivars: Marmo, Sienna Glen

Miyabe maple *Acer miyabei*

Height: 30-40 ft.

Spread: 20-30 ft.

Site preferences: Zone 4-7.

Moist, well-drained soil. pH: adaptable.

Ornamental characteristics:

Shape: rounded.

Insect/disease factors: None serious.

Cultivars: ‘State Street’ — fast growing, upright oval

habit, dark green leaves
with yellow fall color, corky bark.

Norway maple *Acer platanoides*

Height: 40-50 ft.

Spread: 30-50 ft.

Site preferences: Zone 4-7.

Prefers moist soils and will
tolerate clay (but not wet)

soil. pH: very adaptable.

Ornamental characteristics:

Shape: rounded. Foliage is
dark green with occasionally
good yellow fall color.

Insect/disease factors:

Verticillium wilt and anthracnose.

Cultivars: ‘Crimson King’ — reddish purple
foliage;

‘Columnare’ — narrow oval habit (20-ft.
spread);

‘Summershade’ — fast growing, heat
resistant;

‘Easy Street’ — narrow oval.

Red maple *Acer rubrum*

Height: 40-60 ft.

Site preferences: Zone 3b-9a.

Moist soils necessary; flood
tolerance of specific cultivars
is listed below. Salt sensitive.

pH: 5.0-7.0 (chlorosis occurs
at high pH).

Ornamental characteristics:

Shape: round, upright. Good fall color.

Insect/disease factors: Leafhopper and
borers.

Cultivars: ‘Autumn Flame’ (early, low flood
tolerance,

persistent red fall color, zone 3b);

‘Northwood’ (low flood

tolerance, good orange-red fall color, zone
3b);

‘October Glory’ (intermediate flood
tolerance, excellent

red fall color, zone 5a); ‘Red Skin’ (large,
thick foliage, early reddish maroon fall
color, rare, zone 4); ‘Red Sunset’.

Transplant in spring, high flood tolerance,
specify “own-rooted” — graft
incompatibility can be a problem.

‘Redpointe’ — pyramidal with dominant
central leader

Horse chestnut *Aesculus hippocastanea*

Height: 50 ft. -75 ft.

Spread: 40 ft. -70 ft.

Site preferences: Zone

4-8. Prefers moist, well-drained soils.

pH: adaptable.

Ornamental characteristics: Shape: rounded.

Other: showy white flowers in mid-May.

Insect/disease factors: Leaf scorch can occur
under hot/dry conditions in late summer.

Cultivars: ‘Baumanii’ more showy with
longer lasting flowers and seedless.

American hornbeam *Carpinus caroliniana*

Height: 20-30 ft.

Spread: 20-30 ft.

Site preferences: Zone

3b-9a. Prefers moist

soil but will tolerate

some intermittent

drought. pH: 5.0-8.2.

Prefers shaded, moist

soils.

Ornamental characteristics:

Shape: round, spreading. “Muscled” bark, good orange-red fall color, clumps or single stem.

Insect/disease factors: Relatively pest and disease free, requires little maintenance, though damage by ice storms can be a problem. Cankers can occur with specimens of southern origin, so it is important to know the source of the tree.

Additional: Transplant in spring; somewhat slow to establish. Native to Michigan and eastern United States.

Hackberry *Celtis occidentalis*

Height: 40-60 ft.

Spread: 30 ft.

Site preferences: Zone 3b-8b. Tolerates drought. Salt sensitive. pH: 5.0-8.2. Tolerates light shade, wind, heat.

Ornamental characteristics:

Shape: pyramidal when young; open, irregular when mature, with dark green, leathery leaves.

Insect/disease factors:

Witch’s broom and insect galls (aesthetic but not life-threatening problems).

Cultivars: ‘Prairie Pride’ (rapid, compact grower; thick, leathery foliage).

Additional: Transplant in spring; somewhat slow to establish.

Turkish filbert *Corylus colurna*

Height: 40-50 ft.

Spread: 20-30 ft.

Site preferences: Zone 4-7. Drought tolerance established. pH: adaptable.

Ornamental characteristics:

Shape: broad pyramidal, maintains

formal shape. Other: attractive dark green foliage.

Insect/disease factors:

None serious.

Additional: This is a low-maintenance but attractive species that is quite underused.

Ginkgo *Ginkgo biloba* (To be planted in the flats and neighbor hoods because it is a 4B tree)

Height: 40-50 ft.

Spread: Variable, depending on cultivar.

Site preferences: Zone 4b-8b. Tolerates drought. Moderate salt tolerance.

pH: 5.0-8.2.

Ornamental characteristics:

Shape: irregular when young, becoming pyramidal with age. Yellow fall color.

Cultivars: ‘Autumn Gold’ (symmetrical, broad, outstanding fall color); ‘Lakeview’; and ‘Princeton Sentry’ (very narrow upright); ‘Presidential Gold’ (broadly oval, well branched).

Additional: Specify male trees because of noxious fruit smell (all cultivars are male). Transplant in spring or fall.

Insect/disease factors: None serious.

Thornless honeylocust *Gleditsia*

triacanthos inermis (Again, this a 4B tree and should be planted in a more moderate zone in Butte)

Height: 40-100 ft.

Spread: 40 ft.

Site preferences: Zone 4b- 9a. Tolerates wet and dry sites. High salt tolerance. pH: 5.0-8.2.

Ornamental characteristics:

Shape: Open, spreading.

Insect/disease factors:

Overplanting has encouraged severe insect problems in many areas (honeylocust

plant bug, spider mite, borer, webworm).

Cultivars: ‘Shademaster’ (high, vase-shaped canopy, essentially fruitless); ‘Skyline’ (upright, pyramidal, strong central leader, good fall color); ‘Northern Acclaim’ (most cold hardy, good form).

Additional: Transplants easily in spring. ‘Inermis’ refers to the thornless selection.

Amur maackia *Maackia amurensis*

Height: 20-30 ft.

Spread: 30 ft.

Site preferences:

Zone 4-7. Moist, well-drained soil. pH: adaptable.

Ornamental characteristics:

Shape: rounded. White flowers in June; copper-brown, peeling, attractive bark.

Insect/disease factors: None serious.

Amur corktree *Phellodendron amurense*

Height: 30-45 ft.

Spread: 40-50 ft.

Site preferences: Zone 3b-7. Drought and pollution tolerant. pH: adaptable.

Ornamental characteristics:

Shape: broad, rounded. Yellow to bronze-yellow fall color. Ridged, corky bark in old age.

Insect/disease factors: None serious.

Cultivars: ‘Eye Stopper’ ‘His Majesty’ ‘Macho’

Common chokecherry *Prunus virginiana*

Height: 20-30 ft.

Spread: 18-25 ft.

Site preferences: Zone 2-6. Tolerant of moist and dry sites. pH: adaptable.

Ornamental

characteristics: Shape: rounded. White flowers in early May, red fruit that ripen to a dark purple.

Insect/disease factors:

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Black knot.

Cultivars: ‘Schubert’ and ‘Canada Red’ — foliage emerges green but changes to a reddish purple for the

Swamp white oak *Quercus bicolor*

Height: 45 ft.

Spread: 45 ft.

Site preferences: Zone 4a-8b. Tolerates temporary flooding, wet soils and somewhat dry soils. Salt sensitive. pH: 5.0- 7.0.

Ornamental

characteristics: Shape: broad oval with round

top. Foliage is green with wavy margins.

Insect/disease factors:

None serious. Variable susceptibility to iron chlorosis.

Northern pin oak *Quercus ellipsoidalis*

Height: 50-60 ft.

Spread: 50 ft.

Site preferences:

Zone 4-6. Prefers moist, well-drained soil but tolerates wet and dry conditions.

pH: neutral to slightly acidic.

Ornamental

characteristics: Shape: pyramidal. Can have nice fall color.

Insect/disease factors:

Stem and leaf galls.

Additional: Does not have the chlorosis problems that occur in pin oak.

Height: 55 ft.

Spread: 45 ft.

Site preferences: Zone 3a- 9a. Tolerates drought and intermittent flooding. pH: 5.0- 8.2.

Ornamental characteristics: Shape: broadly oval, irregular and open. Foliage is dark green. Fall color is yellow to yellow-brown. Corky bark.

Insect/disease factors: Susceptible to anthracnose, intermediate preference by

orange-striped oakworm but generally not seriously affected.

Additional: Slow growing, massive tree needs adequate space. Transplant small sizes in spring.

Linden or Basswood *Tilia americana*

Height: 35-50 ft.

Spread: 25-30 ft.

Site preferences: Zone 3a-8a. Requires moist,

well-drained sites but will tolerate intermittent

drought once established. Salt sensitive. pH: 6.5-8.2.

Ornamental characteristics:

Shape: narrow to broad pyramidal, depending on cultivar. Foliage is light green to dark green, depending on cultivar.

Fragrant flowers in June.

Insect/disease factors: Very susceptible to Japanese beetles; mites, aphids, borers, leaf miners and scale may also be problematic.

Cultivars: ‘Boulevard’ (narrowly pyramidal, hardy to zone 3); Legend® (broadly pyramidal, zone 4, medium green); ‘Redmond’ (pyramidal, light green foliage).

Additional: Transplant in spring or fall.

Silver linden *Tilia tomentosa*

Height: 50-70 ft.

Spread: 30-50 ft.

Site preferences: Zone 3b-7. Prefers moist, well-drained soils but is somewhat

drought and heat tolerant. pH: adaptable.

Ornamental characteristics:

Shape: upright oval. Glassy dark green leaves that are silvery underneath. Yellowish white, fragrant flowers in early July.

Insect/disease factors: Same as little-leaf linden but less susceptible.

Cultivars: ‘Green Mountain’ — fast growing, better drought and heat tolerance; ‘Sterling’ — broad

Little-leaf linden *Tilia cordata*

Height: 60-70 ft.

Spread: 40-50 ft.

Site preferences: Zone 3b-7. Prefers moist, well-drained soil. pH: adaptable. Pollution tolerant.

Ornamental characteristics:

Shape: rounded and densely branched. Yellowish, fragrant flowers that emerge in late June.

Elm hybrids *Ulmus spp.*

Height: 40-50 ft.

Spread: 30-50 ft.

Site preferences: Zone varies. Tolerates intermittent flooding and drought once established. pH: 5.0-8.2.

Ornamental characteristics: Shape: upright vase.

Cultivars: Cultivars reportedly resistant to Dutch elm disease: Hybrids: ‘Accolade’ ‘Commendation’ ‘Frontier’ ‘Homestead’ ‘New Horizon’ ‘Triumph’ American: ‘Valley Forge’ ‘Princeton’ ‘Jefferson’

Appendix 3 Survey Results

Appendix 4

Suspended pavement for appropriate planting sites on roads with no green space:

http://www.asla.org/uploadedFiles/CMS/Meetings_and_Events/2010_Annual_Meeting_Handouts/Sat-B1The%20Great%20Soil%20Debate_Structural%20Soils%20Under%20Pavement.pdf

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