



# NEW ENGLAND CIVIL ENGINEERING CORP.

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## Municipal Street Tree Assessment Project - Phase II City of Salem

### January 2018



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## City of Salem

### Municipal Street Tree Assessment Project

#### Project Understanding

In 2016, the City of Salem retained New England Civil Engineering Corp (NECE) to GPS locate and evaluate the condition of the street trees along four major corridors in the city. This pilot project was funded by a grant through Mass in Motion and facilitated through the Engineering Department. In 2017, the City received a second grant funded by the Urban and Community Forestry Challenge Grant from the Massachusetts Department of Conservation and Recreation with matching funds to continue the efforts of the pilot program and continue to GPS locate and evaluate the condition of the remaining street trees throughout the City. Under the second grant additional field data was collected regarding insect and disease.



**Photo 1: Typical Tree Survey Photo**

The outline for the data collection is based on the I-Tree format used by the US Forest Service. As each street tree was GPS located, an overall photo was taken, and various

attributes about the tree condition and the surrounding sidewalk were populated into the GIS database with a link to the geodatabase (See Figure 1 for description of data collected.). In addition to tree descriptive data a photo was taken of each tree

Field	Value
Photo_Lnk	H:\Clients\Salem\Street Tree Su
Street #	8
Street Name	Hancock
Comments	
ID	Hancock-16
Wire Conflict	No Lines
Land Use	Multi family residential
Site Type	Planting strip
Tree Name	Norway Maple
Wood Cond	Good
Leaf Cond	Fair
DBH	12.0-18.0 in
Maintenance Recommendation	None
Priority Task	None
Sidewalk Damage	0 - 3/4 in
Sidewalk Material	Concrete
Tree Pit Cover	Soil
Dieback	<null>
Epicormic Sprouts	No
Foliage Wilted	No wilt
Environmental tress	None
Human Stress	None
Defoliation	Defoliation >10%, not pervasive
Discolored	Mottling, spots, or blotches
Abnormal Foliage	None
Insect Signs	None
% Foliage Affected	None
Insect Signs on Branches	None
Insect Present	None
Disease Signs	None
Problem Location	None
Loose Bark	None
Pest Name	None

**Figure 1: GPS Data Collected**

surveyed and is included in the GIS. (See Photo 1.) As part of the Pilot program, a spreadsheet of previous tree observations was provided by the Tree Warden was incorporated into the database. Although the dataset in the spreadsheet is not as robust as the tree assessment project database, the data was valuable in determining the extent of current needs such as pruning needs and empty pit locations throughout the city. (See Attachment C for an example of the GIS Dataset.) The attached disc contains the complete table and ArcMap street tree shapefile.

## Project Summary

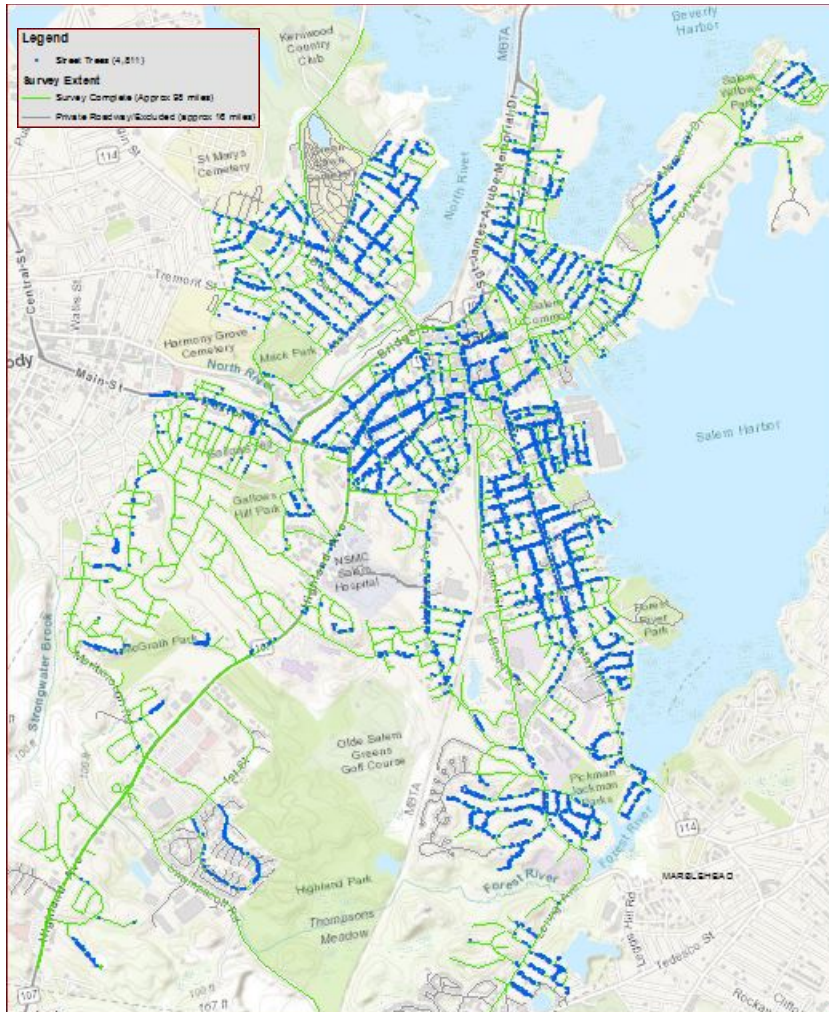
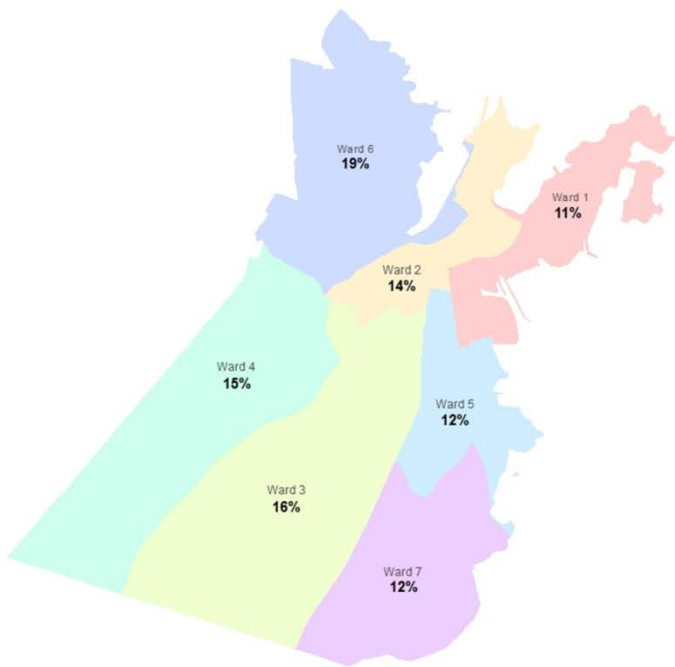


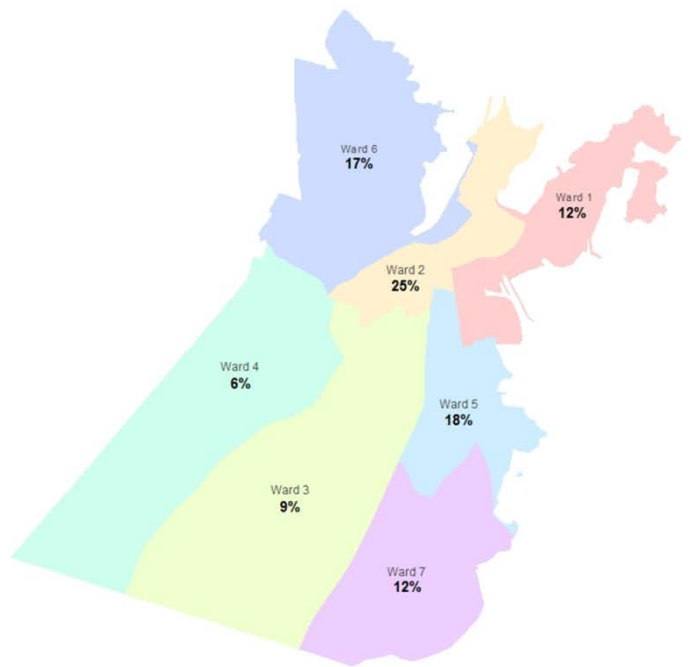
Figure 2: Project Area

The data from the 2017 Municipal Street Tree Assessment Project covered approximately 98 street miles. Within this surveyed area a total of 4,812 street tree locations were identified with 4435 trees and 377 stumps or empty tree pits. These data are easily broken up into Wards for future projects. Figure 2 shows the extent of survey. The City of Salem has approximately 98 miles of City streets and 16 street miles of private roads. The following four graphics demonstrates current conditions by Ward.



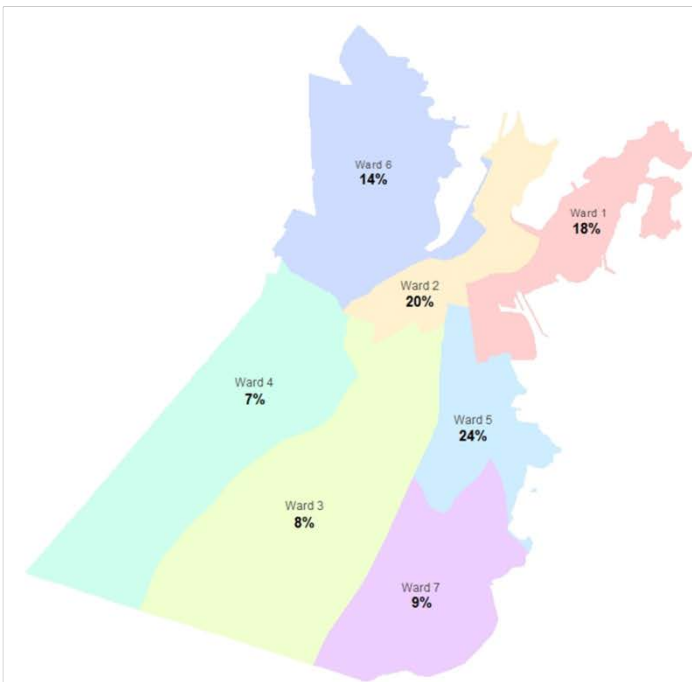
**Graphic 1: Ward % of City Street Miles**

(98 Street Miles, not including Private or State)



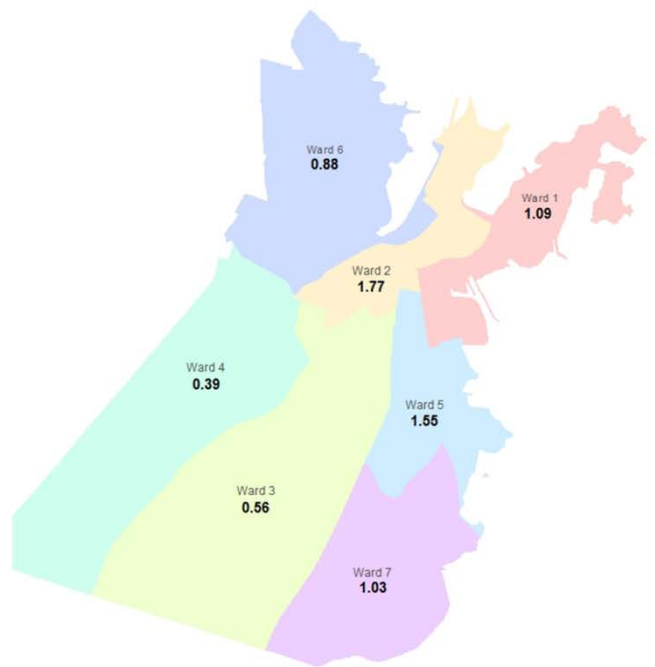
**Graphic 2: Ward % of City Street Trees**

(4,812 City Street Trees in 2017)



**Graphic 3: Ward % Tree Pits**

(377 Stumps and Empty Tree Pits in 2017)



**Graphic 4: Ratio of % City Trees to % City Streets**

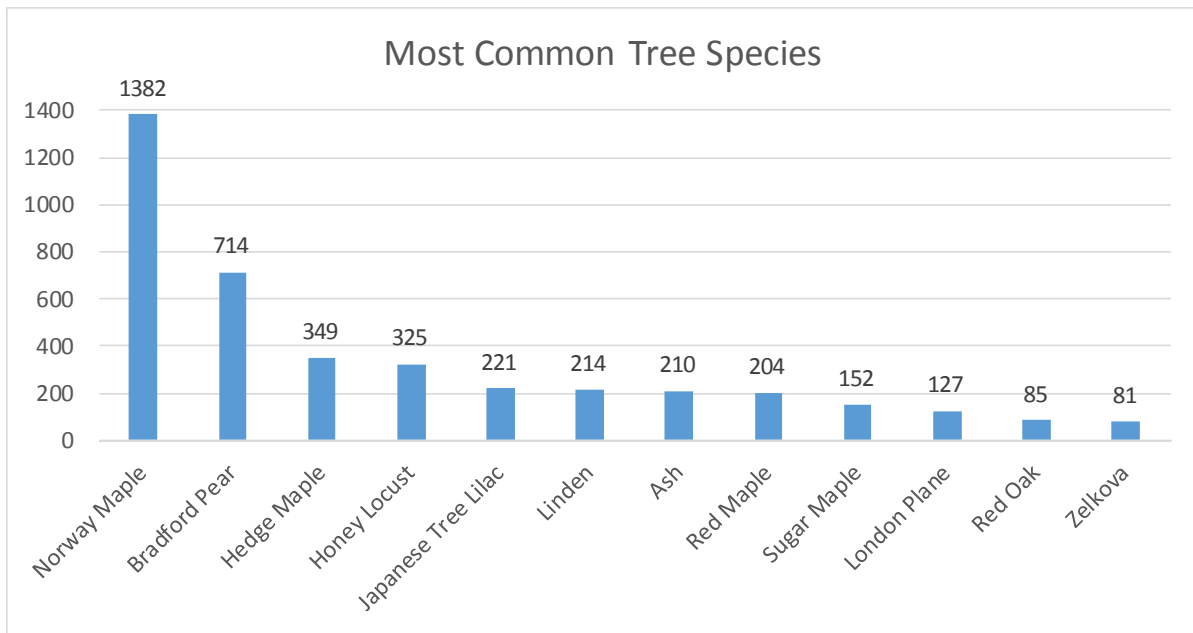
(Average Trees/Mile relative to City average, Ratio >1.0 represents greater than average trees per mile)

**Figure 3: Street Tree Breakdown by Ward**



## Tree Species and Size

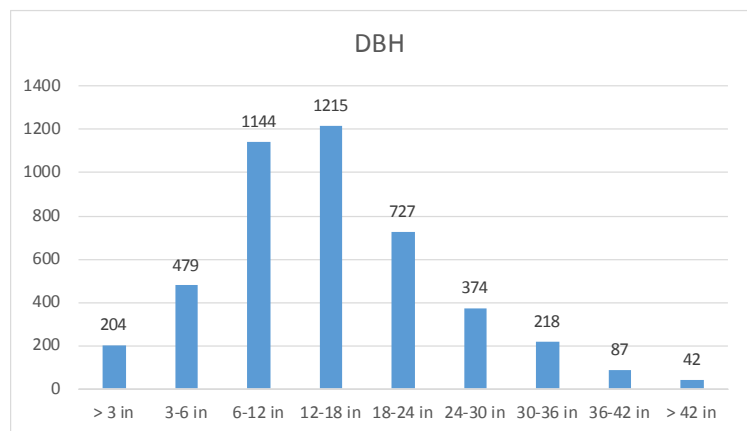
The majority of the trees surveyed are Norway maple, Bradford pear, Hedge Maple and Honey Locust. The Norway maple is now listed as an invasive species. The lifespan of the Bradford



**Figure 4: Citywide Common Tree Species**

pear is 20-30 years. The branches tend to break easily in winter storms and often are caught in power lines. The emerald ash borer and Asian long-horned beetle have already been observed in nearby communities. These invasive insects target many types of trees but have been reported to affect the Norway maple and Ash more often than other tree species.

Refer to Figure 4 for a graph illustrating the most common types of tree species observed. The majority of trees are greater than 6-inches at breast height indicating an aging population of trees which will require increased maintenance and



**Figure 5: Diameter at Breast Height**

replacement in the coming years. Refer to Figure 5 for a graph illustration of trees by size based on observed diameter at breast height.

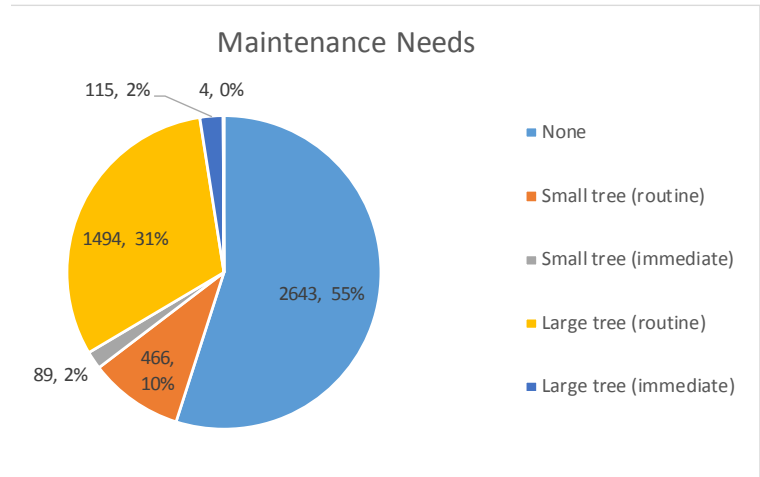


**Maintenance Needs**

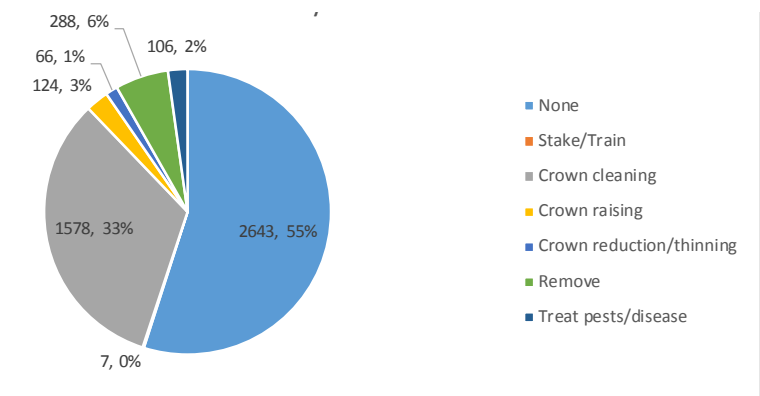
In total, 4,812 trees and 377 empty tree pits/stumps were GPS located and assessed as part of the project. No maintenance is currently needed on 2,643 or 55% of the trees; see Figure 6. The majority of maintenance needed

is either deadwood removal or pruning of 1702 trees, see Figure 7. “Routine” maintenance is not considered an immediate public danger while “immediate” may pose a threat to pedestrians, homes or vehicles. See Figures 7 and 8 for a breakdown of maintenance needs and priority tasks. The field “wood condition” in the GIS was used to account for tree health and

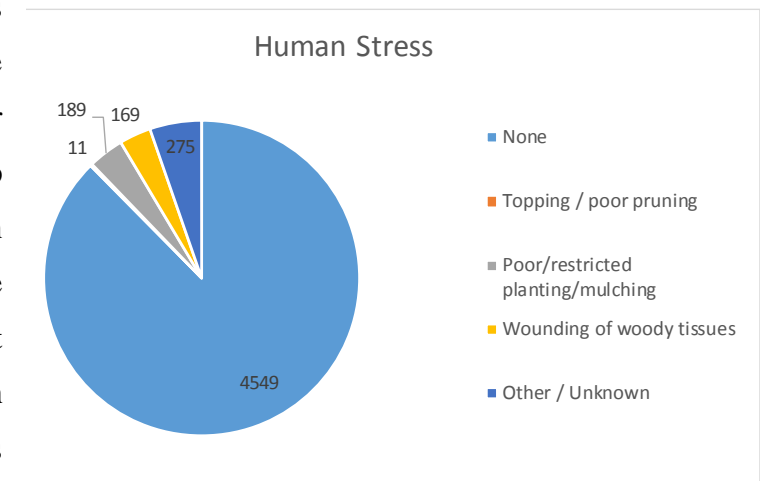
shows nearly 70% of the street trees surveyed to be in “good” health while only 8% of trees were in “poor” health or “dead/dying. Tree planting or stump grinding and tree planting are needed in approximately 375 locations. Wires are present in nearly half the survey area but only 25% are in potential conflict with tree locations. This information is included in the data collection and may help determine future tree type plantings where tree replacement is in order.



**Figure 6: Citywide Maintenance Needs**



**Figure 7: Citywide Priority Tasks**



**Figure 8: Citywide Human Stressors**



### **Detailed Breakdown by Ward**

The results of the assessment are broken down in more detail by Ward in Attachment 2. A map and table of each Ward is provided to identify the street miles surveyed; the number, size, and type of trees, and maintenance needs.

### **Further Study**

The City has expressed interest in utilizing volunteers and students to complete the survey in schools, parking lots, parks and other green space throughout the City. To assist with that effort a two sided City of Salem Tree Survey sheet was developed and can be found in Attachment A. In addition, an identification key was created depicting the trees observed during the survey and can be found in Attachment B. The free app “Leaf Snap” can also be utilized to help identify trees. This reference guide and application can also be utilized for the future City program to work with homeowners and volunteers to identify and assess the trees in their neighborhoods.





# **Attachment 1**

## **Overall Scope of Survey Map**



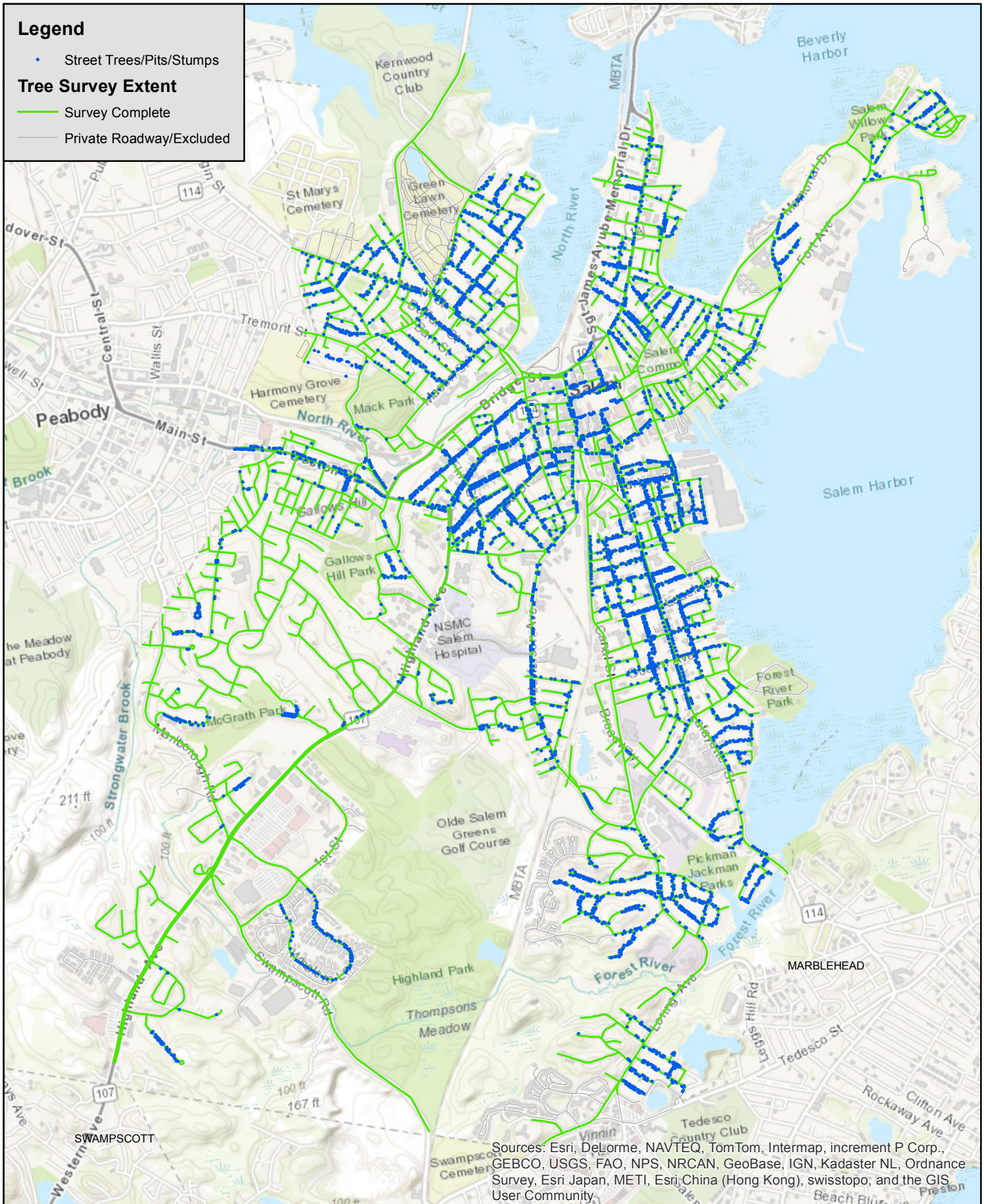
### Legend

• Street Trees/Pits/Stumps

### Tree Survey Extent

— Survey Complete

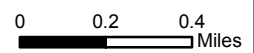
— Private Roadway/Excluded



Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community



**Street Trees  
Salem, MA**  
Wednesday, January 31, 2018



# **Attachment 2**

## **City and Ward Maps and Tables**



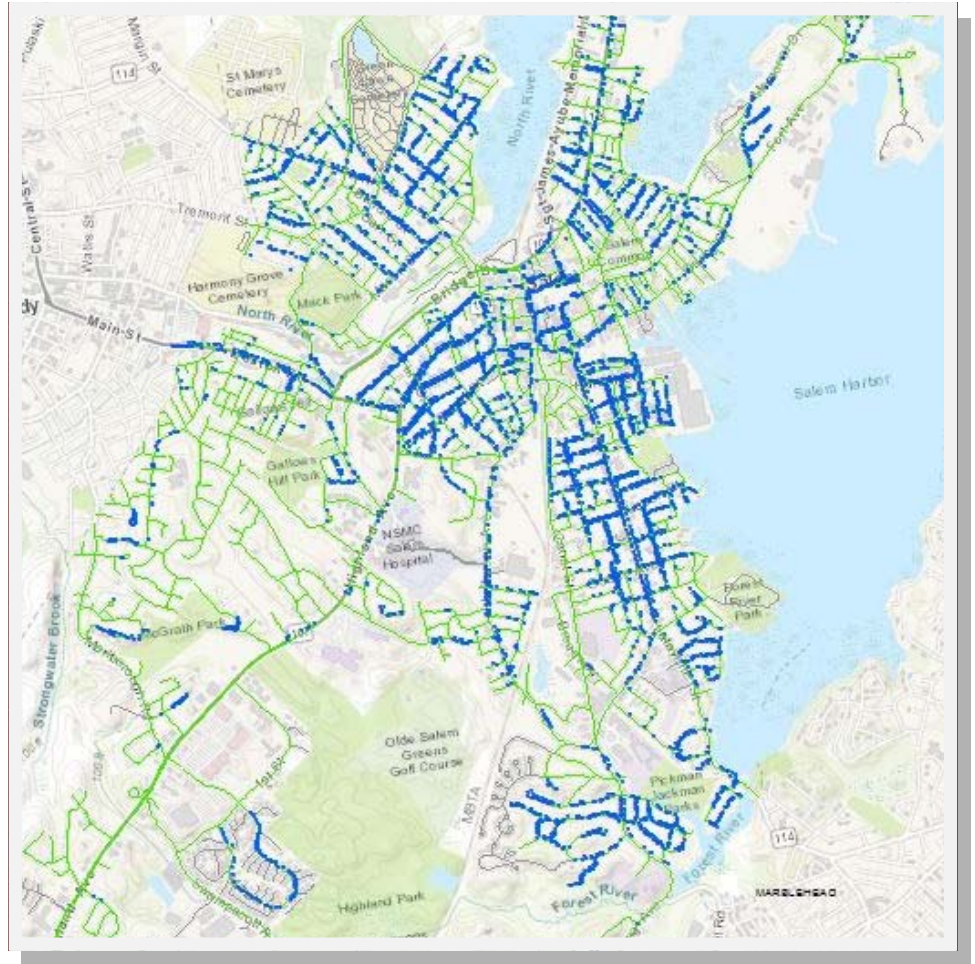
# City of Salem

8.42 Sq. miles

98 +/- miles City Streets

4,435 City Street Trees

37 Tree Species Throughout City

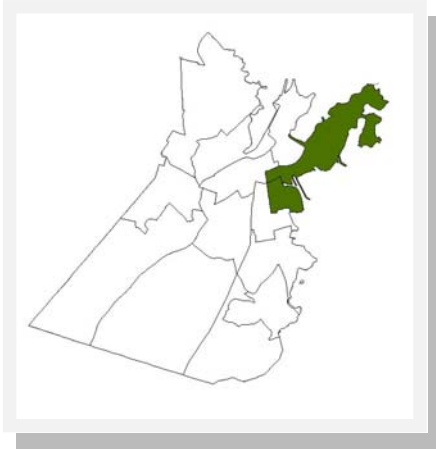


Overall Characteristics	City Total
# of Trees	4435
# of Tree Pits	377
Trees in Good/Fair Condition	3946
Trees in Poor Condition	491
Trees Requiring Maintenance	2169
# of Tree Types	37

Trees DBH	Quantity	% of Total Trees
< 6 in	275	15%
6-12 in	1942	26%
12-24 in	239	44%
24-30 in	374	8%
> 30 in	347	8%

Most Common Tree Types	Quantity	% of Total Trees
Norway Maple	1382	31%
Bradford Pear	714	12%
Honey Locust	325	10%
Hedge Maple	349	7%
Japanese Tree Lilac	221	6%

# Ward 1



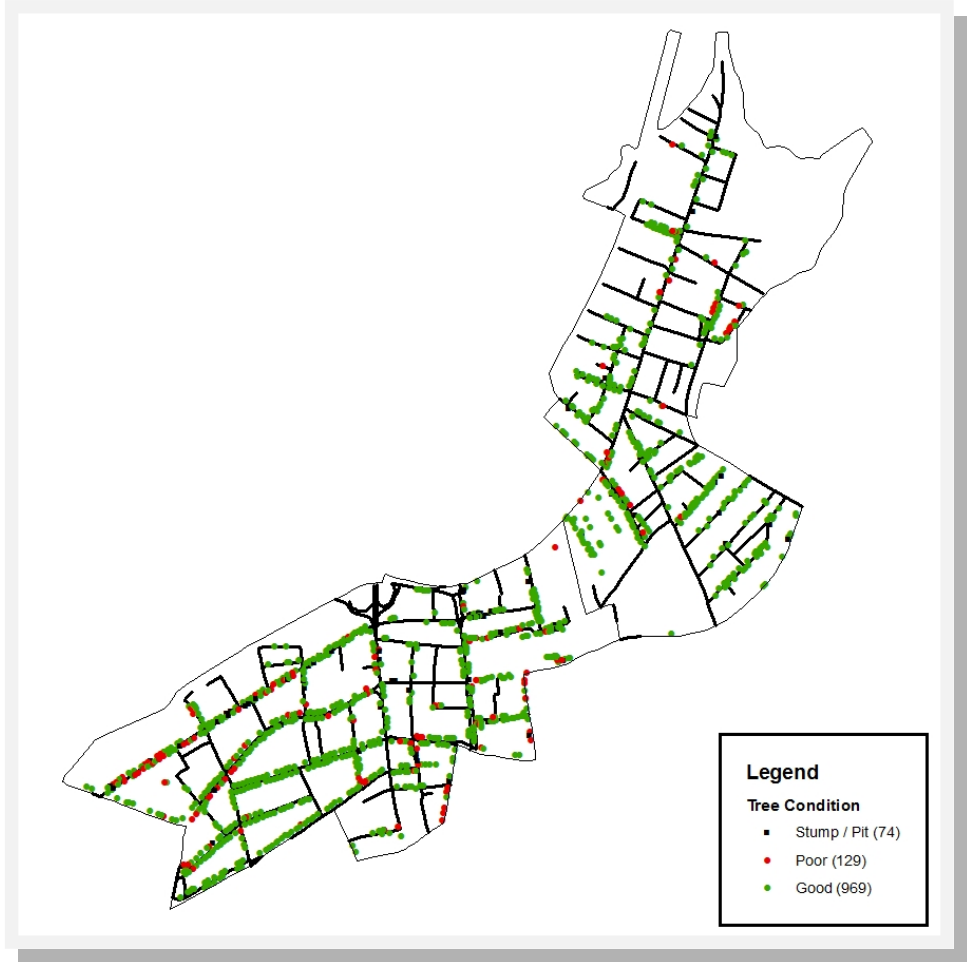
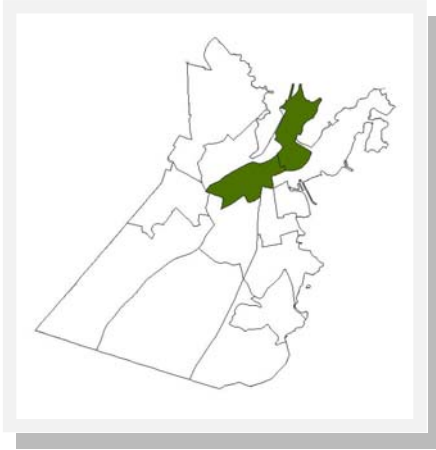
1 Sq. miles (12% of City Area)  
 11% of City Streets  
 12% of City Street Trees  
 19 Tree Species in Ward

Overall Characteristics	Ward	City Total	% of City
# of Trees	547	4435	12%
# of Tree Pits	68	377	18%
Trees in Good/ Fair Condition	462	3946	12%
Trees in Poor Condition	86	491	18%
Trees Requiring Maintenance	349	2169	16%
# of Tree Types	19	37	51%

Trees DBH	Quantity	% in Ward
< 6 in	96	17%
6-12 in	137	24%
12-24 in	260	46%
24-30 in	40	7%
> 30 in	35	6%

Most Common Tree Types	Quantity	% in Ward
Norway Maple	132	24%
Bradford Pear	69	13%
Hedge Maple	64	12%
Red Maple	37	7%
London Plane	37	7%

# Ward 2



0.57 Sq. miles (7% of City Area)  
 14% of City Streets  
 25% of City Street Trees  
 31 Tree Species in Ward

Overall Characteristics	Ward	City Total	% of City
# of Trees	1098	4435	25%
# of Tree Pits	74	377	20%
Trees in Good/ Fair Condition	969	3946	25%
Trees in Poor Condition	129	491	26%
Trees Requiring Maintenance	643	2169	30%
# of Tree Types	31	37	84%

Trees DBH	Quantity	% in Ward
< 6 in	186	17%
6-12 in	244	22%
12-24 in	506	46%
24-30 in	75	7%
> 30 in	83	8%

Most Common Tree Types	Quantity	% in Ward
Norway Maple	256	23%
Bradford Pear	231	21%
Honey Locust	102	9%
Linden	70	6%
Ash	65	6%

# Ward 3



2.08 Sq. miles (25% of City Area)  
 16% of City Streets  
 9% of City Street Trees  
 17 Tree Species in Ward



Overall Characteristics	Ward	City Total	% of City
# of Trees	408	4435	9%
# of Tree Pits	31	377	8%
Trees in Good/ Fair Condition	370	3946	9%
Trees in Poor Condition	38	491	8%
Trees Requiring Maintenance	174	2169	8%
# of Tree Types	17	37	46%

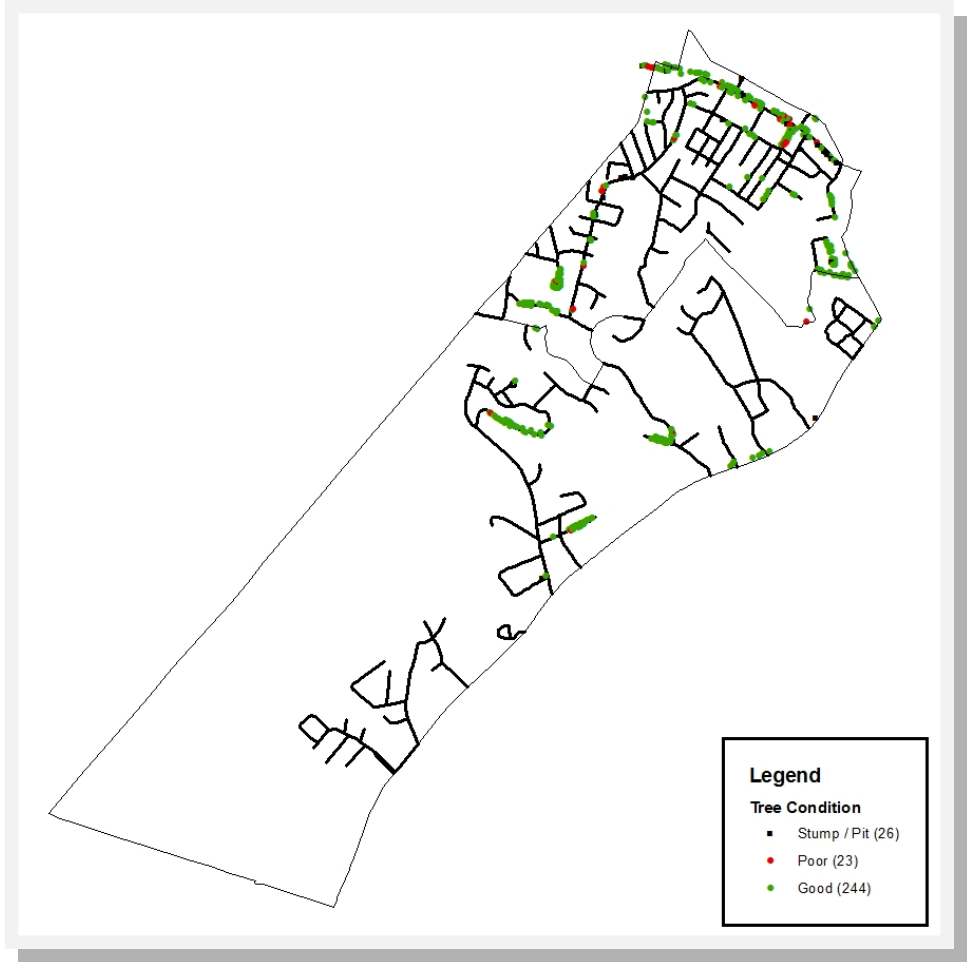
Trees DBH	Quantity	% in Ward
< 6 in	39	9%
6-12 in	92	22%
12-24 in	215	52%
24-30 in	37	9%
> 30 in	29	7%

Most Common Tree Types	Quantity	% in Ward
Norway Maple	180	44%
Hedge Maple	39	10%
Bradford Pear	32	8%
Honey Locust	32	8%
Ash	28	7%

# Ward 4



1.72 Sq. miles (20% of City Area)  
 15% of City Streets  
 6% of City Street Trees  
 18 Tree Species in Ward



Overall Characteristics	Ward	City Total	% of City
# of Trees	267	4435	6%
# of Tree Pits	26	377	7%
Trees in Good/ Fair Condition	244	3946	6%
Trees in Poor Condition	23	491	5%
Trees Requiring Maintenance	106	2169	5%
# of Tree Types	18	37	49%

Trees DBH	Quantity	% in Ward
< 6 in	27	10%
6-12 in	76	27%
12-24 in	127	46%
24-30 in	30	11%
> 30 in	18	6%

Most Common Tree Types	Quantity	% in Ward
Norway Maple	71	27%
Bradford Pear	58	22%
Hedge Maple	24	9%
Linden	21	8%
Ash	19	7%



# Ward 5



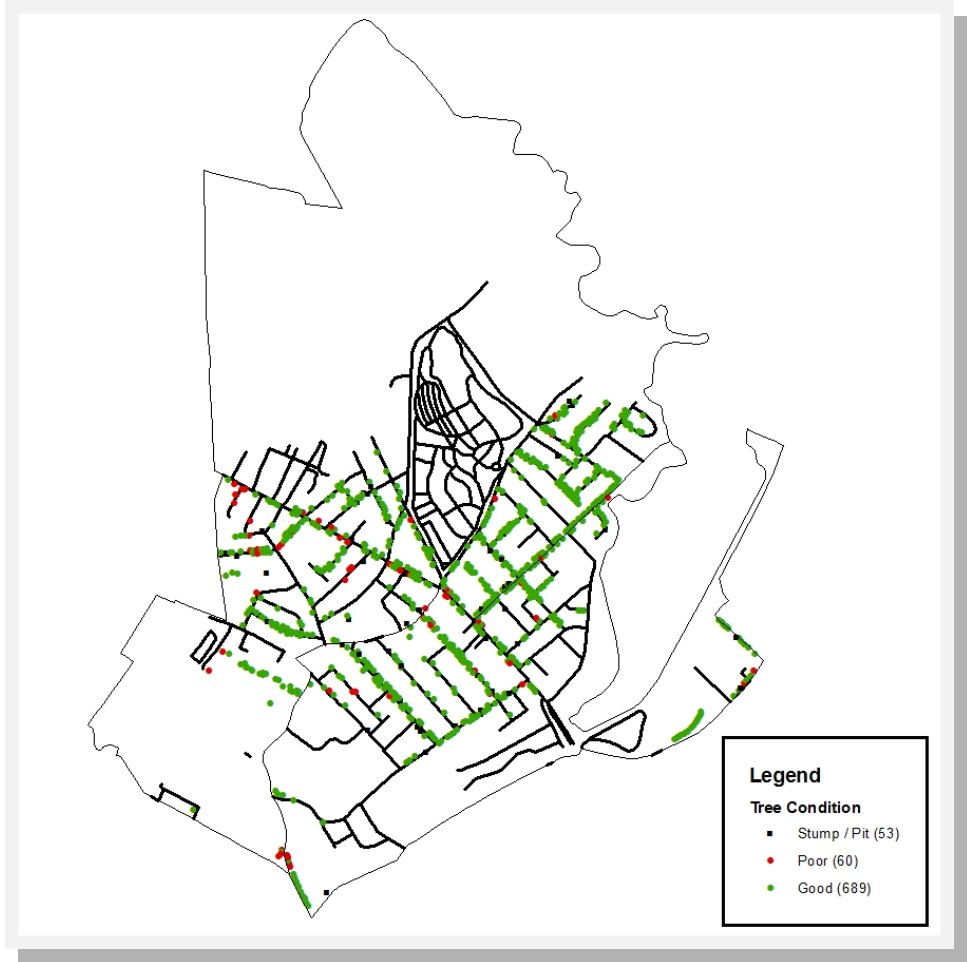
0.63 Sq. miles (7% of City Area)  
 12% of City Streets  
 18% of City Street Trees  
 21 Tree Species in Ward

Overall Characteristics	Ward	City Total	% of City
# of Trees	819	4435	18%
# of Tree Pits	90	377	24%
Trees in Good/ Fair Condition	730	3946	19%
Trees in Poor Condition	90	491	18%
Trees Requiring Maintenance	326	2169	15%
# of Tree Types	21	37	57%

Trees DBH	Quantity	% in Ward
< 6 in	139	17%
6-12 in	235	28%
12-24 in	300	36%
24-30 in	62	7%
> 30 in	93	11%

Most Common Tree Types	Quantity	% in Ward
Norway Maple	196	24%
Bradford Pear	125	15%
Hedge Maple	118	14%
Honey Locust	66	8%
Japanese Tree Lilac	60	7%

# Ward 6



1.34 Sq. miles (16% of City Area)  
 19% of City Streets  
 17% of City Street Trees  
 22 Tree Species in Ward

Overall Characteristics	Ward	City Total	% of City
# of Trees	749	4435	17%
# of Tree Pits	53	377	14%
Trees in Good/ Fair Condition	689	3946	17%
Trees in Poor Condition	60	491	12%
Trees Requiring Maintenance	370	2169	17%
# of Tree Types	22	37	60%

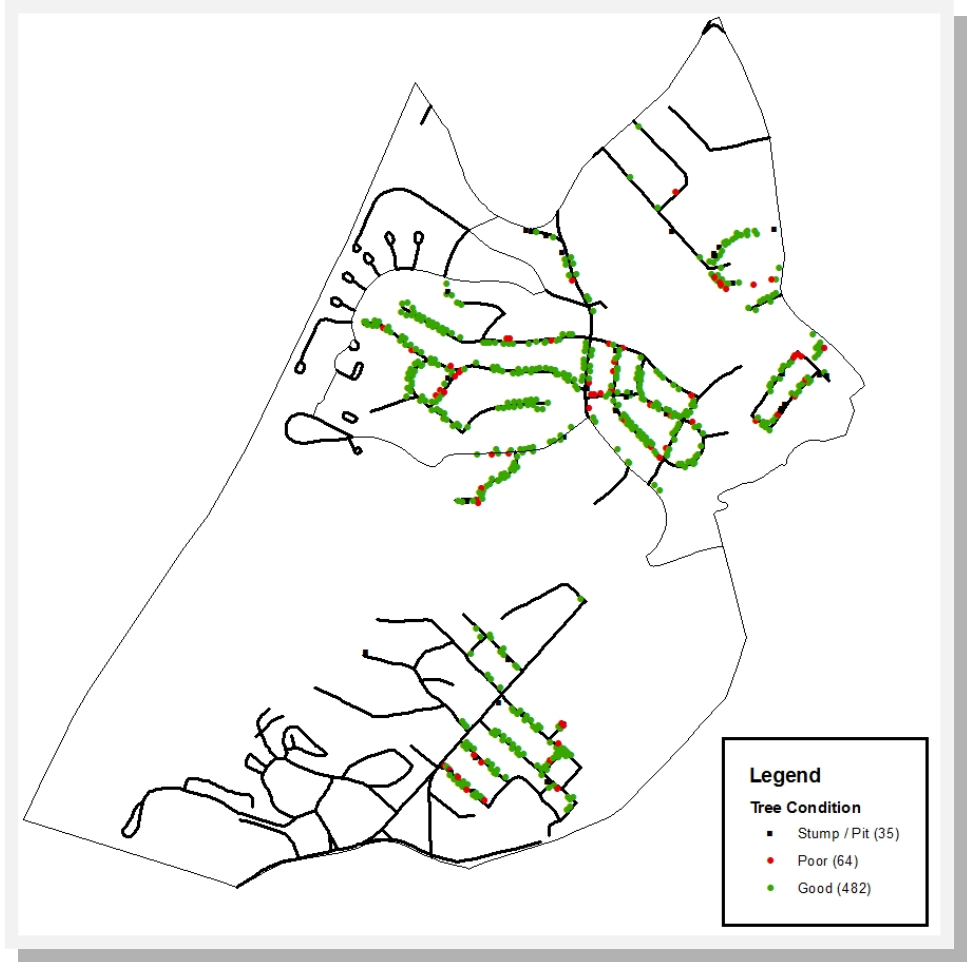
Trees DBH	Quantity	% in Ward
< 6 in	118	16%
6-12 in	217	29%
12-24 in	295	39%
24-30 in	66	9%
> 30 in	62	8%

Most Common Tree Types	Quantity	% in Ward
Norway Maple	299	40%
Bradford Pear	134	18%
Hedge Maple	62	8%
Japanese Tree Lilac	54	7%
Red Maple	45	6%

# Ward 7



1.34 Sq. miles (16% of City Area)  
 19% of City Streets  
 17% of City Street Trees  
 22 Tree Species in Ward



Overall Characteristics	Ward	City Total	% of City
# of Trees	549	4435	17%
# of Tree Pits	35	377	9%
Trees in Good/ Fair Condition	482	3946	12%
Trees in Poor Condition	65	491	13%
Trees Requiring Maintenance	201	2169	9%
# of Tree Types	16	37	43%

Trees DBH	Quantity	% in Ward
< 6 in	78	14%
6-12 in	143	26%
12-24 in	239	43%
24-30 in	64	12%
> 30 in	27	5%

Most Common Tree Types	Quantity	% in Ward
Norway Maple	148	45%
Bradford Pear	65	12%
Hedge Maple	52	10%
Japanese Tree Lilac	37	7%
Red Maple	34	6%

# **Attachment 3**

## **Street Tree Data Collection Example**



**Legend**

- Good
- Fair
- Poor
- Dead or Dying
- Stump
- Empty Tree Pit

Identify

Identify from: Street Trees

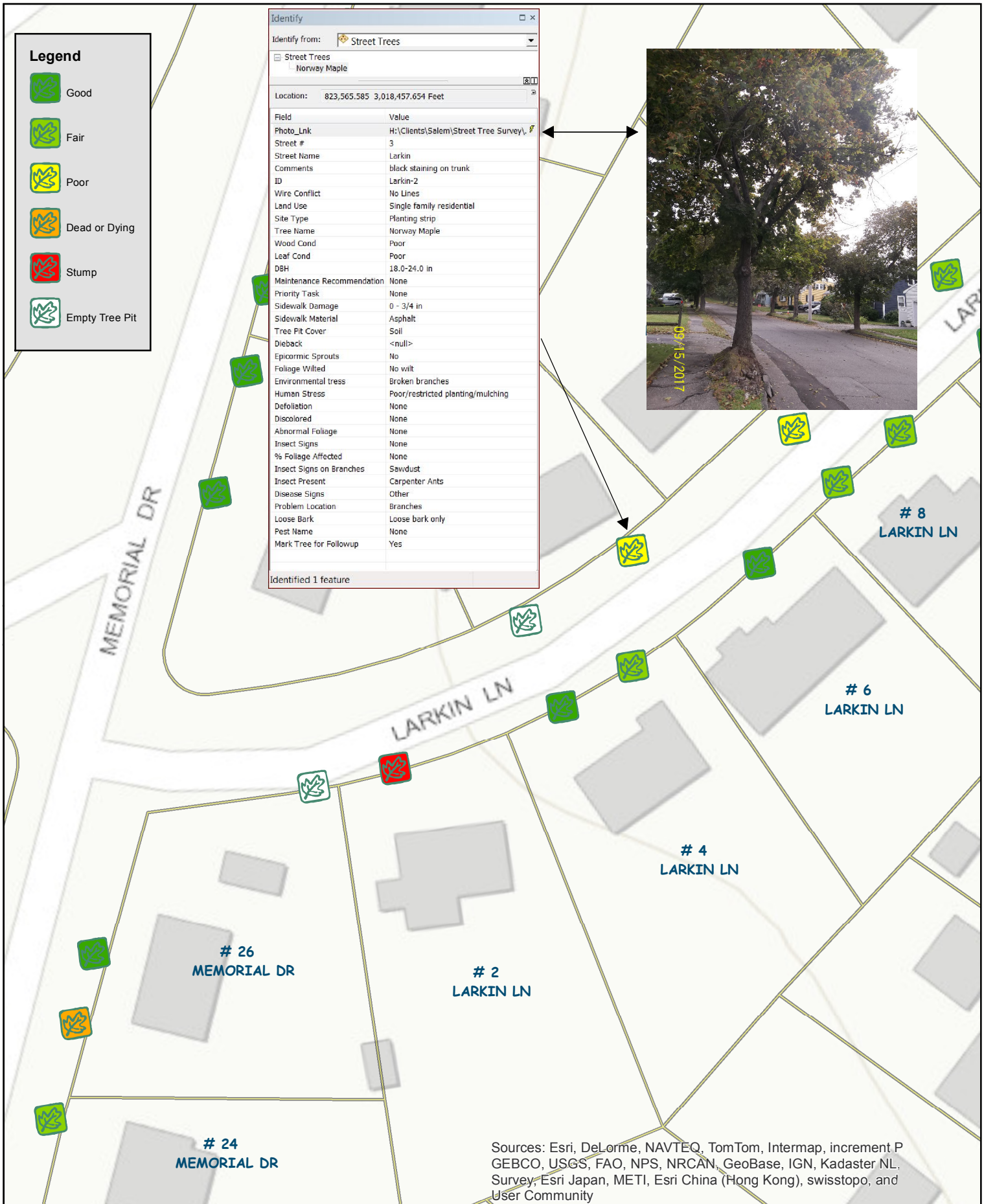
Street Trees

Norway Maple

Location: 823,565.585 3,018,457.654 Feet

Field	Value
Photo_Lnk	H:\Clients\Salem\Street Tree Survey\...
Street #	3
Street Name	Larkin
Comments	black staining on trunk
ID	Larkin-2
Wire Conflict	No Lines
Land Use	Single family residential
Site Type	Planting strip
Tree Name	Norway Maple
Wood Cond	Poor
Leaf Cond	Poor
DBH	18.0-24.0 in
Maintenance Recommendation	None
Priority Task	None
Sidewalk Damage	0 - 3/4 in
Sidewalk Material	Asphalt
Tree Pit Cover	Soil
Dieback	<null>
Epicormic Sprouts	No
Foliage Wilted	No wilt
Environmental tress	Broken branches
Human Stress	Poor/restricted planting/mulching
Defoliation	None
Discolored	None
Abnormal Foliage	None
Insect Signs	None
% Foliage Affected	None
Insect Signs on Branches	Sawdust
Insect Present	Carpenter Ants
Disease Signs	Other
Problem Location	Branches
Loose Bark	Loose bark only
Pest Name	None
Mark Tree for Followup	Yes

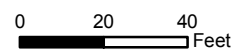
Identified 1 feature



Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P  
 GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL,  
 Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and  
 User Community



**Street Street Trees - Data Collection**  
**Salem, MA**  
**Wednesday, January 31, 2018**



Document Path: H:\Clients\Salem\Street Tree Survey\TreeSurveyWorkingMap.mxd

# **Attachment 4**

Street Tree Survey (PDF Version) for Volunteers



# City of Salem Tree Survey



Street Name \_\_\_\_\_  
 Street # \_\_\_\_\_

Date \_\_\_\_\_  
 Time \_\_\_\_\_

**Land Use**                      Single family residential                      Small commercial  
    Multi family residential                      Industrial/large commercial                      Park/vacant/other

**Site Type**                      Front yard                      Cutout                      Other maintained locations  
    Planting strip                      Median                      Other un-maintained locations

**Tree Name**                      American Elm                      Hedge Maple                      Red Oak  
    Aristocrat                      Honey Locust                      Silver Maple  
    Ash                      Japanese Tree Lilac                      Weeping Willow  
    Birch                      Kwanzan Cherry                      White Pine  
    Box Elder                      London Plane                      Zelkova  
    Bradford Pear                      Norway Maple                      Linden  
    Cherry                      Pin Oak                      Stump/Pit  
    Chestnut                      Red Maple                      Other  
    Ginkgo                      Sugar Maple

**Wood Condition**                      Dead or dying                      Fair                      Stump  
    Poor                      Good                      Empty tree pit

**Leaf Condition**                      Dead or dying                      Fair                      Stump  
    Poor                      Good                      Empty tree pit

**Diameter at Breast Height**                      0.0 in                      6.0-12.0 in                      24.0-30.0 in  
    0.0-3.0 in                      12.0-18.0 in                      30.0-36.0 in  
    3.0-6.0 in                      18.0-24.0 in                      36.0-42.0 in

**Maintenance Needs**                      Small tree (routine)                      Large tree (routine)                      Critical concern (public safety)  
    Small tree (immediate)                      Large tree (immediate)

**Priority Task**                      Crown cleaning                      Crown raising                      Remove  
    Stake/Train                      Crown reduction/thinning                      Treat pests/disease

**Sidewalk Damage**                      0 - 3/4 in                      3/4 - 1 1/2 in                      >1 1/2 in

**Sidewalk Material**                      Concrete                      Asphalt                      Other  
    Brick                      Mixed materials

**Pit Cover**                      Soil                      Flexipave                      Other \_\_\_\_\_  
    Grate                      Mulch

**Env Stress**                      Broken branches                      Drought/poor soil                      Other \_\_\_\_\_

**Human Stress**                      Topping/poor pruning                      Poor/restricted planting/mulching                      Other  
    Wounding of bark

**Comments** \_\_\_\_\_  
 \_\_\_\_\_

<b>Dieback</b>	Twig dieback >10%	Pervasive twig dieback	
<b>Epicormic Sprouts</b>	At Roots	At Trunk	
<b>Foliage Wilted</b>	wilt whole crown	wilt partial crown	
<b>Defoliation</b>	None	Defoliation <10%	Defoliation <50%
<b>Discolored Foliage</b>	Mottling Browning/bronzing	White coating Black coating (often sticky)	Yellow/orange/white pustules Other_____
<b>Abnormal Foliage</b>	Foliage/twigs distorted or galls	Witches' brooms present	Other_____
<b>Insect Signs Leaf</b>	Caterpillars pervasive Beetles pervasive	Scales pervasive Tents/webbing	Aphids/white cotton pervasive
<b>% of Foliage Effected</b>	< 10%	>30% but not the whole crown	>30% Whole crown affected
<b>Insect Signs Branch</b>	Frass only Sawdust	D-shaped exit holes Pitch/resin exudation	Pencil round/oval exit holes Shot holes <2mm
<b>Insects Presence</b>	Caterpillars Beetles	Aphids Carpenter Ants	Scale Other insects_____
<b>Disease Signs</b>	Decay Conks	Cankers Fleshy mushrooms	Woody galls or burls Other_____
<b>Problem Location</b>	Branches	Bole and/or root collar	Both
<b>Loose Bark</b>	Loose bark only	Insect boring or galleries	Other
<b>Pest Name</b>	Unknown Anthracnose	Fall army worm Gypsy moth	Emerald ash borer Asian longhorned beetle
<b>Wire Conflict</b>	No wires	Present and conflicting	Present and no potential conflict
<b>Followup Needed</b>	Yes	No	

**Additional Comments/Observations**

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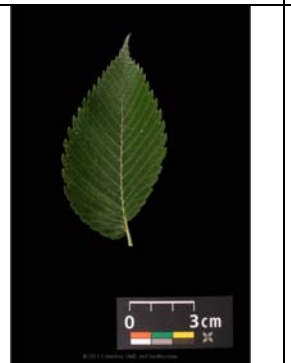





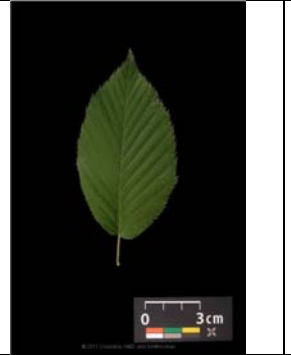











# **Attachment 5**









## **Tree Identification Guide**

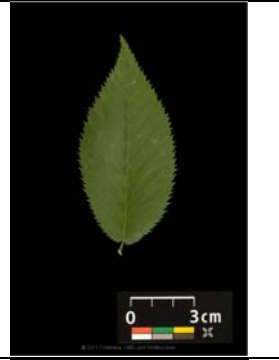

















# Tree Identification Guide





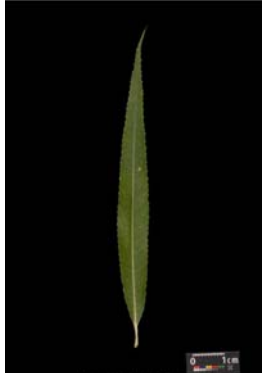



Common Name	Scientific Name	Leaf	Bark
American Elm	<i>Ulmus Americana</i>		
Ash (Black)	<i>Fraxinus nigra</i>		
Ash (Green)	<i>Fraxinus pennsylvanica</i>		
Birch (Sweet)	<i>Betula lenta</i>		

<p>Box Elder</p>	<p><i>Acer negundo</i></p>		
<p>Bradford Pear</p>	<p><i>Pyrus calleryana</i></p>		
<p>Cherry (Higan)</p>	<p><i>Prunus subhirtella</i></p>		
<p>Chestnut</p>	<p><i>Caastanea detate</i></p>		

<p>Eastern Redbud</p>	<p><i>Cercis canadensis</i></p>		
<p>Ginkgo</p>	<p><i>Ginkgo biloba</i></p>		
<p>Hedge Maple</p>	<p><i>Acer campestre</i></p>		
<p>Honey Locust</p>	<p><i>Gleditsia triacanthos</i></p>		

<p>Hophornbeam</p>	<p><i>Ostrya virginiana</i></p>		
<p>Japanese Tree Lilac</p>	<p><i>Syringa reticulata</i></p>		
<p>Linden (American)</p>	<p><i>Tilia americana</i></p>		
<p>London Plane</p>	<p><i>Platanus acerifolia</i></p>		

<p>Norway Maple</p>	<p><i>Acer platanoides</i></p>		
<p>Pin Oak</p>	<p><i>Quercus palustris</i></p>		
<p>Red Maple</p>	<p><i>Acer rubrum</i></p>		
<p>Red Oak</p>	<p><i>Quercus rubra</i></p>		

Silver Maple	<i>Acer saccharum</i>		
Sugar Maple	<i>Acer saccharum</i>		
Weeping Willow	<i>Salix babylonica</i>		
White Pine	<i>Pinus strobus</i>		

Zelkova (Japanese)

*Zelkova serrata*



**Reference:** [Leafsnap.com](http://Leafsnap.com)