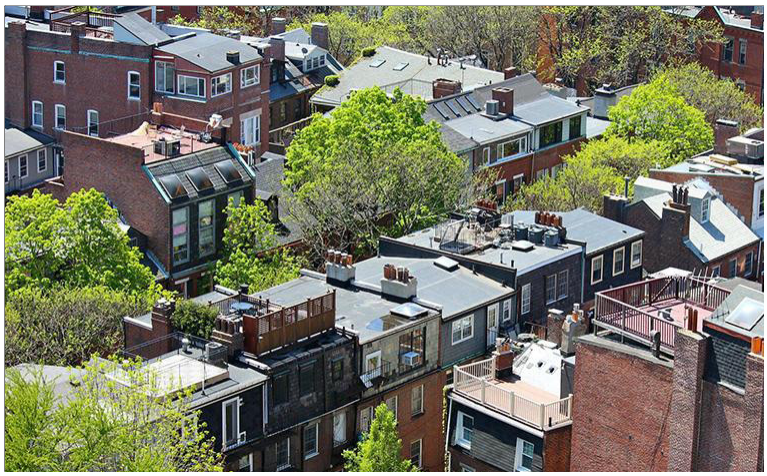
CLIMATE CHANGE VULNERABILITY OF URBAN TREES
BOSTON, MASSACHUSETTS



This list was developed to aid Boston, Massachusetts community forestry practitioners in selecting trees to reduce climate change vulnerability of their urban forests. **This is not a recommended planting list; it is meant to be a complement to other tree selection resources.** Other factors may also need to be considered, such as aesthetics, local site conditions, wildlife value, or nursery availability. It is also important to note that *some species may have climate benefits but may not be suitable for planting for other reasons, such as having invasive potential or susceptibility to pests or pathogens.*

Vulnerability: Trees can be vulnerable to a variety of climate-related stressors such as intense heat, drought, flooding, and changing pest and disease patterns. Climate vulnerability is a function of the impacts of climate change on a species and its adaptive capacity. Species with negative impacts on habitat suitability and low adaptive capacity will have high vulnerability and vice versa. The following factors were used to determine climate vulnerability:

Urban adaptability: Adaptability scores were generated for each species based on literature describing its tolerance to disturbances such as drought, flooding, pests, and disease, as well as its growth requirements such as shade tolerance, soil needs, and ease of nursery propagation. Scores were assigned to species using methods developed in an urban forest vulnerability assessment for Chicago for trees planted in developed sites. A positive score indicates that a species is tolerant to a wide range of disturbances and can be planted on a variety of sites. A negative score indicates a species is highly susceptible to disturbances and/or is limited to specific planting sites.

Hardiness and heat zone suitability: Tree species ranges were recorded from government, university, and arboretum websites. Species tolerance ranges were compared to current and projected heat and hardiness zones for Boston, Massachusetts using downscaled climate models under low emissions (RCP 4.5) and high emissions (RCP 8.5) scenarios for changes in greenhouse gases. Trees were considered to have suitable zone suitability if the species' tolerance was within the range of current and projected hardiness and heat zone through the end of the 21st century.

NOTE: This list was primarily created for species planted in developed sites, such as streets, yards, boulevards, and parks. If you are interested in projected changes in habitat suitability for native species in natural areas, see the Climate Change Tree Atlas at https://www.fs.usda.gov/nrs/atlas/tree/.

Current and projected USDA Hardiness Zones and AHS Heat Zones for Boston, Massachusetts. Hardiness zone is determined by the average lowest temperature over a 30 year period. Heat zones are determined by the number of days above 86°F.

Time Period	Hardiness Zone Range		Heat Zone Range	
1980–2010	6 to 7		4	
	Low Emissions	High Emissions	Low Emissions	High Emissions
2010–2039	6 to 7	7	5	6
2040–2069	7	8	6	7 to 8
2070–2099	7	8 to 9	6 to 7	8 to 9

SOURCE: *Adaptability scores were assigned using methods developed in an urban forest vulnerability assessment for Chicago by Brandt et al. 2017 (https://www.fs.usda.gov/research/treesearch/54128). Future heat and hardiness zone information were provided from: https://usfs.maps.arcgis.com/apps/MapSeries/index.html?appid=96088b1c086a4b39b3a75d0fd97a4c40.*

USDA FOREST SERVICE DEPARTMENT OF AGRICULTURE NIACS Northern Institute of Applied Climate Science

www.forestadaptation.org

URBAN ADAPTABILITY:

- \+ ***High:*** *Species may perform better than modeled*
- • ***Medium***
- – ***Low:*** *Species may perform worse than modeled*

ZONE SUITABILITY:

- ✓ Suitable
- ✗ Not Suitable

VULNERABILITY:

- ▼ ***Low:*** *Suitable zone, high adaptability*
- ● ***Low-moderate:*** *Suitable zone, medium adaptability*
- ⊖ ***Moderate:*** *Suitable zone, low adaptability or zone not suitable, high adaptability*
- ○ ***Moderate- high:*** *Zone not suitable, medium adaptability*
- △ ***High:*** *Zone not suitable, low adaptability*

**Invasive species* ***Species should be monitored due to elevated pest and disease susceptibility*

COMMON NAME	ADAPT	LOW EMISSIONS ZONE SUIT	LOW EMISSIONS VULN	HIGH EMISSIONS ZONE SUIT	HIGH EMISSIONS VULN
'Accolade' flowering cherry	•	✓	●	✗	○
'Accolade' elm	+	✓	▼	✗	⊖
Allegheny serviceberry	+	✓	▼	✓	▼
American basswood, linden	•	✓	●	✗	○
American beech**	•	✓	●	✓	●
American chestnut	–	✓	⊖	✗	△
American elm	•	✓	●	✓	●
American holly	+	✓	▼	✓	▼
American hornbeam	+	✓	▼	✓	▼
American smoketree	•	✓	●	✗	○
American sweetgum	•	✓	●	✓	●
American sycamore	•	✓	●	✓	●
American witchhazel	•	✓	●	✗	○
Amur maackia	+	✓	▼	✗	⊖
Amur maple*	•	✓	●	✗	○
Apple serviceberry	+	✓	▼	✗	⊖
Atlantic white cedar	+	✓	▼	✗	⊖
Bald cypress	+	✓	▼	✓	▼
Balsam fir	•	✗	○	✗	○
Bigtooth aspen	–	✗	△	✗	△
Bitternut hickory	•	✓	●	✓	●
Black cherry	–	✓	⊖	✓	⊖
Black hickory	–	✓	⊖	✓	⊖
Black locust	•	✓	●	✗	○
Black oak	•	✓	⊖	✓	⊖
Black tupelo, Black gum	+	✓	▼	✓	▼
Black willow	–	✓	⊖	✓	⊖
Blackjack oak	–	✓	⊖	✓	⊖
Bur oak	+	✓	▼	✗	⊖
Butternut**	–	✓	⊖	✗	△
Callery pear*	•	✓	●	✓	●
Carolina silverbell	•	✓	●	✗	○
Cedar elm	+	✓	▼	✓	▼
Cherrybark oak	•	✓	●	✓	●
Chestnut oak	+	✓	▼	✗	⊖
Chinese elm	+	✓	▼	✓	▼
Chinkapin oak	•	✓	●	✗	○
Chokecherry	•	✓	●	✗	○
Cockspur hawthorn	•	✓	●	✗	○
Common hackberry	+	✓	▼	✓	▼
Common hawthorn	•	✓	●	✗	○
Common hoptree (wafer ash)	•	✓	●	✓	●
Common hornbeam	+	✓	▼	✗	⊖
Common persimmon	+	✓	▼	✓	▼
Cornelian cherry dogwood	•	✓	●	✗	○
Crabapple	•	✓	●	✗	○

COMMON NAME	ADAPT	LOW EMISSIONS ZONE SUIT	LOW EMISSIONS VULN	HIGH EMISSIONS ZONE SUIT	HIGH EMISSIONS VULN
Crimson king maple	+	✓	▼	✗	⊖
Cucumbertree	+	✓	▼	✗	⊖
Dawn redwood	•	✓	●	✓	●
Downy serviceberry	–	✓	⊖	✓	⊖
Eastern black walnut	•	✓	●	✓	●
Eastern cottonwood	–	✓	▼	✓	▼
Eastern hemlock	–	✓	⊖	✗	△
Eastern redbud	•	✓	●	✗	○
Eastern redcedar	•	✓	●	✓	●
Eastern white pine	•	✓	●	✗	○
English oak	•	✓	●	✗	○
European horsechesnut	•	✓	●	✗	○
Flowering dogwood	•	✓	●	✓	●
Freeman maple	+	✓	▼	✗	⊖
Ginkgo	+	✓	▼	✓	▼
Goldenrain tree*	+	✓	▼	✓	▼
Gray birch	–	✓	⊖	✗	△
Green ash**	•	✓	●	✓	●
Green hawthorn 'Winter King'	•	✓	●	✗	○
Hardy rubber tree	+	✓	▼	✗	⊖
Hedge maple	•	✓	●	✗	○
Heritage oak	+	✓	▼	✗	⊖
Higan cherry	•	✓	●	✗	○
Honeylocust*	•	✓	●	✗	○
Ironwood	+	✓	▼	✓	▼
Japanese cherry	•	✗	○	✗	○
Japanese pagoda tree	+	✓	▼	✗	⊖
Japanese tree lilac	+	✓	▼	✗	⊖
Japanese umbrella pine	•	✓	●	✓	●
Japanese zelkova	+	✓	▼	✗	⊖
Katsura tree	–	✓	⊖	✗	△
Kentucky coffeetree	+	✓	▼	✗	⊖
Kousa dogwood	+	✓	▼	✗	⊖
Kwansan cherry	•	✓	●	✓	●
Littleleaf linden	+	✓	▼	✗	⊖
Loblolly pine	•	✓	●	✓	●
London planetree	•	✓	●	✗	○
Longleaf pine	•	✓	●	✓	●
Miyabei maple	+	✓	▼	✗	⊖
Mockernut hickory	•	✓	▼	✓	▼
Morden hawthorn	•	✓	●	✗	○
Northern catalpa	–	✓	⊖	✗	△
Northern red oak	•	✓	●	✓	●
Northern white cedar, Arborvitae	•	✓	●	✗	○
Norway maple*	+	✓	▼	✗	⊖
Norway spruce	•	✓	●	✗	○

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Okame cherry	+	✓	▼	✗	⊖
Osage-orange	+	✓	▼	✓	▼
Paper birch	•	✗	○	✗	○
Paperbark maple	–	✓	⊖	✗	△
Pawpaw	•	✓	●	✓	●
Peach	•	✓	●	✓	●
Pecan	–	✓	⊖	✓	⊖
Persian ironwood	+	✓	▼	✗	⊖
Pignut hickory	•	✓	●	✓	●
Pin cherry	•	✓	●	✗	○
Pin oak	•	✓	●	✗	○
Pitch pine	–	✓	⊖	✗	△
Pond pine	–	✓	⊖	✓	⊖
Post oak	•	✓	⊖	✓	⊖
Quaking aspen	–	✗	△	✗	△
Red horsechestnut	•	✓	●	✓	●
Red maple	•	✓	●	✓	●
Red mulberry	•	✓	●	✓	●
Red pine	–	✗	△	✗	△
Red spruce	•	✗	○	✗	○
River birch	•	✓	●	✓	●
Sand pine	–	✓	⊖	✓	⊖
Sargent cherry	•	✓	●	✗	○
Sassafras	•	✓	●	✓	●
Scarlet oak	+	✓	▼	✓	▼
Scrub oak	•	✓	●	✗	○
Serbian spruce	•	✓	●	✗	○
Shagbark hickory	–	✓	⊖	✓	⊖
Shantung maple	+	✓	▼	✗	⊖
Shellbark hickory	–	✓	⊖	✓	⊖
Shingle oak	+	✓	▼	✗	⊖
Shortleaf pine	–	✓	⊖	✓	⊖
Shumard oak	+	✓	▼	✓	▼
Siebold viburnum	+	✓	▼	✗	⊖
Silver linden	•	✓	●	✓	●
Silver maple	•	✓	●	✓	●
Slippery elm	•	✓	●	✓	●
Snowgoose cherry	+	✓	▼	✗	⊖
Sourwood	+	✓	▼	✓	▼
Southern red oak	•	✓	●	✓	●
Striped maple	•	✓	●	✗	○
Sugar maple	•	✓	●	✗	○
Sugarberry	•	✓	●	✓	●
Swamp chestnut oak	•	✓	●	✓	●
Swamp tupelo	–	✓	⊖	✓	⊖
Swamp white oak	+	✓	▼	✓	▼
Sweet bay magnolia	•	✓	●	✗	○
Sweet birch	•	✓	●	✗	○
Swiss stone pine	+	✓	▼	✗	⊖
Thornless cockspur hawthorn	+	✓	▼	✗	⊖
Trident maple	•	✓	●	✓	●
Tuliptree	–	✓	⊖	✓	⊖
Turkey oak	•	✓	●	✓	●
Turkish filbert	•	✓	●	✗	○
Virginia pine	–	✓	⊖	✗	△
Washington hawthorn	•	✓	●	✗	○
Water oak	•	✓	●	✓	●
Weeping willow	•	✓	●	✓	●
White ash**	–	✓	⊖	✓	⊖
White fir	•	✓	●	✗	○
White fringetree	+	✓	▼	✓	▼
White oak	•	✓	●	✓	●
White spruce	•	✗	○	✗	○
Willow oak	+	✓	▼	✓	▼
Winged elm	•	✓	●	✓	●
Yellow birch	+	✓	▼	✗	⊖
Yellowwood	+	✓	▼	✓	▼
Yoshino cherry	–	✗	△	✗	△