Taxon: Populus tremuloides Michx. **Family:** Salicaceae

Common Name(s): American aspen
quaking aspen
trembling aspen

Synonym(s):

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 26 Sep 2016

WRA Score: 5.0 **Designation:** H(HPWRA) **Rating:** High Risk

Keywords: Temperate Tree, Shade-Intolerant, Dioecious, Clonal Growth, Wind-Dispersed

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	Low
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	y
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	n
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	n
301	Naturalized beyond native range		
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	y
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	y
304	Environmental weed		
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic	y=1, n=0	n
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans		
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	n

Qsn #	Question	Answer Option	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	y
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally	y=1, n=-1	y
604	Self-compatible or apomictic	y=1, n=-1	n
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	2
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	y
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)		
708	Propagules survive passage through the gut	y=1, n=-1	n
801	Prolific seed production (>1000/m2)	y=1, n=-1	y
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	n
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	y
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	**Is the species highly domesticated?**	**n**
	Source(s)	**Notes**
	Burns, R.M. & Honkala, B.H. 1990. Silvics of North America. Volume 2: Hardwoods. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[No evidence of domestication] "Quaking aspen (Populus tremuloides) is the most widely distributed tree in North America. It is known by many names: trembling aspen, golden aspen, mountain aspen, popple, poplar, trembling poplar, and in Spanish, álamo blanco, and álamo temblón (49)."

102	Has the species become naturalized where grown?	
	Source(s)	**Notes**
	WRA Specialist. 2016. Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	**Notes**
	WRA Specialist. 2016. Personal Communication	NA

201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	Low
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 25 Sep 2016]	"Native: Northern America Eastern Canada: Canada - New Brunswick, - Newfoundland, - Nova Scotia, - Ontario, - Prince Edward Island, - Quebec North-Central U.S.A.: United States - Illinois, - Iowa, - Minnesota, - Missouri, - Nebraska, - North Dakota, - South Dakota, - Wisconsin Northeastern U.S.A.: United States - Connecticut, - Indiana, - Maine, - Massachusetts, - Michigan, - New Hampshire, - New Jersey, - New York, - Ohio, - Pennsylvania, - Rhode Island, - Vermont, - West Virginia Northern Mexico: Mexico - Baja Norte, - Coahuila, - Durango, - Nuevo Leon, - San Luis Potosi, - Sonora, - Tamaulipas, - Zacatecas Northwestern U.S.A.: United States - Colorado, - Idaho, - Montana, - Oregon, - Washington, - Wyoming South-Central U.S.A.: United States - New Mexico, - Texas Southeastern U.S.A.: United States - Delaware, - Maryland, - North Carolina, - Virginia Southern Mexico: Mexico - Guanajuato, - Hidalgo, - Mexico Southwestern U.S.A.: United States - Arizona, - California, - Nevada, - Utah Subarctic America: Canada - Northwest Territory, - Yukon Territory United States - Alaska Western Canada: Canada - Alberta, - British Columbia, - Manitoba, - Saskatchewan"

Qsn #	Question	Answer
202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 25 Sep 2016]	

203	**Broad climate suitability (environmental versatility)**	**y**
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"P. tremuloides is a North American transcontinental species (Klinka et al., 1999), ranging over 111° of longitude and 48° of latitude; this represents the widest distribution of any native tree species in North America (Little, 1979). The range extends from Newfoundland and Labrador west across Canada along the northern limit of trees to northwestern Alaska, and southeast through Yukon and British Columbia." ... "Climatic conditions vary greatly over the range of P. tremuloides, especially winter minimum temperatures and annual precipitation. The widest known range in temperatures P. tremuloides has endured in the conterminous USA is in Montana, where January lows of -57°C and summer highs of 41°C have been recorded. In Alaska and northwest Canada, part of its range lies within the permafrost zone, but P. tremuloides grows only on the warmest sites free of permafrost. At the eastern edge of the range, in the Maritime Provinces of Canada, the climate is mild and humid, and snowfall is extremely heavy, 3 m or more per year (DeByle and Winokur, 1985). P. tremuloides spans an elevation range from sea level to 3505 m in northern Colorado, USA, but at either of its altitudinal limits the tree can be poorly developed. In very high, exposed locations it becomes stunted, with the stem bent or almost prostrate from snow and wind; at its lower limit, combined with low precipitation, it is a shrubby tree growing along creeks."

204	**Native or naturalized in regions with tropical or subtropical climates**	**n**
	Source(s)	**Notes**
	Howard, J. L. 1996. Populus tremuloides. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/tree/poptre/all.html. [Accessed 26 Sep 2016]	"Quaking aspen is the most widely distributed tree in North America. It occurs from Newfoundland west to Alaska and south to Virginia, Missouri, Nebraska, and northern Mexico. A few scattered populations occur further south in Mexico to Guanajuato [99]. Quaking aspen is distributed fairly continuously in the East. Distribution is patchy in the West, with trees confined to suitable sites. Density is greatest in Minnesota, Wisconsin, Michigan, Colorado, and Alaska; each of those states contains at least 2 million acres of commercial quaking aspen forest. Maine, Utah, and central Canada also have large acreages of quaking aspen [89,125]."

205	**Does the species have a history of repeated introductions outside its natural range?**	**n**

Qsn #	Question	Answer
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Introduction of P. tremuloides outside its natural range is limited to arboreta and parks."
	Skolmen, R.G. 1980. Plantings on the forest reserves of Hawaii: 1910–1960. Institute of Pacific Islands Forestry, Pacific Southwest Forest & Range Experiment Station, US Forest Service, Honolulu, HI	16 Populus tremuloides trees planted on Hawaii Island in 1931-32 [Honuala = 10 trees & Mauna Kea & Pohakuloa = 6 trees]

301	Naturalized beyond native range	
	Source(s)	**Notes**
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	Listed as naturalized in the following reference. Unable to access reference & confirm status: Gederaas, L., Salvesen, I. & Viken, Å. (Ed.) 2007. Norsk svarteliste 2007 – Økologiske risikovurderinger av fremmede arter. (2007 Norwegian Black List – Ecological Risk Analysis of Alien Species). Artsdatabanken, Norway. pp:118-141

302	Garden/amenity/disturbance weed	y
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Quaking aspen is an aggressive pioneer. It readily colonizes burns and can hold invaded land even though subjected to fires at intervals as short as 3 years. In the northeastern USA, it is an old-field type, and in Canada it invades grassland if fire is excluded."
	Rejmánek, M., & Richardson, D. M. (1996). What attributes make some plant species more invasive?. Ecology, 77(6), 1655-1661	"Some occasionally spreading species are correctly predicted to be close to the dividing point (Catalpa bignonioides, Cedrus atlantica, and Fraxinus excelsior). However, some non-invasive species of Populus (P. tremula, P. tremuloides) are classified as invasive. The short seed viability and high seedling mortality brought about by the slow growth of seedling primary roots in these species apparently prevent them from becoming invasive (McDonough 1979, Krasny et al. 1988)."
	Dave's Garden. 2016. Quaking Aspen - Populus tremuloides. http://davesgarden.com/guides/pf/go/54165/. [Accessed 26 Sep 2016]	"Yes, this is a very fast growing tree. Like a WEED. It will send runners all over your yard, your neighbors yard, and your neighbors neighbors yard. It will send shoots around your yard and planting beds that you will have to mow and pull out unless you want more trees. Every where you dig, you will run into its roots. This plant is a weed. A huge mistake for 1st time homeowners who didn't know any better. Don't plant it. EVER." ... "If you care for the foundation of your home, the integrity of your soil, the life span of your planting beds or your lawn, your relationship with your neighbors, keep this tree out of your neighborhood. "

303	Agricultural/forestry/horticultural weed	y
	Source(s)	**Notes**
	Shu Hua Liu, Campbell, R., John A. Studens, & Wagner, R. (1996). Absorption and Translocation of Glyphosate in Aspen (Populus tremuloides Michx.) as Influenced by Droplet Size, Droplet Number, and Herbicide Concentration. Weed Science, 44(3), 482-488	"Aspen (Populus tremuloides Michx.) is a major competitor of coniferous trees in Canadian forests (5), and glyphosate is widely used to control it."

Qsn #	Question	Answer
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	Listed as an agricultural or environmental weed

304	Environmental weed	
	Source(s)	**Notes**
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	Possibly. Listed as an environmental weed, but unable to verify impacts

305	Congeneric weed	y
	Source(s)	**Notes**
	Invasive Species South Africa. 2016. White poplar - Populus alba. http://www.invasives.org.za/legislation/item/312-white-poplar-populus-alba. [Accessed 26 Sep 2016]	" It invades river banks, vleis and dongas." ... "Why is it a problem? Competes with and replaces indigenous riverine species. Dense stands formed by suckering from the roots can narrow and block water channels, causing flooding and increased siltation. Extensive stands are likely to cause a significant reduction in stream flow "
	CABI, 2016. Populus nigra. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"P. nigra is a fast-growing tree utilized for afforestation and as an ornamental in all the temperate areas of the world. As an endemic species, P. nigra can be considered on the verge of extinction in a large part of its natural range, particularly in west and central Europe, because its natural habitat is gradually being reduced by human activity and because it easily hybridizes with other species (especially P. x canadensis) and with its fastigiate form var. italica (Lombardy poplar). It is the latter, P. nigra var. italica, which is considered an invasive or potentially invasive species in some parts of the world, including North America, South Africa and Argentina. It is considered an invasive species in very localized areas in the USA, notably around the Great Lakes region and particularly in Michigan, where it was originally planted for dune stabilization. This has led to the disruption of natural dune migration with concomitant impacts on natural habitats and biodiversity. However, as a male clone it produces no seeds so invasive spread is limited and effected by profuse suckering. Its invasiveness is also aided by cultivation as an ornamental, windbreak and landscape tree."

401	Produces spines, thorns or burrs	n
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"P. tremuloides is a medium-sized tree, rarely growing over 35 m, with a d.b.h. of 100 cm and a short, rounded crown. The stem is long, cylindrical and smooth, with little taper and branch-free in the lower part. The bark is smooth with a waxy appearance, and is pale green to almost white when young, becoming darker and furrowed into flat-topped ridges (Farrar, 1995)."

402	Allelopathic	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Plants for a Future. 2012. Populus tremuloides. http://www.pfaf.org/user/Plant.aspx?LatinName=Populus+tremuloides. [Accessed 26 Sep 2016]	[No evidence] "A fast-growing tree, it rapidly invades bare areas such as logged woodland and soon establishes dense stands of young trees by sending up suckers[226, 229]. It provides excellent conditions for other species of trees to become established and these will eventually out-compete the poplar [229]. "
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	No evidence
	Howard, J. L. 1996. Populus tremuloides. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/tree/poptre/all.html. [Accessed 26 Sep 2016]	No evidence

403	Parasitic	n
	Source(s)	**Notes**
	Howard, J. L. 1996. Populus tremuloides. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/tree/poptre/all.html. [Accessed]	[No evidence] "Quaking aspen is a native deciduous tree. It is small- to medium-sized, typically less than 48 feet (15 m) in height and 16 inches (40 cm) dbh [75]. It has spreading branches and a pyramidal or rounded crown [60,75,88,166]. The bark is thin. Leaves are orb- to ovately shaped, with flattened petioles [90]. The fruit is a tufted capsule bearing six to eight seeds. A single female catkin usually bears 70 to 100 capsules [88,166]. The root system is relatively shallow, with widespreading lateral roots and vertical sinker roots descending from the laterals. Laterals may extend over 100 feet (30 m) into open areas [88]. Gifford [59] found that vertical roots of quaking aspen in Utah extended more than 9 feet (2.7 m) down, branching into fine, dense roots at their extremities [88]."

404	Unpalatable to grazing animals	n
	Source(s)	**Notes**
	Burns, R.M. & Honkala, B.H. 1990. Silvics of North America. Volume 2: Hardwoods. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	"Young trees are sometimes killed by bark-eating mammals, such as meadow mice and snowshoe hares, which may girdle the stem at or near the ground line. Also, larger animals, such as mule deer, white-tailed deer, elk, and moose, frequently seriously damage reproduction by browsing and by rubbing their antlers against the stems. Elk and moose can also damage pole- and saw log-size trees by "barking" them with their incisors." ... "Cattle and sheep browsing is a serious problem in many areas of the Rockies because livestock are allowed to range through recent aspen clearcuts."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Young trees are sometimes killed by bark-eating mammals, which may girdle the stem at or near the ground line. Also, larger animals, including cattle and sheep, frequently cause serious damage to reproduction by browsing and by rubbing their antlers against the stems."

405	Toxic to animals	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	USDA NRCS. 2008. Quaking Aspen - Populus tremuloides. Plant Guide. https://plants.usda.gov/plantguide/pdf/cs_potr5.pdf. [Accessed 26 Sep 2016]	"Young quaking aspen provides food and habitat for a variety of wildlife: black bear, deer, beaver, porcupine, elk, moose, ruffed grouse and many smaller birds and animals, including small mammals such as mice, voles, shrews, chipmunks, and rabbits. Bark, buds, new sprouts, twigs from the tops of fallen or logged trees, and fallen leaves all are wildlife foods."
	Burns, R.M. & Honkala, B.H. 1990. Silvics of North America. Volume 2: Hardwoods. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[No evidence] "Young trees are sometimes killed by bark-eating mammals, such as meadow mice and snowshoe hares, which may girdle the stem at or near the ground line. Also, larger animals, such as mule deer, white-tailed deer, elk, and moose, frequently seriously damage reproduction by browsing and by rubbing their antlers against the stems. Elk and moose can also damage pole- and saw log-size trees by "barking" them with their incisors." ... "Cattle and sheep browsing is a serious problem in many areas of the Rockies because livestock are allowed to range through recent aspen clearcuts."

406	**Host for recognized pests and pathogens**	
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"P. tremuloides is susceptible to a large number of diseases, which are usually of only minor concern (Hinds and Wengert, 1977; DeByle and Winokur, 1985). Of the many stem pathogens, stain and decay have the greatest direct impact on wood production. The role of microorganisms frequently associated with discoloration is poorly understood because staining also develops in their absence. Bacteria and yeast organisms are commonly associated with 'wetwood', a water-soaked condition of live trees that leads to wood collapse during sawtimber drying (Perala, 1990). Phellinus tremulae causes a white rot of the heartwood at first, but may eventually invade the entire stem. It causes the greatest volume of decay and is so prevalent that it conceals rot caused by other fungi. More fungus species cause butt and root rots (for example, Collybia velutipe, Ganoderma applanatum) than trunk rots, representing as much as one-third of the decay volume. Stem cankers (Ceratocystis spp., Encoelia pruinosa) are common diseases that have a great impact on the P. tremuloides resource (Hinds and Ryan, 1985). For example, Hypoxylon canker caused by Hypoxylon mammatum annually kills 1-2% of P. tremuloides east of the Rocky Mountains (Manion and Griffin, 1986; Falk et al., 1989; Lavalee, 1990). Stem cankers can kill a tree within a few years or persist for decades (Perala, 1990). Pests P tremuloides acts as a host to a wide range of insects (defoliators, borers and sucking species), but only a few are known to severely damage trees. Defoliators belong primarily to the orders Lepidoptera and Coleoptera. The forest tent caterpillar (Malacosoma disstria) and the western tent caterpillar (M. californicum) are the most common defoliators (Witter, 1979; DeByle and Winokur, 1985; Roland, 1993; Batzer et al., 1995)."

407	**Causes allergies or is otherwise toxic to humans**	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"(Bark infusion drink for fractures, ruptures. Mosquito repellent.)" ... "(Leaves as a poultice applied on wounds, boils. Infusion of young cottonwood branches, roots of Rosa woodsii and Potentilla glandulosa drunk for syphilis.)"
	Plants for a Future. 2012. Populus tremuloides. http://www.pfaf.org/user/Plant.aspx?LatinName=Populus+tremuloides. [Accessed 26 Sep 2016]	"Possible toxic effects due to salicylates (e.g. heartburn, tinnitus). Avoid with ulcers, stomach or peptic ulcers"
	USDA NRCS. 2008. Quaking Aspen - Populus tremuloides. Plant Guide. https://plants.usda.gov/plantguide/pdf/cs_potr5.pdf. [Accessed 26 Sep 2016]	[No evidence] "Native Americans used Populus bark (including aspen) as a food source. They cut the inner bark into strips, dried and ground it into meal to be mixed with other starches for bread or mush. Catkins were eaten raw, and the cambium was eaten raw or in a soup."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	**Notes**
	USDA NRCS. 2008. Quaking Aspen - Populus tremuloides. Plant Guide. https://plants.usda.gov/plantguide/pdf/cs_potr5.pdf. [Accessed 26 Sep 2016]	"Aspen stands are good firebreaks, often dropping crown fires in conifer stands to the ground when they reach aspens and even sometimes extinguishing the fire because of the small amount of flammable accumulation."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Due to low fuel accumulations, P. tremuloides stands are low in flammability and make excellent firebreaks (DeByle and Winokur, 1985)."

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	**Notes**
	Burns, R.M. & Honkala, B.H. 1990. Silvics of North America. Volume 2: Hardwoods. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	"In both the eastern and western parts of its range, quaking aspen is classed as very intolerant of shade, a characteristic it retains throughout its life."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"P. tremuloides is a shade-intolerant, short-lived, wind-firm tree with a rapid initial growth rate." ... "Under low light levels, the potential for natural regeneration is poor. Natural regeneration is favoured in the open, with the amount of sucker regeneration being proportional to the degree of cutting and burning. Initial growth rates (<5 years) are high, about 30 cm in the first growing season from root suckers, >50 cm per year thereafter."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	**Notes**
	Burns, R.M. & Honkala, B.H. 1990. Silvics of North America. Volume 2: Hardwoods. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	"It grows on many soil types, especially sandy and gravelly slopes, and it is quick to pioneer disturbed sites where there is bare soil."

Qsn #	Question	Answer
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"P. tremuloides is the most widely distributed tree in North America. It grows on a range of soils, and it is quick to pioneer disturbed sites where there is bare soil." ... "P. tremuloides grows on a great range of soils (mainly alfisols, spodosols and inceptisols), from shallow and rocky soils to deep loamy sands and heavy clays. Only occasional scattered trees occur on glacial outwash, rock outcrops and some histosols (Perala, 1990)." "Soil descriptors - Soil texture: light; medium; heavy - Soil drainage: free; impeded - Soil reaction: acid; neutral - Soil types: alfisols; alluvial soils; bog soils; cambisols; calcareous soils; chernozems; granite soils; luvisols; mangrove soils; mountain soils; peat soils; podzoluvisols; podzols; regosols; sandstone soils; silty soils"

411	Climbing or smothering growth habit	n
	Source(s)	**Notes**
	Howard, J. L. 1996. Populus tremuloides. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/tree/poptre/all.html. [Accessed 25 Sep 2016]	"Quaking aspen is a native deciduous tree. It is small- to medium-sized, typically less than 48 feet (15 m) in height and 16 inches (40 cm) dbh [75]. It has spreading branches and a pyramidal or rounded crown [60,75,88,166]. The bark is thin. Leaves are orb- to ovately shaped, with flattened petioles [90]."

412	Forms dense thickets	y
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"P. tremuloides typically grows in even-aged, pure stands and in later successional stages with many shade-tolerant conifers."

501	Aquatic	n
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[Terrestrial] "P. tremuloides is a medium-sized tree, rarely growing over 35 m, with a d.b.h. of 100 cm and a short, rounded crown."

502	Grass	n
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 26 Sep 2016]	"Family: Salicaceae"

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 26 Sep 2016]	"Family: Salicaceae"

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Seedlings initially have a short taproot, but a heart root system develops on deep, well-drained soils. Clonal ramets have a flat root system when young, but again will develop a heart root system on deep, well-drained soils. If rooting depth is restricted, a flat root system develops regardless of regeneration origin (DeByle and Winokur, 1985)."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[No evidence] "P. tremuloides is the most widely distributed tree in North America. It grows on a range of soils, and it is quick to pioneer disturbed sites where there is bare soil. This fast-growing tree is short-lived (up to 200 years) and pure stands are gradually replaced by shade-tolerant species."

602	Produces viable seed	y
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Good seed crops are produced every 4 or 5 years, with light crops in most intervening years. The minimum age for large seed crops is 10-20 years old; the optimum is 50-70. Seeds are very light, with 5500 to 8000 clean seeds per g (Strothmann and Zasada, 1965; Maini and Cayford, 1968). Seeds begin to be dispersed within a few days of ripening and seed dispersal may last for 3-5 weeks. The seeds, buoyed by long silky hairs, can be carried for many kilometres by air currents. Water also serves as a dispersal agent (Strothmann and Zasada, 1965). The viability of fresh fertile seeds is high (usually greater than 95%), but normally of short duration (Schopmeyer, 1974)."

603	Hybridizes naturally	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"P. tremuloides is known to hybridize naturally with the following Populus species (Little, 1979): P. alba (P. x heimburgeri Boivin) P. angustifolia (P. x senni Boivin) P. balsamifera (P. x dutillyi Lepage) P. basamlifera x deltoides (P. x polygonifolia Barnard) P. deltoides (P. x bernardii Boivin) P. grandidentata (P. x smithii Boivin, P. x barnesii W.H. Wagner). Natural hybrids between the European P. alba and P. tremuloides have been reported from Michigan, USA, and occur in a number of localities in the vicinity of Ottawa and Ontario, Canada (Strothmann and Zasada, 1965). This cross produces viable seeds, as does the cross of P. x canescens (Ait.) Sm. with P. tremuloides. P. tremuloides also crosses readily with P. tremula, the European aspen (Li and Wu, 1997; Li et al., 1998). Crosses between diploid P. tremuloides females and a tetraploid male P. tremula from Sweden have produced triploid progeny with exceptionally improved growth. Numerous other artificial crosses have been made, but only P. tremuloides x davidiana Dode (Asiatic aspen) has shown much promise for commercial use. Many breeding programmes chiefly involving interspecific hybridization have been in existence for a long time all over the word, for example, in Germany (Joachim, 1991), Sweden (Christersson, 1996), USA (Li et al., 1993) and Canada (Li, 1995). Little intraspecific breeding of P. tremuloides has been performed (Strothmann and Zasada, 1965)."

604	Self-compatible or apomictic	n
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"P. tremuloides is primarily dioecious, with trees in a given clone being usually either all male or all female, although some clones produce both stamens and pistils."

605	Requires specialist pollinators	n
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The pendulous flower catkins, 3.8-6.4 cm long, appear before the leaves expand and are wind pollinated."

606	Reproduction by vegetative fragmentation	y
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The shallow and extensive laterals have cord-like branch roots that undulate and meander for great distances without tapering. These roots are the main producers of suckers, particularly when they are close to the soil surface." ... "It has a high reproduction potential, occurring predominantly from root suckers and stump sprouts." ... "P. tremuloides seedlings at 1 year old are already capable of reproducing by root sprouts (suckers), and mature stands reproduce vigorously in this way (Jones, 1974; Brinkman and Roe, 1975)."

607	Minimum generative time (years)	2

Qsn #	Question	Answer
	Source(s)	**Notes**
	Burns, R.M. & Honkala, B.H. 1990. Silvics of North America. Volume 2: Hardwoods. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	"Quaking aspen seedlings at 1 year of age are already capable of reproducing by root sprouts (suckers), and mature stands reproduce vigorously by this means (19,43)."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The minimum age for seed crops is about 10 years and seed is disseminated by wind and water."
	USDA NRCS. 2008. Quaking Aspen - Populus tremuloides. Plant Guide. https://plants.usda.gov/plantguide/pdf/cs_potr5.pdf. [Accessed 3 Oct 2016]	"Young trees first flower at 2-3 years but production of large seed crops begins at about 10-20 years; maximum seed production occurs at 50-70 years."

701	**Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)**	**n**
	Source(s)	**Notes**
	Howard, J. L. 1996. Populus tremuloides. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/tree/poptre/al.html. [Accessed 26 Sep 2016]	"The plumose seeds are dispersed by wind for distances of 1,600 feet (500 m) to several miles with heavy winds. Seeds also disperse by water, and can germinate while floating or submerged [54]." [Unlikely. Seeds lack means of external attachment, although plumes may aid in attachment to clothing]

702	**Propagules dispersed intentionally by people**	**y**
	Source(s)	**Notes**
	Dave's Garden. 2016. Quaking Aspen - Populus tremuloides. http://davesgarden.com/guides/pf/go/54165/. [Accessed 26 Sep 2016]	Cultivated within broad native range

703	**Propagules likely to disperse as a produce contaminant**	**n**
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The minimum age for seed crops is about 10 years and seed is disseminated by wind and water." [No evidence. Unlikely given long time to sexual maturity & short seed viability]
	Howard, J. L. 1996. Populus tremuloides. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/tree/poptre/al.html. [Accessed 26 Sep 2016]	"Viability of fresh seed is good; germination of 80 to 95 percent is reported under laboratory conditions [103,109,142]. Viability lasts 2 to 4 weeks under favorable conditions of low temperature and humidity [123], but seed loses viability rapidly under less than optimum conditions [54,171]."

704	**Propagules adapted to wind dispersal**	**y**
	Source(s)	**Notes**

Qsn #	Question	Answer
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The fruiting catkins are about 10 cm long when mature, each bearing many one-celled capsules. Each capsule contains about 10 small brown seeds, each of which is surrounded by tufts of long, white silky hairs (Strothmann and Zasada, 1965; Schopmeyer, 1974; DeByle and Winokur, 1985)." ... "Seeds begin to be dispersed within a few days of ripening and seed dispersal may last for 3-5 weeks. The seeds, buoyed by long silky hairs, can be carried for many kilometres by air currents."

705	Propagules water dispersed	y
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Water also serves as a dispersal agent (Strothmann and Zasada, 1965)."

706	Propagules bird dispersed	n
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The minimum age for seed crops is about 10 years and seed is disseminated by wind and water."

707	Propagules dispersed by other animals (externally)	
	Source(s)	**Notes**
	Howard, J. L. 1996. Populus tremuloides. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/tree/poptre/al.html. [Accessed 26 Sep 2016]	[Unlikely, although plumes may aid in attachment to fur] "Seeds disperse a few days after they ripen. Dispersal lasts 2 to 3 weeks [123]. The plumose seeds are dispersed by wind for distances of 1,600 feet (500 m) to several miles with heavy winds. Seeds also disperse by water, and can germinate while floating or submerged [54]."

708	Propagules survive passage through the gut	n
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The minimum age for seed crops is about 10 years and seed is disseminated by wind and water."

Qsn #	Question	Answer
801	**Prolific seed production (>1000/m2)**	**y**
	Source(s)	**Notes**
	Burns, R.M. & Honkala, B.H. 1990. Silvics of North America. Volume 2: Hardwoods. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	"Good seed crops are produced every 4 or 5 years, with light crops in most intervening years. Some open-grown clones may produce seeds annually, beginning at age 2 or 3. The minimum age for large seed crops is 10 to 20; the optimum is 50 to 70. One 23-year-old quaking aspen produced an estimated 1.6 million seeds (51,59,78). Seeds are very light, 5,500 to 8,000 clean seeds per gram (156,000 to 250,000/oz)."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Good seed crops are produced every 4 or 5 years, with light crops in most intervening years. The minimum age for large seed crops is 10-20 years old; the optimum is 50-70. Seeds are very light, with 5500 to 8000 clean seeds per g (Strothmann and Zasada, 1965; Maini and Cayford, 1968)."

802	**Evidence that a persistent propagule bank is formed (>1 yr)**	**n**
	Source(s)	**Notes**
	Burns, R.M. & Honkala, B.H. 1990. Silvics of North America. Volume 2: Hardwoods. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	"The viability of fresh fertile seeds is high (usually greater than 95 percent) but normally of short duration. Under favorable conditions viability lasts only 2 to 4 weeks after maturity and may be much less under unfavorable conditions. When air dried and stored in polyethylene bags at -10° C (14° F), seed retains high viability for at least I year. Seedlings are sturdiest when germinated at 5° to 29° C (41° to 84° F) and grown at about 20° C (68° F). Ripe quaking aspen seeds are not dormant, and germination occurs within a day or two after dispersal if a suitably moist seedbed is reached. Because germination declines rapidly after water potential exceeds -4 bars (-.4 MPa), a water-saturated seedbed is critical. Seeds germinate even when totally submerged in water or in the absence of light (32,47,50,66,78,92)."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The viability of fresh fertile seeds is high (usually greater than 95%), but normally of short duration (Schopmeyer, 1974)."
	Howard, J. L. 1996. Populus tremuloides. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/tree/poptre/all.html. [Accessed 26 Sep 2016]	"Viability of fresh seed is good; germination of 80 to 95 percent is reported under laboratory conditions [103,109,142]. Viability lasts 2 to 4 weeks under favorable conditions of low temperature and humidity [123], but seed loses viability rapidly under less than optimum conditions [54,171]."

803	**Well controlled by herbicides**	**y**
	Source(s)	**Notes**

Qsn #	Question	Answer
	Shu Hua Liu, Campbell, R., John A. Studens, & Wagner, R. (1996). Absorption and Translocation of Glyphosate in Aspen (Populus tremuloides Michx.) as Influenced by Droplet Size, Droplet Number, and Herbicide Concentration. Weed Science, 44(3), 482-488	"Aspen (Populus tremuloides Michx.) is a major competitor of coniferous trees in Canadian forests (5), and glyphosate is widely used to control it. used to control it. A number of studies show that spray volume or herbicide concentration, and droplet size affect glyphosate phytotoxicity. Generally, glyphosate phytotoxicity increases as spray volume decreases (3, 4, 11, 14, 17, 19) or herbicide concentration increases, when applied as individual droplets (1, 13). Prasad (15) found that smaller droplets were more efficacious than larger ones, but Merritt (13), Kudsk (11), and our unpublished data showed that droplet size did not affect glyphosate."

804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	**y**
	Source(s)	**Notes**
	Dave's Garden. 2016. Quaking Aspen - Populus tremuloides. http://davesgarden.com/guides/pf/go/54165/. [Accessed 26 Sep 2016]	" Very fast growing so they make a great tree when a tree is needed quick. However, the new trees coming off the roots will take over even after being cut back year after year."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"In general, sucker regeneration is proportional to the degree of cutting, with most suckers arising after a complete clearcut. Typically, about 25,000-75,000 suckers per ha are regenerated in Alaska and the Great Lakes region, and about half as many in the Rocky Mountains (Strothmann and Zasada, 1965; Jones, 1974; Steneker, 1976; Perala, 1977; Schier, 1981; DeByle and Winokur, 1985). Light burning on heavily-cut areas increases the number of suckers and stimulates their initial growth, although hot slash fires diminish sucker vigour. Repeated burning increases stand density because it stimulates suckering and prepares mineral soil seedbeds for seedling establishment at the expense of stand growth. Herbicides have been used to kill residual trees and to increase suckering without affecting sucker growth or vigour (Perala, 1974, 1977; Brinkman and Roe, 1975; Schier and Campbell, 1978; DeByle and Winokur, 1985; Stiell and Berry, 1986)."

805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	Source(s)	**Notes**
	WRA Specialist. 2016. Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits
• Broad climate suitability, & elevation range exceeds 1000 m, demonstrating environmental versatility
• Possibly naturalized (confirmation needed)
• Disturbance-adapted aggressive tree
• Invades & controlled in conifer forests
• Other Populus species have become invasive
• Tolerates many soil types
• Forms dense stands within native range
• Reproduces sexually (seeds) & asexually (vegetative)
• Hybridizes with other Populus species
• Reproduces by root suckers & stump sprouts
• Able to reproduce by suckers at 1 year and by seed at 2-3 years
• Seeds dispersed by wind, water & intentionally by people
• Prolific seed production (on a 4-5-year cycle)
• Able to resprout after repeated cutting

Low Risk Traits
• A temperate species which may only be able to grow at higher elevation regions of tropical & subtropical islands
• Unarmed (no spines, thorns or burrs)
• Provides fodder for livestock
• Non-toxic to animals
• Ornamental
• Shade-intolerant
• Dioecious
• Seeds rapidly lose viability
• Herbicides may provide effective control

Second Screening Results for Tree/tree-like shrubs

(A) Shade tolerant or known to form dense stands?> Yes. Forms pure stands in native range (but shade intolerant)
(B) Bird or clearly wind-dispersed?> Yes. Wind-dispersed
(C) Life cycle <4 years? Yes. Reaches sexual maturity in 2-3 years & able to spread vegetatively in 1 year
Outcome = Reject (High Risk)