WEED RISK ASSESSMENT FORM

Botanical name: *Nymphaea odorata* ssp. *odorata* Ait.

Common name: white waterlily

Assessors:

Irina Lapina
Botanist, Alaska Natural Heritage Program, University of Alaska Anchorage, 707 A Street, Anchorage, Alaska 99501
tel: (907) 257-2710; fax (907) 257-2789

Matthew L. Carlson, Ph.D.
Assistant Professor, Alaska Natural Heritage Program, University of Alaska Anchorage, 707 A Street, Anchorage, Alaska 99501
tel: (907) 257-2790; fax (907) 257-2789

Reviewers:

Michael Shephard
Vegetation Ecologist Forest Health Protection State & Private Forestry 3301 C Street, Suite 202, Anchorage, AK 99503 (907) 743-9454; fax 907 743-9479

Jeff Conn, Ph.D.
Weed Scientist, USDA Agricultural Research Service
PO Box 757200 Fairbanks, Alaska 99775
tel: (907) 474-7652; fax (907) 474-6184

Roseann Densmore, Ph.D.
Research Ecologist, US Geological Survey, Alaska Biological Science Center, 1101 East Tudor Road Anchorage, AK 99503
tel: (907) 786-3916, fax (907) 786-3636

Jeff Heys
Exotic Plant Management Program Coordinator, National Park Service, Alaska Region - Biological Resources Team, 240 W. 5th Ave, #114, Anchorage, AK 99501 tel: (907)644-3451, fax: 644-3809

Jamie M. Snyder
UAF Cooperative Extension Service
2221 E. Northern Lights Blvd. #118
Anchorage, AK 99508-4143
tel: (907) 786-6310 alt. tel: (907) 743-9448

Outcome score:

A.	**Climatic Comparison**		
	This species is present or may potentially establish in the following eco-geographic regions:		
1	South Coastal	Yes	
2	Interior-Boreal		No
3	Arctic-Alpine		No

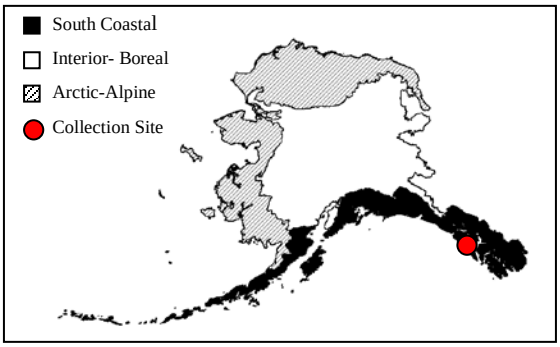
B.	**Invasiveness Ranking**	Total (Total Answered*) Possible	Total
1	Ecological impact	40 (40)	36
2	Biological characteristic and dispersal ability	25 (25)	18
3	Ecological amplitude and distribution	25 (25)	18
4	Feasibility of control	10 (7)	6
	Outcome score	100 (97)[b]	78 [a]
	Relative maximum score†		0.80

* For questions answered "unknown" do not include point value for the question in parentheses for "Total Answered Points Possible."

† Calculated as [a]/[b].

A. CLIMATIC COMPARISON:

	1.1. Has this species ever been collected or documented in Alaska?
Yes	Yes – continue to 1.2
	No – continue to 2.1
	1.2. Which eco-geographic region has it been collected or documented (see inset map)? *Proceed to Section B. Invasiveness Ranking.*
Yes	South Coastal
	Interior-Boreal
	Arctic-Alpine



Documentation: One individual of *Nymphaea odorata* ssp. *odorata* has been recorded in a muskeg pool on Baranof Island near Sitka in 1997 (UAM 2004). Site has been monitored since then and no spreading of the species has been observed (M. Shephard – pers. comm.).
Sources of information:
Shephard, M., Vegetation Ecologist Forest Health Protection State & Private Forestry 3301 C Street, Suite 202, Anchorage, AK 99503 (907) 743-9454; fax 907 743-9479.
University of Alaska Museum. University of Alaska Fairbanks. 2004. http://hispida.museum.uaf.edu:8080/home.cfm

2.1. Is there a 40% or higher similarity (based on CLIMEX climate matching) between climates anywhere the species currently occurs and

a. Juneau (South Coastal Region)?

Yes

Yes – *record locations and similarity; proceed to Section B. Invasiveness Ranking*

No

b. Fairbanks (Interior-Boreal)?

Yes – *record locations and similarity; proceed to Section B. Invasiveness Ranking*

No

No

c. Nome (Arctic-Alpine)?

Yes – *record locations and similarity; proceed to Section B. Invasiveness Ranking*

No

No – *If "No" is answered for all regions, reject species from consideration*

Documentation: *Nymphaea odorata* ssp. *odorata* is native to eastern half of North America, including southern Canada. It has been introduced into British Columbia, Oregon, Washington, Idaho, Montana, and other western states. It is also documented in Manitoba and Saskatchewan (Wiersema 1997). The CLIMEX climate matching program indicates the climatic similarity between interior boreal and arctic alpine ecoregions of Alaska and areas where the species occurs is low. Similarity between Anchorage, Fairbanks and Nome, and areas of species native range is 25% to 35%. Similarity between Anchorage, Fairbanks and Nome climate with areas in Washington and British Columbia where waterlily has introduced is 30% to 40%. Thus establishment of *Nymphaea odorata* in Interior-Boreal and Arctic Alpine ecogeographic regions of Alaska is unlikely. Climatic similarity between Juneau, Alaska and Grand Banks and St. Johns, Newfoundland where white waterlily is introduced is high (55% and 54% respectively). White waterlily is therefore expected to expand its range in the South Coastal region of Alaska.
Sources of information:
CLIMEX for Windows, Version 1.1a. 1999. CISRO Publishing, Australia.
Wiersema, J.H. 1997. Nymphaeaceae Salisbury – Water-lily Family. *Nymphaea* In: Flora of North America. Vol. 3. Magnoliophyta: Magnoliidae and Hammamelidae. Oxford University Press, Oxford. pp. 66-77.

B. INVASIVENESS RANKING

1. ECOLOGICAL IMPACT

1.1. Impact on Natural Ecosystem Processes

A.	No perceivable impact on ecosystem processes	0
B.	Influences ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability)	3
C.	Significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coastlines, reduces open water that are important to waterfowl)	7
D.	Major, possibly irreversible, alteration or disruption of ecosystem processes (e.g., the species alters geomorphology; hydrology; or affects fire frequency, altering community composition; species fixes substantial levels of nitrogen in the soil making soil unlikely to support certain native plants or more likely to favor non-native species)	10
U.	Unknown	

Score 8

Documentation:

Identify ecosystem processes impacted:
Macrophytes change water quality. Extensive infestations of white waterlily create low oxygen conditions beneath the dense canopy. It has the ability to alter nutrient dynamics by uptake from the sediments, and later release during scenescent decay (Moore et al. 1994). Infestation of waterlily may promote other exotic species such as carp, which has the ability to tolerate low oxygen conditions (Frodge et al. 1995, Moore et al. 1994). Dense infestations may accelerate the natural siltation process in shallow bodies of water. Waterlily can clog irrigation ditches or streams, thus slowing water flow and hastening water loss through transpiration (Else and Riemer 1984).
Rational:

Sources of information:
Else, M.J. and D.N. Riemer. 1984. Factors affecting germination of seeds of fragrant waterlily (*Nymphaea odorata*). Journal of Aquatic Plant Management 22: 22-25.
Frodge, J.D., D.A. Marino, G.B. Pauley and G.L. Thomas. 1995. Mortality of largemouth bass (*Micropterus salmoides*) and steelhead trout (*Oncorhynchus mykiss*) in densely vegetated littoral areas tested using in situ bioassay. Lake and Reservoir Management 11 (2): 343-358.
Moore, B.C., W.H. Funk and E. Anderson. 1994. Water quality, fishery, and biologic characteristics in a shallow, eutrophic lake with dense macrophyte population. Lake and Reservoir Management 8(2): 175-188.

1.2. Impact on Natural Community Structure

A.	No perceived impact; establishes in an existing layer without influencing its structure	0
B.	Influences structure in one layer (e.g., changes the density of one layer)	3
C.	Significant impact in at least one layer (e.g., creation of a new layer or elimination of an existing layer)	7
D.	Major alteration of structure (e.g., covers canopy, eradicating most or all layers below)	10
U.	Unknown	

Score 8

Documentation:
Identify type of impact or alteration:
White waterlily tends to form dense floating mats of vegetation that prevent light penetration to native aquatic plants (Washington Department of Ecology 2005). Distribution of macrophytes mats influences the distribution phyto- and zooplankton, aquatic insects, and fish populations (Frodge et al. 1995, Moore et al. 1994).
Rational:
Frodge and others (1995) in a study of fish mortality in two western Washington lakes observed that fish avoid heavily vegetated areas and move to unaffected parts of the lake.
Sources of information:
Frodge, J.D., D.A. Marino, G.B. Pauley and G.L. Thomas. 1995. Mortality of largemouth bass (*Micropterus salmoides*) and steelhead trout (*Oncorhynchus mykiss*) in densely vegetated littoral areas tested using in situ bioassay. Lake and Reservoir Management 11 (2): 343-358.
Moore, B.C., W.H. Funk and E. Anderson. 1994. Water quality, fishery, and biologic characteristics in a shallow, eutrophic lake with dense macrophyte population. Lake and Reservoir Management 8(2): 175-188.
Washington Department of Ecology, Water Quality Program. 2005. Non-native freshwater plants – fragrant water lily. Washington. Available from: http://www.ecy.wa.gov/programs/wq/wqhome.html

1.3. Impact on Natural Community Composition

A.	No perceived impact; causes no apparent change in native populations	0
B.	Influences community composition (e.g., reduces the number of individuals in one or more native species in the community)	3
C.	Significantly alters community composition (e.g., produces a significant reduction in the population size of one or more native species in the community)	7
D.	Causes major alteration in community composition (e.g., results in the extirpation of one or several native species, reducing biodiversity or change the community	10

composition towards species exotic to the natural community)

U. Unknown

Score 10

Documentation:

Identify type of impact or alteration:

White waterlily infestations may shift microorganism species composition toward anaerobic species dominance. These infestations may cause a reduction of fish population size and lead to extirpation of fish species over the long term. Marcophyte beds create conditions favorable for rotifers and exotic fish species such as carp (Frodge et al. 1995, Moore et al. 1994).

Rational:

Sources of information:

Frodge, J.D., D.A. Marino, G.B. Pauley and G.L. Thomas. 1995. Mortality of largemouth bass (*Micropterus salmoides*) and steelhead trout (*Oncorhynchus mykiss*) in densely vegetated littoral areas tested using in situ bioassay. Lake and Reservoir Management 11 (2): 343-358.

Moore, B.C., W.H. Funk and E. Anderson. 1994. Water quality, fishery, and biologic characteristics in a shallow, eutrophic lake with dense macrophyte population. Lake and Reservoir Management 8(2): 175-188.

1.4. Impact on higher trophic levels (cumulative impact of this species on the animals, fungi, microbes, and other organisms in the community it invades)

A. Negligible perceived impact 0

B. Minor alteration 3

C. Moderate alteration (minor reduction in nesting/foraging sites, reduction in habitat connectivity, interference with native pollinators, injurious components such as spines, toxins) 7

D. Severe alteration of higher trophic populations (extirpation or endangerment of an existing native species/population, or significant reduction in nesting or foraging sites) 10

U. Unknown

Score 10

Documentation:

Identify type of impact or alteration:

White waterlily provides important habitat for fish, frogs, and invertebrates. However, a decline in the positive influences on fish production occurs once a threshold of approximately 40% of the surface area cover is exceeded. Wildlife including beaver, moose, muskrat, porcupine, and deer eat waterlily leaves and roots. Waterfowl eat the seeds (Washington Department of Ecology 2005). Aquatic and semi-aquatic insects use this species both for habitat and food (Dorn et al. 2001, Cronin et al. 1998). Beetles and bees have been observed visiting the flowers of waterlily. Dead insects were frequently found in flowers of *Nymphaea odorata* in studies of flowers pollination (Schneider and Chaney 1981). A change in nutrient regime may alter phyto- and zooplankton community composition and productivity (Murray and Hodson 1986). Fish population distribution also appears to be strongly influenced by waterlily infestations. In addition, waterfowl utilization of lakes has declined with the expansion of the white waterlily. Aqueous extracts from leaves, petioles, and rhizomes of white waterlily have strong allelopathy potential (Quayyum et al. 1999, Spence 1998). Sometimes other noxious plants such as *Hydrilla* can be introduced to lakes when waterlilies are planted (Washington Department of Ecology 2005, Moore et al. 1994).

Rational:

Lake restoration diagnostic study in Washington indicated that game fish populations are stressed by high temperatures, low summer oxygen concentration, and predation from carp. The stress resulted in reproductive failure and lower growth rates, in contrast to a population typically observed in lakes with less macrophyte biomass (Moore et al. 1994). Concentrations of dissolved oxygen in dense beds of *Nymphaea odorata* in two western Washington lakes were measured below lethal limits for largemouth bass and steelhead trout. Although, no significant mortality occurred in the surface water, all the fish found at 1 m in dense macrophyte beds were dead within 12

hours (Frodge et al. 1995). Schneider and Chaney (1981) considered that insects may drown in fluid in the cup-like center of the flower. The death of the insects may be because of asphyxiation due to the heavy floral odor or the accumulation of carbonic acid. Insects also died from drowning in closed flowers.

Sources of information:

Cronin, G., K.D. Wissing, and D.M. Lodge. 1998. Comparative feeding selectivity of herbivorous insects on water lilies: aquatic vs. semi-terrestrial insects and submerses vs. floating leaves. Freshwater Biology 39:243-257.

Dorn, N.J., G. Cronin and D.M. Lodge. 2001. Feeding preferences and performance of an aquatic lepidopteran on macrophytes: plant hosts as food and habitat. Oecologia 128: 406-415.

Frodge, J.D., D.A. Marino, G.B. Pauley and G.L. Thomas. 1995. Mortality of largemouth bass (*Micropterus salmoides*) and steelhead trout (*Oncorhynchus mykiss*) in densely vegetated littoral areas tested using in situ bioassay. Lake and Reservoir Management 11 (2): 343-358.

Moore, B.C., W.H. Funk, E. Anderson. 1994. Water quality, fishery, and biologic characteristics in a shallow, eutrophic lake with dense macrophyte population. Lake and Reservoir Management 8(2): 175-188.

Murray R.E. and R.E. Hodson. 1986. Influence of macrophyte decomposition on growth rate and community structure of Okefenokee swamp bacterioplankton. Applied and Environmental Microbiology 51: 293-301.

Quayyum, H.A., A.U. Mallik, and P.F. Lee. 1999. Allelopathic potential of aquatic plants associated with wild rice (Zizania palustris): I. Bioassay with plant and lake sediment samples. Journal of Chemical Ecology 25(1): 209-220.

Schneider, E.L. and T. Chaney. 1981. The floral biology of *Nymphaea odorata* (Nymphaeaceae). The Southwestern Naturalist 26 (2): 159-165.

Spence, S.K. 1998. Bioassay-directed isolation of the allelopathic constituents of the aquatic plant *Nymphaea odorata*. Dissertation Abstracts International Part B: Science and Engineering 58(10): 4762.

Washington Department of Ecology, Water Quality Program. 2005. Non-native freshwater plants – fragrant water lily. Washington. Available from: http://www.ecy.wa.gov/programs/wq/wqhome.html

Total Possible	40
Total	36

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2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY

2.1. Mode of reproduction

A.	Not aggressive reproduction (few [0-10] seeds per plant and no vegetative reproduction)	0
B.	Somewhat aggressive (reproduces only by seeds (11-1,000/m^2)	1
C.	Moderately aggressive (reproduces vegetatively and/or by a moderate amount of seed, <1,000/m^2)	2
D.	Highly aggressive reproduction (extensive vegetative spread and/or many seeded, >1,000/m^2)	3
U.	Unknown	

Score 2

Documentation:

Describe key reproductive characteristics (including seeds per plant):

Waterlily reproduces through both seeds and rhizome (Washington Department of Ecology 2005).

Rational:

Sources of information:

Washington Department of Ecology, Water Quality Program. 2005. Non-native freshwater plants – fragrant water lily. Washington. Available from: http://www.ecy.wa.gov/programs/wq/wqhome.html

2.2. Innate potential for long-distance dispersal (bird dispersal, sticks to animal hair, buoyant fruits, wind-dispersal)

A. Does not occur (no long-distance dispersal mechanisms) 0
B. Infrequent or inefficient long-distance dispersal (occurs occasionally despite lack of adaptations) 2
C. Numerous opportunities for long-distance dispersal (species has adaptations such as pappus, hooked fruit-coats, etc.) 3
U. Unknown

Score 3

Documentation:
Identify dispersal mechanisms:
Mature seeds released into water. Seeds are able to float for few days, by retaining air in the aril. Seeds are transported to other areas and other lakes by water currents and ducks that eat the seeds (Washington Department of Ecology 2005, Schneider and Chaney 1981).
Rational:

Sources of information:
Washington Department of Ecology, Water Quality Program. 2005. Non-native freshwater plants – fragrant water lily. Washington. Available from: http://www.ecy.wa.gov/programs/wq/wqhome.html
Schneider, E.L. and T. Chaney. 1981. The floral biology of *Nymphaea odorata* (Nymphaeaceae). The Southwestern Naturalist 26 (2): 159-165.

2.3. Potential to be spread by human activities (both directly and indirectly – possible mechanisms include: commercial sales, use as forage/revegetation, spread along highways, transport on boats, contamination, etc.)

A. Does not occur 0
B. Low (human dispersal is infrequent or inefficient) 1
C. Moderate (human dispersal occurs) 2
D. High (there are numerous opportunities for dispersal to new areas) 3
U. Unknown

Score 2

Documentation:
Identify dispersal mechanisms:
White waterlily is an extremely popular plant for cultivation in ornamental ponds. It has been intentionally introduced into many lakes. Cultivars with color variations have been developed and can be readily obtained at nurseries. (Washington Department of Ecology 2005).
Rational:

Sources of information:
Washington Department of Ecology, Water Quality Program. 2005. Non-native freshwater plants – fragrant water lily. Washington. Available from: http://www.ecy.wa.gov/programs/wq/wqhome.html

2.4. Allelopathic

A. No 0
B. Yes 2
U. Unknown

Score 2

Documentation:
Describe effect on adjacent plants:
Aqueous extracts from leaves, petioles, and rhizomes of white waterlily exhibit high allelopathy potential and are reported to inhibit seed germination and root growth of other aquatic plants (Quayyum et al. 1999, Spence 1998).
Rational:

Sources of information:
Quayyum, H.A., A.U. Mallik, and P.F. Lee. 1999. Allelopathic potential of aquatic plants associated with wild rice (Zizania palustris): I. Bioassay with plant and

lake sediment samples. Journal of Chemical Ecology 25(1): 209-220.
Spence, S.K. 1998. Bioassay-directed isolation of the allelopathic constituents of the aquatic plant *Nymphaea odorata*. Dissertation Abstracts International Part B: Science and Engineering 58(10): 4762.

2.5. Competitive ability

A. Poor competitor for limiting factors 0
B. Moderately competitive for limiting factors 1
C. Highly competitive for limiting factors and/or nitrogen fixing ability 3
U. Unknown

Score 1

Documentation:
Evidence of competitive ability:
No studies on competitive ability of *Nymphaea odorata* were found. Since established white waterlily is able to dominate and replace native macrphytes (Washington Department of Ecology 2005), it is likely able to outcompete other aquatic species.
Rational:

Sources of information:
Washington Department of Ecology, Water Quality Program. 2005. Non-native freshwater plants – fragrant water lily. Washington. Available from: http://www.ecy.wa.gov/programs/wq/wqhome.html

2.6. Forms dense thickets, climbing or smothering growth habit, or otherwise taller than the surrounding vegetation

A. No 0
B. Forms dense thickets 1
C. Has climbing or smothering growth habit, or otherwise taller than the surrounding vegetation 2
U. Unknown

Score 2

Documentation:
Describe grow form:
White waterlily forms dense floating mats of vegetation (Washington Department of Ecology 2005).
Rational:

Sources of information:
Washington Department of Ecology, Water Quality Program. 2005. Non-native freshwater plants – fragrant water lily. Washington. Available from: http://www.ecy.wa.gov/programs/wq/wqhome.html

2.7. Germination requirements

A. Requires open soil and disturbance to germinate 0
B. Can germinate in vegetated areas but in a narrow range or in special conditions 2
C. Can germinate in existing vegetation in a wide range of conditions 3
U. Unknown

Score 0

Documentation:
Describe germination requirements:
Seeds require light for germination. Seedlings are rarely observed in the field, when the adult population is high. However, a large number of seeds germinate after removal of adult plants when light breaks dormancy and stimulates germination (DiTomaso and Healy 2003, Else and Riemer 1984, Welker and Riemer 1982).
Rational:

Sources of information:
DiTomaso, J.M. and E.A. Healy. 2003. Aquatic and riparian weeds of the West. California: University of California, Agriculture and Natural Resources; 442

p.
Else, M.J. and D.N. Riemer. 1984. Factors affecting germination of seeds of fragrant waterlily (*Nymphaea odorata*). Journal of Aquatic Plant Management 22: 22-25.
Welker, W.V. and D.N. Riemer. 1982. Fragrant waterlily (*Nymphaea odorata*) control with multiple applications of glyphosate. Weed Science 30: 145-146.

2.8. Other species in the genus invasive in Alaska or elsewhere

A.	No	0
B.	Yes	3
U.	Unknown	

Score 3

Documentation:
Species:
Nymphaea mexicana Zucc. is a noxious weed in California (DiTomaso and Healy 2003, USDA 2002).
Sources of information:
DiTomaso, J.M. and E.A. Healy. 2003. Aquatic and riparian weeds of the West. California: University of California, Agriculture and Natural Resources; 442 p.
USDA (United States Department of Agriculture), NRCS (Natural Resource Conservation Service). 2002. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

2.9. Aquatic, wetland, or riparian species

A.	Not invasive in wetland communities	0
B.	Invasive in riparian communities	1
C.	Invasive in wetland communities	3
U.	Unknown	

Score 3

Documentation:
Describe type of habitat:
White waterlily grows in shallow ponds, lakes, ditches, slow streams, sloughs and pools in marshes (Washington Department of Ecology 2005, Woods 2005, Wiersema 1997).
Rational:

Sources of information:
Washington Department of Ecology, Water Quality Program. 2005. Non-native freshwater plants – fragrant water lily. Washington. Available from: http://www.ecy.wa.gov/programs/wq/wqhome.html
Wiersema, J.H. 1997. Nymphaeaceae Salisbury – Water-lily Family. *Nymphaea* In: Flora of North America. Vol. 3. Magnoliophyta: Magnoliidae and Hammamelidae. Oxford University Press, Oxford. pp. 66-77.
Woods, K., K.W. Hilu, J.H. Wiersema and T. Borsch. 2005. Pattern of variation and systematics of *Nymphaea odorata*: I. Evidence from morphology and inter-simple sequence repeats (ISSRs). Systematic Botany 30(3): 471-480.

Total Possible 25
Total 18

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3. DISTRIBUTION

3.1. Is the species highly domesticated or a weed of agriculture

A.	No	0
B.	Is occasionally an agricultural pest	2
C.	Has been grown deliberately, bred, or is known as a significant agricultural pest	4
U.	Unknown	

Score 4

Documentation:
Identify reason for selection, or evidence of weedy history:
White waterlily is a popular plant for cultivation in ornamental ponds. Many cultivars with color variations have been developed (Washington Department of Ecology 2005).
Rational:

Sources of information:
Washington Department of Ecology, Water Quality Program. 2005. Non-native freshwater plants – fragrant water lily. Washington. Available from: http://www.ecy.wa.gov/programs/wq/wqhome.html

3.2. Known level of ecological impact in natural areas

A.	Not known to cause impact in any other natural area	0
B.	Known to cause impacts in natural areas, but in dissimilar habitats and climate zones than exist in regions of Alaska	1
C.	Known to cause low impact in natural areas in similar habitats and climate zones to those present in Alaska	3
D.	Known to cause moderate impact in natural areas in similar habitat and climate zones	4
E.	Known to cause high impact in natural areas in similar habitat and climate zones	6
U.	Unknown	

Score 6

Documentation:
Identify type of habitat and states or provinces where it occurs:
A number of small lakes in Washington have been choked with white waterlily (Washington Department of Ecology 2005, City of Federal Way 2004). Alteration of water quality, nutrient dynamics, and plant and animal species composition has been documented for infested lakes (Frodge et al. 1995, Moore et al. 1994).
Sources of information:
City of Federal Way. 2004. Steel Lake. Integrated aquatic vegetation management plan. Washington: City of Federal Way, Public Works Department, Surface Water Management Division. 69 p.
Frodge, J.D., D.A. Marino, G.B. Pauley and G.L. Thomas. 1995. Mortality of largemouth bass (*Micropterus salmoides*) and steelhead trout (*Oncorhynchus mykiss*) in densely vegetated littoral areas tested using in situ bioassay. Lake and Reservoir Management 11 (2): 343-358.
Moore, B.C., W.H. Funk and E. Anderson. 1994. Water quality, fishery, and biologic characteristics in a shallow, eutrophic lake with dense macrophyte population. Lake and Reservoir Management 8(2): 175-188.
Washington Department of Ecology, Water Quality Program. 2005. Non-native freshwater plants – fragrant water lily. Washington. Available from: http://www.ecy.wa.gov/programs/wq/wqhome.html

3.3. Role of anthropogenic and natural disturbance in establishment

A.	Requires anthropogenic disturbances to establish	0
B.	May occasionally establish in undisturbed areas but can readily establish in areas with natural disturbances	3
C.	Can establish independent of any known natural or anthropogenic disturbances	5
U.	Unknown	

Score 3

Documentation:
Identify type of disturbance:
White waterlily has been introduced into lakes with various levels of human disturbances (Washington Department of Ecology 2005).
Rational:

Sources of information:
Washington Department of Ecology, Water Quality Program. 2005. Non-native freshwater plants – fragrant water lily. Washington. Available from: http://www.ecy.wa.gov/programs/wq/wqhome.html
Wiersema, J.H. 1997. Nymphaeaceae Salisbury – Water-lily Family. *Nymphaea* In:

Flora of North America. Vol. 3. Magnoliophyta: Magnoliidae and Hammamelidae. Oxford University Press, Oxford. pp. 66-77.

3.4. Current global distribution

A.	Occurs in one or two continents or regions (e.g., Mediterranean region)	0
B.	Extends over three or more continents	3
C.	Extends over three or more continents, including successful introductions in arctic or subarctic regions	5
U.	Unknown	

Score 0

Documentation:

Describe distribution:

White waterlily is native to the eastern half of North America, including southern Canada. It has been introduced as an ornamental in many parts of the world and it is expected to expand its range. It is naturalized in South America (Washington Department of Ecology 2005, Woods 2005, Wiersema 1997).

Rational:

Sources of information:

Washington Department of Ecology, Water Quality Program. 2005. Non-native freshwater plants – fragrant water lily. Washington. Available from: http://www.ecy.wa.gov/programs/wq/wqhome.html

Wiersema, J.H. 1997. Nymphaeaceae Salisbury – Water-lily Family. *Nymphaea* In: Flora of North America. Vol. 3. Magnoliophyta: Magnoliidae and Hammamelidae. Oxford University Press, Oxford. pp. 66-77.

Woods, K., K.W. Hilu, J.H. Wiersema and T. Borsch. 2005. Pattern of variation and systematics of *Nymphaea odorata*: I. Evidence from morphology and inter-simple sequence repeats (ISSRs). Systematic Botany 30(3): 471-480.

3.5. Extent of the species U.S. range and/or occurrence of formal state or provincial listing

A.	0-5% of the states	0
B.	6-20% of the states	2
C.	21-50%, and/or state listed as a problem weed (e.g., “Noxious,” or “Invasive”) in 1 state or Canadian province	4
D.	Greater than 50%, and/or identified as “Noxious” in 2 or more states or Canadian provinces	5
U.	Unknown	

Score 5

Documentation:

Identify states invaded:

White waterlily distribution includes nearly all American states and most Canadian provinces (Woods et al. 2005, USDA 2002, Wiersema 1997). *Nymphaea odorata* ssp. *odorata* is listed as a noxious weed in Washington (Invaders Database System 2003, USDA 2002).

Rational:

Sources of information:

Invaders Database System. The University of Montana. 2003. Montana Noxious Weed Trust Fund. Department of Agriculture. http://invader.dbs.umt.edu/

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Total Possible	25
Total	18

4. FEASIBILITY OF CONTROL

4.1. Seed banks

A.	Seeds remain viable in the soil for less than 3 years	0
B.	Seeds remain viable in the soil for between 3 and 5 years	2
C.	Seeds remain viable in the soil for 5 years and more	3
U.	Unknown	

Score U

Documentation:
Identify longevity of seed bank:
Unknown
Rational:

Sources of information:

4.2. Vegetative regeneration

A.	No resprouting following removal of aboveground growth	0
B.	Resprouting from ground-level meristems	1
C.	Resprouting from extensive underground system	2
D.	Any plant part is a viable propagule	3
U.	Unknown	

Score 2

Documentation:
Describe vegetative response:
White white waterlily is able to resprout from rhizomes (Washington Department of Ecology, City of Federal Way 2004).
Rational:
Cutting of rhizomes into 4 inches or larger pieces is recommended for propagation in cultivation (Washington Department of Ecology 2005).
Sources of information:
City of Federal Way. 2004. Steel Lake. Integrated aquatic vegetation management plan. Washington: City of Federal Way, Public Works Department, Surface Water Management Division. 69 p.
Washington Department of Ecology, Water Quality Program. 2005. Non-native freshwater plants – fragrant water lily. Washington. Available from: http://www.ecy.wa.gov/programs/wq/wqhome.html

4.3. Level of effort required

A.	Management is not required (e.g., species does not persist without repeated anthropogenic disturbance)	0
B.	Management is relatively easy and inexpensive; requires a minor investment in human and financial resources	2
C.	Management requires a major short-term investment of human and financial resources, or a moderate long-term investment	3
D.	Management requires a major, long-term investment of human and financial resources	4
U.	Unknown	

Score 4

Documentation:
Identify types of control methods and time-term required:
White waterlily can be controlled by cutting, harvesting, covering with bottom barrier materials, and aquatic herbicides (City of Federal Way 2004, Washington Department of Ecology 2005, Welker and Riemer 1982). Persistant picking of emerging leaves every other day during two to three growing seasons will eventually kill the plants. After control treatment dead and decomposing leaves and rhizomes may form floating mats in the lake. Removing all dead materials from the water is recommended. All

control methods are time consuming and labor intensive. There are no effective biological control agents available at this time for waterlily (Washington Department of Ecology 2005).
Rational:

Sources of information:
City of Federal Way. 2004. Steel Lake. Integrated aquatic vegetation management plan. Washington: City of Federal Way, Public Works Department, Surface Water Management Division. 69 p.
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Welker, W.V. and D.N. Riemer. 1982. Fragrant waterlily (*Nymphaea odorata*) control with multiple applications of glyphosate. Weed Science 30: 145-146.

Total Possible	7
Total	6

Total for 4 sections Possible	97
Total for 4 sections	78

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