

Appendix A - Memoranda of Understanding

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Appendix B - Vegetation, Arundo, and Tamarisk Maps

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Appendix C - Native and Non-native Plant Species Present in the 2008 Survey

Table 1 below lists the plant species observed during the 2008 CCARP vegetation mapping survey. This survey occurred during a season when many plant species are not detectable, and not every riparian corridor in the watershed was surveyed. Therefore, this list does not represent a comprehensive flora of the project area.

Table 1 – Plant Species List – 2008 CCARP Vegetation Mapping Survey

Scientific Name	Common Name	Family	Native
<i>Acacia redolens</i>	prostrate acacia, bank catclaw	Fabaceae	No
<i>Acacia</i> sp.	Unknown Acacia Tree	Fabaceae	No
<i>Achillea millefolium</i>	yarrow	Asteraceae	Yes
<i>Achnatherum coronatum</i>	giant needlegrass	Poaceae	Yes
<i>Acourtia microcephala</i>	perezia	Asteraceae	Yes
<i>Adenostoma fasciculatum</i>	chamise	Rosaceae	Yes
<i>Agave americana</i>	Century plant	Liliaceae	No
<i>Ailanthus altissima</i>	tree of heaven	Simaroubaceae	No
<i>Alnus rhombifolia</i>	white alder	Betulaceae	Yes
<i>Ambrosia psilostachya</i>	Western ragweed	Asteraceae	Yes
<i>Amorpha californica</i>	false indigo	Fabaceae	Yes
<i>Anagallis arvensis</i>	scarlet pimpernel	Primulaceae	No
<i>Anemopsis californica</i>	yerba mansa	Saururaceae	Yes
<i>Anthemis nobilis</i>	chamomile	Asteraceae	No
<i>Apium graveolens</i>	celery	Apiaceae	No
<i>Aptenia cordifolia</i>	red apple iceplant	Aizoaceae	No
<i>Argemone munita</i>	chicalote, prickly poppy	Papaveraceae	Yes
<i>Artemisia californica</i>	California sagebrush	Asteraceae	Yes
<i>Artemisia douglasiana</i>	mugwort	Asteraceae	Yes
<i>Arundo donax</i>	giant reed	Poaceae	No
<i>Astragalus trichopodus</i>	locoweed	Fabaceae	Yes
<i>Atriplex lentiformis</i>	quailbush	Chenopodiaceae	Yes
<i>Atriplex semibaccata</i>	Australian saltbush	Chenopodiaceae	No
<i>Avena barbata</i>	slender oat	Poaceae	No
<i>Avena fatua</i>	wild oat	Poaceae	No
<i>Azolla filiculoides</i>	Pacific azolla	Azollaceae	Yes
<i>Baccharis pilularis</i>	coyote brush	Asteraceae	Yes
<i>Baccharis salicifolia</i>	mule fat	Asteraceae	Yes
<i>Bambusa</i> sp.	bamboo (horticultural)	Poaceae	No
<i>Bassia hyssopifolia</i>	five-hooked bassia	Chenopodiaceae	No

Table 1 – Plant Species List – 2008 CCARP Vegetation Mapping Survey (continued)

Scientific Name	Common Name	Family	Native
<i>Brassica nigra</i>	black mustard	Brassicaceae	No
<i>Bromus carinatus</i>	California brome	Poaceae	Yes
<i>Bromus diandrus</i>	ripgut brome	Poaceae	No
<i>Bromus hordeaceus</i>	soft chess	Poaceae	No
<i>Bromus madritensis</i>	red brome	Poaceae	No
<i>Bromus tectorum</i>	cheatgrass	Poaceae	No
<i>Callistemon</i> sp.	bottlebrush	Myrtaceae	No
<i>Calystegia macrostegia</i>	California morning glory	Convolvulaceae	Yes
<i>Carduus pycnocephalus</i>	Italian thistle	Asteraceae	No
<i>Carex</i> sp.	sedge	Cyperaceae	Yes
<i>Carpobrotus edulis</i>	Hottentot fig	Aizoaceae	No
<i>Casuarina equisetifolia</i>	Australian pine, she-oak	Casuarinaceae	No
<i>Ceanothus crassifolius</i>	hoaryleaf ceanothus	Rhamnaceae	Yes
<i>Ceanothus oliganthus</i>	hairyleaf ceanothus	Rhamnaceae	Yes
<i>Ceanothus spinosus</i>	greenbark ceanothus	Rhamnaceae	Yes
<i>Centaurea melitensis</i>	toocalote	Asteraceae	No
<i>Cercocarpus betuloides</i>	birchleaf mountain mahogany	Rosaceae	Yes
<i>Chrysanthemum coronarium</i>	garland chrysanthemum	Asteraceae	No
<i>Clematis lasiantha</i>	chaparral clematis	Ranunculaceae	Yes
<i>Conium maculatum</i>	poison hemlock	Apiaceae	No
<i>Convolvulus arvensis</i>	field bindweed	Convolvulaceae	No
<i>Conyza canadensis</i>	horseweed	Asteraceae	Yes
<i>Cordylanthus rigidus</i>	bird's beak	Scrophulariaceae	Yes
<i>Croton californicus</i>	croton	Euphorbiaceae	Yes
<i>Cucurbita foetidissima</i>	calabazilla	Cucurbitaceae	Yes
<i>Cuscuta californica</i>	dodder	Convolvulaceae	Yes
<i>Cynara cardunculus</i>	artichoke thistle	Asteraceae	No
<i>Cynodon dactylon</i>	Bermuda grass	Poaceae	No
<i>Cyperus</i> spp. (native)	nutsedge	Cyperaceae	Yes
<i>Cyperus</i> spp. (non-native)	nutsedge	Cyperaceae	No
<i>Datura wrightii</i>	jimson weed	Solanaceae	Yes
<i>Delairea odorata</i>	Cape ivy	Asteraceae	No
<i>Dendromecon rigida</i>	bush poppy	Papaveraceae	Yes
<i>Distichilis spicata</i>	salt grass	Poaceae	Yes

Table 1 – Plant Species List – 2008 CCARP Vegetation Mapping Survey (continued)

Scientific Name	Common Name	Family	Native
<i>Echinochloa crus-galli</i>	barnyard grass	Poaceae	No
<i>Eleocharis</i> sp.	spikerush	Cyperaceae	Yes
<i>Elymus glaucus</i>	blue wildrye	Poaceae	Yes
<i>Encelia farinosa</i>	brittle bush	Asteraceae	Yes*
<i>Epilobium canum</i>	California fuchsia	Onagraceae	Yes
<i>Epilobium ciliatum</i>	willow-herb	Onagraceae	Yes
<i>Equisetum hymenale</i>	horsetail	Equisetaceae	Yes
<i>Eriastrum densifolium</i>	giant woollystar	Polemoniaceae	Yes
<i>Ericameria pinifolia</i>	pine bush	Asteraceae	Yes
<i>Eriodictyon crassifolium</i>	thick-leaved yerba santa	Hydrophyllaceae	Yes
<i>Eriogonum crocatum</i>	Conejo buckwheat	Polygonaceae	Yes
<i>Eriogonum elongatum</i>	wand buckwheat	Polygonaceae	Yes
<i>Eriogonum fasciculatum</i>	California buckwheat	Polygonaceae	Yes
<i>Eriophyllum confertifolium</i>	false golden yarrow	Asteraceae	Yes
<i>Erodium cicutarium</i>	filaree	Geraniaceae	No
<i>Eschscholzia californica</i>	California poppy	Papaveraceae	Yes
<i>Eucalyptus globulus</i>	blue gum	Myrtaceae	No
<i>Eucalyptus</i> sp.	eucalyptus (not blue gum)	Myrtaceae	No
<i>Euphorbia lathyris</i>	gopher spurge	Euphorbiaceae	No
<i>Ficus carica</i>	edible fig	Moraceae	No
<i>Foeniculum vulgare</i>	fennel	Apiaceae	No
<i>Fraxinus dipetala</i>	chaparral ash	Oleaceae	Yes
<i>Fraxinus uhdei</i>	Shamel ash	Oleaceae	No
<i>Fraxinus velutina</i>	velvet ash	Oleaceae	No*
<i>Fremontodendron californicum</i>	flannel bush	Sterculiaceae	No*
<i>Galium angustifolium</i>	narrowleaf bedstraw	Rubiaceae	Yes
<i>Gazania rigens</i>	gazania, freeway daisy	Asteraceae	No
<i>Gnaphalium californicum</i>	California everlasting	Asteraceae	Yes
<i>Gnaphalium canescens</i>	pearly everlasting	Asteraceae	Yes
<i>Hazardia squarrosa</i>	saw-tooth goldenbush	Asteraceae	Yes
<i>Hedera helix</i>	English ivy	Araliaceae	No
<i>Helianthus annuus</i>	sunflower	Asteraceae	Yes
<i>Hemizonia fasciculatum</i>	tarweed	Asteraceae	Yes
<i>Heteromeles arbutifolia</i>	toyon	Rosaceae	Yes

Table 1 – Plant Species List – 2008 CCARP Vegetation Mapping Survey (continued)

Scientific Name	Common Name	Family	Native
<i>Heterotheca grandiflora</i>	telegraph weed	Asteraceae	Yes
<i>Hirschfeldia incana</i>	shortpod mustard	Brassicaceae	No
<i>Hordeum</i> sp.	barley	Poaceae	No
<i>Isocoma menziesii</i>	goldenbush	Asteraceae	Yes
<i>Isomeris arborea</i>	bladderpod	Capparaceae	Yes
<i>Juglans californica</i>	California black walnut	Juglandaceae	Yes
<i>Juglans regia</i>	English walnut	Juglandaceae	No
<i>Juncus</i> spp.	rush (not lily-leafed)	Juncaceae	Yes
<i>Juncus xiphioides</i>	lily-leaf rush	Juncaceae	Yes
<i>Keckiella cordifolia</i>	heartleaf penstemon	Scrophulariaceae	Yes
<i>Lactuca serriola</i>	prickly lettuce	Asteraceae	No
<i>Lathyrus vestitus</i>	canyon sweet pea	Fabaceae	Yes
<i>Lemna</i> sp.	duckweed	Lemnaceae	Yes
<i>Lepidium latifolium</i>	perennial pepperweed	Brassicaceae	No
<i>Lepidospartum squamatum</i>	scale broom	Asteraceae	Yes
<i>Leptochloa uninerva</i>	Mexican sprangletop	Poaceae	Yes
<i>Lessingia filaginifolia (Corethrogyne)</i>	California aster	Asteraceae	Yes
<i>Leymus condensatus</i>	giant wild rye	Poaceae	Yes
<i>Leymus triticoides</i>	creeping wild rye	Poaceae	Yes
<i>Liquidambar styraciflua</i>	sweetgum	Hamamelidaceae	No
<i>Lolium multiflorum</i>	Italian ryegrass	Poaceae	No
<i>Lonicera subspicata</i>	chaparral honeysuckle	Caprifoliaceae	Yes
<i>Lotus corniculatus</i>	birdsfoot trefoil	Fabaceae	No
<i>Lotus scoparius</i>	deerweed	Fabaceae	Yes
<i>Lupinus hirsutissimus</i>	stinging lupine	Fabaceae	Yes
<i>Lupinus longifolius</i>	bush lupine	Fabaceae	Yes
<i>Lupinus succulentus</i>	arroyo lupine	Fabaceae	Yes
<i>Malacothamnus fasciculatus</i>	bush mallow	Malvaceae	Yes
<i>Malacothrix saxatilis</i>	cliff aster	Asteraceae	Yes
<i>Malosma laurina</i>	laurel sumac	Anacardiaceae	Yes
<i>Marah macrocarpus</i>	wild cucumber	Cucurbitaceae	Yes
<i>Marrubium vulgare</i>	horehound	Lamiaceae	No
<i>Medicago polymorpha</i>	burr clover	Fabaceae	No
<i>Melilotus alba</i>	white sweetclover	Fabaceae	No

Table 1 – Plant Species List – 2008 CCARP Vegetation Mapping Survey (continued)

Scientific Name	Common Name	Family	Native
<i>Melilotus indicus</i>	Indian sweetclover	Fabaceae	No
<i>Melilotus officinale</i>	Yellow sweetclover	Fabaceae	No
<i>Mimulus aurantiacus</i>	bush monkeyflower	Scrophulariaceae	Yes
<i>Mimulus cardinalis</i>	scarlet monkeyflower	Scrophulariaceae	Yes
<i>Mimulus guttatus</i>	seep monkeyflower	Scrophulariaceae	Yes
<i>Muhlenbergia rigens</i>	deergrass	Poaceae	Yes
<i>Myoporum laetum</i>	myoporum	Myoporaceae	No
<i>Nassella lepida</i>	foothill needlegrass	Poaceae	Yes
<i>Nassella pulchra</i>	purple needlegrass	Poaceae	Yes
<i>Nerium oleander</i>	oleander	Apocynaceae	No
<i>Nicotiana glauca</i>	tree tobacco	Solanaceae	No
<i>Opuntia ficus-indica</i>	prickly pear	Cactaceae	No
<i>Opuntia littoralis</i>	coast prickly pear	Cactaceae	Yes
<i>Parthenocissus quinquefolia</i>	Virginia creeper	Vitaceae	No
<i>Paspalum dilatatum</i>	Dallis grass	Poaceae	No
<i>Pennisetum clandestinum</i>	kikuyu grass	Poaceae	No
<i>Pennisetum setaceum</i>	fountain grass	Poaceae	No
<i>Penstemon centranthifolius</i>	scarlet bugler	Scrophulariaceae	Yes
<i>Persea americana</i>	avocado	Lauraceae	No
<i>Phacelia cicutaria</i>	caterpillar phacelia	Hydrophyllaceae	Yes
<i>Phacelia ramosissima</i>	branching phacelia	Hydrophyllaceae	Yes
<i>Phacelia tanacetifolia</i>	lacy phacelia	Hydrophyllaceae	Yes
<i>Phalaris</i> sp.	canary grass	Poaceae	No
<i>Phoenix canariensis</i>	Canary Island date palm	Arecaceae	No
<i>Phoradendron macrophyllum</i>	bigleaf mistletoe	Viscaceae	Yes
<i>Phoradendron villosum</i>	oak mistletoe	Viscaceae	Yes
<i>Picris echioides</i>	bristly ox tongue	Asteraceae	No
<i>Pinus</i> spp.	non-native pines	Pinaceae	No
<i>Piptatherum millefolium</i>	smilo grass	Poaceae	No
<i>Plantago lanceolata</i>	English plantain	Plantaginaceae	No
<i>Platanus racemosa</i>	California sycamore	Platanaceae	Yes
<i>Platanus X acerifolia</i>	London plane	Platanaceae	No
<i>Polygonum lapathifolium</i>	willow weed	Polygonaceae	Yes
<i>Polypogon monspeliensis</i>	annual rabbitsfoot grass	Poaceae	No

Table 1 – Plant Species List – 2008 CCARP Vegetation Mapping Survey (continued)

Scientific Name	Common Name	Family	Native
<i>Populus balsamifera</i> ssp. <i>trichocarpa</i>	black cottonwood	Salicaceae	Yes
<i>Populus fremontii</i>	Fremont cottonwood	Salicaceae	Yes
<i>Populus nigra</i>	Lombardy poplar	Salicaceae	No
<i>Prunus ilicifolia</i>	hollyleaf cherry	Rosaceae	Yes
<i>Pyracantha</i> sp.	firethorn	Rosaceae	No
<i>Quercus agrifolia</i>	coast live oak	Fagaceae	Yes
<i>Quercus berberidifolia</i>	scrub oak	Fagaceae	Yes
<i>Quercus lobata</i>	valley oak	Fagaceae	Yes
<i>Raphanus sativa</i>	wild radish	Brassicaceae	No
<i>Rhamnus californica</i>	coffeeberry	Rhamnaceae	Yes
<i>Rhamnus ilicifolia</i>	hollyleaf redberry	Rhamnaceae	Yes
<i>Rhus integrifolia</i>	lemonadeberry	Anacardiaceae	Yes
<i>Rhus ovata</i>	sugarbush	Anacardiaceae	Yes
<i>Ribes californicum</i>	hillside gooseberry	Grossulariaceae	Yes
<i>Ribes malvaceum</i>	chaparral currant	Grossulariaceae	Yes
<i>Ribes speciosum</i>	fuschia-flowered gooseberry	Grossulariaceae	Yes
<i>Ricinus communis</i>	castor bean	Euphorbiaceae	No
<i>Rorippa nasturtium-aquaticum</i>	water cress	Brassicaceae	Yes
<i>Rosa californica</i>	California wild rose	Rosaceae	Yes
<i>Rubus discolor</i>	Himalayan blackberry	Rosaceae	No
<i>Rubus ursinus</i>	Pacific blackberry	Rosaceae	Yes
<i>Rumex crispus</i>	curly dock	Polygonaceae	No
<i>Salicornia virginica</i>	pickleweed	Chenopodiaceae	Yes
<i>Salix × sepulcralis</i>	weeping willow	Salicaceae	No
<i>Salix exigua</i>	sandbar willow	Salicaceae	Yes
<i>Salix gooddingii</i>	black willow	Salicaceae	No*
<i>Salix laevigata</i>	red willow	Salicaceae	Yes
<i>Salix lasiolepis</i>	arroyo willow	Salicaceae	Yes
<i>Salsola traegus</i>	Russian thistle	Chenopodiaceae	No
<i>Salvia apiana</i>	white sage	Lamiaceae	Yes
<i>Salvia leucophylla</i>	purple sage	Lamiaceae	Yes
<i>Salvia mellifera</i>	black sage	Lamiaceae	Yes
<i>Salvia spathacea</i>	hummingbird sage	Lamiaceae	Yes
<i>Sambucus mexicana</i>	Mexican elderberry	Caprifoliaceae	Yes

Table 1 – Plant Species List – 2008 CCARP Vegetation Mapping Survey (continued)

Scientific Name	Common Name	Family	Native
<i>Schinus molle</i>	Peruvian pepper	Anacardiaceae	No
<i>Scirpus acutus</i>	tule	Cyperaceae	Yes
<i>Scirpus americanus</i>	three-square bulrush	Cyperaceae	Yes
<i>Scirpus californicus</i>	California bulrush	Cyperaceae	Yes
<i>Scrophularia californica</i>	California figwort	Scrophulariaceae	Yes
<i>Senecio flaccidus</i>	groundsel	Asteraceae	Yes
<i>Silybum marianum</i>	milk thistle	Asteraceae	No
<i>Sonchus asper</i>	spiny sowthistle	Asteraceae	No
<i>Sonchus oleraceus</i>	common sow thistle	Asteraceae	No
<i>Stachys bullata</i>	hedge nettle	Lamiaceae	Yes
<i>Symphoricarpos mollis</i>	creeping snowberry	Caprifoliaceae	Yes
<i>Tamarix aphylla</i>	Athel tamarisk, tamarisk	Tamaricaceae	No
<i>Tamarix</i> spp.	tamarisk	Tamaricaceae	No
<i>Toxicodendron diversilobum</i>	poison oak	Anacardiaceae	Yes
<i>Typha angustifolia</i>	narrowleaf cattail	Typhaceae	Yes
<i>Typha domingensis</i>	southern cattail	Typhaceae	Yes
<i>Typha latifolia</i>	broad-leaved cattail	Typhaceae	Yes
<i>Ulmus parvifolia</i>	Chinese elm	Ulmaceae	No
<i>Ulmus pumila</i>	Siberian elm	Ulmaceae	No
<i>Umbellularia californica</i>	California bay	Lauraceae	Yes
<i>Urtica dioica</i>	stinging nettle	Urticaceae	Yes
<i>Urtica urens</i>	dwarf nettle	Urticaceae	No
<i>Verbena lasiostachys</i>	verbena	Verbenaceae	Yes
<i>Veronica anagallis-aquatica</i>	water speedwell	Scrophulariaceae	No
<i>Vitis girdiana</i>	desert wild grape	Vitaceae	Yes
<i>Vulpia microstachys</i>	small fescue	Poaceae	Yes
<i>Washingtonia robusta</i>	Mexican fan palm	Arecaceae	No
<i>Xanthium strumarium</i>	rough cocklebur	Asteraceae	Yes
<i>Yucca</i> sp.	Mexican yucca	Liliaceae	No
<i>Yucca whipplei</i>	chaparral yucca	Liliaceae	Yes

*Plant is native to southern California but not native to the Calleguas Creek watershed and was locally introduced.

Appendix D - Non-native Invasive Plants - Additional Information Sources

This appendix provides additional information on available resources for non-native invasive plant species and removal projects.

AGENCY RESOURCES

Table 1 - Other Organizations for Assistance with Non-native Invasive Plant Removal

Agency or Group Name	Assistance Available	How to Contact
Ventura County Agricultural Commissioner	Regulates herbicide use. Provides information to obtain certification or licenses. Also provides Operator Identification Number and safety training for application of non-restricted materials.	(805) 933-3165 (805) 647-5931 P.O. Box 889 Santa Paula, CA 93061 815 East Santa Barbara Street
Southern California Air Quality Management District	May require permit for controlled burning or incineration of biomass. Advises days when burning can occur.	(909)396-2000 21865 Copley Dr Diamond Bar, CA 91765 http://www.aqmd.gov/
County or Local Water Districts	May require a permit to access properties.	(661)259-3610
California Conservation Corps (CCC) (Camarillo/Los Angeles/Norwalk)	Can provide labor for control of non-native invasive plants and restoration of native plants.	(805)484-4345 1878 South Lewis Rd. Unit 60 Camarillo, CA 93010 http://www.ccc.ca.gov/
Concerned Resource Environmental Workers (CREW)	Control of non-native invasive plants and restoration of native plants	(805)646-5085 P.O. Box 1532 Ojai, CA 93024 (No Website)
California Department of Fish and Game (San Diego)	Issues Streambed Alteration Agreements and consults for impacts to state listed species.	(916)445-0411 1416 Ninth Street Sacramento, California 95814 http://www.dfg.ca.gov/
California Invasive Plant Council	Provides information on non-native invasive plants in California.	(510)843-3902 1442-A Walnut St., #462 Berkeley, CA 94709 http://www.cal-ipc.org/
Ventura County or local Fire Department	Provides information for fire safety. May issue a burn permit.	165 Durley Ave. Camarillo, CA 93010-8586 (805) 389-9710
Natural Resource Conservation Service (Lancaster)	Provides information for erosion control, non-native plant removal, habitat restoration, and funding	(661)945-2604 44811 N. Date Avenue, Suite G, Lancaster, CA 93534 http://www.ca.nrcs.usda.gov
Ventura County Public Works	Issues encroachment permits	http://publicworks.countyofventura.org/index.html
Team Arundo del Norte (Sonoma Ecology Center)	Provides information on removal techniques, biology, grant information, regional coordination of removal efforts	(707)996-0712 P.O. Box 1486 Eldridge CA 95431 http://www.sonomaecologycenter.org

Table 1 - Other Organizations for Assistance with Non-native Invasive Plant Removal (cont.)

Agency or Group Name	Assistance Available	How to Contact
Arundo Task Force	Provides information on removal techniques, biology, and grant information.	(805)386-4685 P.O. Box 147 Somis CA 93066 http://www.arundotaskforce.org
US Army Corps of Engineers (Los Angeles Region)	Issues Section 404 permit (for earthmoving or fill in stream)	213) 452-3908 P.O. Box 532711 Los Angeles CA 90053-2325 http://www.spl.usace.army.mil
US Fish and Wildlife Service (San Diego)	Provides consultations for potential impacts to federal listed species and may have potential funding through Partners for Wildlife or Santa Clara River Trustee Council	1-800-344-WILD 2493 PORTOLA ROAD SUITE B VENTURA CA 93003 http://www.fws.gov/
Regional Water Quality Control Board (Los Angeles)	Provides information on water quality issues and issues 401 Water Quality Certification (for earthmoving or fill in stream)	(213) 576-1364 P.O. Box 2815 Sacramento, CA 95812-2815 http://www.calepa.ca.gov/
US Bureau of Land Management	Potential funding through War on Weeds	(202) 452-5125 1849 C Street, Room 406-LS Washington, DC 20240 http://www.blm.gov/nhp/index.htm
Ventura County Weed Management Area	Provides information on weed management	(805) 386-4685. P.O. Box 147 Somis, CA 93066 http://www.vcwma.org
The Nature Conservancy	Provides information on removal methods	(805) 642-0345 3639 Harbor Boulevard Suite 201 Ventura CA 93001 http://www.tnccalifornia.org
California Native Plant Society (Ventura)	Provides information on California native plants and on vegetation mapping and monitoring methods.	(916) 447-2677 2707 K Street, Suite 1 • Sacramento, CA 95816-5113 http://www.cnps.org/
Society for Ecological Restoration (SER Cal)	Provides information on California native habitat restoration	2701 20th Street Bakersfield, CA 93301-3334 Tel. (661) 634-9228 http://www.sercal.org/
Chiquita Canyon Landfill	Closest landfill to the project area	3 miles west of Interstate 5 on State Route 126 in the Santa Clarita Valley http://www.chiquitacanyon.com

LITERATURE RESOURCES

Table 2 - Non-native Invasive Plant Books

Organization	Book
Team Arundo del Norte	Arundo: A Landowner Handbook
Team Arundo del Norte	Controlling Arundo in Your Watershed: A Guide for Organizations
The Nature Conservancy	Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas
California Invasive Plant Council	The Weedworker's Handbook: A Guide to Techniques for Removing Bay Area Invasive Plants

WEB RESOURCES

Table 3 - Arundo Resources

Organization	Website
National Park Service Plant Conservation Alliance	http://www.nps.gov/plants/alien/fact/ardo1.htm
Santa Ana Watershed Project Authority	http://www.sawpa.org/arundo/
Team Arundo del Norte	http://teamarundo.org/
Team Arundo del Norte Reference Library	http://teamarundo.org/research_reference/index.html#biblio
The Nature Conservancy Arundo Stewardship Abstract	http://tncweeds.ucdavis.edu/esadocs/documnts/arundon.html
The Nature Conservancy Arundo Images	http://tncweeds.ucdavis.edu/esadocs/arundona.html
U.S. Department of Agriculture	http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=ARDO4
U.S. Army Corp of Engineers	http://www.wes.army.mil/el/pmis/plants/html/arundo_d.html

Table 4 - Tamarisk Resources

Organization	Website
National Biological Information Infrastructure California Information Node	http://cain.nbii.gov/crisis/crisiscat/viewResource?resource
Earlham College	http://www.earlham.edu/~biol/desert/invasive.htm
Invasive Species.gov - Saltcedar profile	http://www.invasivespecies.gov/profiles/saltcedar.shtml
Proceedings Saltcedar Workshop - June 1996	http://www.invasivespecies.gov/education/workshopJun96/index.html
National Park Service	http://www.nps.gov/plants/alien/fact/tama1.htm
The Nature Conservancy Tamarisk Stewardship Abstract	http://tncweeds.ucdavis.edu/esadocs/tamaramo.html
U.S. Fish and Wildlife Service	http://www.fs.fed.us/database/feis/plants/tree/tamsp/all.html
Washington State Board Noxious Weed Control Board	http://www.nwcb.wa.gov/weed_info/Tamarix_ramosissima.html
U.S. Army Corp of Engineers	http://www.wes.army.mil/el/pmis/plants/html/tamarix_.html
University of California, Santa Barbara RIVR Lab	http://rivrlab.msi.ucsb.edu/tamarix.html

Table 5 - Invasive Plant Organizations

Organization	Website
Cal Invasive Plant Council	http://www.cal-ipc.org/
California Weed Management Areas	http://www.cdfa.ca.gov/phpps/ipc/weedmgmtareas/
Santa Barbara County Weed Management Area	http://www.countyofsb.org/agcomm/wma/
Santa Margarita & San Luis Rey Weed Mgmt	http://smslrwma.org/
National Biological Information Infrastructure Invasive Species Information Node	http://invasivespecies.nbii.gov/
Noxious Weed Information Project	http://www.cdfa.ca.gov/phpps/ipc/noxweedinfo/noxweedinfo_html.htm
Center for Invasive Plant Management	http://www.weedcenter.org/
National Park Service	http://science.nature.nps.gov/im/monitor/invasives.htm
U.S. Army Corp of Engineers Aquatic Plant Control	http://www.wes.army.mil/el/aqua/
San Francisco Estuary Institute	http://www.sfei.org/nis/NISguidebook.pdf
The Nature Conservancy Weed Removal Handbook	http://tncweeds.ucdavis.edu/handbook.html
Global Invasive Species Specialists Groups	http://www.issg.org/

Appendix E - Best Management Practices

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BEST MANAGEMENT PRACTICES (BMPS)

Although the primary goal of removal programs for non-native invasive plant species is to improve ecosystem functions and services within the watershed, some removal techniques have the potential to negatively affect the environment and natural resources in and near the project area. Best Management Practices (BMPs) are designed to reduce short-term adverse impacts of the project. Most BMPs are implemented when work is conducted in the field. However, some can be implemented prior to commencement of work.

The following description of project BMPs is divided into categories based on issue area and type of removal method. All BMPs shall be applied to all projects, as applicable, in order to qualify to use the Calleguas Creek Watershed Arundo/Tamarisk Removal Program (CCARP) programmatic permits.

For all BMPs below, "listed species" are defined as state or federally-listed threatened, endangered, or proposed plant and wildlife species. "Special status species" are defined as the following plant and wildlife species: listed species; California Native Plant Society (CNPS) list 1 and 2 plant species; and state fully protected, rare, and species of special concern.

GENERAL BMPS

Timing

- No activity shall occur during a rain event or if forecasts indicate that rain is likely within 24 hours. If rain does occur, erosion control measures such as sand bags and/or silt fences shall be employed to reduce offsite flow of soil. If storm flow enters the project site, work shall only resume once the flow has receded and 72 hours has passed.
- Initial removal work shall avoid the bird breeding season, generally between March 1 and September 15. To perform work during this period, surveys and additional protection measures are required (see Protections for Biological Resources, below).
- Where listed species could be impacted by removal activities, work shall only be implemented during time intervals specified by the USFWS and/or CDFG to avoid sensitive life history stages (see Protections for Biological Resources, below).

Staging, Access, and Project Work Areas

- The work area, including access and staging areas, shall be limited to the smallest possible area.
- Project activities shall utilize existing staging areas and access roads whenever possible.
- Soil disturbance, when required, shall be limited to the smallest possible area.

- Movement of personnel and equipment shall be limited to designated work zones, staging areas, and access roads.
- Staging areas shall be located outside the active channel on the upper terrace, levee, or bank of the stream or tributary.
- Staging areas shall be located in degraded areas and/or where the soil is already compacted, preferably near access points when site conditions allow.
- Staging areas shall serve as parking locations for work vehicles and equipment when not in use.
- Chippers shall be used in designated staging areas.
- Staging areas in locations where the general public may have access shall be enclosed with temporary construction fencing for public safety and to prevent unauthorized access.
- Access points shall be located at existing ramps/roads, or in areas that are already degraded.
- Temporary access ramps must be restored to their original condition when no longer needed for the project.
- The boundaries of projects shall be demarcated.

Flowing or Poned Water

- Work in flowing or ponded water is not allowed, except as indicated below:
 - If temporary or intermittent flows are present onsite, construction shall occur when the stream is dry. If groundwater seeps into the work area, the site shall have the water temporarily diverted.
 - If perennial flows are present onsite, the work area shall be isolated from flowing water by temporarily diverting water around the work site in a manner that maintains downstream flows during construction and minimizes siltation. Excavating a channel for the purpose of isolating the workspace from flowing water is not allowed. Additional conditions apply if special status species could be impacted by the diversion (see Protections for Biological Resources).
- Crews and equipment shall avoid any contact with open water.
- If water must be crossed, an appropriate spanning method such as a temporary bridge consisting of planks or a steel grate/plate shall be used.

Water Quality/Erosion Control

- No activity shall occur during a rain event or if forecasts indicate that rain is likely within 24 hours. If rain does occur, erosion control measures such as sand bags and/or silt fences shall be employed to reduce offsite flow of soil. If storm flow enters the project site, work shall only resume once the flow has receded and 72 hours has passed.

- If potential exists for erosion or sedimentation, erosion control and sediment detention devices (e.g., silt fencing, mulch, matting, soil binder, seeding) shall be incorporated into the project design and installed to prevent sediment input to streams. Sediment collected in these devices shall be disposed of away from the collection site and outside riparian areas or flood hazard areas. These devices shall be inspected before and after rain events, and repaired if necessary, to ensure they are functioning properly.
- Soil disturbance, when required, shall be limited to the smallest possible area.
- All contaminated spoil, rubbish, oil or other petroleum products, or any other substances which could be hazardous to aquatic or terrestrial life, resulting from project related activities, shall be prevented from contaminating the soil and/or entering water bodies.
- When active revegetation is required, no fertilizers shall be used in the streambed or streambank to hasten or improve the growth of plantings.
- All trash items shall be enclosed in sealed receptacles and regularly removed from the site.
- Disposal of project related waste materials such as trash, used equipment, oil, grease, and chemicals shall be done in accordance with federal, state, and local regulations.
- Immediate control, containment, and cleanup of fluids and herbicides due to spills or equipment failure (e.g., broken hoses, punctured tanks) shall be implemented.
- All contaminated materials shall be disposed of promptly and properly to prevent contamination of the site.
- To reduce the potential for spills, the refueling of portable equipment shall occur within a contained area. Where that is not possible, barriers shall be placed around the site where the fuel nozzle enters the fuel tank. The barriers shall be such that spills can be contained and easily cleaned up.
- Refueling activities shall be conducted so that the potential for spillage from overfilling, nozzle removal, or other action is minimized to the extent feasible.

Personnel Supervision and Training

- Per the the California State Licensing Board (CSLB), projects with a cost greater than \$500.00 shall be performed by a firm with a current landscape contractor license (C-27) issued by CSLB.
- If herbicides are used, the hired firm shall be licensed by the California Department of Pesticide Regulation (CDPR) as a Pest Control Business and registered with the Ventura County Agricultural Commissioner.
- Hired firms shall have a minimum of three years of successful experience with non-native invasive plant removal and native plant restoration in compliance with all regulatory permits.

- Personnel shall be supervised onsite by a foreman with a minimum of three years of successful experience with non-native invasive plant removal and native plant restoration in compliance with all regulatory permits.
- All project implementation personnel (landowners, managers, contractors, sub-contractors, etc.) shall be briefed on environmental concerns by a qualified biologist, including:
 - how to avoid impacts to special status species prior to proposed activities;
 - a description of all special status species and their habitats which occur within the site boundaries;
 - a description of the applicable regulations for listed species, such as the Federal and California Endangered Species Act (FESA and CESA) regulations, the need to adhere to these regulations, penalties associated with violations, and measures being implemented to protect the special status species within the project site;
 - if herbicides are used, the avoidance of impacts to biological resources during herbicide application;
 - appropriate work practices (including spill prevention and response measures);
 - other measures needed to minimize impacts;
 - locations of foot and vehicle access paths;
 - areas that are sensitive; and
 - areas that are closed to access.

Equipment and Vehicles

- Vehicle use shall be minimized as much as possible.
- If heavy equipment is required, it shall be operated from the top of streambanks or on terraces above the stream bed whenever possible.
- All vehicles shall observe a maximum speed limit of 10 miles per hour or lower at the project site and staging areas to avoid generation of dust and for personnel safety.
- All vehicles and equipment, including the brush grinder, shall be moved to a staging area or removed from the site overnight.
- Emissions from construction equipment shall be controlled by adherence to the recommended maintenance schedules for each individual equipment type. Repairs to malfunctioning equipment shall be made as soon as possible.
- The fueling and lubrication of mechanical equipment shall be confined to staging areas.

Noise

- Extraneous noise shall be limited to the maximum extent possible (e.g., radios for entertainment).

- All diesel equipment shall be operated with closed engine doors and shall be equipped with factory-recommended mufflers.
- No staging areas shall be placed and no chipping activities shall occur within 500 feet of potential habitat for listed bird species during the breeding season for these species.
- No staging or chipping activities shall be placed within 300 feet (500 feet for raptor nests) of riparian habitat between March 1 and September 15 or between January 1 and September 1 if breeding raptors are present.
- All measures shall be taken to reduce the noise of equipment and machinery and to minimize noise disturbance in areas with potentially sensitive receptors. These may include:
 - Noise levels from equipment and vehicles shall not exceed 60 dBA (A-weighted decibel scale) within 500 feet of nests for listed bird species (see Protections for Biological Resources below).
 - Staging areas shall be located as far from noise sensitive receptors as possible.
 - Crews using power tools and heavy equipment (chainsaws, chippers, brush grinders, etc.) shall be spaced as far away as possible from other crews using power tools and heavy equipment.
 - Additional noise attenuation techniques shall be employed as necessary on all noise generating equipment. Such techniques may include the use of sound blankets on noise generating equipment and the construction of temporary sound barriers between project sites and nearby sensitive receptors.

Non-native Invasive Plants

- If any mechanical and/or hand-held equipment was used for non-native invasive plant removal at another site, it shall be pressure washed at a location with appropriate containment of water runoff before it is used at a new project site to prevent the spread of seed or viable plant material.
- Non-native invasive plants shall be removed and controlled within all staging areas, access points, and access ramps.
- Biomass containing viable seed shall not be chipped.
- Seed bearing biomass shall be stored on a plastic sheet and covered with a tarp while on site and during transport to prevent soil contamination or the dispersal of seed by wind.
- If seed bearing plants are removed, they shall be cut and disposed to a local landfill or green waste facility to avoid re-infestation of the project site.
- Cut and/or chipped biomass shall be hauled to the designated disposal site at the end of each workday when possible. Cut and/or chipped biomass shall be stored for no more than five days in designated staging areas.

Dust Suppression

- Appropriate dust suppression methods shall be used during on-site removal activities. Recommended methods include application of water, use of wind break enclosures, and covering dump truck loads.
- Necessary measures shall be taken to reduce and control dust generated by chipping.

Signage and Project Notice

- Prior to removal activities, treatment areas shall be marked, and signs shall be clearly posted along access points to the project site.
- Signs shall be posted on any affected recreational trails for a sufficient time to warn trail users of heavy equipment and vehicle crossings. The signs shall be posted on either side of the active access and shall be maintained for the entire period of project-related trail use.
- Signs and flaggers shall be used in areas where equipment use would access high speed roads and blind corners.
- All neighbors within 100 feet of project areas shall receive notice of proposed projects one month before start of work.

Biological Resources

For all BMPs below, , "listed species" are defined as state or federally-listed threatened, endangered, or proposed plant and wildlife species. "Special status species" are defined as the following plant and wildlife species: listed species; California Native Plant Society (CNPS) list 1 and 2 plant species; and state fully protected, rare, and species of special concern. Not all conditions for listed or fully protected species apply to rare, CNPS list 1 and 2 plant species, and state species of special concern.

Special Status Species (initial removal of non-native invasive plants)

- Initial site assessments shall be carried out by a qualified individual to evaluate whether characteristic habitat for special status plant and/or wildlife species occurs in proposed work areas.
- If appropriate habitat for special status species is found in the project area or if listed species are known to occur in the project area, conditions described in the Biological Opinions issued by the USFWS and conditions required by CDFG shall be implemented, as applicable.
- If appropriate habitat for rare species or state species of special concern is found in the project area or if rare species or state species of special concern are known to occur in the project area, protection measures outlined by CDFG and/or contained in the CNPS Mitigation Guidelines (for plants) shall be implemented, as applicable.
- If habitat for listed species or fully protected species is found in the project area, a qualified biologist (pre-approved by the USFWS and/or CDFG) shall complete pre-construction surveys to determine if these species or habitat for these species shall be disturbed by planned activities.

- A qualified biologist (as approved) shall use approved protocols to conduct the surveys of each site identified during the initial assessment as containing potential habitat or assume presence of the species if representative habitat is present (in lieu of conducting protocol-level surveys).
- Where special status species could be impacted by removal activities, work shall only be implemented during time intervals specified by the USFWS and/or CDFG that avoid the breeding season of these species.
- No staging areas shall be placed and no chipping activities shall occur within 500 feet of potential habitat for listed bird species during the breeding season for these species.
- Noise levels from equipment and vehicles shall not exceed 60 dBA (A-weighted decibel scale) within 500 feet of nests for listed bird species (see Protections for Biological Resources below).
- If access must go through coastal sage scrub habitat where coastal California gnatcatchers may be nesting, only workers on foot shall walk through the habitat and only during the non-breeding season for coastal California gnatcatcher.
- If special status plants are found in the project area, or could be impacted by being in the vicinity of project activities, a fence with an appropriate size buffer zone between the plants and the work area shall be constructed around the plants/plant population to avoid disturbance and accidental damage or mortality. An appropriate size buffer zone shall be determined by a qualified botanist in conjunction with CDFG and/or USFWS, as appropriate.
- Foliar spraying of herbicides (both for initial removal and treating resprouts) shall not be used within 15 feet of known locations of special status plant species. The cut and daub/paint method of herbicide application is permissible within 15 feet.

Special Status Species (monitoring and retreatment of invasive plants)

- Monitoring and maintenance activities may be conducted during the breeding season (from March 1 to September 15) where listed bird species are known to be present, under the following conditions:
 - Focused surveys shall be conducted by a permitted biologist to determine the locations of nests/territories; the locations of nests shall be mapped.
 - If a nest is found, a 500-foot buffer zone shall be established around the nest and clearly marked, and all activities shall be restricted to areas outside of the exclusion.
 - A qualified biological monitor shall ensure that work activities do not encroach within the 500-foot buffer zone.
 - Monitoring and maintenance activities within the 500-foot buffer zone may be approved by the USFWS and/or CDFG if (1) crews are accompanied by a qualified biological monitor who shall search habitat along the access route and work area prior to entry by the work crew; (2) the biological monitor shall search for nests in all vegetation, including resprouts, before they are

- cut and/or treated with herbicide; and (3) activities are restricted to non-mechanical methods such as cut and paint application (no chainsaws or vehicles mounted with spray equipment).
- Noise levels from equipment shall not exceed 60 dBA (A-weighted decibel scale) within 500 feet of nests.
- No staging areas shall be placed and no chipping activities shall occur within 500 feet of potential habitat for listed bird species during the breeding season for these species.

Riparian Breeding Birds

- If projects are implemented after September 15, surveys by a qualified biologist for riparian breeding birds shall not be required.
- If initial site assessment determines the presence of appropriate habitat for riparian breeding birds and construction must occur between March 1 and September 15, a qualified biologist, approved by CDFG, shall conduct pre-construction surveys for breeding birds or bird nesting activity. If any active nests are found, a 300-foot buffer zone shall be established and maintained to protect the nest until the qualified biologist verifies that birds have fledged or the nest is abandoned. Project applicants may request exceptions to size requirements for buffer zones from CDFG on a case-by-case basis. Take (mortality of eggs and/or young) of active nests is prohibited.
- Monitoring and maintenance activities within the 300-foot buffer zone may be approved by CDFG if (1) crews are accompanied by a qualified biological monitor who shall search habitat along the access route and work area prior to entry by the work crew; (2) the biological monitor shall search for nests in all vegetation, including resprouts, before they are cut and/or treated with herbicide; and (3) activities are restricted to non-mechanical methods such as cut and paint application and/or foliar application (no chainsaws or vehicles mounted with spray equipment).
- If appropriate raptor nesting habitat is present at the project site, work shall avoid raptor nesting season, if possible (January 31 through September 1). If work must occur during this time period, a qualified biologist shall conduct a pre-construction survey to determine presence of raptor species. If raptor nests are found, a 500-foot buffer zone shall be placed around each nest and a biological monitor shall be present onsite during construction activities.
- Monitoring and maintenance activities within the 500 foot buffer zone of raptor nests may be approved by CDFG if (1) activities are restricted to non-mechanical methods such as cut and paint application and/or foliar application (no chainsaws or vehicles mounted with spray equipment) and (2) a qualified biologist monitors the nest for signs of disturbance and limits activities within the buffer zone based on the behavior of the nesting birds.

- No staging or chipping activities shall be placed within 300 feet (500 feet for raptor nests) of riparian habitat between March 1 and September 15 or between January 1 and September 1 if breeding raptors are present.

Native Vegetation

- Native vegetation shall not be trampled, damaged or removed to install the staging area.
- Disturbance or removal of native riparian vegetation in the bed, channel, or bank shall be avoided to the maximum extent possible. When necessary to accomplish project objectives, disturbance or removal may occur as follows:
 - If no existing access is present, a temporary access ramp for vehicles and equipment may be installed. The ramp shall be recontoured to its pre-construction condition and revegetated after the removal and/or maintenance have been completed. For permitted removal of any native plant, the root structure shall be left intact unless otherwise authorized by CDFG on a case by case basis.
 - All native tree and shrub species with a dbh < 3 inches may be removed if they cannot be avoided; trees and shrubs with a dbh > 3 inches shall be avoided.
- Projects shall avoid removal/damage to coastal sage scrub, chaparral, and other upland native habitats while accessing removal sites. No access for equipment/vehicles shall be installed in these habitats.
- Projects shall avoid direct and indirect impacts to vernal pools, vernal pool complexes and other isolated wetlands. No project shall occur in vernal pools or result in decreased water flow, topographic changes, or restricted wildlife access/movement to or within these habitats.

Construction Monitoring

- A qualified individual shall be onsite during any activities related to temporary water diversion, and shall inspect the diversion system daily to ensure proper functioning of the diversion and protection of water quality and biological resources.
- A qualified individual shall monitor the effectiveness of breeding bird buffer zones daily, if staking and flagging is used for the buffer zone, or weekly, if temporary fencing is used for the buffer zone.
- For listed species, a qualified biologist shall ensure that all terms and conditions of the biological opinion issued by the USFWS and the streambed agreement issued by CDFG are implemented. The qualified biologist shall have authority to halt work if necessary to ensure compliance and protect listed species during construction.

TECHNIQUE SPECIFIC BMPS

Herbicides

- A California Department of Pesticide Regulation (DPR) licensed Pest Control Advisor (PCA) shall prepare a written recommendation for the use of herbicides on the project.
- All herbicide usage shall occur only as directed by the written recommendation from a licensed PCA.
- Only herbicides registered for use in California by the DPR and the U.S. Environmental Protection Agency (EPA) shall be used.
- Only herbicides approved for aquatic use shall be used.
- All adjuvants shall be registered by the EPA and approved for use by the relevant environmental regulatory agencies.
- Only non-ionic adjuvants that do not contain nonylphenoethoxylate (non-NPE) shall be used.
- If herbicides are used, the hired firm shall be licensed by the California Department of Pesticide Regulation (CDPR) as a Pest Control Business and registered with the Ventura County Agricultural Commissioner.
- Herbicide application shall be conducted and/or supervised by an individual with a current California DPR Qualified Applicator License (QAL) or Qualified Applicator Certificate (QAC).
- Herbicide usage shall be limited to the minimum amount required to be effective.
- Herbicides shall be applied according to the manufacturer's label specifications.
- Herbicides shall be applied with an appropriate biodegradable dye to facilitate visual control of application.
- Herbicides shall be secured or removed from staging areas at night.
- Herbicide storage during application shall be confined to staging areas.
- Herbicide shall not be left unattended unless it is locked in a secure container, vehicle, or structure.
- All containers containing herbicide formulations shall be clearly labeled with the herbicide type and concentration of active ingredient.
- Herbicide shall not be applied during rain events or when rain is forecast in the next 24 hours.

Removal Methods

Cut-and-Paint

- Target species' canes/trunks shall be cut to less than twelve inches in height and straight across to prevent sharp points from injuring project personnel, wildlife, or the public.

- See BMPs for biomass removal and herbicides

Cut and Spray Resprouts

- See BMPs for biomass removal and herbicides.

Foliar Application (Full Stands, Cut Stands, Resprouts)

- Herbicide shall not be applied when conditions during winds greater than 10 miles per hour.
- Herbicide shall not be applied if air temperature exceeds volatilization limits of herbicide.
- Herbicide shall not be applied during rain events or when rain is forecast in the next 24 hours.
- Booms or ladders shall not be employed for foliar spraying within 200 feet of residences, parks, schools, or similar sensitive receptors. Foliar spray applications shall be limited to the cut and spray technique within this setback.

Tarping

- Prior to installing tarps, target species' canes/trunks shall be cut to less than 12 inches in height and straight across to prevent sharp points from puncturing tarp and from injuring project personnel, special status wildlife, or the public.
- Mechanical equipment shall not be driven over tarped areas so tarp isn't punctured.
- Tarps shall be manually installed.
- Tarps shall be fastened securely to prevent wind damage.
- During the rainy season, tarps shall be removed if installed in areas prone to inundation or flooding.
- Tarping material shall be removed and disposed of properly after completion of the project.

Biomass Disposal Methods

Chipping

- All chipped biomass shall be disposed of off-site in a landfill or shall be used as mulch.
- All measures shall be taken to reduce the noise of chippers to minimize noise disturbance in areas with potentially sensitive receptors. These may include:
 - Noise levels chippers shall not exceed 60 dBA (A-weighted decibel scale) within 500 feet of least nests of listed bird species (see Protections for Biological Resources below).
 - Staging areas shall be located as far from noise sensitive receptors as possible.

- Crews using chippers shall be spaced as far away as possible from other crews using chippers.
- Additional noise attenuation techniques shall be employed as necessary on all noise generating equipment. Such techniques may include the use of sound blankets on noise generating equipment and the construction of temporary sound barriers between project sites and nearby sensitive receptors.
- All measures shall be taken to reduce the noise of chippers and to prevent noise disturbance to potentially sensitive receptors.
- Necessary measures shall be taken to reduce and control dust generated by chipping.
- Chipping shall occur in staging areas only with prior approval of the appropriate landowner and/or agency.
- Biomass containing viable seed shall not be chipped.

Biomass Removal

- No cut biomass shall be left within 20 feet of any active low-flow channel.
- Stockpiled biomass or other debris shall not be left overnight within the stream channel or on its banks. If stockpiled biomass must be left overnight, it shall be moved to staging areas.
- Seed bearing biomass shall be stored on a plastic sheet and covered with a tarp while on site and during transport to prevent soil contamination or the dispersal of seed by wind.

Incineration

- All incineration equipment shall be approved by local fire department and APCD.
- All federal, state, and local laws and provisions regarding incineration of biomass shall be followed, including those of the local fire department and APCD.
- All incineration shall take place at appropriate designated locations.
- Onsite incineration shall not occur during times of high fire danger.

Biomass Disposal

- If seed bearing plants are removed, they shall be cut and disposed to a local landfill or greenwaste facility to avoid re-infestation of the project site.
- Cut and/or chipped biomass shall be hauled to the designated disposal site at the end of each workday when possible. Cut and/or chipped biomass shall be stored for no more than five days in designated staging areas.
- If seed-bearing tamarisk branches or other invasive plant material bearing seed is transported to a landfill, it shall be covered with a tarp or otherwise constrained during transport to decrease the chance of seed dispersal.

Appendix F - Special Status Plant and Wildlife Species - Additional Information

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PLANT SPECIES

Salt marsh bird's-beak (*Cordylanthus maritimus* ssp. *maritimus*)

Federal Status: Endangered **State Status:** Endangered **CNPS:** List 1B

Salt marsh bird's-beak is a small, parasitic annual herb with grey-green, salt-encrusted leaves and spike-form inflorescences bearing several cream or white colored flowers (Hickman 1993). It occurs in the upper portions of coastal salt marshes from Morro Bay to northern Baja California, generally below 35 feet in elevation. It also occasionally occurs on sand dunes (CNDD 2008). It is most detectable during its flowering period in summer or early fall. This plant is threatened by potential development, changes or alterations in the hydrology of salt marsh systems, and competition with non-native plants.

Salt marsh bird's beak was listed as federally endangered by the USFWS in 1978 (USFWS 1978) and state endangered by the CDFG in 1979. The USFWS has not designated critical habitat for this subspecies. Current threats to this plant include the human disturbance to coastal marshes and adjacent upland habitats (USFWS 1984)

Salt marsh bird's beak is known to occur in salt marshes throughout southern California, including Mugu Marsh and near Ormond Beach. Suitable habitat exists throughout much of the Mugu Marsh area including lower Mugu Drain, and in the lowest portions of Calleguas Creek and Revolon Channel within one mile of Highway 1. In general, this plant occurs in areas where arundo is not likely to be found. However, on the edges of the marsh and in dune areas, this plant may occur close enough to CCARP project areas to be affected by project activities. Outside of the vicinity of Mugu Marsh, this plant has no potential to occur in the project area. In addition, it was not detected during the 2008 survey.

Large-scale removal of arundo anywhere in the Calleguas Creek watershed is expected to have positive indirect effects on salt marsh bird's beak. Removal of arundo will result in decreased erosion in the upper watershed and less sediment deposition in Mugu Marsh. Removal of arundo may also result in improved water quality in the Mugu Marsh area.

If an individual CCARP project occurs within the range of salt marsh bird's beak, a focused species survey will be conducted for this plant prior to project implementation. The survey will be conducted at a time when this plant is visible (May through October), and BMPs listed in Appendix E will be implemented to avoid impacts to any populations found.

Conejo dudleya (*Dudleya parva* or *D. abramsii* subsp. *parva*)

Federal Status: Threatened **State Status:** Species of Special Concern **CNPS:** List 1B

Conejo dudleya is a small, succulent perennial herb in the Crassulaceae family with leaves up to one inch in length that are shed during the dry season and roots that narrow at irregular intervals. It bears small flowers in spring, with small, pale yellow petals, often with red flecks on the keel (Hickman 1993). Its leaves exude a purple dye if crushed. It is only known to occur in areas of clay grassland in the western Santa Monica Mountains on the Conejo Volcanics formation (Hickman 1993). It is generally detectable from March through June.

Conejo dudleya was listed as threatened by the USFWS in 1997 (USFWS 1997a). The USFWS has not designated critical habitat for this plant. Current threats include the development and damage associated with recreational activities (CDFG 2008).

Conejo dudleya is found only in scattered locations throughout the Conejo Volcanics geological formation, including the Camarillo Grade and Mountclef Ridge areas. It occurs near the North Fork of Arroyo Conejo in Wildwood Regional Park, and may occur adjacent to riparian areas. Therefore, it may occur close enough to CCARP project areas to be affected by project activities.

If an individual CCARP project occurs within the range of Conejo dudleya, a focused species survey will be conducted for this plant prior to project implementation. The survey will be conducted at a time when this plant is visible (March through June), and BMPs listed in Appendix E will be implemented to avoid impacts to any populations found.

Verity's dudleya (*Dudleya verity*)

Federal Status: Threatened **State Status:** Species of Special Concern **CNPS:** List 1B

Verity's dudleya is a small, succulent perennial herb in the Crassulaceae family with leaves appearing in a basal rosette. It bears small flowers in spring, with small, lemon yellow petals generally borne two to 10 per inflorescence (CDFG 2008, Hohn, pers. obs.). It is only known to occur in the western Santa Monica Mountains on the Conejo Volcanics formation, on north-facing volcanic rock outcroppings (Hickman 1993). Although this plant is visible for much of the year, it is only possible to distinguish from other species in spring or early summer when it flowers. This plant is threatened by development, plant collection, and road maintenance (CDFG 2008).

Verity's dudleya was listed as federally threatened by the USFWS in 1997 (USFWS 1997a). Currently there is no critical habitat designated for Verity's dudleya.

Verity's dudleya is only found in scattered locations throughout the Conejo Volcanics geological formation, and is most likely to be encountered near Long Grade Canyon or Conejo Mountain. It generally occurs in upland areas and may occur adjacent to riparian areas. Therefore, this plant may occur close enough to project implementation areas to be affected by project activities.

If an individual CCARP project occurs within the range of Verity's dudleya, a focused species survey will be conducted for this plant prior to project implementation. The survey will be conducted at a time when this plant is visible (March through June), and BMPs listed in Appendix E will be implemented to avoid impacts to any populations found.

Conejo buckwheat (*Eriogonum crocatum*)

State Status: Rare, Species of Special Concern **CNPS:** List 1B

Conejo buckwheat is a small shrub with densely white-wooly leaves. It bears bright yellow flowers in umbel-like inflorescences, which form reddish-brown seed heads after blooming (Hickman 1993). It is only known to occur in the western Santa Monica Mountains on or near

the Conejo Volcanics geologic formation, and is usually found growing in small cracks or crevasses in rocks, often on vertical or near-vertical cliffs (Hickman 1993, Hohn, pers. obs.). It is easily detected throughout the year.

Conejo buckwheat is currently listed as rare by the state of California. This plant is threatened by development and by damage associated with recreational activities (CDFG 2008).

Conejo buckwheat is known to occur only in scattered locations throughout the Conejo Volcanics geological formation, including the Long Grade Canyon, Hill Canyon, and Wildwood Regional Park areas. Although it generally occurs in upland areas, it can occur on the edge of creeks when they pass through narrow, rocky canyons. During the 2008 survey, this plant was found within the riparian corridor both near the large waterfall of North Fork Arroyo Conejo in Wildwood Regional Park and along Long Grade Creek on the grounds of California State University at Channel Islands.

This plant generally occurs in upland areas, including rocky canyon walls adjacent to riparian areas. In Wildwood Regional Park a population occurs in a riparian area near an arundo infestation.

If an individual CCARP project occurs within the range of Conejo dudleya, a focused species survey will be conducted for this plant prior to project implementation. BMPs listed in Appendix E will be implemented to avoid impacts to any populations found.

WILDLIFE SPECIES

Belding's Savannah Sparrow (*Passerculus sandwichensis beldingi*)

Federal Status: None

State Status: Endangered

The Belding's savannah sparrow (*Passerculus sandwichensis beldingi*) lives year round in coastal salt marshes from Goleta in Santa Barbara County, California to Bahia de San Quintin, Baja, California, Mexico (Powell 1993). They are darker and more heavily streaked on the back, breast, and sides than other subspecies of savannah sparrow and have yellow feathers between the eye and bill. This subspecies breeds from March through August, building their nests in areas of thick pickleweed (*Salicornia virginica*) or saltgrass (*Distichlis spicata*) above the high tide line. This sparrow feeds primarily on insects, but in winter will eat some vegetation such as the succulent tips of pickleweed. In addition, this subspecies is not physiologically adapted to use freshwater and has very efficient kidneys that allow it to drink seawater (CDFG 2005).

This subspecies was listed as state endangered by the California Department of Fish and Game in 1994 when the population was estimated at only 1500 individuals (Powell 1993). However, a statewide population count in 2001 yielded nearly 3000 breeding pairs (CDFG 2005). Current threats to this subspecies include the continued decline in quality habitat caused by hydrologic changes due to upstream development and flood control, the loss of natural tidal regimes in upper marsh habitat, the degradation of pickleweed habitat, flooding caused by the closures of river mouths, mortality caused by native and non-native predators, and human disturbance including illegal trash dumping (CDFG 2005).

This species is known to occur in Mugu Lagoon. In order to minimize impacts to Belding's savannah sparrows, the BMPs in Appendix E should be implemented for any project site where this species is present.

California Brown Pelican (*Pelecanus occidentalis californicus*)

Federal Status: Endangered

State Status: Endangered

The California brown pelican is a large, dark gray-brown water bird with webbed feet, a pouch underneath its long bill, and a wingspan of 2.1 m (7 ft). This bird can be seen throughout the year on coastal salt water, beaches, bays, marshes and on the open ocean. They breed from January through October in nesting colonies on islands without mammalian predators and permanent human habitation. Though their winter range extends from Oregon in the U.S. south to Chile in South America, the only breeding colonies found in the western United States exist on two of the Channel Islands in California, West Anacapa and Santa Barbara islands. Their breeding success is largely determined by the abundance of their primary prey items, northern anchovies (*Engraulis mordax*) and Pacific sardines (*Sagax sardinops*) (NPS 2008).

This subspecies was classified as federally endangered in 1970 and as endangered by the state of California in 1971 (NPS 2008). These pelicans are known to bioaccumulate the organochlorine contaminants in the marine environment, particularly DDT and its metabolites, and polychlorinated biphenyls (PCBs). DDT has been shown to cause thinning in the egg shells of this and other bird species by altering their calcium metabolism. In the 1970s the Channel Islands colonies were nearly extirpated due to reproductive failure caused by eggshell thinning (NPS 2008). These birds are very sensitive to human disturbance of their roosting and nesting areas. Other threats include oil spills and other pollution, entanglement with hooks and fishing lines, and disease outbreaks resulting from overcrowding at winter roosts (NPS 2008).

This species is known to roost in the Mugu Lagoon area. In order to minimize impacts to California brown pelicans, the BMPs in Appendix E should be implemented for any project site where this species is present.

Coastal California Gnatcatcher (*Polioptila californica californica*)

Federal Status: Threatened

State Status: Species of Special Concern

The coastal California gnatcatcher is a small, gray songbird that lives year-round in scrub dominated plant communities in various successional stages. They also use chaparral, grassland, and riparian plant communities where they occur adjacent to or intermixed with sage scrub. This subspecies feeds on a variety of insects, especially arthropods including leafhoppers, spiders, beetles, and tree bugs. Their range extends from southern Ventura County southward through Los Angeles, Orange, Riverside, San Bernardino, and San Diego Counties, California into Baja California, Mexico. The breeding season of the coastal California gnatcatcher occurs from about February 15 through August 30, with a peak of nesting activity occurring from mid-March through mid-May. Breeding territories also have been documented in non-sage scrub habitat including chaparral and grassland/ruderal habitat (USFWS 1997b).

The species was listed as federally threatened on March 30, 1993, because of habitat loss and fragmentation resulting from urban and agricultural development (USFWS 1993). Other management issues include fire, nonnative invasive plants, and predation (Mock 2004). Designated critical habitat for this species includes approximately 197,303 acres (79,846 hectares) of habitat in San Diego, Orange, Riverside, San Bernardino, Los Angeles, and Ventura Counties, California. Coastal California gnatcatcher habitat throughout the species' range in the U.S. was included in a variety of climates and vegetation communities (USFWS 2007).

Suitable habitat for this species exists adjacent to riparian areas throughout the Calleguas Creek watershed. In order to minimize impacts to coastal California gnatcatchers, the BMPs in Appendix E should be implemented for any project site where this species is present.

Light Footed Clapper Rail (*Rallus longirostris levipes*)

Federal Status: Endangered

State Status: Endangered

The light-footed clapper rail is a hen-sized marsh bird with long-legs and toes, a cinnamon-colored breast and streaked grayish-brown back. This rail can be found year-round in coastal salt marshes, and lagoons from Santa Barbara County in California, south to Bahia de San Quintin, Baja California, Mexico. They nest in the lower intertidal zone of coastal salt marshes from March to September where dense stands of cordgrass (*Spartina foliosa*) are present, but can also build nests in pickleweed (*Salicornia virginica*). Light-footed clapper rails also occasionally reside and nest in freshwater marshes. These rails reside in their home marsh except under unusual circumstances, where they forage for invertebrates in shallow water and mudflats. They also require nearby areas with higher vegetation for cover during high tides and high water (USFWS 2006a).

The light-footed clapper rail was federally listed as endangered in 1970 (USFWS 1970), and California state listed as endangered in 1971. The destruction of coastal wetlands in southern California has caused many estuaries where light-footed clapper rails were once abundant to be reduced to smaller, remnant marshes. Although the loss, degradation, and fragmentation of salt-marsh habitat are the primary threats to light-footed clapper rails, they are also affected by disturbance, diseases, contaminants, and predation by non-native red foxes, feral cats, crows, and some hawks or owls (USFWS 2006a).

A significant population of this species is known to occur in Mugu Lagoon. In order to minimize impacts to light-footed clapper rails, the BMPs in Appendix E should be implemented for any project site where this species is present.

Bank Swallow (*Riparia riparia*)

Federal Status: None

State Status: Threatened

The bank swallow, the smallest North American swallow species, is brown above and white below. They are found primarily in riparian and other lowland habitats in western California. During the breeding season, this species prefers riparian, lacustrine, and coastal areas with

vertical banks, bluffs, and cliffs with fine-textured or sandy soils where it digs nesting holes. In migration, they will flock with other swallows over many open habitats (Green 1999).

Bank swallows forage using long, gliding flights and hawking a variety of soft-bodied insects including flies, bees, and beetles. They feed predominantly over open riparian areas, but may also feed over brushland, grassland, wetlands, water, and cropland (Green 1999). Bank swallows breed from early May through July in colonies that range in size from 10 to 1,500 nesting pairs (Garrison et al. 1987). Migration typically begins in August, with birds returning to breed in March.

This species was designated as Threatened in the state of California in March, 1989 (Green 1999). The range of bank swallows in California has declined by an estimated 50 percent since the year 1900. Disturbance and destruction of nesting areas, including the channelization and stabilization of banks along rivers where they nest, are the primary factors causing the decline in this species in California (CDFG 1989).

This species is known to occur in the Santa Clara River and Malibu Creek watersheds, and may occur in any areas with banks or cliffs consisting of fine substrate within the Calleguas Creek watershed. In order to minimize impacts to bank swallows, the BMPs in Appendix E should be implemented for any project site where this species is present.

California Least Tern (*Sterna antillarum browni*)

Federal Status: Endangered

State Status: Endangered

The California least tern is the smallest tern in North America. They forage in shallow estuaries and lagoons, diving head first into the water after a wide variety of small fish. California least terns often follow schools of fish in the ocean as far north as southern Oregon (PBI ESIN 2007). They begin courtship displays in April and May, and begin breeding on open, sandy beaches shortly after. Their current range is limited to San Francisco Bay and a few areas along the coast from San Luis Obispo County to San Diego County. During the winter months, they migrate south to the Pacific coast of Central America.

California least terns were listed as federally endangered in 1970 (USFWS 1970), and endangered in the state of California in 1971. The encroachment of human development into nesting habitat for this species is the primary cause of the decline of this species. The construction of housing developments continues to affect this species and has caused some remaining tern populations to nest on areas away from the shoreline including mudflats and landfills. Therefore, terns and their chicks are increasingly vulnerable to predation by the red fox (*Vulpes vulpes*) as well as dogs, cats and raccoons. In addition, the fishing grounds for this species have also been severely impacted by dredging, development and pollution (PBI ESIN 2007). The U.S. Navy, the Marine Corps, and the U.S. Fish and Wildlife Service are working together to manage a large number of California least tern populations that breed on military lands. This agency cooperation to minimize human impact within these sites has resulted in a dramatic recovery of tern populations. Today, over one-third of California least tern populations breed on Navy and Marine Corps bases (PBI ESIN 2007).

This species is known to occur in the Mugu Lagoon area. In order to minimize impacts to California least terns, the BMPs in Appendix E should be implemented for any project site where this species is present.

Least Bell's Vireo (*Vireo bellii pusillus*)

Federal Status: Endangered

State Status: Endangered

The least Bell's vireo is the western-most subspecies of Bell's Vireo. This subspecies is dull gray or olive green above, and white or yellow below with a faint eye ring. They breed only in riparian woodlands in southern California and northern Baja California, Mexico from mid-March to mid-September and winter along the coast of Mexico and Central America. These vireos typically inhabit areas of riparian woodland that combine an understory of dense, young willows or mule fat with a canopy of mature willow. Therefore, they require young successional habitat or older habitat with a dense understory for breeding. However, they will also forage in chaparral habitats adjacent to riparian areas. These vireos feed on insects picked from the bark and foliage of trees (USFWS 1998).

The least Bell's vireo was listed as endangered in the state of California in 1980, and federally listed as endangered in 1986. The decline in the population of this subspecies has been caused by the loss, degradation, and fragmentation of riparian habitat due to agricultural and urban development, and the channelization of streams and rivers. Designated critical habitat for the least Bell's vireo occurs along the Santa Ynez River (Santa Barbara County), Santa Clara River (Ventura and Los Angeles Counties), Santa Ana River (Riverside and San Bernardino Counties), and the Santa Margarita River, San Luis Rey River, Sweetwater River, San Diego River, Tijuana River, Coyote Creek, and Jamul-Dulzura Creeks in San Diego County (USFWS 1994b).

An individual least Bell's vireo was detected at the site for the CCARP Pilot Project on Arroyo Simi while conducting a site visit on June 5, 2008. Given the date of the observation, this subspecies may nest within or adjacent to the boundaries of the Pilot Project site. In addition, other suitable habitat for this species exists throughout the Calleguas Creek watershed. In order to minimize impacts to least Bell's vireos, the BMPs in Appendix E should be implemented for any project site where this species is present.

Tidewater Goby (*Eucyclogobius newberryi*)

Federal Status: Endangered

State Status: Endangered

The tidewater goby is a small, elongate, grey-brown fish endemic to California. These fish have large pectoral fins and their ventral fins join to form an abdominal disc. Male tidewater gobies are nearly transparent, with a mottled brownish upper surface, and generally remain near the breeding burrows. Female tidewater gobies develop darker colors, often black, on the body and dorsal and anal fins. This fish is typically lives for only one year, and may form loosely associated groups of a few to several hundreds or thousands of individuals (USFWS 2008).

Tidewater gobies are found primarily in coastal lagoons, estuaries, and marshes with low to moderate salinities. The species is benthic, preferring to live at the bottom of shallow bodies of

water. Their habitat is characterized by brackish water in shallow lagoons and in lower stream reaches where the water is fairly still but not stagnant. They range from Tillas Slough (mouth of the Smith River, Del Norte County) to Agua Hedionda Lagoon (northern San Diego County) (USFWS 2005). Peak breeding activities commence in late April through early May, but populations in warmer, more southern areas in its range may breed nearly year-round.

This species was listed as federally endangered in 1994 (USFWS 1994a). Tidewater gobies have been extirpated from large sections of their historic range as a result of the modification and loss of habitat. Current threats to tidewater goby populations include: coastal development; the channelization of streams and estuaries; diversions or alterations of water flows; the discharge of agricultural and sewage effluents; introduced species that compete with or prey upon tidewater gobies; groundwater over drafting; and the negative effects from cattle and feral pig activities including sedimentation, removal of vegetation cover, and increased ambient water temperatures (USFWS 2008). Designated critical habitat for the tidewater goby includes 44 areas in Del Norte, Humboldt, Mendocino, Sonoma, Marin, San Mateo, Santa Cruz, Monterey, San Luis Obispo, Santa Barbara, Ventura, and Los Angeles Counties (USFWS 2008).

This species is known to occur in Mugu Lagoon in and Calleguas Creek within one mile of the ocean. In order to minimize impacts to tidewater gobies, the BMPs in Appendix E should be implemented for any project site where this species is present.

Southern Steelhead Trout (*Oncorhynchus mykiss*)

Federal Status: Endangered

State Status: Endangered

Southern steelhead trout (steelhead) is an anadromous salmonid species endemic to California. Anadromous species hatch in freshwater streams and migrate to the ocean upon reaching maturity. Steelhead have a freshwater range in California extending from the Santa Maria River in Santa Barbara County to the United States/Mexico border (NOAA 2008). They require deep low-velocity pools as wintering habitat, and use pools with gravel substrates free of excessive silt for spawning (USFWS 2006b). Spawning occurs from December through April in small streams and tributaries with suitable habitat present year-round. Young trout fry feed mostly on zooplankton while adults prefer aquatic and terrestrial insects, mollusks, crustaceans, fish eggs, minnows, and other small fishes.

In 1996, the Department of Commerce determined that steelhead belonged to an Evolutionarily Significant Unit (ESU) due to genetic differences from the steelhead trout population north of this area. In 1997, this ESU was listed as Endangered under the Federal Endangered Species Act (NMFS 1997) (NMFS 2007). In 2002, National Marine Fisheries Service revised the extent of the ESU to include the area between Malibu Creek and the United States Border with Mexico (NMFS 2002). In addition, steelhead populations along the West Coast of the United States were re-classified as Distinct Population Segments (DPS) due to the presence of two varying life histories – a resident and an oceanic in 2006 (NMFS 2006).

Steelhead play a critical role as indicator species for ecosystem health (McEwan and Jackson 1996). According to a report prepared for the California Department of Fish and Game (CDFG), the winter distribution of steelhead in southern California has declined from 15 percent to one

percent of its previous range (Moyle et al. 1995). Current threats include dams and water diversions, urban development, livestock grazing, and gravel mining. Designated critical habitat for steelhead includes several rivers, creeks, and bays within San Luis Obispo, Santa Barbara, Ventura, Los Angeles, Orange, and San Diego Counties (NMFS 2005).

This species is known to occur in Mugu Lagoon, but no suitable spawning habitat is present within the watershed. In order to minimize impacts to steelhead, the BMPs in Appendix E should be implemented for any project site where this species is present.

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Appendix G - Other Non-native Invasive Plant Removal Methods

Other Removal Methods

Method	Appropriate Use	Timing	Materials and Tools	Instructions	Advantages	Disadvantages
All Classes of Vegetation						
<p>Controlled Burning</p> <p>Burn above-ground biomass.</p>	<p>Arundo, tamarisk, herbaceous plants, trees, shrubs, and/or vines.</p> <p>Large patches of targeted vegetation not intermixed with native plants.</p> <p>Where there is concern about herbicide use.</p>	<p>Most effective during the growing season.</p> <p>Unlikely to be approved during times of high fire danger.</p>	<p>Flamethrowers, weed burners, or similar equipment.</p> <p>Fuel.</p>	<p>Broadcast burn large patches of target vegetation, spot treat small clusters, or heat-girdle stems at the base of individual plants.</p> <p>For larger controlled burns, fire crews may be required to monitor fires to prevent unintentional spread.</p>	<p>Efficient reduction of biomass for large areas of targeted plants.</p> <p>Biomass removal may reduce flooding and fire hazard.</p>	<p>Requires permits to perform burns.</p> <p>Low mortality rates make it ineffective as sole control method.</p> <p>Large potential for regrowth.</p> <p>Potential for collateral impacts to native plants, wildlife, and habitat.</p> <p>Risk of fire spread to non-intended targets such as structures or buildings.</p> <p>Target species readily recover from fire, allowing them to out-compete native riparian vegetation in post-fire circumstances.</p> <p>Requires appropriate weather conditions.</p>
<p>Controlled Burning and Spray Resprouts</p> <p>Burn above-ground biomass and spray resprouts with herbicide solution.</p>	<p>Arundo, tamarisk, herbaceous plants, trees, shrubs, and/or vines.</p> <p>Large patches of targeted vegetation not intermixed with native plants.</p>	<p>Burning is most effective during growing season.</p> <p>Unlikely to be approved during times of high fire danger.</p> <p>Spring through fall depending on herbicide used.</p>	<p>Flamethrowers, weed burners, or similar equipment for burning.</p> <p>Fuel.</p> <p>Herbicide, surfactant, colorant, and water.</p> <p>Backpack sprayers, spray rigs, or similar equipment for herbicide application.</p>	<p>Broadcast burn large patches of targeted vegetation, spot treat small clusters, or heat-girdle stems at the base of individual plants.</p> <p>For larger controlled burns, fire crews may be required to monitor fires to prevent unintentional spread.</p> <p>Apply herbicide one to two months after burning to allow for significant resprouting (until resprouts are one to three feet tall).</p>	<p>Efficient reduction of biomass for large areas of targeted vegetation.</p> <p>Less herbicide needed than with full patches of target plants.</p> <p>Little risk of herbicide drift to non-target plants and wildlife.</p> <p>Biomass removal may reduce flooding and fire hazard.</p>	<p>Requires permits to perform burns.</p> <p>Not appropriate in areas where listed and/or special status species are present.</p> <p>Potential for collateral impacts to native plants, wildlife and habitat.</p> <p>Risk of fire spread to non-intended targets such as structures or buildings.</p> <p>May be public concern with herbicide use.</p> <p>Requires appropriate weather conditions.</p>
<p>Above-Ground Hand Removal</p> <p>Cut stems to six inches or less above ground</p>	<p>Herbaceous plants, trees, shrubs, and/or vines.</p> <p>Small patches of targeted vegetation.</p> <p>Where there is concern with herbicide use.</p> <p>Targeted species may be intermixed with native plants.</p>	<p>Most effective during the growing season (spring through fall).</p>	<p>Chainsaws, loppers, or similar equipment to cut biomass.</p> <p>Chippers to reduce biomass of hand-cut vegetation (optional).</p> <p>Haul trucks or similar equipment to remove cut biomass.</p>	<p>Cut target plants within six inches of the ground.</p> <p>Leave roots and rhizomes in the ground.</p> <p>Chip biomass and haul off-site for beneficial reuse, chip biomass and dispose at a landfill, or dispose of cut biomass at a landfill.</p>	<p>Minimal potential disturbance to native plants and/or wildlife.</p> <p>Little soil disturbance.</p> <p>Chipped biomass may be used for mulch or other beneficial purposes.</p> <p>Biomass removal may reduce flooding and fire hazard.</p>	<p>Very low mortality rates require repeated re-treatment (five years or more), increasing project cost and frequency of disturbance to sensitive areas.</p> <p>If extensive biomass removal is required, additional time and labor costs may be incurred.</p>
<p>Above-Ground Mechanical Removal</p> <p>Shred above-ground biomass using mechanical equipment</p>	<p>Herbaceous plants, trees, shrubs, and/or vines.</p> <p>Areas with easy access for mechanical equipment.</p> <p>Where there is concern with herbicide use.</p> <p>Targeted species not intermixed with native plants.</p>	<p>Most effective during the growing season (spring through fall).</p>	<p>Brush grinders, flail mowers, or similar equipment for shredding biomass.</p>	<p>Shred target plants within six inches of the ground.</p> <p>Leave roots and rhizomes in the ground.</p> <p>Leave shredded biomass in place.</p>	<p>Efficient reduction of biomass for large stands.</p> <p>Biomass removal may reduce flooding and fire hazard.</p>	<p>Very low mortality rates require repeated re-treatment (five years or more), increasing project cost and frequency of disturbance to sensitive areas.</p> <p>Need suitable access for equipment.</p>

Other Removal Methods (continued)

Method	Appropriate Use	Timing	Materials and Tools	Instructions	Advantages	Disadvantages
All Classes of Vegetation (continued)						
<p>Above and Below-Ground Hand Removal</p> <p>Hand pull or use hand equipment to remove above and below-ground biomass (possibility of significant soil disturbance).</p>	<p>Arundo, Tamarisk, herbaceous plants, trees, small shrubs, or vines</p> <p>Any size patches of targeted vegetation.</p> <p>Where there is concern with herbicide use.</p> <p>Target species may be intermixed with native plants.</p>	<p>Any time of year.</p>	<p>Chainsaws, loppers, or similar equipment to cut above-ground biomass; or gloves to hand pull above and below-ground biomass.</p> <p>Pick axes, mattocks, shovels, "weed wrenches" or similar equipment for extracting below-ground biomass.</p> <p>Chippers to reduce biomass (optional).</p> <p>Haul trucks or similar equipment to remove cut biomass.</p>	<p>Cut target plants within six inches of the ground and dig up roots and rhizomes, or hand pull above and below ground biomass.</p> <p>Chip biomass to reduce biomass or for beneficial reuse (optional).</p> <p>Dispose of all biomass at a landfill, or haul chipped biomass off-site for beneficial reuse and dispose of below-ground biomass at a landfill.</p> <p>Smaller trees may be removed by weed wrench, especially in sandy soils and/or after rainfall.</p>	<p>Minimal potential disturbance to native plants and/or wildlife.</p> <p>Effective if rhizomes and root masses are thoroughly cleared from site.</p> <p>Chipped biomass may be used for mulch or other beneficial purposes.</p> <p>Biomass removal may reduce flooding and fire hazard.</p>	<p>If extensive biomass removal is required, additional time and labor costs may be incurred.</p> <p>Requires thorough extraction of roots/ rhizomes and removal of biomass to be effective.</p> <p>Significant soil disturbance and potential for erosion.</p>
<p>Above and Below-Ground Mechanical Removal</p> <p>Remove above- and below-ground biomass of plants from the site with mechanical equipment.</p>	<p>Arundo, tamarisk, herbaceous plants, trees, shrubs, and/or vines.</p> <p>Areas with easy access for mechanical equipment.</p> <p>Where there is concern with herbicide use.</p> <p>Any size patch not intermixed with native plants.</p>	<p>Any time of year.</p>	<p>Backhoes, excavators, or similar equipment for removing biomass.</p> <p>Pick-axes, mattocks, shovels, "weed wrenches", or similar equipment for extracting below-ground biomass remnants.</p> <p>Haul trucks or similar equipment to remove cut biomass.</p>	<p>Remove plants and their root systems simultaneously.</p> <p>Dig out any root/rhizome fragments that remain after mechanical removal using hand tools.</p> <p>Dispose of all biomass at a landfill.</p>	<p>Effective if rhizomes and root masses are thoroughly cleared from site.</p> <p>Effective for removing large infestations in open and accessible terrain.</p> <p>Biomass removal may reduce flooding and fire hazard.</p>	<p>Significant soil disturbance and potential for erosion.</p> <p>Potential for collateral impacts to native plants, wildlife, and habitat.</p> <p>Need suitable access for equipment.</p>
<p>Biological Control</p> <p>Release pathogen of target species.</p>	<p>Arundo, tamarisk, herbaceous plants, trees, shrubs, and/or vines.</p> <p>Large patches of targeted vegetation.</p> <p>Patch may be intermixed with native plants.</p>	<p>Dependent upon pathogen or species released.</p>	<p>Dependent upon pathogen or species released.</p>	<p>Introduce pathogen to target species or release insect species on-site, depending on control agent selected.</p> <p>The USDA monitors and regulates biological controls.</p>	<p>May be effective in controlling the spread of tamarisk.</p>	<p>No biological control agent approved for use in the Calleguas Creek watershed for either arundo or tamarisk as of the completion of the Plan.</p> <p>May not be effective in eradicating the target species.</p>
<p>Grazing/Herbivory</p> <p>Allow grazing animals to graze on above ground biomass.</p>	<p>Arundo, herbaceous plants, small trees, shrubs, and/or vines.</p> <p>Large patches not intermixed with native plants.</p> <p>Where there is concern about herbicide use.</p>	<p>Any time of year.</p> <p>Most effective during growing season.</p>	<p>Grazing animals such as goats.</p> <p>Secure, temporary fencing.</p>	<p>Focus grazers on areas with high densities of arundo.</p> <p>May require fencing, herding, or other techniques to ensure that the method is effective and that grazers do not consume native vegetation.</p>	<p>May provide effective temporary control of new arundo growth.</p> <p>Provides animal forage.</p>	<p>Labor and time intensive.</p> <p>Low mortality rates require repeated re-treatment (five years or more), increasing project cost and frequency of disturbance to sensitive areas.</p> <p>May be difficult to focus grazers on target plants.</p> <p>Grazers may not find target species palatable.</p> <p>Concentrated areas of animal waste may cause negative impacts to treatment areas.</p> <p>Not appropriate in active channels.</p>

Other Removal Methods (continued)

Method	Appropriate Use	Timing	Materials and Tools	Instructions	Advantages	Disadvantages
Arundo only						
<p>Hand Trim and Spray</p> <p>Trim stems to within four to five feet of the ground, spray remaining stems, and remove trimmed biomass from the site.</p>	<p>Stands of arundo less than 12 feet in height.</p> <p>Stand may be intermixed with native plants.</p>	<p>Spring through fall depending on herbicide used.</p>	<p>Chainsaws, loppers, or similar equipment to trim biomass.</p> <p>Herbicide, surfactant, colorant, and water.</p> <p>Backpack sprayers, spray rigs, or similar equipment for herbicide application.</p> <p>Chippers to reduce biomass of hand-trimmed vegetation (optional).</p> <p>Haul trucks or similar equipment to remove trimmed biomass.</p>	<p>Trim target plants to four or five feet in height.</p> <p>Leave roots and rhizomes in the ground.</p> <p>Apply herbicide on leaves and stems of target species.</p> <p>Dispose of trimmed biomass at a landfill, chip and dispose of biomass at a landfill, or chip biomass and haul off-site for beneficial reuse.</p>	<p>Little soil disturbance.</p> <p>Minimal potential disturbance to native plants and/or wildlife.</p> <p>Chipped biomass may be used for mulch or other beneficial purposes.</p> <p>Biomass removal may reduce flooding and fire hazard.</p>	<p>Potential risk of herbicide drift to non-target plants and wildlife or adjacent sensitive receptors.</p> <p>Stalks intended for spraying may be trampled during cutting and missed during herbicide application.</p> <p>May be public concern with herbicide use.</p> <p>If extensive biomass removal is required, additional time and labor costs may be incurred.</p> <p>Trimming off new growth reduces the effectiveness of the herbicide, resprouts likely.</p>
<p>Mechanical Trim and Spray</p> <p>Cut stems to within four to five feet of the ground, spray remaining stems, and remove trimmed biomass from the site.</p>	<p>Stands of arundo less than 12 feet in height</p> <p>Stand not intermixed with native plants.</p> <p>Areas with easy access for equipment.</p>	<p>Spring through fall depending on herbicide used.</p>	<p>Masticators or similar equipment to trim biomass.</p> <p>Herbicide, surfactant, colorant, and water.</p> <p>Backpack sprayers, spray rigs, or similar equipment for herbicide application.</p> <p>Chippers to reduce biomass of hand-trimmed vegetation (optional).</p> <p>Haul trucks or similar equipment to remove trimmed biomass.</p>	<p>Trim target plants to four or five feet in height.</p> <p>Leave roots and rhizomes in the ground.</p> <p>Apply herbicide on leaves and stems of target species.</p> <p>Dispose of trimmed biomass at a landfill, chip and dispose of biomass at a landfill, or chip biomass and haul off-site for beneficial reuse.</p>	<p>Efficient reduction of biomass with mechanical removal.</p> <p>Chipped biomass may be used for mulch or other beneficial purposes.</p> <p>Biomass removal may reduce flooding and fire hazard.</p>	<p>Potential risk of herbicide drift to non-target plants and wildlife or adjacent sensitive receptors.</p> <p>May be public concern with herbicide use.</p> <p>If extensive biomass removal is required, additional time and labor costs may be incurred.</p> <p>Masticator may disturb the soil and cause collateral impacts to native plants, wildlife, and habitat.</p> <p>Need suitable access for equipment if masticator is used.</p> <p>Trimming off new growth reduces the effectiveness of the herbicide, resprouts likely.</p>

Appendix H - Herbicide Label and Material Safety Data Sheet

DRAFT

ATTENTION:

This specimen label is provided for general information only.

- This pesticide product may not yet be available or approved for sale or use in your area.
- It is your responsibility to follow all federal, state and local laws and regulations regarding the use of pesticides.
- Before using any pesticide, be sure the intended use is approved in your state or locality.
- Your state or locality may require additional precautions and instructions for use of this product that are not included here.
- Monsanto does not guarantee the completeness or accuracy of this specimen label. The information found in this label may differ from the information found on the product label. You must have the EPA approved labeling with you at the time of use and must read and follow all label directions.
- You should not base any use of a similar product on the precautions, instructions for use or other information you find here.
- Always follow the precautions and instructions for use on the label of the pesticide you are using.

21195F3-25



Complete Directions for Use in Aquatic and Other Non-Crop Sites.

EPA Reg. No. 524-343

AVOID CONTACT OF HERBICIDE WITH FOLIAGE, GREEN STEMS, EXPOSED NON-WOODY ROOTS OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES, BECAUSE SEVERE INJURY OR DESTRUCTION MAY RESULT.

2006-1

Read the entire label before using this product.

Use only according to label instructions.

Not all products recommended on this label are registered for use in California. Check the registration status of each product in California before using.

Read the "LIMIT OF WARRANTY AND LIABILITY" statement at the end of the label before buying or using. If terms are not acceptable, return at once unopened.

THIS IS AN END-USE PRODUCT. MONSANTO DOES NOT INTEND AND HAS NOT REGISTERED IT FOR REFORMULATION OR REPACKAGING. SEE INDIVIDUAL CONTAINER LABEL FOR REPACKAGING LIMITATIONS.

1.0 INGREDIENTS

ACTIVE INGREDIENT:

*Glyphosate, N-(phosphonomethyl)glycine,
in the form of its isopropylamine salt 53.8%
OTHER INGREDIENTS: 46.2%
100.0%

*Contains 648 grams per liter or 5.4 pounds per U.S. gallon of the active ingredient glyphosate, in the form of its isopropylamine salt. Equivalent to 480 grams per liter or 4.0 pounds per U.S. gallon of the acid, glyphosate.

No license granted under any non-U.S. patent(s).

2.0 IMPORTANT PHONE NUMBERS

1. FOR **PRODUCT INFORMATION** OR ASSISTANCE IN USING THIS PRODUCT, CALL TOLL-FREE, **1-800-332-3111**.
2. IN CASE OF AN **EMERGENCY INVOLVING THIS PRODUCT**, OR FOR **MEDICAL ASSISTANCE**, CALL COLLECT, DAY OR NIGHT, **(314)-694-4000**.

3.0 PRECAUTIONARY STATEMENTS

3.1 Hazards to Humans and Domestic Animals

Keep out of reach of children.

CAUTION!

Remove contaminated clothing and wash clothing before reuse. Wash thoroughly with soap and water after handling.

3.2 Environmental Hazards

Do not contaminate water when cleaning equipment or disposing of equipment washwaters. Treatment of aquatic weeds can result in oxygen depletion or loss due to decomposition of dead plants. This oxygen loss can cause fish suffocation.

In case of: SPILL or LEAK, soak up and remove to a landfill.

3.3 Physical or Chemical Hazards

Spray solutions of this product should be mixed, stored and applied using only stainless steel, aluminum, fiberglass, plastic or plastic-lined steel containers.

DO NOT MIX, STORE OR APPLY THIS PRODUCT OR SPRAY SOLUTIONS OF THIS PRODUCT IN GALVANIZED STEEL OR UNLINED STEEL (EXCEPT STAINLESS STEEL) CONTAINERS OR SPRAY TANKS. This product or spray solutions of this product react with such containers and tanks to produce hydrogen gas which may form a highly combustible gas mixture. This gas mixture could flash or explode, causing serious personal injury, if ignited by open flame, spark, welder's torch, lighted cigarette or other ignition source.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in any manner inconsistent with its labeling. This product can only be used in accordance with the Directions for Use on this label or in separately published Monsanto Supplemental Labeling. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulations.

4.0 STORAGE AND DISPOSAL

Do not contaminate water, foodstuffs, feed or seed by storage or disposal. Keep container closed to prevent spills and contamination.

PESTICIDE STORAGE: STORE ABOVE 5°F (-15°C) TO KEEP PRODUCT FROM CRYSTALLIZING. Crystals will settle to the bottom. If allowed to crystallize, place in a warm area 68°F (20°C) for several days to redissolve and roll or shake container or recirculate in mini-bulk containers to mix well before using.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product that cannot be used or chemically reprocessed should be disposed of in a landfill approved for pesticide disposal or in accordance with applicable Federal, state, or local procedures.

CONTAINER DISPOSAL: Emptied container retains vapor and product residue. Observe all labeled safeguards until container is cleaned, reconditioned, or destroyed.

FOR PLASTIC ONE-WAY CONTAINERS & BOTTLES: Do not reuse container. Triple rinse container, then puncture and dispose of in a sanitary landfill or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

FOR ONE-WAY DRUMS: Do not reuse container. Return container per the Monsanto container return program. If not returned, triple rinse container,

then puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

FOR REFILLABLE PORTABLE (MINI-BULK) CONTAINERS: This container must only be refilled with pesticide product. **Do not reuse this container for any other purpose.**

Final disposal must be in compliance with state and local regulations. If not refilled, returned, or recycled, triple rinse or pressure rinse, puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

Do not transport this container if it is damaged or leaking. If the container is damaged, leaking or obsolete, or to obtain information about recycling portable refillable containers, contact Monsanto Company at 800-768-6387.

Users: When the container is empty, replace the cap and seal all openings that have been made during usage, and return the container to the point of purchase, or to an alternate location designated by the manufacturer at the time of purchase of this product. If not returned, triple rinse or pressure rinse the empty container and offer it for recycling if available.

Refillers: Do not reuse this mini-bulk container except for refill in accordance with a valid Monsanto Repackaging or Toll Repackaging Agreement. Prior to refilling, inspect carefully for damage such as cracks, punctures, abrasions, worn-out threads and closure devices. Check for leaks after refilling and before transporting.

FOR REFILLABLE STATIONARY BULK CONTAINERS: This container must only be refilled with pesticide product. **Do not reuse this container for any other purpose.**

Prior to refilling, inspect carefully for damage such as cracks, punctures, abrasions, worn-out threads and closure devices.

Final disposal must be in compliance with state and local regulations. If not refilled, triple rinse or pressure rinse container and offer for recycling or reconditioning if possible. If burned, stay out of smoke.

5.0 GENERAL INFORMATION (How This Product Works)

Product Description: This product is a postemergent, systemic herbicide with no soil residual activity. It gives broad-spectrum control of many annual weeds, perennial weeds, woody brush and trees.

Time to Symptoms: This product moves through the plant from the point of foliage contact to and into the root system. Visible effects on most annual weeds occur within 2 to 4 days, but on most perennial weeds may not occur for 7 days or more. Extremely cool or cloudy weather following treatment may slow activity of this product and delay development of visual symptoms. Visible effects are a gradual wilting and yellowing of the plant which advances to complete browning of above-ground growth and deterioration of underground plant parts.

Mode of Action in Plants: The active ingredient in this product inhibits an enzyme found only in plants and microorganisms that is essential to formation of specific amino acids.

Cultural Considerations: Reduced control may result when applications are made to annual or perennial weeds that have been mowed, grazed or cut, and have not been allowed to regrow to the recommended stage for treatment.

Rainfastness: Heavy rainfall soon after application may wash this product off of the foliage and a repeat application may be required for adequate control.

No Soil Activity: Weeds must be emerged at the time of application to be controlled by this product. Weeds germinating from seed after application will not be controlled. Unemerged plants arising from unattached underground rhizomes or rootstocks of perennials will not be affected by the herbicide and will continue to grow.

Tank Mixing: This product does not provide residual weed control. For subsequent residual weed control, follow a label-approved herbicide program. Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used. Use according to the most restrictive label directions for each product in the mixture.

When this label recommends a tank mixture with a generic active ingredient such as diuron, 2,4-D or dicamba, the user is responsible for ensuring that the mixture product's label allows the specific application.

Buyer and all users are responsible for all loss or damage in connection with the use or handling of mixtures of this product with herbicides or other materials that are not expressly recommended in this label. Mixing this product with herbicides or other materials not recommended on this label may result in reduced performance.

Annual Maximum Use Rate: The combined total of all treatments must not exceed 8 quarts of this product per acre per year in terrestrial sites. Any single broadcast application made over water must not exceed 7.5 pints per acre. The maximum use rates stated throughout this product's labeling apply to this product combined with the use of all other herbicides containing glyphosate or sulfosate as the active ingredient, whether

applied as mixtures or separately. Calculate the application rates and ensure that the total use of this and other glyphosate or sulfosate containing products does not exceed stated maximum use rates.

ATTENTION

AVOID CONTACT OF HERBICIDE WITH FOLIAGE, GREEN STEMS, EXPOSED NON-WOODY ROOTS OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES, BECAUSE SEVERE INJURY OR DESTRUCTION MAY RESULT.

AVOID DRIFT. EXTREME CARE MUST BE USED WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS.

Do not allow the herbicide solution to mist, drip, drift or splash onto desirable vegetation since minute quantities of this product can cause severe damage or destruction to the crop, plants or other areas on which treatment was not intended. The likelihood of injury occurring from the use of this product increases when winds are gusty, as wind velocity increases, when wind direction is constantly changing or when there are other meteorological conditions that favor spray drift. When spraying, avoid combinations of pressure and nozzle type that will result in splatter or fine particles (mist) that are likely to drift. AVOID APPLYING AT EXCESSIVE SPEED OR PRESSURE.

NOTE: Use of this product in any manner not consistent with this label may result in injury to persons, animals or crops, or other unintended consequences.

6.0 MIXING

Clean sprayer parts immediately after using this product by thoroughly flushing with water.

NOTE: REDUCED RESULTS MAY OCCUR IF WATER CONTAINING SOIL IS USED, SUCH AS VISIBLY MUDDY WATER OR WATER FROM PONDS AND DITCHES THAT IS NOT CLEAR.

6.1 Mixing with Water

This product mixes readily with water. Mix spray solutions of this product as follows: Fill the mixing or spray tank with the required amount of water. Add the recommended amount of this product near the end of the filling process and mix well. Use caution to avoid siphoning back into the carrier source. Use approved anti-back-siphoning devices where required by state or local regulations. During mixing and application, foaming of the spray solution may occur. To prevent or minimize foam, avoid the use of mechanical agitators, terminate by-pass and return lines at the bottom of the tank and, if needed, use an approved anti-foam or defoaming agent.

6.2 Surfactant

This product requires the use of a nonionic surfactant. When using this product, mix 2 or more quarts of a nonionic surfactant per 100 gallons of spray solution. Increasing the rate of surfactant may enhance performance. Examples of when to use the higher surfactant rate include, but are not limited to: hard-to-control woody brush, trees and vines, high water volumes, adverse environmental conditions, tough-to-control weeds, weeds under stress, surfactants with less than 70 percent active ingredient, tank mixes, etc. These surfactants should not be used in excess of 1 quart per acre when making broadcast applications.

Always read and follow the manufacturer's surfactant label recommendations for best results. Carefully observe all cautionary statements and other information appearing in the surfactant label.

When applied as recommended under the conditions described, this product controls annual and perennial weeds listed in the label booklet. Do not reduce rates of this product when adding surfactant.

6.3 Tank Mixing Procedure

Mix labeled tank mixtures of this product with water as follows:

1. Place a 20- to 35-mesh screen or wetting basket over filling port.
2. Through the screen, fill the spray tank one-half full with water and start agitation.
3. If a wettable powder is used, make a slurry with the water carrier, and add it SLOWLY through the screen into the tank. Continue agitation.
4. If a flowable formulation is used, premix one part flowable with one part water. Add diluted mixture SLOWLY through the screen into the tank. Continue agitation.
5. If an emulsifiable concentrate formulation is used, premix one part emulsifiable concentrate with two parts water. Add diluted mixture slowly through the screen into the tank. Continue agitation.
6. Continue filling the spray tank with water and add the required amount of this product near the end of the filling process.

- Add nonionic surfactant to the spray tank before completing the filling process.
- Add individual formulations to the spray tank as follows: wettable powder, flowable, emulsifiable concentrate, drift control additive, water soluble liquid and nonionic surfactant.

Maintain good agitation at all times until the contents of the tank are sprayed. If the spray mixture is allowed to settle, thorough agitation is required to resuspend the mixture before spraying is resumed.

Keep by-pass line on or near the bottom of the tank to minimize foaming. Screen size in nozzle or line strainers should be no finer than 50-mesh.

Always predetermine the compatibility of labeled tank mixtures of this product with water carrier by mixing small proportional quantities in advance. Ensure that the specific tank mixture product is registered for application at the desired site.

Refer to the “**Tank Mixing**” section of “GENERAL INFORMATION” for additional precautions.

6.4 Mixing Percent Solutions

Prepare the desired volume of spray solution by mixing the amount of this product in water as shown in the following table:

Spray Solution

DESIRED VOLUME	Amount of AquaMaster Herbicide					
	0.5%	0.75%	1%	1.5%	4%	8%
1 gal	2/3 oz	1 oz	1.3 oz	2 oz	5 oz	10 oz
25 gal	1 pt	1.5 pt	1 qt	1.5 qt	4 qt	2 gal
100 gal	2 qt	3 qt	1 gal	1.5 gal	4 gal	8 gal

2 tablespoons = 1 fluid ounce

For use in backpack, knapsack or pump-up sprayers, it is suggested that the recommended amount of this product be mixed with water in a larger container. Fill sprayer with the mixed solution.

6.5 Colorants or Dyes

Agriculturally approved colorants or marking dyes may be added to this product. Colorants or dyes used in spray solutions of this product may reduce performance, especially at lower rates or dilution. Use colorants or dyes according to the manufacturer’s recommendations.

6.6 Drift Reduction Additives

Drift reduction additives may be used with all equipment types, except wiper applicators, and sponge bars. When a drift reduction additive is used, read and carefully observe the cautionary statements and all other information appearing on the additive label. The use of drift reduction additives can affect spray coverage which may result in reduced performance.

7.0 APPLICATION EQUIPMENT AND TECHNIQUES

Do not apply this product through any type of irrigation system.

APPLY THESE SPRAY SOLUTIONS IN PROPERLY MAINTAINED AND CALIBRATED EQUIPMENT CAPABLE OF DELIVERING DESIRED VOLUMES.

SPRAY DRIFT MANAGEMENT

AVOID DRIFT. EXTREME CARE MUST BE USED WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS.

Do not allow the herbicide solution to mist, drip, drift or splash onto desirable vegetation since minute quantities of this product can cause severe damage or destruction to the crop, plants or other areas on which treatment was not intended.

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment- and weather-related factors determine the potential for spray drift. The applicator and the grower are responsible for considering all these factors when making decisions.

7.1 Aerial Equipment

DO NOT APPLY THIS PRODUCT USING AERIAL SPRAY EQUIPMENT EXCEPT UNDER CONDITIONS AS SPECIFIED WITHIN THIS LABEL.

FOR AERIAL APPLICATION IN CALIFORNIA, REFER TO THE FEDERAL SUPPLEMENTAL LABEL FOR AERIAL APPLICATIONS IN THAT STATE FOR SPECIFIC INSTRUCTIONS, RESTRICTIONS AND REQUIREMENTS.

This product plus Oust, 2,4-D or dicamba tank mixtures may not be applied by air in California.

TO PREVENT INJURY TO ADJACENT DESIRABLE VEGETATION, APPROPRIATE BUFFER ZONES MUST BE MAINTAINED.

Avoid direct application to any body of water.

Use the recommended rates of this herbicide in 3 to 25 gallons of water per acre.

Ensure uniform application—To avoid streaked, uneven or overlapped application, use appropriate marking devices.

AERIAL SPRAY DRIFT MANAGEMENT

The following drift management requirements must be followed to avoid off-target drift movement from aerial applications to agricultural field crops. These requirements do not apply to public health uses.

- The distance of the outermost nozzles on the boom must not exceed 3/4 the length of the wingspan or rotor.
- Nozzles must always point backward parallel with the air-stream and never be pointed downwards more than 45 degrees. Where states have more stringent regulations, they should be observed.

Importance of Droplet Size

The most effective way to reduce drift potential is to apply large droplets. The best drift management strategy is to apply the largest droplets that provide sufficient coverage and control. Applying larger droplets reduces drift potential, but will not prevent drift if applications are made improperly, or under unfavorable environmental conditions (see the “**Wind**”, “**Temperature and Humidity**” and “**Temperature Inversions**” sections of this label).

Controlling Droplet Size

- Volume:** Use high flow rate nozzles to apply the highest practical spray volume. Nozzles with the higher rated flows produce larger droplets.
- Pressure:** Use the lower spray pressures recommended for the nozzle. Higher pressure reduces droplet size and does not improve canopy penetration. When higher flow rates are needed, use higher flow rate nozzles instead of increasing pressure.
- Number of nozzles:** Use the minimum number of nozzles that provide uniform coverage.
- Nozzle orientation:** Orienting nozzles so that the spray is released backwards, parallel to the airstream, will produce larger droplets than other orientations. Significant deflection from the horizontal will reduce droplet size and increase drift potential.
- Nozzle type:** Use a nozzle type that is designed for the intended application. With most nozzle types, narrower spray angles produce larger droplets. Consider using low-drift nozzles. Solid stream nozzles oriented straight back produce larger droplets than other nozzle types.
- Boom length:** For some use patterns, reducing the effective boom length to less than 3/4 of the wingspan or rotor length may further reduce drift without reducing swath width.
- Application height:** Applications should not be made at a height greater than 10 feet above the top of the largest plants unless a greater height is required for aircraft safety. Making applications at the lowest height that is safe reduces the exposure of the droplets to evaporation and wind.

Swath Adjustment

When applications are made with a crosswind, the swath will be displaced downwind. Therefore, on the up and downwind edges of the field, the applicator must compensate for this displacement by adjusting the path of the aircraft upwind. Swath adjustment distance should increase, with increasing drift potential (higher wind, smaller droplets, etc.).

Wind

Drift potential is lowest between wind speeds of 2 to 10 miles per hour. However, many factors, including droplet size and equipment type determine drift potential at any given speed. Application should be avoided below 2 miles per hour due to variable wind direction and high inversion potential. **NOTE:** Local terrain can influence wind patterns. Every applicator should be familiar with local wind patterns and how they affect drift.

Temperature and Humidity

When making applications in low relative humidity, set up equipment to produce larger droplets to compensate for evaporation. Droplet evaporation is most severe when conditions are both hot and dry.

Temperature Inversions

Applications should not occur during a temperature inversion because drift potential is high. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain in a concentrated cloud. This cloud can move in unpredictable directions due to the light variable winds common during inversions. Temperature inversions are characterized by increasing temperatures with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by ground fog; however, if fog is not present, inversions can also be identified by the movement of smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a concentrated cloud (under low wind conditions) indicates an inversion,

while smoke that moves upward and rapidly dissipates indicates good vertical air mixing.

Sensitive Areas

This product should only be applied when the potential for drift to adjacent sensitive areas (e.g., residential areas, bodies of water, known habitat for threatened or endangered species, non-target crops) is minimal (e.g., when wind is blowing away from the sensitive areas).

Aircraft Maintenance

PROLONGED EXPOSURE OF THIS PRODUCT TO UNCOATED STEEL SURFACES MAY RESULT IN CORROSION AND POSSIBLE FAILURE OF THE PART. The maintenance of an organic coating (paint) which meets aerospace specification MIL-C-38413 may prevent corrosion. To prevent corrosion of exposed parts, thoroughly wash aircraft after each day of spraying to remove residues of this product accumulated during spraying or from spills. Landing gear is most susceptible.

7.2 Ground Broadcast Equipment

When used according to label directions this product will give control or partial control of herbaceous weeds, woody brush and trees listed in the "WEEDS CONTROLLED" section of this label. Use the recommended rates of this product in 3 to 40 gallons of water per acre as a broadcast spray unless otherwise specified. As density of weeds increases, spray volume should be increased within the recommended range to ensure complete coverage. Carefully select proper nozzles to avoid spraying a fine mist. For best results with ground application equipment, use flat-fan nozzles. Check for even distribution of spray droplets.

7.3 Hand-Held Equipment

Apply to foliage of vegetation to be controlled. For applications made on a spray-to-wet basis, spray coverage should be uniform and complete. Do not spray to the point of runoff. Use coarse sprays only.

For low-volume directed spray applications, use a 4- to 8-percent solution of this product for control or partial control of annual weeds, perennial weeds, or woody brush and trees. Spray coverage should be uniform with at least 50 to 75 percent of the foliage contacted. Coverage of the top one-half of the plant is important for best results. If a straight stream nozzle is used, start the application at the top of the targeted vegetation and spray from top to bottom in a lateral zig-zag motion. For flat-fan and cone nozzles and with hand-directed mist blowers, mist the application over the foliage of the targeted vegetation. To ensure adequate spray coverage, spray both sides of large or tall woody brush and trees, when foliage is thick and dense, or where there are multiple sprouts. For best results, apply to actively growing woody brush and trees after full leaf expansion and before fall color and leaf drop.

Unless otherwise specified, use the recommended rates listed in the following "Application Rates" table for various methods of foliar application using high-volume, backpack, knapsack and similar types of hand-held equipment. When used according to label directions this product will give control or partial control of herbaceous weeds, woody brush and trees listed in the "WEEDS CONTROLLED" section of this label.

APPLICATION RATES		
APPLICATION	AQUAMASTER	SPRAY VOLUME GALLONS/ACRE
SPRAY-TO-WET		
Handgun or Backpack	0.5 to 1.5% by volume	spray-to-wet*
LOW-VOLUME DIRECTED SPRAY		
Backpack	4 to 8% by volume	15 to 25**
Modified High-Volume	1.5 to 3% by volume	40 to 60**

*For applications made on a spray-to-wet basis, spray coverage should be uniform and complete. Do not spray to the point of runoff.

**Low-volume directed applications with backpacks work best when treating weeds and brush less than 10 feet tall. For taller weeds and brush, high-volume handguns can be modified by reducing nozzle size and spray pressure to produce a low-volume directed spray.

7.4 Selective Equipment

This product may be applied through shielded applicators, hooded sprayers, wiper applicators or sponge bars, after dilution and thorough mixing with water, to listed weeds growing in any aquatic or non-crop site specified on this label.

AVOID CONTACT OF HERBICIDE WITH DESIRABLE VEGETATION, AS SERIOUS INJURY OR DEATH IS LIKELY TO OCCUR.

Applicators used above desired vegetation should be adjusted so that the lowest spray stream or wiper contact point is at least 2 inches above the

desirable vegetation. Droplets, mist, foam or splatter of the herbicide solution settling on desirable vegetation is likely to result in discoloration, stunting or destruction.

Better results may be obtained when more of the weed is exposed to the herbicide solution. Weeds not contacted by the herbicide solution will not be affected. This may occur in dense clumps, severe infestations or when the height of the weeds varies so that not all weeds are contacted. In these instances, repeat treatment may be necessary.

Shielded and Hooded Applicators

A shielded or hooded applicator directs the herbicide solution onto weeds, while shielding desirable vegetation from the herbicide. Use nozzles that provide uniform coverage within the treated area. Keep shields on these sprayers adjusted to protect desirable vegetation. EXTREME CARE MUST BE EXERCISED TO AVOID CONTACT OF HERBICIDE WITH DESIRABLE VEGETATION.

Wiper Applicators and Sponge Bars

Wiper applicators are devices that physically wipe appropriate amounts of this product directly onto the weed.

Equipment must be designed, maintained and operated to prevent the herbicide solution from contacting desirable vegetation. Operate this equipment at ground speeds no greater than 5 miles per hour. Performance may be improved by reducing speed in areas of heavy weed infestations to ensure adequate wiper saturation. Better results may be obtained if 2 applications are made in opposite directions.

Avoid leakage or dripping onto desirable vegetation. Adjust height of applicator to ensure adequate contact with weeds. Keep wiping surfaces clean. Be aware that, on sloping ground, the herbicide solution may migrate, causing dripping on the lower end and drying of the wicks on the upper end of a wiper applicator.

Do not use wiper equipment when weeds are wet.

Mix only the amount of solution to be used during a 1-day period, as reduced activity may result from use of leftover solutions. Clean wiper parts immediately after using this product by thoroughly flushing with water.

Nonionic surfactant at a rate of 10 percent by volume of total herbicide solution is recommended with all wiper applications.

For Rope or Sponge Wick Applicators—Solutions ranging from 33 to 75 percent of this product in water may be used.

For Panel Applicators—Solutions ranging from 33 to 100 percent of this product in water may be used in panel wiper applicators.

8.0 SITE AND USE INSTRUCTIONS

Unless otherwise specified, applications may be made to control any weeds listed in the "Annual Weeds", "Perennial Weeds" and "Woody Brush and Trees" rate tables. Refer also to the "Selective Equipment" section.

8.1 Aquatic Sites

This product may be applied to emerged weeds in all bodies of fresh and brackish water which may be flowing, nonflowing or transient. This includes lakes, rivers, streams, ponds, estuaries, rice levees, seeps, irrigation and drainage ditches, canals, reservoirs, wastewater treatment facilities, wildlife habitat restoration and management areas.

This product may also be used to control the labeled weeds, woody brush and trees growing in other terrestrial non-crop sites listed on this label or in aquatic sites within these areas.

If aquatic sites are present in a non-crop area and are part of the intended treatment, read and observe the following directions:

This product does not control plants which are completely submerged or have a majority of their foliage under water.

There is no restriction on the use of treated water for irrigation, recreation or domestic purposes.

Consult local state fish and game agency and water control authorities before applying this product to public water. Permits may be required to treat such water.

NOTE: Do not apply this product **directly to water** within 0.5 mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within 0.5 mile of an active potable water intake in a standing body of water such as lake, pond or reservoir. To make aquatic applications around and within 0.5 mile of active potable water intakes, the water intake must be turned off for a minimum period of 48 hours after the application. The water intake may be turned on prior to 48 hours if the glyphosate level in the intake water is below 0.7 parts per million as determined by laboratory analysis. These aquatic applications may be made **ONLY** in those cases where there are alternative water sources or holding ponds which would permit the turning off of an active potable

water intake for a minimum period of 48 hours after the applications. This restriction does **NOT** apply to intermittent inadvertent overspray of water in terrestrial use sites.

For treatments after drawdown of water or in dry ditches, allow 7 or more days after treatment before reintroduction of water to achieve maximum weed control. Apply this product within 1 day after drawdown to ensure application to actively growing weeds.

Floating mats of vegetation may require retreatment. Avoid wash-off of sprayed foliage by spray boat or recreational boat backwash or by rainfall within 6 hours of application. Do not retreat within 24 hours following the initial treatment.

Applications made to moving bodies of water must be made while traveling upstream to prevent concentration of this herbicide in water. When making any bankside applications, do not overlap more than 1 foot into open water. Do not spray in bodies of water where weeds do not exist. The maximum application rate of 7.5 pints per acre must not be exceeded in any single broadcast application that is being made over water.

When emerged infestations require treatment of the total surface area of impounded water, treating the area in strips may avoid oxygen depletion due to decaying vegetation. Oxygen depletion may result in fish kill.

Tank Mixtures

Tank mixtures of this product plus 2,4-D amine may be used to increase the spectrum of vegetation controlled in aquatic sites. Use 1.5 to 2 pints of this product plus 2 to 4 pints of 2,4-D amine (4 pounds active ingredient per gallon, labeled for aquatic sites) for control of annual weeds. Use 3 to 7.5 pints of this product plus 2 to 4 quarts of 2,4-D amine (4 pounds per gallon, labeled for aquatic sites) for control or partial control of perennial weeds, woody brush and trees.

When tank mixing, read and carefully observe the label claims, cautionary statements and all information on the labels of all products used. Use according to the most restrictive precautionary statements for each product in the mixture. Mix in the following sequence: Fill sprayer tank one-half full with water, add AquaMaster herbicide, then 2,4-D amine and finally surfactant. Fill sprayer tank to final volume of water.

NOTE: DO NOT MIX AQUAMASTER HERBICIDE AND 2,4-D AMINE CONCENTRATES WITHOUT WATER CARRIER. DO NOT MIX AQUAMASTER HERBICIDE AND 2,4-D AMINE IN BYPASS INJECTOR-TYPE SPRAY EQUIPMENT.

8.2 Cut Stump

Cut stump treatments may be made on any site listed on this label. This product will control many types of woody brush and tree species. Apply this product using suitable equipment to ensure coverage of the entire cambium. Cut trees or sprouts close to the soil surface. Apply a 50- to 100-percent solution of this product to the freshly-cut surface **immediately after** cutting. Delays in application may result in reduced performance. For best results, applications should be made during periods of active growth and full leaf expansion.

For control of *Ailanthus altissima* (Tree-of-heaven) make a cut stump treatment according to the directions in this section using a spray mixture of 50 percent AquaMaster herbicide and 10 percent Arsenal.

DO NOT MAKE CUT STUMP APPLICATIONS WHEN THE ROOTS OF DESIRABLE WOODY BRUSH OR TREES MAY BE GRAFTED TO THE ROOTS OF THE CUT STUMP. Some sprouts, stems, or trees may share the same root system. Adjacent trees having a similar age, height and spacing may signal shared roots. Whether grafted or shared, injury is likely to occur to non-treated stems/trees when one or more trees sharing common roots are treated.

8.3 General Non-Crop Areas and Industrial Sites

Use in areas such as airports, apartment complexes, commercial sites, ditch banks, driveways, dry ditches, dry canals, fencerows, golf courses, greenhouses, industrial sites, lumber yards, manufacturing sites, municipal sites, natural areas, office complexes, ornamentals, parking areas, parks, pastures, petroleum tank farms and pumping installations, railroads, rangeland, recreational areas, residential areas, rights-of-way, roadsides, schools, sod or turf seed farms, sports complexes, storage areas, substations, utility sites, warehouse areas, other public areas, and wildlife management areas.

General Weed Control, Trim-and-Edge and Bare Ground

This product may be used in general non-crop areas. It may be applied with any application equipment described in this label. This product may be used to trim-and-edge around objects in non-crop sites, for spot treatment of unwanted vegetation and to eliminate unwanted weeds growing in established shrub beds or ornamental plantings. This product may be used prior to planting an area to ornamentals, flowers, turfgrass (sod or seed), or prior to laying asphalt or beginning construction projects.

Repeated applications of this product may be used, as weeds emerge, to maintain bare ground.

TANK MIXTURES: This product may be tank-mixed with the following products. Refer to these products' labels for approved non-crop sites and application rates.

Arsenal®	Outrider®
Barricade® 65WG	Pendulum® 3.3 EC
Certainty®	Pendulum WDG
diuron	Plateau®
Endurance®	Princep® DF
Escort®	Princep Liquid
Garlon® 3A	Ronstar® 50 WP
Garlon 4	Sahara®
Hyvar® X	simazine
Karmex® DF	Surflan®
Krovar® I DF	Telar®
Oust®	2,4-D

This product plus dicamba tank mixtures may not be applied by air in California.

Brush Control Tank Mixtures

TANK MIXTURES: Tank mixtures of this product may be used to increase the spectrum of control for herbaceous weeds, woody brush and trees. When tank mixing, read and carefully observe the label claims, cautionary statements and all information on the labels of all products used. Use according to the most restrictive precautionary statements for each product in the mixture. Any recommended rate of this product may be used in a tank mix.

For control of herbaceous weeds, use the lower recommended tank mixture rates. For control of dense stands or tough-to-control woody brush and trees, use the higher recommended rates.

NOTE: For side trimming treatments, it is recommended that this product be used alone or in tank mixture with Garlon 4.

PRODUCT	BROADCAST RATE
Arsenal	6 to 32 fluid ounces per acre
Escort	1 to 2 ounces per acre
Garlon 3A*, Garlon 4	1 to 4 quarts per acre
PRODUCT	SPRAY-TO-WET RATES
Arsenal	0.06 to 0.12% by volume
Escort	1 to 2 ounces per acre
PRODUCT	LOW-VOLUME DIRECTED SPRAY RATES
Arsenal	0.1 to 0.5% by volume
Escort	1 to 2 ounces per acre

* Ensure that Garlon 3A is thoroughly mixed with water according to label directions before adding this product. Have spray mixture agitating at the time this product is added to avoid spray compatibility problems.

8.4 Habitat Management

Habitat Restoration and Management

This product may be used to control exotic and other undesirable vegetation in habitat management and natural areas, including riparian and estuarine areas, rangeland and wildlife refuges. Applications can be made to allow recovery of native plant species, prior to planting desirable native species, and for similar broad-spectrum vegetation control requirements. Spot treatments can be made to selectively remove unwanted plants for habitat management and enhancement.

Wildlife Food Plots

This product may be used as a site preparation treatment prior to planting wildlife food plots. Any wildlife food species may be planted after applying this product, or native species may be allowed to repopulate the area. If tillage is needed to prepare a seedbed, wait 7 days after application before tillage to allow translocation into underground plant parts.

8.5 Injection and Frill (Woody Brush and Trees)

This product may be used to control woody brush and trees by injection or frill applications. Apply this product using suitable equipment that must penetrate into the living tissue. Apply the equivalent of 1/25 fluid ounce (1 milliliter) of this product per each 2 to 3 inches of trunk diameter at breast height (DBH). This is best achieved by applying a 50- to 100-percent concentration of this product either to a continuous frill around the tree or as cuts evenly spaced around the tree below all branches. As tree diameter increases in size, better results are achieved by applying diluted material to a continuous frill or more closely spaced cuttings. Avoid application techniques that allow runoff to occur from frilled or cut areas in species that exude sap freely. In species such as this, make the frill or cuts at an oblique angle to produce a cupping effect and use a

100-percent concentration of this product. For best results, application should be made during periods of active growth and after full leaf expansion.

8.6 Roadsides

All of the instructions in the “General Non-Crop Areas and Industrial Sites” section apply to roadsides.

Shoulder Treatments

This product may be used on road shoulders. It may be applied with boom sprayers, shielded boom sprayers, high-volume off-center nozzles, hand-held equipment, and similar equipment.

Guardrails and Other Obstacles to Mowing

This product may be used to control weeds growing under guardrails and around signposts and other objects along the roadside.

Spot Treatment

This product may be used as a spot treatment to control unwanted vegetation growing along roadsides.

TANK MIXTURES: This product may be tank-mixed with the following products for shoulder, guardrail, spot and bare ground treatments, provided that the specific tank mixture product is labeled for this site:

diuron	Princep DF
Endurance	Princep Liquid
Escort	Ronstar 50 WP
Garlon 4	Sahara
Krovar I DF	simazine
Oust	Surflan
Outrider	Telar
Pendulum 3.3 EC	2,4-D
Pendulum WDG	

See the “MIXING” section of this label for general instructions for tank mixing.

Release of Bermudagrass or Bahiagrass

Dormant Applications

This product may be used to control or partially control many winter annual weeds and tall fescue for effective release of dormant Bermudagrass or bahiagrass. Treat only when turf is dormant and prior to spring greenup. This product may also be tank mixed with Outrider herbicide or Oust for residual control. Tank mixtures of this product with Oust may delay greenup.

For best results on winter annuals, treat when plants are in an early growth stage (below 6 inches in height) after most have germinated. For best results on tall fescue, treat when fescue is at or beyond the 4- to 6-leaf stage.

Apply 6 to 48 fluid ounces of this product in a tank mixture with 0.75 to 1.33 ounces Outrider herbicide per acre. Read and follow all label directions for Outrider herbicide.

TANK MIXTURES: Apply 6 to 48 fluid ounces of this product per acre alone or in a tank mixture with 0.25 to 1 ounce per acre of Oust. Apply the recommended rates in 10 to 40 gallons of water per acre. Use only in areas where Bermudagrass or bahiagrass are desirable ground covers and where some temporary injury or discoloration can be tolerated. To avoid delays in greenup and minimize injury, add no more than 1 ounce of Oust per acre on Bermudagrass and no more than 0.5 ounce of Oust per acre on bahiagrass and avoid treatments when these grasses are in a semi-dormant condition.

Actively Growing Bermudagrass

This product may be used to control or partially control many annual and perennial weeds for effective release of actively growing Bermudagrass. Apply 12 to 36 fluid ounces of this product in 10 to 40 gallons of spray solution per acre. Use the lower rate when treating annual weeds below 6 inches in height (or runner length). Use the higher rate as weeds increase in size or as they approach flower or seedhead formation. These rates will also provide partial control of the following perennial species:

Bahiagrass	Johnsongrass
Bluestem, silver	Trumpetcreeper
Fescue, tall	Vaseygrass

This product may be tank-mixed with Outrider herbicide for control or partial control of Johnsongrass and other weeds listed in the Outrider herbicide label. Use 6 to 24 ounces of this product with 0.75 to 1.33 ounces of Outrider herbicide per acre. Use the higher rates of both products for control of perennial weeds or annual weeds greater than 6 inches in height.

TANK MIXTURES: This product may be tank-mixed with Oust. If tank-mixed, use no more than 12 to 24 fluid ounces of this product with 1 to 2 ounces of Oust per acre. Use the lower rates of each product to control annual weeds less than 6 inches in height or runner length that are listed in this label and the Oust label. Use the higher rates as annual weeds increase in size and approach the flower or seedhead stages. These rates will also provide partial control of the following perennial weeds:

Bahiagrass	Fescue, tall
Bluestem, silver	Johnsongrass
Broomsedge	Poorjoe
Dallisgrass	Trumpetcreeper
Dock, curly	Vaseygrass
Dogfennel	Vervain, blue

Use only on well-established Bermudagrass. Bermudagrass injury may result from the treatment, but regrowth will occur under moist conditions. Repeat applications of the tank mix in the same season are not recommended, since severe injury may occur.

Actively Growing Bahiagrass

For suppression of vegetative growth and seedhead inhibition of bahiagrass for approximately 45 days, apply 4 fluid ounces of this product in 10 to 40 gallons of water per acre. Apply 1 to 2 weeks after full greenup or after mowing to a uniform height of 3 to 4 inches. This application must be made prior to seedhead emergence.

For suppression up to 120 days, apply 3 fluid ounces of this product per acre, followed by an application of 2 to 3 fluid ounces per acre about 45 days later. Make no more than 2 applications per year.

This product may be used for control or partial control of Johnsongrass and other weeds listed on the Outrider herbicide label in actively growing bahiagrass. Apply 1.5 to 3.5 fluid ounces of this product with 0.75 to 1.33 ounces of Outrider herbicide per acre. Use the higher rates for control of perennial weeds or annual weeds greater than 6 inches in height. Use only on well established bahiagrass.

TANK MIXTURES: A tank mixture of this product plus Oust may be used. Apply 4 fluid ounces of this product plus 0.25 ounce of Oust per acre 1 to 2 weeks following an initial spring mowing. Make only one application per year.

9.0 WEEDS CONTROLLED

Always use the higher rate of this product per acre within the recommended range when weed growth is heavy or dense or weeds are growing in an undisturbed (noncultivated) area.

Reduced results may occur when treating weeds heavily covered with dust. For weeds that have been mowed, grazed or cut, allow regrowth to occur prior to treatment.

Refer to the following label sections for recommended rates for the control of annual and perennial weeds and woody brush and trees. For difficult to control perennial weeds and woody brush and trees, where plants are growing under stressed conditions, or where infestations are dense, this product may be used at 4.5 to 8 quarts per acre for enhanced results.

9.1 Annual Weeds

Apply to actively growing annual grasses and broadleaf weeds.

Allow at least 3 days after application before disturbing treated vegetation. After this period the weeds may be mowed, tilled or burned. See the “GENERAL INFORMATION”, “MIXING”, and “APPLICATION EQUIPMENT AND TECHNIQUES” sections for labeled uses and specific application instructions.

Use 1.5 pints per acre if weeds are less than 6 inches in height or runner length and 1 to 4 quarts per acre if weeds are over 6 inches in height or runner length or when weeds are growing under stressed conditions.

For spray-to-wet applications, apply a 0.5-percent solution of this product to weeds less than 6 inches in height or runner length. Apply prior to seedhead formation in grass or bud formation in broadleaf weeds. For annual weeds over 6 inches tall, or for smaller weeds growing under stressed conditions, use a 0.75- to 1.5-percent solution. Use the higher rate for tough-to-control species or for weeds over 24 inches tall.

WEED SPECIES

Anoda, spurred	Cheeseweed
Balsamapple**	(<i>Malva parviflora</i>)
Barley*	Chervil*
Barnyardgrass*	Chickweed*
Bittercress*	Cocklebur*
Black nightshade*	Copperleaf, hophornbeam
Bluegrass, annual*	Corn*
Bluegrass, bulbous*	Corn speedwell*
Bassia, fivehook	Crabgrass*
Brome, downy*	Dwarfdandelion*
Brome, Japanese*	Eastern mannagrass*
Broomsedge	Eclipta*
Browntop panicum*	Fall panicum*
Buttercup*	Falsedandelion*
Carolina foxtail*	Falseflax, smallseed*
Carolina geranium	Fiddleneck
Castor bean	Field pennycress*
Cheatgrass*	Filaree

WEED SPECIES (Cont'd)

Fleabane, annual*	Ragweed, common*
Fleabane, hairy (<i>Conyza bonariensis</i>)*	Ragweed, giant
Fleabane, rough*	Red rice
Florida pusley	Russian thistle
Foxtail*	Rye*
Goatgrass, jointed*	Ryegrass*
Goosegrass	Sandbur, field*
Grain sorghum (milo)*	Shattercane*
Groundsel, common*	Shepherd's-purse*
Hemp sesbania	Sicklepod
Henbit	Signalgrass, broadleaf*
Horseweed/Marestail (<i>Conyza canadensis</i>)	Smartweed, ladysthumb*
Itchgrass*	Smartweed, Pennsylvania*
Johnsongrass, seedling	Sowthistle, annual
Junglerice	Spanishneedles***
Knotweed	Speedwell, purslane*
Kochia	Sprangletop*
Lamb's-quarters*	Spurge, annual
Little barley*	Spurge, prostrate*
London rocket*	Spurge, spotted*
Mayweed	Spurry, umbrella*
Medusahead*	Starthistle, yellow
Morningglory (<i>Ipomoea spp.</i>)	Stinkgrass*
Mustard, blue*	Sunflower*
Mustard, tansy*	Teaweed/Prickly sida
Mustard, tumble*	Texas panicum*
Mustard, wild*	Velvetleaf
Oats	Virginia copperleaf
Pigweed*	Virginia pepperweed*
Plains/Tickseed coreopsis*	Wheat*
Prickly lettuce*	Wild oats*
Puncturevine	Witchgrass*
Purslane, common	Woolly cupgrass*
	Yellow rocket

*When using field broadcast equipment (aerial applications or boom sprayers using flat-fan nozzles) these species will be controlled or partially controlled using 12 fluid ounces of this product per acre. Applications must be made using 3 to 10 gallons of carrier volume per acre. Use nozzles that ensure thorough coverage of foliage and treat when weeds are in an early growth stage.

** Apply with hand-held equipment only.

***Apply 3 pints of this product per acre.

9.2 Perennial Weeds

Best results are obtained when perennial weeds are treated after they reach the reproductive stage of growth (seedhead initiation in grasses and bud formation in broadleaves). For non-flowering plants, best results are obtained when the plants reach a mature stage of growth. In many situations treatments are required prior to these growth stages. Under these conditions, use the higher application rate within the recommended range.

Ensure thorough coverage when using spray-to-wet treatments using hand-held equipment. When using hand-held equipment for low-volume directed spot treatments, apply a 4- to 8-percent solution of this product.

Allow 7 or more days after application before tillage. If weeds have been mowed or tilled, do not treat until regrowth has reached the recommended stages. Fall treatments must be applied before a killing frost.

Repeat treatments may be necessary to control weeds regenerating from underground parts or seed.

WEED SPECIES	RATE (QT/A)	HAND-HELD % SOLUTION
Alfalfa*	0.7	1.5
Alligatorweed*	3.0	1.3
Anise (fennel)	1.5 - 3.0	1.0 - 1.5
Bahiagrass	2.3 - 3.75	1.5
Beachgrass, European (<i>Ammophila arenaria</i>)	—	3.5
Bentgrass*	1.0	1.5
Bermudagrass	4.0	1.5
Bermudagrass, water (knotgrass)	1.0	1.5
Bindweed, field	3.0 - 3.75	1.5
Bluegrass, Kentucky	1.5 - 2.3	0.75
Blueweed, Texas	3.0 - 3.75	1.5
Brackenfern	2.3 - 3.0	0.75 - 1.0
Bromegrass, smooth	1.5 - 2.3	0.75
Bursage, woolly-leaf	—	1.5
Canarygrass, reed	1.5 - 2.3	0.75

WEED SPECIES	RATE (QT/A)	HAND-HELD % SOLUTION
Cattail	2.3 - 3.75	0.75
Clover; red, white	2.3 - 3.75	1.5
Cogongrass	2.3 - 3.75	1.5
Cordgrass	2.3 - 3.75	1.0 - 2.0
Cutgrass, giant	3.0	1.0
Dallisgrass	2.3 - 3.75	1.5
Dandelion	2.3 - 3.75	1.5
Dock, curly	2.3 - 3.75	1.5
Dogbane, hemp	3.0	1.5
Fescue (except tall)	2.3 - 3.75	1.5
Fescue, tall	2.3	1.0
Guineagrass	2.3	0.75
Horsenettle	2.3 - 3.75	1.5
Horseradish	3.0	1.5
Iceplant	1.5	1.5
Ivy; German, cape	1.5 - 3.0	0.75 - 1.5
Jerusalem artichoke	2.3 - 3.75	1.5
Johnsongrass	1.5 - 2.3	0.75
Kikuyugrass	1.5 - 2.3	0.75
Knapweed	3.0	1.5
Lantana	—	0.75 - 1.0
Lespedeza	2.3 - 3.75	1.5
Loosestrife, purple	2.0	1.0 - 1.5
Lotus, American	2.0	0.75
Maidencane	3.0	0.75
Milkweed, common	2.3	1.5
Muhly, wirestem	1.5 - 2.3	0.75
Mullein, common	2.3 - 3.75	1.5
Napiergrass	2.3 - 3.75	1.5
Nightshade, silverleaf	3.0 - 3.75	1.5
Nutsedge; purple, yellow	2.3	0.75
Orchardgrass	1.5 - 2.3	0.75
Pampasgrass	2.3 - 3.75	1.5
Paragrass	3.0	0.75
Pepperweed, perennial	3.0	1.5
Phragmites*	2.0 - 3.75	0.75 - 1.5
Poison hemlock	1.5 - 3.0	0.75 - 1.5
Quackgrass	1.5 - 2.3	0.75
Redvine*	1.5	1.5
Reed, giant (<i>Arundo donax</i>)	3.0 - 3.75	1.5
Ryegrass, perennial	1.5 - 2.3	0.75
Salvinia, (<i>spp.</i>)	—	2.0
Smartweed, swamp	2.3 - 3.75	1.5
Spatdock	3.0	0.75
Spurge, leafy*	—	1.5
Starthistle, Yellow	—	1.5
Sweet potato, wild*	—	1.5
Thistle, artichoke	1.5 - 2.3	2.0
Thistle, Canada	1.5 - 2.3	1.5
Timothy	1.5 - 2.3	1.5
Torpedograss*	3.0 - 3.75	0.75 - 1.5
Trumpet creeper*	1.5 - 2.3	1.5
Tules, common	—	1.5
Vaseygrass	2.3 - 3.75	1.5
Velvetgrass	2.3 - 3.75	1.5
Waterhyacinth	2.5 - 3.0	0.75 - 1.0
Waterlettuce	—	0.75 - 1.0
Waterprimrose	—	0.75
Wheatgrass, western	1.5 - 2.3	0.75

*Partial control

Alligatorweed—Apply 6 pints of this product per acre as a broadcast spray or as a 1.3-percent solution with hand-held equipment to provide partial control of alligatorweed. Apply when most of the target plants are in bloom. Repeat applications will be required to maintain such control.

Beachgrass, European—Apply an 8-percent solution of this product plus 0.5- to 1.5-percent nonionic surfactant on a low-volume spray-to-wet basis. Best results are obtained when applications are made when European beachgrass is actively growing through the boot to the full heading stages of growth. Make applications prior to the loss of more than 50 percent green leaf color in the fall. Do not treat when weeds are under drought stress. Repeat applications may be necessary.

Bermudagrass—Apply 7.5 pints of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and when seedheads appear.

Bindweed, field / Silverleaf Nightshade / Texas Blueweed—Apply 6 to 7.5 pints of this product per acre as a broadcast spray west of the Mississippi River and 4.5 to 6 pints of this product per acre east of the Mississippi River. With hand-held equipment, use a 1.5-percent solution. Apply when target plants are actively growing and are at or beyond full bloom. For silverleaf nightshade, best results can be obtained when appli-

cation is made after berries are formed. Do not treat when weeds are under drought stress. New leaf development indicates active growth. For best results apply in late summer or fall.

Brackenfern—Apply 4.5 to 6 pints of this product per acre as a broadcast spray or as a 0.75- to 1-percent solution with hand-held equipment. Apply to fully expanded fronds which are at least 18 inches long.

Cattail—Apply 4.5 to 6 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when target plants are actively growing and are at or beyond the early-to-full bloom stage of growth. Best results are achieved when application is made during the summer or fall months.

Cogongrass—Apply 4.5 to 7.5 pints of this product per acre as a broadcast spray. Apply when cogongrass is at least 18 inches tall and actively growing in late summer or fall. Allow 7 or more days after application before tillage or mowing. Due to uneven stages of growth and the dense nature of vegetation preventing good spray coverage, repeat treatments may be necessary to maintain control.

Cordgrass—Apply 4.5 to 7.5 pints of this product per acre as a broadcast spray or as a 1- to 2-percent solution with hand-held equipment. Schedule applications in order to allow 6 hours before treated plants are covered by tidewater. The presence of debris and silt on the cordgrass plants will reduce performance. It may be necessary to wash targeted plants prior to application to improve uptake of this product into the plant.

Cutgrass, giant—Apply 6 pints of this product per acre as a broadcast spray or as a 1-percent solution with hand-held equipment to provide partial control of giant cutgrass. Repeat applications will be required to maintain such control, especially where vegetation is partially submerged in water. Allow for substantial regrowth to the 7- to 10-leaf stage prior to retreatment.

Dogbane, hemp / Knapweed / Horseradish—Apply 6 pints of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the late bud-to-flower stage of growth. For best results, apply in late summer or fall.

Fescue, tall—Apply 4.5 pints of this product per acre as a broadcast spray or as a 1-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the boot-to-head stage of growth. When applied prior to the boot stage, less desirable control may be obtained.

Guineagrass—Apply 4.5 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when target plants are actively growing and when most have reached at least the 7-leaf stage of growth.

Johnsongrass / Bluegrass, Kentucky / Bromegrass, smooth / Canarygrass, reed / Orchardgrass / Ryegrass, perennial / Timothy / Wheatgrass, western—Apply 3 to 4.5 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the boot-to-head stage of growth. When applied prior to the boot stage, less desirable control may be obtained. In the fall, apply before plants have turned brown.

Lantana—Apply this product as a 0.75- to 1-percent solution with hand-held equipment. Apply to actively growing lantana at or beyond the bloom stage of growth. Use the higher application rate for plants that have reached the woody stage of growth.

Loosestrife, purple—Apply 4 pints of this product per acre as a broadcast spray or as a 1- to 1.5-percent solution using hand-held equipment. Treat when plants are actively growing at or beyond the bloom stage of growth. Best results are achieved when application is made during summer or fall months. Fall treatments must be applied before a killing frost.

Lotus, American—Apply 4 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Treat when plants are actively growing at or beyond the bloom stage of growth. Best results are achieved when application is made during summer or fall months. Fall treatments must be applied before a killing frost. Repeat treatments may be necessary to control regrowth from underground parts and seeds.

Maidencane / Paragrass—Apply 6 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Repeat treatments will be required, especially to vegetation partially submerged in water. Under these conditions, allow for regrowth to the 7- to 10-leaf stage prior to retreatment.

Milkweed, common—Apply 4.5 pints of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the late bud-to-flower stage of growth.

Nutsedge; purple, yellow—Apply 4.5 pints of this product per acre as a broadcast spray, or as a 0.75-percent solution with hand-held equipment to control existing nutsedge plants and immature nutlets attached to treated plants. Apply when target plants are in flower or when new nutlets can be found at rhizome tips. Nutlets which have not germinated will not be controlled and may germinate following treatment. Repeat treatments will be required for long-term control.

Pampasgrass—Apply a 1.5-percent solution of this product with hand-held equipment when plants are actively growing.

Phragmites—For partial control of phragmites in Florida and the counties of other states bordering the Gulf of Mexico, apply 7.5 pints per acre as a broadcast spray or apply a 1.5-percent solution with hand-held equipment. In other areas of the U.S., apply 4 to 6 pints per acre as a broadcast spray or apply a 0.75-percent solution with hand-held equipment for partial control. For best results, treat during late summer or fall months when plants are actively growing and in full bloom. Due to the dense nature of the vegetation, which may prevent good spray coverage and uneven stages of growth, repeat treatments may be necessary to maintain control. Visual control symptoms will be slow to develop.

Quackgrass / Kikuyugrass / Muhly, wirestem—Apply 3 to 4.5 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment when most quackgrass or wirestem muhly is at least 8 inches in height (3- to 4-leaf stage of growth) and actively growing. Allow 3 or more days after application before tillage.

Reed, giant / Ice Plant—For control of giant reed and ice plant, apply a 1.5-percent solution of this product with hand-held equipment when plants are actively growing. For giant reed, best results are obtained when applications are made in late summer to fall.

Spatterdock—Apply 6 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when most plants are in full bloom. For best results, apply during the summer or fall months.

Sweet potato, wild—Apply this product as a 1.5-percent solution using hand-held equipment. Apply to actively growing weeds that are at or beyond the bloom stage of growth. Repeat applications will be required. Allow the plant to reach the recommended stage of growth before retreatment.

Thistle; Canada, artichoke—Apply 3 to 4.5 pints of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment for Canada thistle. To control artichoke thistle, apply a 2-percent solution as a spray-to-wet application. Apply when target plants are actively growing and are at or beyond the bud stage of growth.

Torpedograss—Apply 6 to 7.5 pints of this product per acre as a broadcast spray or as a 0.75- to 1.5-percent solution with hand-held equipment to provide partial control of torpedograss. Use the lower rates under terrestrial conditions, and the higher rates under partially submerged or a floating mat condition. Repeat treatments will be required to maintain such control.

Tules, common—Apply this product as a 1.5-percent solution with hand-held equipment. Apply to actively growing plants at or beyond the seedhead stage of growth. After application, visual symptoms will be slow to appear and may not occur for 3 or more weeks.

Waterhyacinth—Apply 5 to 6 pints of this product per acre as a broadcast spray or apply a 0.75- to 1-percent solution with hand-held equipment. Apply when target plants are actively growing and at or beyond the early bloom stage of growth. After application, visual symptoms may require 3 or more weeks to appear with complete necrosis and decomposition usually occurring within 60 to 90 days. Use the higher rates when more rapid visual effects are desired.

Waterlettuce—For control, apply a 0.75- to 1-percent solution of this product with hand-held equipment to actively growing plants. Use higher rates where infestations are heavy. Best results are obtained from mid-summer through winter applications. Spring applications may require retreatment.

Waterprimrose—Apply this product as a 0.75-percent solution using hand-held equipment. Apply to plants that are actively growing at or beyond the bloom stage of growth, but before fall color changes occur. Thorough coverage is necessary for best control.

Other perennials listed on this label—Apply 4.5 to 7.5 pints of this product per acre as a broadcast spray or as a 0.75- to 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached early head or early bud stage of growth.

9.3 Woody Brush and Trees

Apply this product after full leaf expansion, unless otherwise directed. Use the higher rate for larger plants and/or dense areas of growth. On vines, use the higher rate for plants that have reached the woody stage of growth. Best results are obtained when application is made in late summer or fall after fruit formation.

In arid areas, best results are obtained when applications are made in the spring to early summer when brush species are at high moisture content and are flowering.

Ensure thorough coverage when using spray-to-wet treatments using hand-held equipment. When using hand-held equipment for low-volume directed-spray spot treatments, apply a 4- to 8-percent solution of this product.

Symptoms may not appear prior to frost or senescence with fall treatments.

Allow 7 or more days after application before tillage, mowing or removal. Repeat treatments may be necessary to control plants regenerating from underground parts or seed. Some autumn colors on undesirable deciduous species are acceptable provided no major leaf drop has occurred. Reduced performance may result if fall treatments are made following a frost.

WEED SPECIES	BROADCAST RATE (QT/A)	HAND-HELD SPRAY-TO-WET % SOLUTION
Alder	2.3 - 3.0	0.75 - 1.2
Ash*	1.5 - 3.75	0.75 - 1.5
Aspen, quaking	1.5 - 2.3	0.75 - 1.2
Bearclover (Bearnat)*	1.5 - 3.75	0.75 - 1.5
Beech*	1.5 - 3.75	0.75 - 1.5
Birch	1.5	0.75
Blackberry	2.3 - 3.0	0.75 - 1.2
Blackgum	1.5 - 3.75	0.75 - 1.5
Bracken	1.5 - 3.75	0.75 - 1.5
Broom; French, Scotch	1.5 - 3.75	1.2 - 1.5
Buckwheat, California*	1.5 - 3.0	0.75 - 1.5
Cascara*	1.5 - 3.75	0.75 - 1.5
Castor bean	—	1.5
Catsclaw*	—	1.2 - 1.5
Ceanothus*	1.5 - 3.75	0.75 - 1.5
Chamise*	1.5 - 3.75	0.75
Cherry; bitter, black, pin	1.5 - 3.75	1.0 - 1.5
Cottonwood, eastern	1.5 - 3.75	0.75 - 1.5
Coyote brush	2.3 - 3.0	1.2 - 1.5
Cypress; swamp, bald	1.5 - 3.75	0.75 - 1.5
Deerweed	1.5 - 3.75	0.75 - 1.5
Dewberry	2.3 - 3.0	0.75 - 1.2
Dogwood*	3.0 - 3.75	1.0 - 2.0
Elderberry	1.5	0.75
Elm*	1.5 - 3.75	0.75 - 1.5
Eucalyptus	—	1.5
Gallberry	1.5 - 3.75	0.75 - 1.5
Gorse*	1.5 - 3.75	0.75 - 1.5
Hackberry, western	1.5 - 3.75	0.75 - 1.5
Hasardia*	1.5 - 3.0	0.75 - 1.5
Hawthorn	1.5 - 2.3	0.75 - 1.2
Hazel	1.5	0.75
Hickory*	3.0 - 3.75	1.0 - 2.0
Honeysuckle	2.3 - 3.0	0.75 - 1.2
Hornbeam, American*	1.5 - 3.75	0.75 - 1.5
Huckleberry	1.5 - 3.75	0.75 - 1.5
Knotweed; Japanese, Giant**	—	—
Kudzu	3.0	1.5
Locust, black*	1.5 - 3.0	0.75 - 1.5
Madrone resprouts*	—	1.5
Magnolia, sweetbay	1.5 - 3.75	0.75 - 1.5
Manzanita*	1.5 - 3.75	0.75 - 1.5
Maple, red	1.0 - 3.75	0.75 - 1.2
Maple, sugar	—	0.75 - 1.2
Maple, vine*	1.5 - 3.75	0.75 - 1.5
Monkey flower*	1.5 - 3.0	0.75 - 1.5
Oak; black, white*	1.5 - 3.0	0.75 - 1.5
Oak, northern pin	1.5 - 3.0	0.75 - 1.2
Oak, post	2.3 - 3.0	0.75 - 1.2
Oak, red	—	0.75 - 1.2
Oak, Scrub*	1.5 - 3.0	0.75 - 1.5
Oak, southern red	1.5 - 3.75	1.0 - 1.5
Orange, Osage	1.5 - 3.75	0.75 - 1.5
Peppertree, Brazilian (Florida holly)*	1.5 - 3.75	1.5
Persimmon*	1.5 - 3.75	0.75 - 1.5
Pine	1.5 - 3.75	0.75 - 1.5
Poison ivy	3.0 - 3.75	1.5
Poison oak	3.0 - 3.75	1.5
Poplar, yellow*	1.5 - 3.75	0.75 - 1.5
Prunus	1.5 - 3.75	1.0 - 1.5
Raspberry	2.3 - 3.0	0.75 - 1.2
Redbud, eastern	1.5 - 3.75	0.75 - 1.5
Redcedar, eastern	1.5 - 3.75	0.75 - 1.5
Rose, multiflora	1.5	0.75
Russian olive*	1.5 - 3.75	0.75 - 1.5
Sage, black	1.5 - 3.0	0.75
Sage, white*	1.5 - 3.0	0.75 - 1.5

WEED SPECIES	BROADCAST RATE (QT/A)	HAND-HELD SPRAY-TO-WET % SOLUTION
Sage brush, California	1.5 - 3.0	0.75
Salmonberry	1.5	0.75
Saltbush	—	1.0
Saltcedar**	1.5 - 3.75	0.75 - 1.5
Sassafras*	1.5 - 3.75	0.75 - 1.5
Sea Myrtle	—	1.0
Sourwood*	1.5 - 3.75	0.75 - 1.5
Sumac; laurel, poison, smooth, sugarbush, winged*	1.5 - 3.0	0.75 - 1.5
Sweetgum	1.5 - 2.3	0.75 - 1.5
Swordfern*	1.5 - 3.75	0.75 - 1.5
Tallowtree, Chinese	—	0.75
Tan oak resprouts*	—	1.5
Thimbleberry	1.5	0.75
Tobacco, tree*	1.5 - 3.0	0.75 - 1.5
Toyon*	—	1.5
Trumpet creeper	1.5 - 2.3	0.75 - 1.2
Vine maple*	1.5 - 3.75	0.75 - 1.5
Virginia creeper	1.5 - 3.75	0.75 - 1.5
Waxmyrtle, southern*	1.5 - 3.75	1.5
Willow	2.3	0.75
Yerba Santa*	—	1.5

*Partial control

**Refer to specific instructions below

Alder / Blackberry / Dewberry / Honeysuckle / Oak, post / Raspberry—For control, apply 4.5 to 6 pints per acre as a broadcast spray or as a 0.75- to 1.2-percent solution with hand-held equipment.

Aspen, quaking / Hawthorn / Trumpet creeper—For control, apply 3 to 4.5 pints of this product per acre as a broadcast spray or as a 0.75- to 1.2-percent solution with hand-held equipment.

Birch / Elderberry / Hazel / Salmonberry / Thimbleberry—For control, apply 3 pints per acre of this product as a broadcast spray or as a 0.75-percent solution with hand-held equipment.

Broom; French, Scotch—For control, apply a 1.2- to 1.5-percent solution with hand-held equipment.

Buckwheat, California / Hasardia / Monkey flower / Tobacco, tree—For partial control of these species, apply a 0.75- to 1.5-percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.

Castor bean—For control, apply a 1.5-percent solution of this product with hand-held equipment.

Catsclaw—For partial control, apply a 1.2- to 1.5-percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Cherry; bitter, black, pin / Oak, southern red / Sweetgum / Prunus—For control, apply 3 to 7.5 pints of this product per acre as a broadcast spray or as a 1- to 1.5-percent solution with hand-held equipment.

Coyote brush—For control, apply a 1.2- to 1.5-percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Dogwood / Hickory—For partial control, apply a 1- to 2-percent solution of this product with hand-held equipment or 6 to 7.5 pints per acre as a broadcast spray.

Eucalyptus, bluegum—For control of eucalyptus resprouts, apply a 1.5-percent solution of this product with hand-held equipment when resprouts are 6- to 12-feet tall. Ensure complete coverage. Apply when plants are actively growing. Avoid application to drought-stressed plants.

Knotweed; Japanese, Giant (*Polygonum cuspidatum* and *P. sachalinense*) Stem Injection. Apply 0.18 fluid ounce (5 milliliters) of this product injected below the 2nd node above the ground of each stem in the clump. Use suitable equipment that must penetrate into the internode region.

Cut Stem. Cut stems cleanly just below the 2nd or 3rd node above the ground. Immediately apply 0.36 fluid ounce (10 milliliter) of a 50-percent solution of this product into the 'well' or remaining internode. Ensure that removed upper plant material is carefully gathered and discarded so that it will not contact soil and regenerate plants from sprouting buds. Use of a bio-barrier such as cardboard, plywood or plastic sheeting is recommended. The combined total for all treatments must not exceed 8 quarts per acre. At 5 milliliters per stem, 8 quarts should treat about 1500 stems

Kudzu—For control, apply 6 pints of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Repeat applications will be required to maintain control.

Maple, red—For control, apply as a 0.75- to 1.2-percent solution with hand-held equipment when leaves are fully developed. For partial control, apply 2 to 7.5 pints of this product per acre as a broadcast spray.

Maple, sugar / Oak, northern pin, red—For control, apply as a 0.75- to 1.2-percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Peppertree, Brazilian (holly, Florida) / Waxmyrtle, southern—For partial control, apply this product as a 1.5-percent solution with hand-held equipment.

Poison ivy / Poison oak—For control, apply 6 to 7.5 pints of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Repeat applications may be required to maintain control. Fall treatments must be applied before leaves lose green color.

Rose, multiflora—For control, apply 3 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Treatments should be made prior to leaf deterioration by leaf-feeding insects.

Sage, black / Sage brush, California / Chamise / Tallowtree, Chinese—For control of these species, apply a 0.75-percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.

Saltbush, Sea Myrtle—For control, apply this product as a 1-percent solution with hand-held equipment.

Saltcedar—For partial control, apply a 1- to 2-percent solution of this product with hand-held equipment or 6 to 7.5 pints per acre as a broadcast spray. For control, apply a 1- to 2-percent solution of this product mixed with 0.25-percent Arsenal with hand-held equipment. For control using broadcast applications, apply 3 pints of this product in a tank mix with 1 pint of Arsenal to plants less than 6 feet tall. To control saltcedar greater than 6 feet tall using broadcast applications, apply 6 pints of this product in a tank mix with 2 pints of Arsenal.

Willow—For control, apply 4.5 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment.

Other woody brush and trees listed in this label—For partial control, apply 3 to 7.5 pints of this product per acre as a broadcast spray or as a 0.75- to 1.5-percent solution with hand-held equipment.

10.0 LIMIT OF WARRANTY AND LIABILITY

Monsanto Company warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes set forth in the Complete Directions for Use label booklet (“Directions”) when used in accordance with those Directions under the conditions described therein. NO OTHER EXPRESS WARRANTY OR IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR MERCHANTABILITY IS MADE. This warranty is also subject to the conditions and limitations stated herein.

Buyer and all users shall promptly notify this Company of any claims whether based in contract, negligence, strict liability, other tort or otherwise.

To the fullest extent permitted by law, buyer and all users are responsible for all loss or damage from use or handling which results from conditions beyond the control of this Company, including, but not limited to, incompatibility with products other than those set forth in the Directions, application to or contact with desirable vegetation, unusual weather, weather conditions which are outside the range considered normal at the application site and for the time period when the product is applied, as well as weather conditions which are outside the application ranges set forth in the Directions, application in any manner not explicitly set forth in the Directions, moisture conditions outside the moisture range specified in the Directions, or the presence of products other than those set forth in the Directions in or on the soil, crop or treated vegetation.

This Company does not warrant any product reformulated or repackaged from this product except in accordance with this Company’s stewardship requirements and with express written permission from this Company.

THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE LIMIT OF THE LIABILITY OF THIS COMPANY OR ANY OTHER SELLER FOR ANY AND ALL LOSSES, INJURIES OR DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT (INCLUDING CLAIMS BASED IN CONTRACT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE) SHALL BE THE PURCHASE PRICE PAID BY THE USER OR BUYER FOR THE QUANTITY OF THIS PRODUCT INVOLVED, OR, AT THE ELECTION OF THIS COMPANY OR ANY OTHER SELLER, THE REPLACEMENT OF SUCH QUANTITY, OR, IF NOT ACQUIRED BY PURCHASE, REPLACEMENT OF SUCH QUANTITY, TO THE FULLEST EXTENT PERMITTED BY LAW, IN NO EVENT SHALL THIS COMPANY OR ANY OTHER SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES.

Upon opening and using this product, buyer and all users are deemed to have accepted the terms of this LIMIT OF WARRANTY AND LIABILITY which may not be varied by any verbal or written agreement. If terms are not acceptable, return at once unopened.

AquaMaster, Certainty, Outrider, and the Monsanto & Vine symbol are trademarks of Monsanto Technology LLC.

All other trademarks are the property of their respective owners.

EPA Reg. No. 524-343

In case of an emergency involving this product,
or for medical assistance,
Call Collect, day or night, (314) 694-4000.

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ST. LOUIS, MISSOURI, 63167 U.S.A.



MONSANTO COMPANY
Material Safety Data Sheet
Commercial Product

1. PRODUCT AND COMPANY IDENTIFICATION

Product name

AquaMaster[™] Herbicide

EPA Reg. No.

524-343

Product use

Herbicide

Chemical name

Not applicable.

Synonyms

None.

Company

MONSANTO COMPANY, 800 N. Lindbergh Blvd., St. Louis, MO, 63167

Telephone: 800-332-3111, **Fax:** 314-694-5557

Emergency numbers

FOR CHEMICAL EMERGENCY, SPILL LEAK, FIRE, EXPOSURE, OR ACCIDENT Call CHEMTREC - Day or Night: 1-800-424-9300 toll free in the continental U.S., Puerto Rico, Canada, or Virgin Islands. For calls originating elsewhere: 703-527-3887 (collect calls accepted).

FOR MEDICAL EMERGENCY - Day or Night: 314-694-4000 (collect calls accepted).

2. COMPOSITION/INFORMATION ON INGREDIENTS

Active ingredient

Isopropylamine salt of N-(phosphonomethyl)glycine; {Isopropylamine salt of glyphosate}

Composition

COMPONENT	CAS No.	% by weight (approximate)
Isopropylamine salt of glyphosate	38641-94-0	53.8
Water	7732-18-5	46.2

OSHA Status

This product is not hazardous according to the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

3. HAZARDS IDENTIFICATION

Emergency overview

Appearance and odour (colour/form/odour): Colourless - Amber / Liquid, (viscous) / Odourless

CAUTION!

Potential health effects

Likely routes of exposure

Skin contact, eye contact, inhalation

Eye contact, short term

Not expected to produce significant adverse effects when recommended use instructions are followed.

Skin contact, short term

Not expected to produce significant adverse effects when recommended use instructions are followed.

Inhalation, short term

Not expected to produce significant adverse effects when recommended use instructions are followed.

Refer to section 11 for toxicological and section 12 for environmental information.

4. FIRST AID MEASURES

Eye contact

Immediately flush with plenty of water.
If easy to do, remove contact lenses.

Skin contact

Take off contaminated clothing, wristwatch, jewellery.
Wash affected skin with plenty of water.
Wash clothes and clean shoes before re-use.

Inhalation

Remove to fresh air.

Ingestion

Immediately offer water to drink.
Do NOT induce vomiting unless directed by medical personnel.
If symptoms occur, get medical attention.

Advice to doctors

This product is not an inhibitor of cholinesterase.

Antidote

Treatment with atropine and oximes is not indicated.

5. FIRE-FIGHTING MEASURES

Flash point

none

Extinguishing media

Recommended: Water, foam, dry chemical, carbon dioxide (CO₂)

Unusual fire and explosion hazards

None.
Environmental precautions: see section 6.

Hazardous products of combustion

Carbon monoxide (CO), phosphorus oxides (P_xO_y), nitrogen oxides (NO_x)

Fire fighting equipment

Self-contained breathing apparatus.
Equipment should be thoroughly decontaminated after use.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Use personal protection recommended in section 8.

Environmental precautions

SMALL QUANTITIES:
Low environmental hazard.

LARGE QUANTITIES:
Minimise spread.
Keep out of drains, sewers, ditches and water ways.
Notify authorities.

Methods for cleaning up

SMALL QUANTITIES:
Flush spill area with water.
LARGE QUANTITIES:
Absorb in earth, sand or absorbent material.
Dig up heavily contaminated soil.
Collect in containers for disposal.
Refer to section 7 for types of containers.
Flush residues with small quantities of water.
Minimise use of water to prevent environmental contamination.

Refer to section 13 for disposal of spilled material.

7. HANDLING AND STORAGE

Good industrial practice in housekeeping and personal hygiene should be followed.

Handling

Avoid contact with skin and eyes.
When using do not eat, drink or smoke.
Wash hands thoroughly after handling or contact.
Thoroughly clean equipment after use.
Do not contaminate drains, sewers and water ways when disposing of equipment rinse water.
Refer to section 13 for disposal of rinse water.
Emptied containers retain vapour and product residue.

Storage

Minimum storage temperature: -15 °C
Maximum storage temperature: 50 °C
Compatible materials for storage: stainless steel, aluminium, fibreglass, plastic, glass lining
Incompatible materials for storage: galvanised steel, unlined mild steel, see section 10.
Keep out of reach of children.
Keep away from food, drink and animal feed.
Keep only in the original container.
Partial crystallization may occur on prolonged storage below the minimum storage temperature.
If frozen, place in warm room and shake frequently to put back into solution.
Minimum shelf life: 5 years.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Airborne exposure limits

Components	Exposure Guidelines
Isopropylamine salt of glyphosate	No specific occupational exposure limit has been established.
Water	No specific occupational exposure limit has been established.

Engineering controls

No special requirement when used as recommended.

Eye protection

No special requirement when used as recommended.

Skin protection

No special requirement when used as recommended.

Respiratory protection

No special requirement when used as recommended.

When recommended, consult manufacturer of personal protective equipment for the appropriate type of equipment for a given application.

9. PHYSICAL AND CHEMICAL PROPERTIES

These physical data are typical values based on material tested but may vary from sample to sample. Typical values should not be construed as a guaranteed analysis of any specific lot or as specifications for the product.

Colour/colour range:	Colourless - Amber
Form:	Liquid, (viscous)
Odour:	Odourless
Flash point:	none
Specific gravity:	1.206 @ 20 °C / 15.6 °C
Solubility:	Water: Completely miscible.
pH:	4.6 - 4.8 @ 63 g/l
Partition coefficient (log Pow):	< 0.000 (active ingredient)

10. STABILITY AND REACTIVITY

Stability

Stable under normal conditions of handling and storage.

Hazardous decomposition

Thermal decomposition: Hazardous products of combustion: see section 5.

Materials to avoid/Reactivity

Reacts with galvanised steel or unlined mild steel to produce hydrogen, a highly flammable gas that could explode.

11. TOXICOLOGICAL INFORMATION

This section is intended for use by toxicologists and other health professionals.

Data obtained on product and components are summarized below.

Acute inhalation toxicity

Rat, LC50, 4 hours, aerosol:

Slightly toxic.

FIFRA category III.

No 4-hr LC50 at the maximum achievable concentration.

Skin sensitization

Guinea pig, 9-induction Buehler test:

Positive incidence: 0 %

Mutagenicity

Micronucleus test(s):

Not mutagenic.

Ames test(s):

Not mutagenic with and without metabolic activation.

Isopropylamine salt of glyphosate (62%)

Data obtained on product and components are summarized below.

Acute oral toxicity

Rat, LD50 (limit test): > 5,000 mg/kg body weight

Practically non-toxic.

FIFRA category IV.

No mortality.

Mouse, LD50 (limit test): > 5,000 mg/kg body weight

Practically non-toxic.

FIFRA category IV.

No mortality.

Acute dermal toxicity

Rabbit, LD50 (limit test): > 5,000 mg/kg body weight

Practically non-toxic.

FIFRA category IV.

No mortality.

Skin irritation

Rabbit, 6 animals, Draize test:

Days to heal: 3

Primary Irritation Index (PII): 0.0/8.0

Essentially non irritating.

FIFRA category IV.

Acute inhalation toxicity

Rat, LC50, 4 hours, aerosol: > 4.24 mg/L

Practically non-toxic.

FIFRA category IV.

No mortality. Maximum attainable concentration.

Skin sensitization

Guinea pig, Buehler test:

Positive incidence: 0 %

N-(phosphonomethyl)glycine: {glyphosate}

Mutagenicity

In vitro and in vivo mutagenicity test(s):

Not mutagenic.

Repeated dose toxicity

Rabbit, dermal, 21 days:

NOAEL toxicity: > 5,000 mg/kg body weight/day

Target organs/systems: none

Other effects: none

Rat, oral, 3 months:

NOAEL toxicity: > 20,000 mg/kg diet

Target organs/systems: none

Other effects: none

Chronic effects/carcinogenicity

Mouse, oral, 24 months:

NOEL tumour: > 30,000 mg/kg diet

NOAEL toxicity: ~ 5,000 mg/kg diet

Tumours: none

Target organs/systems: liver

Other effects: decrease of body weight gain, histopathologic effects

Rat, oral, 24 months:

NOEL tumour: > 20,000 mg/kg diet

NOAEL toxicity: ~ 8,000 mg/kg diet
Tumours: none
Target organs/systems: eyes
Other effects: decrease of body weight gain, histopathologic effects

Toxicity to reproduction/fertility

Rat, oral, 3 generations:

NOAEL toxicity: > 30 mg/kg body weight
NOAEL reproduction: > 30 mg/kg body weight
Target organs/systems in parents: none
Other effects in parents: none
Target organs/systems in pups: none
Other effects in pups: none

Developmental toxicity/teratogenicity

Rat, oral, 6 - 19 days of gestation:

NOAEL toxicity: 1,000 mg/kg body weight
NOAEL development: 1,000 mg/kg body weight
Other effects in mother animal: decrease of body weight gain, decrease of survival
Developmental effects: weight loss, post-implantation loss, delayed ossification
Effects on offspring only observed with maternal toxicity.

Rabbit, oral, 6 - 27 days of gestation:

NOAEL toxicity: 175 mg/kg body weight
NOAEL development: 175 mg/kg body weight
Target organs/systems in mother animal: none
Other effects in mother animal: decrease of survival
Developmental effects: none

12. ECOLOGICAL INFORMATION

This section is intended for use by ecotoxicologists and other environmental specialists.

Data obtained on components are summarized below.

Isopropylamine salt of glyphosate (62%)

Aquatic toxicity, fish

Bluegill sunfish (*Lepomis macrochirus*):

Acute toxicity, 96 hours, static, LC50: > 1,000 mg/L
Practically non-toxic.

Rainbow trout (*Oncorhynchus mykiss*):

Acute toxicity, 96 hours, static, LC50: > 1,000 mg/L
Practically non-toxic.

Aquatic toxicity, invertebrates

Water flea (*Daphnia magna*):

Acute toxicity, 48 hours, static, EC50: 930 mg/L
Practically non-toxic.

Aquatic toxicity, algae/aquatic plants

Green algae (*Scenedesmus subspicatus*):

Acute toxicity, 72 hours, static, ErC50 (growth rate): 166 mg/L
Practically non-toxic.

Soil organism toxicity, invertebrates

Earthworm (*Eisenia foetida*):

Acute toxicity, 14 days, LC50: > 5,000 mg/kg dry soil
Practically non-toxic.

N-(phosphonomethyl)glycine: {glyphosate}

Avian toxicity

Bobwhite quail (*Colinus virginianus*):

Dietary toxicity, 5 days, LC50: > 4,640 mg/kg diet
No more than slightly toxic.

Mallard duck (*Anas platyrhynchos*):

Dietary toxicity, 5 days, LC50: > 4,640 mg/kg diet
No more than slightly toxic.

Bobwhite quail (*Colinus virginianus*):

Acute oral toxicity, single dose, LD50: > 3,851 mg/kg body weight
Practically non-toxic.

Arthropod toxicity

Honey bee (*Apis mellifera*):

Oral, 48 hours, LD50: 100 µg/bee

Honey bee (*Apis mellifera*):

Contact, 48 hours, LD50: > 100 µg/bee
Practically non-toxic.

Bioaccumulation

Bluegill sunfish (*Lepomis macrochirus*):

Whole fish: BCF: < 1
No significant bioaccumulation is expected.

Dissipation

Soil, field:

Half life: 2 - 174 days
Koc: 884 - 60,000 L/kg
Adsorbs strongly to soil.

Water, aerobic:

Half life: < 7 days

13. DISPOSAL CONSIDERATIONS

Product

Not classified as hazardous waste by the Resource, Conservation and Recovery Act (RCRA), 40 CFR 261.
Recycle if appropriate facilities/equipment available.
Burn in special, controlled high temperature incinerator.
Keep out of drains, sewers, ditches and water ways.
Follow all local/regional/national/international regulations.
Consult your attorney or appropriate regulatory officials for information on disposal.

Container

Triple or pressure rinse empty containers.
Pour rinse water into spray tank.
Store for collection by approved waste disposal service.
Dispose of as non hazardous industrial waste.
Do NOT re-use containers.
Follow all local/regional/national/international regulations.

14. TRANSPORT INFORMATION

The data provided in this section is for information only. Please apply the appropriate regulations to properly classify your shipment for transportation.

Not hazardous under the applicable DOT, ICAO/IATA, IMO, TDG and Mexican regulations.

15. REGULATORY INFORMATION

TSCA Inventory

All components are on the US EPA's TSCA Inventory

SARA Title III Rules

- Section 311/312 Hazard Categories
Not applicable.
- Section 302 Extremely Hazardous Substances
Not applicable.
- Section 313 Toxic Chemical(s)
Not applicable.

CERCLA Reportable quantity

Not applicable.

16. OTHER INFORMATION

The information given here is not necessarily exhaustive but is representative of relevant, reliable data.

Follow all local/regional/national/international regulations.

Please consult supplier if further information is needed.

For more information refer to product label.

Please consult Monsanto if further information is needed.

In this document the British spelling was applied.

® Registered trademark of Monsanto Company or its subsidiaries.

	Health	Flammability	Instability	Additional Markings
NFPA	0	1	1	

0 = Minimal hazard, 1 = Slight hazard, 2 = Moderate hazard, 3 = Severe hazard, 4 = Extreme hazard

Full denomination of most frequently used acronyms. BCF (Bioconcentration Factor), BOD (Biochemical Oxygen Demand), COD (Chemical Oxygen Demand), EC50 (50% effect concentration), ED50 (50% effect dose), I.M. (intramuscular), I.P. (intraperitoneal), I.V. (intravenous), Koc (Soil adsorption coefficient), LC50 (50% lethality concentration), LD50 (50% lethality dose), LDLo (Lower limit of lethal dosage), LEL (Lower Explosion Limit), LOAEC (Lowest Observed Adverse Effect Concentration), LOAEL (Lowest Observed Adverse Effect Level), LOEC (Lowest Observed Effect Concentration), LOEL (Lowest Observed Effect Level), MEL (Maximum Exposure limit), MTD (Maximum Tolerated Dose), NOAEC (No Observed Adverse Effect Concentration), NOAEL (No Observed Adverse Effect Level), NOEC (No Observed Effect Concentration), NOEL (No Observed Effect Level), OEL (Occupational Exposure Limit), PEL (Permissible Exposure Limit), PII (Primary Irritation Index), Pow (Partition coefficient n-octanol/water), S.C. (subcutaneous), STEL (Short-Term Exposure Limit), TLV-C (Threshold Limit Value-Ceiling), TLV-TWA (Threshold Limit Value - Time Weighted Average), UEL (Upper Explosion Limit)

This Material Safety Data Sheet (MSDS) serves different purposes than and DOES NOT REPLACE OR MODIFY THE EPA-APPROVED PRODUCT LABELING (attached to and accompanying the product container). This MSDS provides important health, safety, and environmental information for employers, employees, emergency responders and others handling large quantities of the product in activities generally other than product use, while the labeling provides that information specifically for product use in the ordinary course. Use, storage and disposal of pesticide products are regulated by the EPA under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) through the product labeling, and all necessary and appropriate precautionary, use, storage, and disposal information is set forth on that labeling. It is a violation of federal law to use a pesticide product in any manner not prescribed on the EPA-approved label.

Although the information and recommendations set forth herein (hereinafter "Information") are presented in good faith and believed to be correct as of the date hereof, MONSANTO Company makes no representations as to the completeness or accuracy thereof. Information is supplied upon the condition that the persons receiving same will make their own determination as to its suitability for the purposes prior to use. In no event will MONSANTO Company be responsible for damages of any nature whatsoever resulting from the use of or reliance upon information. NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO INFORMATION OR TO THE PRODUCT TO WHICH INFORMATION REFERS.

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Appendix I - Additional Herbicide Information

DRAFT

GLYPHOSATE

M. Tu, C. Hurd, R. Robison & J.M. Randall

Herbicide Basics

Chemical formula: N-(phosphonomethyl) glycine

Herbicide Family:
None generally recognized

Target Species: most annual and perennial plants

Forms: salts

Formulations: SL, EC

Mode of Action: amino acid synthesis inhibitor

Water Solubility:
900,000 ppm

Adsorption potential: high

Primary degradation mech:
slow microbial metabolism

Average Soil Half-life:
47 days

Mobility Potential: low

Dermal LD50 for rabbits:
>5,000 mg/kg

Oral LD50 for rats:
5,600 mg/kg

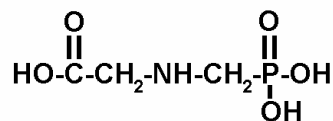
LC50 for bluegill sunfish:
120 mg/L

Trade Names: RoundUp[®], RoundUp-Pro[®], Rodeo[®], GlyPro[®], Accord[®], Glyphomax[®], Touchdown[®]

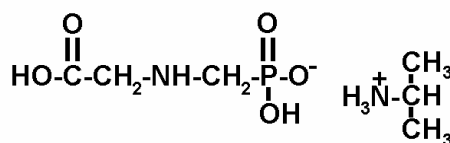
Manufacturers: Monsanto, Cenex/Land O'Lakes, Dow AgroSciences, Du Pont, Helena, and Platte.

Synopsis

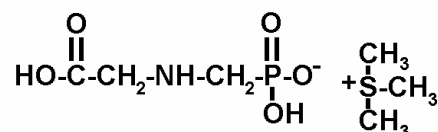
Glyphosate is a non-selective, systemic herbicide that can control most annual and perennial plants. It controls weeds by inhibiting the synthesis of aromatic amino acids necessary for protein formation in susceptible plants. Glyphosate is strongly adsorbed to soil particles, which prevents it from excessive leaching or from being taken-up from the soil by non-target plants. It is degraded primarily by microbial metabolism, but strong adsorption to soil can inhibit microbial metabolism and slow degradation. Photo- and chemical degradation are not significant in the dissipation of glyphosate from soils. The half-life of glyphosate ranges from several weeks to years, but averages two months. In water, glyphosate is rapidly dissipated through adsorption to suspended and bottom sediments, and has a half-life of 12 days to ten weeks. Glyphosate by itself is of relatively low toxicity to birds, mammals, and fish, and at least one formulation sold as Rodeo[®] is registered for aquatic use. Some surfactants that are included in some formulations of glyphosate, however, are highly toxic to aquatic organisms, and these formulations are not registered for aquatic use. Monsanto's patent for glyphosate expired in 2000, and other companies are already selling glyphosate formulations.



Glyphosate acid



Glyphosate isopropylamine salt



Glyphosate trimethylsulfonium salt

Herbicide Details

Chemical Formula: N-(phosphonomethyl) glycine

Trade Names: Monsanto discovered and held the patent for glyphosate, and was for many years, the only company that manufactured and sold this herbicide. The patent expired in 2000, however, and already several other companies are making and selling glyphosate formulations. Some of the current trade names include: Roundup Ultra[®], Roundup Pro[®], Accord[®], Honcho[®], Pondmaster[®], Protocol[®], Rascal[®], Expedite[®], Ranger[®], Bronco[®], Campain[®], Landmaster[®], and Fallow Master[®] by Monsanto; Glyphomax[®] and Glypro[®] by Dow AgroSciences; Glyphosate herbicide by Du Pont; Silhouette[®] by Cenex/Land O'Lakes; Rattler[®] by Helena; MirageR[®] by Platte; JuryR[®] by Riverside/Terra; and Touchdown[®] by Zeneca. As of November 2001, Rodeo[®] (previously manufactured by Monsanto) is now being manufactured by Dow AgroSciences and Monsanto is now producing Aquamaster[®].

Manufacturers: Current manufacturers include Monsanto, Cenex/Land O'Lakes, Helena, Platte, Riverside/Terra, Dow AgroSciences, and Zeneca.

Use Against Natural Area Weeds: Glyphosate is a broad-spectrum, nonselective systemic herbicide that kills or suppresses many grasses, forbs, vines, shrubs, and trees. Care should be taken, especially in natural areas, to prevent it from being applied to desirable, native plants, because it will likely kill them. In terrestrial systems, glyphosate can be applied to foliage, green stems, and cut-stems (cut-stumps), but cannot penetrate woody bark (Carlisle & Trevors 1988). Only certain formulations of glyphosate (e.g., Rodeo[®]) are registered for aquatic use, as glyphosate by itself is essentially non-toxic to submersed plants (Forney & Davis 1981), but the adjuvants often sold with glyphosate may be toxic to aquatic plants and animals.

Glyphosate is one of the most commonly used herbicides in natural areas, because it provides effective control of many species. Natural area weeds that have been controlled with glyphosate include: bush honeysuckle (*Lonicera maackii*), cogon grass (*Imperata cylindrica*), common buckthorn (*Rhamnus cathartica*), glossy buckthorn (*Frangula alnus*), Japanese honeysuckle (*Lonicera japonica*), and smooth brome (*Bromus inermis*). In TNC preserves, glyphosate has been used to control dewberries (*Rubus* spp.), bigtooth aspen (*Populus grandidentata*), and black cherry (*Prunus serotina*) at Kitty Todd preserve in Ohio, sweetclover (*Melilotus officinalis*) in Indiana preserves, leafy spurge (*Euphorbia esula*) and St. John's wort/Klamath weed (*Hypericum perforatum*) in Michigan preserves, and bindweed (*Convolvulus arvensis*) and velvetgrass (*Holcus lanatus*) in Oregon and Washington preserves.

In aquatic or wetland systems, glyphosate has successfully controlled common reed (*Phragmites australis*) in Delaware, Michigan, and Massachusetts preserves, purple loosestrife (*Lythrum salicaria*) in Indiana and Michigan preserves, reed canarygrass (*Phalaris arundinacea*) in Illinois preserves, and glossy buckthorn (*Frangula alnus*) and hybrid cattail (*Typha x glauca*) in Michigan preserves.

Mode of Action: Glyphosate kills plants by inhibiting the activity of the enzyme 5-enolpyruvylshikimic acid-3-phosphate synthase (EPSP), which is necessary for the formation of the aromatic amino acids tyrosine, tryptophan, and phenylalanine. These amino acids are important in the synthesis of proteins that link primary and secondary metabolism (Carlisle & Trevors 1988). EPSPs are present in the chloroplast of most plant species, but are not present in animals. Animals need these three amino acids, but obtain them by eating plants or other animals.

Glyphosate is therefore, relatively non-toxic to animals (Monsanto Company 1985). Certain surfactants or other ingredients that are added to some glyphosate formulations are toxic to fish and other aquatic species (EXTOXNET 1996).

Glyphosate can also act as a competitive inhibitor of phosphoenolpyruvate (PEP), which is one of the precursors to aromatic amino acid synthesis. It also affects other biochemical processes, and, although these effects are considered secondary, they may be important in the total lethal action of glyphosate.

Dissipation Mechanisms:

Summary: Glyphosate is degraded primarily by microbial metabolism. Glyphosate is believed to be susceptible to photodegradation (Lund-Hoie & Friestad 1986), but the extent to which this occurs is uncertain. Glyphosate is not significantly degraded by other chemical mechanisms in the field. Glyphosate is strongly adsorbed to soil, which can slow microbial metabolism but prevents excessive movement in the environment. Glyphosate is non-volatile (T. Lanini, pers. obs).

Volatilization

Glyphosate does not volatilize readily when applied in the field (T. Lanini, pers. obs.).

Photodegradation

Although originally thought to be unaffected by sunlight (Rueppel et al. 1977), later studies found glyphosate to be susceptible to photodegradation (Lund-Hoie & Friestad 1986; Carlisle & Trevors 1988). Lund-Hoie and Friestad (1986) reported a half-life of four days for glyphosate in deionized water under UV light.

Microbial Degradation

Glyphosate is degraded primarily by microbial metabolism. Two steady rates of degradation have been identified (Rueppel et al. 1977). It has been hypothesized that the more rapid rate of degradation represents the metabolism of unbound glyphosate molecules, while the slower rate represents the metabolism of glyphosate molecules bound to soil particles (Nomura & Hilton 1977; Rueppel et al. 1977). The degradation of glyphosate is slower in soils with a higher adsorption capacity. Degradation rate was also affected by the particular microbial community of each soil (Carlisle & Trevors 1988; Malik et al. 1989). The primary metabolite of glyphosate is aminomethylphosphonic acid, which is non-toxic and degraded microbially at a somewhat slower rate than the parent compound (Nomura & Hilton 1977; Rueppel et al. 1977;

Carlisle & Trevors 1988). A number of other minor, biodegradable metabolites have also been identified.

Adsorption

Glyphosate is water-soluble, but it has an extremely high ability to bind to soil particles. Adsorption of glyphosate increases with increasing clay content, cation exchange capacity, and decreasing soil pH and phosphorous content (Sprankle et al. 1975a,b; Hance 1976; Nomura & Hilton 1977; Rueppel et al. 1977; Glass 1987). Glyphosate is adsorbed to soil particles rapidly during the first hour following application and slowly thereafter (Sprankle et al. 1975b). Strong adsorption to soil particles slows microbial degradation, allowing glyphosate to persist in soils and aquatic environments. Because glyphosate rapidly binds to soils, it has little or no herbicidal activity (“killing power”) once it touches soil (Sprankle et al. 1975a; Hance 1976; Nomura & Hilton 1977). Glyphosate can also be inactivated by adsorption if mixed with muddy water.

Adsorption prevents glyphosate from being mobile in the environment except when the soil particles themselves are washed away (Sprankle et al. 1975b; Rueppel et al. 1977; Roy et al. 1989a). Comes et al. (1976) found that glyphosate sprayed directly into a dry irrigation canal was not detectable in the first irrigation waters flowing through the canal several months later, although glyphosate residues remained in the canal soils. In most cases, glyphosate is quickly adsorbed to suspended and bottom sediments (Feng et al. 1990).

Chemical Decomposition

Glyphosate is not readily hydrolyzed or oxidized in the field (Rueppel et al. 1977; Anton et al. 1993; Zaranyika & Nyandoro 1993).

Behavior in the Environment

Summary: Glyphosate binds readily with soil particles, which limits its movement in the environment. It is degraded through microbial metabolism with an average half-life of two months in soils and two to ten weeks in water. In plants, glyphosate is slowly metabolized.

Soils

Glyphosate is highly water soluble, but unlike most water-soluble herbicides, glyphosate has a very high adsorption capacity. Once glyphosate contacts soil it is rapidly bound to soil particles rendering it essentially immobile (Roy et al. 1989a; Feng & Thompson 1990). Unbound glyphosate molecules are degraded at a steady and relatively rapid rate by soil microbes (Nomura & Hilton 1977; Rueppel et al. 1977). Bound glyphosate molecules also are biologically degraded at a steady, but slower rate. The half-life of glyphosate in soil averages two months but can range from weeks to years (Nomura & Hilton 1977; Rueppel et al. 1977; Newton et al. 1984; Roy et al. 1989a; Feng & Thompson 1990; Anton et al. 1993). Although the strong adsorption of glyphosate allows residues to persist for over a year, these residues are largely immobile and do not leach significantly. Feng and Thompson (1990) found that >90% of glyphosate residues were present in the top 15 cm of soil and were present as low as 35 cm down the soil column in only one of 32 samples. Adsorption to soil particles prevents glyphosate from being taken-up by the roots of plants.

Water

Because glyphosate binds strongly to soils, it is unlikely to enter waters through surface or sub-surface runoff except when the soil itself is washed away by runoff, and even then, it remains bound to soil particles and unavailable to plants (Rueppel et al. 1977, Malik et al. 1989). Most glyphosate found in waters likely results from runoff from vegetation surfaces, spray drift, and intentional or unintentional direct overspray. In most cases, glyphosate will dissipate rapidly from natural water bodies through adsorption to organic substances and inorganic clays, degradation, and dilution (Folmar et al. 1979; Feng et al. 1990; Zaranyika & Nyandoro 1993; Paveglio et al. 1996). Residues adsorbed to suspended particles are precipitated into bottom sediments where they can persist until degraded microbially with a half-life that ranges from 12 days to 10 weeks (Goldsborough & Brown 1993; EXTOWNET 1996). At least one study found that >50% of the glyphosate added directly to the waters of an irrigation canal were still present 14.4 km downstream (Comes et al. 1976).

Vegetation

Glyphosate is metabolized by some, but not all plants (Carlisle & Trevors 1988). It is harmless to most plants once in the soil because it is quickly adsorbed to soil particles, and even when free, it is not readily absorbed by plant roots (Hance 1976). The half-life of glyphosate on foliage has been estimated at 10.4 to 26.6 days (Newton et al. 1984). Roy et al. (1989b) found 14% and 9% of applied glyphosate accumulated in the berries of treated blueberry and raspberry bushes, respectively. These residues dissipated from the fruit with a half-life of <20 days for blueberries and <13 days for raspberries (Roy et al. 1989b).

Environmental Toxicity

Birds and Mammals

Glyphosate is of relatively low toxicity to birds and mammals (Evans & Batty 1986). The LD50 of glyphosate for rats is 5,600 mg/kg and for bobwhite quail, >4,640 mg/kg. EPA's Re-registration Eligibility Decision states that blood and pancreatic effects and weight gain were noted during subchronic feeding studies with rats and mice (EPA 1993). Other studies show developmental and reproductive impacts to animals given the highest dose.

Newton et al. (1984) examined glyphosate residues in the viscera of herbivores following helicopter application of glyphosate to a forest in Oregon and found residue levels comparable to those found in litter and ground cover (<1.7 mg/kg). These residue levels declined over time and were undetectable after day 55 (Newton et al. 1984). Although carnivores and omnivores exhibited much higher viscera residue levels (5.08 mg/kg maximum), Newton et al. (1984) concluded that carnivores were at lower risk than herbivores due to the lower relative visceral weights and a proportionally lower level of food intake.

Batt et al. (1980) found no effect on chicken egg hatchability or time to hatch when an egg was submerged in a solution of 5% glyphosate. Sullivan and Sullivan (1979) found that black-tailed deer showed no aversion to treated foliage and consumption of contaminated forage did not reduce total food intake. Significant impacts to bird and mammal populations due to large-scale habitat alterations following treatment of forest clearcuts with glyphosate have been reported (Morrison & Meslow 1984; Santillo et al. 1989a,b; MacKinnon & Freedman 1993).

Aquatic Species

Glyphosate itself is of moderate toxicity to fish. The 96-hour LC50 of technical grade glyphosate for bluegill sunfish and rainbow trout are 120 mg/L and 86 mg/L, respectively. Fish exposed to 5 mg/L of glyphosate for two weeks were found to have gill damage and liver damage was observed at glyphosate concentrations of 10 mg/L (Neskovic et al. 1996). The technical grade of glyphosate is of moderate toxicity to aquatic species, and the toxicity of different glyphosate formulations can vary considerably. For example, Touchdown 4-LC[®] and Bronco[®] have low LC50s for aquatic species (<13 mg/L), and are not registered for aquatic use. On the other hand, Rodeo[®] has relatively high LC50s (>900 mg/L) for aquatic species and is permitted for use in aquatic systems. The surfactant in Roundup[®] formulations is toxic to fish, however, Rodeo[®] has no surfactant, and is registered for aquatic use.

The surfactant X-77 Spreader[®], which is often used in conjunction with Rodeo[®], is approximately 100 times more toxic to aquatic invertebrates than Rodeo[®] alone (Henry et al. 1994). The surfactant MONO818[®] is included in Roundup[®] formulations because it aids the break-down of surface tension on leaf surfaces, but it may also interfere with cutaneous respiration in frogs and gill respiration in tadpoles (Tyler 1997 a,b). In addition, MONO818[®] is highly toxic to fish (Folmar et al. 1979; Servizi et al. 1987). The LC50 of MONO818[®] is 2-3 mg/L for sockeye, rainbow, and coho fry (Folmar et al. 1979; Servizi et al. 1987; Tyler 1997 a,b). The LC50 of Roundup[®] for bluegill sunfish and rainbow trout is only slightly higher at 6-14 mg/L and 8-26 mg/L, respectively. Similarly for *Daphnia*, the 96-hour LC50 of glyphosate alone is 962 mg/L, but the LC50 of Roundup[®] drops to 25.5 mg/L (Servizi et al. 1987). Roundup[®] is therefore not registered for use in aquatic systems.

Despite these toxicity levels, Hildebrand et al. (1980) found that Roundup[®] treatments at concentrations up to 220 kg/ha did not significantly affect the survival of *Daphnia magna* or its food base of diatoms under laboratory conditions. In addition, Simenstad et al. (1996) found no significant differences between benthic communities of algae and invertebrates on untreated mudflats and mudflats treated with Rodeo[®] and X-77 Spreader[®]. It appears that under most conditions, rapid dissipation from aquatic environments of even the most toxic glyphosate formulations prevents build-up of herbicide concentrations that would be lethal to most aquatic species.

Other Non-Target Organisms

Roberts and Berk (1993) investigated the effects of Roundup[®] on chemoattraction of the protozoa *Tetrahymena pyriformis* and found that it significantly interfered with chemoreception but not motility. Doses of glyphosate <10 ppm were stimulatory to soil microflora including actinomycetes, bacteria, and fungi, while concentrations > 10 ppm had detrimental impacts on microflora populations in one study (Chakravarty & Sidhu 1987). While some short-term studies (< 30 days) found glyphosate caused significant impacts to microbial populations, Roslycky (1982) found that these populations rebound from any temporary increase or decrease within 214 days. Similarly, Tu (1994) found that microorganisms recovered rapidly from treatment with glyphosate and that the herbicide posed no long-term threat to microbial activities.

Application Considerations:

Glyphosate can be applied using conventional, recirculating, wet apron, hooded and hand-operated sprayers; controlled drop, rope-wick, roller, and carpet applicators; mistblowers; injectors; and wipe-on devices (Carlisle & Trevors 1988). Feng et al. (1990) found that 10 meter buffer zones limited unintentional effects through chemical drift and off-target deposits into streams during application, while Marrs et al. (1993) concluded that 20 meters was a safe buffer width. Liu et al. (1996) found that increasing the glyphosate concentration was more effective in controlling weeds than increasing the droplet size. Thielen et al. (1995) concluded that the cations of hard water, including Ca^{++} and Mg^{++} , can greatly reduce the efficacy of glyphosate when present in a spray solution. Addition of ammonium sulfate or other buffer can precipitate out heavy elements in “hard” water if added before the herbicide is mixed with water.

When glyphosate is used as an aquatic herbicide, do not treat the entire water body at one time. Treat only one-third to one-half of any water body at any one time, to prevent fish kills caused by dissolved oxygen depletion.

Safety Measures:

Some glyphosate formulations are in EPA toxicity categories I and II (the two highest categories) for eye and skin exposure. Care should be taken and protective clothing worn to prevent accidental contact of these formulations on skin or eyes.

Human Toxicology:

EPA classified glyphosate as a “Group E” carcinogen or a chemical that has not shown evidence of carcinogenicity in humans (EPA 1993).

References

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TRICLOPYR

M. Tu, C. Hurd, R. Robison & J.M. Randall

Herbicide Basics

Chemical formula: [(3,5,6-trichloro-2-pyridinyl)oxy] acetic acid

Herbicide Family:

Pyridine (Picolinic acid)

Target Species: Broadleaf herbs and woody species

Forms: salt & ester

Formulations: EC, SL

Mode of Action: Auxin mimic

Water solubility: 430 ppm (acid), 23 mg/L (ester), 2,100,000 mg/L (salt)

Adsorption potential:

Intermediate (higher for ester than salt)

Primary degradation mech:

Microbial metabolism, photolysis, and hydrolysis

Average Soil Half-life: 30 days

Mobility Potential: Intermediate

Dermal LD50 for rabbits:

>2,000 mg/kg

Oral LD50 for rats:

713 mg/kg

LC50 for bluegill sunfish:

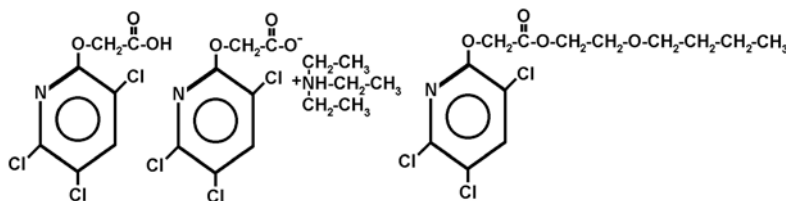
148 mg/L

Trade Names: Garlon® and Access®

Manufacturers: Dow Agro-Sciences and Platte

Synopsis

Triclopyr is a selective systemic herbicide used to control woody and herbaceous broadleaf plants along right-of-ways, in forests, and in grasslands and parklands. It has little or no impact on grasses. Triclopyr controls target weeds by mimicking the plant hormone auxin, causing uncontrolled plant growth. There are two basic formulations of triclopyr - a triethylamine salt, and a butoxyethyl ester. In soils, both formulations degrade to the parent compound, triclopyr acid. Degradation occurs primarily through microbial metabolism, but photolysis and hydrolysis can be important as well. The average half-life of triclopyr acid in soils is 30 days. Offsite movement through surface or sub-surface runoff is a possibility with triclopyr acid, as it is relatively persistent and has only moderate rates of adsorption to soil particles. In water, the salt formulation is soluble, and with adequate sunlight, may degrade in several hours. The ester is not water-soluble and can take significantly longer to degrade. It can bind with the organic fraction of the water column and be transported to the sediments. Both the salt and ester formulations are relatively non-toxic to terrestrial vertebrates and invertebrates. The ester formulation, however, can be extremely toxic to fish and aquatic invertebrates. Because the salt cannot readily penetrate plant cuticles, it is best used as part of a cut-stump treatment or with an effective surfactant. The ester can be highly volatile and is best applied at cool temperatures on days with no wind. The salt formulation (Garlon 3A®) can cause severe eye damage.



Triclopyr acid

Triethylamine salt

Butoxyethyl ester

Herbicide Details

Chemical Formula: [(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid

Trade Names: There are two basic formulations of triclopyr: a triethylamine salt (triclopyr amine or salt), and a butoxyethyl ester (triclopyr ester). The amine formulation is sold under the trade name Garlon 3A[®] and is marketed in garden shops and hardware stores as Turflon Amine[®] or as Brush-B-Gone[®]. The ester formulation is sold under the trade name Garlon 4[®] and is marketed in garden shops and hardware stores as Turflon Ester[®]. Other trade names include Access[®], Crossbow[®], ET[®], PathFinder II[®], Redeem[®], and Remedy[®]. These products also may be mixed with picloram or 2,4-D to increase their versatility.

Manufacturers: Dow Agrosiences (formerly known as DowElanco or Dow Chemical), Platte

Use Against Natural Area Weeds: Triclopyr is used to control broadleaf herbs and woody species (WSSA 1994). It is particularly effective at controlling woody species with cut-stump or basal bark treatments. Susceptible species include the brooms (*Cytisus* spp., *Genista* spp., and *Spartium* spp.), the gorses (*Ulex* spp.), and fennel (*Foeniculum vulgare*). Triclopyr ester formulations are especially effective against root- or stem-sprouting species such as buckthorns (*Rhamnus* spp.), ash (*Fraxinus* spp.), and black locust (*Robinia pseudoacacia*), because triclopyr remains persistent in plants until they die.

Even though offsite movement of triclopyr acid through surface or sub-surface runoff is a possibility, triclopyr is one of the most commonly used herbicides against woody species in natural areas. Bill Neil, who has worked extensively on tamarisk/saltcedar (*Tamarix* spp.) control, concluded that Pathfinder II[®], a triclopyr ester formulation by DowElanco, is the most cost effective herbicide for combating saltcedar. On preserves across the U.S., triclopyr has provided good control of tree-of-heaven (*Ailanthus altissima*), salt cedar (*Tamarix* spp.), glossy buckthorn (*Frangula alnus*), common buckthorn (*Rhamnus cathartica*), sweet fennel (*Foeniculum vulgare*), Brazilian peppertree (*Schinus terebinthifolius*), and Chinese tallow tree (*Sapium sebiferum*). TNC preserves in Hawaii have successfully used triclopyr to control blackwood acacia (*Acacia melanoxylon*), bush honeysuckle (*Lonicera maackii*), Chinese banyan (*Ficus microcarpa*), corkystem passionflower (*Passiflora suberosa*), eucalyptus (*Eucalyptus globulus*), Florida prickly blackberry (*Rubus argutus*), Mexican weeping pine (*Pinus patula*), Monterey pine (*Pinus radiata*), strawberry guava (*Psidium cattleianum*), tropical ash (*Fraxinus uhdei*), and velvet leaf (*Miconia calvescens*). Triclopyr can also be used in forest plantations to control brush without significant impacts to conifers (Kelpsas & White). Spruces (*Picea* spp.) can tolerate triclopyr, but some species of pine (*Pinus* spp.) however, can only tolerate triclopyr during the dormant fall and winter months (Jotcham et al. 1989).

Mode of Action: Triclopyr is an auxin mimic or synthetic auxin. This type of herbicide kills the target weed by mimicking the plant growth hormone auxin (indole acetic acid), and when administered at effective doses, causes uncontrolled and disorganized plant growth that leads to plant death. The exact mode of action of triclopyr has not been fully described, but it is believed to acidify and “loosen” cell walls, allowing cells to expand without normal control and

coordination. Low concentrations of triclopyr can stimulate RNA, DNA, and protein synthesis leading to uncontrolled cell division and growth, and, ultimately, vascular tissue destruction. Conversely, high concentrations of triclopyr can inhibit cell division and growth.

Dissipation Mechanisms:

Summary: Both the ester and amine formulations are degraded by sunlight, microbial metabolism, and hydrolysis. In soils, both the ester and amine formulations will degrade rapidly to the parent compound, triclopyr acid. The acid and ester formulations bind well with soils, and therefore, are not likely to be mobile in the environment. The salt however, does not readily adsorb and can be mobile. The ester can be highly volatile (T. Lanini, pers. com.).

Volatilization

Ester formulations of triclopyr can be highly volatile, and care should be taken in their application. The potential to volatilize increases with increasing temperature, increasing soil moisture, and decreasing clay and organic matter content (Helling et al. 1971).

Photodegradation

Both the ester and salt formulations are degraded readily in sunlight to the parent compound, triclopyr acid, which is also photodegradable. A study of photolysis found the half-life of triclopyr acid on soil under midsummer sun was two hours (McCall & Gavit 1986). Photodegradation can be particularly important in water. Johnson et al. (1995) found triclopyr acid dissolved in water had a half-life due to photolysis of one to 12 hours.

Microbial Degradation

Microbial metabolism accounts for a significant percentage of triclopyr degradation in soils. In general, warm, moist soils with a high organic content will support the largest microbial populations and the highest rates of herbicide metabolism (Newton et al. 1990). Johnson et al. (1995a) found that microbial degradation of triclopyr was significantly higher in moist versus dry soils, and higher at 30° C than at 15° C (DT50 is 46 days versus 98 days in dry soils, and 57 days versus 199 days in moist soils, respectively). Additionally, the presence of sunlight plays a role in the rates of microbial metabolism of triclopyr. Johnson et al. (1995a) found that microbial metabolism was slowed when soil was deprived of light.

Chemical Decomposition

Hydrolysis of both the salt and ester to the acid form occurs readily in the environment and within plants (Smith 1976). McCall and Gavit (1986) reported that the ester was converted to an acid with a half-life of three hours, and that the rate of hydrolysis in water increased with an increase in pH.

Adsorption

Adsorption temporarily or permanently immobilizes triclopyr, but adsorption is not degradation. Adsorption is more important for the immobilization of the ester than of the salt formulation. The ester binds readily with the organic component of the soil, with adsorption rates increasing as organic content increases and soil pH decreases (Pusino et al. 1994; Johnson et al. 1995a). The salt form is soluble in water and binds only weakly with soil (McCall & Gavit 1986). The

strong bond between the ester and soils accounts for the relatively low mobility of the ester in soils, whereas the salt form is much more mobile (McCall & Gavit 1986). In practice, however, both compounds are degraded rapidly to triclopyr acid, which has an intermediate adsorption capacity.

Behavior in the Environment

Summary: In soils, both formulations are degraded by photolysis, microbial metabolism, and hydrolysis to the parent compound, triclopyr acid. Triclopyr acid has an intermediate adsorption potential, limiting movement of the acid in the environment. The acid degrades with an average half-life of 30 days. In water, the salt will remain in the water column until it is degraded, which can occur in as little as a few hours under favorable conditions. The ester formulation, however, is not water-soluble and can take significantly longer to degrade in water. Within plants, both the salt and ester formulations are hydrolyzed to the acid form, and transported through the plant. Residues can persist in the plant until the tissues are degraded in the environment.

Soils

Both the ester and salt formulations degrade rapidly in soils to triclopyr acid, and thereafter, behave similarly in soils. Adsorption, photodegradation, microbial metabolism, and volatility, can all play a role in the dissipation of triclopyr from soils. The reported half-life of triclopyr in soils varies from 3.7 to 314 days, but averages 30 days, depending on the formulation applied and the specific soil and environmental conditions. If soil conditions are warm and moist, microbial metabolism can be the primary means of degradation (Newton et al. 1990).

Johnson et al. (1995a) reported an average half-life of triclopyr acid in four laboratory soils of 138 days, but this time varied significantly with soil temperature. At 15°C half-lives ranged from 64-314 days, while at 30°C half-lives were 9-135 days (Johnson et al. 1995). In Southwest Oregon, Newton et al. (1990) found 24-51% of triclopyr residues remained after 37 days in a dry and cool climate. Following an increase in warmth and moisture, however, dissipation increased dramatically and triclopyr residues exhibited a half-life of 11-25 days. In a study of triclopyr persistence in soil and water associated with rice production, triclopyr had a half-life of less than ten days in the three soil types tested (Johnson et al. 1995b). In a pasture near Corvallis, Oregon, the half-life of triclopyr acid was estimated to be 3.7 days (Norris et al. 1987).

Because of the importance of photodegradation and a decrease in the size of microbial populations with soil depth, triclopyr located deeper in the soil column (>15 cm) degrades more slowly than residues near the surface (Johnson et al. 1995a). Traces of triclopyr residues have been found at soil depths of 45 cm as late as 477 days after application (Newton et al. 1990). Sandy soils that are highly permeable may therefore, retain triclopyr longer. Most studies, however, found that triclopyr generally does not tend to move in significant quantities below the top 15 cm of soil (Norris et al. 1987; Newton et al. 1990; Stephenson 1990; Johnson et al. 1995a).

Water

In water, the two formulations can behave very differently. The water-soluble salt is degraded in the water column through photolysis and hydrolysis (McCall & Gavit 1985). The ester, however, is not water-soluble and can be persistent in aquatic environments. The ester binds to organic particles in the water column and precipitates to the sediment layers (McCall & Gavit 1986). Bound ester molecules will degrade through hydrolysis or photolysis to triclopyr acid (Smith 1976), which will move back into the water column and continue to degrade. The rate of degradation is dependent on the water temperature, pH, and sediment content.

Triclopyr acid has an intermediate soil adsorption capacity. Thus, movement of small amounts of triclopyr residues following the first significant rainfall are likely (McCall & Gavit 1986), but further leaching is believed to be minor (Newton et al. 1990; Stephenson et al. 1990; Thompson et al. 1991). Movement of triclopyr through surface and subsurface runoff in areas with minimal rainfall is believed to be negligible (Newton et al. 1990; Stephenson et al. 1990). In southwest Oregon, Norris et al. (1987) found that neither leaching nor long-distance overland water flow contributed significant amounts of the herbicide into a nearby stream, and concluded that the use of triclopyr posed little risk for non-target organisms or downstream water users. Triclopyr can, however, enter waterways via aerial drift and inadvertent overspray. When the acid was applied to rice paddy fields, residues remained in the water column and were not found in significant amounts in the soil (Johnson et al. 1995b). Degradation in water was rapid and showed a half-life of four days.

Vegetation

Both the ester and salt formulations are hydrolyzed to the acid after entering plant tissue. The acid tends to remain in plants until they die or drop leaves and begin to decay (Newton et al. 1990). Newton et al. (1990) reported that triclopyr in evergreen foliage and twigs showed remarkable persistence. Although concentrations of triclopyr in the soil will decrease quickly and remain low through the winter, levels can rise again in the spring if a new supply of contaminated foliage falls from defoliating crowns (Newton et al. 1990). The residues of some herbicides in fruit have been shown to persist up to one month (Holmes et al. 1994). There is therefore a potential for long-term exposure of triclopyr to animal species that eat wild fruit. In non-target plants, triclopyr soil residues can cause damage via root uptake (Newton et al. 1990).

Environmental Toxicity

Birds and Mammals

Triclopyr is regarded as only slightly toxic to birds and mammals. The oral LD50 for rats is 630-729 mg/kg. The LD50s for mallard ducks and bobwhite quail are 1,698 mg/kg and 2,935 mg/kg, respectively. Newton et al. (1990) predicted that triclopyr would not be present in animal forage in doses large enough to cause either acute or chronic effects to wildlife, and concluded that the tendency for triclopyr to dissipate quickly in the environment would preclude any problems with bioaccumulation in the food chain. Garlon 3A[®] can cause severe eye damage to both humans and wildlife, due to the high pH of its water-soluble amine salt base. Care must be taken during mixing and application to prevent accidental splashing into eyes.

In a study of the potential effects of herbicide residues on forest songbirds, sub-lethal doses of triclopyr ester (500 mg/kg in the diet for 29 days) were found to cause weight loss and behavior alterations in zebra finches (Holmes et al. 1994). In a 1987 study of triclopyr metabolism using one cow, all traces of triclopyr were eliminated from the cow's urine within 24 hours, and no residues were detected in its milk or feces. This study, however, did not track whether any triclopyr was absorbed into the cow's tissues, or whether the triclopyr recovered in the urine was still active (Eckerlin 1987).

Aquatic Species

Triclopyr acid and the salt formulation are slightly toxic to fish and aquatic invertebrates. The LC50 of the acid and the salt formulation for rainbow trout are 117 mg/L and 552 mg/L, respectively, and for bluegill sunfish 148 mg/L and 891 mg/L, respectively. The ester formulation is highly toxic to fish and aquatic invertebrates, with an LC50 (96-hour) of 0.74 mg/L in rainbow trout and 0.87 mg/L in bluegill sunfish (WSSA 1994; EPA 1998). The hydrophobic nature of the ester allows it to be readily absorbed through fish tissues where it is rapidly converted to triclopyr acid. The acid can be accumulated to a toxic level when fish are exposed to sufficient concentrations or for sufficient durations.

The extent to which the toxic effects of the ester are reduced by degradation is poorly understood. Studies have shown that the ester formulation degrades rapidly to less toxic forms (Thompson et al. 1991). Kreutzweiser et al. (1994) however, has shown that there is a significant chance of acute lethal effects to fish exposed to low level residues for more than six hours. In addition, delayed lethal effects were seen in fish exposed to high concentrations for a short duration. Considering that Thompson et al. (1991) concluded that organisms subjected to direct overspray were exposed to a high level of herbicide for short periods of time while organisms downstream were exposed to low levels for longer periods, the findings of Kreutzweiser et al. (1994) are of concern.

Nevertheless, most authors including the authors of the fish mortality study have concluded that if applied properly, triclopyr would not be found in concentrations adequate to kill aquatic organisms. As a measure of precaution, however, Kreutzweiser et al. (1991) suggest that some water bodies remain at risk of lethal contamination levels including shallow and slow moving water bodies where dissipation is slow, and heavily shaded streams that experience reduced photodegradation.

Other Non-Target Organisms

Triclopyr inhibited growth of four types of ectomycorrhizal fungi associated with conifer roots at concentrations of 1,000 parts per million (ppm) and higher (Estok et al. 1989). Some evidence of inhibition of fungal growth was detected in bioassays with as little as 100 ppm triclopyr. Typical usage in forest plantations, however, results in triclopyr residues of only four to 18 ppm on the forest floor (Estok et al. 1989).

Application Considerations:**Application Under Unusual Conditions:**

Several natural area managers have found that Garlon 4[®] and 3A[®] are effective when applied in mid-winter as a cut-stump treatment against buckthorns (*Rhamnus cathartica* and *R. frangula*). It is often easier to get to these plants when boggy soils around them are frozen. Randy Heidorn, Deputy Director for Stewardship of the Illinois Nature Preserve Commission (INPC), recommends three protocols to increase the safety of triclopyr ester application in winter:

- (1) use a mineral oil based carrier;
- (2) make sure that at the time of application, no water is at or above the ground surface, and no snow or ice is present that might serve as a route to spread the herbicide following a thaw, and;
- (3) initiate a monitoring program to assess ambient water concentrations of triclopyr ester in communities that seasonally have water at or above the ground surface with little or no discharge (i.e. bogs).

Safety Measures

The salt formulation in Garlon 3A[®] can cause severe eye damage because of the high pH of its water-soluble amine salt base. Care should be taken to prevent splashing or other accident contact with eyes.

Human Toxicology

Because studies into the carcinogenicity of triclopyr have produced conflicting results, EPA has categorized triclopyr as a “Group D” compound, or a chemical that is not classifiable as to human carcinogenicity. The salt formulation in Garlon 3A[®] can cause severe eye damage.

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