

WUCOLS

WATER USE CLASSIFICATION OF LANDSCAPE SPECIES

A Guide to the Water Needs of Landscape Plants

Revised 4/1/94

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PERSPECTIVE

This project was initiated and funded by the Water Conservation Office of the California Department of Water Resources. The work was performed by the University of California Cooperative Extension (San Francisco and San Mateo County Office) in cooperation with 32 landscape professionals. Work began in January, 1991 and a project report was completed in February, 1992. Further work was conducted in 1993 and this revised document was completed in April 1994.

PURPOSE

To provide guidance to landscape professionals in selecting and maintaining plants based on their irrigation water needs.

INTENDED USE

The WUCOLS list is intended solely as a guide to help landscape professionals identify irrigation water needs of landscape species. It can be used either for the selection of species or to assist in developing irrigation schedules for existing landscapes. It is not intended to be used as a "**required**", "**mandatory**", "**approved**" or "**master**" list by local, regional, or statewide governments, government agencies, or water authorities for the selection of plant species. This list should not be used in part or in entirety to restrict species selection to only those species listed here.

In addition, the evaluations of irrigation water requirements presented here should not be considered absolute and are not intended to be used as such, i.e., the user is not "**required**" to use these evaluations. This is a guide to species water needs. If the user has reason to believe that an evaluation made for a species is not appropriate, then the species could be reclassified to reflect the user's assessment.

ACKNOWLEDGEMENTS

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GETTING STARTED

If you are using the Guide for the **FIRST TIME**, we suggest that you begin by reading **HOW THIS GUIDE WAS DEVELOPED** (page 6). This section contains important background information on why and how the Guide was created, as well as an overview of the species evaluation process. Both first time and experienced users should keep the following question in mind:

**In order to be maintained in good condition,
in the region you are considering and under the
standard conditions outlined, does the species
need HIGH, MODERATE, LOW or VERY LOW
amounts of irrigation water?**

The answer to this question is the focus of the WUCOLS Guide. To arrive at the answer, you will need to understand several essential terms. They are introduced in **SPECIES EVALUATIONS - KEY TO SYMBOLS** and then described in various sections such as:

What are VEGETATION Types?

Go to: **VEGETATION TYPES**

What are STANDARD CONDITIONS?

Go to: **STANDARD CONDITIONS**

What REGION should you choose?

Go to: **WUCOLS REGIONS**

What does HIGH, MODERATE
LOW and VERY LOW mean?

Go to: **CATEGORIES OF
WATER NEEDS**

How can you CALCULATE the right
amount of irrigation water to apply?

Go to: **HOW TO CALCULATE
LANDSCAPE WATER NEEDS**

Is there more you should know?

Go to: **INVASIVE SPECIES
and
OTHER IMPORTANT
INFORMATION**

ABOUT

THE GUIDE

It is important that you understand these terms, as well as how the Guide was developed, to effectively use the Guide.

HOW THIS GUIDE WAS DEVELOPED

RATIONALE

Water conservation is an essential consideration in the design and management of California landscapes. Effective strategies that increase water use efficiency in landscapes need to be identified and implemented. One key strategy to increase efficiency is that of matching water supply to plant needs. By supplying only the amount of water needed to maintain landscape health and appearance, unnecessary applications that exceed plant needs can be avoided. To do so, however, requires some knowledge of species needs.

Although substantial information exists on the water needs of agricultural species and turfgrasses, there is little information on woody and herbaceous landscape species. More precisely, field studies have quantified irrigation requirements for six groundcover species (Pittenger, 1990) and three tree species (Hartin, 1991). Considering that over 1,200 tree, shrub, groundcover, vine, and perennial species are available from California nurseries, it is evident that over 99% of landscape species have not been evaluated for water needs. Were 20 or 30 more species studied in the next few years, still over 97% of the landscape plants used in California will not have been evaluated.

It is well recognized that substantial information of an observational nature exists regarding plant water needs. The water needs of olive and redbud, for instance, are known to be quite low compared to birch and dogwood. This information has been derived from many field observations and years of experience growing and maintaining these species. Considerable information exists for other species. It is acknowledged that objective field data is generally more useful information than subjective assessments. Nonetheless, some information regarding the 99+ percent of landscape species that have not been field tested is considered here to be better than no information. By collecting such information and using consistent evaluation methods, it was proposed that reasonable assessments of species water needs could be developed. These evaluations may then be used to provide some guidance to landscape planners and managers in selecting and maintaining species for water use efficiency. It was based on this rationale that the Water Use Classification of Landscape Species (WUCOLS) Project was initiated.

OBJECTIVES

- 1) To evaluate landscape species for irrigation water needs using "standard" methods and conditions. "Standard" meaning that the same evaluation methods were used for all species and plant site conditions were equivalent for all evaluations.
- 2) To compile the evaluations into a useful guide for plant selection.
- 3) To make the guide adaptable for computer use.

APPLICATIONS

- To assist landscape architects, designers, and planners in selecting plants for water efficient landscapes. Plants with similar needs can be grouped together in effective hydrozones. (A hydrozone is a portion of a landscaped area having plants with similar water needs that are served by one irrigation value, or set of values with the same schedule.)
- To assist landscape managers to evaluate water needs for existing plantings and to create irrigation schedules that match species needs.
- To provide options for landscape managers seeking to change species composition in order to reduce variation in water needs within plantings.
- To provide a basis for estimating water needs for newly planned landscapes.

IMPORTANT NOTE: Species selection is only one part of designing and maintaining water efficient landscapes. Information on soil physical and chemical properties, irrigation system performance, and microclimates is also needed. In addition, a plant's water requirement is not the only factor to consider in species selection. Plant shape, size at maturity, growth rate, and susceptibility to pests are a few of many other factors to consider.

METHOD

Subjective evaluations of irrigation water needs of landscape species were made using a standardized format. Evaluations were based on the experience and observations of project participants, as well as relevant research information. Standard conditions for each species to be evaluated were established by a coordinating committee, and the same evaluation process was used by each of six regional committees. Details of this process are outlined in the following sections and are presented in the order in which they were developed.

COORDINATING COMMITTEE

A statewide coordinating committee was established to develop standard conditions for

evaluations, identify appropriate water use categories, determine regions within the state which represent differing climatic conditions, and select appropriate members for regional evaluation teams. This committee consisted of six members. See **Project Participants** (page 2).

REGIONAL COMMITTEES

It was recognized that a single statewide committee would have difficulty evaluating species water needs in all six regions. Therefore, committees were established in each region consisting of from 5 to 9 members. Members were selected on the basis of their horticultural knowledge, familiarity with the region, and experience in the landscape industry. Attempts were made to include representatives of the various landscape professions: contractors, consultants, architects, nurserymen, park supervisors, irrigation specialists, and academics.

SPECIES LIST

A comprehensive species list was initially compiled from fifteen California wholesale growers and brokers catalogs. Over 900 species (trees, shrubs, groundcovers, vines and perennials) were included. The list was subsequently expanded by the regional committees and now includes over 1200 species.

PRELIMINARY EVALUATIONS

Current horticultural literature (see below) was used to research recommendations of species water needs. Species were assigned to preliminary categories of high, moderate and low water use.

Few authors use precise terminology when describing water use. Instead, general words that describe frequency of irrigations (periodic, monthly, etc.) or quantity of water applied (ample, generous, little) or soil and atmospheric conditions (moist, wet, dry) or ability to withstand periods of less than normal watering (drought tolerant, drought resistant) are used. Therefore, preliminary assignments of species to water requirement categories were simply based on an interpretation of these various terms and phrases.

The list was reviewed by the six regional committees and preliminary evaluations of water needs were changed as determined by committee consensus.

SOURCES OF INFORMATION FOR PRELIMINARY EVALUATIONS

- Success List of Water Conserving Plants, Saratoga Horticultural Foundation, San Martin, Ca., 1983

- Feldman, F., and Fogle, C. Ed., Sunset Waterwise Gardening, Lane Publishing Company, Menlo Park, Ca., 1989.
- Sunset Book and Magazine Editors, Sunset Western Garden Book, Menlo Park, Ca., 1990.
- Perry, R., Trees and Shrubs for Dry California Landscapes, Land Design Publishing, San Dimas, Ca., 1987.
- Coate, B., Water-Conserving Plants and Landscape of the Bay Area, East Bay Municipal Utility District, Alamo, Ca., 1990.
- Relative Water Requirements of Commonly Used Plants, Sacramento Water Use Ordinance.
- Pittenger, D. R., Can You Save Water With Ground Covers?, Environmental Horticulture Newsletter, 1990.
- Beutel, J., Saving Water in Home Orchards, - U.C. Leaflet 2975, 1977.
- Nursery catalogs (1990) with water designations: Boething, S & S Seeds, Hines, El Modeno and Bordiers.

REGIONAL COMMITTEE MEETINGS

In 1991, regional committees met for a two day period to review the project rationale, the evaluation process and standard conditions. Most of the time was devoted to evaluating each species on the preliminary list and making water needs assignments. In 1993, committees met for another two-day period to reevaluate certain species and to evaluate additional species.

MAKING WATER NEEDS ASSIGNMENTS

Each species was assigned to one water requirement category, as determined by consensus of each regional committee. Standard conditions applied for all evaluations. Essentially, the following question was being addressed:

"In order to be maintained in good condition in the region considered and under the standard conditions outlined, does the species need high, moderate, low, or very low amounts of irrigation water?"

Starting with this question, committee members shared their experiences in growing and maintaining the particular species and then made a decision to assign it to one category. When disagreements occurred, the higher water requirement category was assigned. For example, if some evaluators thought the species required a "moderate" ranking, while others thought "low" was appropriate, then the "moderate" assignment was used.

In cases where the committee did not know the species, or did not have sufficient experience growing it, then no water requirement assignment was made and a question mark (?) was entered for the species. When the species was simply not appropriate for the region (i.e., it doesn't grow there, or it is known not to perform well) then no evaluation

was made and a slash (/) was entered for the species. For example, Ocotillo is not grown in the Central Valley and therefore was assigned a (/) for the region.

The "very low" category was assigned to species that do not need irrigation during the summer months during normal rainfall years. When below normal rainfall occurs, then some irrigation may be needed.

SPECIES EVALUATIONS

KEY TO SYMBOLS*

TYPE	BOTANICAL NAME	COMMON NAME	REGIONAL EVALUATIONS					
			1	2	3	4	5	6
☹ T	Ailanthus altissima	tree of heaven	VL	VL	L	L	L	L
S	Brugmansia spp.	angel's trumpet	M	/	M	H	/	/

*This KEY provides essential information for using the WUCOLS Species Evaluation List. Two plant species are shown above as examples of how entries are made. All abbreviations and symbols used on the list are defined in the boxes. Go to the Guide for details on each category.

VEGETATION TYPES		
T....	Tree	
S....	Shrub	
V....	Vine	
Gc...	Groundcover	
P....	Perennial (includes ferns, grasses & bulbs)	

WUCOLS REGIONS		
1...	No. Central Coastal	
2...	Central Valley	
3...	South Coastal	
4...	South Inland Valley	
5...	High & Intermediate Desert	
6...	Low Desert	

WATER USE CLASSIFICATION OF LANDSCAPE SPECIES (WUCOLS) - Revised 1994

INVASIVE SPECIES		
⊗	Ⓢ	Greater Statewide Concern
⊗		Lesser Statewide Concern

CATEGORIES OF WATER NEEDS		
H.		High
M.		Moderate
L.		Low
VL		Very Low
/		Inappropriate
?		Unknown

	TYPE	BOTANICAL NAME	COMMON NAME	REGIONAL EVALUATIONS					
				1	2	3	4	5	6
	S	Abelia 'Edward Goucher'	pink abelia	M	M	M	M	/	M
	S	Abelia floribunda	Mexican abelia	M	M	M	M	/	/
	S	Abelia X grandiflora	glossy abelia	L	L	M	M	/	M
	Gc	Abelia grandiflora prostrata	prostrate glossy abelia	M	M	M	M	/	/
	S	Abelia 'Sherwoodii'	Sherwood dwarf abelia	M	M	M	M	/	/
	T	Abies spp.	fir	M	/	M	M	/	/
	T	Abies pinsapo	Spanish fir	L	/	L	/	/	/
	S	Abutilon hybridum	flowering maple	M	H	H	H	/	/
	S T	Acacia abyssinica	Abyssinian acacia	/	?	/	?	/	L
	T	Acacia aneura	mulga	/	?	?	?	/	L
⊗	T	Acacia baileyana	Bailey acacia	L	L	L	L	/	/
	T S	Acacia berlandieri	guajillo	?	?	?	M	/	L
	T	Acacia cognata (A.subporosa)	bower wattle	L	L	M	M	/	/
	T S	Acacia constricta	whitethorn acacia	?	L	L	L	L	L
	T S	Acacia craspedocarpa	leatherleaf cacia	?	?	?	?	L	L
	T	Acacia cultriformis	knife acacia	L	L	L	L	/	/
⊗	T	Acacia dealbata	silver wattle	VL	L	L	L	/	/
⊗	T	Acacia decurrens	green wattle	VL	L	L	L	/	/
	T	Acacia farnesiana	sweet acacia	?	?	L	L	/	L
	T S	Acacia greggii	catclaw acacia	L	L	L	L	L	L
⊗	T S	Acacia longifolia	Sydney golden wattle	L	L	L	L	/	/
⊗	T	Acacia melanoxylon	blackwood acacia	VL	L	L	L	/	/
	T	Acacia pendula	weeping acacia	L	L	M	M	/	L
	T	Acacia pennatula	acacia (pennatula)	?	?	VL	?	L	L
	S Gc	Acacia redolens	prostrate acacia	L	L	L	L	L	L
	T	Acacia salicina	willow acacia	?	?	L	M	/	M
	T S	Acacia saligna	blue leaf wattle	L	L	L	L	/	M

T	Acacia schaffneri	twisted acacia	?	?	?	?	/	L
T	Acacia smallii	desert sweet acacia	?	?	VL	L	/	L
T	Acacia stenophylla	eumong/shoestring acacia	?	L	L	L	/	L
T	Acacia willardiana	palo blanco	/	?	?	?	/	L
P	Acanthus mollis	bear's breech	M	M	M	M	/	M
T	Acer buergeranum	trident maple	M	M	M	/	/	/
T S	Acer circinatum	vine maple	M	H	/	/	/	/
T	Acer griseum	paperbark maple	M	M	?	?	?	?
T	Acer macrophyllum	big leaf maple	M	H	M	H	/	/

	TYPE	BOTANICAL NAME	COMMON NAME	REGIONAL EVALUATIONS					
				1	2	3	4	5	6
	T	Acer negundo	box elder	M	M	M	M	/	/
	T	Acer oblongum	evergreen maple (oblongum)	M	/	M	M	/	/
	T	Acer palmatum	Japanese maple	M	M	H	H	/	/
	T	Acer paxii	evergreen maple (paxii)	M	M	M	M	/	/
	T	Acer platanoides	Norway maple	M	M	/	H	/	/
	T	Acer rubrum	scarlet red maple	M	H	H	H	/	/
	T	Acer saccharinum	silver maple	M	M	/	M	/	/
	T	Acer saccharum	sugar maple	M	/	/	/	/	/
	T	Acer truncatum	Chinese maple	M	M	/	H	/	/
	P	Achillea ageratifolia	Greek yarrow	L	M	M	M	M	M
	P	Achillea filipendulina	fern leaf yarrow	L	L	L	L	M	M
⊗	P	Achillea millefolium	common yarrow	L	L	L	L	M	M
	Gc P	Achillea tomentosa	woolly yarrow	L	L	L	L	M	M
	P	Aconitum napellus	garden monkshood	M	/	/	/	/	/
	P	Acorus gramineus	sweet flag	H	H	H	H	H	H
	V	Actinidia deliciosa	kiwi	H	H	H	H	/	/
	S	Adenostoma fasciculatum	chamise	VL	VL	VL	VL	/	/
	T S	Adenostoma sparsifolium	red shanks/ribbonwood	VL	?	VL	VL	/	/
	P	Adiantum spp.	maidenhair fern	H	H	H	H	H	H
	S P	Aeonium spp.	Canary Island rose	L	/	L	L	/	L
	T	Aesculus californica	California buckeye	VL	VL	VL	L	/	/
	T	Aesculus carnea	red horsechestnut	M	M	M	/	/	/
	P	Agapanthus africanus	lily-of-the-Nile	M	M	M	M	/	M
	T	Agathis australis	Australian agathis/ kauri	M	/	M	/	/	/
	T	Agathis robusta	Queensland kauri	M	/	M	H	/	/
	S P	Agave spp.	agave	L	L	L	L	/	L
	T	Agonis flexuosa	peppermint tree	L	/	L	M	/	/
⊗	T	Ailanthus altissima	tree of heaven	VL	VL	L	L	L	L

	Gc	Ajuga reptans	carpet bugle	M	M	M	H	H	H
	V	Akebia quinata	fiveleaf akebia	M	M	M	M	/	/
☹	T	Albezia distachya	plume albizia	L	/	L	/	/	/
	T	Albizia julibrissin	silk tree	L	L	M	M	M	M
	T	Alectryon excelsus	alectryon/titoki	M	/	M	/	/	/
	V	Allamanda cathartica	golden trumpet	/	/	M	/	/	/
	T	Alnus cordata	Italian alder	M	M	M	M	/	/
	T	Alnus glutinosa	black alder	M	M	M	H	/	/

	TYPE	BOTANICAL NAME	COMMON NAME	REGIONAL EVALUATIONS					
				1	2	3	4	5	6
	T	Alnus oregona	Oregon alder	H	H	/	/	/	/
	T	Alnus rhombifolia	white alder	H	H	H	H	H	/
	P	Alocasia spp.	elephant's ear	H	H	H	H	/	/
	T S	Aloe spp.	aloe	L	L	L	L	/	L
	P	Alopecurus pratensis 'Aureus'	golden foxtail	?	?	M	?	?	?
	S	Aloysia machrostachya	aloysia	?	?	?	?	L	L
	S P	Alpinia zerumbet	shell ginger	H	/	H	H	/	H
	P	Alstroemeria spp.	Peruvian lily	M	M	M	M	?	M
	S	Alyogyne hakeifolia	red centered hibiscus	/	/	L	L	/	/
	S	Alyogyne huegelii	blue hibiscus	L	L	L	L	/	L
	P	Amaryllis belladonna	naked lady	VL	VL	VL	L	L	L
	S	Ambrosia dumosa	white bursage	?	?	/	/	L	L
	V	Ampelopsis brevipedunculata	blueberry creeper	M	M	/	M	M	M
	P	Anagallis monellii	pimpernel	?	?	M	/	/	/
	S Gc	Andromeda polifolia	bog rosemary	H	H	/	/	/	/
	P	Anemone X hybrida	Japanese anemone	M	M	M	M	M	M
	V	Anemopaegma chamberlaynii	yellow trumpet vine	?	?	M	M	/	/
	T	Angophora costata	gum myrtle	L	/	L	M	/	/
	P	Anigozanthos flavidus	kangaroo paw	M	M	M	M	/	M
	S	Anisacanthus spp.	desert honeysuckle	?	?	L	L	L	L
	S	Anisodonte X hypomandarum	South African mallow	M	M	M	M	/	M
	S	Anisodonte scabrosa	false mallow	M	M	M	M	/	M
	T	Annona cherimola	cherimoya	M	/	M	/	/	/
	Gc V	Antigonon leptopus	coral vine	M	/	M	M	/	M
	Gc	Aptenia cordifolia	ice plant (Aptenia)	L	L	L	L	/	H
☹ ☹	GC	Aptenia 'Red Apple'	ice plant (Red Apple)	L	L	L	L	/	H
	P	Aquilegia spp.	columbine	L	L	M	M	M	M
	P	Arabis spp.	rockcress	L	M	M	?	?	?
	T	Araucaria araucana	monkey puzzle tree	L	M	/	M	/	/

Sugar Maple
 Summer Holly
 Summer Snow
 Sunrose
 Swamp Mahogany
 Swamp Mallee
 Swan River Daisy
 Sweedish Ivy
 Sweet Acacia
 Sweet Bay
 Sweet Flag
 Sweet Hakea
 Sweet Garlic
 Sweet Gum
 Sweet Olive
 Sweet Pea Shrub
 Sweet Sarcococca
 Sweet Shade
 Sweet Viburnum
 Sweet Violet
 Sweet Woodruff
 Sword Fern
 Sydney Golden Wattle
 Sykes Coral Tree
 Tamarisk
 Tanbark Oak
 Tarata
 Tarragon
 Tasmanian Tree Fern
 Tawhiwhi
 Tecate Cypress
 Tenaza
 Texas Ebony
 Texas Firecracker Bush
 Texas Mountain Laurel
 Texas Olive
 Texas Red Oak
 Texas Sage
 Thread Leaf False Aralia
 Threadleaf Coreopsis
 Thyme
 Tipu Tree
 Titoki
 Toadflax
 Toog
 Torch Cactus
 Torrey Pine
 Totem Poles
 Toyon
 Trailing Indigo Bush
 Trailing Rosemary
 Transvaal Daisy
 Tree Banksia

Acer saccharum
Comarostaphylis diversifolia
Plumbago scandens
Helianthemum nummularium
Eucalyptus robusta
Eucalyptus spathulata
Brachycome multifida
Plectranthus spp.
Acacia farnesiana
Laurus nobilis
Acorus gramineus
Hakea suaveolens
Tulbaghia fragrans
Liquidambar styraciflua
Osmanthus fragrans
Polygala X dalmaisiana
Sarcococca hookerana humilis
Hymenosporum flavum
Viburnum davidii
Viola odorata
Gallium odoratum
Nephrolepis exaltata
Acacia longifolia
Erythrina sykesii
Tamarix spp.
Lithocarpus densiflorus
Pittosporum eugenioides
Artemesia spp.
Dicksonia antarctica
Pittosporum tenuifolium
Cupressus guadalupensis forbsii
Pithecellobium palens
Pithecellobium flexicaule
Hamelia patens
Sophora secundiflora
Cordia boissieri
Quercus texana
Salvia coccinia
Dizygotheca elegantissima
Coreopsis verticilata cvs.
Thymus spp.
Tipuana tipu
Alectryon excelsus
Linaria purpurea
Bischofia javanica
Trichocereus spp.
Pinus torreyana
Melaleuca decussata
Heteromeles parvifolia
Dalea greggii
Rosmarinus 'Prostratus'
Gerbera jamesonii
Banksia integrifolia

Tree Dahlia
 Tree of Heaven
 Tree Malow
 Triangle Palm
 Trident Maple
 Trinidad Flame Bush
 True Myrtle
 Trumpet Creepers
 Trumpet Honeysuckle
 Tufted Evening Primrose
 Tufted Hair Grass
 Tulip Tree
 Tulip Wood
 Tupelo
 Turpentine Bush
 Tweedia
 Twinspur
 Twisted Acacia
 Umbrella Plant
 Valley Oak
 Vancouver Gold Genista
 Velvet Centauria
 Velvet Honeysuckle
 Velvet Mesquite
 Verde Vista Coprosma
 Vervian
 Victorian Box
 Vine Maple
 Violet Trumpet Vine
 Virginia Creeper
 Wall Flower
 Wallflower
 Water Birch
 Weeping Acacia
 Weeping Bottlebrush
 Weeping Chinese Banyan
 Western Catalpa
 Western Dogwood
 Western Hazelnut
 Western Poplar
 Western Redbud
 Western Spice Bush
 Western Virgin's Bower
 White Alder
 White Ash
 White Barked Himalayan Birch
 White Breath of Heaven
 White Bursage
 White Floss Silk Tree
 White Flowering Currant
 White Ginger Lily
 White Mulberry
 White Ironbark

Dahlia imperialis
 Ailanthus altissima
 Lavatera assurgentiflora
 Neodopsis decaryi
 Acer buergeranum
 Calliandra tweedii
 Myrtus communis
 Campsis spp.
 Lonicera sempervirens
 Oenothera caespitosa
 Deschampsia caespitosa
 Liriodendron tulipifera
 Harpullia arborea
 Nyssa sylvatica
 Ericameria laricifolia
 Oxypetalum caeruleum
 Diascia spp.
 Acacia schaffneri
 Cyperis alternifolius
 Quercus lobata
 Genista pilosa
 Centaurea gymnocarpa
 Dicleptera suberecta
 Prosopis veleutina
 Coprosma pumila 'Verde Vista'
 Verbena rigida
 Pittosporum undulatum
 Acer circinatum
 Clytostoma callistigioides
 Parthenocissus quinquefolia
 Cherianthus cheiri
 Erysimum linifolium
 Betula fontinalis
 Acacia pendula
 Callistemon viminalis
 Ficus benamina
 Catalpa speciosa
 Cornus nuttallii
 Corylus cornuta californica
 Populus fremontii
 Cercis occidentalis
 Calycanthus occidentalis
 Clematis ligusticifolia
 Alnus rhombifolia
 Fraxinus americana
 Betula jacquemontii
 Coleonema album
 Ambrosia dumosa
 Chorisia insignis
 Ribes indecorum
 Hedychium coronarium
 Morus alba
 Eucalyptus leucoxylon

White Sage
 White Sapote
 Whitethorn Acacia
 Wild Ginger
 Wild Rye
 Wild Strawberry
 Willow
 Willow Acacia
 Willow Pittosporum
 Wilson Holly
 Windmill Palm
 Winter Blooming Bergenia
 Winter Creeper
 Winter Daphne
 Wonga Wonga Vine
 Wood Fern
 Woolly Blue Curls
 Woolly Butterfly Bush
 Woolly Senna
 Woolly Yarrow
 Yaupon
 Yellow Archangel
 Yellow Bells
 Yellow Oleander
 Yellow Orchid Vine
 Yellow Pennstemmon
 Yellow Trumpet Vine
 Yellow Yucca
 Yesterday, Today and Tomorrow
 Yew Pine
 York Gum
 Zephyr Flower

Salvia apiana
 Casimiroa edulis
 Acacia constricta
 Asarum caudadum
 Elymus spp.
 Fragaria chiloensis
 Salix spp.
 Acacia salicina
 Pittosporum phillyraeoides
 Ilex X altaclarensis 'Wilsonii'
 Trachycarpus fortunei
 Bergenia crassifolia
 Euonymus fortunei radicans
 Daphne odora
 Pandorea pandorana
 Dryopteris erythrosora
 Trichostema lanatum
 Buddleia marrubiifolia
 Cassia tomentosa
 Achillea tomentosa
 Ilex vomitoria
 Lamiastrum galeobdolon
 Tecoma stans
 Thevetia peruviana
 Mascagnia macroptera
 Keckiella cordifolia
 Anemopaegma chamberlaynii
 Hesperaloe parvifolia
 Brunfelsia pauciflora
 Podocarpus macrophyllus
 Eucalyptus loxophleba
 Zephyranthes spp.

VEGETATION TYPES

The species list includes over 1,200 species of landscape plants which are identified by botanical and common names. The plants are listed alphabetically according to botanical names. An index of common names follows the species list.

Each species falls into one or more of the following vegetation types: Trees, Shrubs, Groundcovers, Vines and Perennials (includes ferns, grasses and bulbs). Vegetation types are entered on the list for each plant under **TYPE** as:

T....Tree

S....Shrub

V....Vine

Gc...Groundcover

P....Perennial

CULTIVARS

Cultivars, with a few exceptions, are not mentioned. It is presumed that most cultivars will have the same water requirements as the species. Exceptions include the following : 1) Nandina domestica, the cultivar 'Purpurea' was included because it was thought to require more water than the species in three regions and 2) Lonicera japonica 'Halliana' was included because the cultivar was thought to be more common than the species.

TURFGRASSES

Turfgrass water needs are not included in this guide. Literature and software relevant to turfgrass species are listed in Appendix 3 **ADDITIONAL RESOURCES**.

WUCOLS REGIONS

Since there are substantially different climate zones in California, six regions representing different climatic conditions were identified by the coordinating committee:

Region 1 **North-Central Coastal** (California Climate Zones 14, 15, 16, and 17)*

Region 2 **Central Valley** (zones 8, 9 and 14),

Region 3 **South Coastal** (zones 22, 23 and 24),

Region 4 **South Inland Valleys and Foothills** (zones 18, 19, 20 and 21),

Region 5 **High and Intermediate Desert** (zone 11) and

Region 6 **Low Desert** (zone 13).

* California climate zones are described in University of California Publication 3328, Generalized Plant Climate Zones of California and Sunset Western Garden Book.

NOTES ON REGIONS

- Within each WUCOLS Region there is some variability in climate patterns among the cities listed. For example, some cities may be considerably warmer than others during the summer months, yet they are within the same region. This variability can only be reduced by increasing the number of regions, which would cause the WUCOLS list to become enlarged and somewhat more complicated.

For certain locations (considered atypical for the region), it may be useful to consider evaluations from another region that more closely characterizes the location of interest. For example, if a city in Region 1 has a climate more closely characterized by Region 2, then Region 2 species evaluations should be considered for that location. Such assessments will need to be based on the judgement of the user.

- If a city is not listed and is located in California Climate Zone 14 which overlaps regions 1 and 2, it will be necessary to decide if the city is more similar in climate to Petaluma (coastal influence) or Sacramento Valley.
- If a city is located in a California Climate Zone which was not evaluated (zones 1, 2, 3, and 7 - mainly high elevation, cold winter areas) an estimate may be made by looking at all the evaluations for the species in question. Hardiness is typically the major factor in determining if a species is appropriate or not.
- The main difference between the California high and intermediate desert regions is that the high desert is colder in the winter; as the elevation increases so does the frequency of temperatures below freezing. As a result, species which are listed as appropriate for

the low desert and inappropriate for the high desert may be marginally hardy and appropriate to try in the intermediate desert.

The following is a list of some cities that characterize each region:

WUCOLS REGIONS

REGION 1

NORTH-CENTRAL COASTAL

Concord
Cupertino
Healdsburg
Livermore
Los Altos Hills
Napa
Novato
Oakland
Petaluma
Salinas
San Francisco
San Jose
San Luis Obispo
Santa Cruz
Santa Rosa

REGION 2

CENTRAL VALLEY

Auburn
Bakersfield
Chico
Coalinga
Fresno
Los Banos
Marysville
Merced
Modesto
Red Bluff
Redding
Roseville
Sacramento
Stockton
Tracy
Visalia

REGION 3

SOUTH COASTAL

Anaheim
Camarillo
Fallbrook
Fullerton
Irvine
Laguna Beach
La Mesa
Long Beach
Los Angeles
Mission Viejo
Oxnard
Santa Ana
San Barbara
San Diego
San Juan Capistrano
Santa Monica
Ventura
Vista
Whittier

REGION 4

SOUTH INLAND VALLEY

Altadena
Azusa
Chino
Corona
Covina
El Monte
Escondido
Hemet
Ojai
Pasadena
Perris
Pomona
Ramona

REGION 5

INTERMEDIATE AND HIGH DESERT

Apple Valley
Barstow
Bishop
Boulder City
China Lake
Gorman
Independence
Joshua Tree
Lancaster
Lone Pine
Mojave
Olancho
Palmdale

REGION 6

LOW DESERT

Borrego Springs
Blythe
Brawley
Coachella
Desert Center
Desert Hot Springs
Death Valley
El Centro
Indian Wells
Indio
Jacumba
Needles
Palm Desert

Riverside
San Bernardino
San Fernando
Santa Paula
Sun City
Thousand Oaks
Van Nuys

Pear Blossom
Tehachapi
Victorville

Palm Springs
Rancho Mirage
Thermal

STANDARD CONDITIONS

The following conditions were applied to all species when the evaluations were made. Please note that adjustments in water needs may be required for other conditions, such as new plantings or a need for rapid growth.

- 1) Established Plants. Irrigation water needs are assessed for plants that have become "established" in the landscape. "Established" meaning that substantial root development has occurred in the landscape soil adjacent to the rootball. The landscape soil becomes the principal source of water for established plants i.e., rather than the rootball soil. The time for establishment varies among species and with soil conditions, but generally occurs by the second or third year after planting. After establishment, roots of trees, shrubs, groundcovers, etc., become intertwined in the soil, creating a common rootzone.
- 2) Reference ET Conditions. Reference evapotranspiration (ET_o) approximates water loss from a large field of 4 to 7 inch tall, cool season grass that is not water stressed. Although ET_o can be measured directly, it is usually calculated from measured weather data. Daily ET_o information for many regions of the state is available through the California Irrigation Management Information System (CIMIS). WUCOLS evaluations are made for site conditions equivalent to those used for ET_o measurements, i.e., full sun, no extraordinary winds, no shading from nearby structures or plants, and no heat inputs from nearby sources such as buildings, pavements, or reflective surfaces. As an exception, shade requiring species (e.g., Japanese aucuba) are evaluated for shade conditions. Shade species are considered to be those plants which when exposed to full sun for some part of the day will show visible injury i.e., some loss in appearance. Since species vary in their shade requirements (for example, all day vs afternoon shade), any species requiring some shade to avoid injury (in the region) is evaluated for shade.
- 3) Good Quality. Plant performance can vary substantially depending on the amount of water supplied. Small amounts may simply prevent the dehydration of plant tissues i.e., survival amounts, but appearance is likely to be affected. Increasing amounts may improve appearance (leaf color, canopy density or fullness), but may

not be enough to promote growth. More water may be sufficient to maintain good appearance and support typical (average) growth for the species (and flower or fruit production if desired). Still more water may result in excessive growth; while more water may cause decline (typically from root disease) in certain species. Since both appearance and some growth (not excessive) are important in most landscapes, WUCOLS evaluations were made to provide sufficient water for the species to be maintained as such, i.e., in good condition. This is somewhat difficult to evaluate precisely for some species, however, so whenever a question was raised as to whether a species required a greater or lesser amount of water to maintain good quality, the higher evaluation, i.e., more water was assigned.

- 4) Groundwater Not Available. Although some species of plants develop root systems deep enough to extract groundwater (e.g., Quercus lobata), groundwater is not available in all planting sites. A species capable of extracting groundwater may not be able to do so because the water is simply not available. Therefore, evaluations are made for conditions where the only sources of water were rainfall and irrigation. In areas where groundwater is available and a species is known to utilize groundwater, then adjustments in irrigation scheduling should be made for that species (or group of species).
- 5) Plants Must be "Irrigatable". In some cases the soil surface may be sealed around plants (particularly trees) by pavements or other surface barriers. This inhibits the infiltration of water into the rootzone. In other cases the soil volume capable of holding water may be so small and may dry so rapidly that it may be difficult to maintain available water in the rootzone. In either case, the amount of water identified as being needed to maintain good quality may not be sufficient simply because the plant is not "irrigatable". Evaluations made here assume as a standard condition that the species can be irrigated, i.e., the water applied can enter and be held in the rootzone sufficiently long for uptake.

CATEGORIES OF WATER NEEDS

Water needs evaluations are listed for each species and in each region. Symbols are defined as follows:

- H = High
- M = Moderate
- L = Low
- VL = Very Low
- / = Not appropriate or not grown in the region
- ? = No experience growing it in the region by the members of this committee. This does not imply it should not be tried. Consult local horticulturists and literature for more information.

The categories High, Moderate, and Low indicate how much irrigation water is thought to be needed to maintain plant health and appearance, and are expressed as a percentage of reference evapotranspiration (ET_o). See **Standard Conditions** (page 70) for a definition of ET_o .

H = 70 - 90% ET_o

M = 40 - 60% ET_o

L = 10 - 30% ET_o

L = <10% ET_o

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Schwankl, L., Hanson, B., Prichard T., Low-Volume Irrigation: a Handbook for Water Managers, University of California Irrigation Program, University of California, Davis, 1993.

* References added to 1994 revision.

OTHER RESOURCES

California Department of Water Resources
Water Conservation Office
1020 Ninth Street P.O.Box 942836
Sacramento, California 94236-0001
(916) 327-1620

California Irrigation Management Information System (CIMIS)
California Department of Water Resources
Division of Local Assistance
P.O. Box 942836
Sacramento, California 94236-0001

California State Department of Water Resources Information (800) 272-8869

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