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LAGUNA CHARACTERIZATION STUDY 1989

CHARACTERIZATION OF WOODY HABITATS IN THE LAGUNA DE SANTA ROSA

Prepared as part of the Laguna Area Characterization, a project authorized by the Subregional System as part of Task Order # 27 between the City of Santa Rosa and CH2M Hill.

December, 1989

Including Addendum Feb. 9, 1990

ABSTRACT

The Valley Oak Woodland and the Valley Foothill Riparian habitat types within the Laguna de Santa Rosa have been greatly reduced in acreage. The Valley Oak Woodland Habitat is not self perpetuating due to lack of regeneration. Some current management practices are not compatable with the protection of the residual habitats or with the regeneration of these habitat types. Crown Density averages within the oak samples show that the old oaks that are irrigated have less healthy crowns than in non-irrigated areas. Historic photos show an increase in old growth oak mortality in 2 irrigated sample areas over the last 11 years. A sample of dead or nearly dead valley oaks shows that trenching pipelines under the crowns and irrigating, or just irrigation within a concave micro-topography leads to an accelerated decline of mature valley oaks. Soil/vegetation criteria can guide the location and type of regeneration efforts.

OBJECTIVES

1. Describe existing woodland habitats according to the Wildlife Habitat Relationships System (WHR).
2. Develop sub categories by soils, irrigation, cultural practices.
3. Collect data on individual trees to refine type descriptions and
4. Correlate tree conditions (vigor or state of decline) with the above descriptors.
5. Research historic conditions,
6. Look for regeneration and
7. Look for and describe suitable areas for revegetation.

METHODOLOGY

The November 1988 1"=500' orthophotos were used as the field basemaps to determine areas to be investigated. The Sonoma County Soil Conservation Service (SCS) soil survey with 1961 orthophotos was used to determine soil sample areas and to check soil/vegetation relationships. The 1917 "Soil Survey of the Healdsburg Area" was reviewed for a historic perspective. 1942 and 1977 aerial photos were used in the historic tree counts. All public lands (Santa Rosa, Sebastopol, Dept. of Fish and Game) were field inspected. Only a small portion of private lands were surveyed due to difficulties with access permission. Some private properties were roughly surveyed from the roadside.

A data collection form was developed to standardize sampling proceedures and correlate with WHR criteria (see Appendix A). Sample sites were selected based on habitat, habitat stage, soil type, irrigation method, culture, and relative homogeneity. Individual trees were measured for diameter, age, height, and crown diameter, with occular estimates of crown density, root rot, and heart rot. Also recorded were habitat elements, understory, oak seedlings, micro topography, epicormic branching,

pruning, and pipelines trenched under the drip lines of trees.

73 data sheets were completed, with up to 10 trees per sheet. I was hoping to obtain age and growth information from coring trees with an increment borer. However, on the older valley oaks, especially in the open areas on Wright series soils, reading the cores was extremely difficult. Eventually, ages for these older trees were estimated as "greater than..." based on counting rings on stumps of similar size oaks on similar soils.

Several soil samples were taken on representative soil types. A truck mounted auger was used to bring samples up from various depths. Texture, color, and horizon depth were compared to the SCS descriptions (See Appendix D).

VALLEY OAK WOODLAND (VOW)

The VOW type is a residual of old valley oak trees dispersed in clumps usually of 10 to 20 acres in size throughout what is now annual grassland, pasture, or cropland. It is residual because most trees are over 140 or 160 years of age and there is no regeneration other than along roadsides and railroad embankments (see figure 1). One explaination for no younger trees would be that cultivation and/or grazing began in earnest 120 to 140 years ago.

Oak Densities, Soil Relationships

The VOW type occurs primarily on Wright series loams in the flatlands of the Laguna basin (see sample soil map, Appendix D). VOW does not seem to occur on Clearlake clay soils except when the area is near a drainage channel or creek. Then, VOW will often merge into the Valley Foothill Riparian (VRI) type. On the Wright series loams, residual trees are generally 30 to 40 inches in diameter at breast height (DBH), there are 1.5 to 2 trees per acre, and the basal area per acre is in the 13 to 16 square foot range. In natural conditions without cultivation or grazing or the introduction of exotic species, one might expect a denser and more varied size and age class distribution spread over more of the Wright series soil type. An example of this type of structure is found north of Piner Road on Huichia loam which includes small areas of Wright loams in the soil mapping (and Wright loams include Huichia loams).

Oak Population Trends

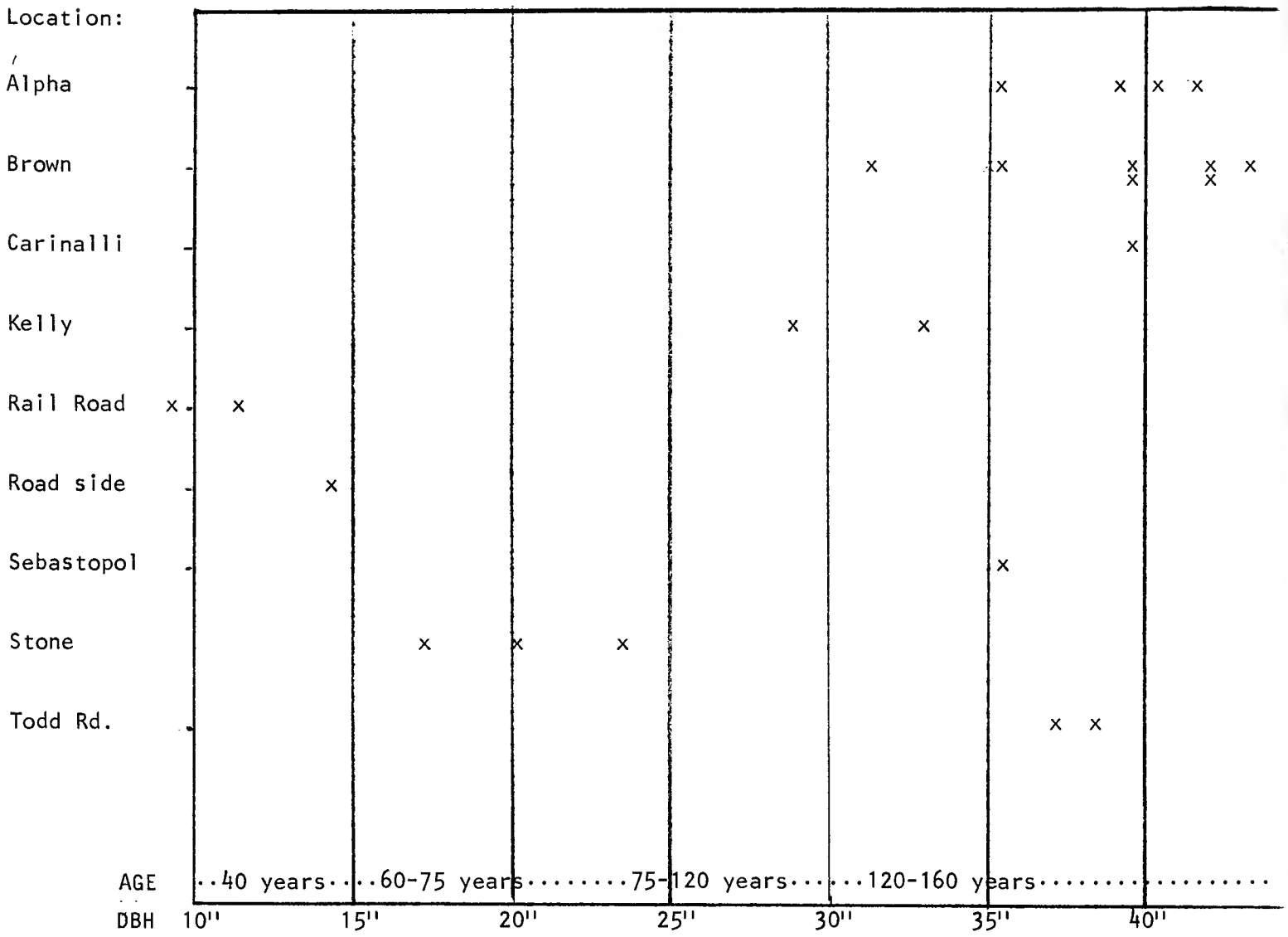
Estimates of current and historic Valley Oak Woodland/Vernal Pool acreage have been compiled by Marco Waaland in a companion report.

Figure 2 shows the Valley Oak population trends on three sample sites from 1942 to 1988. Trees were counted using 1942, 1977, and 1988 aerial photographs. (Only the large oaks were counted in a clearly defined area.) Brown and Alpha farms have been intensly managed with irrigation, pruning, and mowing within the

Figure 1. SIZE/AGE CLASS AVERAGES

Representing Sampled Sites

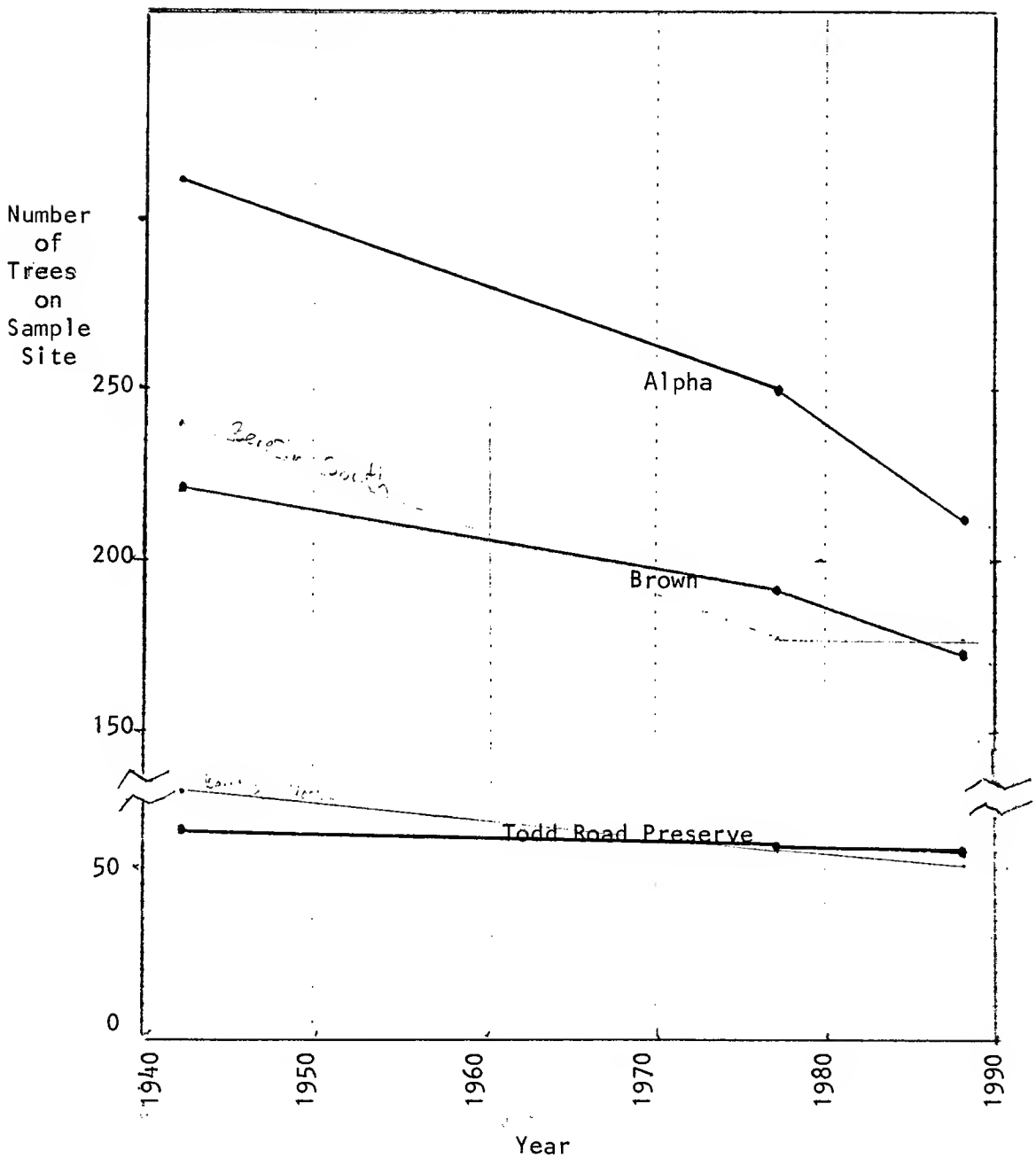
Valley Oak Woodland



Each "x" represents one sample location with a minimum of 10 trees sampled

Figure 2. POPULATION TRENDS

Valley Oak Woodland Samples



ADDENDUM TO DECEMBER '89 LAGUNA CHARATERIZATION OF WOODY HABITATS

OAK TREE TALLIES

In figure 2 of my December 1989 report, valley oak tallies were graphed for Alpha, Brown, and Todd Road Preserve. Aerial photos from 1942, 1977, and 1988 were used to obtain the relative change in number of trees over time.

The Beretta farm has now been tallied, with Roseland Creek dividing the area into two parts. North of the creek is the handline irrigated side, and south of the creek is not irrigated. The most notable observation is that no trees were lost south of the creek between 1977 and 1988.

Disclaimer: Tallies are not exact and were subject to interpretation. Only what appeared to be large valley oaks were talled. Every effort was made to maintain consistancy between tally year photos by applying the same relative criteria. 1988 photo coverage of the Beretta farm was not as good as other coverage.

TREE TALLIES

Area	1942	(loss/year)	1977	(loss/year)	1988
Alpha farm	313	(1.8)	250	(3.4)	213
Beretta farm					
North of creek	73	(0.5)	55	(0.4)	51
South of creek	240	(1.8)	177	(0.0)	177
Brown farm	221	(0.8)	191	(1.5)	174
Todd Road Preserve	61	(0.1)	57	(0.0)	57

February 9, 1990

last 11 years. The Todd road preserve has not had irrigation or pruning. The three areas are similar in soil and topography. Residual oak age and size class are also similar.

The trend for all areas is a decline in oaks with no replacement. Over the last 11 years, the two intensly managed farms are losing oaks at a faster rate than the Todd Road Preserve. Alpha farm has lost 15% of its oaks, with 3% of the loss due to the Aqueduct, 27% (or more) due to pipelines trenched under the trees, 19% due to construction. Trends in this study suggest that the remaining 51% of the mortality are due to one or more of the recent management practices, notably irrigation and pruning.

Brown farm has lost 9% of its oaks over the last 11 years, with 12% of that loss due to construction, 29% due to pipelines trenched under the trees, and the remaining 59% probably due to the afforementioned management practices.

Todd Road Preserve may or may not have lost one tree over the last 11 years - the date of mortality is uncertain.

More striking is the change in the annual loss rate between 1942 and 1977 and between 1977 and 1988. The Alpha farm sample area had 313 trees in 1942 and 250 in 1977 with an average annual loss of 1.8 trees per year. Between 1977 and 1988, Alpha lost another 37 trees which translates to an average annual loss of 3.4 trees per year, almost twice the earlier average.

The Brown farm sample area had 221 trees in 1942 and by 1977, 191. This was an average annual loss of 0.8 trees per year. Between 1977 and 1988, 17 more trees died, making the average annual loss for that period 1.5 trees per year, again almost twice the earlier average.

Meanwhile, the Todd road preserve had 61 trees in 1942 and 57 in 1977 an almost insignificant loss. Two trees died due to construction. One or no trees died between 1977 and 1988.

There was an effort to regenerate oaks at Brown Farm in 1979. 200 oaks were planted in an area between the pond and Llano road. 86 of those trees are still alive. Many died due to discing or other farming practices according to project leader Pam Muick. One problem with the project however, is that the seed source was not local.

In 1988, a regeneration project was started at the Todd Road preserve. No natural regeneration was observed - probably the result of no fire or flood deposits coupled with the presence of a thick European annual grass thatch.

Oak species

The VOW type is almost pure Quercus lobata or crosses of Q. lobata and other species such as Q. Garryana. Occasionally Quercus Kelloggii and Q. agrifolia are found but this is rare in

the Wright series loams. As soon as one approaches a slight hill, the soil type changes generally to more sandy loams and the habitat type changes to include more tree species.

Anderson and Pasquenelli, in their Sonoma State Master's thesis, observed much hybridization of oaks in sites around Sonoma county. Q. Garryana crossed with Q. Douglasii to make Q. x Eplingii. Q. Garryana crossed with Q. dumosa to produce Q.x Howellii. Unfortunately none of their studies were in the Laguna. Although valley oak doesn't hybridize freely (abundantly), it will cross with Q. Douglasii, Q. Garryana, and Q. dumosa (John M. Tucker, personal communication). The populations must be close to one another for free association, however. With blue oak near Windsor, and Garry oak to the east, some hybridization of valley oaks within the Laguna is possible.

In Mendocino county I have found the cross between Q. Kelloggii and Q. Wislizenii which produces the "oracle oak," Q. x morehus. Black oak will not hybridize with valley oak however (Steve Barnhart, personal communication). Munz and Keck refer to much hybridization among the oaks, and oak scholars have observed "swarms" of oak varieties in Mendocino and Sonoma counties (Pam Muick, personal communication).

During the Laguna fieldwork in the summer, and during acorn collecting in the fall, I have observed interesting variations in leaf, bark, and acorn characteristics. The point to be made is that the valley oaks in the Laguna could be a distinct race which would be a subject for future studies. In any event, the genetic integrity of the oaks in the Laguna should be maintained by revegetation with only locally collected seed.

Habitat Stages

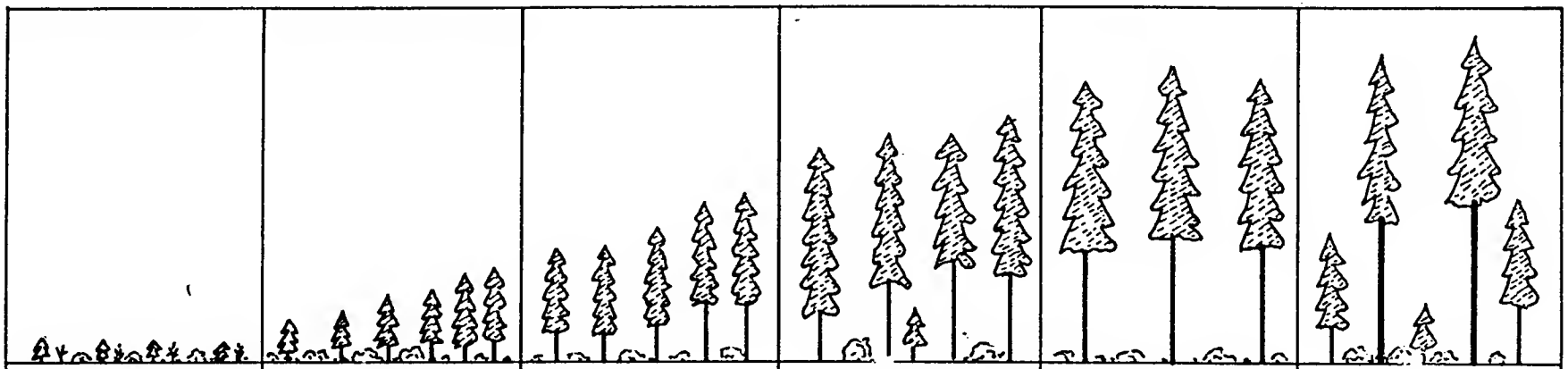
The most common habitat stage for the VOW in the Laguna is medium-large trees with a sparce canopy (5S-see Figure 3). Several of the areas sampled had canopy closures close to the 10% minimum defined by WHR, and only careful boundary delineation puts these relic stands within the VOW type. Samples were collected on Alpha, Brown, Carinalli, and Kelly farms and the Todd Road preserve. Roadside surveys were conducted on the Beretta, Dotti, LaFranconi, and Mello farms. Special habitat elements lacking in these areas include snags, logs, stumps, slash, and shrub layer - the understory is usually grazed or mowed annual grasses. One would expect coyote brush, poison oak, rose, and blackberry to be among the understory species in an undisturbed Laguna VOW. Before European influence, perennial grasses (for example Hordeum brachyantherum) may have provided significant ground cover (David Amme, personal communication). Presently, European annual grasses dominate most of the understory.

Two surveyed areas that stand apart from the rest are the Stone Farm and Sebastopol lands. The Stone farm VOW type may actually

Figure 3

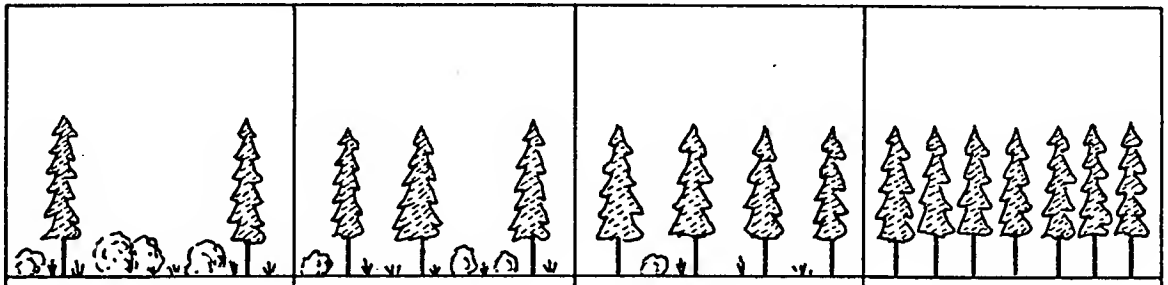
HABITAT STAGES - From Guide to the California Wildlife Habitat Relationships System

a) Size Classes



SEEDLING (1)	SAPLING (2)	POLE (3)	SMALL (4)	MEDIUM-LARGE (5)	MULTI-STORIED (6)
Diameter @ Breast Height:	1-6" DBH	6-11" DBH	11-24" DBH	greater than 24"	Size 5 over size 3 or 4
Hardwood Crown diameters:	< 15'	15-30'	30-45'	> 45'	

b) Canopy Closure Classes (identified for size classes 2-5)



CANOPY CLASS	SPARSE (S)	OPEN (P)	MODERATE (M)	DENSE (D)
PERCENT CANOPY CLOSURE	10-24 %	25-39 %	40-59 %	60-100 %

Diagramatic Representation of the Habitat Stages Identified for Forest and Woodland Habitats in the Statewide Wildlife Habitat Relationships Program. Habitat Stages are Based on Tree Size Classes Alone for Stages 1 and 6, and for Combinations of Size Classes and Canopy Closures for Size Classes 2 through 5.

be a thinned-out VRI. The soils are Clearlake clays as opposed to the usual Wright loams, the oaks are younger (70 to 75) and Oregon ash, Fraxinus latifolia is intermixed. The stand density is also higher (which corresponds to the younger smaller trees).

On the City of Sebastopol lands north of Highway 12 and east of the Laguna channel, a mix of valley oak size classes occurs on the Clearlake clays and what is incorrectly classified by SCS as the Cortina series (it is actually a deep sandy loam).

VALLEY OAK TREE CONDITIONS

At each VOW habitat sample site, individual tree data were collected. These data include microtopgraphy, diameter and height, approximate age, crown density and diameter, epicormic branching, pruning, root rot, heart rot, pipeline trenched under the drip line, and the presence of seedlings under the canopy. These data were averaged or used to develop percent proportions for each subarea within a farm (see Appendix B-1).

Subareas are the sample sites determined by uniformity of soil, irrigation type, cultural practices, and physical proximity of trees to one another. A database was developed using the sample data to facilitate sorting of parameters. Numeric values of 0 for no or 1 for yes were assigned to the epicormic, pruning, root rot, heart rot, pipeline, and seedling fields. The crown density evaluation is based on a scale of 1 to 5, with 1 being a very sparce, almost dead or dead tree, and 5 being a thick full crown, hard to see through. The higher the value, the healthier or more vigorous the tree. These surveys were taken in June when the foliage is thick.

The data were first sorted by crown density (Appendix B-2&3). The worst crown density averages correspond to the highest pruning averages and highest pipeline occurance. The best (highest) crown density averages correspond to the lowest pruning averages and the lowest pipeline occurance. The Rank Sum Test was used to determine significant differences (Ambrose & Ambrose, 1981).

The next sort was by irrigation systems (Appendix B-4). Using the crown density criteria, it would appear that the solid set system (trenched pipe) is more detrimental to the trees than handline or no irrigation. The solid set system of course has most of the pipeline under drip line occurrances. There were not enough samples of the "Gun" system to numerically compare, but trees under the gun did not look to healthy to me. There were also not enough samples to compare grazing vs. hay vs. no agriculture. It is obvious, however, that in areas of intense cattle use suqh as in stockyards, the residual valley oaks are usually dead or dying.

The final sorts were for heart rot (B-5) and root rot (B-6). A tree was classified as having heart rot if there were obvious swellings or rot pockets in the lower bowl. Trees were

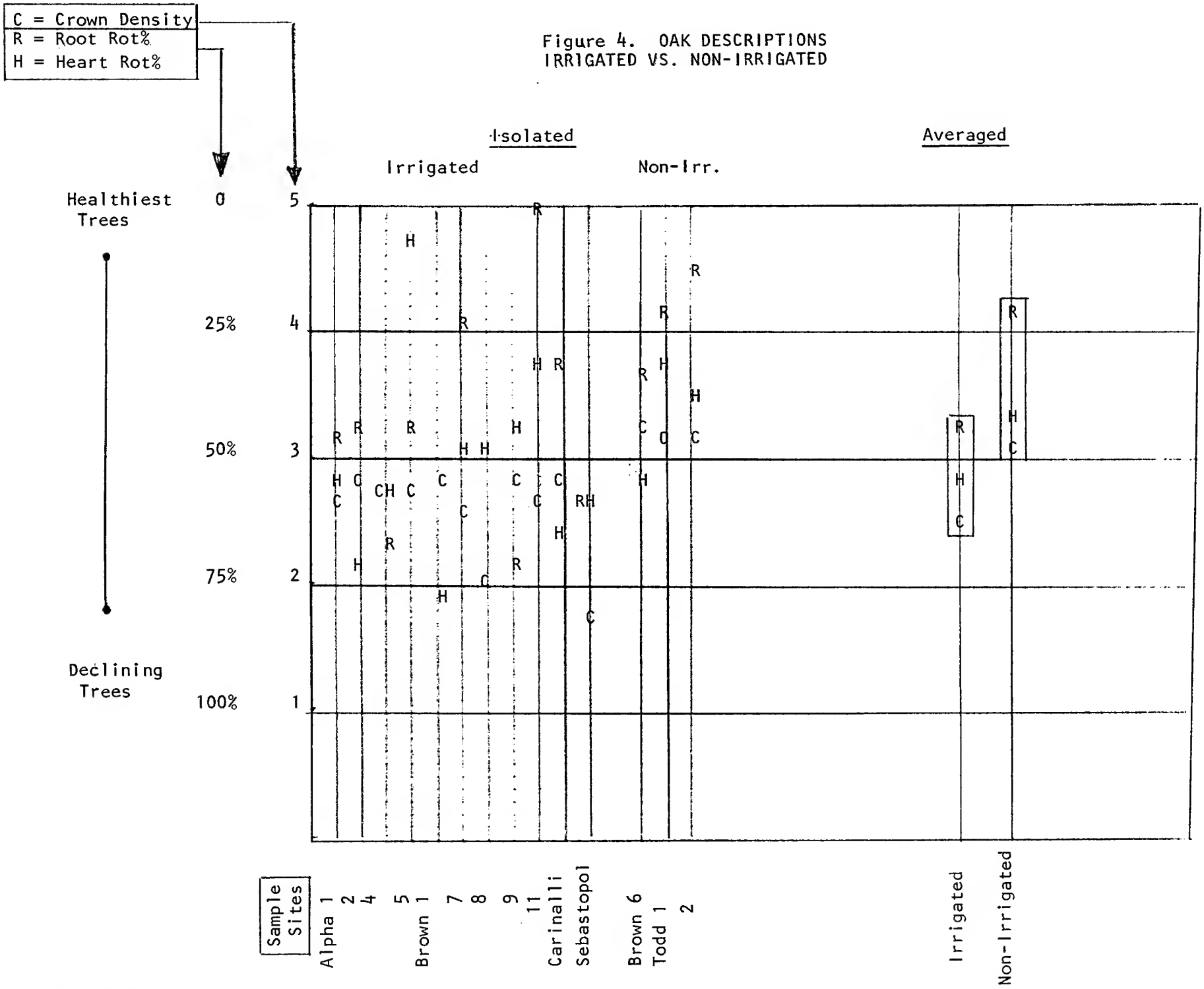


Figure 4. OAK DESCRIPTIONS
IRRIGATED VS. NON-IRRIGATED

stage. Grazing and hay cutting eliminate the regeneration. However, even on the Todd Road preserve where no mowing or grazing occurs, there were no seedlings or saplings on the Wright Loam (WhA) sample site. The thick introduced annual grasses apparently have made regeneration difficult on the eastern half of the preserve. The absence of disturbances such as fire or significant sediment deposit from flooding in the years since the area has become a preserve would also account for lack of natural oak regeneration.

Valley oak regeneration does occur along roadways and the old railroad bed. Here, ages range from seedling to mature oak, with many in the 40 year age class. Valley oak regeneration also occurs within the Riparian areas, but it is the more open Valley Oak Woodland Habitat which is not being replaced as the mature trees die.

To replace or perpetuate the VOW type, a revegetation program will have to be developed. This would rely largely on artificial regeneration (planting) and tree protection (fencing). In some areas, natural regeneration may be possible if the current management practices change, however as we have seen on the Todd Road preserve, competition by exotic species alone hinders regeneration.

Efforts to restore the VOW type should be concentrated on the Wright Series loams and the Huichia series loams. Restoration efforts can be compatable with current management practices on farms in the Laguna if revegetation areas are fenced during an establishment period. Where lands are irrigated, the plantings should be concentrated on convex or hummocky micro topography. A detailed plan by an experienced revegetation specialist should be developed for each site. Maintenance and establishment period monitoring must be part of any plan.

As mentioned earlier, it is important to collect acorns for the regeneration program from within the Laguna to preserve the genetic integrity of the local oaks. The California Department of Forestry and Fire Protection has long recognized the importance of reforestation using locally collected seed. California has been divided into seed zones according to various criteria including latitude, longitude, and elevation. Trees are long-lived species and have genetically adapted to their microclimate. Revegetation using the local gene pool which is most adapted to the site should help to ensure the longevity of the trees, as well as preserving the unique local ecology.

VALLEY FOOTHILL RIPARIAN HABITAT (VRI)

The VRI type occurs on a variety of soils along small drainageways as well as the main channel of the Laguna de Santa Rosa. The most frequently occurring species are the willows (*Salix spp.*), then Oregon ash (*Fraxinus latifolia*), Valley oak,

box elder (Acer negundo), and occasionally walnut (Juglans Hindsii) and cottonwood (Populus fremontii).

Young stands of pure willow develop soon after channelization activities if the area is protected from grazing. As the stands mature, ash, oak, and boxelder are the most frequent additions to the type. Cottonwood was noticeably absent from the sample sites, and it would appear that within the study area, it only occurs where there is sandy or gravelly river wash. Cottonwoods are widely planted as landscape trees so its original distribution becomes confused. Griffin and Critchfield in The Distribution of Forest Trees in California, place the nearest stands of cottonwoods mostly to the north of the Russian River.

An interesting change in species composition occurs as one travels from south to north along the main channel of the Laguna. To the south, the riparian tree species are mostly willow then ash. Valley oaks show up usually in areas which have been less disturbed. The boxelder is rare south of the Occidental Road bridge, usually showing up on sandier soils, not the Clearlake clay. As one travels towards Guerneville road going north, more boxelder show up until finally, just north of the Guerneville road bridge, they become a major component (see figures 5 & 6).

On the Pajaro Clay loam overwash soils along Santa Rosa Creek and north of River Road along the Laguna Channel (which becomes Mark West Creek), the greatest variety of species occurs (figure 7).

Stand structure is related to the age of the stands and the species variety. Older stands in areas which are less disturbed such as south of Highway 12 along the Laguna channel exhibit the most complex structure. The stand has been relatively undisturbed in the last 30 or 40 years. There is an almost impenetrable understory of rose, blackberry, poison oak, snowberry and grasses. The lower canopy is willow and ash with an open overstory of scattered remnant valley oak. The average density is greater than 90 trees per acre for trees of diameters from 8 to 14 inches DBH. Most of the WHR "special habitat elements" associated with riparian habitats are found here.

By contrast, areas which are subject to recent clearing and grazing have very little species variety and structure. Just north of the afforementioned site, north of highway 12 on the same soil type, the stand is almost pure young willow of one size class (average 6" DBH) with grass and some rose as the only understory.

RIPARIAN REGENERATION: EXISTING AND POTENTIAL

Analysis of historic photos in earlier studies by Marco Waaland (Nov. 1988) shows that the riparian forests were much more extensive in the recent past. Broad swaths of forests existed up

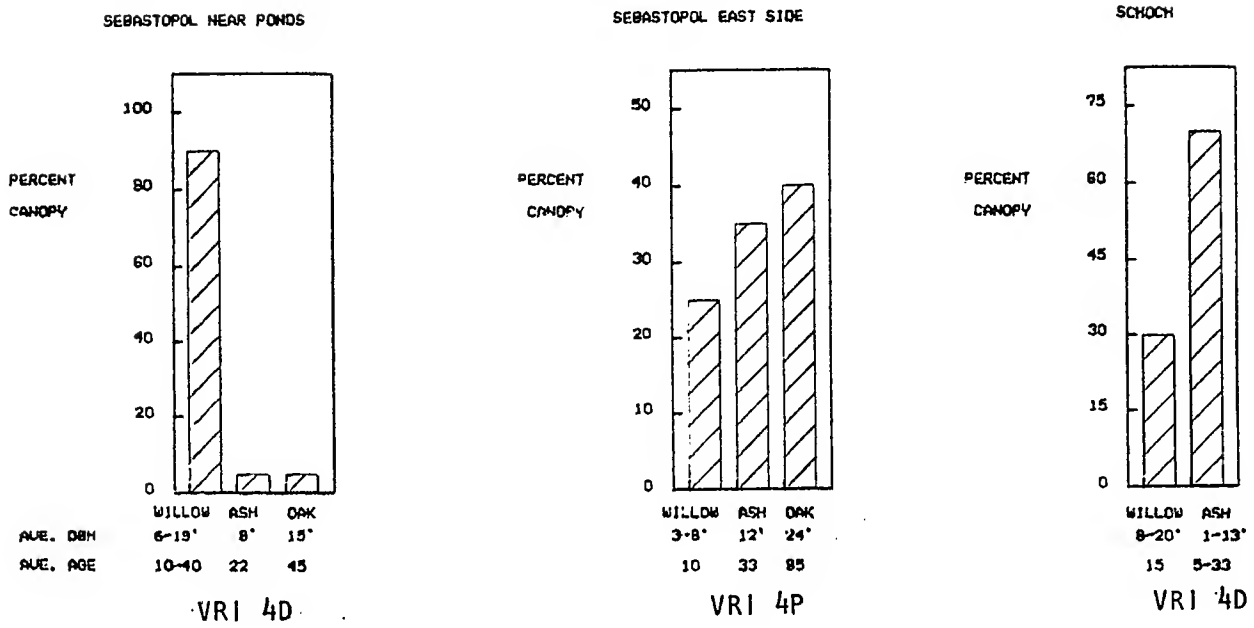
Figure 5. SPECIES COMPOSITION

CLEARLAKE CLAY SOILS NEAR THE LAGUNA CHANNEL

Representing Sampled Sites

Valley Foothill Riparian Habitat

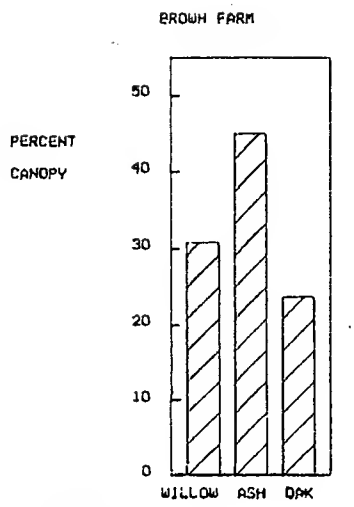
(VRI)



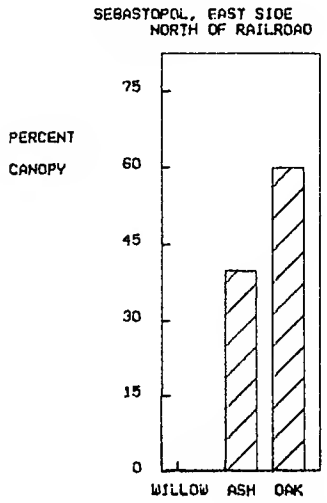
Note: All figures are averaged and approximate. The purpose of the figures is to demonstrate the variability in stand structure and composition.

VRI Codes: Numbers = size classes. 2=sapling, 3=pole, 4=small, 5=medium-large
Letters = canopy closure. P= open, M= moderate, D= dense

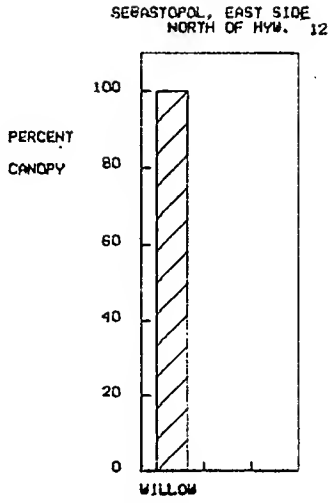
Figure 6. SPECIES COMPOSITION
BLUCHER FINE SANDY LOAM OVERWASH
Representing Sampled Sites
Valley Foothill Riparian Habitat



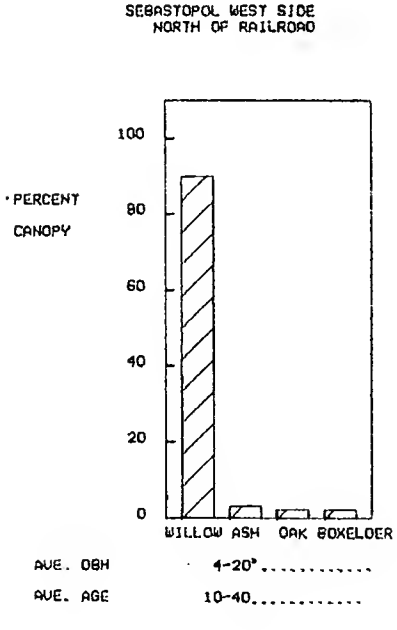
VRI 4D



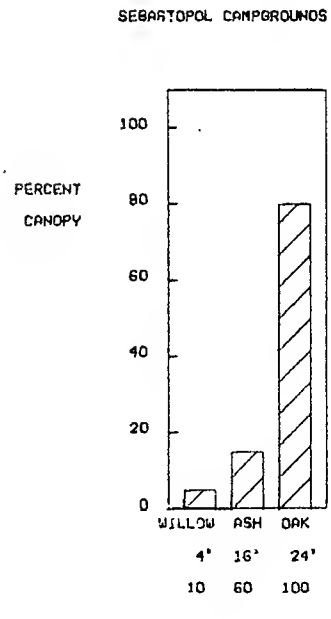
VRI 4D



VRI 2D

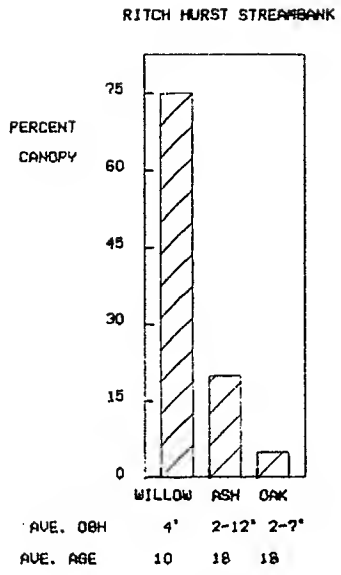


VRI 2D

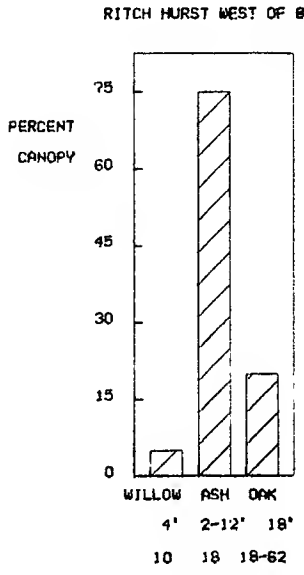


VRI 4M

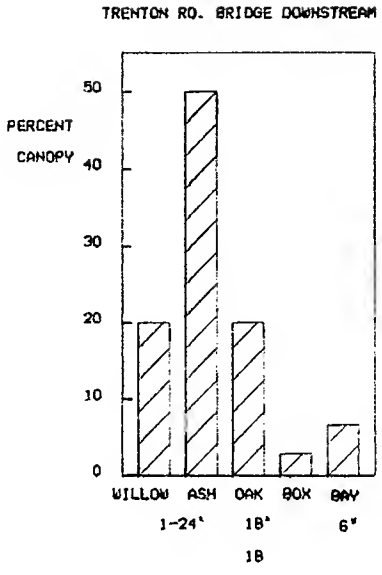
Figure 7. SPECIES COMPOSITION
PAJARO CLAY LOAM OVERWASH
Representing Sampled Sites
Valley Foothill Riparian Habitat



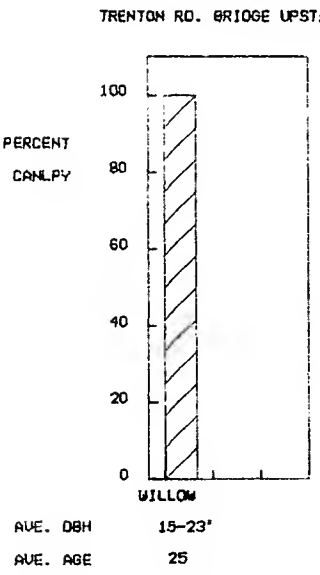
VRI 2M



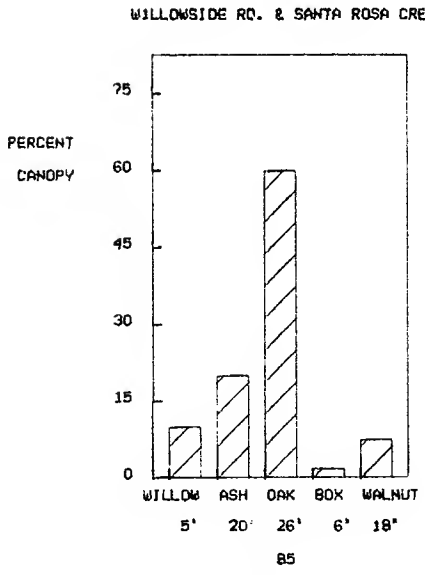
VRI 2M



VRI 4D



VRI 4D



VRI 5D

to 1500 feet wide along the Laguna channel meanders of the Clearlake clay soil type. Cattle grazing, clearing vegetation for crops, flood control, and mosquito control, and the ever expanding urbanization have all contributed to the the loss of riparian habitat. In the nearby watershed of Stemple Creek, farmers nearly eliminated willows by aerial spraying of herbicides in the 1950's & 60's - herbicides have been used in the Laguna, but I have not researched to what degree.

Riparian forest regeneration is still hampered by the above management practices. In addition, the introduction of exotic species such as the aggressive Acacia in Sebastopol, Himalaya blackberry, and the European annual grasses and weeds hamper regeneration and land management. The elimination of fire and control of flooding reduce regeneration opportunities as well.

Despite the above, the only real stumbling block to the restoration of riparian forests is land ownership patterns and the priorities of those land owners. In order to bring about riparian regeneration in the Laguna, landowners must be willing to take the streamside areas out of production. Cooperating farmers or landowners should be compensated for loss of productive property through tax incentives or land purchase. Alternative watering sources for cattle would have to be developed as part of the program. The Sonoma/Marin Mosquito Abatement District (M.A.D.) must be brought into the revegetation planning process. Presently they clean ditches and channels throwing up spoils on both sides of the drainage way. If clearing can be designed to disturb only the north side of channels, vegetation could be re-established on the southside. In the long run, the shade could reduce algae bloom which will help M.A.D.'s program. Defining the permanent access points is a critical part of coordination with M.A.D.

The Sonoma County Water Agency and any other landowner who practices clearing channels must also be part of the over-all revegetation planning. Channel clearing can be done in such a way as to allow riparian regeneration. Colgan creek next to the Meadowlane ponds West of Llano road is a case in point. Here, the willow canopy is closing over the channel, shading out unwanted vegetation which might restrict flow within the channel. Careful thinning and pruning by hand maintains access to the channel without eliminating the closed canopy. With the development of the closed canopy, maintenance costs should be reduced over time.

In many drainages and channels throughout the Laguna, simply placing a fence or eliminating mowing alongside or clearing within the channel will allow willows to proliferate if there are willows nearby. To speed up the regeneration process, especially where there is competition from grasses or tree seed sources are more distant, a regeneration plan should be developed.

The highest priority for riparian revegetation would be in the areas which have been identified on Waaland's November 1988 maps

as having been riparian forest. Next priority should go to drainages contiguous to existing riparian forests. The larger the area, the more valuable the habitat. Revegetation plans must consider the wildlife species whose habitat is to be restored. The breeding habitat of critical avian wildlife species such as the endangered yellow-billed cuckoo (Coccyzus americanus) require riparian forests with areas of dense cottonwood and willow growth at least 300 feet wide and 25 acres in surface area (Appleton, Rigney, & Stanley, 1987). Planning riparian revegetation in conjunction with developing more open water marsh would benefit many species of waterfowl.

On the Clearlake clays which dominate the central Laguna channel, willow and ash would be the primary species to plant. Local cuttings for the willows should be used, and local seed for the other species. Valley oaks would be the next species in order of frequency. The addition of boxelder, walnut, and cottonwood would be more experimental.

On the Blucher series soils, the same species would be recommended with boxelder and walnut becoming a key part of the mix. Cottonwood could be considered as an experimental addition on these soils.

For the Pajaro series, all of the above species would be appropriate. All seed sources should be local to protect the genetic integrity of the species in the area and to assure the greatest long-term success. Again, a detailed plan by an experienced revegetation specialist should be developed for each site. Maintenance and establishment period monitoring must be part of any plan.

SOIL-VEGETATION RELATIONSHIPS SUMMARIZED

The following generalizations are useful when considering management or revegetation of woody species in the Laguna. The soil types are from the 1972 SCS Soil Survey of Sonoma County maps. Major soil and vegetation types were checked by this investigator.

MAP SYMBOL	NAME	DOMINANT VEGETATION
BcA	Blucher fine sandy loam overwash	Riparian: willow, ash, valley oak
CeA	Clear Lake Clay	Grass, marsh
CfA*	Clear Lake Clay, ponded	Riparian along creeks Grass, marsh
CrA**	Cortina very gravelly sandy loam	Valley oaks, grass
CtC	Cotati fine sandy loam	Valley oaks, grass
CtD	Cotati fine sandy loam - slopes	Live, black, valley oaks, grass
CtE	Cotati fine sandy loam - slopes	" " " " "
fil***	railroad bed, roadside disturbance	Valley & black oaks, grass
HaB	Haire fine sandy loam, hummocky	Valley oak, grass
HtC	Huichica loam	Valley oak, grass
HtD	" " slopes	
HuB	" " ponded	V. oak, grass vernal pools
HwB	" " ponded, shallow	" " " "
HvC	" " shallow	Black & valley oak, grass
LoD	Los Osos clay loam	Grass
PcA	Pajaro Clay loam overwash - flat	Mixed riparian: willow, ash, V. oak, boxelder, walnut
PcB	" " " " - slope	" " "
RnA	Riverwash, gravel, sand & silt alluvium	Mixed riparian including cottonwood
WgC	Wright loam	Valley oak, grass
WhA*	" " wet	" " "
WmB	" " shallow	" " "
WoA*	" " shallow, wet	V. oak, grass, vernal pools

* largest acreage in study area
** probably mis-typed on Sebastopol lands-see Appendix D
*** my own convention - all others are SCS

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APPENDICIES

Appendix A - Data collection form

Appendix B - Averaged sample data and data sorts

Appendix C - Snag survey and data sorts

Appendix D - Soil samples

Appendix E - Maps

LAGUNA CHARACTERIZATION page____of____

Farm/Landowner _____ Investigator _____ Date ____
Map Area_____
Veg. Type: VOW V.R1 EUC Soil Type _____
Stage: Size = 1 2 3 4 5 6 Canopy = S P M D

Elements present: _____

Species: Spacing:
Ave. DBH: Understory:

Regeneration: seedling, sapling

Hydro-topography: flat, concave, convex, hummocky, swale, drainage ditch, pond, watercourse-ephemeral, intermittent, blue line

History: Irrigation: solid, handline, gun, none; 1 yr, 10 yr.
Culture: hay, grazing, none

Potential:

Problems:

TREE SAMPLES

	1	2	3	4	5	6	7	8	9	10
Species										
DBH										
Age Growth										
Height										
Crown dens. Crown diam.										
Vigor (GFPD) Micro										
Under										
Epicor (Y/N) Pruning (Y/N) Root Rot (ODF) Heart Rot (Y/N) Other										

LAGUNA DE SANTA ROSA CHARACTERIZATION STUDY 1989

COMPARISON OF AVERAGE FIELD MEASUREMENTS, VALLEY OAK WOODLAND HABITAT

								Crown		percent in decimals					
Area	Sub	Soil	Irrig	Cultr	Topo	DBH	Age	Dens	Dia	Epic	Prun	Root	Heart	Pipe	Ht	Seed
Alpha	1	wha	solid	hay	conv	38	140	2.5	51	0.18	0.94	0.47	0.59	0.24	45	.T.
Alpha	2	woa	solid	hay	conv	42	140	2.7	56	0.47	1.00	0.47	0.77	0.24	58	.T.
Alpha	4	woa	solid	graz	flat	40	140	2.6	46	0.40	0.70	0.70	0.60	0.60	48	.F.
Alpha	5	woa	solid	graz	conv	35	140	2.6	46	0.40	0.14	0.40	0.10	0.00	46	.F.
Beret	0	woa	handl	graz	humm	30	140	2.0	0	0.00	0.00	0.00	0.00	0.00	0	.F.
Brown	1	wha	solid	hay	conv	42	160	2.7	52	0.10	0.80	0.33	0.80	0.40	48	.T.
Brown	6	wha	none	hay	humm	39	140	3.2	52	0.27	0.33	0.33	0.60	0.00	45	.T.
Brown	7	wgc	solid	hay	humm	40	160	2.4	48	0.50	1.00	0.25	0.50	0.13	49	.T.
Brown	8	wha	solid	hay	conc	32	140	2.0	45	0.12	0.75	0.33	0.50	0.25	40	.T.
Brown	9	woa	solid	hay	humm	36	140	2.7	48	0.13	0.93	0.73	0.40	0.33	51	.F.
Brown	11	woa	solid	hay	humm	43	140	2.5	51	0.00	1.00	0.00	0.36	0.46	53	.T.
Brown	RR	fil	none	none	conv	12	40	3.0	25	0.60	0.00	0.00	0.00	0.00	37	.T.
Brown	YD	wha	none	traf	flat	42	160	4.0	45	0.00	0.50	0.50	0.50	0.00	45	.T.
Carin	1	wha	handl	hay	humm	39	145	2.7	49	0.20	0.40	0.30	0.70	0.00	47	.T.
Dotti	1	wha	gun	hay	humm	30	140	2.5	50	0.00	0.00	0.00	0.00	0.00	0	.F.
Fulto	Oc	woa	none	hay	humm	30	140	2.7	37	0.40	0.80	0.00	0.00	0.00	53	.T.
Kelly	1	wha	solid	hay	flat	33	100	3.0	52	0.30	1.00	0.50	0.30	0.40	48	.T.
Kelly	2	woa	solid	hay	humm	28	120	2.7	44	0.50	0.80	0.40	0.40	0.40	52	.T.
LaFra	nc	wha	handl	graz	humm	34	140	3.0	50	0.00	0.00	0.00	0.00	0.00	0	.F.
LaFra	nc	woa	handl	graz	humm	34	140	3.0	0	0.00	0.00	0.00	0.00	0.00	0	.F.
Mello	1	woa	handl	graz	humm	0	0	2.5	0	0.00	0.00	0.00	0.00	0.00	0	.F.
RR&Me	rc	fil	none	none	conv	8	40	3.0	22	0.10	0.00	0.00	0.00	0.00	33	.T.
Br&Ll	an	wha	none	none	conv	12	43	3.6	25	0.00	0.10	0.00	0.10	0.00	35	.T.
Sebas	3	cra	solid	graz	conv	35	150	1.6	40	0.20	0.40	0.60	0.60	0.60	49	.F.
Stone	1	cfa	handl	graz	conv	23	70	3.5	34	0.10	0.30	0.00	0.30	0.00	56	.T.
Stone	2	cfa	handl	graz	flat	17	75	3.0	22	0.40	0.20	0.30	0.30	0.00	50	.F.
Stone	3	cfa	handl	graz	flat	20	75	3.3	34	0.00	0.00	0.00	0.00	0.00	51	.F.
Todd	1	wha	none	none	humm	38	140	3.0	51	0.30	0.00	0.20	0.30	0.00	44	.F.
Todd	2	woa	none	none	flat	37	140	3.0	47	0.20	0.00	0.10	0.40	0.00	40	.T.

The individual tree values for each subarea were averaged to produce this database. Some areas were roadside evaluations, and the values may show zeros. Where appropriate, these were included or excluded in the sorts.

Sub = Sub area within identified farms. Refer to maps.
Soil = SCS symbol for soil type. See soil-vegetation relationships in main text.
Irrig = Irrigation system: solid set, handline, gun, none
Cultr = Cultural practices: hay, grazing, traffic, none
Topo = Topography: convex, flat, hummocky, concave
DBH = Diameter at breast height in inches
Age = Approximate average age of oaks
Crown Density = 5 is dense foliage, 1 is sparce
Crown Diameter = Average diameter in feet
Epic = Presence of excess epicormic branching
Prun = Trees have been pruned. % of trees sampled in decimals
Root = External signs of root rot. " " " " " "
Heart= External signs of heart rot." " " " " "
Pipe = Pipeline trenched beneath crown. " " " "
Ht = Height of trees in feet
Seed = Presence of seedlings. T = yes, F = no

SORT BY CROWN DENSITY

Crown Density greater than or = to 3

ecord#	AREA	SUBAREA	SOIL	IRRIGAT	CULTURE	TOPOG	EPICORMIC	PRUNING	PIPELINE
7	Brown	6	wha	none	hay	humm	0.27	0.33	0.00
12	Brown	RR	fil	none	none	conv	0.60	0.00	0.00
13	Brown	YD	wha	none	traf	flat	0.00	0.50	0.00
17	Kelly	1	wha	solid	hay	flat	0.30	1.00	0.40
19	LaFra	nc	wha	handl	graz	humm	0.00	0.00	0.00
20	LaFra	nc	woa	handl	graz	humm	0.00	0.00	0.00
22	RR&Me	rc	fil	none	none	conv	0.10	0.00	0.00
23	Br&Ll	an	wha	none	none	conv	0.00	0.10	0.00
25	Stone	1	cfa	handl	graz	conv	0.10	0.30	0.00
26	Stone	2	cfa	handl	graz	flat	0.40	0.20	0.00
27	Stone	3	cfa	handl	graz	flat	0.00	0.00	0.00
28	Todd	1	wha	none	none	humm	0.30	0.00	0.00
29	Todd	2	woa	none	none	flat	0.20	0.00	0.00

Crown Density less than or = to 2.5

ecord#	AREA	SUBAREA	SOIL	IRRIGAT	CULTURE	TOPOG	EPICORMIC	PRUNING	PIPELINE
1	Alpha	1	wha	solid	hay	conv	0.18	0.94	0.24
5	Beret	0	woa	handl	graz	humm	0.00	0.00	0.00
8	Brown	7	wgc	solid	hay	humm	0.50	1.00	0.13
9	Brown	8	wha	solid	hay	conc	0.12	0.75	0.25
11	Brown	11	woa	solid	hay	humm	0.00	1.00	0.46
15	Dotti	1	wha	gun	hay	humm	0.00	0.00	0.00
21	Mello	1	woa	handl	graz	humm	0.00	0.00	0.00
24	Sebas	3	cra	solid	graz	conv	0.20	0.40	0.60
						averages:	0.125	1.26	0.21

Crown Density less than or = to 3

Record#	AREA	SUBAREA	SOIL	IRRIGAT	CULTURE	TOPOG	EPICORMIC	PRUNING	PIPELINE
1	Alpha	1	wha	solid	hay	conv	0.18	0.94	0.24
2	Alpha	2	soa	solid	hay	conv	0.47	1.00	0.24
3	Alpha	4	woa	solid	graz	flat	0.40	0.70	0.60
4	Alpha	5	woa	solid	graz	conv	0.40	0.14	0.00
5	Beret	0	woa	handl	graz	humm	0.00	0.00	0.00
6	Brown	1	wha	solid	hay	conv	0.10	0.80	0.40
8	Brown	7	wgc	solid	hay	humm	0.50	1.00	0.13
9	Brown	8	wha	solid	hay	conc	0.12	0.75	0.25
10	Brown	9	woa	solid	hay	humm	0.13	0.93	0.33
11	Brown	11	woa	solid	hay	humm	0.00	1.00	0.46
12	Brown	RR	fil	none	none	conv	0.60	0.00	0.00
14	Carin	1	wha	handl	hay	humm	0.20	0.40	0.00
15	Dotti	1	wha	gun	hay	humm	0.00	0.00	0.00
16	Fulto	Oc	woa	none	hay	humm	0.40	0.80	0.00
17	Kelly	1	wha	solid	hay	flat	0.30	1.00	0.40
18	Kelly	2	woa	solid	hay	humm	0.50	0.80	0.40
19	LaFra	nc	wha	handl	graz	humm	0.00	0.00	0.00
20	LaFra	nc	woa	handl	graz	humm	0.00	0.00	0.00
21	Mello	1	woa	handl	graz	humm	0.00	0.00	0.00
22	RR&Me	rc	fil	none	none	conv	0.10	0.00	0.00
24	Sebas	3	cra	solid	graz	conv	0.20	0.40	0.60
26	Stone	2	cfa	handl	graz	flat	0.40	0.20	0.00
28	Todd	1	wha	none	none	humm	0.30	0.00	0.00
29	Todd	2	woa	none	none	flat	0.20	0.00	0.00

Crown Density greater than 3

Record#	AREA	SUBAREA	SOIL	IRRIGAT	CULTURE	TOPOG	EPICORMIC	PRUNING	PIPELINE
7	Brown	6	wha	none	hay	humm	0.27	0.33	0.00
13	Brown	YD	wha	none	traf	flat	0.00	0.50	0.00
23	Br&Ll	an	wha	none	none	conv	0.00	0.10	0.00
25	Stone	1	cfa	handl	graz	conv	0.10	0.30	0.00
27	Stone	3	cfa	handl	graz	flat	0.00	0.00	0.00
						averages:	0.074	0.246	0

SORT BY IRRIGATION SYSTEMS

Solid Set

Record#	AREA	SUBAREA	SOIL	CULTURE	TOPOG	CROWNDENS	CROWNDIAM	EPICORMIC	PRUNING
1	Alpha	1	wha	hay	conv	2.5	51	0.18	0.94
2	Alpha	2	woa	hay	conv	2.7	56	0.47	1.00
3	Alpha	4	woa	graz	flat	2.6	46	0.40	0.70
4	Alpha	5	woa	graz	conv	2.6	46	0.40	0.14
6	Brown	1	wha	hay	conv	2.7	52	0.10	0.80
8	Brown	7	wgc	hay	humm	2.4	48	0.50	1.00
9	Brown	8	wha	hay	conc	2.0	45	0.12	0.75
10	Brown	9	woa	hay	humm	2.7	48	0.13	0.93
11	Brown	11	woa	hay	humm	2.5	51	0.00	1.00
17	Kelly	1	wha	hay	flat	3.0	52	0.30	1.00
18	Kelly	2	woa	hay	humm	2.7	44	0.50	0.80
24	Sebas	3	cra	graz	conv	1.6	40	0.20	0.40

Handline

Record#	AREA	SUBAREA	SOIL	CULTURE	TOPOG	CROWNDENS	CROWNDIAM	EPICORMIC	PRUNING
5	Beret	0	woa	graz	humm	2.0	0	0.00	0.00
14	Carin	1	wha	hay	humm	2.7	49	0.20	0.40
19	LaFra	nc	wha	graz	humm	3.0	50	0.00	0.00
20	LaFra	nc	woa	graz	humm	3.0	0	0.00	0.00
21	Mello	1	woa	graz	humm	2.5	0	0.00	0.00
25	Stone	1	cfa	graz	conv	3.5	34	0.10	0.30
26	Stone	2	cfa	graz	flat	3.0	22	0.40	0.20
27	Stone	3	cfa	graz	flat	3.3	34	0.00	0.00

Gun

Record#	AREA	SUBAREA	SOIL	CULTURE	TOPOG	CROWNDENS	CROWNDIAM	EPICORMIC	PRUNING
15	Dotti	1	wha	hay	humm	2.5	50	0.00	0.00

None

Record#	AREA	SUBAREA	SOIL	CULTURE	TOPOG	CROWNDENS	CROWNDIAM	EPICORMIC	PRUNING
7	Brown	6	wha	hay	humm	3.2	52	0.27	0.33
12	Brown	RR	fil	none	conv	3.0	25	0.60	0.00
13	Brown	YD	wha	traf	flat	4.0	45	0.00	0.50
16	Fulto	Oc	woa	hay	humm	2.7	37	0.40	0.80
22	RR&Me	rc	fil	none	conv	3.0	22	0.10	0.00
23	Br&Li	an	wha	none	conv	3.6	25	0.00	0.10
28	Todd	1	wha	none	humm	3.0	51	0.30	0.00
29	Todd	2	woa	none	flat	3.0	47	0.20	0.00

SORT BY HEART ROT

Heart Rot greater than 30%

ecord#	AREA	SUB	SOIL	IRRIG	CULTR	TOPO	DENS	EPICOR	PRUN	ROOT	HEART	PIPE
1	alpha	1	wha	soli	hay	conv	2.5	0.18	0.94	0.47	0.59	0.24
2	alpha	2	woa	soli	hay	conv	2.7	0.47	1.00	0.47	0.77	0.24
3	alpha	4	woa	soli	graz	flat	2.6	0.40	0.70	0.70	0.60	0.60
6	brown	1	wha	soli	hay	conv	2.7	0.10	0.80	0.33	0.80	0.40
7	brown	6	wha	none	hay	humm	3.2	0.27	0.33	0.33	0.60	0.00
8	brown	7	wgc	soli	hay	humm	2.4	0.50	1.00	0.25	0.50	0.13
9	brown	8	wha	soli	hay	conc	2.0	0.12	0.75	0.33	0.50	0.25
10	brown	9	woa	soli	hay	humm	2.7	0.13	0.93	0.73	0.40	0.33
11	brown	11	woa	soli	hay	humm	2.5	0.00	1.00	0.00	0.36	0.46
13	brown	yd	wha	none	traf	flat	4.0	0.00	0.50	0.50	0.50	0.00
14	carin	1	wha	hand	hay	humm	2.7	0.20	0.40	0.30	0.70	0.00
18	kelly	2	woa	soli	hay	humm	2.7	0.50	0.80	0.40	0.40	0.40
24	sebas	3	cra	soli	graz	conv	1.6	0.20	0.40	0.60	0.60	0.60
29	todd	1	woa	none	none	flat	3.0	0.20	0.00	0.10	0.40	0.00
							2.6	av.				

Heart Rot greater than or = to 30%

Record#	AREA	SUB	SOIL	IRRIG	CULTR	TOPO	DENS	EPICOR	PRUN	ROOT	HEART	PIPE
1	alpha	1	wha	soli	hay	conv	2.5	0.18	0.94	0.47	0.59	0.24
2	alpha	2	woa	soli	hay	conv	2.7	0.47	1.00	0.47	0.77	0.24
3	alpha	4	woa	soli	graz	flat	2.6	0.40	0.70	0.70	0.60	0.60
6	brown	1	wha	soli	hay	conv	2.7	0.10	0.80	0.33	0.80	0.40
7	brown	6	wha	none	hay	humm	3.2	0.27	0.33	0.33	0.60	0.00
8	brown	7	wgc	soli	hay	humm	2.4	0.50	1.00	0.25	0.50	0.13
9	brown	8	wha	soli	hay	conc	2.0	0.12	0.75	0.33	0.50	0.25
10	brown	9	woa	soli	hay	humm	2.7	0.13	0.93	0.73	0.40	0.33
11	brown	11	woa	soli	hay	humm	2.5	0.00	1.00	0.00	0.36	0.46
13	brown	yd	wha	none	traf	flat	4.0	0.00	0.50	0.50	0.50	0.00
14	carin	1	wha	hand	hay	humm	2.7	0.20	0.40	0.30	0.70	0.00
17	kelly	1	wha	soli	hay	flat	3.0	0.30	1.00	0.50	0.30	0.40
18	kelly	2	woa	soli	hay	humm	2.7	0.50	0.80	0.40	0.40	0.40
24	sebas	3	cra	soli	graz	conv	1.6	0.20	0.40	0.60	0.60	0.60
25	stone	1	cfa	hand	graz	conv	3.5	0.10	0.30	0.00	0.30	0.00
26	stone	2	cfa	hand	graz	flat	3.0	0.40	0.20	0.30	0.30	0.00
28	todd	1	wha	none	none	humm	3.0	0.30	0.00	0.20	0.30	0.00
29	todd	1	woa	none	none	flat	3.0	0.20	0.00	0.10	0.40	0.00
							2.7	av.				

Heart Rot less than 30%

Record#	AREA	SUB	SOIL	IRRIG	CULTR	TOPO	DENS	EPICOR	PRUN	ROOT	HEART	PIPE
4	alpha	5	woa	soli	graz	conv	2.6	0.40	0.14	0.40	0.10	0.00
~~5~~	~~beret~~	~~1~~	~~woa~~	~~hand~~	~~graz~~	~~humm~~	~~2.0~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~
12	brown	rr	fil	none	none	conv	3.0	0.60	0.00	0.00	0.00	0.00
~~15~~	~~dotti~~	~~1~~	~~wha~~	~~gun~~	~~hay~~	~~humm~~	~~2.5~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~
~~16~~	~~fultn~~	~~1~~	~~woa~~	~~none~~	~~hay~~	~~humm~~	~~2.7~~	~~0.40~~	~~0.80~~	~~0.00~~	~~0.00~~	~~0.00~~
~~19~~	~~lafra~~	~~1~~	~~wha~~	~~hand~~	~~graz~~	~~humm~~	~~3.0~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~
~~20~~	~~lafra~~	~~2~~	~~woa~~	~~hand~~	~~graz~~	~~humm~~	~~3.0~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~
~~21~~	~~mello~~	~~1~~	~~woa~~	~~hand~~	~~graz~~	~~humm~~	~~2.5~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~
22	merce	rr	fil	none	none	conv	3.0	0.10	0.00	0.00	0.00	0.00
23	br&ll	rd	wha	none	none	conv	3.6	0.00	0.10	0.00	0.10	0.00
27	stone	3	cfa	hand	graz	flat	3.3	0.00	0.00	0.00	0.00	0.00
							3.1	av.				

lined out values are roadside evaluations (no data)

SORT BY ROOT ROT

Root Rot greater than 30%

Record#	AREA	SUB	SOIL	IRRIG	CULTR	TOPO	DENS	EPICOR	PRUN	ROOT	HEART	PIPE
1	alpha	1	wha	soli	hay	conv	2.5	0.18	0.94	0.47	0.59	0.24
2	alpha	2	woa	soli	hay	conv	2.7	0.47	1.00	0.47	0.77	0.24
3	alpha	4	woa	soli	graz	flat	2.6	0.40	0.70	0.70	0.60	0.60
4	alpha	5	woa	soli	graz	conv	2.6	0.40	0.14	0.40	0.10	0.00
6	brown	1	wha	soli	hay	conv	2.7	0.10	0.80	0.33	0.80	0.40
7	brown	6	wha	none	hay	humm	3.2	0.27	0.33	0.33	0.60	0.00
9	brown	8	wha	soli	hay	conc	2.0	0.12	0.75	0.33	0.50	0.25
10	brown	9	woa	soli	hay	humm	2.7	0.13	0.93	0.73	0.40	0.33
13	brown	yd	wha	none	traf	flat	4.0	0.00	0.50	0.50	0.50	0.00
17	kelly	1	wha	soli	hay	flat	3.0	0.30	1.00	0.50	0.30	0.40
18	kelly	2	woa	soli	hay	humm	2.7	0.50	0.80	0.40	0.40	0.40
24	sebas	3	cra	soli	graz	conv	1.6	0.20	0.40	0.60	0.60	0.60
							2.7 av.					

Root Rot greater than or = to 30%

Record#	AREA	SUB	SOIL	IRRIG	CULTR	TOPO	DENS	DIAM	EPICOR	PRUN	ROOT	HEART	PIPE
1	alpha	1	wha	soli	hay	conv	2.5	51	0.18	0.94	0.47	0.59	0.24
2	alpha	2	woa	soli	hay	conv	2.7	56	0.47	1.00	0.47	0.77	0.24
3	alpha	4	woa	soli	graz	flat	2.6	46	0.40	0.70	0.70	0.60	0.60
4	alpha	5	woa	soli	graz	conv	2.6	46	0.40	0.14	0.40	0.10	0.00
6	brown	1	wha	soli	hay	conv	2.7	52	0.10	0.80	0.33	0.80	0.40
7	brown	6	wha	none	hay	humm	3.2	52	0.27	0.33	0.33	0.60	0.00
9	brown	8	wha	soli	hay	conc	2.0	45	0.12	0.75	0.33	0.50	0.25
10	brown	9	woa	soli	hay	humm	2.7	49	0.13	0.93	0.73	0.40	0.33
13	brown	yd	wha	none	traf	flat	4.0	45	0.00	0.50	0.50	0.50	0.00
14	carin	1	wha	hand	hay	humm	2.7	49	0.20	0.40	0.30	0.70	0.00
17	kelly	1	wha	soli	hay	flat	3.0	52	0.30	1.00	0.50	0.30	0.40
18	kelly	2	woa	soli	hay	humm	2.7	44	0.50	0.80	0.40	0.40	0.40
24	sebas	3	cra	soli	graz	conv	1.6	40	0.20	0.40	0.60	0.60	0.60
26	stone	2	cfa	hand	graz	flat	3.0	22	0.40	0.20	0.30	0.30	0.00
							2.7 av.						

Root Rot less than 30%

Record#	AREA	SUB	SOIL	IRRIG	CULTR	TOPO	DENS	EPICOR	PRUN	ROOT	HEART	PIPE
~~5~~	~~beret~~	~~1~~	~~woa~~	~~hand~~	~~graz~~	~~humm~~	~~2.0~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~
8	brown	7	wgc	soli	hay	humm	2.4	0.50	1.00	0.25	0.50	0.13
11	brown	11	woa	soli	hay	humm	2.5	0.00	1.00	0.00	0.36	0.46
12	brown	rr	fil	none	none	conv	3.0	0.60	0.00	0.00	0.00	0.00
~~15~~	~~dotti~~	~~1~~	~~wha~~	~~gun~~	~~hay~~	~~humm~~	~~2.5~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~
~~16~~	~~fultn~~	~~1~~	~~woa~~	~~none~~	~~hay~~	~~humm~~	~~2.7~~	~~0.40~~	~~0.80~~	~~0.00~~	~~0.00~~	~~0.00~~
~~19~~	~~lafra~~	~~1~~	~~wha~~	~~hand~~	~~graz~~	~~humm~~	~~3.0~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~
~~20~~	~~lafra~~	~~2~~	~~woa~~	~~hand~~	~~graz~~	~~humm~~	~~3.0~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~
~~21~~	~~mello~~	~~1~~	~~woa~~	~~hand~~	~~graz~~	~~humm~~	~~2.5~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~	~~0.00~~
22	merce	rr	fil	none	none	conv	3.0	0.10	0.00	0.00	0.00	0.00
23	br&ll	rd	wha	none	none	conv	3.6	0.00	0.10	0.00	0.10	0.00
25	stone	1	cfa	hand	graz	conv	3.5	0.10	0.30	0.00	0.30	0.00
27	stone	3	cfa	hand	graz	flat	3.3	0.00	0.00	0.00	0.00	0.00
28	todd	1	wha	none	none	humm	3.0	0.30	0.00	0.20	0.30	0.00
29	todd	1	woa	none	none	flat	3.0	0.20	0.00	0.10	0.40	0.00
							3.0 av.					

Sort for Topography = convex only

Record#	AREA	SOIL	DBH	IRRIG	CULTURE	TOPO	PIPE
1	Alpha	woa	30	.T.	graz	conv	.T.
2	Alpha	woa	30	.T.	graz	conv	.T.
3	Alpha	woa	30	.T.	graz	conv	.T.
12	Brown	wha	27	.T.	hay	conv	.T.
20	Brown	wha	50	.T.	hay	conv	.F.
22	Brown	wha	37	.T.	hay	conv	.T.

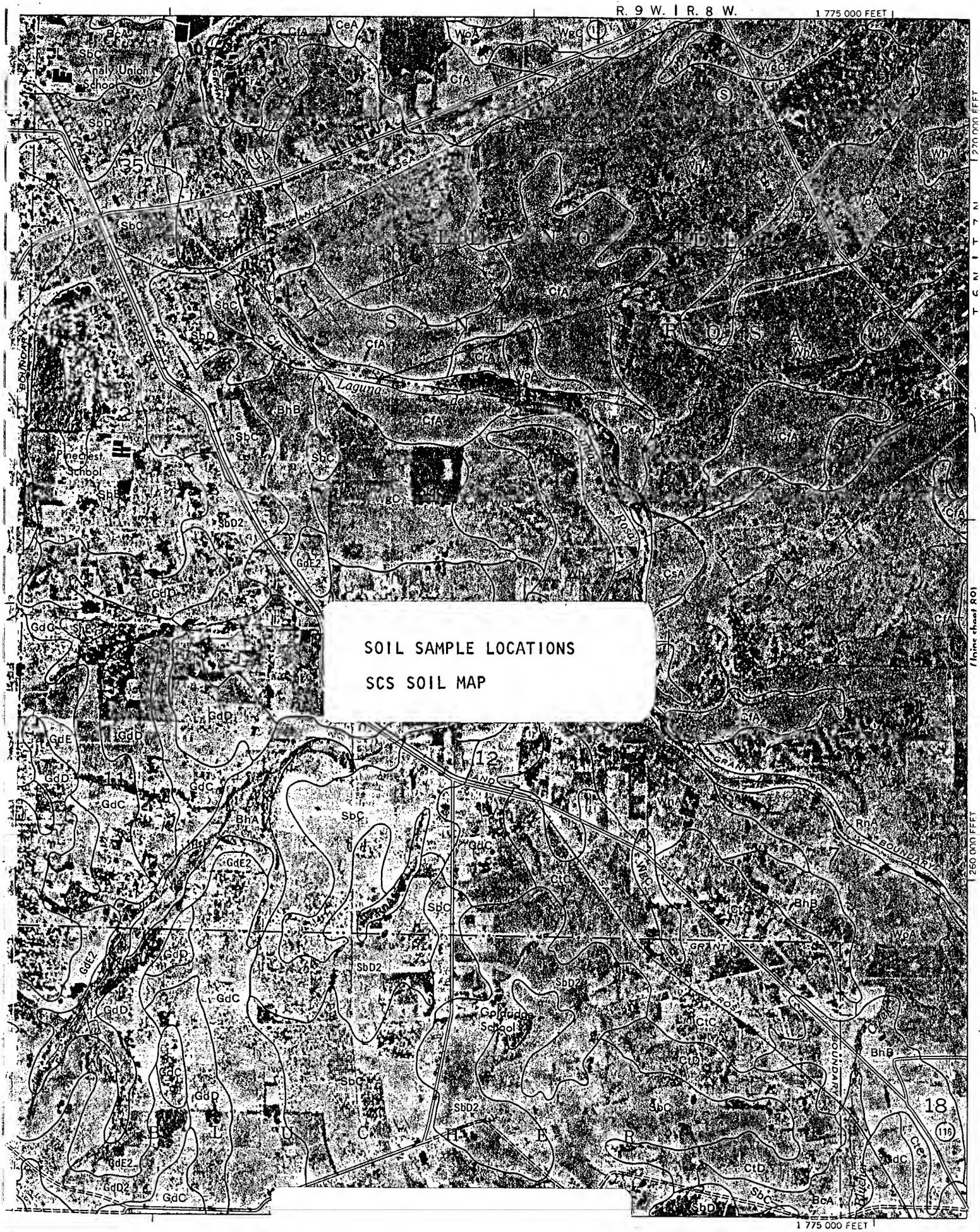
Note: there were not enough non-irrigated samples to justify a sort for irrigation vs. non-irrigation

SOIL SAMPLES

Samples were obtained using an 8" diameter power auger to make initial excavation. Maximum depth = 6'.

#	SCS Type	Location	Field Description
1	WhA	Brown	Topsoil = dark grey loam. Grey clay at 3'
2	BcA	Brown	Topsoil = sandy loam to 1.5'. Dark grey moist Sand to 5', sandy clay at 5'
3	BcA	Brown	Sandy clay loam first 1' then very sandy clay. Wet sand at 5.5'
4	CfA	Brown	Topsoil = jumbled organics, clay loam At 1.5 or 2', black clay with no mottles
5	CfA?	Channel	Black clay, more organics
6	WoA	Brown	Loam to 1.5', sandy clay to 4'
7	CfA	Brown	Heavy dark clay (several sample sites)
8	WgC	Brown	Topsoil = sandy loam, light grey Grey clay at 2'
9	CrA	Sebastopol	Topsoil = sandy loam, color 10YR 3/2 moist Change to greyish sand at 60" 3 samples taken - all the same. Does not fit CrA description in manual
10	CfA	Sebastopol	Black, dark clay - deep. 10YR 3/1 moist
11	CfA	Sebastopol	Same at #10. Was mapped BcA. BcA boundary is closer to channel.
12	BcA	Sebastopol	Topsoil = fine sandy loam, light grey dry

These descriptions are breif because the samples were compared to SCS descriptions in the field and generally conformed to SCS typing except as noted at sites # 9 and 11.


R. 9 W. | R. 8 W.
1 775 000 FEET
T 6 N | T 7 N
2 260 000 FEET
2 270 000 FEET
SOIL SAMPLE LOCATIONS
SCS SOIL MAP
Laguna de Santa Rosa
Pinecrest School
Piner Union School
Goldridge School
CfA
CeA
WgC
SbC
SbD
SbD2
GdC
GdD
GdE
GdE2
BhB
BhA
WhA
WoA
WpA
RhA
CtC
CtD
CsA
BcA
1 775 000 FEET

D - 2

1" = 1666'