STEVEN F. JENSEN

The Jordan River Nature Park:

A Plan for Urban Wildlife Habitat

Murray City, Utah

The Jordan River Nature Park:

A Plan for Urban Wildlife Habitat

Murray City, Utah

Mayor: Lynn Pett

City Council: P. Gary Ferrero
Lynn H. Turner
Julie L. Davis
Arline Gillen
Mary-Jane Ashton

Parks and Recreation Superintendent: Bill Crocker

Advisory Board: Richard Hutchinson
Karen Edwards
L. Clark Cushing
Michael R. Carlston
J. Richard Evans

A Masters Degree Project Report by: Kathlyn J. Collins

Project Committee Members: Craig W. Johnson
John A. Kadlec
Richard E. Toth
Vern J. Budge

Department of
Landscape
Architecture and
Environmental Planning
Utah State University,
Logan
1990

ACKNOWLEDGEMENTS

I would like to express my graditude to my committee members for their time and assistance. Particular recognition goes to Craig Johnson, as my major professor, whose enthusiasm, insite, and encouragment helped to see this project through. John Kadlec patiently taught me about wetlands. Richard Toth and Vern Budge provided support when it was needed the most.

I am grateful to the City of Murray for providing the funding for my research, Mayor Lynn Pett for his personal efforts in developing the Jordan River Parkway, and Bill Crocker and the Parks and Recreation Board for their enthusiasm and support.

I would like to thank the professional people who took time out of their busy schedules to answer my questions and freely provide their expertise. Although there are too many to mention here, most of these people are included in the reference list. My thanks also goes to Nancy O'Rourke for her diligent editing work.

Friends provided encouragement and support throughout my time in Logan for which I am deeply grateful.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1
INTRODUCTION

OVERVIEW

Riparian areas and wetlands are vital to wildlife and to people and are particularly significant in the Great Basin Desert, an area with little rainfall and sparse natural vegetation. Many species of birds, mammals, reptiles, amphibians, fish, and invertebrates forage, rest, migrate, or live out their entire lives dependent on vegetation in riparian and wetland areas. In turn, vegetation community composition and succession are affected by wildlife through vegetation removal, transport of plant propagules (including pollination), plant establishment, soil mixing, and altering materials in the soil which affect decomposition rates (MacMahon 1981).

Humans have historically depended on riparian and wetland areas for water, wood, plants, and game. Native Americans and settlers in Northern Utah along the Wasatch Mountains traveled the river and creek corridors, camped, and lived near the riparian areas (Morgan 1988, 102, 204). In the Great Basin Desert, the vegetation associated with rivers and wetlands, particularly the trees, are an attracting visual force. They give a sensory relief from the surrounding arid grass/shrub land. Today, in a built environment, they give important visual and physical structure to the urban landscape (Toth 1990).

A river with its riparian and wetland areas is a dynamic rather than a static system. Water in rivers and streams fed by snows in the Wasatch Mountains widely fluctuates depending on weather events and the time of year. The riparian area provides a defense from destructive floods by allowing the water to spread over the floodplain and recede slowly. Some water percolates into the ground to recharge the aquifer; other water is released slowly into the river channel from wetlands and old oxbows that fill during these events. Nutrients important to plants and animals in wetlands are released and renewed with floodwaters. Riparian and wetland vegetation helps to slow the floodwater velocity, reducing scouring and depositing rich topsoil. Scouring occurs typically on the outside edge of meanders where water removes and redeposits bank materials downstream as gravel bars. These gravel bars become noncompetitive nurseries for cottonwood and willow seedlings. As new stands of cottonwoods

are re-established on gravel bars, older stands die out leaving snags useful to many wildlife species.

The riparian area with its associated wetlands along the Jordan River plays a major role in natural water management. In the mid-1800s as settlers arrived along the Wasatch Front, they began to alter the structure and disrupt the function of the Jordan River riparian system. Disturbance to the system has continued for over 100 years. Activities such as straightening and dredging the channel, filling wetlands, withdrawing water, constructing bridges and storm sewer inputs, and riprapping banks have significantly lowered the water table, increased severity of flooding, and destroyed native fish and wildlife habitat. Encroaching development, tree harvesting, release of contaminated urban water runoff, and overgrazing have all contributed to loss of native wildlife habitat, loss of fertile soils and the flow of nutrients, and the proliferation of nuisance species of plants and animals. In short, Wasatch Front communities have seriously degraded a valuable natural resource.

In an effort to reverse this trend, the Jordan River from 4500 South to the Davis County Line was master planned in 1971 (Urban Technology Associates) and in 1979 (Kaiser Associates and Genge Consultants) as part of the Jordan River Parkway. South of 4500 South, individual communities were held responsible for Parkway planning and implementation. Few of the Jordan River Parkway sections as proposed in the master plans have been developed or preserved. For example, in Murray, Utah, city planning efforts for 4500 South to 6400 South were fragmented and implementation delayed, dependent on funds for land acquisition. In those few developed parks and open spaces preserved along the Jordan River Parkway in Salt Lake County, native vegetation communities and dynamic natural forces were eliminated in favor of a tightly controlled environment. Design and management practices have included diking, uniform grading, planting exotic species, using herbicides and pesticides, watering, mowing, trimming, and removing debris. This approach may be necessary in some settings, but it is often used inappropriately. Parks and open spaces of this type are costly to maintain and contribute to the loss of the rich aesthetic diversity of native plants and animal species.

THE JORDAN RIVER NATURE PARK

Murray City's recent efforts in parkway master planning reflect the renewed interest nationally in rivers in the urban environment. Murray has taken a big step in understanding that manicured lawns and trees are not the only way a parkway can be designed. Murray has recognized the value of the riparian and wetland habitats along the Jordan River for water quality, wildlife habitat, and passive recreation activities.

In the 1970s, Murray began acquiring land parcels along the river between 4800 South and 5300 South for the Jordan River Parkway (see Fig. 1a and 1b.) Despite previous site planning

Fig. 1a Aerial Photo. North section of the Jordan River Nature Park

Fig. 1b Aerial Photo. South section of the Jordan River Nature Park

efforts, the area remained undeveloped primarily because of lack of funding for a proposed road and extensive irrigation. In 1986 Murray City and the Division of Wildlife Resources approached the Utah State University Department of Landscape Architecture and Environmental Planning for help with a new master plan. Six graduate students under Professor Craig Johnson developed a plan that recommended preservation, enhancement, and restoration of wildlife habitat as an integral part of the park plan concept. In the new concept, the use of irrigation was minimized and the road eliminated in favor of a trail system.

The students conducted a site analysis, considering current and alternative land-use relationships as well as current and potential wildlife habitats as represented by existing and potential plant communities. They proposed two different park development scenarios. One maximized the development of wetland, riparian, and upland habitats, providing human access for specific wildlife related activities. The other approach provided for more active recreation use, including a softball field, while minimizing irrigated turf and developing some wetland habitat.

Based on these recommendations and alternatives, the following year Murray funded a research project with Utah State University's Department of Landscape Architecture and Environmental Planning to develop an atypical design solution for their section of the Jordan River Parkway. The research project entailed two phases of study. Phase one included development of a conceptual land use and circulation master plan for the entire Jordan River Parkway within the city from 4800 South to 6400 South. These were developed by Professor Craig Johnson and graduate students Kathlyn Collins and Paul Larsen, incorporating ideas from the original Nature Park plan. The master plan was accepted by Murray residents and approved by the Murray City Council in the summer of 1989 after several public meetings, community review, and some revisions. Within the master plan, a new design was solidified for the Jordan River Nature Park between 4800 South and 5400 South. The Nature Park design included enhanced wetlands, re-established riparian and upland vegetation, irrigated picnic areas, playfields, and a buffer strip adjacent to the residences. Canoe launch facilities and a nature interpretive center were also included; a trail system would eventually connect with the rest of the Jordan River Parkway. See Appendix A, The Jordan River Parkway Master Plan.

Phase two, the purpose of the project reported here, investigated using native plants to re-establish wildlife habitats and developing irrigated park facility areas. This included preparing a general planting plan, specifications, and implementation and maintenance guidelines for the Jordan River Nature Park portion of the Parkway between 4800 South and 5400 South.

PROJECT OBJECTIVES AND METHODS

The specific objective of this project was to develop a vegetation plan that re-creates a mosaic of native riparian, wetland, and upland vegetation communities in the Jordan River Nature Park within the limits of existing soil, water, and microclimate conditions. This vegetation plan would create an urban nature park that attracts and retains a diversity of wildlife (emphasizing avian species) and that provides a pleasant, safe recreational experience with an increased opportunity for human/wildlife interaction.

The design and the implementation and management guidelines of the Jordan River Nature Park was based on state-of-the-art knowledge and techniques applicable to the Intermountain West, found in the literature and in consultation with experts. In addition, information obtained at national symposiums pertaining to wetlands and river systems, from Utah and federal natural resource agencies, and from natural resource departments at local colleges and universities comprised the sources of expertise in native plant selection and community dynamics, site preparation, and non-irrigated plant establishment and maintenance. The purpose of this report is to present the results of the research, the recommendations and specifications for a planting design, and the implementation and management plan alternatives.

This project report contains:

1. a site analysis,
2. a site preparation plan,
3. a planting plan at 1" to 100' scale,
4. planting and general maintenance specifications,
5. detail drawings of installation methods, and
6. sections and illustrations of planting schemes.

It must be noted here that these are guidelines for the city of Murray to use, not a specific planting plan. The information in this report allows flexibility in implementation. Murray may choose from a variety of options such as completing the plan in phases determined by the fiscal resources available and contracting or doing segments of the plan with city personnel and equipment.

CHAPTER 2
SITE ANALYSIS

REGIONAL SETTING

The site is located within the Jordan River basin which covers approximately 3,450 square miles in north central Utah, extending 86 miles from the mountains to the Great Salt Lake. (See Fig. 2.) It drains parts of Salt Lake, Wasatch, Utah, Juab, and Sanpete Counties. The Jordan River proper originates from Utah Lake and flows north 44 miles to the Great Salt Lake. All major tributaries of the Jordan River and Utah Lake flow from the Wasatch Range to the east. Little water is contributed from the Oquirrh mountains and other ranges on the west side of the basin. Approximately three miles of the Jordan River flow through Murray, Utah.

The Jordan River is located in the growing megalopolis locally described as "the Wasatch Front." An estimated 64 percent of Utah's population, or 1,191,900 people, lived in the four counties of the Wasatch Front in 1987. Murray's population was 25,750 in 1980 and has continued to grow (State of Utah 1987); it is within a few minutes drive of downtown Salt Lake City via Interstate Highway 15. The Nature Park is within one mile of Interstate Highway 15 and easily accessed from the 4500 South and 5300 South interchanges. (See Fig. 3.)

The Jordan River lies on the west side of Murray. At the Nature Park site, the river forms the city boundary. The west side of the river is unincorporated, privately owned, and under the jurisdiction of Salt Lake County. Both sides of the river are being converted from agriculture to industrial and residential subdivisions. (See Figs. 4 and 5.)

LOCAL SETTING

The Jordan River Nature Park is situated along 1.25 miles of the Jordan River. (See Figs. 6a and 6b.) 4800 South bounds it on the north and 5400 South on the south (both major four-lane roads). On the east side, adjacent residential development includes the backyards of single family housing on the south end and condominiums and a clubhouse on the north end. The site varies in width from 200 feet to 1200 feet (60 meters to 365 meters), comprising approximately 100 acres. Currently, the city owns all except 22 acres. The city passed a 1.5 million dollar bond to acquire all remaining land along the Jordan River within the city limits

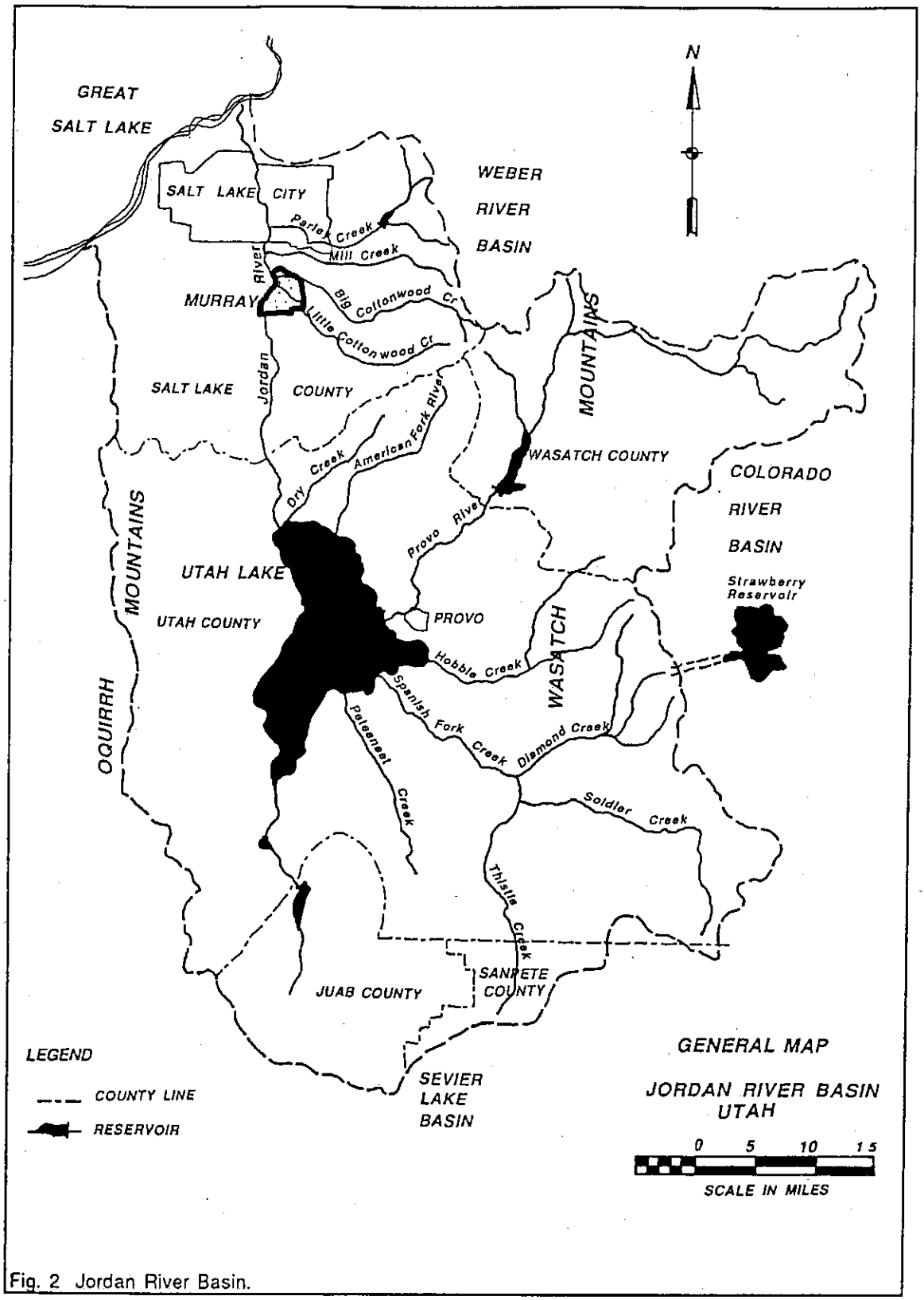


Fig. 2 Jordan River Basin.

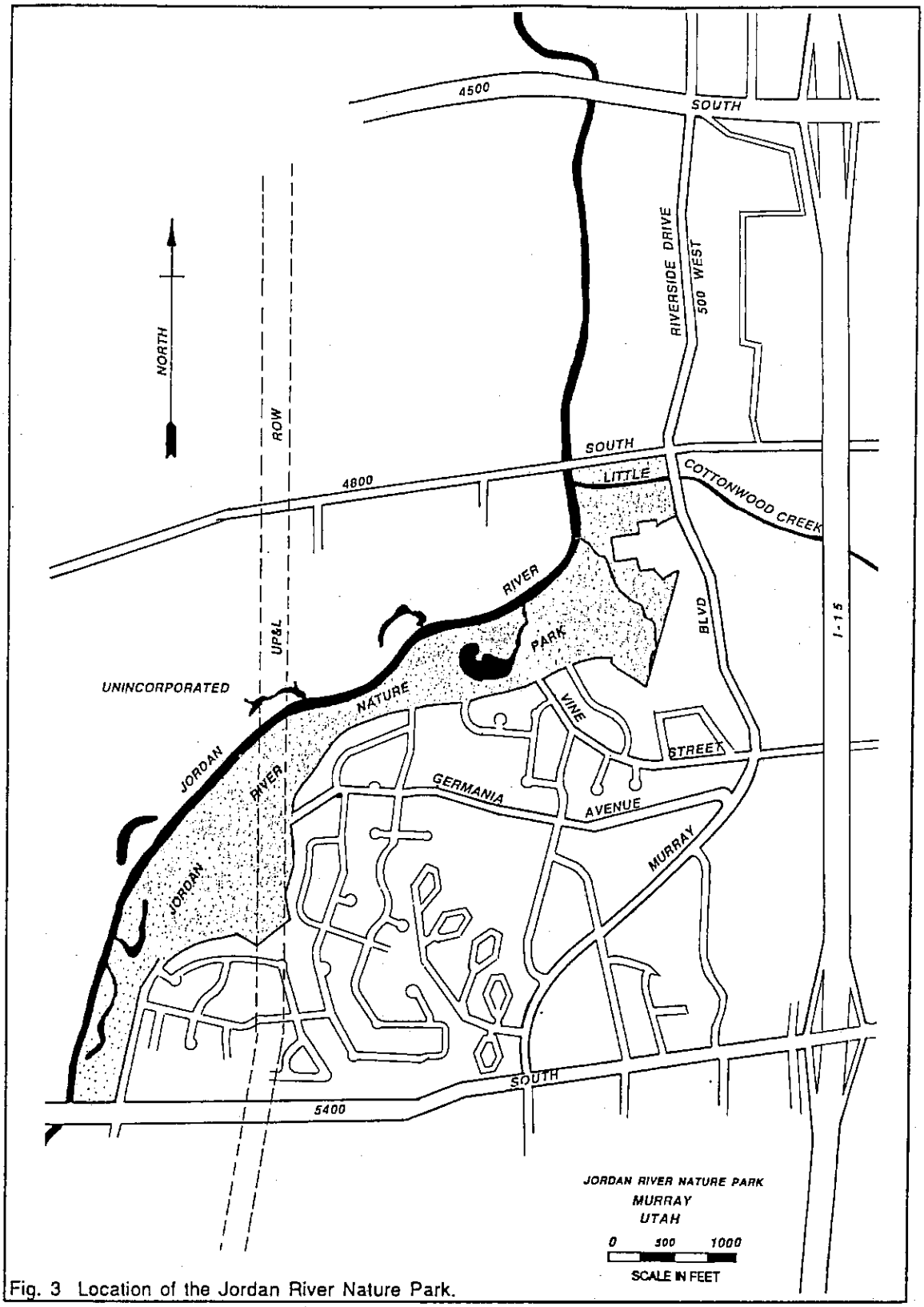


Fig. 3 Location of the Jordan River Nature Park.

Fig. 4 Marsh area in the north section of the Jordan River Nature Park

Fig. 5. Upland area and powerlines in the south section of the Jordan River Nature Park.

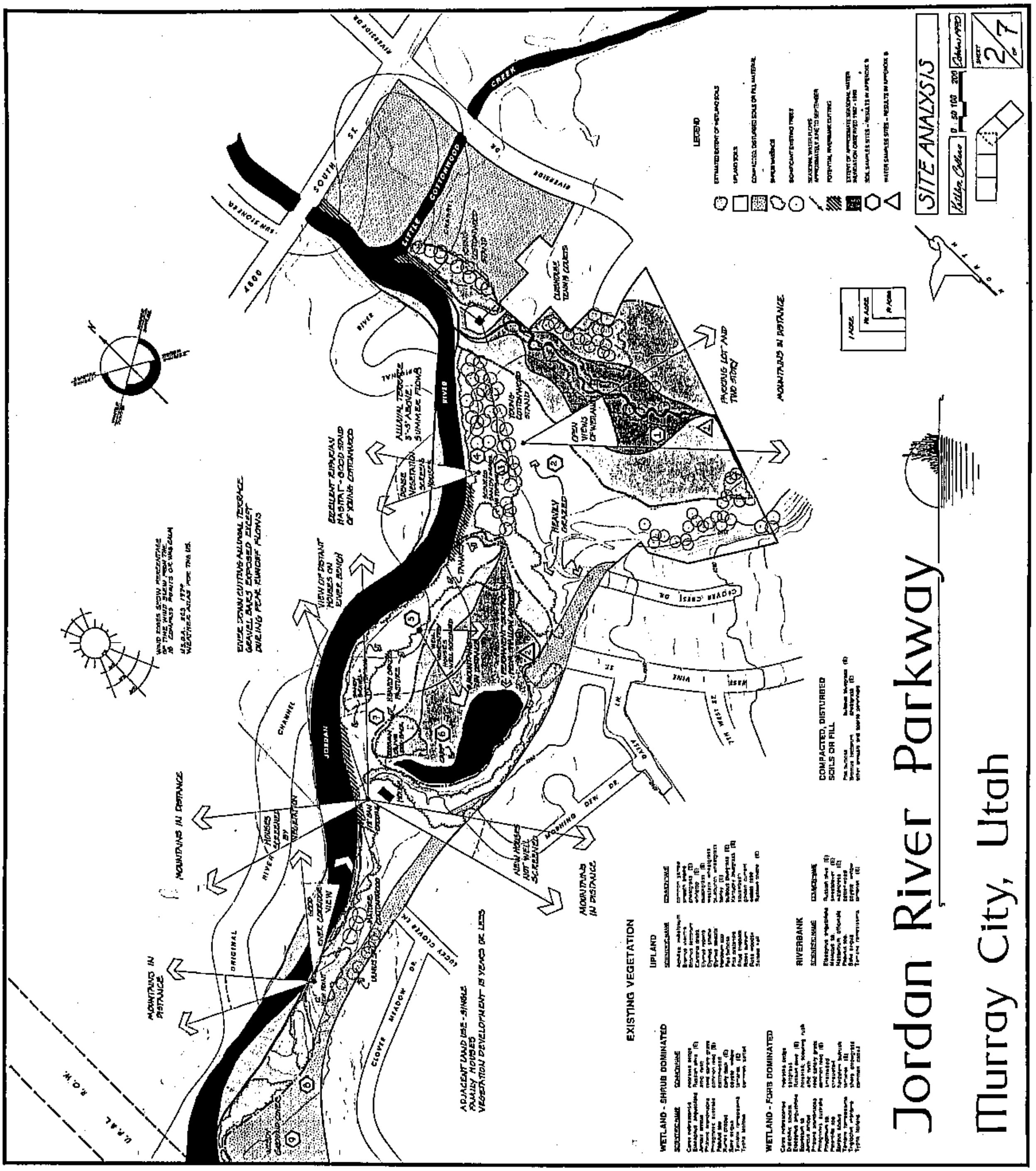


Fig. 6a Site Analysis. North section of the Jordan River Nature Park.

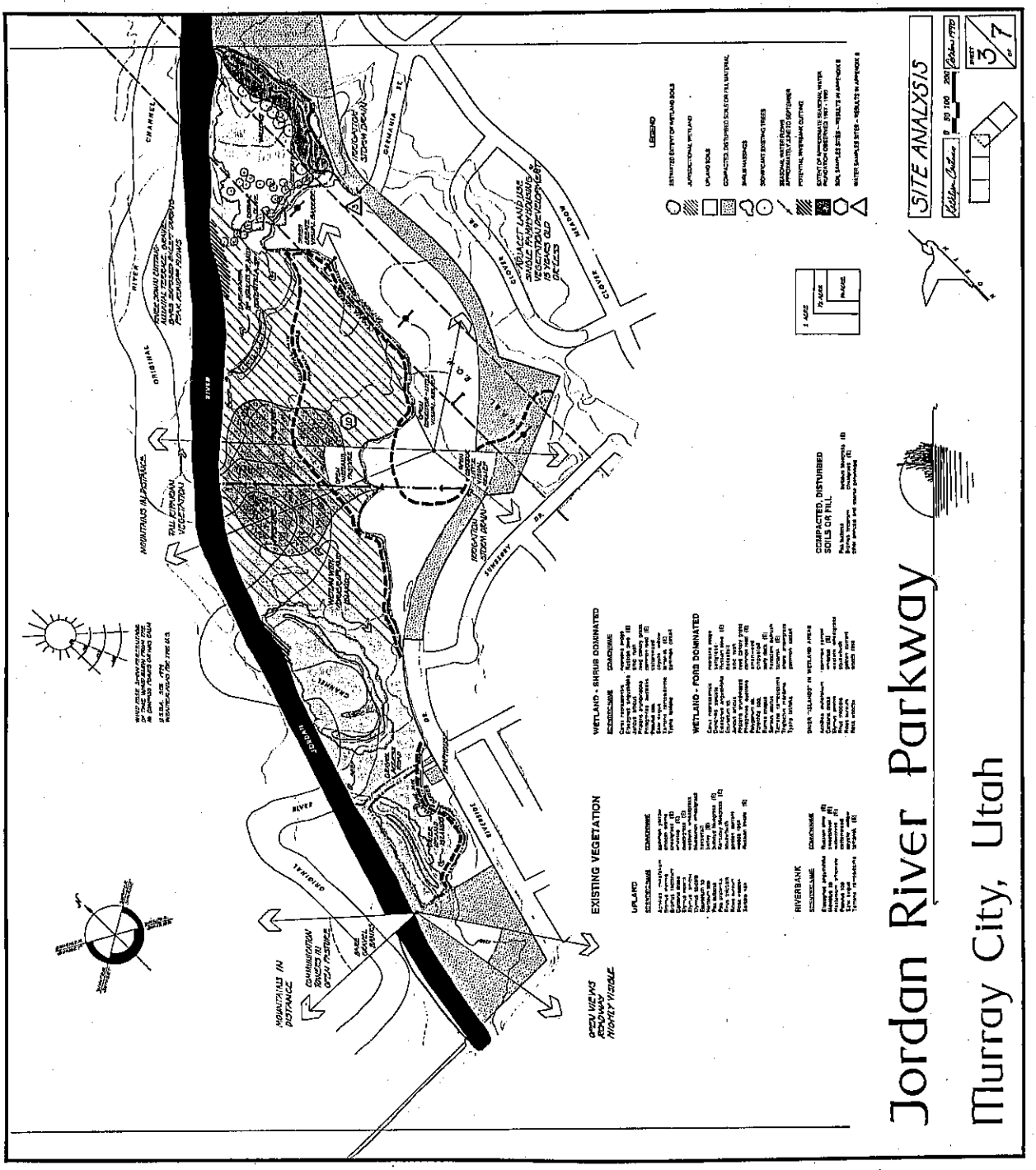


Fig. 6b Site Analysis. South section of the Jordan River Nature Park.

including the Nature Park lands. Little Cottonwood Creek enters the Jordan River at the north end of the site. The site is part of the Jordan River flood plain riparian zone with remnant associated wetland and upland plant communities. The west side of the river is similar, with remnants of riparian vegetation where it has not been encroached on by development or recently grazed. All the old meanders on both sides of the river were inundated by flood waters during 1984 and 1985. The site and its vegetation communities have been drastically altered. Obvious results of these disturbances include lowering of the water table, river headcutting, and a change in historic vegetation patterns.

CLIMATE

The climate is characterized by hot dry summers and moderately severe winters with only minor precipitation on the basin floor and by mild dry summers and severe winters with heavy snowfalls in the Wasatch Mountains. Mean annual precipitation varies from 10 inches in the valley to over 35 inches in the high Wasatch Mountains--amounting to several hundred inches of snow during the winter--from October through May. Murray typically receives 15 inches of precipitation annually. The mean annual temperature along the Jordan River is 49 degrees F., the average summer temperature is 71 degrees, and the frost free period varies from 120-140 days (Brough et al. 1987). The prevailing winds come from the south/southeast and winter storms from the north (Environmental Data Services 1968).

PLANNING AND DESIGN CONSIDERATIONS

The Jordan River Nature Park climate is determined by the area-wide climate plus the modifying factors of the site itself including orientation, topography, and vegetation. The site is typically windy due to the general north/south orientation of the Jordan River, making it susceptible to the prevailing winds from the south/southeast and cold winter storms from the north. The alluvial river bench on the north end offers some wind protection for the wetlands. There are few large trees on the site to modify the effects of the wind and sun. Human comfort, wildlife survival, and establishment and growth of certain plants are determined by favorable microclimates enhanced by vegetation.

Establishment of vegetation poses the largest problem in this dry climate (MacMahon 1987). Except for the irrigated areas indicated in the plan, native vegetation will rely on seasonal rainfall and ground moisture. Strategies such as planting under 'nurse plants' and planting tight massings of shrubs utilize the microclimate associated with these techniques. See section on Planting Strategies in Chapter 3.

HYDROLOGY

The Jordan River Basin hydrology is based on the annual discharge and recharge of underground water bodies called aquifers. Groundwater occurs in (1) a confined aquifer, (2) a deep-unconfined aquifer, (3) a shallow-unconfined aquifer, and (4) in locally perched aquifers (Price 1985). (See Fig.7.) The shallow-unconfined aquifer is of the greatest interest for this project.

The shallow-unconfined aquifer is generally not used to supply water for domestic or industrial purposes because it yields water slowly and is readily contaminated. It is recharged by water moving upwards from the confined aquifer as well as by downward infiltration from precipitation, canals, irrigated lands, and streams. Water in the shallow-unconfined aquifer flows toward the Jordan River. The maximum thickness of this aquifer is about 50 feet. Along the Jordan River it is found at a depth of zero to five feet below the soil surface. Typically the highest water levels occur in March or April, the lowest water levels in mid to late summer. This corresponds with the seasonal recharge from the confined aquifer which similarly fluctuates. Precipitation can cause a rapid rise in the shallow-unconfined aquifer but will recede as water drains to the Jordan River (Seiler 1984).

This shallow-unconfined aquifer (historically close to the surface) has lowered near the Jordan River due to river down-cutting which drains the groundwater to a lower level. Heavy urbanization with its associated hard surfaces and water channelization has reduced recharge of the shallow-unconfined aquifer. When the riverbed was higher, back pressure slowed the water draining the aquifer. (See Fig. 8.) As the river down-cut, the water in the aquifer drained more quickly. (See Fig. 9.) When the water table falls, plant composition changes to plants with a greater tolerance for dry soils, including invasive weedy species. Retaining water on site in wetlands, as in the plan, will help to raise the local ground water level and enhance the growth of vegetation favorable to wildlife.

Ground water is one of the hydrologic factors that influences the structure and function of wetlands. Water is contributed to a wetland by precipitation, from surface water, and from underground flows. Water loss from wetlands occurs from surface outflow, underground flow, evaporation, and plant evapotranspiration. General hydrology of wetlands is shown in Figs. 10 and 11.

In the Nature Park, three locations were identified that have retained water all year for the last four years. Water from the shallow-unconfined aquifer is intercepted by the wetland near West Vine, thus retaining some water all year even in dry years. It is also fed by an irrigation/storm water drain which is typically dry in the fall and winter. Perennial stream flows on the site occur west of Hunter's Woods condominiums and the storm water outlet west of Germania Street.

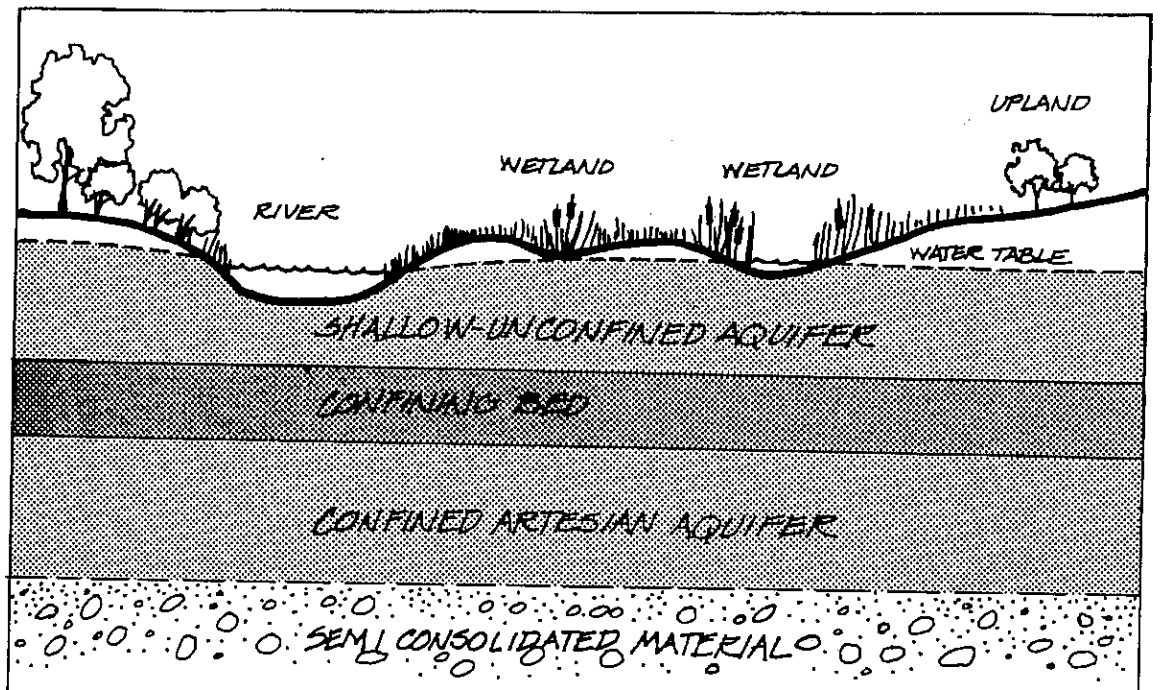


Fig. 7 Ground water of the Jordan River Nature Park. The ground water (shown not to scale) is contained in a shallow-unconfined aquifer and a deeper confined aquifer. The shallow-unconfined aquifer is the major component of the site hydrology.

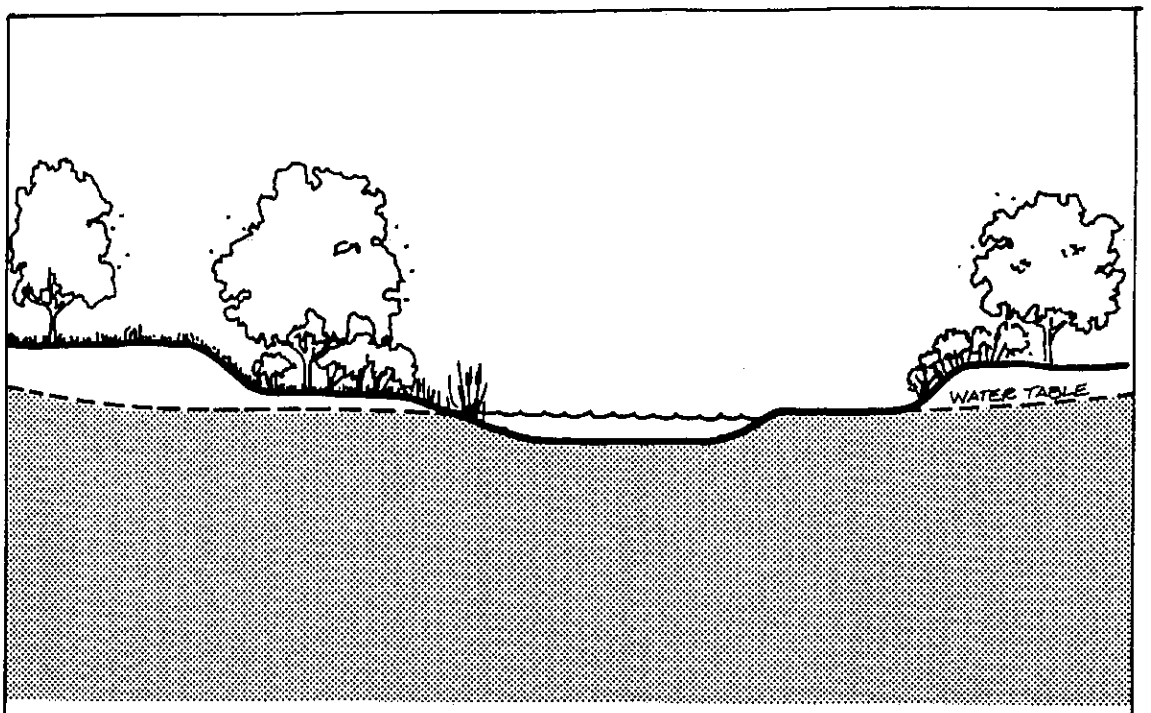


Fig. 8 Historic Jordan River hydrology. The riverbed and the water table of the shallow-unconfined aquifer was higher. Riparian vegetation species were prevalent.

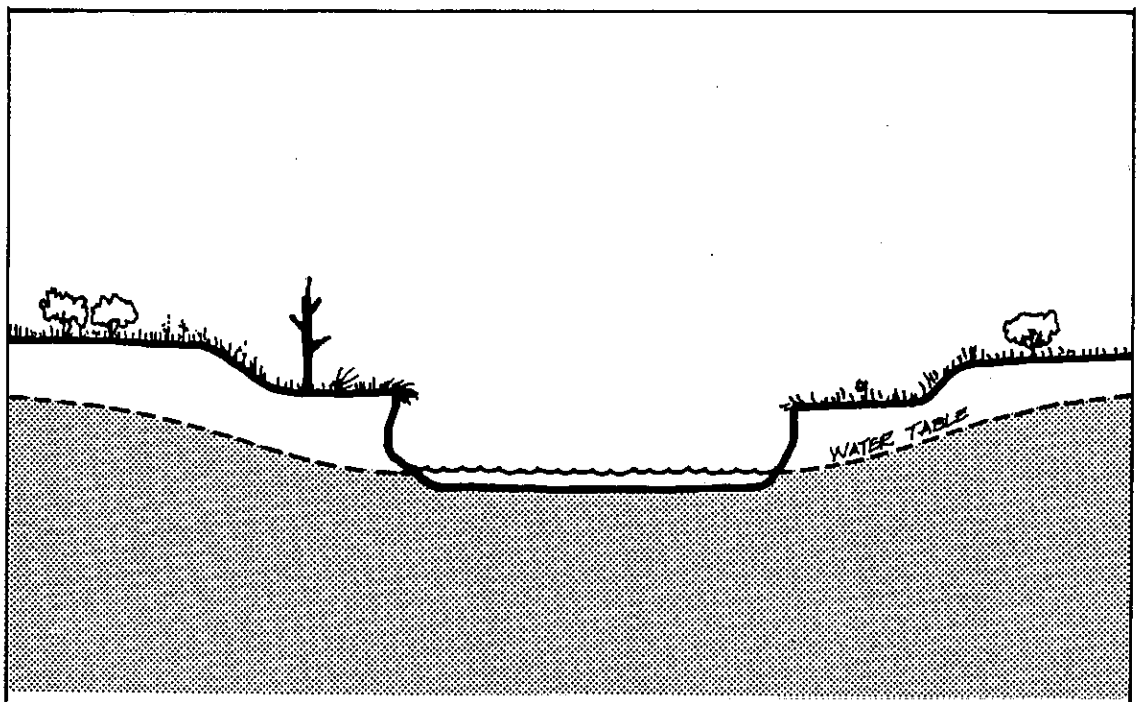


Fig. 9 Current Jordan River hydrology. The riverbed has been downcut, lowering the water table of the shallow unconfined aquifer. As a result, the riparian vegetation dies back and is replaced by upland and weedy species.

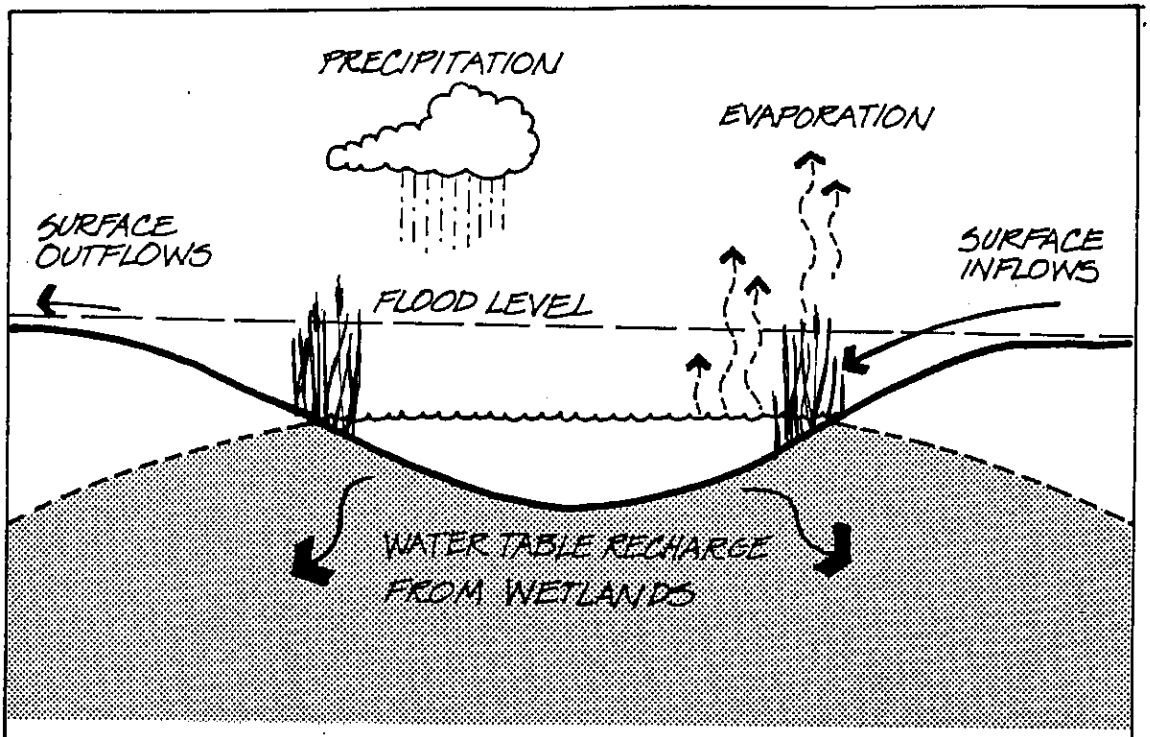


Fig. 10 Hydrology of wetlands: recharge of ground water. This condition may occur determined by the other hydrologic factors, the time of year, climate and soils.

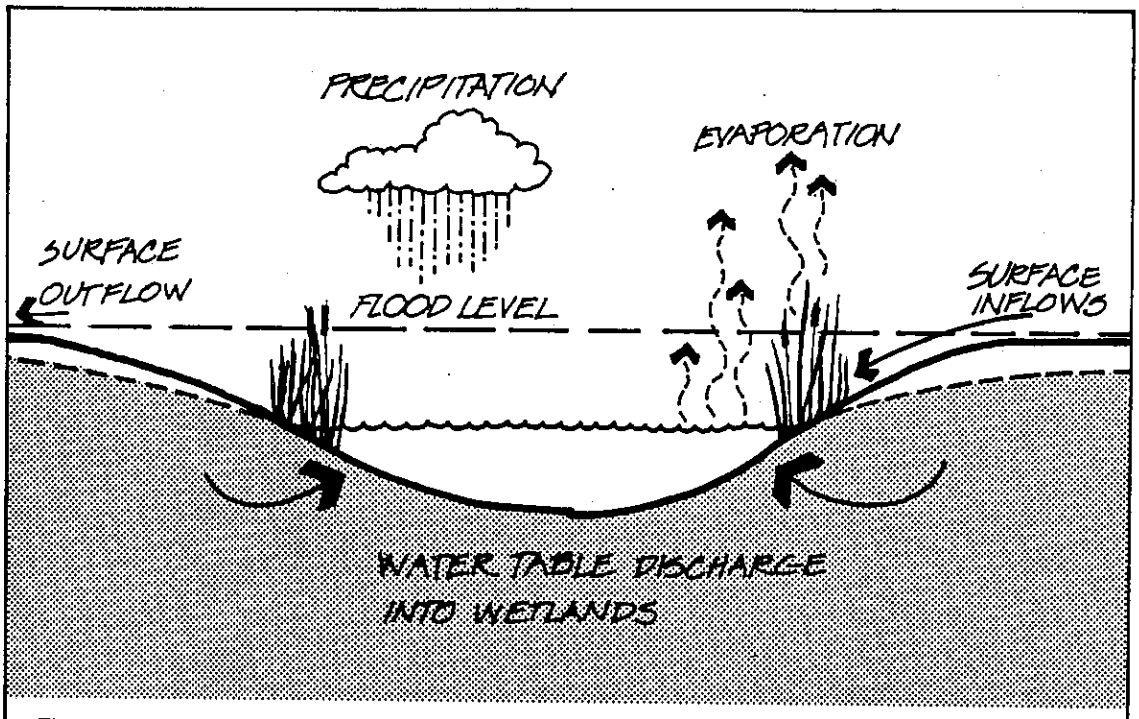


Fig. 11 Hydrology of wetlands: ground water discharge of into wetlands. This condition may occur determined by the other hydrologic factors, the time of year, climate and soils.

WATER QUALITY

Surface water quality was tested at three sites in early March 1990 at very low water levels. Generally, the pH and alkalinity are tolerable for most plants. The salinity is low to moderate; thus, only the most sensitive plants would be affected. Nitrates and phosphates were measured as baseline data. (See Appendix B.)

PLANNING AND DESIGN CONSIDERATIONS

Understanding and planning for the hydrological conditions of the site is vital to the success of the wetlands enhancement project. In order to optimize the potential value of the wetlands for wildlife habitat, interpretation, and recreation, water must be supplied and used to its full advantage. This can take different forms depending on the water source. In the case of perennial streams, upstream water quality and quantity must be assured. With irrigation/storm water outlets, the irrigation company must be included in planning and regulating the flows. Also, some city-owned water rights not currently used can be directed to the Nature Park. However, if the water rights are not permanently allocated for that use, another water source will need to be secured.

Available water will be backed up to enhance wetlands for wildlife habitat. Saturating soils and increasing surface water will affect plant growth and plant community composition. See section on Wetland Enhancement and Creation, Chapter 4. Retaining water on site will not adversely affect the water table beneath the local neighborhood due to the differences in elevation and ditches.

Water monitoring wells are to be placed in the wetland areas in order to obtain baseline data and monitor groundwater levels. These wells will establish the basis for wetland management decisions and will also be a useful tool for interpreting groundwater systems.

SOILS

Alluvial mix and hydric soil patterns on the site have developed as a result of the hydrologic influence of the Jordan River, other surface water flows, and groundwater. Soils vary from sand/gravel to silt, clay, and peat. Fill material on the site is found primarily adjacent to the river and the housing development. These materials lack topsoil. Soils are described generally below; locations are indicated on the Site Analysis Map found on pages 11 and 12, Figs. 6a and 6b. *USGS Soil Survey of Salt Lake Area, Utah.*, (1974) provides further information.

SOILS TYPE

Chipman silty clay loam (Ch). Soils are deep, poorly drained, and saturated between 20" and 40" for at least part of the year. The soil has a surface layer of gray silty clay loam and underlying material of white or light-gray silty clay loam with a strong lime accumulation at a depth of about 16". Soil is typically non-saline to slightly saline. Permeability is moderately slow and runoff is slow. Organic content is high.

Magna silty clay, peaty surface (Mg). Soils are deep, poorly drained, and saturated at or near the surface part of each growing season. Surface layer is overlaid by a layer of peat 2 to 12 inches thick. The surface layer of gray silty clay and underlying material of light-gray or gray silty clay loam and silty clay has a layer of strong lime accumulation at a depth of about 12 inches. The surface is noncalcareous to moderately calcareous and strongly calcareous below. Permeability and runoff are slow. Organic content is very high. Erosion hazard is slight.

Mixed alluvial land (Mu). Soils are deep, somewhat poorly drained to poorly drained and highly stratified. The soil is typically adjacent to the Jordan River and subject to frequent flooding. Texture ranges from clay to sand and commonly has gravelly strata. Mottles occur within 30 inches of the surface. It is moderately saline-alkaline. Run-off is slow. The organic-matter content is medium. Hazard of erosion is moderate.

Wasatch loamy coarse sand (WgD). These consist of excessively drained soils on alluvial fans (in this location) and lake terraces. Typically, the surface layer is dark grayish-brown loamy coarse sand about 11 inches thick. Between depths of 11 and 50 inches lies grayish-brown and pale brown loamy coarse sand. The profile is noncalcareous. Water intake and permeability is rapid. The organic matter content is low. Runoff is medium on this soil. The hazard of erosion is high in irrigated areas but only slight in range areas.

SOIL FERTILITY

Representative samples of soils throughout the site were tested for fertility in order to determine plant selection and soil treatment. Generally, the results indicated good fertile soils except where fill material is present. The pH ranged from 7.09 to 8.2. Soluble salts (EC) ranged from .23 to 3.8 mmhos/cm. Salinity and alkalinity are within the tolerable range for most plants. (See Appendix B.)

PLANNING AND DESIGN CONSIDERATIONS

Soil, water, climate, and the presence of propagules in the soil determine what will grow naturally in a particular location (van der Valk 1981). Soil fertility, texture, and profile further define the potential community structure. Recommended plant selection and water manipulation in this plan are based on these parameters. Specific recommendations are contained in Appendix I.

Stabilizing soils is a major function of vegetation. In the Jordan River Nature Park, erosion is a concern where the alluvial bench meets the river and where the riverbank is being undercut, as identified on the Site Analysis Map on page 11 and 12, Figs. 6a and 6b. Stabilization of these soils on both sides of the river is important. Further discussion of bank stabilization with vegetation is contained in the section on Riverbank and Biostabilization in Chapter 4.

TOPOGRAPHY

The general topography of the Jordan River Nature Park shows typical characteristics of an old meandering riverbed. The site lies primarily in a gently sloping (less than 2%) riverine floodplain. Shallow depressions up to 2 feet deep have been created by old oxbows and water channels. The riverbank was 3 to 5 feet above the spring 1990 water level of the Jordan River. An alluvial terrace 15 feet above the river defines the topography on the north end of the site. Where this terrace meets the river, slopes up to 100% occur. Topographic information supplied by the City Engineer's Office shows four-foot contour intervals and interpolated two-foot contour intervals.

PLANNING AND DESIGN CONSIDERATIONS

Plant communities are influenced by the topography of the site. Upland habitats are generally the higher areas on the site whereas wetland vegetation is found in the lowest. Subtle changes in plant community composition occur according to species' preference, even in the relatively flat areas, corresponding to the nearness of groundwater where upland shrubs, willows, cattails, and sedges grow in definite patterns. Topography was used to determine plant locations for the Planting Plan.

WILDLIFE

The Jordan River Nature Park provides year-round habitat for a variety of bird species. Observations since 1985 list 95 species utilizing the site; these species are listed in Appendix

C. Literature from the Utah Division of Wildlife Resources indicates a potential of 30 more species that may use the Jordan River corridor for migration, resting, feeding, nesting, and cover.

Mammals or their sign observed on the site include small rodents, ground squirrel, gopher, raccoon, beaver, muskrat, bats, and possibly skunk. A live-trap line was set out November of 1988 and May of 1989 for small rodents. Although small rodent activity was evident by remnant winter tunnels, only a few western harvest mice were caught.

Garter snakes have been observed in the warmer months and frogs have been heard in the wetlands in June. Butterflies and dragonflies are the showier insects found on the site in spring. The abundance of small flying insects is indicated by the great numbers of swallows, flycatchers, and bats feeding above the site.

A survey of wildlife and their habitats relating to the Jordan River Nature Park follows. These habitats and the species that use them are general in order to indicate the site's value as wildlife habitat. A wildlife species may use a number of these categories for different habitat requirements.

1. River, including shoreline vegetation -- food, cover, brood rearing, and travel corridor for ducks, shorebirds, terns, gulls, herons, warblers, beaver, and muskrat.
2. Wetlands with some open water, grasses, cattail, bulrush, and shrub willow -- food, nesting, cover, resting areas for ducks, snipe, herons, egrets, terns, shorebirds, red-winged blackbirds, sparrows, harvest mice, muskrat, beaver, raccoon, bats, and amphibians.
3. Exposed wetland mudflats and short grasses -- habitat for invertebrates, food for avocets, sandpipers, and other shorebirds.
4. Cattail and grass areas -- food, cover for pheasant, small rodents, and reptiles.
5. Dead trees (snags) -- food for woodpeckers and flickers, resting areas for bats, herons and a variety of other birds, hunting perches for hawks and owls, and nesting for owls and woodpeckers.
6. Habitat on the opposite side of the river -- escape route and haven for pheasant and other birds, security for species using the river corridor itself.
7. Upland -- food and nesting for quail, pheasant, sparrows, killdeer, meadowlarks, raptors, reptiles, and ground squirrels.

PLANNING AND DESIGN CONSIDERATIONS

Composition and structure of vegetation determines habitat value for wildlife species. The planting design should build on current plant communities to enhance the wildlife habitat. The

goal is to provide a variety of habitats to attract species during migration and the rest of the year. Interpretive opportunities can be provided without jeopardizing the integrity of the habitats. For instance, vegetative screening can be placed between trails and wetlands to minimize disturbance and blinds provided for observation. Recreation areas should interconnect pockets of less disturbed habitat nearby. It has been shown that some individuals of typically shy species will accustom themselves to human presence if good habitat is available to meet their needs (Gilbert 1989). Birds will use both sides of the river and adjacent neighborhood habitats if available. In order to optimize habitat value in the Jordan River Nature Park, future planning with the County Parks Department is necessary to protect and enhance habitat on the west side of the Jordan River. Neighborhood habitat development needs to be promoted throughout the area.

NUISANCE WILDLIFE

Wildlife is considered a nuisance when wildlife activities conflict with human activities creating a habitat then exploited by the animal. Some residents are concerned that the development of habitat in the Nature Park will also attract nuisance wildlife to the adjacent neighborhood. The planting design, however, is not expected to increase nuisance wildlife. In fact, the loss of native habitat often invites nuisance wildlife when replaced with habitats that only generalist or opportunist species can survive and actually thrive in. Typically, if diverse native habitats are maintained and precautions are taken, the nuisance species will be less of a problem (Gies and Van Druff 1978). Depending on the circumstances, populations may be thinned by direct eradication or just by discouraging them. For instance, the European wharf rat will not be attracted to a vegetated riverbank as it would be to a concrete rip-rapped riverbank.

Bats should be considered a nuisance only when they live unwanted in a house or other structure. They are one of the biggest consumers of flying insects such as mosquitos and grasshoppers and should be encouraged to live in the neighborhood (Tuttle 1989). Mosquito hatches are due more to rapid water fluctuation than the actual presence of water. Hatches can be expected a week after major storm events where storm water drainage goes into the wetlands and raises the water quickly (Dixon 1989). Environmentally safe mosquito control is available locally. However, consequences of any control program should be well thought-out.

Two animals that may be detrimental to the Jordan River Nature Park are muskrat and beaver. Muskrat are currently on the site in the Hunters Woods wetland. Recent beaver cutting has been seen along the river in the cottonwoods. In low numbers, muskrat will maintain open water in a cattail marsh by eating the tubers and using the leaves for building huts and platforms. However, the population may grow too large and can quickly eliminate all

cattail from a marsh. Muskrat can be controlled by trapping or bycompletely withdrawing water all winter (Weller 1981). Beaver are currently casual visitors and are harvesting some small cottonwoods along the river. There is an old beaver hut along the riverbank, indicating they once were resident. Intense beaver activity can eliminate trees from a large section of the riverbank. This can be devastating, particularly here where natural tree regeneration rarely takes place and there is competition from weedy species such as tamarisk and Russian olive, tree species not utilized by beaver. Beaver can also be controlled by trapping. Beaver populations and activities should be monitored and a management program implemented only if they cause a problem.

VEGETATION COMMUNITIES

Two major vegetation communities, aquatic and upland, are determined by existing hydrological conditions in the Jordan River Nature Park. Aquatic vegetation occurs whenever there is some free or unbound water, such as a river, stream, canal, wetland, or areas associated with a seasonally high water table. These hydrophytic plants grow in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content (Federal Interagency Committee 1989). Some aquatic plants, such as cattail (*Typha spp.*) whose seed germinates only under dry conditions, are tolerant of, or may be dependent on, dry periods. Emergents such as bulrush (*Scirpus spp.*) and cattail dominate the wetter sites. Rushes (*Juncus spp.*), sedges (*Carex spp.*), and salt grass (*Distichilis spicata*) dominate the seasonal high water table areas. Upland vegetation cannot tolerate soil saturation and anaerobic conditions. Native upland plant communities consist of a grass/forb mix, such as western wheatgrass (*Elymus smithii*) and yarrow (*Achillea millefolium*), with scattered shrubs such as sumac (*Rhus trilobata*) and rose (*Rosa woodsii*) establishing nearer the wetter zones. Weedy exotic species, some classified as noxious by the State of Utah, are found all over the site. More complete listings of plants appears in Appendix D.

PLANNING AND DESIGN CONSIDERATIONS

For the purposes of the planting plan, plants have been divided into categories with similar water tolerances or requirements and with similar soils. Current vegetation cover strongly indicates what is most likely to grow under present conditions. When water is controlled and manipulated in the wetlands, plant distribution will change. Vegetation patterns in adjacent upland areas may also be affected. Soils (discussed on pp. 18-20) are also an indication of potential species as listed in the USGS Soil Survey for the Salt Lake Area.

Listed below are five major categories to be used as guidelines for nonirrigated areas and one category for irrigated areas. Plants recommended for nonirrigated areas have been determined by water regime, soils, current vegetation, and comparison to similar sites. Within these guidelines, plants will grow best on the site where slight variations in soil and water conditions favor them. Plants in the irrigated areas will not be subject to these slight variations in growing conditions associated with water. The recommended plant list and categories are based on the USGS Soil Survey and consultations with botanists, wildlife habitat specialists, and wetland biologists. See Appendix E.

Nonirrigated:

1. Permanent surface water -- water varies in depth but is present all year. Emergents such as cattail and bulrush grow in approximately 6 inches of water or less.
2. Seasonal inundation -- typically will have standing water in mid-spring from snowmelt runoff raising the water table, or late spring flows from irrigation/stormwater outlets.
3. Seasonal high water table -- typically will have saturated soils to a depth of 40" or less in the spring.
4. Upland -- soils are dry, sandy or gravelly and include the fill materials on the site.
5. Riverbank -- category is divided into lower, middle, and upper bank; width is 50' or less.

Irrigated:

1. Soils may include upland, wetland, and imported topsoil over gravel fill material.

VISUAL QUALITY

Vegetation, water, and the naturalness of the Jordan River Nature Park bring visual relief to the surrounding highly urbanized area. The Oquirrh Mountains to the west and the Wasatch Range to the east serve as a backdrop to the river corridor; the wetlands, trees, and shrubs help screen the city in places. The site varies from open meadows to dense willow thickets, and from very dry uplands to a year-round marsh. Footpaths along the river provide a more secluded visual experience, less intruded on by the city. This seclusion is felt because of the presence of riparian vegetation, particularly willows and a few strategically located trees, on one or both sides of the river. The visual experience along the path behind the adjoining neighborhood is not as secluded but is pleasant in locations where vegetation is thick and where there are views of the mountains. The alluvial bench 12 to 15 feet above the river offers two

great vantage points. The presence of water is seen on most of the site as associated with lush vegetation, though the water itself is not always in view. Houses on both sides of the river have little visual buffering, depending on the location of the observer. The majority of the houses on the southern end of the site are not screened at all. There are some glaring intrusions such as the high tension powerline corridor that cuts across the site, transmission towers on both sides of the river, and the channelized portion of the Jordan River downstream of 5400 South. Other visual intrusions include the yard trash and garbage dumped near the adjoining neighborhood.

PLANNING AND DESIGN CONSIDERATIONS

Trees create the framework of the planting design. With trees, spaces are defined and made coherent, preferred views are framed, and intrusions softened if they cannot be screened totally. Shrubs round out hard lines in the landscape, enhance space definition and focal points, and provide interesting textures, colors, and forms for the tree framework. Ground covers provide an equally important element to most views with rich textures, color, and form. These landscape elements can enhance wildlife habitat-the objective of the nature park.

In the final design, the following guidelines have been followed:

1. Save all large trees.
2. Save good distant mountain views and enhance the views by framing them with vegetation.
3. Keep high points open for viewing opportunities by using low vegetation such as shrubs and grasses.
4. Plant massings of trees and shrubs along the river in areas to be stabilized.
5. Break up lineal powerline corridor with shrub massings. (Power company prohibits vegetation over 12 feet high under the powerlines.)
6. Provide shade and enclose playfields, picnic areas, and playgrounds.
7. Screen restrooms and maintenance structures.

SOCIAL CONCERNS

Murray's support and involvement in a nature park concept is anticipated to continue. However, concerns were raised in meetings with the local citizens and the city council that need to be addressed. (Some of the issues not directly concerned with vegetation and natural systems are included in the Jordan River Parkway: A Master Plan for the 1990s, a report to Murray City by Craig Johnson found in Appendix A.)

1. Safety is a major concern, including vandalism; the park is perceived by some as a haven for drug abusers and the homeless. To provide for more security near homes, the design includes a buffer strip of lawn, 10' to 50' wide, and large trees adjacent to property lines to reduce hiding places. A less specific solution but important deterrent is an increase of legitimate park users which act as a neighborhood watchdog (Newman 1972).

2. Natural hazards such as fire, water, and bank sloughing are also addressed in the design. The irrigated lawn buffer will reduce flash fuels near homes. Water hazard and bank sloughing are reduced by grading back and stabilizing steep, five-foot riverbanks. Wetland shorelines and water depths are very shallow, reducing chances of drowning.

3. Flooding in local neighborhoods is not expected to be a problem from on site water manipulation. However, major flooding such as in 1985 may continue to wet some basements near 5300 South.

4. Nuisance wildlife occurs because certain wildlife species thrive on the habitat provided by urban development, a habitat not necessarily provided by the Nature Park. In some cases there are ways to discourage use rather than killing them. These are briefly discussed in the previous section on wildlife.

5. Noxious weeds are an important concern because of their abundance on the site. The city is required, under state law, to have a control program. If they fail to implement the program, the state is allowed to spray the weeds and bill the city. This report highly recommends that spraying or other forms of weed control become part of the plan to revegetate the area with native plant species. A long term management program is necessary to reduce weed numbers and keep them in balance with wildlife habitat goals.

6. Police and fire vehicles require access for emergencies and safety. The hard surface trail can act as the main access way. Turf block, a concrete block that allows plants to grow through it, can be used in other areas that will receive light or occasional use.

CHAPTER 3
THE PLANTING DESIGN

PLANTING CONCEPT

The goal of the proposed planting concept is to re-create a mosaic of native riparian, wetland, and upland vegetation communities in the Jordan River Nature Park that respond to existing soil, water, and microclimate conditions and are critical components of wildlife habitat. This will provide a unique opportunity for wildlife enjoyment in an urban park setting and a pleasant, safe recreational experience.

To accomplish this goal, the plan recommends using an ecological approach to restore wildlife habitat. The ecological approach uses plant materials found in local native plant communities, which can be established with little or no irrigation, and then allowed to mature with minimum maintenance. Application of this approach is experimental in urban areas of the Wasatch Front. In order to aid Murray with this approach, the plan proposes long term, low cost methods that the municipality can implement as quickly as possible.

The vegetation plan proposes two types of planting, irrigated and nonirrigated. The proposed nonirrigated areas of the site would be a structural and functional replication of the Jordan River riparian habitat before the disturbance from settlement and urban development. Irrigated areas would provide a fire break and visual buffer between existing development and the park. Native plants were chosen because they have adapted over time with the particular soils, water, and climate conditions of the site and have evolved with indigenous wildlife species. The native plants used must be able to become established and exist in disturbed sections of the site under three proposed revegetation conditions: manipulated water levels, nonirrigation, and irrigation.

The wetland soils on the site contain a seedbank of the native hydrophytic plants. These plant propagules would respond in somewhat predictable ways to fluctuations of water levels. Wetland plants would be maintained by periodically manipulating water levels in the wetlands and allowing high water events to occasionally flood old river oxbows and channels. Once established, monitoring and occasional maintenance of the wetland vegetation would be required.

It is proposed that native plants adapted to upland site conditions be used in the non-irrigated areas to diversify the structure, function, and species abundance of the habitat. Planting configuration, species choices and methods would be determined by climatic and edaphic conditions as well as by wildlife habitat requirements. Establishment of upland and riverbank plantings may take a few years, after which they would be regularly monitored. It is expected that subsequent minimal maintenance would be required. Periodic monitoring of riverbank vegetation may be necessary following water fluctuations associated with storm events.

For the irrigated turf areas, a mix of native grass and introduced adapted grass species is proposed. This mixture would be hardy, adapted to the site conditions, and require about one-third the water needed to sustain Kentucky bluegrass. Native trees are recommended because they are more adapted to site conditions and may require less water than introduced ornamental species. Using native trees in the irrigated zone would also provide visual and habitat continuity with nonirrigated lands.

Implementing the vegetation plan in small segments will take advantage of the experimental nature of the plan and spread the costs over time. However, cost and time requirements for vegetation maintenance may be high in the beginning because of the intense care needed to insure establishment. Long-term costs for management of the park would be minimized as plant communities establish and develop.

The vegetation plan proposed here is a first attempt at restoration of indigenous plant communities in an intermountain urban area. It has the potential to become a test case for habitat restoration along the Wasatch Front where there is a growing awareness of the loss of wildlife habitat to urban development. There is also increasing interest, as noted by Dr. Ty Harrison of the Salt Lake Regional Trails Council (1989), in preserving remnant habitats, restoring disturbed sites, and linking these parcels for use by wildlife and recreationists. If implemented, this plan would provide a prototypical model for careful evaluation and analysis -- a reference point for future work.

PLANTING AND MANAGEMENT STRATEGIES

The proposed planting strategies would establish native species for long term habitat development through plant community succession. Habitat areas would be planted and maintained until established. A program of monitoring should be initiated once the plants have been established. Occasional maintenance would be necessary in order to control or encourage certain plant species, or remove public hazards.

The proposed planting and habitat management strategy is based on principles of plant community succession. The goal is that, through succession, the habitat of the Nature Park would become stable and self-perpetuating, providing plant communities that could support healthy populations of desirable wildlife species. Numerous successional changes will occur, however, that will alter plant and animal community composition before the final objective -- a mosaic of native riparian, wetland and upland vegetation communities -- will be realized (Morrison 1982). The specific nature of these changes cannot always be foreseen because the plan relies on ecological processes not yet fully understood. However, MacMahon (1987) has suggested that applying ecological theory pertaining to plant community revegetation may result in a more effective, less expensive land management program that could shorten the time required to reach the desired endpoint.

SUCCESSION

Succession can be defined as change in a plant community, i.e., an invasion or elimination of species. Although there are conflicting interpretations of succession, there is renewed interest in one set forth by Gleason in the early 1900s. A. G. van der Valk (1988) summarizes contemporary formulations that have their origins traced back to Gleason:

> ...That plant communities are impermanent assemblages of species that are not in equilibrium with their environment; that they are constantly recovering from disturbance(s) (i.e., that communities have a history); that communities can undergo several different kinds of changes; and that understanding and predicting all kinds of changes requires a knowledge of the life-history characteristics of species whose invasion, growth and elimination cause them. (p. 464)

The principle of plant succession could be used to establish plants or manage existing plant community conditions. Using these principles of succession, activities could be undertaken that trigger desirable change in community composition and structure by encouraging or discouraging plant species. Some of these factors are (1) destruction; (2) change in the environment such as hydrology, organic matter, soil or water chemistry, animals; (3) interaction of plants; and (4) invasion and establishment of new species (van der Valk 1981). Time and spatial opportunities for plant growth that are created by a disturbance are called windows. Knowledge of life history characteristics of species, and of the type and frequency of disturbance events is needed in order to create potential invasion windows and/or eliminate species (van der Valk 1988). Successional principles should be applied to establish and develop the wetland, nonirrigated upland, and riverbank habitats of the Nature Park.

WETLAND

Vegetative succession and habitat development in wetlands is not difficult if the water and the seedbank are available (Kadlec 1990). Habitat changes occur and are maintained with occasional water manipulation or natural water fluctuations. Freshwater wetland species have long-lived seeds and thus are abundant in seedbanks. Seeds of most emergents and aquatic annuals germinate only when there is no standing water (van der Valk 1978). For instance, creating a disturbance in a wetland by drawing down water for the right duration at the right time of the year could re-establish an emergent plant community. This is a "natural" habitat management technique as described by Weller (1978). It is useful in creating a mosaic of plant communities for optimum habitat of a variety of birds and animals. This might not be done more than once in a five-year period during which monitoring occurs; further management is minimal. Management with wetland water manipulation is used in wildlife refuges and on private wetlands because it is effective, easy, and inexpensive. This method and its results are not necessarily precise but predictable enough in this situation to use effectively in an urban setting.

NONIRRIGATED UPLAND

The proposed planting on the nonirrigated uplands will be more difficult to establish and develop into quality wildlife habitat than the wetlands (Fairchild 1990). Plant competition will be the most difficult obstacle for establishing native plant species. Pendleton (1990) notes that some plant species, often undesirable, are more adapted to exploit moisture and nutrient resources and be highly competitive under the proposed conditions of establishment. The plant establishment during the first few years will be the most critical for nonirrigated plants in the proposed plan.

"Artificial" methods of habitat manipulation, such as mechanical or chemical removal of vegetation (Weller 1978), could be useful to begin upland habitat restoration. Under the principles of succession discussed earlier, when a partial or complete mechanical or chemical vegetation removal takes place, a disturbance (window) is created. Subsequent seeding or planting of the disturbed area would begin a new successional period. When selected vegetation is removed, the remaining species may gain greater size or numbers before an invasive species return.

Site conditions may be made more favorable for establishing an individual seed or plant with the following proposed techniques. Providing a suitable microclimate for seedlings under the protection of nurse plants could open an establishment window. In other situations, closely spaced seedlings could act as a collective windbreak, catch soil particles, and retain soil moisture. Eventually, natural thinning may occur as these plants grow to maturity (Pendleton

1990). Another technique that could be employed is seeding a mix of species across an environmental gradient such as moisture or soil types to insure that some seed will land in optimum conditions for establishment. Interplanting could also be done. A more aggressive species, such as a rhizomatous grass, could be introduced after the other plants have established. Another option would be to interplant an understory species in the shaded microclimate of the established plants. In all cases, competition should be eliminated by hand or by using post-emergent herbicides before planting or seeding and pre-emergent herbicides up to 2 years following planting.

The percent survival rate of seedlings may depend on variables such as soil conditions, water availability, weed competition, condition of seedling at the time of planting and species hardiness. By decreasing the recommended plant spacings, the proposed planting plan takes survival rates into account (See Appendix G). The establishment period may be 3 to 5 years, due to normal environmental stresses. Other factors could come into play such as incorrect planting or maintenance, animal damage, or unusual weather conditions. The plants that do become established would ideally mature and eventually reflect normal dispersion patterns based on environmental conditions and competition with other species. Changes may occur such as shrubs displacing grass communities in some areas, whereas in other areas, grasses may eventually dominate. Monitoring and evaluating the habitat as succession proceeds is necessary to compare the revegetation progress with the goals of the project. At times, manipulation of plant communities will again be required through arresting or promoting successional processes to maintain the diversity of high quality habitat required to meet plan objectives.

RIVERBANK

Establishment of the riverbank community is similar to establishment of nonirrigated upland site but must account for the additional variable of stream flow fluctuation. Establishment techniques must be able to stabilize the soil immediately after planting and remain in place until the plant's root system growth begins to anchor the soil. Riverbank stabilization is required not only for habitat and visual interest but also to arrest the natural tendency of the river to create new channels, which in constructed urban floodplains can cause serious and expensive damage. Typical riverine plant succession is often also arrested since the scouring and depositing of sediment as gravel bars in the floodplain would be limited and could not provide natural opportunities for the regeneration of cottonwoods and willows. Thus, planting trees may be required in the future to renew decadent stands.

PLANT COMMUNITY PATTERN AND STRUCTURE

Plant community pattern and structure is the expression of plant community architecture in the landscape. These patterns are caused by disturbance and influenced by plant community successional processes. Horizontal and vertical structure result from the interactions of diverse plant species that are adapted to the local water, soil, and climatic conditions. The pattern and structure of the plant community affects its habitat value. In the Nature Park, human caused disturbances over the last hundred years have changed the plant community pattern and structure. The proposed habitat enhancement attempts to replicate pre-settlement riparian and upland plant community forms with native plant species. This would typically include trees such as narrow leaf cottonwood (*Populus angustifolia*), peachleaf willow (*Salix amygdaloides*), netleaf hack berry (*Celtis reticulata*); shrubs such as coyote willow (*Salix exigua*) and squaw bush (*Rhus trilobata*); grasses such as Great Basin wildrye (*Elymus cinereus*) and alkali sacaton (*Sporobolus airiodes*); and flowers such as common yarrow and Hooker's evening primrose (*Oenothera hookeri*). The recommended planting list is listed in Appendix E. The native plants would provide the preferred long-term vegetation structural characteristics to meet the habitat need of desired wildlife species. In order for the proposed plan to be successful, the native plantings must also be able to respond to new site conditions and meet the public's needs.

LANDSCAPE STRUCTURE

The model set forth by Forman and Godron (1986) to describe landscape structure is useful as a conceptual model for the habitat enhancement of the Jordan River Nature Park. They suggest that a landscape is a heterogeneous land area, composed of three fundamental elements: patches, corridors, and a background matrix. A patch is generally a plant and animal community surrounded by areas with differing community structures; however, a patch could be lifeless. A corridor is a linear patch that differs from the matrix on either side. A matrix is the background within which patches and corridors exist.

The characteristics and arrangement of these elements significantly affect both plant and wildlife diversity within a landscape. These qualities include patch size and shape, the nature of the edge, degree of isolation and corridor connectivity, width, and permeability (Forman and Godron 1986)

Patch size and shape determines wildlife species diversity and numbers. Larger patches have proportionally less edge than smaller patches. The larger patches favor wildlife species that utilize the interior, such as warblers. The smaller patches favor species that utilize the edge, such as pheasant (Trautman 1982).

The shape of the patch determines the edge characteristics. An edge is defined as a transition zone, or an ecotone, between two plant community types. The edge and the attendant ecotone are rich habitats for wildlife (Leopold 1933). Traditionally, wildlife managers have used increased edge to diversify and increase numbers of wildlife. Recently, however, there has been growing concern that creating maximum edge ignores the detriment to interior species (Yahner 1988).

The proposed revegetation plan includes large patches and numerous small patches with considerable edge that would produce a balance attractive to sensitive interior species and edge species of wildlife as recommended by Forman and Godron (1986). (See Figs. 12a and 12b.) The proposed wetland management would be similar, striving for a ratio of 50 percent water to 50 percent vegetative cover to optimize wildlife species diversity (Weller 1987).

Forman and Godron (1986) report for terrestrial habitats that general species diversity appears to be positively correlated with patch structural diversity, area, age, and matrix heterogeneity. At the same time, species diversity appears to correlate negatively with isolation. This implies the importance of plant community interspersion to wildlife species diversity. Linking habitat patches with corridors as conduits for animal movement would enhance opportunity for increasing diversity.

In the proposed plan, the shade trees and associated understory vegetation adjacent to the trail system would form the major corridor to connect the habitat patches along the length of the Nature Park. These trees may also serve as a link from the park to the adjoining neighborhood habitat patches. Smaller habitat linkages with trees and shrubs are proposed within the site. As the Jordan River Parkway develops, the revegetated riparian area could enhance the Jordan River as a major corridor and habitat link in the valley. If the Jordan River tributaries were similarly revegetated, a more complete and important wildlife habitat link to the mountains could be re-established on the Wasatch Front.

The structural characteristics within habitat are among the most important determinants of habitat used by wildlife (MacMahon 1983). Multiple layers of vegetation constitute vertical structure. The proposed plantings consist of trees, large shrubs, short shrubs, tall and short herbaceous cover. The use of layers would be recommended where appropriate for the site conditions, habitat goals, visual interest, and public's needs. For instance, irrigated turf would have short ground cover and trees (see Fig. 13), whereas some wetland edges may include trees, shrubs, and ground covers (see Fig. 14). Also, the powerline corridor may have shrubs as the tallest vertical layer since the power company regulates the maximum height of vegetation to 12 feet. (See Fig. 15.) Patches of tall grasses, forbs, and short shrubs would add structural diversity to some short grass upland areas. (See Fig. 16.)

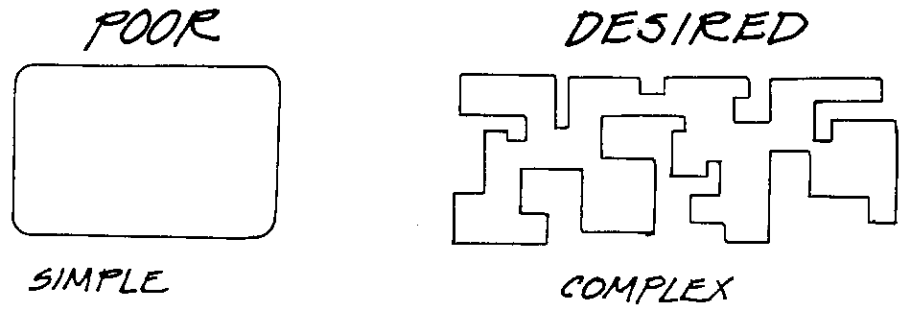


Fig. 12a Edge concept.
(drawn from W.D. Sanders et al. 1982)

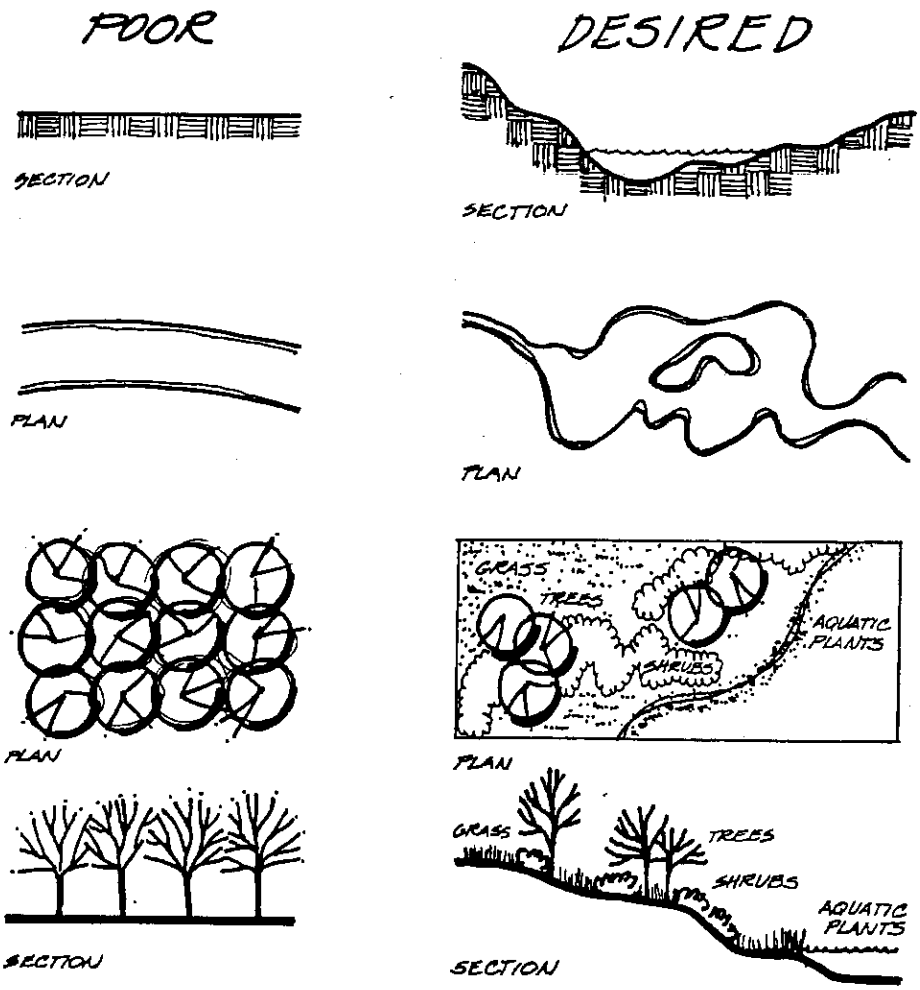


Fig. 12b Landscape elements expressing the edge concept.
(drawn from W.D. Sanders et al. 1982)

Fig. 13 Vertical structure of irrigated park areas. Vegetation is composed of two layers: trees and short turf grass.

Fig. 14 Vertical structure of some wetland edges. Vegetation is composed of four layers: trees, tall shrubs, short shrubs and tall forbs, and short forbs. (Other wetland edges may contain two layers of shrubs and forbs or one layer of forbs.)

Fig. 15 Vertical structure of upland shrub areas. Vegetation is composed of two layers: tall shrubs, and short shrubs and grasses.

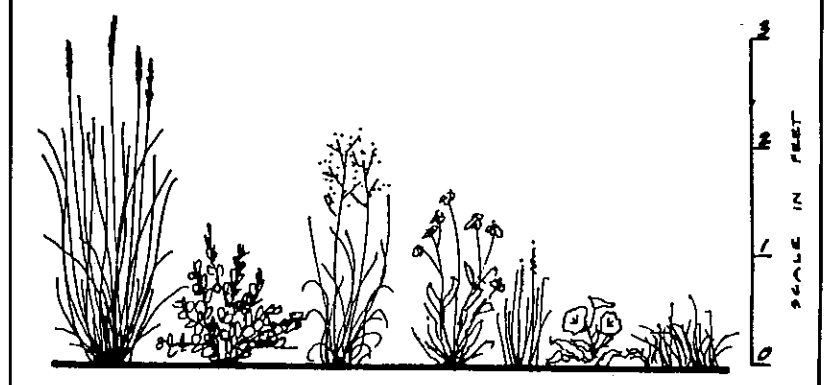


Fig. 16 Vertical structure of meadow areas. Vegetation is composed of two layers: tall grass, and short grasses and flowers.

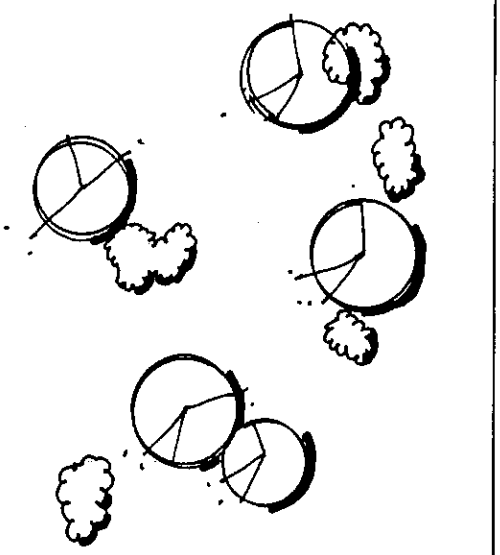


Fig. 17 Horizontal vegetation structure randomly spaced.

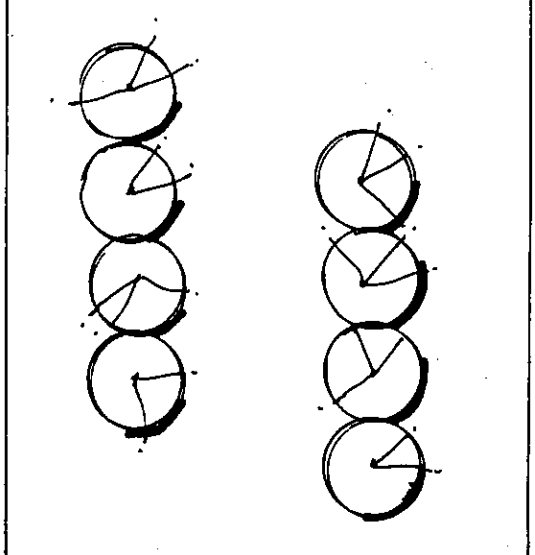


Fig. 18 Horizontal vegetation structure regularly spaced.

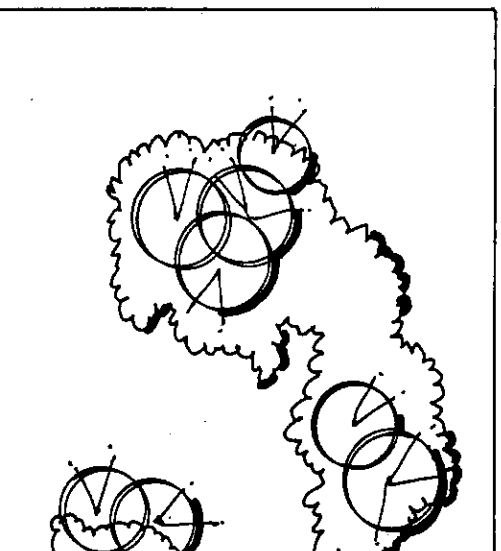


Fig. 19 Horizontal vegetation structure clumped.

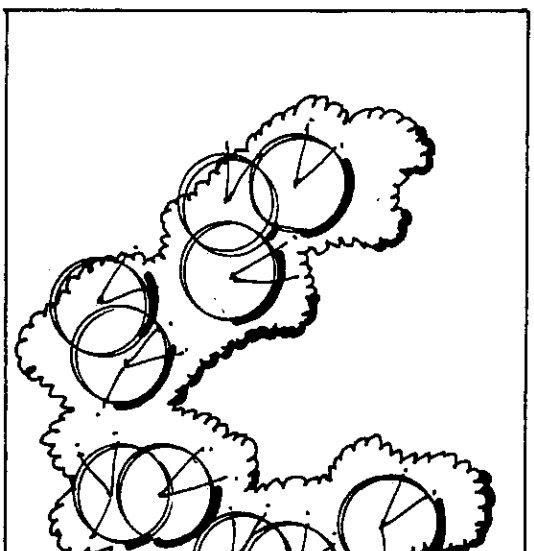


Fig. 20 Horizontal vegetation structure creating enclosure.

The spacings of the plants and patches of plant communities define horizontal structure. Varied spacings of plant community patches are recommended to enhance habitat and provide visual interest for the public. Masses of vegetation could be spaced on the landscape randomly (see Fig. 17), regularly (see Fig. 18), and clumped (see Fig. 19); lineal patches or hedgerows could enclose space, creating visual barriers and physical barriers (See Fig. 20). Recommended spacings within mass plantings would be determined by the establishment techniques, site conditions, plant species, and type of plant materials. See Appendix G. These spacings would naturally change over time because of successional forces, and the eventual horizontal spacings would be determined by the site conditions and species tolerances regardless of the original plant spacings.

To illustrate the recommended horizontal and vertical planting structure, the drawings of the proposed plan, at a scale of 1" = 100', show general locations of trees and more general areas of shrub, grasses, and forb plantings. These areas are grouped by similarities of site characteristics and planting objectives. Each of the areas has a recommended palette of plants listed. The recommended planting structure for each of these areas is referenced to the figures in the drawings, the Seeding Schedule, and Plant Species and Size Schedule in Appendix G. The shape of the patch, the edge configuration, and the plant spacing within the patch could vary depending on the site conditions, the species, type of plant material, and aesthetics and will clearly change with succession over time. Except for the irrigated turf areas, typically the configurations utilize the multiple vertical layering structure, the shortest plants towards the edge of the patches.

USE OF NATIVE PLANT SPECIES

The proposed planting design specifies only native plants. Native plants have evolved with local insect populations, diseases, and herbivores and are adapted to the soil, water, and climate conditions. They would provide food, cover, and nesting sites for a myriad of wildlife species that have co-evolved with them. They also could provide a rich natural and cultural resource which could be interpreted for users of the Nature Park in interpretive education programs.

The goal of the planting design is to increase native plant species diversity in order to restore the pre-settlement riparian habitat of the Jordan River. However, it is expected that some nonnative species would currently remain on the site because they are tenacious and difficult to remove. (They may also die out, however, as native species develop and replace them.) Nonnatives could contribute a habitat structure that animals respond to (MacMahon 1983). Some nonnative plant species could be acceptable in small numbers but become

detrimental when they occur as a monoculture. Russian olive is an example of a tree that is used by some birds as a source of food but is not suitable for nesting by some riparian bird species, especially the cavity nesters that prefer native cottonwoods. Large stands of Russian olive could also inhibit cottonwood establishment when they occur as a monoculture (Knopf 1988).

The Appendices E, F, and G contain plant lists that identify plant communities, their size, general spacings, and seeding rates. Preferred soil and water conditions for species are also noted. Exotic or undesirable plants because of invasive qualities are identified so that they may eventually be replaced or not allowed to increase from present numbers. The plantings lists only include the plants and seed available commercially or present on site for transplanting. Collection of other plants or seeds should be considered on an experimental basis.

CHAPTER 4
IMPLEMENTATION

PHASING, SITE PREPARATION, AND PLANTING

Site preparation and planting should be phased over a minimum of 3 years in any one of the wetland, nonirrigated upland or riverbank areas. The irrigated areas should be installed and established in 1 year. Phasing has an advantage in a wildlife habitat park because inherently slow natural processes of growth and succession of native plants are being managed. Wetland plants respond in the long term to stable water levels and in the short term to water level changes. In the upland areas, without the predictable environment of irrigation, successful establishment and development may require years. However, without irrigation, root systems are deeper and more substantial, plants are capable of surviving drought, and weeds are not encouraged. The same holds true for riverbank stabilization. Establishment and growth depends upon the plant's adaptation to the site conditions and plant interactions rather than a highly maintained irrigated environment.

Phasing can provide an opportunity to experiment with native plant establishment and habitat manipulation. Lessons learned from testing different site preparation and planting techniques on a smaller scale can be applied to similar areas of the site. Phasing also allows for spreading project cost over a longer period of time.

The public should be educated about the process of phasing. It should be made clear that the results of native plant planting in phases will not be achieved as quickly as a more typical irrigated park landscape. Planning of phases should be coordinated with facility construction to avoid damage to landscaped areas.

Phase One includes site preparation activities that affect the Nature Park, generally such things as trash cleanup, livestock removal, carp eradication, and tamarisk control. These activities do not require great expense, and the immediate results create a positive impact on the development of the Nature Park.

Phase Two includes (1) construction of water control structures, dikes, and excavation of wetlands; (2) site preparation and planting wetland and upland areas; (3) riverbank stabilization; and (4) site preparation and planting irrigated areas. It is proposed that four

wetlands be enhanced and two created (see Fig. 21). Planting is recommended for the created wetlands, but not for the enhanced wetlands. The upland vegetation community would be enhanced by interspersing masses of trees, shrubs, grasses, and forbs to diversify the plant structure and species composition. Riverbanks would be graded and stabilized with vegetation and structures where necessary. Irrigated areas would be topsoiled and planted with trees and turf.

Many of the proposed activities in Phase Two can be implemented concurrently. However, it is recommended that the wetland water control structures be constructed and the water raised for a minimum of 2 years before planting adjacent upland areas. Created wetland areas may be planted with shrub willows (*Salix spp.*) and hardstem bulrush (*Scirpus acutus*) as soon as the desired water levels are determined. The water level changes proposed for wetland enhancement and creation would cause changes in wetland vegetation and may cause changes in adjacent upland vegetation communities. Upland and irrigated area site preparation and planting, and riverbank stabilization would require planning to coincide with plant material availability, other planting activities, facility construction schedules, and time of year. See Figs. 21a and 21b, Implementation Plan, and Figs. 22a and 22b, Planting Plan.

The following sections contain descriptions of Phase One and Phase Two. Optional techniques are discussed briefly. Specific implementation techniques are recommended and applications discussed in greater detail.

PHASE ONE: GENERAL SITE PREPARATION

TRASH CLEANUP

Trash and debris on the site is ugly, dangerous and should be cleaned up. Over the years, the site has been a casual dumping ground for concrete, metal and other trash. A cleanup project, which could involve the local community, is highly recommended. Careful thought should go into leaving things that children are currently using for play, such as the treehouse, if they could be kept reasonably clean and safe.

Snags, logs, and leaves are not necessarily trash and, furthermore, are an important element for wildlife habitat. In the process of decay through the action of weather, plants and animals, soils are enriched. Standing decadent or downed trees as well as leaf and grass litter are required in order to provide food and cover for some species of birds, mammals, amphibians and reptiles. Snags, particularly cottonwood, should be allowed to stand.

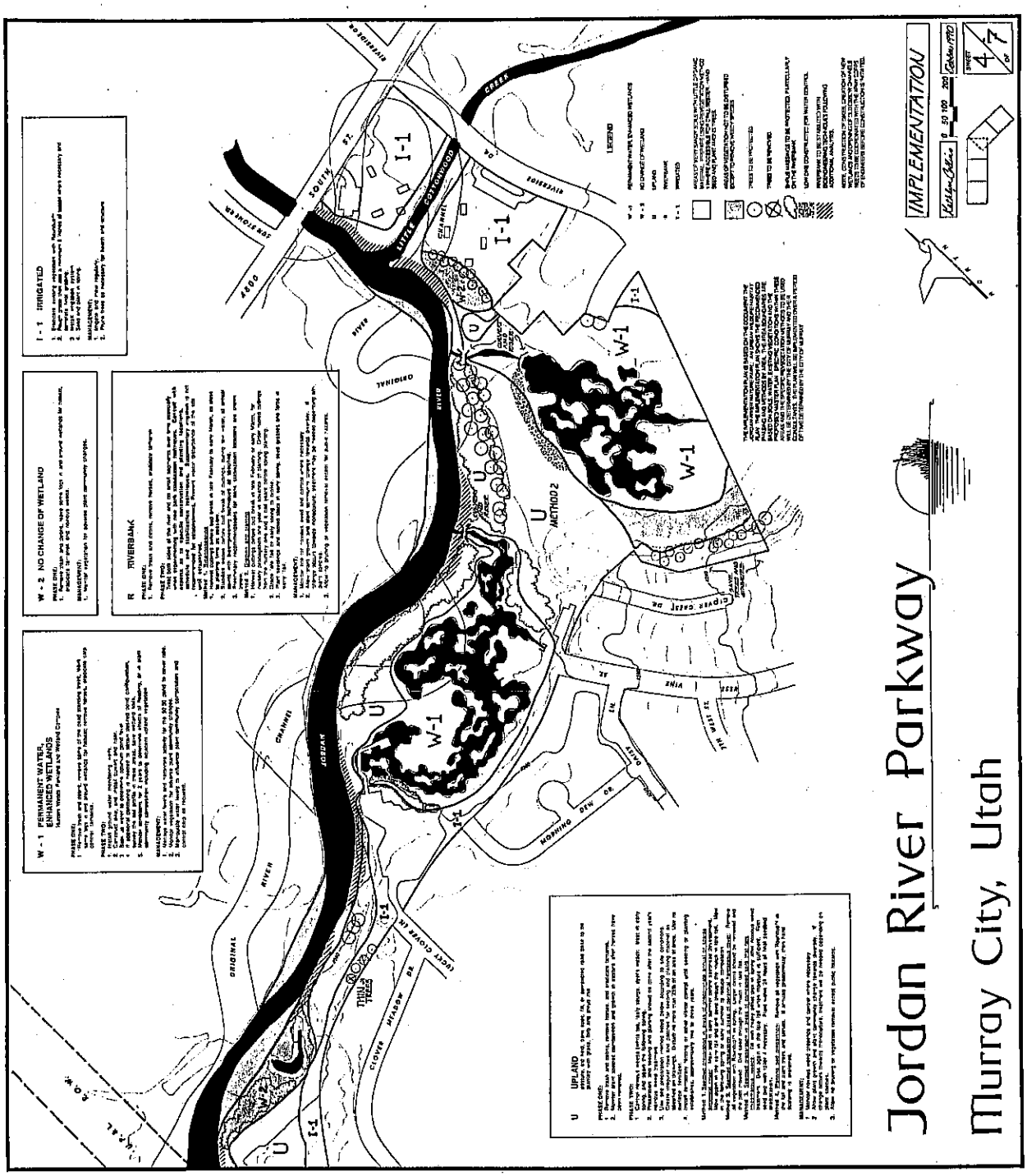


Fig. 21a Implementation. North section of the Jordan River Nature Park.

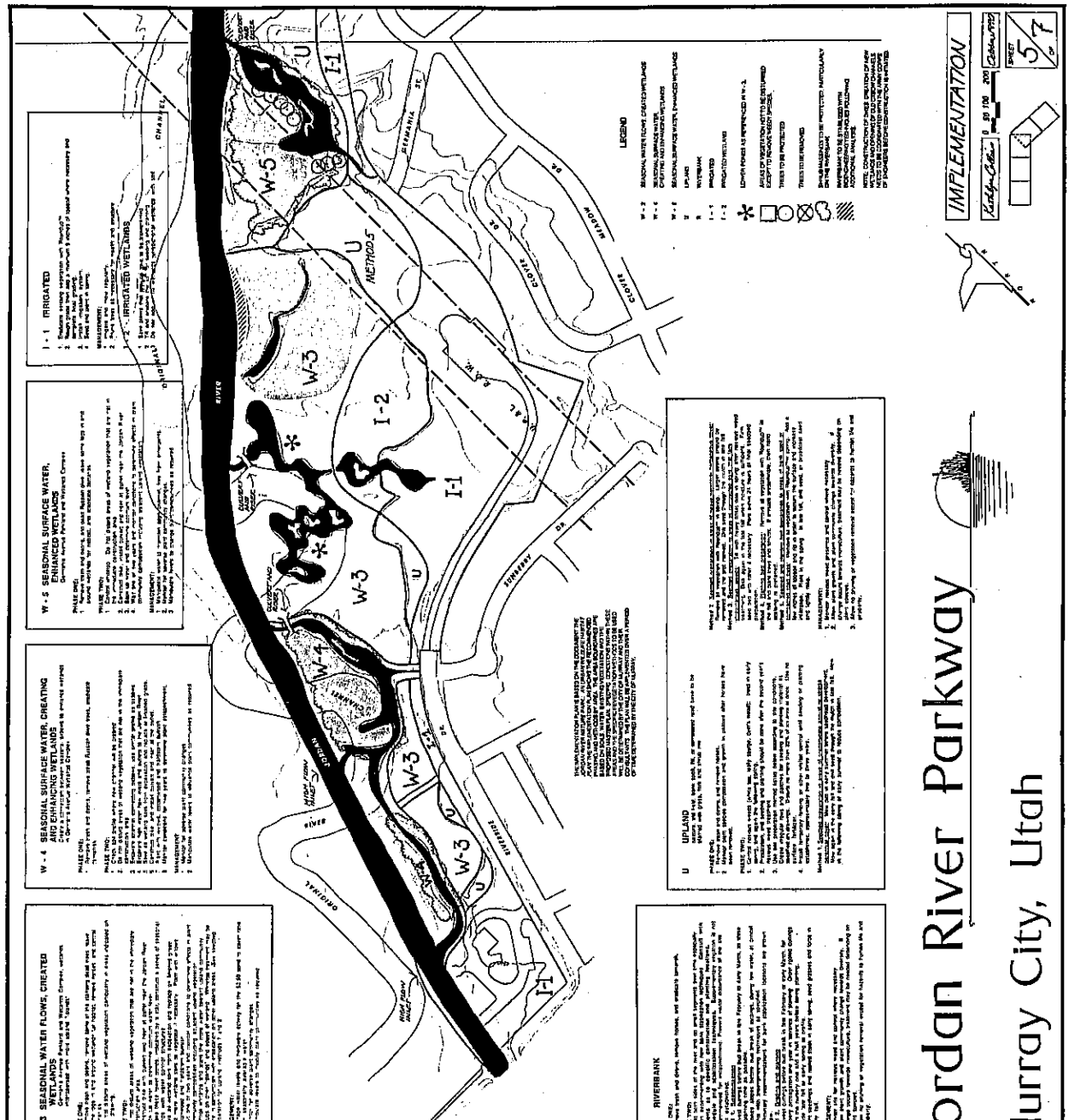


Fig. 21b Implementation. South section of the Jordan River Nature Park.

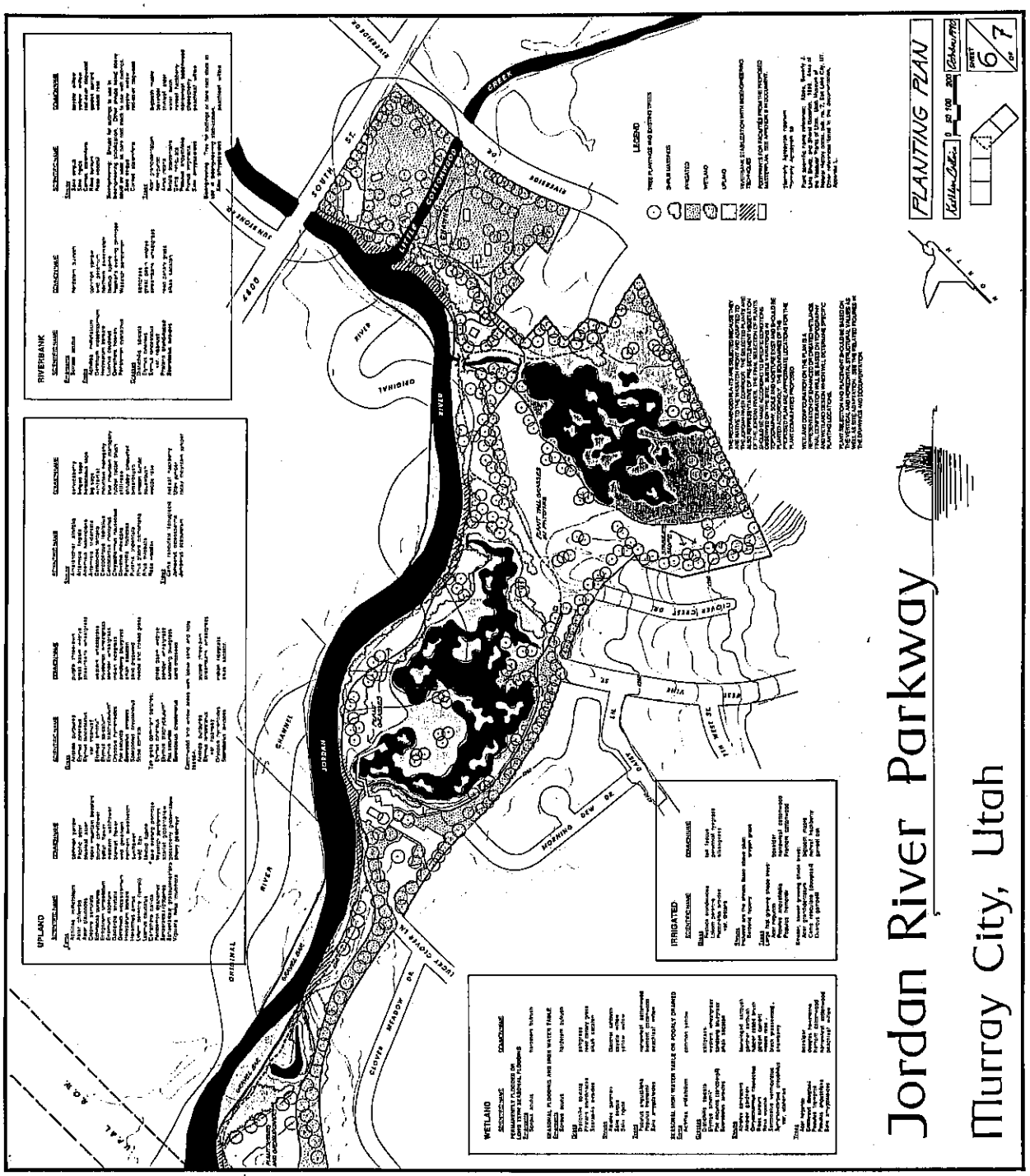


Fig. 22a Planting Plan. North section of the Jordan River Nature Park.

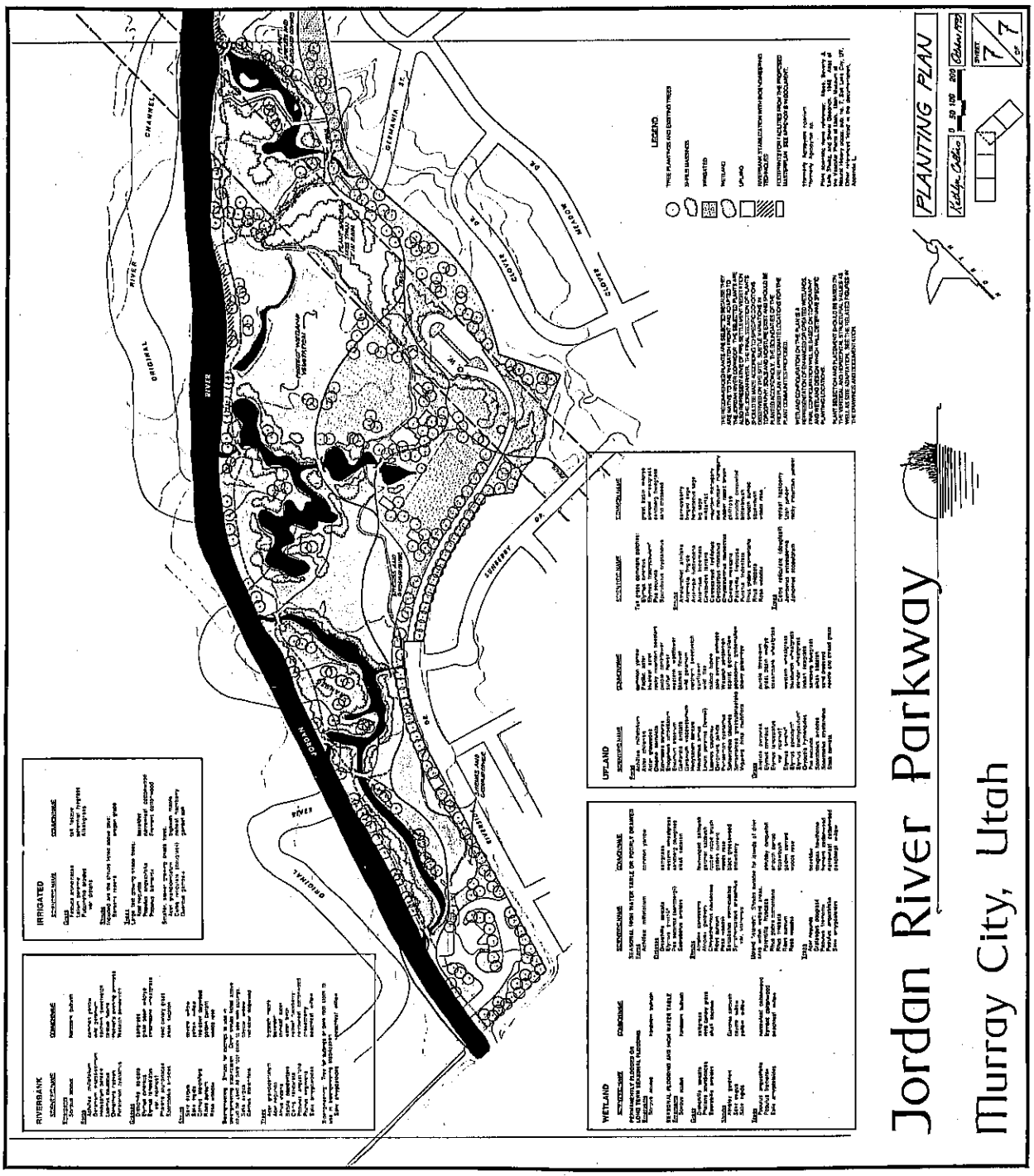


Fig. 22b Implementation. South section of the Jordan River Nature Park.

Russian olive snags are of limited value as wildlife habitat. The flood years of 1985 and 1986 left dense stands of dead Russian olive, most of which needs to be removed, particularly in the Hunter's Woods Wetland complex. A few larger, sturdy trees should be selected to remain as perching sites. All cottonwood snags and downed trees should be retained on site. Logs should be scattered in the shrub and woodland areas and in and around wetland ponds. Other organic yard debris dumped on site including stumps, branches, leaves, and lawn clippings should be removed. Further dumping of yard debris should be prohibited.

LIVESTOCK REMOVAL

Grazing must be eliminated from the site in order to allow existing desirable vegetation to develop. Overgrazed pastures on the site contribute (1) to erosion of the riverbank, (2) to loss of riparian and wetland vegetation species, (3) to introduction and establishment of nonnative weedy species, and (4) to increased fertilization of the wetlands. Once livestock is removed, pasture vegetation should be monitored closely. Noxious weeds such as Canadian thistle (*Cirsium arvense*) should be controlled before they become a problem. Weed control would reduce competition for the other desirable grasses and forbs. Further site preparation and planting should be done according to Phase Two as necessary.

CARP ERADICATION

Carp (*Cyprinus carpio*) must be eliminated from the wetlands. Carp are nonnative fish, introduced to riparian wetlands when a flood event occurs. Once established, they uproot vegetation and stir up silt while feeding along the bottom. Reduced clarity of the water column results, which reduces light penetration and the ability of aquatic plants to photosynthesize. Consequently, necessary vegetative structure for macroinvertebrates, an important food source for wildlife, have a difficult time becoming established.

A complete drawdown of water, if it is possible, would effectively kill carp (Weller 1987). In this situation where a complete drawdown is not possible, it is recommended that a combination of live trapping and treatment with the chemical Rotenone be used to remove carp. An organization called the Wasatch Fish and Gardens Project trap live carp to provide food for low income people in the area. They could remove the larger fish from the pond. This would resolve two problems that would occur if the pond was only treated with Rotenone: dead fish removal and the higher amount of chemical required to kill the larger fish. If used properly, Rotenone is an inexpensive, effective, and environmentally safe method of control. The following conditions should be considered before treatment. Rotenone should be used when no

surface water is flowing into the Jordan River. It should not be used when amphibians are in the gill stage of their life cycle. Rotenone breaks down in a week in warm water but requires more time in cold water. Rotenone could be used concurrently with a water drawdown to reduce the amount of chemical needed. The use of Rotenone must be approved and directed through the Utah Department of Wildlife Resources. See Appendix H for Division of Wildlife Resources contact.

TAMARISK ERADICATION

Salt cedar tamarisk (*Tamarix ramosissima*) must be controlled as soon as possible. Although tamarisk is not yet considered a noxious plant by the state, it is a serious weed problem. In riparian areas it outcompetes desirable species such as willow and cottonwood, and shades out all understory species. Tamarisk was introduced in California in the early 1700s and is now common throughout the West along waterways, replacing natural vegetation and transpiring large amounts of water. They have very little wildlife value, are very aggressive and extremely difficult to remove once established. Tamarisk can root deeply and quickly send up new shoots when cut back. Four areas contain tamarisk, the north pasture along the river having the oldest, most established stand. It is recommended that the following control program be implemented as soon as possible, continued by close monitoring.

Application techniques are recommended according to the control objective. Herbicide product label and manufacturer information should be followed. This information should be obtained in advance from the Extension Weed Specialist at Utah State University and from a sales representative. The label should be carefully followed for environmentally safe and successful application. Small scale experimenting is recommended to refine the process for the Nature Park.

Objective: To control tamarisk with the least disturbance to the surrounding vegetation and the environment.

Herbicide: Arsenal™ (imazaphyr) -- nonselective, will remain effective for up to 2 years in the soil. Do not apply over water.

Application: Cut and paint or spray: Cut trunks and canes 6 to 8 inches from the ground. Immediately apply herbicide with paintbrush or small sprayer. The cambium layer should be totally saturated. Avoid dripping and contact with other vegetation and soil. A herbicide dye should be used to help identify treated areas. Experimenting with stump heights and application methods should be done before the technique is used on a large scale. Follow directions on label.

Time Frame: Treat in the fall when the plant is sending down reserves to the roots. Another treatment should be applied the following year and thereafter only when necessary.

PHASE TWO: SPECIFIC SITE PREPARATION AND PLANTING

WETLAND ENHANCEMENT AND CREATION

Wetlands are characterized by fluctuating water levels and hydric soils. Wetland vegetation is dominated by hydrophytes which can tolerate various degrees of flooding or live in frequently saturated areas (Weller 1981). The type of wetland found on this site is palustrine (marsh) characterized by soft-stemmed herbaceous plants called emergents (Jensen 1989). Inundation from the Jordan River occurs during high water years which also backs up increased surface and groundwater flows. During low water years, surface flows are reduced and irrigation drain outlet supplement the lowered groundwater.

Water level control is important to maintain the vegetation diversity required for optimum wetland habitat; it is central to the proposed wetland enhancement and creation. Water supplies must be assured and at the right time of the year as much as possible. The sources of stream and irrigation outlets should be traced and future flows guaranteed. Currently, water flows do not increase until the first of June and taper off at the end of the summer. The Cahoon Irrigation Company controls the system draining onto the site. To supplement needed spring and fall flows, cooperation with the irrigation company should be secured to possibly alter the timing of flows or maybe increase flows. Diversion of water may be necessary to supplement water to wetlands during low flow periods.

The seedbank in a wetland is typically rich in plant species, waiting for the right growing conditions (van der Valk 1978). Plant species stratify in preferred water depths and advance or recede according to changing water levels. Depth of water, timing of drawdown, and reflooding determine the type of vegetation structure that will result with drawdowns. For example, emergents such as cattails germinate in exposed mud early in the growing season but may be discouraged if they are inundated through late summer and/or winter.

The goal of wetland management in the Jordan River Nature Park is the recommended ideal configuration for habitat diversity at a 50:50 ratio of open water to vegetation cover (Weller 1981) (See Fig. 23). Six inches is the preferred water depth with some areas deeper, but not over 18", and some shallower with a gradually sloping shore of 5: 1 (Bachman 1990). Water supplies would determine the length of time that this configuration can be achieved. Some

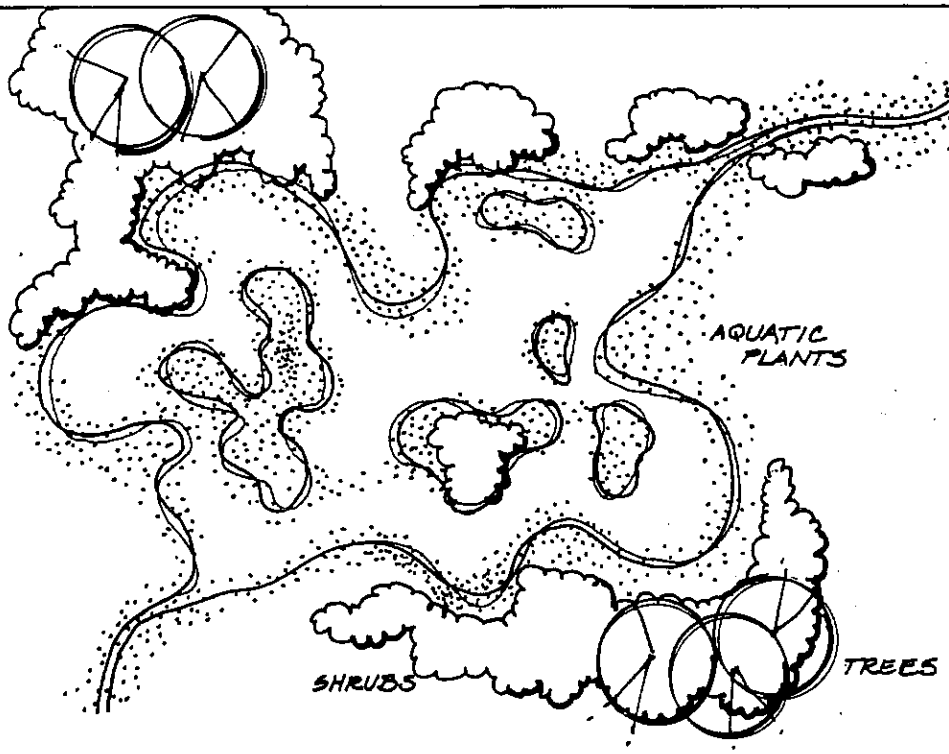


Fig. 23 The ideal wetland configuration for habitat diversity: 50 percent open water to 50 percent vegetative cover.

wetlands may be filled seasonally; others may have water present all year. Some of the wetlands on the site may be more like a wet meadow except during high water years when they flood. This type of diversity of wetlands is desirable because of the variations in the plant communities that attract different wildlife species.

Site Preparation

Knowledge of the hydrology of the site, water control structures, and proper topography are necessary to effectively manage wetland water levels. A general hydrologic cycle of wetlands is discussed in Chapter 2 (see Fig. 10 and 11).

Water Monitoring Wells. Groundwater level and fluctuation is an important indicator of underground water flows. In order to understand the groundwater hydrology, it is recommended that monitoring wells be placed in the wetland project area (See Fig. 24). They would provide information about the groundwater elevations at selected points during the year. This would help to determine if the wetland is gaining or losing water through the ground, rates of gain or loss, and time of the year. It also indicates how much surface water would be required and at what time of the year it is needed to maintain desirable water levels.

The monitoring wells should be placed during the season of the lowest water. This would aid in placement and insure they are deep enough. PVC pipe, 2 inches in diameter should be used. Length would be determined by the depth that groundwater is intercepted, minimally at 18 inches. Holes along the entire length would be cut into the pipe to allow water to enter. A fine screen should be placed on the bottom to prevent soil filling the pipe. Ground holes should be dug by hand auger and the pipe inserted with about 6 inches above ground level and capped with a removable lid. For accurate readings, care should be taken not to disturb the soil during installation in a way that would alter the ground water movement. Monitoring frequency and duration depends on the goal for the wetland. The wells could be flagged or hidden, depending on necessity of protecting them from disturbance by park users.

Water Manipulation. Installing water control structures and constructing small dikes are principally recommended for site preparation of the wetlands and for vegetation management. These structures would provide an easy and inexpensive way of establishing an optimum water level. Even small changes in water level may have a major impact on pond configuration and vegetation composition. Current topographic information is limited to four-foot contour intervals with interpolated two-foot intervals from the Murray City Engineer's Office. This scale is not adequate for wetlands enhancement. Small increments in water levels, even an inch, may drastically change flood configuration in the wetland because of the generally flat

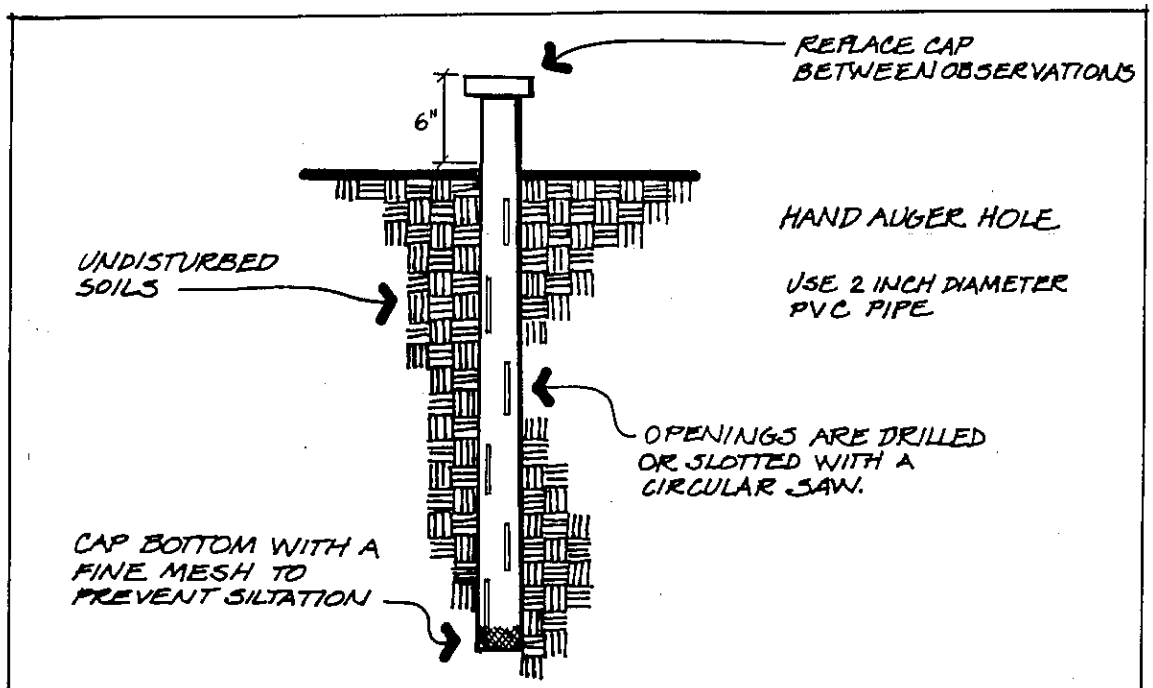


Fig. 24 Groundwater observation well construction and installation. These wells provide water table information that is useful when enhancing or creating wetlands.

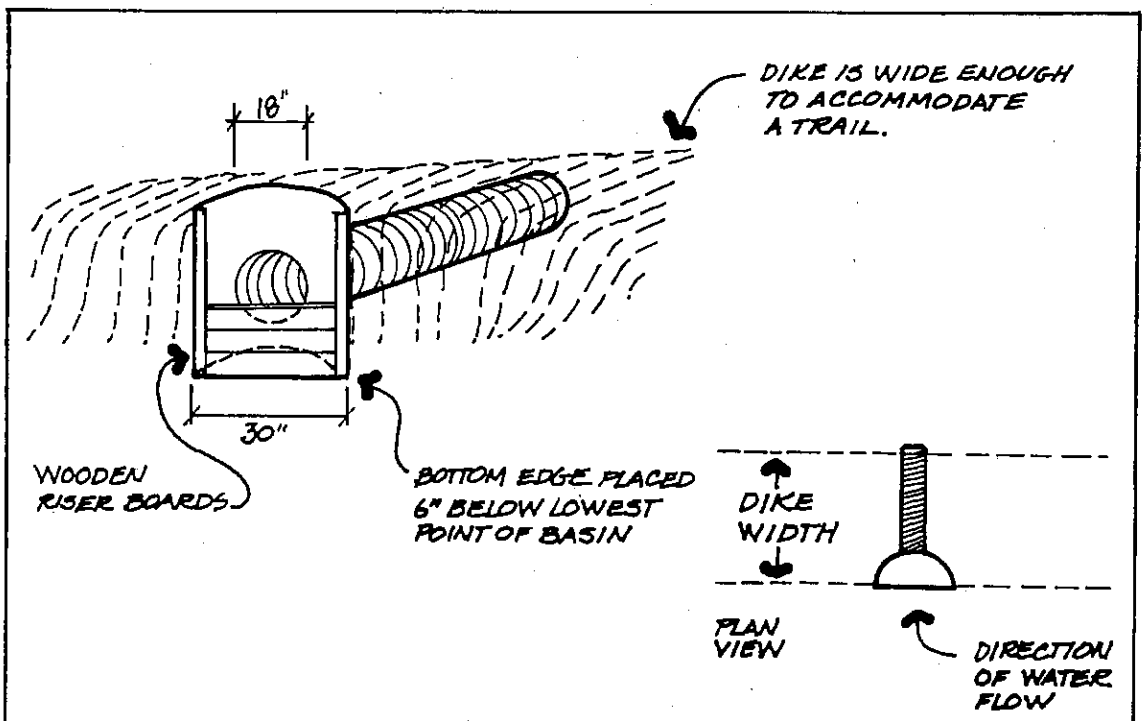


Fig. 25 Culvert and riser water control structure construction and installation.

topography. To find the water level that meets depth and shore configuration goals, it is recommended that first a preliminary survey be conducted to choose dike and water control structure locations. They should be installed and then the area flooded. The results should be noted and the desired level determined. It is important to locate the structure where a complete draw-down is possible to aid in carp removal, muskrat control, and regenerating or thinning out vegetation. Site work, such as grading to sculpt deeper ponds, might be found necessary at this time. Additional water control structures may be needed for the upper basins. Any excavated wetland soils should be saved as a seedbank for other on-site or off-site wetland projects. Soil profiles may be needed to locate proper wetland soil that hold water if wetlands are to be expanded. It is important to note that if there is any excavation or discharge of materials on jurisdictional wetlands, it must be first permitted by the local office of the Army Corps of Engineers.

A dike with a culvert and riser is recommended as the most versatile water control structure for wetland management. A galvanized steel culvert and riser shown in Fig. 25, allows easy incremental water control, is self-cleaning and long lasting (Bachman 1990). The dike would hold water and accommodate maintenance access and trail crossings. The culvert and riser should be installed 6 inches below the soil surface at the outlet, the lowest point of the wetland.

Once the optimum water level is found, it should be left there for 1 or 2 years while monitoring vegetation in wetlands and surrounding upland species. Monitoring wells would give a clearer view of any changes in the groundwater levels. Each wetland would have a different management requirement according to water inflows, surface and ground water discharge, and evaporation. Some wetlands would have water all year, seasonal wetlands would have water only in the spring, and both would depend on the current climate cycle.

Seeding and Planting Techniques

Typically, planting is most often associated with wetlands created on new sites where the seedbank is either deficient in wetland species or nonexistent. Two created wetlands are proposed for the Jordan River Nature Park in the Germania Avenue Parkland and Wetlands Complex management unit. One is a series of seasonal ponds and the other would connect two existing but eutrophied oxbow wetlands. In both cases, wetland soils with viable seedbanks would be available near or on-site. Additional wetland soils would be available from the Hunter's Woods Wetlands enhancement project on the north end of the Nature Park.

Generally, aquatic plants are established by seed, vegetative organs (above and below ground), and transplants. Typical agricultural planting techniques cannot be used. In general,

annuals need to be propagated by seed and perennials by seed or any of several vegetative parts depending upon the species (Kadlec and Wentz 1974). Since viable wetland seedbanks are available, it is recommended that only one wetland species, hardstem bulrush, be transplanted from within the Nature Park (Kadlec 1990). Nursery supplied native aquatic plants in the Intermountain region are not available. It is recommended that only shrub willow, saltgrass, and hardstem bulrush be planted in the created wetland areas to supplement the seedbank in the wetland soils. Shrub willow in areas disturbed by the construction should be transplanted or cuttings should be nursery grown for 1 year or planted directly, depending on the site conditions. Bulrush tubers should be dug from stands; saltgrass sod should be dug and divided into sprigs. All plants, whether transplants or cuttings, must be kept moist and cool until they are planted. No fertilizers or herbicides should be used in saturated soils or over water.

Seed. Germinating gathered seed of aquatic plants is more difficult than other establishment methods. Seed of local species are not available through commercial suppliers. When the seed is gathered, germination may have to be induced by treating the seed coat chemically or mechanically such as soaking in water or freezing. Seed can be germinated under controlled conditions, but timing is important and they must be planted immediately (Kadlec and Wentz 1974). Water levels must be controlled in order to establish treated seed.

An easier and the recommended way to seed is to use wetland soils. Wetland soils contain a seedbank that could be applied as topsoil to the bottom and shoreline of created wetlands. If the natural seedbank exists, drawdowns during the growing season and the exposure to air would stimulate germination of cattail, sedges, rushes, smartweed, and willow. Cattail fluff could also simply be hand dispersed over wetlands. Water control is mandatory for successful seeding using seedbank material. Beds should be drained during the summer and through the winter to encourage cattail and hardstem bulrush (Kadlec and Wentz 1974). These species could be discouraged by flooding through that same time period. Tamarisk, phragmites, and reed canary grass also respond to a similar flooding regime. Perennials and annuals would germinate in mud with a summer drawdown. (The mud should be allowed to dry enough to crack on the surface.) When reflooded in late summer, these plants would provide habitat and food for waterfowl and other birds. A partial drawdown has very shallow surface water and would be similar to a wet meadow. A partial drawdown during the growing season would also encourage some species of plants such as cattail, rushes, and sedges (Weller 1981).

Tubers and Rootstock. Hardstem bulrush is the only emergent recommended as a transplant. Tubers of hardstem are available from stands on the site. They are very dense and hard and should be chopped with a blade into softball size chunks. They should be gathered and

planted in spring before the year's shoot growth begins, or later in the season if the leaves are kept intact and, when planted, the leaf ends stay above the surface of the water during the winter. The recommended planting method would be to plant the tubers by hand by simply pushing them into the bottom. A hole may first have to be poked in the mud with a stick. They should be planted three feet apart, not more than a few centimeters deep in mud, and may be planted with surface water present (Kadlec 1990). If animal damage becomes a problem, another method would be to place the tubers in a wire mesh with a few stones or a mixture of gravel and mud for weight. These would then be planted as described above. This recommendation comes from Kester's Wild Game Food Nurseries in Omro, Wisconsin.

Saltgrass transplanting is recommended because it is a warm season grass and is difficult to establish by seed. Saltgrass is rhizomatous and can be transplanted as sprigs. Two-inch plugs of sod, with at least three to four nodes, should be planted on one-foot centers with one end sticking above ground level. They should be collected and planted in May when the ground is still moist. The planting area should be tilled 8 to 10 inches deep and be free of other herbaceous plants (Decker 1988). Rodeo™ (glyphosate) is recommended and approved for use in wetland areas. Mechanical removal of existing vegetation is not recommended where rhizomatous plants occur. More information on herbicide treatments is found in the upland section of this chapter. Follow label directions. The sprigs may need watering occasionally until new growth begins. Monitoring condition of newly planted sprigs is highly recommended.

Shrub willow could also be transplanted, but cuttings, rooted or unrooted, generally are used in larger planting areas. Willows that may be disturbed by wetland excavation could be experimentally planted if in dormancy.

Rooted Cuttings. Woody species can be established from (1) "slips" or unrooted stem cuttings, (2) rooted cuttings, (3) nursery or greenhouse grown seedlings, or (4) wildlings, which are root sections or small seedlings dug from wildland sites. Species easily propagated from cuttings include willows, poplars, and dogwood (Platts, et al. 1987).

Unrooted cuttings have been successfully used in wetland creation and riparian restoration and, in some cases, have been more successful than rooted stock (Johnson 1990). However, it is recommended that rooted cuttings be used rather than unrooted cuttings because of the greater percent establishment success (Platts et al. 1987 and Beagle 1990). The exception is the use of unrooted cuttings in the bioengineering techniques discussed later in Planting Techniques for Riverbank Stabilization. Following is the method that the Utah State Forestry Nursery in Draper uses to root cuttings in nursery beds. This differs from field techniques to establish unrooted cuttings. For more information on field planted cuttings, see Platts et al. (1987) as listed in the Reference List or see Appendix H.

Willow cuttings selected from the previous year's new growth should be gathered in early spring before bud break, preferably in late February to early March. These should be cut into five-inch long sections and treated with a fungicide and rooting hormone, then planted at the nursery and grown for 1 year. The bare root stock would then be lifted before bud break the following spring, kept cool and moist, and stored until planted. The planting technique is the same as described for bare root plant material in the upland section in this chapter. Soils should not be saturated but must be moist for willow establishment. Fertilizer should not be used. The herbaceous understory should be removed by mechanical or chemical means. A cleared area of 2 feet by 2 feet is recommended around each seedling. Hand scalping is preferred except where rhizomatous plants occur. Rodeo™ is recommended for chemical vegetation removal near a water source. More information on herbicide treatments is found in the Upland Areas section of this chapter.

UPLAND AREAS

The existing upland habitat is classified as a shrub/grassland community. It is a predominantly open area with perennial and annual grasses and forbs with patches of woody vegetation (See Fig. 26). The upland areas on the site are an extension of the foothill habitat found along the Wasatch Front. (Trees and certain shrubs would be more commonly found at the interface with wetter habitats such as rivers, streams, seeps, wetlands, and irrigated areas.) In addition to grasses, forbs, and shrubs, current vegetation includes fairly dense patches of noxious weeds.

The goals of establishing and managing upland vegetation areas are (1) to enhance wildlife habitat by diversifying native vegetation structure and species; (2) to save and encourage the growth of the native diversity of grasses and forbs while controlling the weedy nonnative species; and (3) to establish and maintain vegetation without irrigation. The Planting Design Concept has been previously discussed in Chapter 3.

Site Preparation

Soils, water, exposure, and current vegetation cover determine the selection of site preparation and planting techniques. Upland soils in the Jordan River Nature Park are primarily well drained alluvial sand and gravels. There are some rich soils that developed under hydric conditions but no longer have the required high water table to be considered wetlands. Other areas contain bank spoil or compacted road base material that have no organic soil or soil horizon development. It is anticipated that current upland plant communities may change in

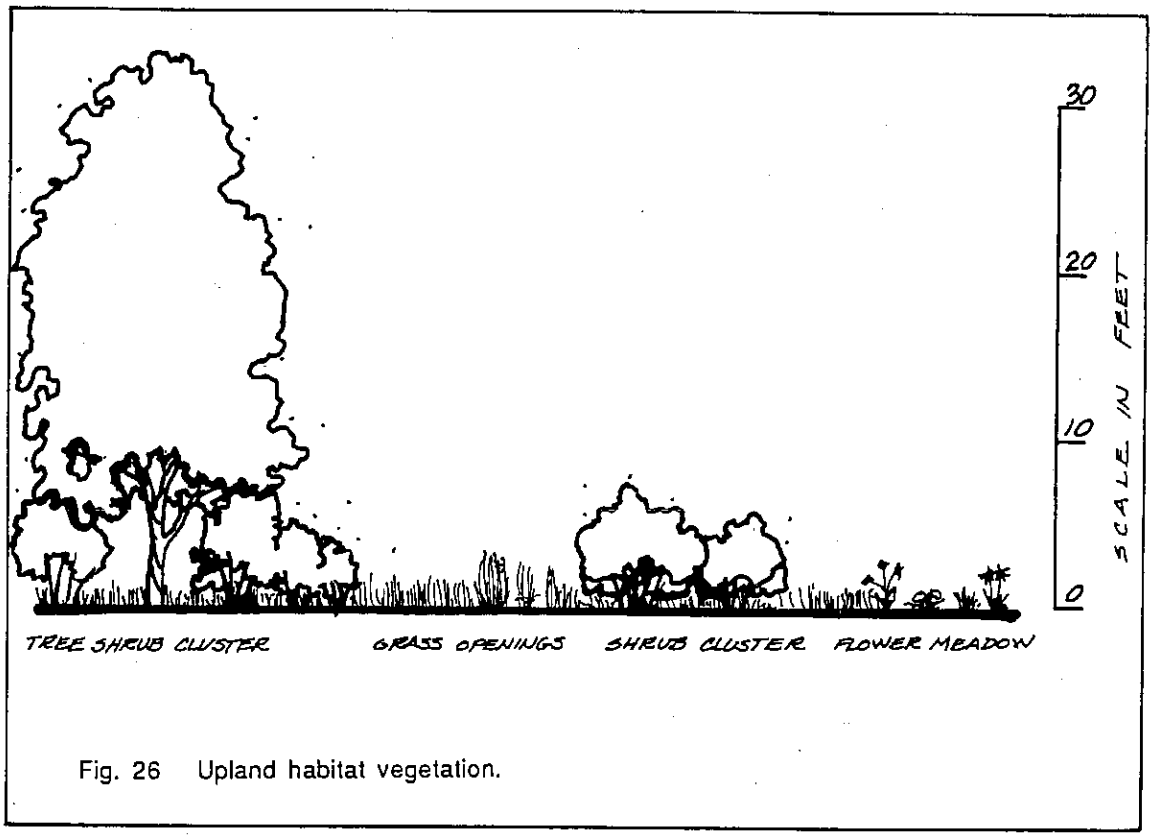


Fig. 26 Upland habitat vegetation.

areas where whitetop (*Cardaria draba*), a noxious weed, would be controlled; in the grazed areas when livestock would be removed; and in areas adjacent to the enhanced or created wetlands with higher water levels. These new conditions should be assessed before specific site preparation and planting take place. Noxious weed control should be implemented as part of site preparation for planting as discussed below.

The landscape architect should examine and mark the vegetation boundaries of the upland area before site work begins. This would prevent unnecessary disturbance of adjacent vegetation such as wetland communities. Small patches of more upland type plant species exist within the wetland areas due to the presence of upland or disturbed soils, or slight rises in topographic relief and subsequently lower groundwater. In addition, other vegetation that is to be undisturbed should be marked. Trees should be marked or fenced as far as their dripline to reduce tree injury and ground compaction. Some of the trees to be undisturbed are identified on Figs. 20a and 20b, Implementation Plan. Additional trees and shrubs should be located in the field before site preparation begins.

Weed Control. Competition is the biggest factor controlling native plant establishment (Pendleton 1990). Grasses and weeds, particularly noxious weeds, must be controlled near tree, shrub, and forb plantings to meet the desired wildlife habitat goals. Grasses and weeds disperse seed easily to nearby planting beds. Rhizomatous grasses and weeds are very competitive once established and have a tendency to take over planting beds.

Any planting bed or seedbed must be weed free at the time of planting or seeding through the use of herbicides or by other methods. In planting beds, pre-emergent herbicides and mulch should be used when planting and later to prevent germination of weed seeds. In some areas of the proposed plan, the objective is to remove weeds selectively, leaving behind desirable plants. This technique eliminates the need to plant natives which may be hard to establish and which may not be commercially available. Caution is advised when selecting the treatment. Considering the goals, the environmental conditions during and after spraying, and use of chemicals near humans, animals, and water, is essential.

The State of Utah officially designates noxious weeds which are then subject to control regulations (Dewey 1990). Most of the noxious weeds on the site are located in the upland areas or on the drier edges of wetland areas. The following is a brief status of noxious weeds of the Jordan River Nature Park.

- Whitetop is a hardy rhizomatous plant widespread on the site forming large dense patches suppressing other plant growth.
- Dyer's woad (*Isatis tinctoria*) is sparse enough that pulling by hand and removing from the site before the seed sets could keep it from spreading.

- Leafy spurge (*Euphorbia esula*) is in isolated disturbed areas but is increasing in patch size.

- Current pasture areas may develop noxious weed patches after livestock is removed. Monitoring and control are important in these areas.

Control Recommendations. Three post-emergent herbicides are recommended by Steve Dewey, Extension Weed Specialist at Utah State University. Brand names are recommended where research and testing have shown these products to be effective. Types or brand names of pre-emergent herbicides are not specified due to their availability for a wide variety of conditions which can be assessed when drawing up the final planting plan. Application techniques are recommended according to the objective of the control. Herbicide product label and manufacturer information should be followed. This information should be obtained in advance from the Cooperative Extension Service of Utah State University and from a sales representative. The label should be carefully adhered to in order to be environmentally safe and successful. Small scale experimenting with the techniques is recommended to refine the process for the Nature Park. Information should be disseminated to the local neighborhood to educate, remove any objections to the use of the herbicides, and gain their cooperation.

The following are three situations that can occur. Situation One and Two are the most common; the control treatments described would most likely be used. Situation Three occurs less often; control treatment may be used on a smaller scale. See Appendix I for details on weed wipers, backpack sprayers, and herbicide dyes.

Situation One: Areas of whitetop, leafy spurge and dyers woad with understory of desirable grasses and forbs.

Objective: To remove whitetop and encourage the native grasses and forbs to grow, or to drill seed without disking. To plant, if necessary, soon after application.

Herbicide: Roundup™ (glyphosate) - a systemic, nonselective herbicide. The greatest uptake occurs within the first 24 hours of application; full uptake occurs in the next 48 hours. Any chemical in the soil becomes immediately bound to the particles where they are eventually broken down by soil microbes.

Application: Weed Wiper -- Commercial or hand made. Wipe the whitetop to saturate but not dripping. Avoid touching or dripping on desirable plants. Follow label directions carefully.

Time Frame: Apply in the spring, near the end of May, before flower bud breaks and when the plant is taller than understory of grasses and forbs. A second application may have to be done the following spring. After the second year application, mowing

and drill seeding can take place in 5 days where annuals have been treated and in 7 days where perennials have been treated.

Situation Two: Remove all vegetation.

Objective: Complete control of vegetation in order to prepare a seed or planting bed by disking or topsoiling; to kill and mow vegetation for drill seeding.

Herbicide: Roundup™ (glyphosate) - a systemic, nonselective herbicide. The greatest uptake occurs within the first 24 hours of application; full uptake occurs in the next 48 hours. Any chemical in the soil becomes immediately bound to the particles where they are eventually broken down by soil microbes.

Application: Backpack sprayer (or other hand-held spray unit) -- a 4 gallon capacity unit that allows close control of spray to eliminate overspray and drift. It is also economical for that reason. It is available commercially. Other models may be used in the larger areas. Plant should be thoroughly saturated but not dripping. A surfactant and dye should be added to the herbicide. Follow label directions carefully.

Time Frame: Treat in spring when grasses such as smooth brome are 6 inches high. Disking, mowing, or drill seeding can take place in 5 days where annuals have been treated and in 7 days where perennials have been treated.

Situation Three: Heavy whitetop area has good grass understory that needs to be retained; no desirable broadleaf understory and broadleaf plants are not scheduled to be planted.

Objective: To remove whitetop and other broadleaf plants and retain grass understory and drill seed without disking.

Herbicide: A combination of Escort™ (metsulfuron) and 2,4-D (concentration of 3.8 amines, manufacturers vary). Both are selective for broadleaf plants. Grasses can be planted 2 weeks after application. Broadleaf can be planted 2 years after application.

Application: Backpack sprayer (or other hand-held spray unit) - a 4 gallon capacity unit that allows close control of spray to eliminate overspray and drift. It is also economical for that reason. It is available commercially. Plant should be thoroughly saturated but not dripping. A surfactant and dye should be added to the herbicide. Follow label directions carefully.

Time Frame: Apply in spring, near the end of May, before flower bud breaks. A second application may be necessary the following spring. After the second year application, mowing and drill seeding of grasses can take place in 2 weeks.

Pre-emergent Herbicide. A variety of pre-emergent herbicides are available on the market, applicable to a wide range of conditions. They typically need water to transport them down into the soil where the seeds are present. They do not need to go further than an inch to be most effective. Pre-emergents should be applied in the fall when planting so that the herbicide will be in the soil in the spring when the first weed seeds would germinate. There may be some decrease in strength so they should again be applied later in the spring. These herbicides may be applied once more in the following season if needed to insure a weed free planting bed. Pre-emergents could also be used in early spring planting when rains will occur.

Russian Olive. The status of stands of Russian olive (*Elaeagnus angustifolia*) should be monitored and in some cases controlled. Russian olive is a nonnative used for wildlife plantings, horticulture plantings, and is the most common tree throughout the Jordan River Nature Park. Throughout the West, Russian olive is rapidly naturalizing within riparian zones and wet meadows sites. Monotypic stands prevent cottonwood regeneration due to shading. They are easily established by seed and killed by water inundation. Russian olive does provide habitat for some passerine species but excludes cavity nesting birds. The proposed planting list does not include Russian Olive and the trees on site should be eventually replaced with native trees or removed where water levels in wetlands will be raised. The Russian olive can be controlled by cutting and treating the stumps similarly to tamarisk or by placing a horizontal notch in the trunk and injecting Roundup™. Follow label directions carefully.

Seed and Planting Bed Preparation. Seed and planting bed preparation provides proper soil conditions and a noncompetitive environment. The amount of soil disturbance before seeding or planting should be minimized. Minimum tillage reduces soil erosion and prevents the buried weed seed crop from germinating. Weeds and understory herbaceous plants should be removed by herbicides and a pre-emergent herbicide applied to planting beds. Areas with annual weeds and grasses should be mowed and then planted. Disking and rolling may be necessary to condition compacted or disturbed soil. Timing of the following techniques is important. These schedules should take into account the optimum time of weed growth, the best time of herbicide effectiveness, and the recommended planting times according to ground moisture, plant material availability, dormancy, and growing periods.

Seedbed Preparation Without Tilling or Herbicide: To establish seed in predominantly annual vegetation cover or in very sparse perennial cover, it is recommended to mow the plot to be seeded in the early summer before the seed head

develops. Mowing should take place again in the early fall; seed should be drilled through the mulch in late fall. The area should be mowed again late in the following spring/early summer to reduce competition.

Seedbed Preparation Without Tilling: To establish seed in an area of heavy perennial herbaceous cover, applying Roundup™ is recommended in spring to kill vegetation including cool season rhizomatous plants. A second application of Roundup may be required in late summer before seeding. Larger debris should be removed and the plot mowed. Seed should be drilled through the mulch in the late fall.

Seedbed Preparation with Tilling: To loosen compacted soil and remove non-rhizomatous weeds, a heavy offset disk is recommended. This method is not recommended, however, for areas of heavy rhizomatous weed infestation because they easily reproduce vegetatively from root parts. Large patches and irregular rows of seedbed should be disked 8 inches deep in not more than 25% of the area to be seeded. The seedbeds should be disked in the spring of the second year of whitetop control, then left fallow for the summer. The seedbeds should be again disked in the fall when the moisture is sufficient. A roller may be needed to firm the seedbed. Seeding in the late fall should be done by drilling or by broadcast seeding and light raking. Before seeding, the top 2 inches of soil should be made friable, free of clods and live vegetation. Seeding should be done within 24 hours of seedbed preparations. If the seeding is done later and a crust forms on the surface, the seedbed must be prepared again. No surface fertilizer should be used since it will primarily aid weed establishment.

Seed and Planting Bed Preparation of Bank Spoil and Compacted Road Base: Bank spoil is sterile sand and gravel riverbed material that is dredged and placed on the riverbank. The riverbank is built up with this material to control flooding. Road base is typically compacted and sterile or weedy. Adding a few inches of topsoil and ripping is recommended to loosen the surface, to increase organic material and water infiltration (Gregory 1990). Planting and seeding should be done with hardy upland native plants. Any weeds growing on the plot should be removed with Roundup™ in the spring. A follow-up application of Round-up™ may be necessary in the late summer before soil preparation, and before planting or seeding in the late fall. A pre-emergent should be used when planting, not seeding, and a follow-up application should be applied in the spring. No surface fertilizer should be used since it will primarily aid weed establishment.

Planting Bed Preparation: It is recommended that areas to be planted should have vegetation removed and have no live roots or rhizomes within 2 feet of newly planted tublings or bare root material, preferably 10 feet from adjacent grass or weedy areas (Pendleton 1990). Chemical removal with the herbicide Roundup™ is preferred where perennials are present. Mowing or scalping alone may be sufficient in areas of annuals. A pre-emergent should be used when planting. Most planting is recommended in the late fall but could be done in the early spring.

Seeding and Planting Techniques

Planting and seeding techniques are related to the site preparation techniques and to the selection of seed or type of planting material. The decision to seed or to use planting stock is based on the ease of establishment and objective of the planting plan. Selection of the type of plant material is based on survival rates, availability, ease of establishment, and cost.

Seeding is recommended generally for the large grass areas where a mix of species could be broadcast or drilled. It is recommended that most of the flowers be planted as tublings because of the problems of germination and the competition of the more aggressive flowers when establishing them. Tublings can be placed more specifically, thereby creating the desired effect in less time. Flowers can be planted under and around shrubs without the problems of competition as with grasses. Flowers and bunch grasses can be planted in masses to create a meadow (Pendleton 1990).

The type of shrub and tree planting materials that could be used are bare root, tubling, container, and balled and burlapped. Tublings and 1 gallon container sized plant material is recommended for most of the nonirrigated plantings. Tublings and small container sizes are recommended because the entire root system of the plant is transplanted within the container soil. The small size of the plant materials is recommended because young plants adjust better to site conditions, and they cost less (Pendleton 1990 and Beagle 1990). A problem with tublings and container plants, however, is that the root system can grow too large for the container and create root bind, or the roots can be underdeveloped and thus unable to hold the soil together when removed from the container. The proper root growth should be specified for all plant material and should be returned if unacceptable. Other factors of size and health should also be specified. Plants will not survive when planted in poor condition.

Bare root stock is nursery grown from seed or cuttings, then removed from the nursery after 1 year. Plants are removed in a way that no soil is attached to the root system. The fine root hairs are lost when the plants are removed from the ground; the roots can easily dry and

should always be kept cool and moist. Although the cost of bare root stock is less than tublings and container stock, the survival rate is typically lower. Native shrubs and trees are available as bare root stock and are often used in reforestation and in large reclamation and restoration projects. Bare root is recommended on this site for the willow plantings of the riverbank and wetlands because the ground moisture should be sufficient to support the plants. Healthy well developed plants should be specified for bare root stock. Dehydrated or poorly developed stock should not be accepted.

Balled and burlapped plants are usually larger stock, frequently evergreens. These plants are field grown, then dug up with the soil which inevitably cuts some root ends in the process. Balled and burlapped stock is not generally recommended, but a planting discussion is included in this section in case it is used.

Seeding rates and plant spacing would depend on site conditions, survival rates, and planting objectives. The Plant Species and Seeding Schedule in Appendix G gives recommended rates. The plant survival rates are listed in Appendix F.

Seeding and planting time will depend on the available moisture and the dormancy period for plants. The recommended planting time for both seeds and plants is in the late fall. Frost heave is avoided by not watering when planting (Pendleton 1990). The moisture from winter through early spring is important for germination and root development. The cold winter temperatures may aid in greater seed germination. If planting or seeding were to be done in the spring, there may be delays from muddy conditions and a late planting may miss spring rains. Fall planting also allows the use of pre-emergent herbicides to prevent early spring weed germination.

The majority of the planting should be professionally done to insure the highest establishment rate and lowest cost in the long term. The community, however, should participate in some aspect of the planting project to garner support and a sense of stewardship and pride of ownership of the Nature Park. It must be recognized, though, that a community planting could result in significantly lower plant survival rate of only 25%. With close, expert supervision, the survival rate may increase (Beagle 1990).

The use of community help for planting should depend on the objectives of the project rather than trying to save on planting costs. For instance, some plants will be more difficult to establish or more critical to the overall plan. These plantings should be done by professional contractors and may cost more in plant materials and labor. However, this method will more likely provide the desirable result sooner and with less cost to the city in the long term. Community projects, under close supervision, could plant less difficult or less critical plantings using less expensive plant materials. The anticipated lower survival rates from volunteer plantings may be compensated for in part with such methods as decreasing plant spacings to

compensate for plant mortality. Willow plantings of bare root stock or transplanting hardstem bulrush and salt grass are recommended as possible choices for a community project.

The contractor or persons planting native plant material should be familiar with the unique aspects of planting these materials. Plant materials must be ordered a year or more in advance to reserve the better stock because of the high demand. There are few native plant suppliers; late orders may not be filled. Some suppliers have little experience in propagating native plants. It is best to find out which suppliers deliver consistently good plant materials with a return guarantee. If plants are unavailable, substitutions may be possible if selections are taken from the recommended plant list in Appendix E. Feasible substitutions of species should be specified in advance in case first choice plant materials are unavailable.

Seeding. Two seeding techniques are recommended: drill seeding and broadcast seeding. Their use is determined by the type of soil preparation, the size of area to be seeded, and the slope. Mulches are not recommended to establish nonirrigated seed because it changes the moisture regime which results in less drought tolerance over the long term. Fertilizers should not be used in nonirrigated conditions. See Appendix F for seeding rates.

Drill Seeding: Drill seeding should be done with a no till grain drill through standing or mowed dead vegetation or on tilled soil. Drill depths should be selected based on the type of seed and the soil. Multiple species of seed should be drilled in separate rows. Seeds that must be planted at a greater depth should be drilled over the same area or hand planted. Seed in sandy soils should be drilled a quarter of an inch deeper than in firmer soils.

Broadcast Seeding: Broadcast seeding should be done by hand with a cyclone seeder over soil cleared of vegetation and tilled. The seed should then be lightly raked or harrowed. Hand broadcast seeding is recommended where the slope is too steep or the seed plots are too small for the drill. Broadcast seeding requires about twice the amount of seed than drilling. If the seed is very small, or if there are different sizes of seed in a mix, it is recommended that a medium such as sand be added to the seed to aid dispersal. Hydroseeding is another type of broadcast seeding. However, hydroseeding is not recommended on the site because of the small areas to be seeded.

Shrubs and Trees. Planting techniques for trees and shrubs are determined by the type of plant material used. In a nonirrigated area, shrubs and trees should be planted as tubling or smaller container stock. Trees and shrubs should be planted in the late fall when the ground is

still moist and the plants are dormant. See Appendix K, Plant Species and Size Schedule. Slow release fertilizer tablets, typically sold in nurseries, should be placed into the bottom of the planting hole. No surface fertilizers should be used. Pendleton (1990) recommends that shrubs and trees be at least 10 feet from grass plantings to reduce seed dispersal. Experimenting with distances of shrub and grass plantings is also possible when using pre-emergent herbicides and mulch to reduce the risk of grass and weed invasions. Some species of shrub tublings may be planted beneath established shrubs and trees which act as nurse plants. These places provide a favorable microclimate and nutrients for shrub establishment. (See Fig. 27.) Flowers could be occasionally planted under and around newly planted shrubs and trees without risk of competition. The flowers add color and interest while shrubs are growing.

Flower Meadow. Flower meadows are small colorful highlights in the Nature Park, rich in texture and form. Meadow areas have flowering forb species massed and slightly overlapped similar to natural meadows, rather than mixed homogeneously. (See Fig. 28.) Species should be selected for a variety of flowering times which increases wildlife value. Species that are highly aggressive should be avoided. Flowers should be planted as dormant tublings in the late fall when there is ground moisture. A pre-emergent should be applied in the fall when planting so that the herbicide will be in the soil in the spring when the first weed seeds would germinate. There may be some decrease in strength so it should again be applied later in the spring. It may be applied once more in the following season if needed to insure a weed free planting bed. A weed seed free composted mulch may be used in addition to or instead of pre-emergents. Hand weeding may be required the first two growing seasons. The meadow should not be irrigated except irregularly in the first summer when it is necessary. Regular irrigation or topsoiling would promote weedy invasions.

Seeding flower meadows rather than planting would be very difficult. Species have different germination and seeding rates; early aggressive species would take over the site. All weeding would have to be done by hand because pre-emergents could not be used. The effect of masses of species would be difficult to attain with irregular germination; placement could not be as precise. Tublings may cost more initially, but once established, the flower meadow should persist with minimum maintenance.

Types of planting stock may vary depending on availability through private and state nurseries. All native plants specified are not included in the American Standard for Nursery Stock. Steve Pendleton of Progressive Plants Nursery has developed standards for native plant

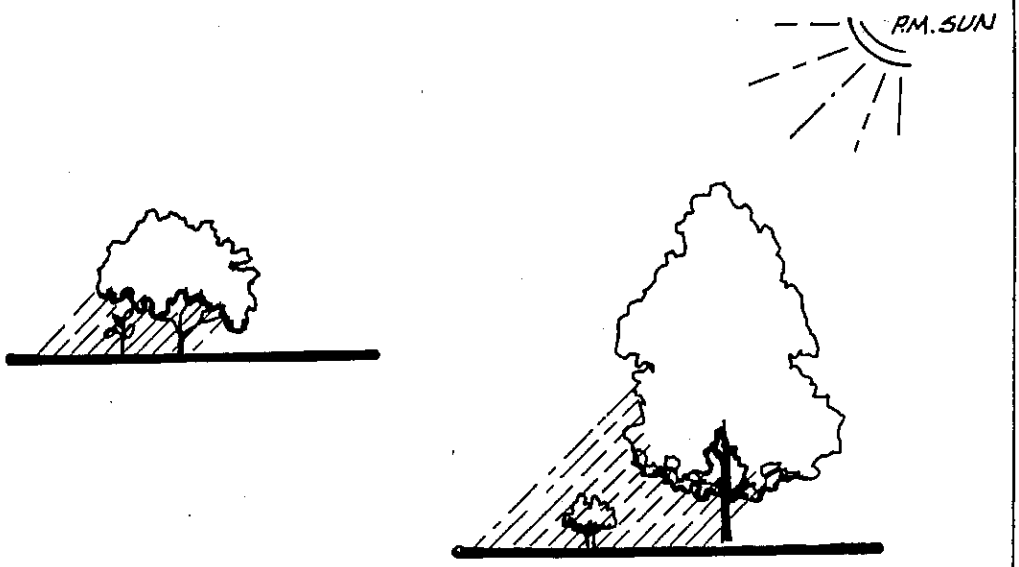


Fig. 27 Nurse plants. Seedlings can benefit from being planted under shrubs and trees to provide a more favorable microclimate and nutrient supply. The nurse crop may also be planted at the same time as the seedling. (See Appendix F for appropriate plant selection.)

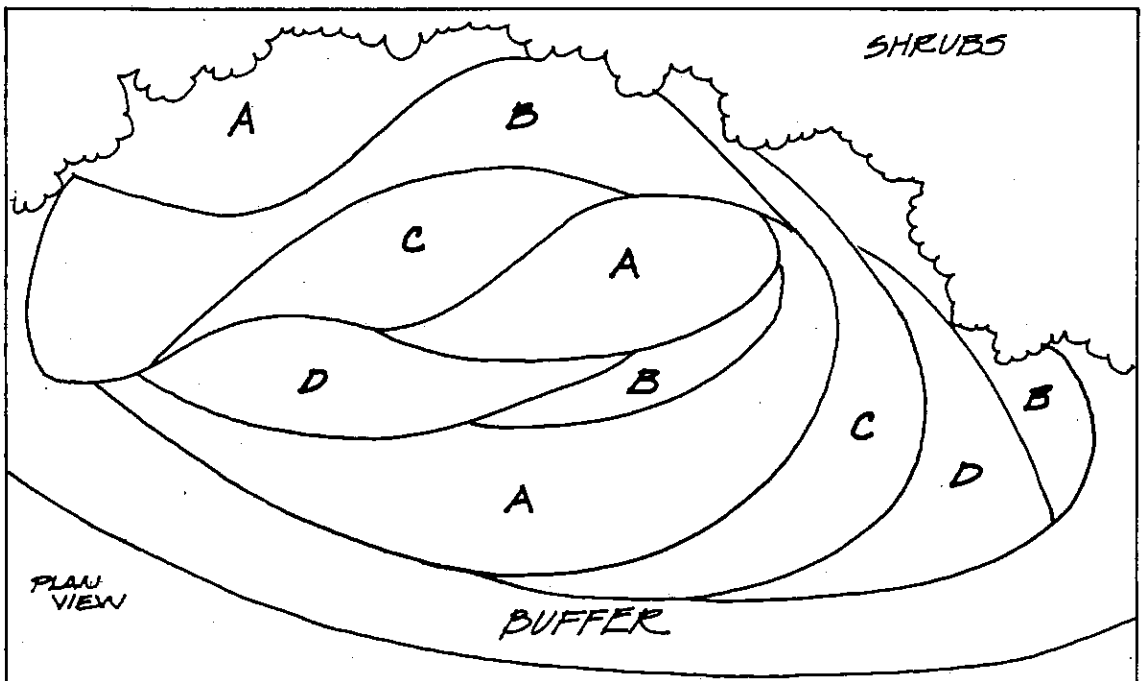


Fig. 28 Flower meadow. An example of a layout of a wildflower meadow with four species represented by letters A to D. The meadow should be only large enough to insure proper weeding and maintenance the first 2 years to establish it. Buffer is grass and weed free zone until flowers are established.

nursery stock. These are listed in Appendix G. His recommended standards are based on his experience with native plant material and show, if planted and maintained carefully, increased survival rates and reduced establishment costs.

Bare root: Seedlings should be dormant and kept cool and moist until the moment they are put in the ground. Air drying can kill roots very quickly. Soil should be moist, not saturated or frozen. Planting spots should be prepared by scraping off existing vegetation within a square yard area. The seedlings should be located as near the center of the planting spot as possible. A planting bar should be used, and the blade inserted 2 inches deeper than the root length (See Fig. 29). The bar should be pulled back, dirt lifted out of ground, then the loose dirt scooped from the hole by hand. A slow release fertilizer tablet should be placed in the bottom of the hole. The seedling should be dropped into the hole and a handful of loose dirt returned to the hole over the roots. The roots should be suspended near the center of the hole and extended straight down in a natural arrangement. The seedling should be pulled up so that the root collar is level with the original ground surface. The seedling should be held and the hole filled 1/3 to 1/2 full with dirt and tamped firmly with the hands. The hole should be filled 2/3 full with dirt and tamped. Filling and tamping should continue to fill hole. Planting holes should be filled by hand to avoid air spaces, to properly compact soil, and to keep foreign material (rocks, litter, dry soil) out of the holes. The ground should then be smoothed around the seedling. A slight berm should be formed 1 to 2 feet around the plant as a water harvest basin. To avoid frost heaves, the plant should not be watered when planted in the fall. Watering is recommended when planting in the spring if the ground is not moist enough. Apply a pre-emergent herbicide or 2 to 3 inches of weed seed free composted mulch or both around the planting site.

Tubling: Tublings should be dormant and kept cool and moist prior to planting. Soil should be moist, not saturated or frozen. Planting spots should be prepared by scraping off existing vegetation within a square yard area. The seedlings should be located as near the center of the planting spot as possible. A hole, minimum 3 inches in diameter, should be augured 2 inches below the length of the tubling root mass (See Fig. 16). A slow release fertilizer tablet should be placed in the bottom of the hole. The seedling should be dropped in hole, filled and tamped as described for bare root seedlings. A slight berm should be placed around the scalped area for a water harvest basin. The plant should not be watered when planted in the fall to avoid frost heaves. Watering is recommended when spring planting if the ground is not moist enough. Apply

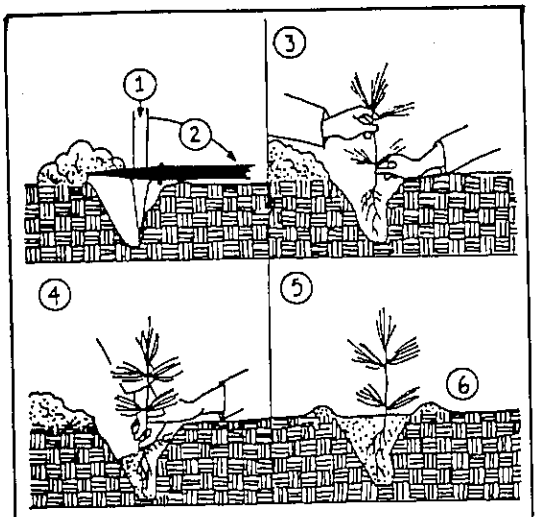


Fig. 29 Planting a bare root or tubling stock. (drawn from a Utah State Lands and Forestry pamphlet)

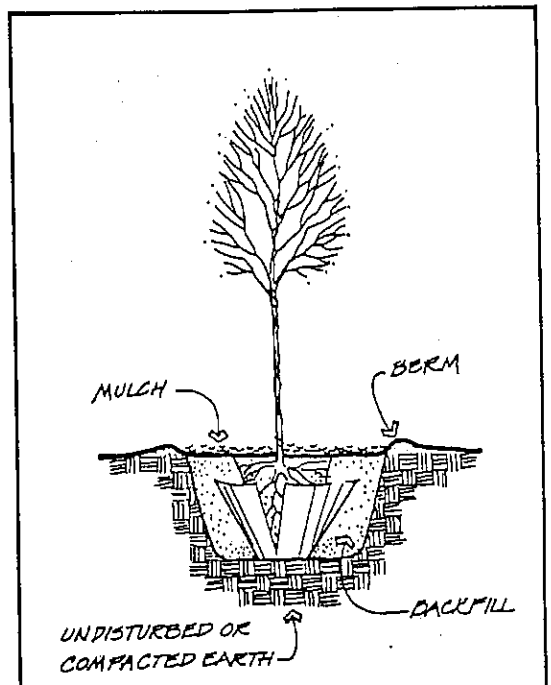


Fig. 30 Planting a container shrub. (adapted from Johnson et al. 1989)

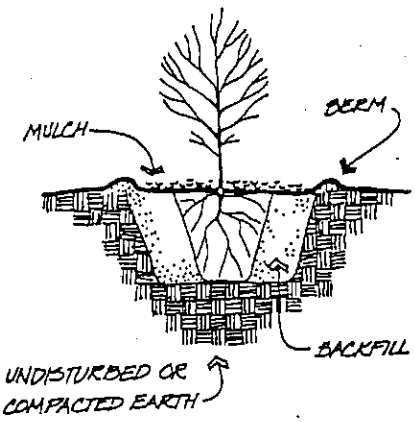


Fig. 31 Planting a container tree. (drawn from Johnson et al. 1989)

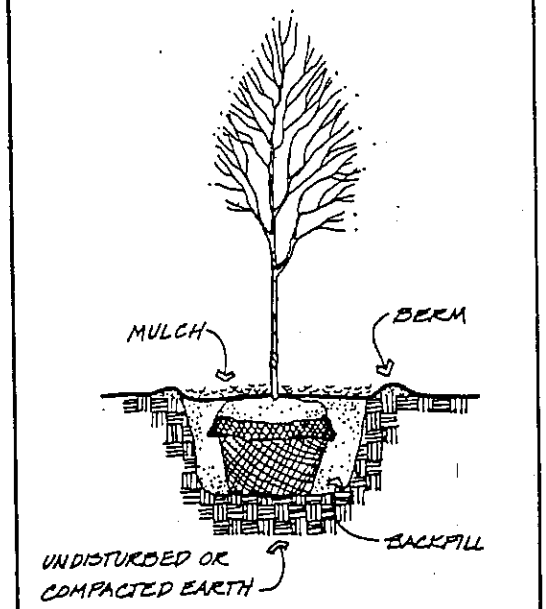


Fig. 32 Planting a balled and burlapped tree. (drawn from Johnson et al. 1989)

a pre-emergent herbicide or 2 to 3 inches of weed seed free composted mulch or both.

The following planting recommendations for container and balled and burlapped trees are taken from *Urban and Community Forestry: A Guide for the Interior Western United States* by C. Johnson, F. Baker and W. Johnson, 2nd edition, 1990.

Container: Container grown trees have developed root systems in the contained soil and are "established." The most common containers are the 5, 7, and 15 gallon metal or plastic containers. The recommended size specified for the upland areas are one-gallon containers planted in the late fall during dormancy when the soil is moist, not saturated or frozen. Container grown trees may be planted in early spring, but this is not as desirable. If planting is delayed, the trees should be kept in a partially shaded cool place protected from the wind. They should be watered enough to keep the roots moist, not saturated. The planting hole should be dug at least twice the width of the container and as deep. (See Figs. 30 and 31.) If a small tree is to be planted (1 to 5 gallons), the container should be removed before placing the plant in the hole. The metal can should be slit down the sides with a can cutter. If the container is tapered and not fluted, the bottom and sides should be tapped sharply and the root ball slid out. The tree should be moved into the planting hole carefully to keep the root ball from breaking or falling apart. The ball should be wrapped securely in burlap or held together with hands if necessary.

Before backfilling, the roots should be checked. If they are crowded or coiled on the bottom, sides, or surface of the root ball, they should be gently teased away from the edges. If the roots are pot bound (dense and circling), the tree should be returned to the nursery for a replacement. Or, as a last resort, several vertical cuts should be made with a knife, then the roots gently loosened at the sides and bottom of the root mass and spread into the hole. Cutting encourages infestation of numerous soil borne diseases and should not be done if possible. If there are kinked root, "J" root, or one-sided root problems, they can be observed by looking closely at the top of the root ball. A pocketknife should be used to expose the top 1 to 2 inches of soil to examine the roots. Girdling roots and lack of fibrous roots would be observed after the container or burlap wrapping has been removed. Any of these problems may result in poor tree growth or death. If any of these problems are found during planting, the tree should not be planted and should be returned to the nursery.

After loosening crowded roots, the top of the root ball should be examined to insure that it is at or slightly above grade. It should be adjusted so that it is vertically

plumb and facing the right direction. The backfill should be worked around the root ball. It should be compacted with the end of the shovel handle or hands. After the soil has settled, more backfill should be added, and the area graded. A slight berm should be retained around the planting hole as a water harvest basin. To avoid frost heaves, do not water if planting in the fall. Water if necessary when planting in the early spring.

A pre-emergent should be applied to reduce weed seed germination. The soil surface should be mulched with 1 or 2 inches of clean weed seed free composted mulch to reduce weeds, retain moisture, and maintain moderate ground temperatures. Uncomposted manure and mulches such as grass clippings and sawdust should not be used. Small shoots along the trunk should not be pruned, only diseased and broken branches.

Balled and Burlapped (B & B): Prior to planting, balled and burlapped stock should be placed in a protected area and the ball kept moist, not saturated with a covering of damp peat moss, sawdust, or straw. Balled and burlapped trees should be planted in the late fall during dormancy when the soil is moist, not saturated or frozen. They may be planted in early spring, but this is not as desirable. When handling the stock, a tree should never be picked up by the stems or trunk. This damages the trunk and may separate the soil ball. B & B plants should not be dropped since this would crack the soil ball and damage the fragile feeder roots. The root ball should be carried by supporting the bottom with one or both hands, or, if large, it should be slipped onto a canvas or piece of plywood. If the plant is too heavy for one person, two people should move it.

After moving the tree to a position adjacent to the planting site, a planting hole should be dug about twice the width of the root ball and at the same height as the ball. The soil should be kept available for backfill. The grass should not be returned to the planting hole.

The trees should be planted so that the original soil level, as indicated by the soil line on the trunk, corresponds with the finished grade. If the bottom of the hole is disturbed upon digging, settling should be allowed for by planting the tree 1 or 2 inches higher than grade (See Fig. 32). Plants set higher than 2 inches above grade would suffer from root exposure and root death for the first few inches of roots. Those set lower than grade may experience water-logged conditions, which leads to collar and root rot and subsequent death of the tree. In sandy, well-drained sites, plants may be planted 1 to 2 inches lower than grade without danger of root rot. The bottom of the planting hole should be flat undisturbed or compacted earth.

The soil ball should not be damaged. All manmade materials must be removed such as the burlap, the wire basket, or any rope or plastic twine from around the trunk and roots. The plant should be checked that it is set upright and facing in the desired direction.

The backfill should be worked around the root ball. It should be compacted with the end of the shovel handle or with hands. After the soil has settled, more backfill should be added, and the area graded. A slight berm should be retained around the planting hole as a water harvest basin. To avoid frost heaves, do not water if planting in the fall. Water if necessary when planting in the early spring.

A pre-emergent should be applied to reduce weed seed germination. The soil surface should be mulched with 1 or 2 inches of clean weed seed free composted mulch to reduce weeds, retain moisture, and maintain moderate ground temperatures. Uncomposted manure and mulches such as grass clippings and sawdust should not be used. Small shoots along the trunk should not be pruned. Only diseased and broken branches should be pruned.

Staking: Trees should not be staked unless stability of the roots or the trunk would be affected by frequent high winds. For root anchorage, three stakes should be driven at least 18 inches into the ground at the edge of the root ball (See Fig. 33). Three foot stakes painted white or florescent orange will less likely be tripped over or struck by vehicles than short ones. Roots should be anchored by tying stakes to the tree as low as possible with flexible web belting. The ties should be removed at the end of the first year, leaving the stakes to protect the trunk if necessary (Johnson et al. 1990).

If protection is not needed, the root ball may be secured and the tree supported with one stake. A two-inch square tree stake should be driven at a 45 degree angle into the direction of the prevailing wind, just missing the top of the root ball (See Fig. 34). The trunk should be secured to the stake with a protective tie 1 to 2 feet above the soil. This method of staking small trees, B & B, and container stock smaller than 10 gallons secures the root system and supports the young tree as well (Johnson et al. 1990).

Trunk support stakes may be required for the first winter and growing season. Top support should be as low on the trunk as possible but high enough that the tree will return to an upright position after being bent. Support stakes should be tall enough for the particular tree and driven at least 18 inches into the ground (See Fig. 35). Wood stakes, 2 inch by 2 inch, are suggested. Two stakes should be placed so that a line

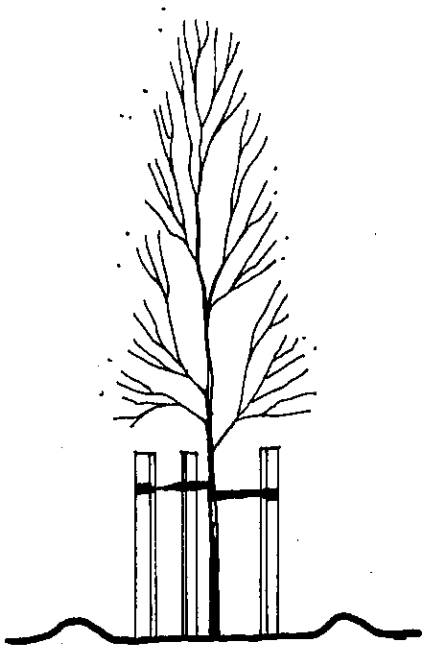


Fig. 33 Proper height and arrangement of support stakes. (drawn from Johnson et al. 1989)

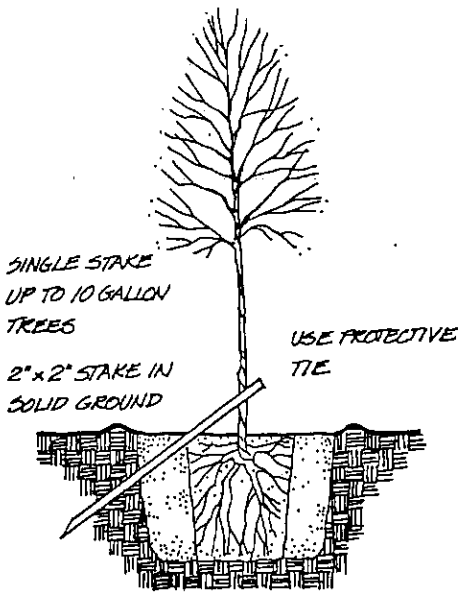


Fig. 34 Staking to stabilize the rootball. (Design by Tom Stilles, drawn from Johnson et al. 1989)

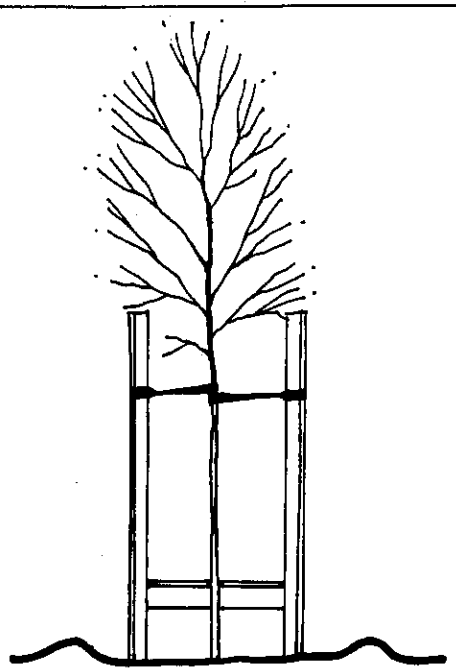


Fig. 35 Staking for protection and anchorage.
(Drawn from Johnson et al. 1989)

drawn between them is at a right angle to the south/southeast wind, the most troublesome. A one-inch by three-inch cross tie placed at the soil surface would increase the strength of the support stakes. It should be placed to the leeward of the stakes to lessen the risk of rubbing injury to the trunk (Johnson et al. 1990).

The tie should form a loose loop around the tree trunk, tied so that the trunk cannot move towards the support stake in a strong wind. The stake should be cut off just above the tie so that the stake will not rub and damage lower limbs or trunk. Ties should be inspected periodically during the growing season for slipping, breakage, untying, or girdling. Tie materials should contact the tree with a broad surface to minimize rubbing and have some elasticity to permit a small amount of trunk movement (Johnson et al. 1990). Elastic webbing or nylon webbing with grommets are recommended (Decker 1988).

Anti-desiccant: Anti-desiccants reduce the loss of water from the leaves of evergreen trees planted in nonirrigated areas. Most anti-desiccants are liquid plastics diluted in water, typically contain a green dye, and are sprayed on the foliage and stems with a pressure sprayer. The tree should be sprayed prior to transplanting (Johnson et al. 1990). If deciduous trees are planted early in the spring before bud break, anti-desiccants may not be required.

Irrigation: Supplemental watering may be needed for the first through the third summer, particularly during drought years. Deep watering should be done up to five times the first season, four times the second season, and three times the third season with a water truck or a temporary water system. Close monitoring of soil moisture and plant conditions is recommended because the plants should only be watered when needed.

Water Harvesting: Water harvesting is a technique to capture and retain surface runoff. Water should be harvested by forming a basin around newly planted trees or shrubs to catch and hold snow and rain water and direct it to the roots as shown previously in Figs. 29-32 . The lip of the basin acts as a windbreak so there should be less drying of the soil around the plant. Water harvest basins should be maintained for 3 years to insure adequate moisture to developing roots.

Protection: Seeded and planted areas must be protected during the establishment period (which may be three years). An effort should be made to educate the public

about this protection. Sturdy temporary fencing visually attuned with the nature park should be used which could be be moved to different areas as they are planted. Interpretive signing would educate the public about the Nature Park and its purpose and provide a reason for the fencing.

RIVERBANK GRADING AND BIOSTABILIZATION

Vegetation is an important bank stabilizing element in river systems. Trunks, branches, and leaves slow floodwaters, which fosters deposition of nutrient rich silt from upstream. Roots hold riverbank soil in place against the onslaught of the scouring action of water, thus increasing stream channel stability. Riverbank vegetation also provides wildlife habitat more closely associated with the river. A study by Jensen (1987) indicates that most of the riverbanks of the Jordan River within the study area are currently fairly stable, but additional vegetation would enhance stability.

The proposed Nature Park plan includes revitalization of the vegetation within the riparian area for wildlife habitat, and for public use and safety, on both sides of the Jordan River and Little Cottonwood Creek. Stabilization of the banks would reduce the probability that the main mean flow channel would make major changes in alignment. This is imperative in the urbanized setting to protect development in the river flood plain. Unstable areas within the study area would require regrading, armoring, and planting to provide bank stability, promote riparian wildlife habitat development, and create a safe recreational opportunity. For the health of the riparian system, old oxbow wetlands should be allowed to flood during periods of high water flow. These goals can only be realized with the cooperation of Murray City, Salt Lake County, and private land owners.

The Jordan River and Little Cottonwood Creek are complex hydrological systems and the Nature Park section has multiple management objectives, i.e., flood control, water quality, wildlife habitat, and recreation. For these reasons, an overall project plan which would incorporate the Nature Park plan should be designed and implemented with the advice of hydrologists and stabilization experts. Expertise and information on permit requirements can be found at the Salt Lake County Flood Control Office, the Salt Lake City/County Health Department, the Utah State Engineer Office, and the U.S. Army Corps of Engineers.

Site Preparation

The river has downcut the channel over the entire length of the site, leaving some steep overhanging banks prone to erosion and possible mass wasting during the next high water.

Some of the steep banks should be regraded into low terraces with an overall slope of 3:1 or less as shown in Figs. 36 to 38. Topsoil should be stockpiled during operations and replaced. After regrading and topsoiling, these banks should be stabilized with trees, shrubs, and ground covers. (See Fig. 39.) Some of these graded areas could be river access points for Park users, including fishermen. Other areas would require little or no grading but would be armored with vegetated log crib walls, vegetated gabions, brushlayers, or live stakes as shown in Figs. 40 to 43. Site work should be done in the early spring when the water is still low and dormant plants could be gathered for revegetation. Bank stabilization should be done in small sections to avoid exposing long reaches of newly vegetated soils to flooding. Young plantings may require more than 1 year to establish and then 2 to 3 years more to provide adequate soil protection. Grading and planting should minimize erosion and the addition of sediments into the stream. No fertilizers or herbicides should be used in saturated soils or over water. After reshaping and grading, the seedbed should be firm with 2 inches of prepared soil (Platts et al. 1987).

Project pre-planning is important. For example, sources for willow cuttings need to be identified prior to site work. There is some shrub willow on the site, but not enough for the entire stabilization project. Additional sources need to be located. Timing is also critical. Cuttings must be harvested before bud break and placed on the riverbank at low water in early spring. If willow cuttings must be propagated, they have to be gathered over 1 year in advance. Planting should be done as soon as possible after site preparation disturbance to reduce erosion. If community volunteer groups are to be involved in planting, time would be required to educate them prior to planting.

Planting Techniques

Revegetating the riverbank requires using techniques appropriate to the hydraulics, soils, available planting materials, installation expertise, cost, and desired land use. The total project should be done incrementally, which allows experimenting with techniques and learning from successes and failures. The techniques listed below use unrooted plant material combined with some bare root stock that initially stabilizes the slope with its structure and placement until rooting occurs. Some techniques use additional heavy structures such as log cribs for absolute slope protection, but the long term stability actually derives from the vegetation. Graded terraces may use some of these techniques to stabilize the edges. Willow planting and tuber planting techniques for these areas are the same as described in the wetland section. Tree, shrub, and ground cover planting techniques would be the same as those described in the upland section.

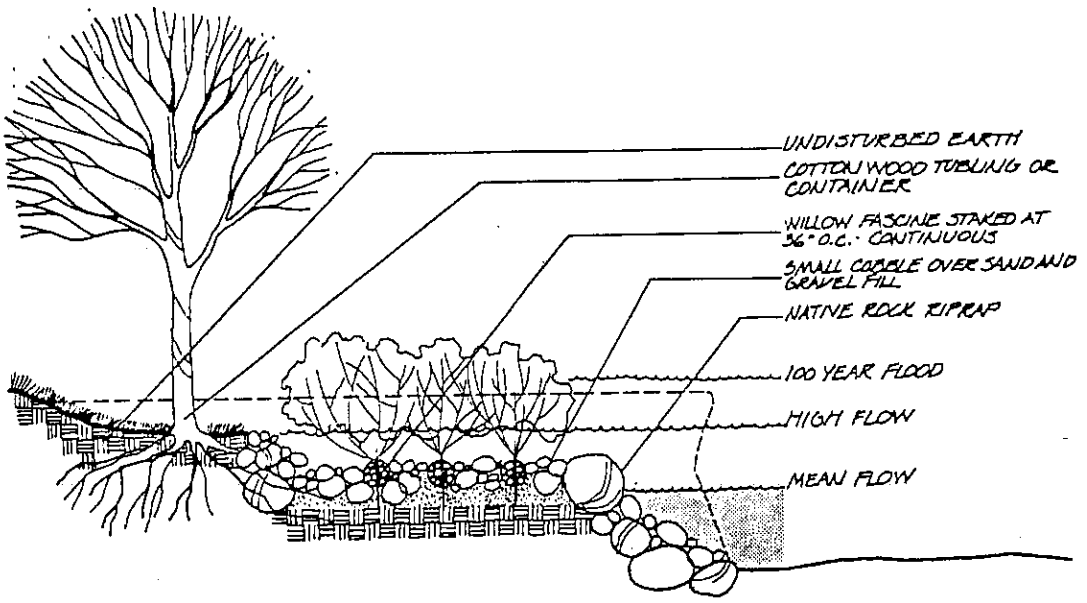


Fig. 36 Riverbank regraded and stabilized at a 1:3 slope. Terraces are stabilized with rock riprap and vegetation.

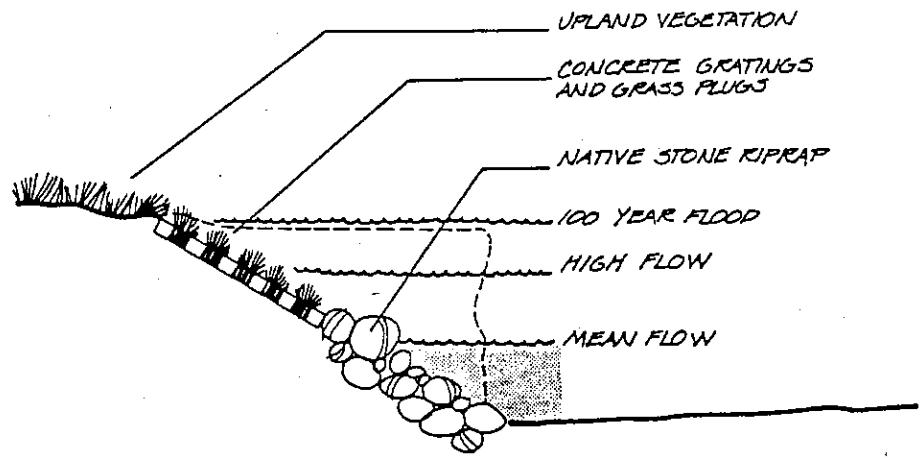


Fig. 37 Riverbank regraded and stabilized at a 1:2 slope. Rock riprap, concrete grating and vegetation are used to stabilize the riverbank. The concrete grating prevents bank erosion in access areas used by recreationists such as for fishing.

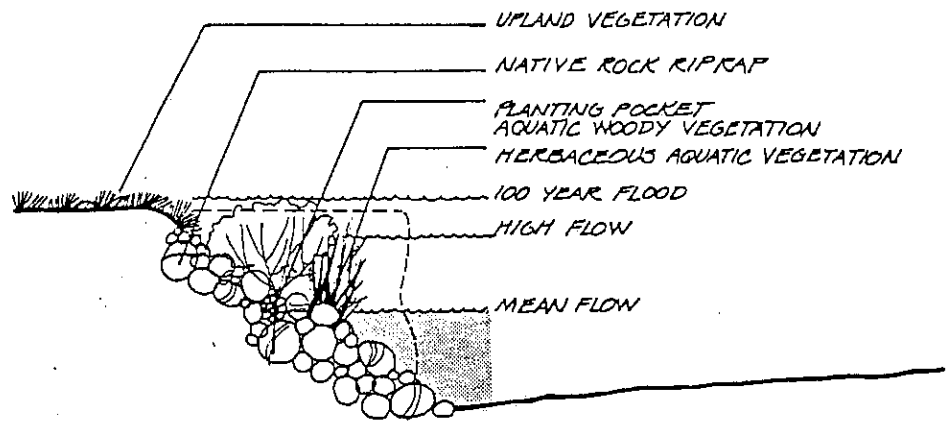


Fig. 38 Riverbank regraded and stabilized at a 1:1 slope. Rock riprap and vegetation are used to stabilize the riverbank.

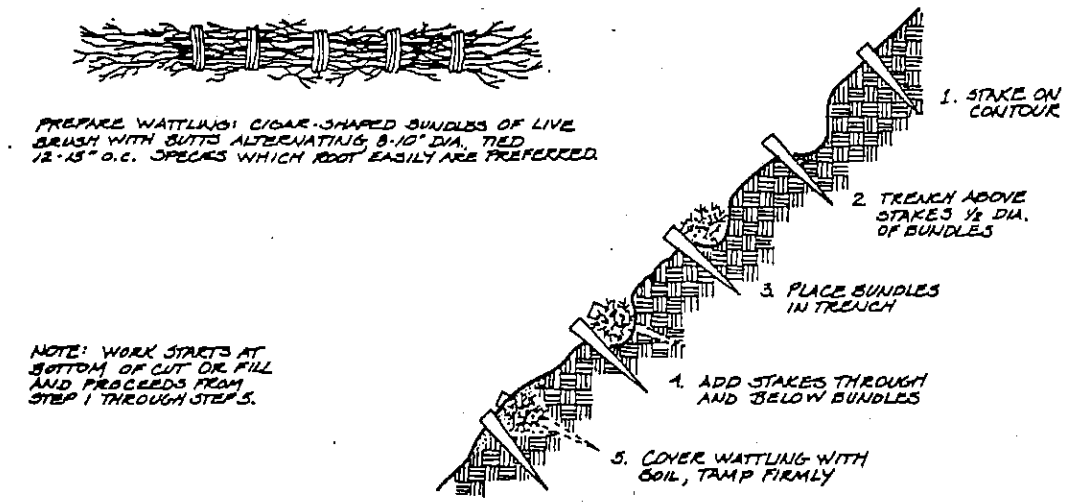
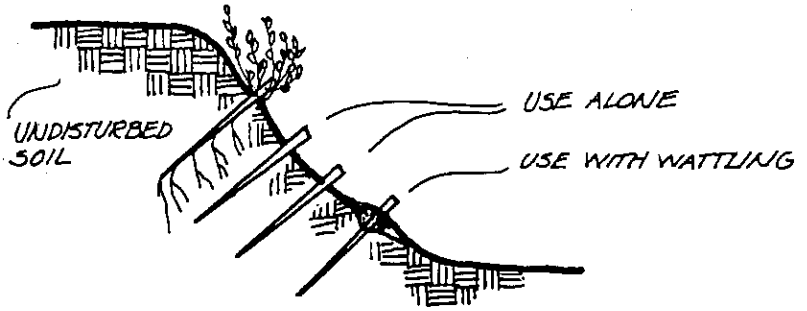


Fig. 39 Preparation of wattling and installation procedure. Sequence of operation is shown schematically in the diagram. Bundles are overlapped so overall thickness is uniform. Two stakes should be used at each bundle overlap. Additional stakes are driven through bundles at a maximum spacing of 18 inches o.c., usually near the ties. (Drawn from Gray and Leiser 1982)



USE OLD STOCK, POUNDED IN AT LEAST 2 FEET DEEP WITH 6 INCHES EXPOSED. IN HARD SOIL, MAKE A HOLE WITH A SMALL DIAMETER PIPE FIRST. THERE SHOULD BE NO AIRPOCKETS WHEN LIVE STAKES ARE IN PLACE. USE DEAD-BLOW HAMMER ON LIVE STAKES. AVOID DAMAGING BARK.

Fig. 40 Preparation of live stakes and installation procedure. Live stakes may be alternately substituted for dead stakes when installing wattling or used alone on a cut bank. (Sortir 1990)

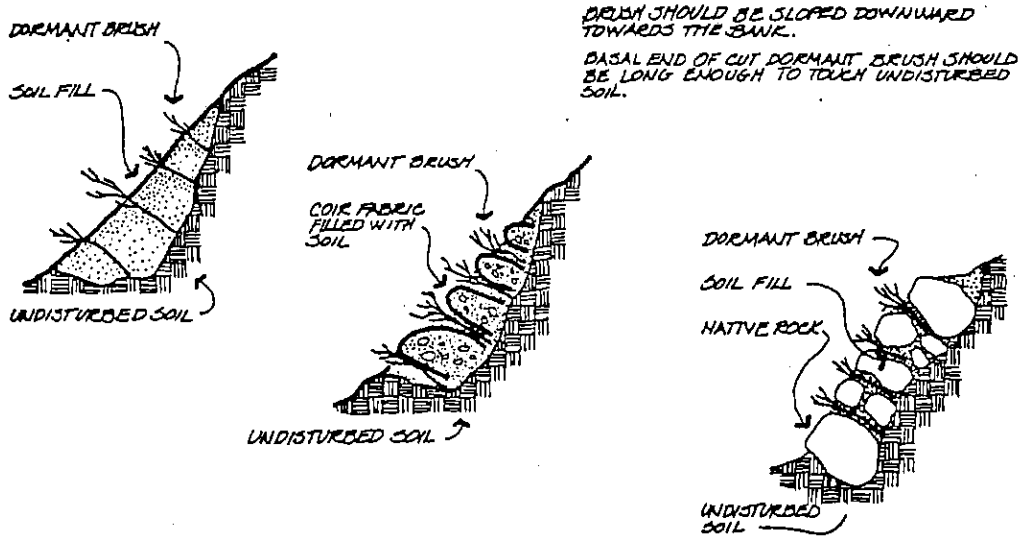


Fig. 41 Brushlayering and installation techniques. Layers of dormant brush are alternated with soil. Large rock may be used to stabilize the slope immediately. (from Schiechtl 1980) Coir, a biodegradable fabric, may be used to stabilize the soil until the vegetation grows. (Sortir 1990)

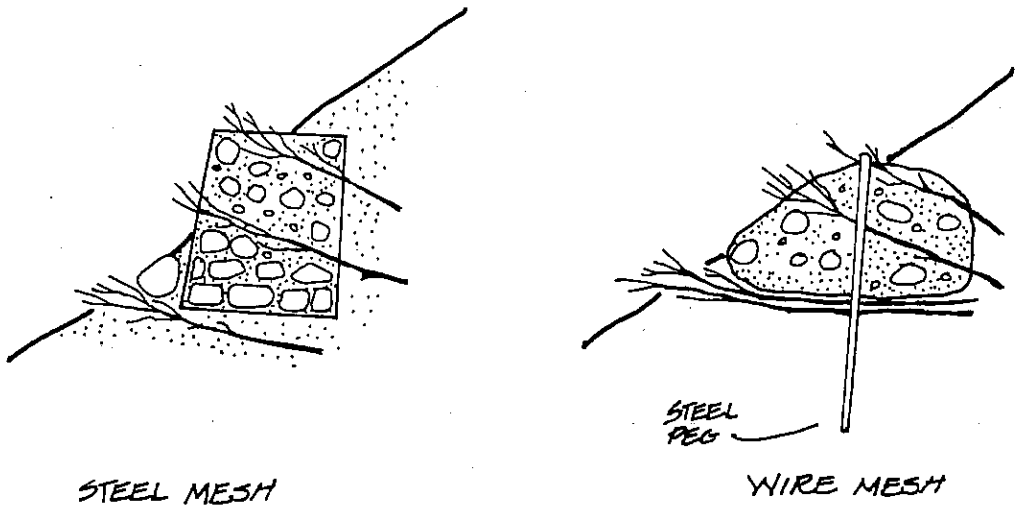


Fig. 42 Vegetated gabions. To protect the gabions from washouts (especially along water channel banks) it is best to place them on top of brush layers. Steel pegs can be driven into the ground with a compressor or sledge hammer. Gabions containing large rock can only be planted between the joints of the gabions. (from Schiechtl 1980)

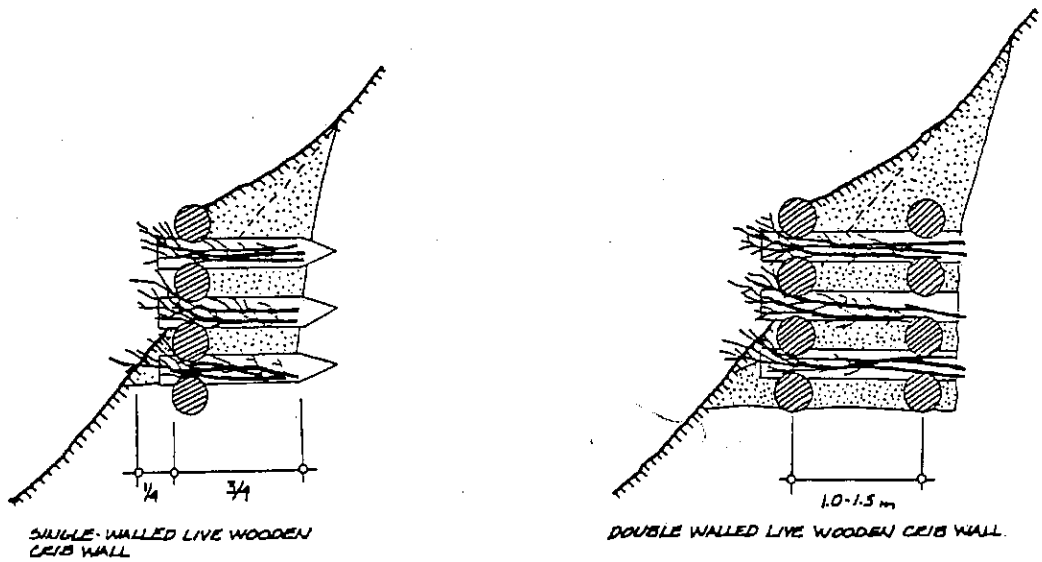


Fig. 43 Live wooden crib walls. The joints between the timber parts should be approximately the same as the thickness of the timbers. Only 1/4 of the live branches should stick out. Avoid hollow spaces when filling. Fill should be fine grained enough to insure plant growth. Ideally, the basal cut end should reach into the soil behind the wall. (from Schiechtl 1980)

Bioengineering. Using plants to stabilize waterways has seen increased attention recently. Stabilization technology has advanced with a better understanding of river dynamics and riparian vegetation. Methods recommended here are taken from these techniques, generally called bioengineering, that have proven effective in the United States, Canada, and Europe. Some of these methods date back to the Roman times. Although they appear simple in concept, careful implementation is essential for success. These techniques and more information can be found in *Bioengineering for Land Reclamation and Conservation* by Hugo Schiechtl and *Biotechnical Slope Protection and Erosion Control* by Donald H. Gray and Andrew T. Leiser. Robin Sortir of Robin Sortir and Associates in Georgia (address listed in Appendix L) is highly recommended for advice on bioengineering techniques. She has expressed an interest in conducting a seminar on bioengineering for the Jordan River. It may be possible for the city to cooperate with agencies and interested groups to bring her to the Salt Lake City area.

The following are the bioengineering techniques considered most appropriate for this project. H. Schiechtl (1980) has noted that slope protection techniques should be used in combinations to obtain the best performance. Examples of combinations are fascines with brush mattresses and gabions with brush layering. All should be installed late fall to early spring during plant dormancy.

Wattle or Fascine: Wattles or fascines are bound bundles of live brush approximately 10 inches in diameter. Starting at the bottom of the slope, bundles should be laid in shallow trenches along the slope contour and anchored with dead or live stakes. Brush which roots easily, such as shrub willow, should be used. The light weight of wattles and shallow trenching minimize slope stability problems. The wattles provide a good seed environment and a small up-slope platform conducive to plant growth. There are variations in numbers and sizes of live and dead branches per bundle, tying intervals, and trench dimensions depending on the slope, soil, and hydrology (See Fig. 39).

Live Stakes: Live stakes are dormant shrub and tree stems driven into the soil and may be used to hold wattling in place. (See Fig. 40.) Live stakes can be used on steep slopes without the necessity of grading. The live stakes should be driven deep, angled downward. It is best if the stake can intercept soils that are saturated for part of the year especially if using hydrophytic species such as cottonwood. A sand filled hammer should be used to drive the stake to avoid splitting it. Soaking before placement is not recommended in order to avoid softening and tearing the bark (Sortir 1990).

Brush Layering: Brush layering stabilizes slopes by alternating cuttings, which root well, with soil. Cuttings of different ages and species should be used for a variety of root growth and length. Brush layering may also be established on steeper slopes between rocks in piled up retaining walls and riprap. Coir, a material made from coconut husk fiber, could be filled with soil and used between brush layers. It is very durable and can stand flooding soon after installation. Coir decomposes completely in 5 to 10 years, thus providing protection until vegetation has become established and has stabilized the slope (Sortir 1990). Brush layering could also be used in conjunction with fascines and gabions. Rooted cuttings of a later successional type of vegetation could be used with the unrooted cuttings; this method provides two successional stages. According to Schiechtl (1980), this method also provides the best soil penetrating effect of other bioengineering techniques. Brush layering is not recommended for retaining topsoil (See Fig. 41).

Vegetated Gabion: Gabions are wire mesh boxes filled with rock used to stabilize slopes and stream banks. Schiechtl (1980) suggests that in the long term, the typical box gabions are not flexible enough to withstand strong pressure. He recommends cylindrical wire mesh that contain live cuttings layered inside with the gravel and rock. They should be staked with metal stakes when placed under particular pressure from river current. To further protect gabion from a washout along a channel bank, they should be set on top of a brush layer. Vegetated gabions secure unstable slopes and banks. They are elastic and permeable, forming solid linear protection or protection points (See Fig. 42).

Live Crib Walls: Live crib walls are built of logs and layers of live willow branches. This system is used to stabilize parts of slopes, water channels, and toes of slopes. The timber of the crib wall, which eventually rots, is replaced by the growing plants. The established plants also drain the slope effectively through transpiration. This is a highly effective method to secure highly unstable points in the landscape (See Fig. 43).

Irrigation: Riverbank plantings should not be irrigated because a shallow root system will result. The roots will not travel deep to the groundwater level. Thus, the soils will not stabilize properly and may wash away.

It is important to keep people and domestic animals from trampling the newly planted banks until they establish. Planting should be protected for 1 or 2 years depending on growth and intensity of use.

Hardening of the shore in some heavily used places may be necessary, favored fishing spots for example. Turf block is a prefabricated material often used for this purpose. Turf block is a concrete block that is laid into the soil at grade as shown in Fig. 37. Each block has spaces for vegetation, such as reed canary grass in this case, to grow through. Placement should not be below mean water level. Monitoring and recording results of stabilization is important for future projects.

IRRIGATED AREAS

Recommended areas of irrigated turf and trees include the buffer strip between the main trail and the neighborhood's backyards, and the developed recreation sites, such as picnic shelters and playfields. The goal for the irrigated areas is to provide shade and a durable turf that requires limited watering and maintenance and that enhances the safety and aesthetic value of the Nature Park. The buffer strip would provide a safety buffer and a visual transition from neighborhood to native habitats of the Nature Park (See Fig. 44).

Site preparation and planting of irrigated areas is discussed in less detail because the planting techniques for the native plants are similar to those for nonirrigated upland planting except for the presence of water. Availability of water makes it possible to plant larger stock. Water also reduces the risk of a dry spring planting. Establishment should take less time for the irrigated grass and trees. Staking irrigated trees may be important to stabilize the root ball that becomes more susceptible to shifting when irrigated (Johnson et al. 1990). The proposed master plan shows an irrigated area of 1 to 2 acres that is in jurisdictional wetland. This means that a permit must be issued by the Army Corps of Engineers in order to remove or place material in this area. Normal agricultural practices are, however, acceptable.

Site Preparation

Turf. Site preparation should include removing current vegetation, grading, adding topsoil if needed for uniform turf growth, and installing an irrigation system. Soil preparation should include tilling and rolling to provide a firm seedbed, and applying a broadleaf weed pre-emergent herbicide and fertilizer. Contact seed supplier for specific soil preparations. Scheduling site preparation and installation should be coordinated with facility construction.

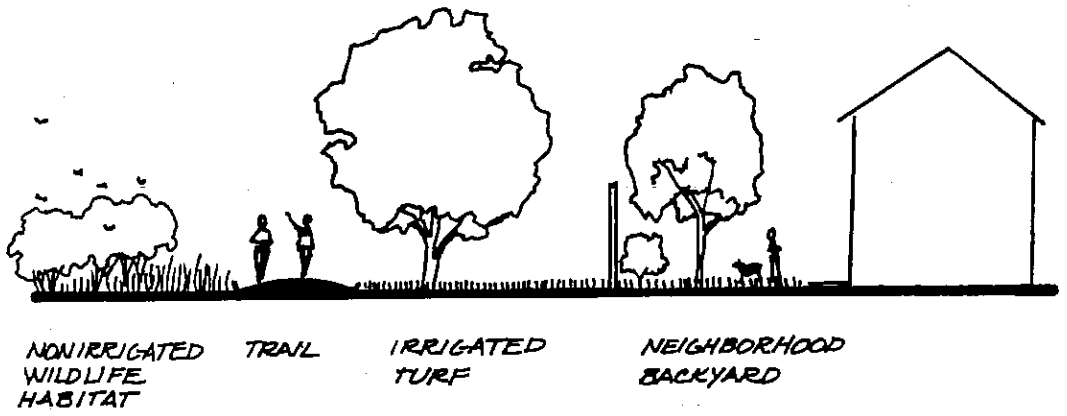


Fig. 44 Irrigated buffer strip.

Planting Beds. Site preparation should proceed the same as for turf discussed above. In addition, care should be taken not to locate trees over utilities or under powerlines.

Topsoil. It is recommended that weeds be chemically controlled before applying topsoil. The topsoil should also be weed free, no less than 6 inches deep, and firm but not compacted. A roller could be used to firm the seedbed. The top 2 inches of soil should be friable, free of clods, and live vegetation. Topsoil should be reasonably free of subsoil, stones, earth clods, sticks, roots, or other extraneous matter. It should contain no toxic materials. If subsoil is compacted, topsoil should be integrated by ripping or deep disking.

Seeding and Planting Techniques

Turf. The following recommendations are for cool season grasses. Seed should be drilled on prepared seedbed, lightly raked, and rolled. Seeders called cultipackers do all of these operations at once. The ideal depth for seed is listed in the Seeding Schedule, Appendix K. The seed should be watered (at least 3 inches per week) for the first 3 weeks, or watered as much as necessary to keep the seedbed moist at all times until establishment. Established seedings should be watered 1 inch at a time, at intervals of about a week, depending on the drought tolerance of the grass species. New seedings should be mowed on the typical time schedule of established turf. The rule of thumb is to remove a third of the growth at a time. If there is a faster growing species in the grass mix, it should be mowed down to 1 inch for the first two to three mowings in order to allow the less competitive grasses to grow. Fertilizer should be applied just prior to seeding and again 2 to 3 weeks after the grass seedlings have begun to appear.

Turfgrasses should be watered when they need it. Decker and Decker (1988) recommend the following indicators of need.

1) Footprints remain on the lawn for a time after the impression has been made.
2) The soil is obviously dry.
3) The lawn has a bluish-gray cast.
4) The grass leaves are wilted and folded or rolled up.

The rule of thumb is to always water at least 1 inch at a time once per week and more often if necessary. One inch of water is usually sufficient to saturate a sandy soil to a depth of 1 foot, a loam to 8 inches and a clay to 5 inches. Light, more frequent waterings encourage shallower rooting and also promote the germination of surface-situated weeds.

The amount of watering depends on the grass species and the amount of rain through the growing season. Cool season grasses go through a dormant period in the middle of the summer, creating an opportunity to reduce the watering schedule.

Trees. Trees are planted in the same way as described in the upland section of this chapter, although the tree stock should be larger than that used in the nonirrigated areas. Irrigation reduces transplanting stress and increases survival of larger planting stock. Irrigated trees may be planted after bud break in the spring, but it is recommended that the trees be planted in early spring, or in late fall when there is ground moisture and the trees are dormant. Trees need as much of the first growing season as possible begin to establishing a good root system.

Trees should be watered when planting in the spring. Deep watering as often as required is recommended but over-watering should be avoided. A late fall planting, similar to the nonirrigated plantings, should not be watered because of winter frost heave. Water harvest basins described for upland planting should be used to reduce watering needs.

The soil surface should be mulched with 2 or 3 inches of a coarse slow decomposing media such as shredded bark, wood chips, peat, or compost. Organic mulches retain moisture, retard evaporation, moderate soil temperatures, control weeds, and improve appearance. Uncomposted manure and mulches such as grass clippings and sawdust should not be used.

When planted, small shoots should not be pruned along the trunk. Only diseased and broken branches should be pruned. Typically, within 2 years, trees should start to be pruned to keep the top open and healthy, for structural strength, and to train trees that have a tendency to become shrubby to a single trunk. Within 10 years of planting, the tree should be pruned to shape. The local urban forestry practices should also apply.

For more information, see the upland shrub and tree planting techniques in this chapter. Also refer to the *Urban and Community Forestry: A Guide for the Interior Western United States* by C. Johnson, F. Baker, and W. Johnson, 2nd edition, 1990.

CHAPTER 5
MONITORING AND MANAGEMENT CONCEPTS

Once vegetation is established, resource management is important in order to retain vegetative structural diversity and thus meet the stated goal of maximum wildlife species diversity. Maximum vegetation diversity should, however, remain within the limits defined by the native plant communities and their response to climatic and edaphic conditions. Problems or undesirable conditions, if discovered, should be acted upon immediately. It is also important to monitor public response to implementing the proposed plan and management practices. A continual dialog with Murray residents is important to generate a positive outlook and support for the project.

Monitoring programs should be directed through the Parks and Recreation Department and should be carefully designed and conducted by competent professionals. Utah Division of Wildlife Resources, Salt Lake City/County Health Department, or one of the state's universities would be excellent choices to design a monitoring program. Information on the plan and its progress should be made available by Murray to other interested city and county communities. This information is valuable because the Jordan River Nature Park has the potential of becoming a test case on the Wasatch Front for a habitat enhancement approach to stream corridor park development.

The opportunity for others to become involved in informal monitoring of plants and wildlife, and their interactions with the environment are limitless. Local schools, organizations, and businesses should be encouraged to participate. Groups such as the Regional Trails Council, Salt Lake Chapter of the Audobon Society, and the Utah Native Plants Society may be interested in long term monitoring projects.

Monitoring and management recommendations follow for wetland, upland, riverbank, and irrigated plant communities. Further listings of contacts, references, and plant material sources are listed in Appendix H.

WETLAND

Wetlands should be monitored primarily for water levels, plant diversity, and animal use. This should include inspection of dikes and water control structures for proper functioning, monitoring of plant community dynamics, including excessive vegetation removal by animals, and carp. No removal or alteration of wetland plant or animal species, other than those mentioned below, should be allowed except through processes of natural succession and survival.

1. One classification of wetland identified on the drawings should ideally attain a ratio of 50 percent open water to 50 percent vegetative cover. This should occur during most of the year for permanent wetlands and during spring and summer for seasonal wetlands. If this situation is not present, then several options, listed below, can be pursued.

a) There may be a lack of inlet water flows even though it may have been originally determined that flows would be adequate for management goals. The city may need to negotiate increased or diverted water flows with the irrigation company. The city could also pursue obtaining additional water rights. Where possible, water could be diverted from another stable supply.

b) Evaporation may be contributing to excessive water loss. To supplement levels, the water supply could be increased as discussed above. Another solution may be to plant wind breaks to reduce evaporation from spring and summer winds. However, vegetation would take time to attain the size and height to be effective.

c) Excess ground leakage may occur if created ponds have not been adequately located or lined with water holding clays. These ponds may be recontoured and lined with clay and the wetland soils replaced. Groundwater level monitoring wells described in Chapter 4 may aid in determining ground water conditions.

In the event that these recommendations are not feasible, management goals may have to be altered to suit the water regime, e.g., areas of wet meadow could be maintained instead of the ratio of 50:50 open water to vegetative cover. For more information on wetland water management, contact the Wetland Habitat Specialist, Division of Wildlife Resources, or manager of a state or federal waterfowl refuge.

2. The second classification of wetland identified on the drawings should be reclaimed or not disturbed. These wetlands are remnants of river oxbows and may hold water only when the river floods or during spring snowmelt. These wetlands should be monitored only for tamarisk, Russian olive, or noxious weed invasion. These species should be removed if a stand begins to establish.

3. Plant community diversity is an important component of wetland habitats (Weller 1981). Cattails germinate and spread rapidly under the right conditions. A limited number of

muskrat should aid in keeping stands of cattail thinned. If the muskrat population grows too large, however, they could denude the wetland of cattail and bulrush (Kadlec 1990). The following are problem situations and recommended management actions.

a) A monoculture of cattail may occur and should be reduced by removing patches of the stand. Cattails cannot survive the winter if they are totally submerged. It is recommended that cattail be mowed and flooded during the winter if the water is available. A stand may also be burnt or treated with Rodeo™ (glyphosate) in the late summer or fall. Keeping the wetland flooded during the spring and summer would prevent further germination. For more information, contact the Wetland Habitat Specialist, Division of Wildlife Resources, Salt Lake City.

b) Loss of vegetation may occur from muskrat digging the tubers for food and harvesting the leaves for lodges and platforms. It is recommended that water be lowered and allowed to dry and crack on the surface in the summer to establish cattails and emergents, then flooded in the fall. For more information, contact the Wetland Habitat Specialist, Division of Wildlife Resources, Salt Lake City.

c) Muskrat numbers may have to be reduced due to extreme vegetation losses they cause. Lowering water levels in the winter and allowing the water to freeze through may help to temporarily reduce numbers. However, a trapping program may be necessary since the site is near the Jordan River which is a major dispersal corridor for muskrats. For more information, contact the Division of Wildlife Resources.

4. Monoculture of phragmites, reed canary grass, and other aggressive plants listed in Appendix D can become a problem when the goal is vegetative diversity. These areas should be watched for stands that are increasing to the detriment of other desirable species. If there is a problem, the Wetland Habitat Specialist at the Division of Wildlife Resources should be contacted for more information.

5. Tamarisk can be a persistent problem and should be removed as soon as a stand starts to become established by the treatment discussed in Phase One of Chapter 4. For more information, contact the Weed Extension Specialist, Utah State University, Logan.

6. Carp should not return after their initial removal unless reintroduced during a flood of the Jordan River or illegally stocked by fishermen. If they do return, remove fish as discussed in Phase One in Chapter 4. For more information, contact the Fisheries Office of the Division of Wildlife Resources in Springville.

7. Mosquitoes are not expected to increase. Any mosquito control program will affect other invertebrate populations, such as midges, that are important wildlife foods. If a control program must be implemented, *Bacillus thuringiensis var. israeliensis*, a nontoxic biological formulation to control mosquito larvae, should be used. It is harmless to wildlife, domestic

animals, some insects, fish, and humans. It is commercially available. The Salt Lake City Mosquito Abatement District implemented a program using this method in 1988 for the North Salt Lake area. They could be contacted.

8. Domestic ducks and geese should be removed from the wetlands as soon as they appear. This should be handled through the city or county animal control department.

UPLAND

Upland areas should be monitored for plant species diversity as specified in the plan. Monitoring should include identification of weeds, trends towards a species monoculture, and plant damage due to excessive recreational use. No removal or alteration of upland plant or animal species, other than hazards, nuisance animals, or noxious weeds, should be allowed except through processes of natural succession.

1. Noxious weeds and monocultures of plants such as Russian olive and aggressive grasses (e.g. western wheatgrass) should be controlled; affected areas may be replanted with other species once weeds or aggressive species are removed. These areas may be replanted with other species depending on the situation. Refer to discussion of Upland Site Preparation Techniques in Chapter 4. For more information, contact the Weed Extension Specialist, Utah State University in Logan, and the Upland Habitat Specialist, Division of Wildlife Resources, Salt Lake City.

2. Drought killed plants may be replanted with a more tolerant species to avert a weed invasion. For more information, contact the Upland Habitat Specialist, Division of Wildlife Resources.

RIVERBANK

The riverbanks should be monitored with regard to plant community stability, wildlife habitat value, and tolerance of recreational use. Monitoring should include identifying erosion problems, noxious weeds, and tamarisk. Vegetation should be as diverse in species composition and in physical structure as specified in the plan. No removal or alteration of riverbank plant or animal species, other than nuisance animals or undesirable weeds, should be allowed except through processes of natural succession and survival.

1. Erosion, bank cutting, and overhanging banks should be stabilized as soon as possible with vegetation, or a combination of mechanical structure and vegetation as discussed in the section on Riverbanks in Chapter 4. For more information, contact the County Flood Control Office and consult references on bioengineering techniques listed in Appendix H.

2. Water flow in the river channel may change due to channel downcutting or realignment as a result of restrictions, potentially causing bank erosion. Restriction may occur from trees or debris carried during flooding. The river should be checked after storm events and immediately repaired. For more information and aid, contact the Salt Lake County Flood Control Office.

3. Noxious weeds and monocultures of undesirable plants should be controlled and may be replanted with other species depending on the situation. Refer to discussion of Upland Site Preparation Techniques in Chapter 4. For more information, contact the Weed Extension Specialist, Utah State University in Logan, and the Upland Habitat Specialist, Division of Wildlife Resources, Salt Lake City.

4. Tamarisk can be a persistent problem and should be removed by the treatment discussed in Phase One of Chapter 4 as soon as stands start to become established. For more information, contact the Weed Extension Specialist, Utah State University, Logan.

5. Beaver numbers are currently low and there appears to be no active den on the site. Their recent cutting along the riverbanks, however, indicates they are in the area, using the Jordan River. If mild damage by beaver to trees and shrubs occur, some trees could be temporarily protected with wire mesh. However, in the event of excessive damage, reducing the population by live trapping may be the only solution. For more information on beaver control, contact the Division of Wildlife Resources, Salt Lake City.

6. Riverbank damage from excessive vegetation trampling and compaction may be caused by recreational use such as fishing. This jeopardizes bank stability and aesthetics. Use could be diverted with education, signage, and fencing until bank vegetation is well established. It is recommended that turf block be installed where appropriate as discussed in the Riverbanks section of Chapter 4. More information may be researched in river recreation management literature or from other park and recreation authorities in the country.

IRRIGATED

Irrigated areas should be monitored for a clean, open appearance and a park-like setting. Monitoring should include identification of hazards, weeds, and proper watering schedule.

1. Trees should be pruned to remove hazardous broken or diseased limbs, to open up the limbs to stay healthy, for structural strength, and to train trees that have a tendency to be shrub-like.

2. Turf should be maintained weed free for healthy growth.

CHAPTER 6
CITY AND COMMUNITY SUPPORT

Implementation of the plan requires cooperation with county offices, city budget commitments, and volunteer efforts by the community. This cooperation and involvement are important to the success of the proposed plan's goal.

The involvement and support of Murray City residents are crucial. The greater the number of community members involved, the more the community gains a sense of ownership, stewardship, and pride in the project. Knowing the plan gives people a vision of the project goals and dispels misunderstandings of the Nature Park's unique concept. A recommended guide to establishing a wildlife habitat community program can be found in *A Wildlife Conservation Guide for Urbanizing Areas in Utah* by Craig Johnson, Professor in the Landscape Architecture and Environmental Planning Department at Utah State University in Logan, to be published in 1991. The Guide includes a variety of approaches for community involvement in protecting, enhancing, and creating wildlife habitat.

The following are actions that Murray can be take in order for the goals and objectives of the proposed planting plan to be realized. Some of the recommendations involve time, money, or planning, but all are important to support the proposed planting plan. The recommended actions are based on the concern expressed by residents, experiences of natural resource scientists and managers, and personal observations of other urban nature centers and wildlife habitat parks. These recommendations should help fulfil the potential of the proposed Nature Park plan.

FUNDING COMMITMENTS

JORDAN RIVER NATURE PARK PLANNING AND DEVELOPMENT COORDINATOR

The duties of a Nature Park Planning and Development Coordinator would be to coordinate all Nature Park activities, working closely with Murray City Parks and Recreation Department; to search for outside public and private funding; to plan and implement interpretive programs; and to direct and follow through with volunteer efforts. That person should have strong

organizational skills and some knowledge of natural resources, interpretation, outdoor education, fund raising, and grant writing.

REVEGETATION SPECIALIST

A revegetation specialist with wildlife biology interests should be on site during site preparation and planting, and involved during site planning and monitoring. That person could help identify plants, recommend specific planting locations as indicated in the plan, and aid in determining appropriate establishment techniques.

HYDROLOGIST/BANK STABILIZATION EXPERT

The hydrology of the Jordan River is complex and any change in flows or channel configuration in the watershed will have a downstream effect. See Appendix H for references. A hydrologist and bank stabilization expert should be consulted before designing and implementing riverbank work as discussed in Chapter 4.

LONG TERM PROJECT AND PERSONNEL FUNDING

Murray should commit long-term funding for monitoring, management, and personnel to carry the project through the recommended phasing. An open dialog should be maintained with the community to insure continued support of city actions.

FUNDING FOR PLANT MATERIAL AND INSTALLATION

Adequate funding for plant material and installation should be made available over an extended period of time. Planting should proceed in phases as recommended in Chapter 4.

PERMITS AND COORDINATION

PERMITS AND AGENCY COORDINATION

Approval from various agencies will be required before work can be done on the Jordan River, Little Cottonwood Creek, and the wetlands. Information on required permits should be obtained from from County Flood Control, State Engineer, and Army Corps of Engineers.

WATER SUPPLY

Water sources must be adequate for proposed wetland enhancement and creation projects. Permanent sources of water should be identified and the feasibility of maintaining or increasing water supply to the wetland areas studied. Coordination with the irrigation company will help to define times of peak and minimum flows.

JORDAN RIVER CORRIDOR HABITAT

Murray should cooperate with Salt Lake County to preserve and enhance the west side of the Jordan River as wildlife habitat. Development and management of both sides of the river should be complementary. A county wildlife habitat protection ordinance amendment may be considered for the west side of the river. More information on urban wildlife habitat protection ordinances can be found in *A Wildlife Conservation Guide for Urbanizing Areas in Utah* by Craig Johnson, Professor in the Landscape Architecture and Environmental Planning Department at Utah State University in Logan, to be published in 1991.

EDUCATION

COMMUNITY EDUCATION AND OUTREACH

An education and community outreach program should be developed. Community efforts could help in project implementation as discussed in Chapter 4; the community could also collect natural resource data as discussed in Chapter 5. Long-term maintenance agreements with schools and civic groups could help with weeding and litter cleanup, similar to the state adopt-a-highway program. Groups such as the Native Plants Society and school environmental and science clubs could participate in educating the public about the Jordan River environment. Community involvement also sets an example for other communities that may want to start a similar project.

NEIGHBORHOOD HABITAT DEVELOPMENT

Homeowners could enhance wildlife habitat in their yards to take advantage of the species attracted to the Jordan River Nature Park. *A Homeowners Guide to Landscaping for Wildlife* by Sue Nordstrom and Kathlyn Collins provides a basic guide and native plant lists for Utah homeowners. See Appendix H.

LAW ENFORCEMENT

SECURITY

City security personnel should be provided to adequately patrol the park and to operate the night gates proposed in the master plan. Other options include organizing neighborhood watch security and cleanup. Concern for personal safety in the park and for adjacent property protection was expressed by residents in community meetings. Security will also help to deter vandalism to plants and destruction of wildlife.

DOMESTIC ANIMALS

Free roaming dogs and cats may pose a problem in the Nature Park. They can be destructive to wildlife either by killing or disturbing the wildlife during stressful periods of nesting and raising broods. For these reasons, all dogs should be required to be on leash in the Nature Park. Domestic ducks can also create a problem when they breed with wild ducks, increase in number, and fed by the public. Domestic ducks should be removed and the public educated to the fact that a duck feeding pond is not one of the objectives of the Nature Park. Feeding of any animals should not be permitted in the Park.

CHAPTER 7
CONCLUSIONS AND IMPLICATIONS

This project report has presented the findings of extensive research for ways of enhancing wildlife habitat and formulating a vegetation plan for a natural urban park along the Jordan River. The objective of the planting plan for the park is to recreate the mosaic of native riparian, wetland, and upland vegetation communities of the Jordan River. Native plants adapted to the soil, water, and climate of the site should be used. The intent is to attract indigenous wildlife species and provide a pleasant, safe recreational experience for park users with an increased chance for human/wildlife interactions.

Information was gathered from a variety of sources: conferences, scientific literature, university researchers, land managers, and private consultants. Identification, establishment, and management of three native vegetative communities -- wetland, upland, and riparian -- were researched along with the potential for using native plants under irrigation. Information was gathered from wetland, upland, and riparian scientists and wildlife managers, streambank stabilization experts, botanists, landscape architects, landscape maintenance managers, nursery operators, engineers, and park planners. Literature on native plants and their establishment and the use of the principles of succession and ecology in habitat restoration and management was reviewed.

After reviewing the information gathered from these sources, it was found that more research is needed, specifically in riparian and wetland vegetation for the Jordan River, hydrology of the Jordan River watershed, and habitat restoration in an urban environment. The riparian and wetland vegetation for the Jordan River needs to be studied and classified. The vegetation of the river corridor, situated between the Great Basin Desert and Wasatch Range, is influenced by these geographic areas as well as by plant introductions from agriculture and urbanization. General hydrologic characteristics of the Jordan River basin have been studied, but research is needed on the specific impacts of urban development on the Jordan River, its tributaries and associated wetlands. Habitat restoration efforts in the context of urban development should replicate and test the methods of larger scale range and forest improvement, as well as mine reclamation and restoration research. However, emphasis on the use of native plants is needed rather than the introduced species preferred for soil stabilization and forage.

Opportunities for habitat development in the urban environment along the Jordan River pose particular challenges. The ground water table is lowered, and the river banks are only partially stable due to poor past management practices. The main river channel course cannot be allowed to change. Stream flow regimes have been altered by control for irrigation. Weeds have invaded the soils disturbed by agriculture, filling, and development. The site lacks specific topographic information needed for wetland creation and enhancement. Human recreational use and its impacts on habitat and river stability must also be considered.

The site, however, does have many positive attributes. The site contains areas of wetland soils with some stream flows to aid in wetland enhancement and creation. A variety of native plant and wildlife species is present, particularly in the wetland areas. And, importantly, city and community support have insured protection through the acquisition of key land parcels.

The project is proposed to be phased over a minimum of 3 years for any one part of the site. Implementing the first phase is intended to target the most obvious problems such as trash removal over the entire site. The second phase is designed to concentrate on habitat development in the wetland, upland, and riverbank areas of the site. Phases could be extended or overlapped, depending on the time available for implementation and cost.

The project must be monitored over a long period of time in order to maintain structural vegetative diversity to meet the stated goal of maximum wildlife species. Close monitoring can immediately correct problems and undesirable conditions. Continual dialog with Murray residents about the implementation and management practices will be necessary to generate a positive outlook and support for the project. Information from implementation and management successes and failures should be recorded to aid in future decisions for this site and on the rest of the Jordan River Parkway.

The proposed Jordan River Nature Park vegetation plan provides Murray with information and options for implementation. The plan allows flexibility for adjustment according to Murray's resources, field conditions, and new information. The city must now prioritize and plan their course of action with the vegetation plan in conjunction with the proposed Jordan River Parkway Master Plan.

REFERENCE LIST

Bachman, Val. 1990. Personal communication. Ogden, UT: Ogden Bay Refuge.

Beagle, Glen. 1990. Personal communication. Draper, UT: Lone Peak State Nursery.

Brough, Clayton, D. L. Jones, and D. J. Stevens. 1987. Utah's comprehensive weather almanac. Salt Lake City, UT: Publishers Press.

Bureau of Economic and Business Research. 1987. Statistical abstract of Utah. Salt Lake City, UT: Graduate School of Business, University of Utah.

Decker, Henry F. and J. M. Decker. 1988. Lawn care: A handbook for professionals. Englewood Cliffs, NJ: Prentice-Hall.

Dewey, Steven A. 1990. Utah weed control handbook 1990. Logan, UT: Utah State University Extension Service.

Dixon, Sam. 1989. Personal communication. Salt Lake City, UT: Salt Lake City Mosquito Abatement District.

Fairchild, John. 1990. Personal communication. Salt Lake City, UT: Utah Division of Wildlife.

Federal Interagency Committee for Wetlands Delineation. 1989. Federal manual for the identifying and delineating jurisdictional wetlands. Washington D.C.: Cooperative Technical Publication, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S.D.A. Soil Conservation Service.

Forman, Richard T. and M. Godron, 1986. Landscape ecology. New York: Wiley.

Geis, A.P. and L.W. Van Druff. 1978. Developing wildlife habitat in urban areas. Laurel, MD: U.S. Fish and Wildlife Service, unpublished manuscript.

Gilbert, Barry. 1989. Personal communication. Logan, UT: Department of Natural Resources, Utah State University.

Gray, Donald H. and A. T. Leiser. 1982. Biotechnical slope protection and erosion control. New York, Van Nostrand Reinhold.

Gregory, Robin. 1990. Personal communication. Jackson, WY: Landscape Architect, Teton National Park.

Harrison, Ty. 1990. Personal communication. Salt Lake City, UT: Westminster College.

Jensen, Steven. 1987. Stream reach inventory and channel stability evaluation for the Jordan River in Salt Lake County, Utah. Salt Lake City, UT: State of Utah Department of Water Quality, Salt Lake City and County Health Department, Division of Environmental Health.

Jensen, Steven. 1989. Jordan River wetlands advanced identification study, wetland functional assessment interpretive report. Salt Lake City, UT: State of Utah Bureau of Water Quality, Division of Environmental Health.

Johnson, Cindy. 1990. Personal communication. Logan, UT: Ecosystems Research Institution, Inc.

Johnson, Craig W., F. A. Baker and W. S. Johnson. 1990. Urban and community forestry, a guide for the interior western United States, 2n ed. Ogden, UT: USDA Forest Service, Intermountain Region.

Kadlec, John A. 1990. Personal communication. Logan, UT: Department of Natural Resources, Utah State University.

Kadlec, John A. and W. A. Wentz. 1974. State-of-the-art survey and evaluation of marsh plant establishment techniques: Induced and natural. Ann Arbor, MI: School of Natural Resources, University of Michigan.

Kaiser Associates and Genge Consultants. 1979. Provo-Jordan River Parkway: Master implementation plan. Salt Lake City, UT.

Knopf, Fritz L. 1988. Riparian wildlife habitats: More, worth less, and under invasion. In Restoration, creation and management of wetland and riparian ecosystems in the American West: Proceedings of the symposium in Denver, CO, November 14-16, 1988, by the Rocky Mountain Chapter of the Society of Wetland Scientists, 20-22.

Leopold, Aldo. 1933. Game management. New York: Charles Schribner Sons.

MacMahon, James A. 1981. Successional processes: Comparisons among biomes with special reference to probable roles of and influences on animals. In Forest succession: Concept and application. eds. D.C West, H.H. Shugart, and D.B. Botkin, 277-304. New York: Spranger-Verlag.

_____. 1983. Nothing succeeds like succession: Ecology and the human lot. Logan, UT: Utah State University Press.

_____. 1987. Disturbed lands and ecological theory: an essay about a mutualistic association. In Restoration Ecology. eds. W.R. Jordan, M.E. Gilpin and J.D. Aber, 222-237. Cambridge, MA: Cambridge University Press.

Morgan, Dale L. 1986. The Great Salt Lake. 2nd ed. Lincoln: University of Nebraska Press.

Morrison, Darrell G. 1982. Principles of revegetating mined lands. In Wildlife values of gravel pits. eds. W.D. Svedarsky and R.D. Crawford, 51-59. St. Paul, MN: University of Minnesota, Agriculture Experiment Station, Pub. 17.

Newman, Oscar. 1972. Defensible space. New York: Macmillan.

Pendleton, Steve. 1990. Personal communication. Sandy, UT: Progressive Plants Nursery.

Platts, William S. et. al. 1987. Methods for evaluating riparian habitats with applications to management. General Technical Report INT-221. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station.

Price, Don. 1985. Ground water in Utah's densely populated Wasatch Front area: The challenge and the choices. Salt Lake City, UT: U.S. Geological Survey Water-supply Paper 2232.

Sanders, William D., J.B. Burley and C.A. Churchwood. 1982. A study for vegetation and wildlife habitat on lower Grey Cloud Island. In Wildlife values of gravel pits. eds. W.D. Svedarsky and R.D. Crawford, 102-108. St. Paul, MN: University of Minnesota, Agriculture Experiment Station, Pub. 17.

Schiechtl, Hugo M. 1980. Bioengineering for land reclaimation and conservation. Edmonton, Alberta, Canada: University of Alberta.

Seiler, Ralph L. and K.M. Waddell. 1984. Reconnaissance of the shallow-unconfined aquifer in Salt Lake Valley, Utah. Salt Lake City, UT: U.S. Geological Survey Water-resources Investigations Report 83-4272.

Sortir, Robin. 1990. Personal communication. Portland, Oregon.

Toth, Richard E. 1990. Hydrology and riparian systems: The foundation network for landscape planning. Presented at the International Conference on Landscape Planning in Hannover, Germany, 6-8 June.

Trautman, C.G. 1982. History, ecology and management of the ring-necked pheasant in South Dakota. Pierre, SD: South Dakota Department of Fish and Parks.

Tuttle, Merlin D. 1988. America's neighborhood bats. Austin, TX: University of Texas.

U. S. Department of Agriculture, Soil Conservation Service. 1974. Soil survey of Salt Lake Area, Utah.

U.S. Department of Commerce, Environmental Data Services. 1968. Weather atlas of the United States.

Urban Technology Associates. 1971. Jordan River Parkway: An alternative "from liability to asset". Salt Lake City, UT.

van der Valk, Arnold G. 1981. Succession in wetlands, a Gleasonian approach. Ecology 62: 688-696.

_____. 1988. From community ecology to vegetation management: Providing a scientific basis for management. In Transaction of the 53rd National Willdife and Natural Resources Conference.

van der Valk, Arnold G. and C.B. Davis. 1978. The role of seed banks in the vegetation dynamics of prairie glacial marshes. Ecology. 59 (2): 322-335.

Weller, Milton. 1978. Management of freshwater marshes for wildlife. In Freshwater wetlands. eds. R.E. Good, D.F. Whigham and R.L. Simpson, 267-284. New York: Academic Press.

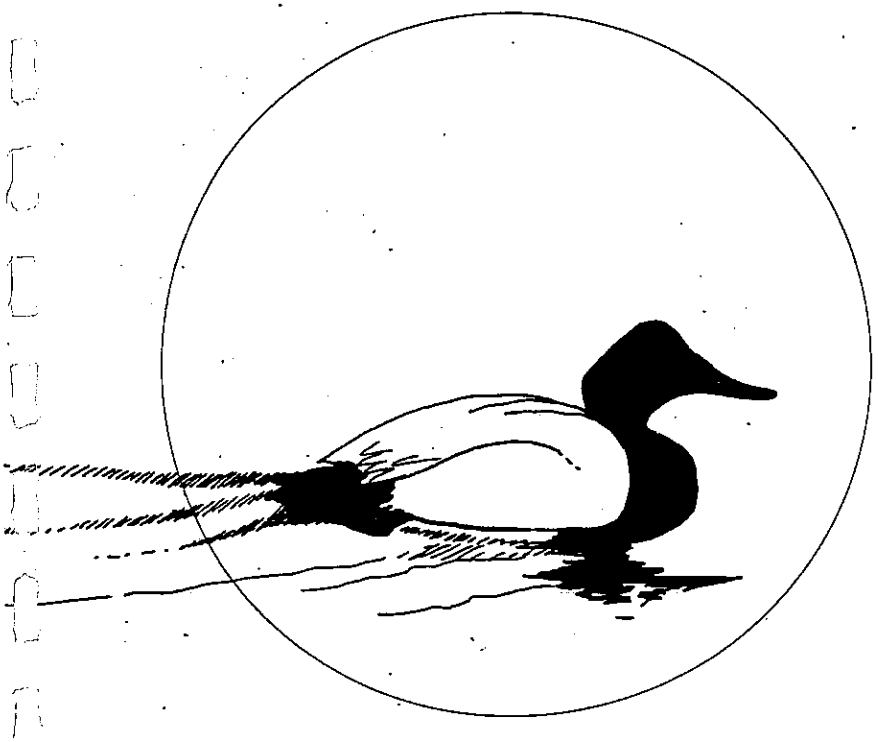
_____. 1981, 87. Freshwater marshes: Ecology and wildlife management. 2nd edition. Minneapolis, MN: University of Minnesota.

_____. 1987. The influence of hydrologic maxima and minima on wildlife habitat and production values of wetlands. In Wetlands Hydrology: Proceedings of the National Wetland Symposium in Chicago, IL, September 16-18, 1987, 55-60. 45.

Yahner, Richard H. 1988. Changes in wildlife communities near edges. Conservation Biology. 2 (4): 333-339.

APPENDIX A
MURRAY CITY, JORDAN RIVER PARKWAY:
A MASTER PLAN FOR THE 1990'S

MURRAY CITY JORDAN RIVER PARKWAY



Murray City

A-1

Lynn Pett
Mayor

P. Gary Ferrero
Councilperson District #1

Lynn H. Turner
Councilperson District #2

Julie L. Davis
Councilperson District #3

Arline Gillen
Councilperson District #4

Mary-Jane Ashton
Councilperson District #5

Bill Crocker
Parks and Recreation Director

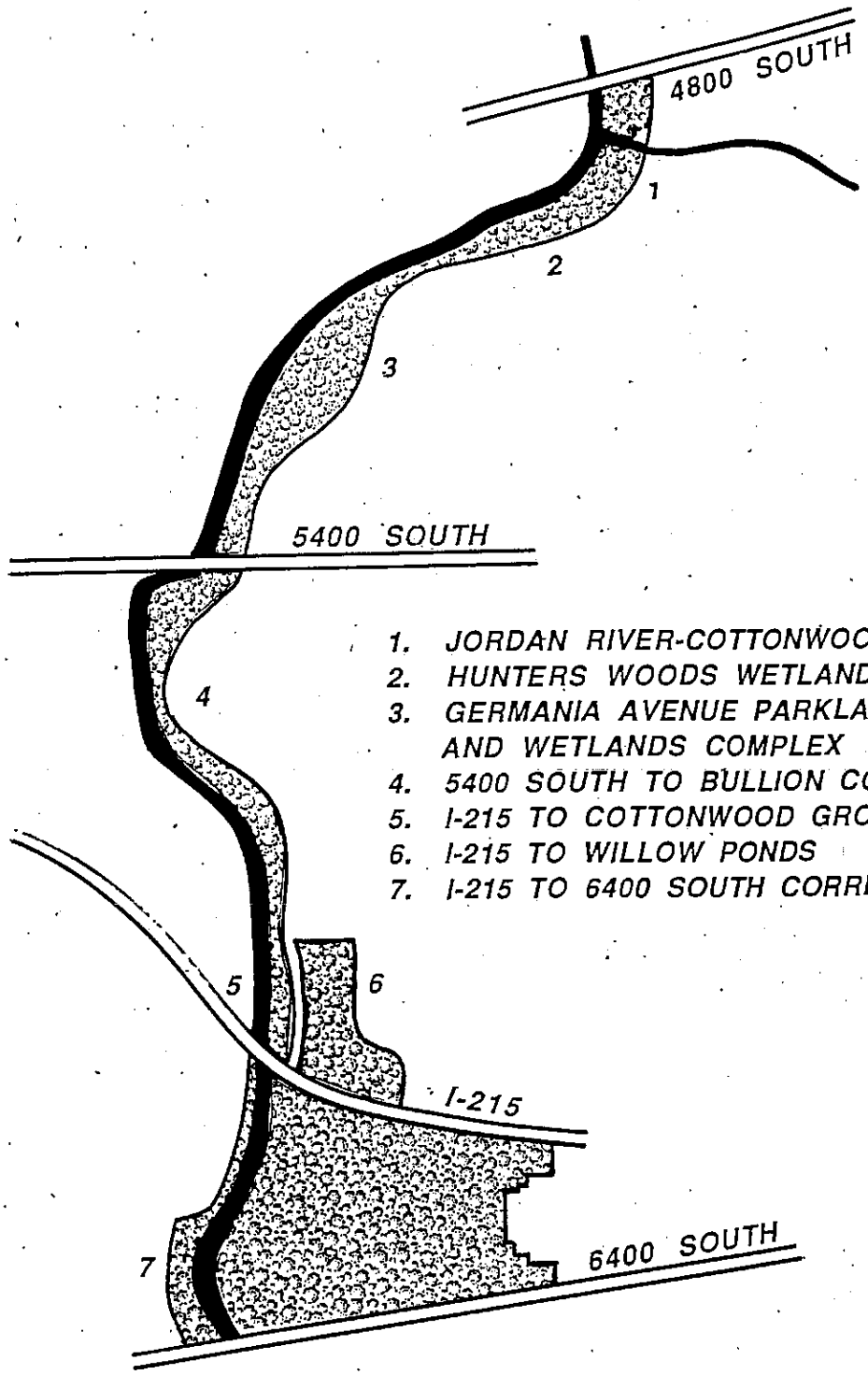
August, 1990

Prepared by

Utah State University
Department of Landscape Architecture
and Environmental Planning
Environmental Field Service Program

Craig W. Johnson
Project Director

Kathlyn Collins
Paul Larsen
Anne Spranger
Research Assistants



1. JORDAN RIVER-COTTONWOOD CREEK
2. HUNTERS WOODS WETLAND COMPLEX
3. GERMANIA AVENUE PARKLAND AND WETLANDS COMPLEX
4. 5400 SOUTH TO BULLION CORRIDOR
5. I-215 TO COTTONWOOD GROVE
6. I-215 TO WILLOW PONDS
7. I-215 TO 6400 SOUTH CORRIDOR

JORDAN RIVER PARKWAY-MURRAY CITY, UTAH

Orientation Map

Detail maps of designated areas are located at the end of this report.

MURRAY CITY JORDAN RIVER PARKWAY

An Introduction

FOR thousands of years the Jordan River meandered back and forth across its broad floodplain. Each spring the river overflowed its bank cutting new channels in unpredictable directions and depositing silt in old oxbows. The resulting landscape, richly patterned and structurally diverse, became a haven for wildlife. Migrating species by the tens of thousands used the marshes and riparian woodlands as a rest stop; many stayed and raised their young in the cattails, willows, and cottonwood trees that lined the Jordan's banks.

The Mormon pioneers were the first to impose the geometric patterns of settlement along the Jordan. The grid of streets and buildings that became Murray City sprang up east of the river along Little Cottonwood Creek. Farms and fields spread westward from the center of town across the grasslands to the edge of the Jordan. Slowly, over time, houses, shops, and offices displaced the farms, fields, and remnants of native vegetation. In recent years development has sprawled out onto the floodplain. The Jordan River was channelized in the 1980s, and its banks armored with concrete rubble and other debris to arrest bank erosion and protect riverside properties.

The river no longer meanders aimlessly. Instead it cuts deeper into the earth carving steeper banks and lowering the water table. Old oxbow wetlands that were once replenished by ground water and the spring floods are now dry most of the year. The dynamic and diverse Jordan River ecosystem is disappearing.

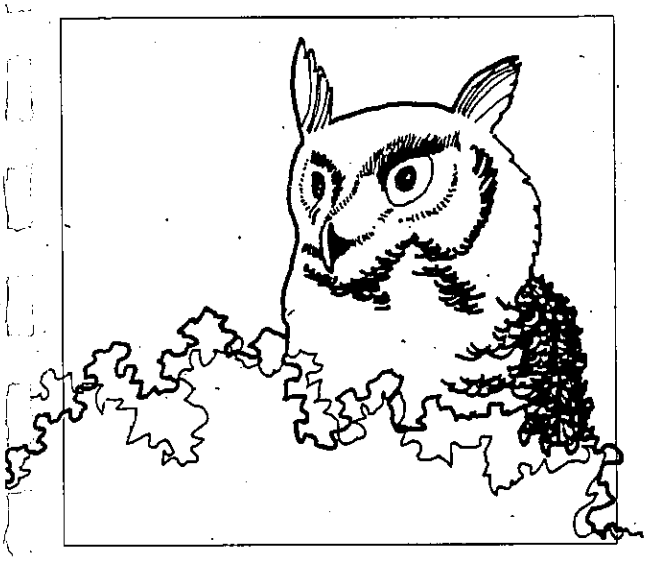
The Jordan River floodplain is not the haven for wildlife it once was, however much of the wildlife habitat potential remains and can be reclaimed. Over 100 different species of wildlife have been observed along the Jordan River in Murray in recent years. Many species that used to frequent the floodplain could be enticed to return if the habitat were enhanced. Indeed, the potential for creating a rich, diverse and vital urban open space that meets the habitat needs of wildlife and the recreational and educational needs of Murray residents is unequaled in the Salt Lake Valley.

"Indeed, the potential for creating a rich, diverse and vital urban open space that meets the habitat needs of wildlife and the recreational and educational needs of Murray residents is unequaled in the Salt Lake Valley."

Purpose of the Parkway Master Plan

THE purpose of this master plan is to illustrate how Murray City can take advantage of the unique natural resources of the Jordan River floodplain. It recommends ways to enhance those areas along the river that have been neglected or abused. The plan proposes to reestablish, to the extent possible, the structural, functional, and visual characteristics of the Jordan River ecosystem that existed prior to the settlement. It recommends introducing a limited number of recreational activities that would be compatible with protecting and enhancing wetland and wildlife habitat values. The master plan provides a vision of how the Jordan River Parkway in Murray can be expanded and enhanced to meet the needs of a growing community.

This master plan has been prepared to guide the actions of the citizens of Murray and its elected officials who wish to capitalize on the recreational and educational benefits the Jordan River affords.



Benefits of Parkway Development

THERE are numerous aesthetic, educational, recreational and ecological benefits that will accrue to Murray City residents with the development of the parkway. A parkway along the Jordan River will provide a welcome visual relief from the pavement and buildings of the city. An expanded and enhanced parkway will create new and more productive habitat for desirable species of birds, mammals, amphibians and reptiles that presently inhabit the area and will attract many new species. It will provide a setting for that essential connection between the natural world and city dwellers.

The proximity of the parkway to residential neighborhoods and schools affords exciting educational opportunities. A nature center, interpretive signs and nature trails, could make community residents and visitors more aware of the Jordan River ecosystem. Natural areas along the river can become outdoor science classrooms for the local schools. The parkway also offers opportunities for other types of active and passive recreation including ball fields, tennis courts, hiking, biking, jogging and equestrian trails, picnicking, boating, and fishing. When completed, the parkway will provide Murray residents with over 2.3 miles of continuous open space linked together by a network of trails.

Wetlands within the parkway have the potential to treat storm water runoff prior to discharge into the Jordan River (Jensen 1983). These wetlands could become key elements in Murray City plans to comply with EPA wastewater discharge standards in a cost efficient manner.

Reopening the wetlands to seasonal flooding during periods of high flow in the Jordan River will enhance their function as flood retention basins, protecting property within the city and downstream. Restoration of the complex native plant communities that once existed along the river will bring biological stability to the remnants of the floodplain included in the parkway.

The Goal of the Parkway Master Plan

THE goal of the Jordan River Parkway Project is to provide present and future residents of Murray City with a unique open space that reestablishes the riparian ecosystem and expands recreational and educational opportunities by creating a continuous parkway along the Jordan River within Murray City

Objectives of the Parkway Master Plan

TO realize this goal, several objectives must be met. Community support must be mobilized, funds must be raised, parkway lands must be acquired, and a detailed re-vegetation plan must be prepared.

Community Support

THE preparation of the master plan relied heavily upon public participation. The Mayor and City Council established a Parks and Recreation Board to coordinate public input and oversee the development of the plan. The board held numerous meetings during 1989 to discuss the project. Informal neighborhood meetings are planned in each Council District to solicit formal public input. Citizen concerns gathered from these public hearings already completed will be used to finalize plans. Draft plan elements were reviewed by the Murray City Engineering Department, Army Corps of Engineers, Utah Division of Wildlife Resources, and Salt Lake City-County Division of Environmental Health. The plan was also reviewed by the Murray City Council on two occasions and was approved conceptually by the Council and Mayor in March of 1990.

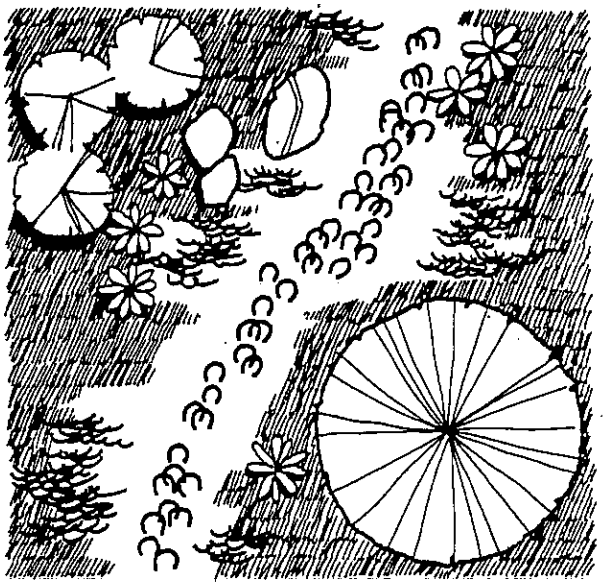
Funding

THE Jordan River Parkway has received support from various sources. Land and Water Conservation funds of over 1 million dollars were used to complete the first phase on Jordan River Parkway development in Murray which was the Golf Course. Its success prompted the Mayor and City officials to secure a 1.2 million Revenue Bond for land acquisition for limited development. Revenue from the Golf Course will be used to pay back the bond debt. Grants from the Jordan River Parkway Foundation in the amount of $16,000.00 will be used to construct a footbridge across the Jordan River for connecting trails. Also, a grant is expected from the EPA to use the Jordan River Parkway between 6400 South and I-215 as a model project on bank stabilization and re-vegetation.

Development of the Jordan River Parkway lends itself nicely to volunteer participation. Planting, trail construction, and seeding are but a few of the types of activities that can be effectively accomplished by volunteers. The contributions of volunteers not only help complete projects at reduced costs but also instill in the participants a sense of pride, accomplishment, and ownership in the project. Service clubs, neighborhood organizations, special interest groups, scouts, and school children can all make contributions as volunteers, i.e., Earth Day observance where through the efforts of the Mayor's office, Parks and Recreation Department, Community Progress Committee, Boy Scouts of America, City Council and citizens, over 300 people participated in a clean up of the Jordan Parkway area. Funding can also be supplemented with in-kind contributions of time, material, and equipment.

Acquiring Parkway Lands

ALL additional lands necessary to complete a continuous parkway along the Jordan River will be purchased with recently approved bond monies. In 1972 Murray City officials had the foresight to commission architects to complete the first master plan for the Jordan River Parkway from 6400 South to 4500 South. Since then property has been acquired when matching funds were available. In addition to the 150 acre Golf Course, approximately 60 acres have been purchased along the river bank northward. Since the first plan was prepared, changes in development, growth, and new federal wetland use regulations along the parkway, made it necessary to update the master plan. Therefore, in 1987 the Mayor and City officials contracted with Utah State University, Department of Landscape Architecture and Environmental Planning, for this current Master Plan. Murray has done its job in conserving this valuable recreational resource. However, the ideal parkway would also include all floodplain lands on the west bank of the Jordan, lands that are presently in the county. County planners and other officials need to be encouraged to seriously consider acquisition and dedication of west bank floodplain properties for parkway uses. Only through a coordinated effort between Murray City and the county will the full potential of the parkway be realized.



"The Jordan River floodplain is not the haven for wildlife it once was, however much of the wildlife habitat potential remains and can be reclaimed."

Master Plan Elements

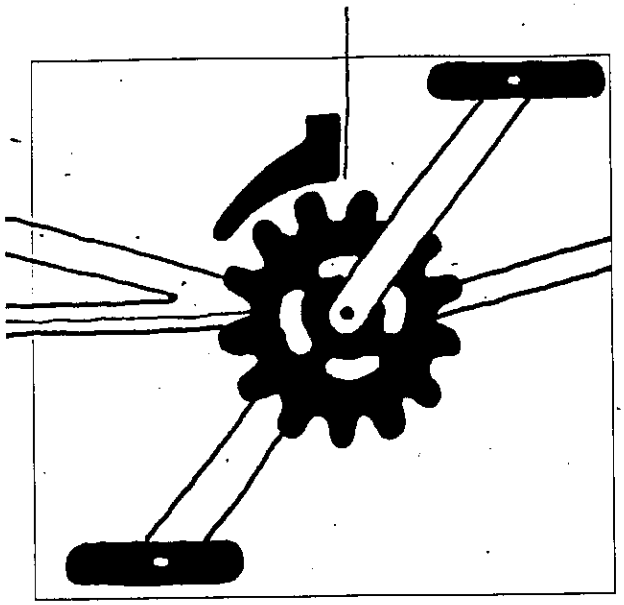
THIS section of the report describes the proposed development of each segment of the Jordan River from 4800 South to 6400 South. The maps and sketches presented here represent what can be done to make the optimum use of Murray City's parkway along the Jordan River. Figure 1 shows the entire parkway system and identifies individual segments. The other maps and graphics illustrate specific planning and design recommendations for each segment of the parkway. The text explains the major design features of each segment.

The master plan is intended to provide a vision of parkway development possibilities. It is comprehensive. The plan proposes use recommendations for all land in the parkway, recommends future acquisitions, suggests phasing for development, sets design standards, and ensures continuity over time through changes in city government leadership. It does not include detailed site plans for individual parkway segments. Detailed site plans and comprehensive plans for river channel and wetland design should be prepared by licensed landscape architect and civil engineering consultants. The forms, spaces, materials, and design details of each site plan should reflect the environmental sensitivity and natural aesthetic established in the master plan.

"The master plan is intended to provide a comprehensive vision of parkway development possibilities."

Trails

A walk, run, or cycle ride along the proposed parkway trail system would reveal to Murray residents the diverse and beautiful landscape hidden away beside the Jordan River. Each segment of the parkway from the Hunters Woods Wetland Complex to the I-215 Cottonwood Grove affords different recreational opportunities and aesthetic experiences. The trail system will be the thread that ties together all the diverse activities planned along the parkway. The primary hiking and biking trails are continuous from 4800 South to 6400 South. In most locations the 2 trails are parallel and where space is available, separated for safety. Secondary trails have been proposed to provide access to natural areas and parkway facilities and to connect with the walk systems of adjacent neighborhoods. Approximately 5 miles of trails would be provided. A separate equestrian trail has also been included in the plan. It would link the nature center in the north with a trailhead and picnic area at 6400 South. Hitching rails would be provided at numerous locations so that riders could dismount and participate in various parkland activities.



Jordan River-Cottonwood Creek Parkland

THE parkland south of 4800 South and west of Murray Boulevard has been designed to accommodate family and group picnic activities. Five picnic shelters, one restroom, play equipment, boat dock, bike rack, parking for 32 cars, and a pedestrian bridge over the Little Cottonwood Creek have been proposed. Fishing is also expected to be a popular activity at this site. The parkland would be irrigated to support lawn areas and trees.

Substantial site regrading, debris removal and topsoiling will be required before the construction of facilities can begin. All existing riparian vegetation would be protected during site preparation and construction except where re-contouring of high stream banks is required.

Hunters Woods-Wetland Complex

THE wetlands west of the Hunters Woods Development south and west to Lucky Clover Lane have been designed for wildlife habitat and nature study in conjunction with their function as detention basins for urban runoff and return irrigation water. The plan proposes to enhance the existing wetlands by constructing a low dike and water control structure across the existing outlet at a location just west of the radio tower. Some dredging of the existing wetlands is also proposed to create more open water areas of value to wildlife. A siltation basin is proposed for the inlet stream north and east of Vine Street. Numerous standing dead trees, old sheds, fences, piles of tree trunks, and other debris would be removed. Over-grazed pastures would be reseeded with drought-tolerant native grasses and shrubs. A tamarix eradication program is recommended for this segment of the parkway and should be applied to all other segments as well. Tamarix is an aggressive exotic plant that out-competes native species and is of little value as habitat for wildlife. To protect submerged aquatic vegetation in the reclaimed wetlands, a carp eradication program should also be considered. Carp are an introduced fish species; their bottom feeding habits uproot vegetation, create turbidity, and ultimately diminish wetland habitat value.

A nature interpretative center which would overlook the wetland is proposed on the bluff at the end of Lucky Glover Lane. A native plants garden with all plants properly labeled would also be constructed to complement the education programs at the center.

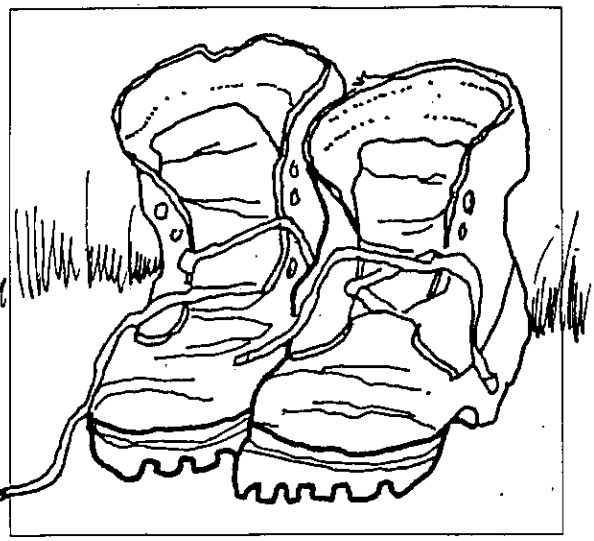
Parking would be provided in two locations: 13 cars and 3 buses at the nature center and 9 cars at the end of Vine Street. Bike racks would also be provided at both parking locations. A boat dock is proposed near the nature center to provide access for boaters to nature center activities. A series of trails with interpretative signage, 2 observation blinds, a boardwalk and viewing tower have been integrated into the wetland complex. Approximately 50 percent of the wetland would remain inaccessible to enhance its value as a habitat for wildlife.

Germania Avenue Parkland and Wetlands Complex

THE parkland complex west of Germania Avenue has been designed primarily for group and family picnic activities with substantial acreage in nature preserve. Three picnic shelters, a restroom, play equipment, bike rack, barbecue pit, horseshoe pits, and a soccer field would be provided. Parking would be provided for 56 cars. Since the parking lot is dead ended, a cul de sac has been provided to eliminate traffic congestion. A night gate is recommended so that the area can be secured after the park closes in the evening.

Approximately 7 acres in this segment of the parkway area would be irrigated to support grass and trees and to sustain the landscape which is projected to receive high levels of use during the summer months. In addition, an irrigated buffer planting between the road and east side trail and existing residential development is proposed as a fire break.

Approximately 65 percent of the land in this segment of the parkway has been classified as a wetland (Jensen 1987) and is, for all practical purposes, unsuitable for most types of development. The plan recommends that the existing wetlands be enhanced to improve their value as habitat for wildlife. Water from an existing ground water source; storm drainage and irrigation return water would be collected in several reclaimed wetlands proposed in the plan. Low dikes and control structures would be installed to regulate water levels with outlets into the Jordan River. Existing wetlands to the south would be reopened by lowering the riverbank to an elevation that would permit inflow during periods of high flow in the Jordan River.



Upland sites outside the major recreation complex would be revegetated with drought- tolerant grasses and shrubs. The banks along the Jordan River would be re-contoured to eliminate highwalls; re-vegetation using bioengineering techniques with indigenous riparian grasses, shrubs and trees is recommended.

The parkland north of 5400 South and just west of 5300 South has been proposed as a major access point for boaters and horseback riders. A boat launch and dock, horse unloading facility, and hitching rail would be provided. The proposed parking facilities would accommodate 11 cars and 6 horse trailers. This entire site would be planted with grass and trees and would be irrigated to enhance its attractiveness as the gateway into the Germania Complex.

Primary access to the Germania Complex would be off 5400 South. At present this is a dangerous intersection and the increased traffic generated by the proposed development would further aggravate the situation. A traffic control light would have to be installed at this intersection to permit safe vehicular access to the site. Pedestrians, cyclists and equestrians can safely access the site via a proposed pedestrian underpass beneath 5400 South.

5400 South to Bullion Parkland Corridor

THE narrow strip of parkland from 5400 South to Bullion Street will be bordered on the east by a proposed parkway road. The landscape between the proposed road and the river has been seriously abused. Little wildlife habitat value and few natural amenities remain. Because of the derelict condition and linear configuration of this section of the parkway, recreation opportunities are limited primarily to trail-oriented activities. However, two widenings along the river are large enough to support additional facilities. South of 5400 South, a trailhead with restrooms, picnic shelter, boat dock and parking for 20 cars has been proposed. An irrigated planting of grass, trees and riparian shrubs is proposed to reestablish wildlife habitat and aesthetic values. A second recreation complex has been designed on a wider site west of Vale Wood. The complex includes a group picnic shelter, play equipment, two tennis courts, an exercise course, bike rack, and parking for 26 cars.

Substantial re-contouring of the river bank would be required to remove dangerous highwalls throughout his section. Re-stabilization of the bank using bioengineering techniques and re-vegetation with indigenous species is proposed. Non-irrigated plantings of native species are recommended between the trail and the river.

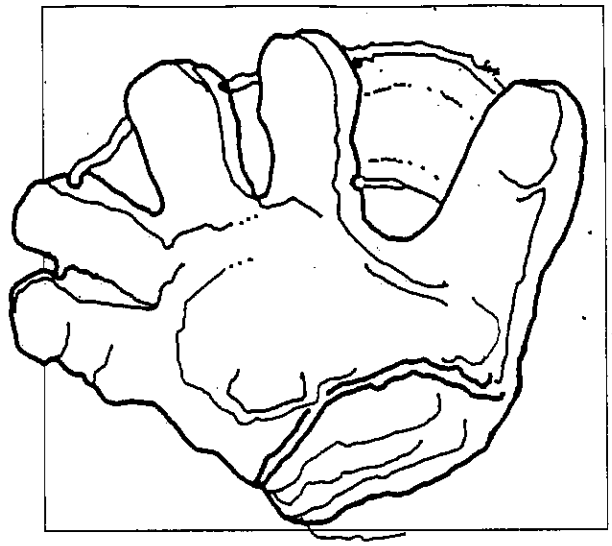
"Implementation of the Master Plan may be the impetus that motivates other communities along the Jordan to rediscover the river and undertake similar restoration projects... "

I-215 to Cottonwood Grove Parkland

THIS section of the parkway is located between Riverside Drive and the Jordan River north of I-215. General site clean up including removal of broken concrete, brush piles, and other urban debris from wetlands and old flood channels must be completed before further site development can proceed. The plan proposes to revitalize these formerly viable riparian features by diverting spring water and run off now carried in pipes along I-215 into old flood channels which drain to the north. Several new parallel channels would also be constructed to "irrigate" a large area in which cottonwood trees could be planted. Overflow water from these channels would be discharged into a reclaimed wetland west of Potomac and ultimately released through a

control structure into the river. As the stand of cottonwood trees grows toward maturity it will provide a critical riparian habitat component for many nesting and migrating species of birds. Substantial re-contouring of the river bank and revegation will also be necessary in this segment.

No specific recreation activities have been assigned to this segment of the parkway. It is expected that picnicking, bird watching, hiking, and fishing will be popular. Parking has been provided for 13 cars.



I-215 Willow Ponds Parkland

THIS site has been designed to provide for both active and passive recreation. Facilities include: a regulation baseball field, soccer field, picnic pavilion with restroom and play equipment. Two parking lots have been provided; one would accommodate 32 cars near the baseball field and another would hold 36 cars near the picnic, soccer and pond complex. All facilities and sports fields have been arranged to avoid infringing upon existing wetlands.

Several small ponds now exist in the southeast corner of the site. The plan proposes to expand and deepen them. However, before initiating pond construction, the feasibility of excavating the ponds to a depth that would provide a year long water supply sufficient to overwinter fish needs to be investigated. This will require further detailed on-site soil testing. If feasible, the ponds would be stocked with warm water fish in sufficient numbers to support fishing.

The ponds would also serve as aesthetic focal points. A picnic pavilion and boardwalk have been located on the edge of the ponds with views across the water to the east. A major tree planting program adjacent to the ponds and existing wetlands is also recommended. Trees are needs to provide a micro climate and visual setting conducive to picnicking and other forms of passive recreation. Trees would also buffer the high levels of noise emanating from I-215.

I-215 to 6400 South Parkland

THIS long narrow section of the parkway would be devoted primarily to trails and wildlife habitat because over 40 percent of the land has been classified as wetlands and is unsuitable for other uses. The main trail would cross to the west bank of the Jordan River on a footbridge just south of I-215 and continue along the west bank to 6400 South. This alignment would bypass the golf course and a recently constructed wetland retention basis.

A trailhead, picnic area, boat launch, and restroom are proposed at 6400 South west of the river. Parking would be provided for 30 cars. This segment of the parkway would be the south terminus of the Murray City Parkway System. The picnic area would be planted with trees and grass and irrigated to accommodate the anticipated high levels of use. The remainder of the parkland between the road and the river would be planted with drought-tolerant trees, shrubs, and grasses.

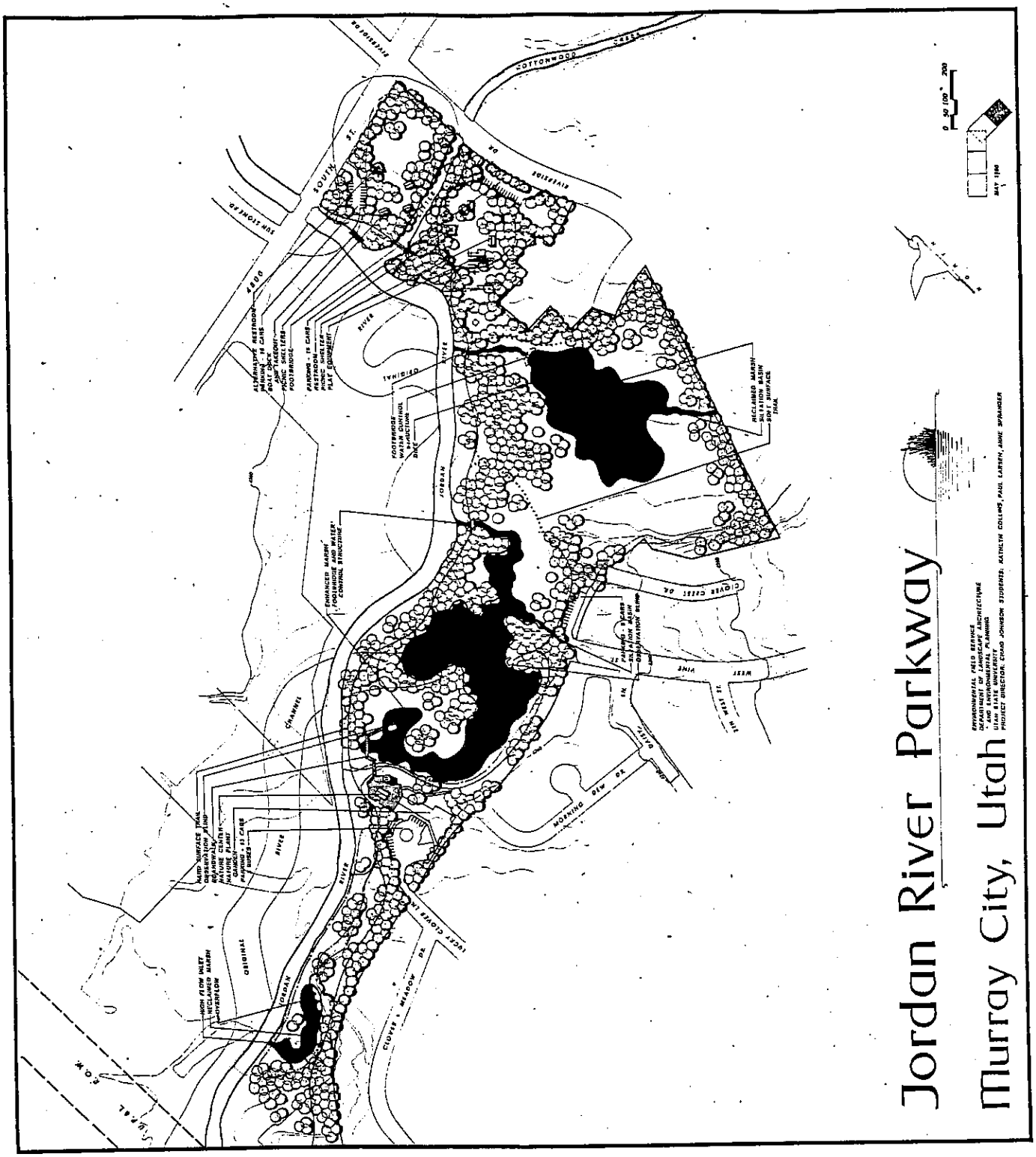
"The plan would protect and enhance valuable wetlands that yield functional, aesthetic, and wildlife habitat benefits and restore a gallery forest along the river."

Summary

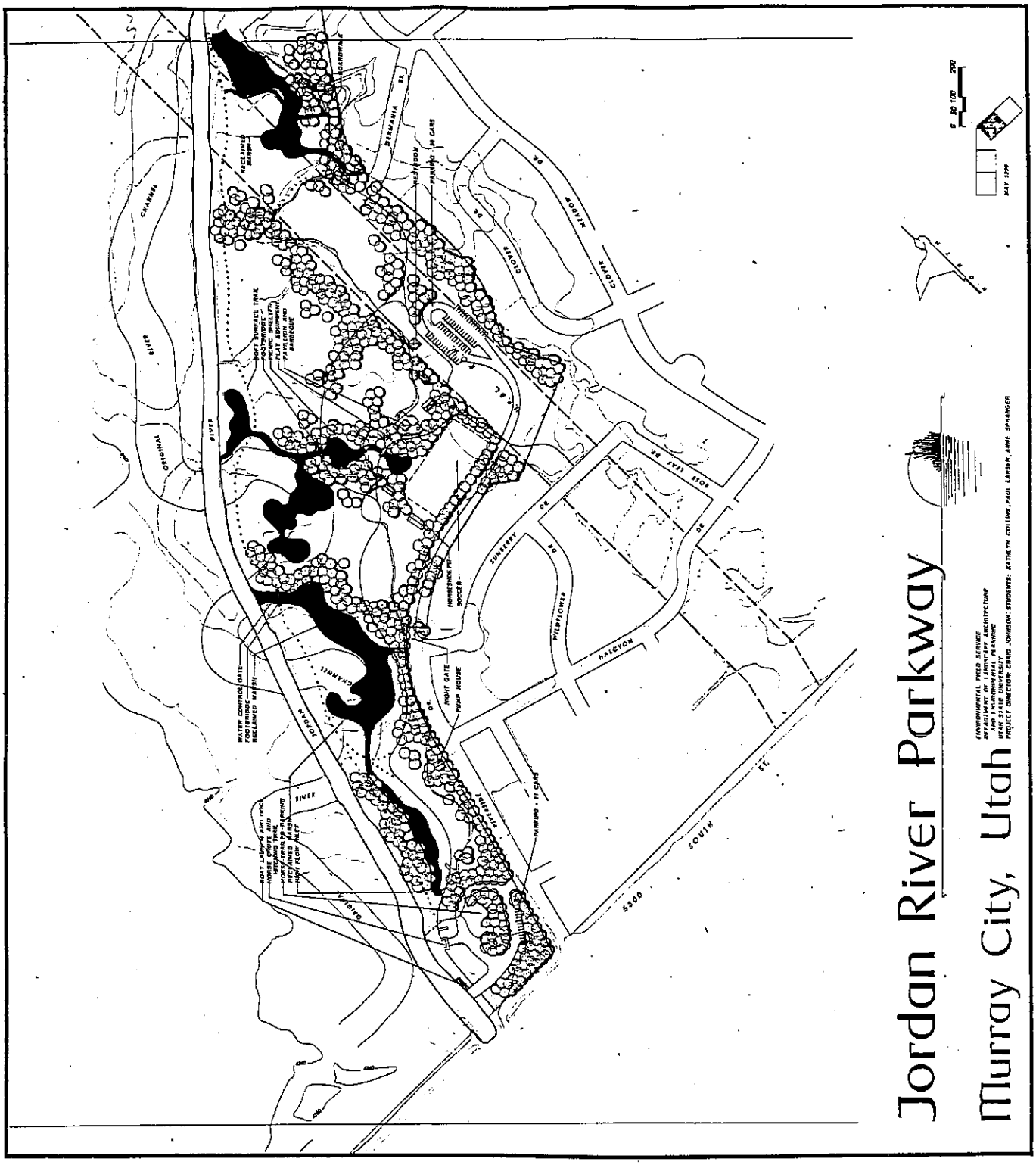
THE proposed Master Plan for the Jordan River provides a new way of experiencing nature in the Salt Lake Valley. When fully implemented, it will afford opportunities to see and learn about wildlife, catch a fish, fly a kite, picnic, ride a horse, walk and cycle miles of trail or participate in more traditional forms of active recreation. The plan would protect and enhance valuable wetlands that yield functional, aesthetic, and wildlife habitat benefits and restore a gallery forest along the river.

Realizing the vision embodied in the Master Plan will not happen over night and without effort. It will require the continued support of the citizens of Murray and their elected leaders. A commitment now to go forward with the plan will increase the prospects that the benefits of this valuable resource will be passed on to future generations. Implementation of the Master Plan may be the impetus that motivates other communities along the Jordan to rediscover the river and undertake similar restoration projects; then maybe, just maybe, the migrating flocks of birds will return as in bygone years.

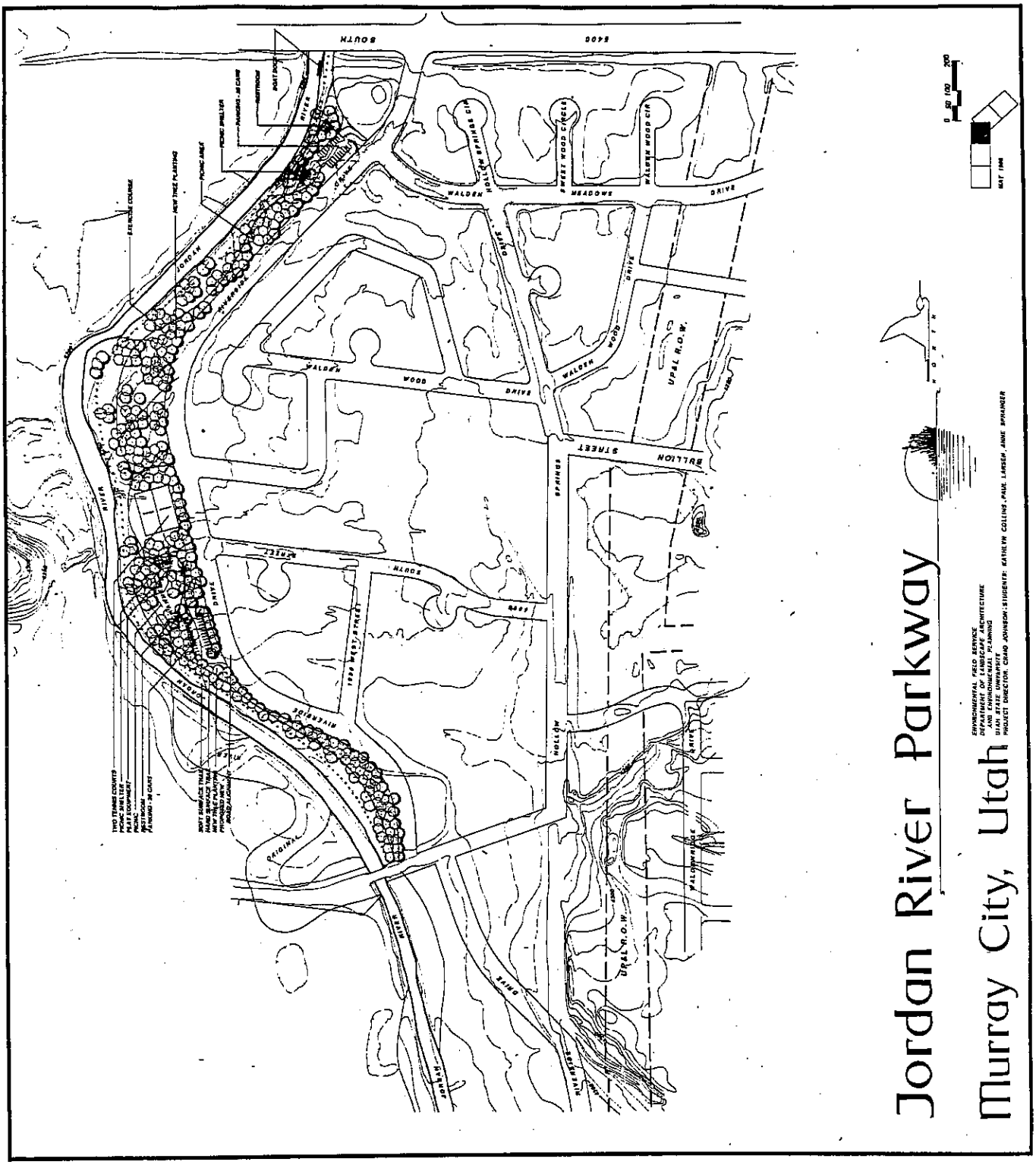
"A commitment now to go forward with the plan will increase the prospects that the benefits of this valuable resource will be passed on to future generations."



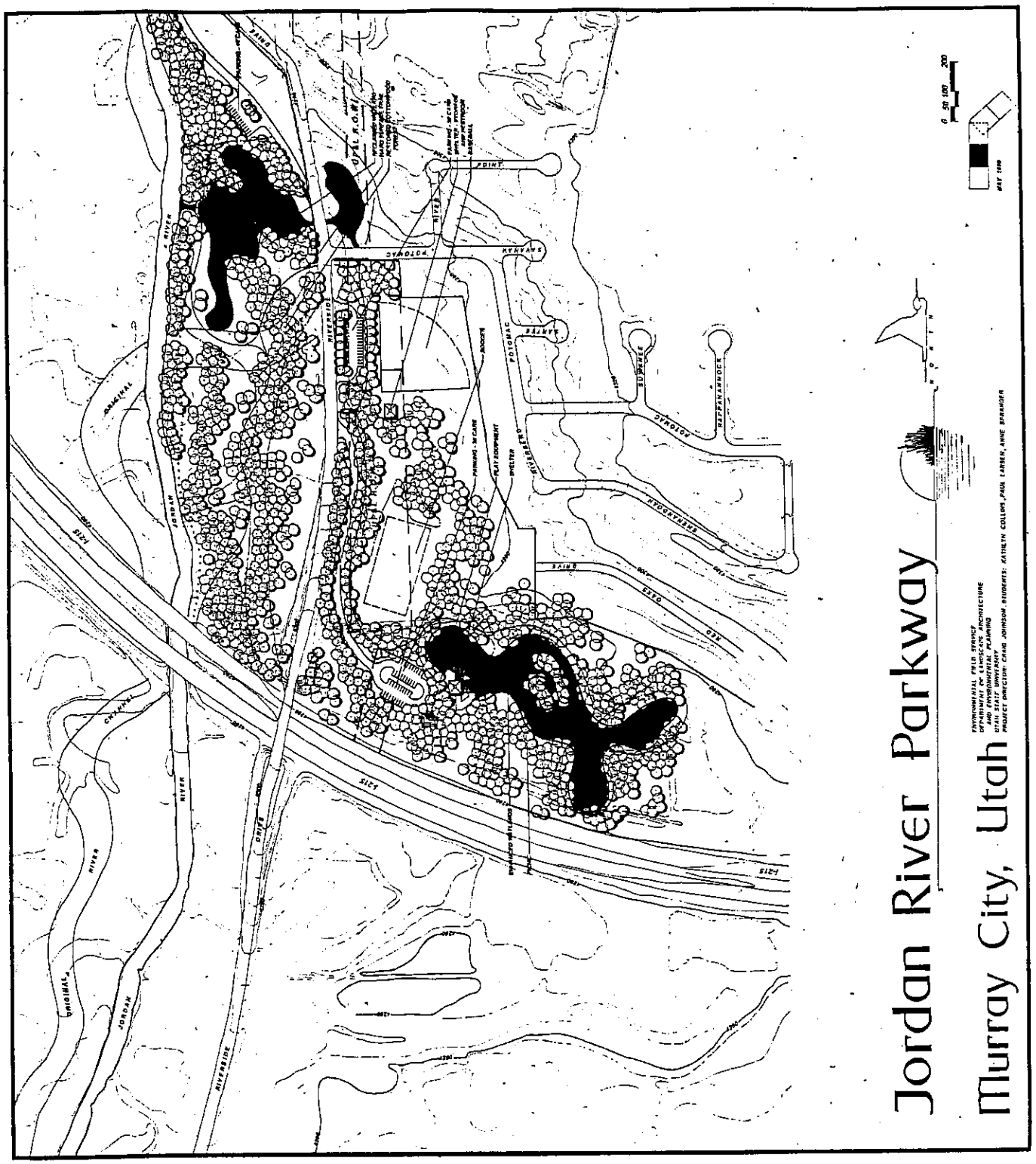
1&2 Jordan River-- Cottonwood Creek and Hunters Woods Wetland Complex



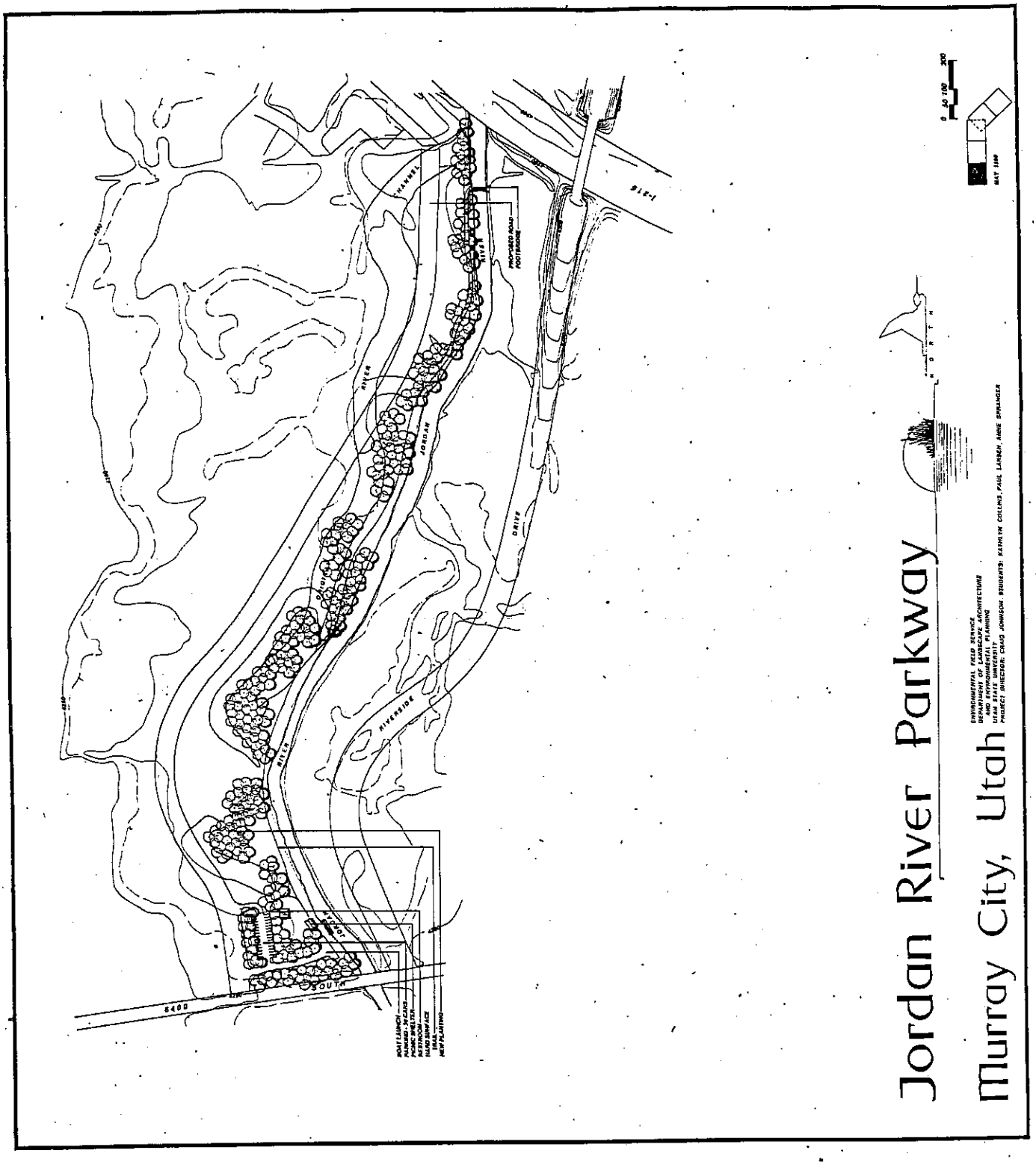
3 Germania Avenue Parkland and Wetlands Complex



4 5400 South to Bullion Complex



5&6 I-215 to Cottonwood Grove and I-215 to Willow Ponds



7 I-215 to 6400 South Corridor

APPENDIX B
LAB TEST RESULTS:
SOILS AND WATER

Contents:

Table 1. Soil test sample results.

Sample location	Soil Type	pH	EC - Soluble Salts
#1	Clay	7.95	1.43
#2	Clay loam	7.98	.23
#3	Sand and gravel	8.29	.95
#4	Clay loam	8.04	.59
#5	Sand with minimal loam	7.66	1.03
#6	Sandy loam	7.54	.39
#7	Loam (high organic)	7.66	1.69
#8	Sandy loam	7.35	.35
#9	Clay	7.84	1.19
#10	Loam (high organic, excellent quality)	7.09	1.85

Table 2. Water test sample results.

Sample location	pH	Total Alkalinity	Sodium	Nitrate	Ortho phosphate
#1	8.4	170 mg/l	85 mg/l	.25 mg/l	< 0.05 mg/l
#2	8	260 mg/l	365 mg/l	2.45 mg/l	0.09 mg/l
#3	8.6	270 mg/l	125 mg/l	1.60 mg/l	< 0.05 mg/l

Tested by Salt Lake City-County Health Department Laboratories

Samples taken March 22, 1990

APPENDIX C
WILDLIFE

Contents:

Table 3. Wildlife Observations in the Jordan River Nature Park.

Observations on the Jordan River between 4800 South and 5400 South by Kathlyn Collins; spring 1988 through spring 1990.

Early June 1988

BIRDS:

- Egret
- Tern
- Cinnamon Teal
- gull
- Magpie
- Barn swallow
- Rosy Finch
- Song sparrow
- Western Flycatcher
- Cormorant
- Mallard brood and female
- Pheasant

MAMMAL, REPTILES, AMPHIBIANS AND FISH:

- snake

Late September 1988

BIRDS:

- hawk
- quail
- Magpie
- Mallard
- Song Sparrow

October 1988

BIRDS:

- Ring-Necked Pheasant
- Common Snipe
- Killdeer
- White crowned sparrow
- Song Sparrow
- Mallard
- Northern Flicker
- Magpie
- Redwing Blackbird
- Redtail Hawk

MAMMAL, REPTILES, AMPHIBIANS AND FISH:

- fry in creek from Hunters Woods
- Beaver activity

November 1,2, 1988
BIRDS:
- Black-Crown Night Heron
- Belted Kingfisher
- sparrows
- Common Snipe
- Mallard
- Magpie
- Brewer's Blackbird
- Pheasant

MAMMAL, REPTILES, AMPHIBIANS AND FISH:
- Western Harvest Mouse (in trap)

April 6, 1989
BIRDS:
- Avocets

May 5, 1989
BIRDS:
- Forster's Terns
- Say's Pheobe
- Great Blue Heron
- Mallard Broods
- Cinnamon Teal
- Mourning Doves
- 2 Avocets on river bank
- Magpie
- Kildeer

May 25, 26, 1989
BIRDS:
- Cowbird
- Song Sparrow
- Pheasant
- Magpie
- Stilts
- Forster's Tern
- Bank Swallow
- Violet Green Swallow
- Barn Swallow
- Redwing Blackbird
- Mallards
- Great Blue Heron
- Black Crowned Night Heron
- Nighthawk

MAMMAL, REPTILES, AMPHIBIANS AND FISH:
- ground squirrel
- bats (two species)
- Western Harvest Mouse (in trap)
- Chorus Frogs

Nov. 20, 1989

BIRDS:

sparrows
shorebird activity in mud
Northern Flicker
Starlings

MAMMAL, REPTILES, AMPHIBIANS AND FISH:

fresh Beaver cutting

Table 4. Bird List for the Jordan River Nature Park.

Documented general observations Jordan River between 4800 South and 5400 South since 1983 by Terry Sadler of Murray, Utah. Additional observations by Kathlyn Collins indicated by **.

GREBES
_Pied-billed Grebe
PELICANS
_White Pelican
_Double-crested Cormorant
HERONS
_Great Blue Heron
_Snowy Egret
_Black-crowned Night Heron
_White-faced Ibis
WATERFOWL
_Canada Goose
_Green-winged Teal
_Mallard
_Northern Pintail
_Cinnamon Teal
_Gadwall
_Redhead
_Common Merganser
HAWKS AND EAGLES
_Turkey Vulture
_Bald Eagle
_Cooper's Hawk
_Red-tailed Hawk
_Golden Eagle
_American Kestrel
_Merlin
_Peregrine Falcon
GROUSE, QUAIL
_Ringed-necked Pheasant
_California Quail
CRANES, RAILS
_Sora
_American Coot
SHOREBIRDS, GULLS
_Killdeer
_Black-necked Stilt
_American Avocet
_Greater Yellowlegs
_Common Snipe**
_Ring-billed Gull
_California Gull
_Forester's Tern
DOVES
_Rock Dove
_Mourning Dove

GOATSUCKERS
_Common Nighthawk
HUMMINGBIRDS
_Black-chinned Hummingbird
_Broad-tailed Hummingbird
KINGFISHER
_Belted Kingfisher
WOODPECKERS
_Downy Woodpecker
_Northern Flicker
FLYCATCHER
_Olive-sided Flycatcher
_Western Wood Pewee
_Say's Pheobe**
_Western Flycatcher**
SWALLOWS
_Tree Swallow
_Violet Green Swallow**
_No. Rough-winged Swallow
_Bank Swallow
_Barn Swallow**
JAYS, CROWS
_Scrub Jay
_Black-billed Magpie
_American Magpie
_American Raven
TITMICE
_Black-capped Chickadee
WRENS
_House Wren
_Marsh Wren
KINGLETS, THRUSHES
_Ruby-crowned Kinglet
_Blue-gray Gnatcatcher
_American Robin
THRASHERS
_Northern Mockingbird
PIPIT
_Water Pipit
WAXWINGS
_Bohemian Waxwing
_Cedar Waxwing
SHRIKES
_Loggerhead Shrike
STARLINGS
_European Starling
VIREOS
_Solitary Vireo

WARBLERS, SPARROWS, TANAGERS, BLACKBIRDS

_Orange-crowned Warbler
_Yellow Warbler
_Yellow-rumped Warbler
_MacGillivary's Warbler
_Wilson's Warbler
_Western Tanager
_Lazuli Bunting
_Rufous-sided Towhee
_Song Sparrow
_White-crowned Sparrow
_Harris' Sparrow
_Dark-eyed Junco
_Red-winged Blackbird
_Western Meadowlark
_Yellow-headed Blackbird
_Brewer's Blackbird
_Brown-headed Cowbird
_Northern Oriole

FINCHES

_Rosy Finch**
_Cassin's Finch
_House Finch
_American Goldfinch
_Evening Grosbeak

WEAVER FINCHES

_House Sparrow

APPENDIX D
PLANT COMMUNITIES

Contents:

Table 5. Existing Plant Species on Site.

NATIVE:

Achillea millefolium -- common yarrow

Agrostis hyemalis (scabra) -- ticklegrass

Apocynum sp. -- dogbane

Aster occidentalis -- western mountain aster

Bromus inermis --smooth brome

Caltha leptosepala -- marsh marigold

Carex nebrascensis -- Nebraska sedge

Carex spp. -- sedge

Distichilis spicata -- saltgrass; alkali grass

Eleocharis sp. -- spikerush

Elymus cinereus -- great basin wildrye

Elymus smithii -- western wheatgrass

Elymus spicata -- bluebunch wheatgrass

Elymus elymoides -- squirreltail

Elymus trachycaulus -- slender wheatgrass

Epilobium sp. -- willowherb; willow-weed

Equisetum sp. -- horsetail; scouring rush

Glaux maritima -- common sea milkwort

Hordeum jubatum -- foxtail barley

Juncus arcticus (balticus) -- arctic rush

Lemna sp. -- duckweed

Phragmites australis -- common reed

Phalaris arundinacea -- reed canary grass

Polygonum sp. -- knotweed; smartweed

Populus angustifolia -- narrowleaf cottonwood

Populus fremontii -- Fremont cottonwood (X)

Potentilla anserina -- silverweed cinquefoil

Potentilla glandulosa -- gland cinquefoil

Potentilla gracilis -- showy cinquefoil

Rhus trilobata -- squawbush

Ribes aureum -- golden currant

Rosa woodsii -- woods rose

Sagittaria cuneata -- arrowhead

Salix exigua (melanopsis) -- sandbar willow; coyote willow

Scirpus acutus -- hardstem bulrush

Triglochin maritima -- shore arrowgrass

Typha latifolia -- common cattail

non-native:

Aegalops cylindrica -- goatgrass

Agrostis stolonifera -- redtop bentgrass

Arctium sp. -- burdock

Asparagus officinalis -- asparagus

Bromus tectorum -- cheatgrass

Cardaria draba -- whitetop

Chenopodium sp. -- goosefoot

Convolvulus arvensis -- field bindweed

Descurainia sp -- tansy mustard (D. sophia, non-native/ D. pinnata, native)

Elaeagnus angustifolia -- Russian olive

Elymus (Elytrigia) repens -- quackgrass

Erodium cicutarium -- storksbill; filaree

Euphorbia esula -- leafy spurge

Hordeum _____ -- barley

Iris pseudacorus -- water iris

Isatis tinctoria -- dyer's woad

Lycium barbarum -- matrimony vine (boxthorn)

Madia sp. -- tarweed

Medicago sativa -- alfalfa

Melilotus sp. -- sweetclover

Muhlenbergia sp -- (richardson's?)

Plantago major -- broadleaf plantain

Poa bulbosa -- bulbous bluegrass

Poa pratensis --Kentucky bluegrass

Rumex crispus -- curly dock

Salsola kali -- russian thistle; tumbleweed

Tamarix sp. -- tamarisk

Table 6. Invasive Plants.

Aegalops cylindrica -- goatgrass

Agrostis stolonifera -- redtop bentgrass

Arctium sp. -- burdock

Asparagus officinalis -- asparagus

Bromus tectorum -- cheatgrass

Cardaria draba -- whitetop

Chenopodium sp. -- goosefoot

Convolvulus arvensis -- field bindweed

Descurainia sp -- tansy mustard (D. sophia, non-native/ D. pinnata, native)

Elaeagnus angustifolia -- Russian olive

Elymus (Elytrigia) repens -- quackgrass

Elymus smithii -- western wheatgrass

Erodium cicutarium -- storksbill; filaree

Euphorbia esula -- leafy spurge

Hordeum _____ -- barley

Iris pseudacorus -- water iris

Isatis tinctoria -- dyer's woad

Lycium barbarum -- matrimony vine (boxthorn)

Lythrum salicaria -- purple loosestrife

Madia sp. -- tarweed

Medicago sativa -- alfalfa

Melilotus sp. -- sweetclover

Muhlenbergia sp -- (richardson's?)

Phalaris arundinacea -- reed canary grass

Phragmites australis -- common reed

Plantago major -- broadleaf plantain

Poa bulbosa -- bulbous bluegrass

Poa pratensis --Kentucky bluegrass

Rumex crispus -- curly dock

Salsola kali -- russian thistle; tumbleweed

Tamarix sp. -- tamarisk

Typha latifolia -- common cattail

APPENDIX E
RECOMMENDED PLANTS

Contents:

Table 7. Recommended Plants for the Jordan River Nature Park

This is a list of plants that are recommended to be planted in the Murray City Nature Park. They are selected because they are native to the Wasatch Front and adapted to the Jordan River corridor. The final selection of plants should be according to specific conditions observed on the site. Subtle variations in topography, soils and moisture exist and should be planted accordingly and not strictly by the boundaries on the plan.

Wetland configuration on plan is a representation of enhanced or created wetlands. Final configuration will be based on topography and wetland design which will determine specific planting locations.

Plant selection should be based on the vertical and horizontal structural values as well as site adaptation. See the related figures in the drawings and document.

WETLAND

PERMANENTLY FLOODED OR LONG TERM SEASONAL FLOODING

Emergents

Scirpus acutus	hardstem bulrush

SEASONAL FLOODING AND HIGH WATER TABLE

Emergents

Scirpus acutus	hardstem bulrush

Grass

Distichilis spicata	saltgrass
Phalaris arundinacea	reed canary grass
Sporabilis airoides	alkali sacaton

Shrubs

Atriplex gardneri	Gardner saltbush
Salix exigua	coyote willow
Salix rigida	yellow willow

Trees

Populus angustifolia	narrowleaf cottonwood
Populus fremontii	fremont cottonwood
Salix amygdaloides	peachleaf willow

SEASONAL HIGH WATER TABLE OR POORLY DRAINED

Forbs

Achillea millefolium	common yarrow

Grasses

Distichilis spicata	saltgrass
Elymus smithii*	western wheatgrass
Poa secunda (sandbergii)	sandberg bluegrass
Sporobolus airoides	alkali sacaton

Shrubs

Atriplex canescens	fourwinged saltbush
Atriplex gardneri	gardner saltbush
Chrysothamnus nauseosus	rubber rabbit brush
Ribes aureum	golden currant
Rosa woodsii	woods rose
Sarcobatus vermiculatus	black greasewood
Symphoricarpus oreophilus var. utahensis	snowberry

Upland "islands": Shrubs suitable for islands of more upland sites within wetland areas.

Potentilla fruticosa	shrubby cinquefoil
Rhus glabra cismontana	smooth sumac
Rhus trilobata	squawbush
Ribes aureum	golden currant
Rosa woodsii	woods rose

Trees

Acer negundo	boxelder
Crataegus douglasii	douglas hawthorne
Populus fremontii	fremont cottonwood
Populus angustifolia	narrowleaf cottonwood
Salix amygdaloides	peachleaf willow

UPLAND

Forbs

Achillea millefolium	common yarrow
Aster chilensis	Pacific aster
Aster glaucodes	blueleaf aster
Cleome serrulata	rocky mountain beeplant
Echinacea purpurea	purple coneflower
Eriogonum umbellatum	sulfer flower
Erisimum asperum	western wallflower
Gaillardia aristata	blanket flower
Geranium viscosissimum	wild geranium
Hedysarum boreale	northern (Utah) sweetvetch
Helianthus annus	sunflower
Linum perenne (lewisii)	wild flax
Lupinus caudatus	tailcup lupine
Oenothera pallida	pale evening primrose
Penstemon cyanathus	Wasatch penstemon
Sphaeralcea coccinea	scarlet globemallow
Sphaeralcea grossulariaefolia	gooseberry globemallow
Viguiera hirta multiflora	showy goldeneye

Grass

Aristida purpurea	purple three-awn
Elymus cinereus	great basin wildrye
Elymus lanceolatus var. riparius†	streambank wheatgrass
Elymus smithii*	western wheatgrass
Elymus spicatum*	bluebunch wheatgrass
Elymus trachycaulum*	slender wheatgrass
Oryopsis hymenoides	indian ricegrass
Poa secunda	sandberg bluegrass
Sporobolus cryptandrus	sand dropseed
Stipa comata	needle and thread grass

Shrubs

Amelanchier alnifolia	serviceberry
Artemisia frigida	fringed sage
Artemisia ludoviciana	herbaceous sage
Artemisia tridentata	big sage
Ceratoides lantana	winterfat
Cercocarpus ledifolius	mountain mahogany
Cercocarpus montanus	true mountain mahogany
Chrysothamnus nauseosus	rubber rabbit brush
Cowania mexicana	cliffrose
Potentilla fruticosa	shrubby cinquefoil
Purshia tridentata	bitterbrush
Rhus glabra cismontana	smooth sumac
Rhus trilobata	squawbush
Rosa woodsii	woods rose

Trees

Celtis reticulata (douglasii)	netleaf hackberry
Juniperus osteosperma	Utah juniper
Juniperus scopulorum	rocky mountain juniper

RIVERBANK

MID- TO UPPER BANK GENERALLY MORE WELL DRAINED THAN WETLAND SOILS

Emergents

Scirpus acutus	hardstem bulrush

Forbs

Achillea millefolium	common yarrow
Geranium viscosissimum	wild geranium
Hedysarum boreale	northern (Utah) sweetvetch
Lupinus caudatus	tailcup lupine
Oenothera hookeri	Hooker's evening primrose
Penstemon cyanathus	Wasatch penstemon

Grasses

Distichilis spicata	saltgrass
Elymus cinereus	great basin wildrye
Elymus lanceolatus var. ripariust	streambank wheatgrass
Phalaris arundinacea	reed canary grass
Sporobolus airoides	alkali sacaton

Shrubs

Salix exigua	coyote willow
Salix rigida	yellow willow
Cornus stolonifera	red-osier dogwood
Ribes aureum	golden currant
Rosa woodsii	woods rose

Boiengineering: Shrubs for cuttings to use in bioengineering stabilization. Others listed above could be used as bare root stock to use with cuttings.

Salix exigua	coyote willow
Cornus stolonifera	red-osier dogwood

Trees

Acer grandidentatum	bigtooth maple
Acer negundo	boxelder
Alnus incana	thinleaf or mountain alder
Betula occidentalis	water birch
Celtis reticulata	netleaf hackberry
Populus angustifolia	narrowleaf cottonwood
Prunus virginiana	chokecherry
Salix amygdaloides	peachleaf willow

Boiengineering: Tree for cuttings or bare root stock to use in bioengineering stabilization.

Salix amygdaloides	peachleaf willow

IRRIGATED

Grass

Festuca arundinacea	tall fescue
Lolium perenne	perennial ryegrass
Puccinellia aroides var.distans	alkaligrass

Shrubs

Included are the shrubs listed above plus:

Berberis repens	oregon grape

Trees

Large fast growing shade trees:

Acer negundo	boxelder
Populus angustifolia	narrowleaf cottonwood
Populus fremontii	Fremont cottonwood

Smaller, slower growing shade trees:

Acer grandidentatum	bigtooth maple
Celtis reticulata (douglasii)	netleaf hackberry
Quercus gambelii	gambel oak

†formerly Agropyron riparium
*formerly Agropyron sp.

name reference: Albee, Beverly J. Leila Shultz, and Sherel Goodrich. 1988. Atlas of the Vascular Plants of Utah. Utah Museum of Natural History occas. pub. no. 7, Salt Lake City, UT. other references listed in the documentation, Appendix L.

APPENDIX F
SEED AND PLANT CHARACTERISTICS

Contents:

Table 8. Forb Species Characteristics

FORBS	COMMON NAME	FORM	HEIGHT Inches	FLOWER color	FLOWER season	COMMENTS
Achillea millefolium	common yarrow	Perennial	12-24	white	S-F	Sun to partial shade; drought tolerant; light helps germination; occurs on dry and moist sites.
Artemisia ludoviciana	Louisiana sagewort	Perennial	12-36	white	SUM-F	Full sun; drought tolerant, warm season sub-shrub; occurs on dry open areas in the foothills and mountains; pioneer species.
Aster chilensis	Pacific aster	Perennial	6-36	lav/ white	SUM	Full sun; moderate water requirments; can be drought tolerant; occurs valleys to midmontane; found on disturbed or native habitats.
Aster glaucodes	blueleaf aster	Perennial	18-24	white	F	Full sun to partial shade; moderate water requirements, can be drought tolerant; occurs from foothills to subalpine, mostly on dry open slopes.
Cleome serrulata	rocky mountain beeplant	Annual	12-36	yellow	S	Full sun; drought tolerant; occurs in valleys; in sandy, usually disturbed, sometimes saline soil; best in masses in meadows and back borders.
Echinacea purpurea	purple coneflower	Perennial	24-36	purple	S	Full sun, moderately drought tolerant; occurs in open woodlands and along roadbanks throughout central and Eastern U.S.; adapted to Wasatch Front.
Eriogonum umbellatum	sulfur flower	Perennial	6-12	yellow	F	Full sun to partial shade; drought tolerant; occurs in foothills to subalpine; on open, rocky slopes.
Erisimum asperum	western wallflower	Biannual	30	orange/yellow	S-SUM	Full sun; drought tolerant; valleys to alpine; on dry rocky hillsides, in grasslands, openings of oak-sage, in dry to mesic meadows, and streamside.
Gaillardia aristata	blanket flower	Perennial	18-24	yellow/red	S-SUM	Full sun to partial shade; fairly drought tolerant; prefers sandy soil; occurs along prairies, foothills and roadsides in western U.S.; adapted to the Wasatch Front.
Geranium viscosissimum	wild geranium	Perennial	12-48	pink	SUM	Diffused sunlight; moderate water requirements; occurs foothills to subalpine; under oak, maple, aspen in mesic to moist meadows, and streamside.
Hedysarum boreale	northern (Utah) sweetvetch	Perennial	10-24	pink/purple	S	Full sun to partial shade; drought tolerant; foothills on open grassy or rocky slopes; performs well on steep disturbed sites.
Helianthus annus	sunflower	Annual	36-72	yellow	SUM	Full sunlight; drought tolerant; valleys and foothills in dry, open, mostly waste places.
Linum perenne (lewisii)	wild flax	Perennial	24	blue	S	Full sun; drought tolerant; foothills to upper montane; mostly in open rocky soils , occasionally found in mesic meadows; intolerant of poor drainage, high water table and flooding; semi-evergreen.

Table 8. Continued

FORBS	COMMON NAME	FORM	HEIGHT inches	FLOWER color	FLOWER season	COMMENTS
Lupinus caudatus	tailcup lupine	Perennial	12-24	blue	S-SUM	Full sunlight; low to moderate water requirements; valleys to upper montane; on dry open slopes with sagebrush, on mesic grassy meadows, wodland clearings, and occasionally streamsides.
Oenothera hookeri	Hooker's evening primrose	Biannual	36-48	yellow	S	Full sun to partial shade; moderate water requirements; valleys to midmontane; in moist lowlands, and along ditches, fencerows, streams and shaded roadsides.
Oenothera pallida	pale evening primrose	Perennial	8-20	white	S	Full sun; drought tolerant; valleys and foothills; in dry, open, often disturbed sites in mostly loose, gravelly or sandy soil.
Penstemon cyanathus	Wasatch penstemon	Perennial	18	blue	SUM	Full sun to partial shade; low to moderate water requirements; from foothills to subalpine; in dry to moist sites, on open slopes, under aspens and in meadows; semi-evergreen.
Scirpus acutus	hardstem bulrush	Perennial	3'-9'	-	-	Found on site in wetland, usually in water.
Sphaeralcea coccinea	scarlet globemallow	Perennial	6-12	red/orange	S	Full sun; drought tolerant; valleys to foothills; in dry open prairie grasslands, sometimes alkaline sites.
Sphaeralcea grossulariaefolia	gooseberry globemallow	Perennial	27-38	orangw/red	S-SUM	Full sunlight; drought tolerant; valleys and foothills; in dry open, sometimes alkaline sites.
Viguiera hirta multiflora	showy goldeneye	Perennial	12-40	yellow	SUM	Full sun to partial shade; moderate moisture requirements; from foothills to upper montane , on open slopes and under trees; competitive with annuals and perennials; establishes quickly on disturbed sites and with rapid seedling growth.

Key:
Season: (S) spring; (Sum) summer; (F) fall

References:
Granite Seed, Lehi, UT
Plants of the Southwest, Santa Fe, NM
Flora of the Central Wasatch Front, Utah, by L. Arnow, B. Albee and A. Wyckoff

Table 9. Grass Species Characteristics

GRASSES	COMMON NAME	GROWTH	FORM	HGHT	TOLERANCE*** flood	drght	salt	PRECIP Ins.	SOILS texture	COMMENTS
Aristida purpurea	purple three-awn	cool	bunch	S-M	-	G	-	10	sandy	
Distichilis spicata	inland saltgrass	warm	sod	S-M	F-G	G	VG	8	best on med. to clayey	
Elymus cinereus	great basin wildrye	cool	bunch	T	G	F	F-G	8	med. to clayey, not sandy	Naturally found in creek bottoms; only tall native grass species; poor seedling vigor but very productive when established; produces sparse stands; plant 1/2"-3/4" deep.
Elymus lanceolatus	streambank wheatgrass	cool	sod	S-M	F	G	F	8	all, best on medium	Long lived; easily established, good in mix; excellent seedling vigor; tolerates slightly acid to saline soils; can stand moderate periodic flooding in early spring; tolerates shade; plant 1/4"-1/2" deep. Variety riparius.
Elymus smithii†	western wheatgrass	cool	sod	M	G	G	VG	10	medium to clayey	Poor germination and seedling vigor resulting is scattered stands that spread in 3-4 years to dominate the site; use sparingly in design; do not plant near forbs or shrubs; plant 1/4"-1/2" deep.
Elymus spicatum†	bluebunch wheatgrass	cool	bunch	M	P	G	F	8-10	best on med. to clayey	Long lived, takes several years to establish full size, greens up in the early spring and again in fall; plant 1/4"-1/2" deep.
Elymus trachycaulum†	slender wheatgrass	cool	bunch	M	P-F	F-G	F-G	16	all, best on med. to clay	Good in mix; quick germination, vigorous seedling, and quick growth but short lived, providing early cover.
Festuca arundinacea@	tall fescue	cool	bunch	T	-	G	G	18	best on clayey	Introduced; turf grass only.
Lolium perenne@	perennial ryegrass	cool	bunch	M-T	-	-	G	18	best on med. to claye	Introduced; turf grass only.
Oryzopsis hymenoides	indian ricegrass	cool	bunch	M	P	VG	F	9	best on sandy and silty	May be difficult to establish by seed; recommend transplant near forbs and shrubs; especially good in sandy areas; plant 1/4"-1/2" deep.
Phalaris arundinacea	reed canary grass	cool	sod	T	V.G	F	P	16	all, best on med to clayey	Initial stands often poor because of tardy germination and weak seedlings; once established is very aggressive in wet areas; use selectively, will also volunteer on site; can withstand flooding for 70 days once established; plant 1/4"-1/2" deep.
Poa secunda	sandberg bluegrass	cool	bunch	M	P	G	G	8	all	Short lived early maturing pioneer species; readily invades disturbed sites; does not tolerate prolonged flooding or high water table but moderate spring flooding is okay; select appropriate variety; plant 1/4" deep.
Puccinellia distans	alkaligrass	cool	bunch	S-M	_	G	G	15	_	Use var. Fults.
Sporobolus airoides	alkali sacaton	warm	bunch	M	G	G	G	6	best on clayey, not sandy	Found in saline bottomlands with saltgrass, western wheatgrass and salt bush; deep moist soils or subirrigated; withstands poor drainage, frequent flooding and shallow water tables; easier to establish with supplemental irrigation; very strong root system; fair shade tolerance.

Table 9. Continued.

GRASSES	COMMON NAME	GROWTH	FORM	HGHT	TOLERANCE*** flood	drght	salt	PRECIP ins.	SOILS texture	COMMENTS
Sporobolus cryptandrus	sand dropseed	warm	bunch	M	F	G	F	10	all, best on sandy	Early successional type grass on sandy soils; very drought tolerant especially on sandy soils; not tolerant of very acid or alkaline soils.
Stipa comata	needle and thread grass	cool	bunch	T	P	G	F	10	best on med. and sandy	

† Formerly, genus was 'Agropyron' and is still listed in seed catalogs this way
* Height (S) 1"-12"; (M) 13"-24"; (T) 25" & up
*** (VG) very good; (G) good; (F) fair; (P) Poor
@ Introduced, used for turf grass only

ref. Granite Seed Company, Lehi, Utah

Recommended turf mix:
70% Festuca arundinacea (tall fescue),
15% Puccinellia distans (alkaligrass),
and 15% Lolium perenne (perennial ryegrass)

Table 10. Shrub Species Characteristics

CODE	SHRUBS	COMMON NAME	HEIGHT	WIDTH	NONIRRIGATED SPACING	DROUGHT TOLERANCE	ESTABLISH.	COMMENTS
Amal	Amelanchier alnifolia	serviceberry	8-10' to 18	10-20'	3-10'	moderate	difficult	Clump-forming, deciduous shrub or small tree; not tolerant of saline soils and high water tables; winter hardy; very attractive white flower clusters followed by deep purple good quality edible fruit; growth will wait for good conditions.
Artr	Artemisia frigida	fringed sage	.5-1.5'	to 1'	2-10'	moderate	good	Half-shrub, flowering in late summer or fall; soft silvery foliage, mat forming to 8" with taller seedheads; medium textured well drained soils, often rocky or gravelly.
Artr	Artemisia tridentata	big sage	2-6'	5-8'	3-10'	high	easy	Evergreen; occurs in foothills to alpine; on well-drained soils.
Atca	Atriplex canescens	fourwinged saltbush	3-5'	3' -	3-9'	high	good	Warm season, medium sized, deciduous to evergreen; occurs in valleys and foothills, on open or wooded slopes and flats; tolerant to infrequent flooding, may be tolerant of high water table.
Atga	Atriplex gardneri	gardner saltbush	.5-2'	3'	3-9'	high	good	Warm season, small suffrutescent half-shrub; occurs in valleys; in alkaline to saline soil; tolernat to sands to dense clays; slow growing; tolerates seasonal flooding and alternating wet/dry periods.
Bere	Berberis repens	oregon grape	1-3'	4-6'	-	low	easy	Low, evergreen trailing undershrub; well drained loams, protected on north-facing slopes; intolerant of high water table; tolerant of weakly acidic, basic and saline soils.
Cela	Ceratoides lanata	winterfat	1-3'	-	plant as seed	high	-	Half shrub; occurs in valleys; in dry alkaline to saline soil, from rocky to sandy loams to clays; flood intolerant; moderately competitive and compatible in both warm and cool season plant mixtures.
Cele	Cercocarpus ledifolius	mountain mahogany	8-12' to 24	15-20'	4-8'	good	-	Deciduous to evergreen small tree to shrub; foothills to upper montane; well drained; fair shade tolerant but thrives in full sun; good nurse plant.
Cemo	Cercocarpus montanus	true mountain mahogany	4-6' to 9'	6'	2-8'	mod to good	-	Shrub to small tree; deciduous beechlike foliage; on dry, rocky soils, well-drained.
Chna	Chrysothamnus nauseosus	rubber rabbit brush	2-4'	2-3'	3-8'	good	good	Brilliant show of fall flowers; in dry, open, often disturbed, sometimes alkaline sites of open plant communities; well drained soils, tolerates occasional flooding.
Cost	Cornus stolonifera	red-osier dogwood	3-10'	to 10'	2-8'	poor	good	Fast growth, thicket forming; sun or shade; streamside or marshy areas with water for short periods; good red twig winter color.
Come	Cowania mexicana	cliffrose	3-4'	3-4'	2-6'	high	difficult	Aromatic evergreen shrub, fair shade tolerance especially as seedling, thrives in full sun; occurs on dry open slopes.
Potr	Potentilla fruticosa	shrubby cinquefoil	1-3'	2'	-	poor	easy	Small, long blooming, deciduous or persistant leaved shrub; on dry or mesic, open slopes; grows on most soils except clay and loose sand; moderate shade tolerance but flowers more abundant in full sun.
Putr	Purshia tridentata	antelope bitterbrush	2-6'	3-4'	-	good	difficult?	Small to medium-sized, deciduous shrub; occurs in foothills to upper montane; on open often rocky slopes; adapted to wide range of soils; may be hard to establish.

Table 10. Continued.

CODE	SHRUBS	COMMON NAME	HEIGHT	WIDTH	NONIRRIGATED SPACING	DROUGHT TOLERANCE	ESTABLISH.	COMMENTS
Rhgl	Rhus glabra cismontana	dwarf smooth sumac	4-5' to9'	5-9'	2-6'	good	good	Fast growing shrub or small tree; occurs in valleys and foothills ; chiefly in dry open sites; widely adaptable; red fruit spikes at branch tips, brilliant scarlet fall color; use var. cismontana.
Rhtr	Rhus trilobata	squawbush	to 6'		2-6'	high	easy	Deciduous, thicket forming warm season shrub; occurs in foothills; in dry to mesic sites on open slope and streamside; intolerant of flooding and high water tables; tolerant of partial shade; fast growing densely branched; good nurse plant; very versatile; very old specimens on slope north of the green house (future nature center site).
Riau	Ribes aureum	golden currant	3-5'	4'	2-5'	poor	easy	Deciduous, small to medium sized, irregular-shaped shrub; occurs in valleys and foothills; in moist to mesic sites, along streams and north slopes; attractive, fragrant yellow flowers and late summer dark blue fruit; widely adapted; excellent for site stability.
Rowo	Rosa woodsii	woods rose	2-6'	6-9'	2-6'	moderate	easy	Deciduous, prickly, briar patch-forming shrub; occurs in valleys to midmontane; in mesic or moist sites, streamside, under oak-maple; intolerant of poor drainage, high water tables and prolonged flooding; aggressive pioneer on disturbed soils; moderately competitive and fairly compatible with herbs;widely adapted; excellent for site stability.
Saex	Salix exigua	coyote willow	6-10'	3-5'	1-4'	poor	good	Dense thicket forming shrub; valleys to midmontane; streamside, near springs, in marshes, and in wet, low lying areas; salt tolerant; occurs along the Jordan River.
Sari	Salix rigida	yellow willow	6-10'	3-5'	1-4'	poor	good	Similar to S. exigua ingrowth habit and use; foothills to midmontane; streamside and other moist places; grows on rich organic soil; more of a secondary succession plant.
Save	Sarcobatus vermiculatus	black greasewood	3-6'	-	-	high	difficult	Warm season, monoecious shrub; valleys; in alkaline to slightly saline soil; grows on sites with shallow water tables and occasionally flooded sites.
Syor	Symphoricarpus oreophilus	snowberry	2-5'	3'	-	good	good	Deciduous, erect, dense colony-forming shrub; occurs foothills to subalpine; on open slopes, streamside and open rocky ridges; tolerant of imperfectly drained soils but not of prolonged flooding and permanent high water.table, strongly competitive; use var. utahensis, not adapted to disturbed sites.

references:
Ecology and Culture of Selected Species useful in Revegetating Disturbed Lands in the West by C. Wasser
Flora of the Central Wasatch Front, Utah by L. Arnow, B. Albee and A, Wyckoff
Interagency Forage and Conservation Planting Guide for Utah, edited by Howard Horton
Landscape Plants from Utah's Mountains by R. Sutton and C. Johnson
Steve Pendleton, Progressive Plants Nursery, Sandy, Utah

Table 11. Tree Species Characteristics

CODE	TREES	COMMON NAME	HEIGHT	WIDTH	NONIRR. SPACING	DROUGHT TOLERANCE	COMMENTS
Acgr	Acer grandidentatum	bigtooth maple	5-15' to 40'	20-25'	-	fair/good	Deciduous , bushy shrub or medium sized tree; foothills and midmontane; along streams and on mesic slopes in the lower reaches of the canyons; often in assoc with A. negundo; in moderately acidic to slightly basic, well drained soils.
Acne	Acer negundo	boxelder	50'	25-30'	15-50'	good	Fast growing shade tree; subject to bugs and breaking;occurs in valleys to midmontane; in waste places, and streamside, often in association with Acer grandentatum; drought tolerant good when established.
Alin	Alnus incana	thinleaf/mountain alder	30'	15-20'	-	poor	Small tree similar in appearance to water birch; occurs in foothills to upper montane; usually streamside; often in association with Betula occidentalis and Acer grandentatum; well drained but tolerates periods of standing water.
Beoc	Betula occidentalis	river birch	30'	10-20'	10-20'	good	Fast growing medium sized tree; foothills and midmontane; streamside, often in association with A. grandentatum and Alnus incana; much less suseptable to bores and winter dieback than other birches; use var. fontinalis.
Cere	Celtis reticulata (douglasii)	netleaf hackberry	30'	15-20'	-	good	Small shade tree large shrub for dry sites; occurs in valleys and foothills; in shallow canyons or in moderately moist sites on open hillsides; recommend training for tree shape where needed.
Crdo	Crataegus douglasii	douglas hawthorne	10-12'	10'	-	good	Small tree or large shrub; occurs in valleys and foothills; streamsides or in marshy areas; well drained but can stand some periods of wet soil; drought tolerance good if established.
Juos	Juniperus osteosperma	Utah juniper	18'	15'	-	good	Short, wide evergreen; occurs in foothills on dry open slopes; usually found on drier sites than Juniperus scopularum.
Jusc	Juniperus scopulorum	rocky mountain juniper	25'	-	4-12'	good	blue green evergreen, narrow growth form; occurs in foothills to midmontane; along streams and on mostly north facing, open slopes; shade tolerant when young; hardier and more drought tolerant than any of its cultivars.
Poan	Populus angustifolls	narrowleaf cottonwood	30-50'	30-40'	3-15'	poor	Fast growing, upright columnar, yellow fall color; occurs in valleys to midmontane; along waterways, occasionally on drier sites; fairly strong.
Polr	Populus fremontii	Fremont cottonwood	30-50'	30-80'	-	poor	Wide spreading crown often wider than tree is tall; wood is soft.
Prvi	Prunus virginiana	chokecherry	to 20'	10-15'	4-10'	poor	Deciduous, loose thicket-forming shrubs or small trees; occurs in foothills to upper montane; streamside on moderately moist slopes and in openings; intolerant of of poor drainage and prolonged spring flooding and high water tables; moderate shade tolerance.
Quga	Quercus gambelii	gambel oak	to 20'	12-15'	6-10'	moderate	Slow growing small tree though quite variable; occurs in foothills as scattered dense clones on hillsides and dense woods in canyon bottoms; associated with Acer grandentatum in mesic sites; recommend 2 gal containers spaced 5-6'.
Saam	Salix amygdaloides	peachleaf willow	to 30'	-	-	poor	Tree or large shrub with a high crown and ascending branches; occurs in valleys and foothills along waterways; is the only large native willow in the region; wood is light and soft susceptable to decay.

reference:
Flora of the Central Wasatch Front, Utah by L. Arnow, B. Albee and A. Wyckoff
Landscape Plants from Utah's Mountains by R. Johnson
Steve Pendleton of Progressive Plants Nursery, Sandy, Utah

APPENDIX G
SEEDING SCHEDULE
AND
PLANT SPECIES AND SIZE SCHEDULE

Contents:

Table 12. Grass Species and Schedule.

GRASSES	ESTABL.	SEEDS/LBS	SEASON	pls#/ac	COST
Aristida purpurea purple three-awn	- -	250,000	F/S	6	$10.00/lb
Distichilis spicata inland saltgrass	difficult	520,000	SUM	10	$8.00/lb
Elymus cinereus great basin wildrye	moderate	130,000	F/S	9	$8.00/lb
Elymus lanceolatus streambank wheatgrass	easy	156,000	F/S	6-8	$8.00/lb
Elymus smithii western wheatgrass	moderate	110,000	F/S	10	$10.00/lb
Elymus spicatum bluebunch wheatgrass	fair	140,000	F/S	6-8	$11.00/lb
Elymus trachycaulum slender wheatgrass	easy	159,000	F	6-8	$16/lb
Festuca arundinacea tall fescue	easy	227,000	S	8	$1.50/lb
Lolium perenne perennial ryegrass	easy	225,000	F	25-35	$1.00/lb
Oryzopsis hymenoides indian ricegrass	difficult	141,000	F	6-8	$9.00/lb
Phalaris arundinacea reed canary grass	difficult/ mod.	533,000	F/S	5-10	$16.00/lb
Poa secunda sandberg bluegrass	moderate	952,000	F/S	2-4	$8.00/lb
Puccinellia distans alkaligrass	- -	1,200,000	F/S	2-3	$15.00/lb
Sporobolus airoides alkali sacaton	poor to fair	1,758,000	late SUM	2-3	$6.00/lb
Sporobolus crytandrus sand dropseed	easy to diff.	5,298,000	late SUM	1	$10.00/lb
Stipa comata needle and thread grass	moderate	115,000	F	8	$10.00/lb

key for Table 12 and 13
Season: (S) spring; (SUM) summer; (F) late fall
pls/acre: pure live seed as a single species planting
* indicates the preferred method of establishment

references:
Granite Seed, Lehi, Utah
Plants of the Southwest, Santa Fe, NM
Flora of the Central Wasatch Front, by L. Arnow, B. Albee, and A. Wyckoff

Table 13. Forb Species and Schedule.

Flowers and Forbs	ESTABL.	SEED/LB	SEASON	SEED DEPTH	pls#/ac	COST
Achillea millefolium common yarrow	seed tubling	2,770,000	F	1/4"	1	$15.00/lb
Artemisia ludoviciana Louisiana sagewort	seed	4,500,000	F	--	--	--
Aster chilensis Pacific aster	seed tubling*	--	F	--	--	$70.00/lb
Aster glaucodes blueleaf aster	seed tubling*	540,000	F	--	5	$70.00/lb
Ceratoides lanata winterfat	seed*	12,000	F	1/4"	15-20	--
Cleome serrulata rocky mountain beeplant	seed tubling	--	F/S	--	--	$20.00/lb
Echinacea purpurea purple coneflower	seed tubling*	117,000	F	--	12	$20.00/lb
Eriogonum umbellatum sulfur flower	seed tubling*	209,000	anytime	--	10	$65.00/lb
Erisimum asperum western wallflower	seed tubling*	--	anytime	--	--	--
Gaillardia aristata blanket flower	seed* tubling*	132,000	anytime	1/8	10	$28.00/lb
Geranium viscosissimum wild geranium	seed tubling*	52,000	F	--	9	$100.00/lb
Hedysarum boreale northern (Utah) sweetvetch	seed tubling*	33,600	F	--	15	$65.00/lb
Helianthus annus sunflower	seed*	58,500	S or F	--	10	$6.00/lb
Linum lewisii blue flax	seed* tubling*	293,000	F	--	8	$20.00/lb
Lupinus caudatus tailcup lupine	seed tubling*	27,600	F	--	12	$70.00/lb
Oenothera hookeri Hooker's evening primrose	seed tubling*	864,000	F	--	2	$20.00/lb
Oenothera pallida pale evening primrose	seed tubling*	512,000	F	--	5	$60.00/lb
Penstemon cyanathus Wasatch penstemon	seed tubling*	550,000	F	--	4	$45.00/lb
Scirpus acutus hardstem bulrush	transplant	--	anytime	--	1-3' O.C.	--
Sphaeralcea coccinea scarlet globemallow	seed tubling*	500,000	F	--	4	$65.00/lb
Sphaeralcea grossulariaefolia gooseberry globemallow	seed tubling*	500,000	F	--	4	$55.00/lb
Viguiera hirta multiflora showy goldeneye	seed tubling	1,055,000	anytime	--	2	$60.00/lb

key for Table 12 and 13
Season: (S) spring; (SUM) summer; (F) late fall
pls/acre: pure live seed as a single species planting
* indicates the preferred method of establishment

references:
Granite Seed, Lehi, Utah
Plants of the Southwest, Santa Fe, NM
Flora of the Central Wasatch Front, by L. Arnow, B. Albee, and A. Wyckoff

Table 14. Shrub Schedule and Survival Rates in Dry Soil Types. Percentages for nonirrigated are based on fall installation and two summers of supplemental irrigation, plus successful control of competition. Percentages for irrigated plants are based on successful control of competition.

SHRUB SPECIES NONIRRIGATED	COMMON NAME	RECOMMENDED SIZE	BARE ROOT	TUBLING	RECOMMENDED CONTAINER SIZE	SOILS PEAT	SOILS UPLAND	SOILS FILL
Amelanchier alnifolia	serviceberry	1 or 5 gallon	30%	75%	90%	X		
			25%	60%	80%		X	
			10%	40%	50%			X
Artemisia frigida	fringed sage	tubling	50%	80%		X		
			50%	90%			X	
			40%	60%				X
Artemisia tridentata	big sagebrush	tubling or 1 gallon	50%	80%	80%	X		
			50%	80%	80%		X	
			40%	70%	70%			X
Atriplex canescens	fourwinged saltbrush	1 gallon	40%	50%	50%	X		
			50%	70%	80%		X	
			50%	70%	80%			X
Atriplex gardneri	three-tooth saltbrush	1 gallon	40%	70%	75%	X		
			50%	75%	85%		X	
			50%	75%	85%			X
Cercocarpus ledifolia	curl-leaf mtn. mahaogany	1 or 5 gallon	25%	80%	85%	X		
			25%	80%	85%		X	
			20%	60%	60%			X

Table 14. Continued

SHRUB SPECIES NONIRRIGATED	COMMON NAME	RECOMMENDED SIZE	BARE ROOT	TUBLING	RECOMMENDED CONTAINER SIZE	SOILS PEAT	SOILS UPLAND	SOILS FILL
Cercocarpus montanus	true mtn mahogany	1 or 5 gallon	25%	65%	80%	X		
			25%	65%	80%		X	
			20%	50%	55%			X
Crysothamnus nauseosus	rubber rabbitbrush	1 gallon	50%	80%	80%	X		
			50%	80%	80%		X	
			40%	60%	60%			X
Cowania mexicana	cliffrose	1 gallon	50%	70%	75%	X		
			50%	70%	75%		X	
			40%	50%	50%			X
Purshia tridentata	antelope bitterbrush	seed or bare root						
Rhus glabra cismontana	smooth sumac	1 gallon	50%	70%	75%	X		
			50%	70%	75%		X	
			20%	30%	30%			X
Rhus trilobata	squawbush	1 gallon	60%	90%	90%	X		
			60%	90%	90%		X	
			50%	70%	70%			X
Rosa woodsii	woods rose	1 gallon	50%	80%	85%	X		
			50%	80%	85%		X	
			40%	60%	65%			X
Sarcobatus vermiculatus	black greasewood	tubling or 1 gallon	40%	60%	60%	X		
			50%	80%	80%		X	
			50%	80%	80%			X

Table 14. Continued

SHRUB SPECIES IRRIGATED	COMMON NAME	RECOMMENDED SIZE	BARE ROOT	TUBLING	RECOMMENDED CONTAINER SIZE	SOILS PEAT	SOILS UPLAND	SOILS FILL
Cornus stolonifera	red-osier dogwood	1 or 5 gallon	70%	75%	85%	X		
			60%	65%	80%		X	
			10%	10%	10%			X
Potentilla fruticosa	shrubby cinquefoil	1 gallon	70%	75%	85%	X		
			20%	60%	65%		X	
			5%	15%	15%			X
Ribes aureum	golden currant	1 gallon	60%	70%	75%	X		
			55%	65%	75%		X	
			10%	10%	10%			X
Salix exigua	coyote willow	1 gallon	60%	80%	85%	X		
			50%	75%	80%		X	
			10%	10%	15%			X
Salix rigida	yellow willow	1 gallon	60%	80%	85%	X		
			50%	75%	80%		X	
			10%	10%	15%			X
Symphoricarpus oreophilus	snowberry	1 gallon	50%	80%	80%	X		
			45%	75%	75%		X	
			10%	10%	15%			X

Reference: Steve Pendleton, *Distinctive Design* and *Progressive Plants* in Sandy, Utah.

Table 15. Tree Schedule and Survival Rates in Dry Soil Types. Percentages for nonirrigated are based on fall installation and two summers of supplemental irrigation, plus successful control of competition. Percentages for irrigated are based on successful control of competition.

TREE SPECIES NONIRRIGATED	COMMON NAME	RECOMMENDED SIZE	BARE ROOT	TUBLING	RECOMMENDED CONTAINER SIZE	SOILS PEAT	SOILS UPLAND	SOILS FILL
Celtis reticulatus	netleaf hackberry	1 gallon	40%	70%	85%	X		
			40%	70%	85%		X	
			25%	40%	40%			X
Crataegus douglasii	Douglas hawthorn	5 gallon	25%	60%	75%	X		
			25%	50%	65%		X	
			15%	25%	30%			X
Juniperous osteosperma	Utah juniper	1 gallon	25%	80%	80%	X		
			20%	75%	75%		X	
			10%	30%	30%			X
Juniperous scopulorum	rocky mtn juniper	1 gallon	25%	80%	80%	X		
			20%	75%	75%		X	
			10%	30%	30%			X
Prunus virginiana	chokecherry	1 gallon	40%	75%	80%	X		
			30%	70%	75%		X	
			10%	30%	35%			X
Quercus gambelii	gambel oak	5 gallon or B&B	0%	60%	80%	X		
			0%	60%	75%		X	
			0%	15%	20%			X

Table 15. Continued.

TREE SPECIES	COMMON NAME	RECOMMENDED SIZE	BARE ROOT	TUBLING	RECOMMENDED CONTAINER SIZE	SOILS PEAT	SOILS UPLAND	SOILS FILL
IRRIGATED								
Acer grandentatum	bigtooth maple	5 gal. or 1 1/2" B&B	60%	75%	90%	X		
			50%	70%	80%		X	
			10%	20%	25%			X
Acer negundo	boxelder	5 gal. or 1 1/2" B&B	60%	75%	90%	X		
			50%	70%	85%		X	
			20%	40%	50%			X
Alnus incana	thinleaf alder	1 or 5 gallon	50%	65%	80%	X		
			40%	60%	75%		X	
			10%	10%	20%			X
Betula occidentalis	river birch	1 or 5 gallon	50%	75%	85%	X		
			40%	65%	80%		X	
			10%	10%	20%			X
Populus angustifolia	narrowleaf cottonwood	1 or 5 gallon	80%	80%	90%	X		
			70%	80%	90%		X	
			10%	10%	10%			X
Populus fremontii	Fremont cottonwood	1 or 5 gallon	80%	80%	80%	X		
			70%	80%	80%		X	
			10%	20%	20%			X
Salix amygdaloides	peachleaf willow	1 or 5 gallon	70%	80%	80%	X		
			60%	75%	75%		X	
			10%	10%	10%			X

Reference: Steve Pendleton, *Distinctive Design* and *Progressive Plants* in Sandy, Utah.

APPENDIX H
LIST OF CONTACTS
AND
SOURCES OF INFORMATION

NATIVE PLANTS

CONTACTS:
Intermountain Herbarium
Utah State University, Logan

Red Butte Gardens, State Arboretum
University of Utah, Salt Lake City

Dr. Ty Harrison, Department of Ecology
Westminster College, Salt Lake City

Native plant and seed suppliers listed later in this Appendix.

REFERENCE PUBLICATIONS:

Albee, Beverly J., Leila Shultz, and Sherel Goodrich. 1988. Atlas of the Vascular Plants of Utah. Utah Museum of Natural History occasional publication no. 7, Salt Lake City, UT.

Arnow, Lois A., Beverly J. Albee, and Ann M. Wycoff. 1980. Flora of the central Wasatch Front, Utah. University of Utah Printing Service, Salt Lake City, UT.

Johnson, Carl M. no date. Native trees of the Intermountain region. Utah State University Cooperative Extension Service, Logan, UT

Johnson, Craig W., Fred A. Baker and Wayne S. Johnson. 1990. Urban and community forestry, a guide for the interior western United States, 2n ed. USDA Forest Service, Intermountain Region, Ogden, UT

Parker, Carl G. no date. Some important Utah range plants. Utah State University Cooperative Extension Service, Logan, UT

Stubbendieck, J, Stephan L. Hatch and Kathie J. Hirsch. 1981. North American range plants. University of Nebraska, Lincoln, Nebraska

Sutton, Richard and Craig Johnson. 1974. Landscape plants from Utah's mountains. Utah State University Cooperative Extension Service, Logan, Utah.

Wasser, Clinton H. 1982. Ecology and culture of selected species useful in revegetating disturbed lands in the west. U.S. Department of the Interior, Fish and Wildlife Service. FWS/OBS-82/56.

PLANT COMMUNITY ESTABLISHMENT AND MANAGEMENT

CONTACTS:
John Fairchild, Habitat Management Project Leader
Utah Division of Wildlife Resources, Salt Lake City

Randy Radant, Nongame Management
Utah Division of Wildlife Resources, Salt Lake City
(801) 538-4760

Val Bachman, Manager
Ogden Bay Wildlife Refuge, Ogden
(801) 773-1398

Joel Huener, Waterfowl Specialist
Division of Wildlife Resources, Salt Lake City
(801) 538-4790

Native plant and seed suppliers listed later in this Appendix.

REFERENCE PUBLICATIONS:

Brown, Darrell. 1984. Reclaiming disturbed lands. USDA Forest Service, Equipment Development Center, Missoula, MT

Platts, William S. et. al. 1987. Methods for evaluating riparian habitats with applications to management. General Technical Report INT-221. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station.

Schmidt, Ralph A., ed. 1983. Management of cottonwood-willow riparian associations below elevation 8000 feet in Colorado. Colorado Chapter of Society of Wetland Scientists.

NUISANCE WILDLIFE

CONTACTS:
Doug Sakaguchi, Fisheries Specialist
Utah Division of Wildlife Resources, Springville
(801) 489-5678
information about carp control with Rotenone

Nick Hershenow
Wasatch Fish and Gardens Project
(801) 364-7765
this organization will live trap carp to provide food for low income people on the Wasatch Front

Sam Dixon
Salt Lake City Mosquito Abatement District, Salt Lake City
(801) 355-9221
information about the use of non chemical treatment for mosquitoes

Hal Black
Department of Biology, BYU, Provo
(801) 378-4553
information on bats

Division of Wildlife Resources

WEED CONTROL

CONTACTS:
Steven Dewey, Extension Weed Specialist
Utah State University, Logan

John Walthers
Pacific Horticulture Supply
Salt Lake City

REFERENCE PUBLICATIONS:

Dewey, Steven A. 1990. Utah weed control handbook 1990. Utah State University Cooperative Extension Service, Logan, UT.

Whitson, Tom D, ed. 1987. Weeds and poisonous plants of Wyoming and Utah. A cooperative publication of the University of Wyoming Cooperative Extension Service and Utah State University Cooperative Extension Service and Agricultural Experimental Station.

JORDAN RIVER AND WETLANDS: PERMITS, APPROVALS AND EXPERTISE

CONTACTS:
Steve Jensen, Environmental Planning Coordinator
Salt Lake City and County Department of Health, Salt Lake City
(801) 534-4547

Brooks Carter, Director of Regulatory Office
Army Corps of Engineers, Bountiful
(801) 295-8380

Dave Lovell
Rick Olson, Permit Coordinator
Salt Lake County Flood Control Office

Bob Morgan, water rights
Chad Gorely, permits
Utah State Engineers Office

REFERENCE PUBLICATIONS:

Jensen, Steven. 1985. Assessment of Salt Lake valley tributatries: Recreational use impairment and opportunities. Salt Lake Department of Public Works, Division of Flood Control and Water Quality.

Jensen, Steven. 1987. Stream reach inventory and channel stability evaluation for the Jordan River in Salt Lake County, Utah. State of Utah Department of Water Quality, Salt Lake City and County Health Department, Division of Environmental Health.

Jensen, Steven. 1989. Jordan River wetlands advanced identification study, wetland functional assessment interpretive report. State of Utah Bureau of Water Quality, Division of Environmental Health.

Jensen, Steven. 1988. Final draft of the Jordan River nonpoint source management plan. State of Utah Department of Water Quality, Salt Lake City and County Health Department, Division of Environmental Health.

BIOENGINEERING

CONTACTS:
Robbin Sortir and Associates
627 Cherokee NE
Suite 11
Marietta, GA 30060
(404) 424-0719
Ms. Sortir is expert on this approach to river stabilization and has expressed interest in offering a seminar in Utah on the techniques she uses.

source for the biodegradable fabric, Coir that is produced under the trade name DeKoWe by:
Belton Industries, Inc
8613 Roswell Road
Atlanta, GA 30350
1-800-225-4099

REFERENCE PUBLICATIONS:
Gray, Donald H. and Andrew T. Leiser. 1982. Biotechnical slope protection and erosion control. Van Nostrand Reinhold, NY.

Schiechtl, Hugo M. 1980. Bioengineering for land reclaimation and conservation. University of Alberta, Edmonton, Alberta, Canada.

PARK PLANNING AND COORDINATION
Gary Heintz
Salt Lake City Planning Division
(801) 535-6220

Becky Chase
Utah State Parks, Jordan River Parkway
(801) 533-4496

Jerry Anderson
Salt Lake County Parks and Recreation

Niel Stack
Salt Lake County Engineering

LAWN CARE AND LANDSCAPE MANAGEMENT

REFERENCE PUBLICATIONS:

Decker, Henry F. and Jane M. Decker. 1988. Lawn care: A handbook for professionals. Prentice-Hall, Englewood Cliffs, NJ.

Feucht, James R. and Jack D. Butler. 1988. Landscape Management. Van Nostrand Reinhold, New York, NY

PLANT AND SEED COMPANIES

indicate wholesale/retail, seed, plants, specialization

Granite Seed Company
1697 West 2100 North
P.O. Box 177
Lehi, Utah 84043
(801) 768-4422
(seed only)

Porter Lane Nurseries
262 West 400 South
Centerville, UT 84014
(801) 298-2613
(plants only)

Lawyer Nurseries
950 Highway 200 West
Plains, Montana 59859

Progressive Plants
9180 South Wasatch Boulevard
Sandy, Utah 84092
(801) 942-7333
(plants and seeds)

Plants of the Wild
P.O. Box 866
Tekoa, Washington 99033
(509) 284-2848

Lone Peak State Forestry Nurseries
Draper, Utah
(801) 571-0900
(plants only)

Bitterroot Native Growers
P.O. Box 566
Hamilton, Montana 59840

Plants of the Southwest
1812 Second Street
Santa Fe, New Mexico 87501
(505) 983-1548
(seeds and plants)

MAP AND AERIAL PHOTOGRAPHY

County Assessor's Office - 1" = 100'; plat or plat with overlay of aerial photo
Murray City Engineer's Office - 1" = 100'; 4' contours with 2' interpolated; aerial photo
Salt Lake County Flood Control Office - 1" = 200'; aerial photo
Army Corps of Engineers, Sacremento, CA - color aerial photos
USDA Aerial Photography Office, Salt Lake City - aerial photography and satellite imagery

EXAMPLES OF URBAN GREENWAYS IN THE REGION

Boulder, CO
Ft. Collins, CO
Denver, CO
Boise, ID
Idaho Falls, ID

APPENDIX I
HERBICIDE PRODUCTS

Contents:

Weed Wiper

Herbicide Sprayer

Herbicide Dye

Surfactants

Calibration

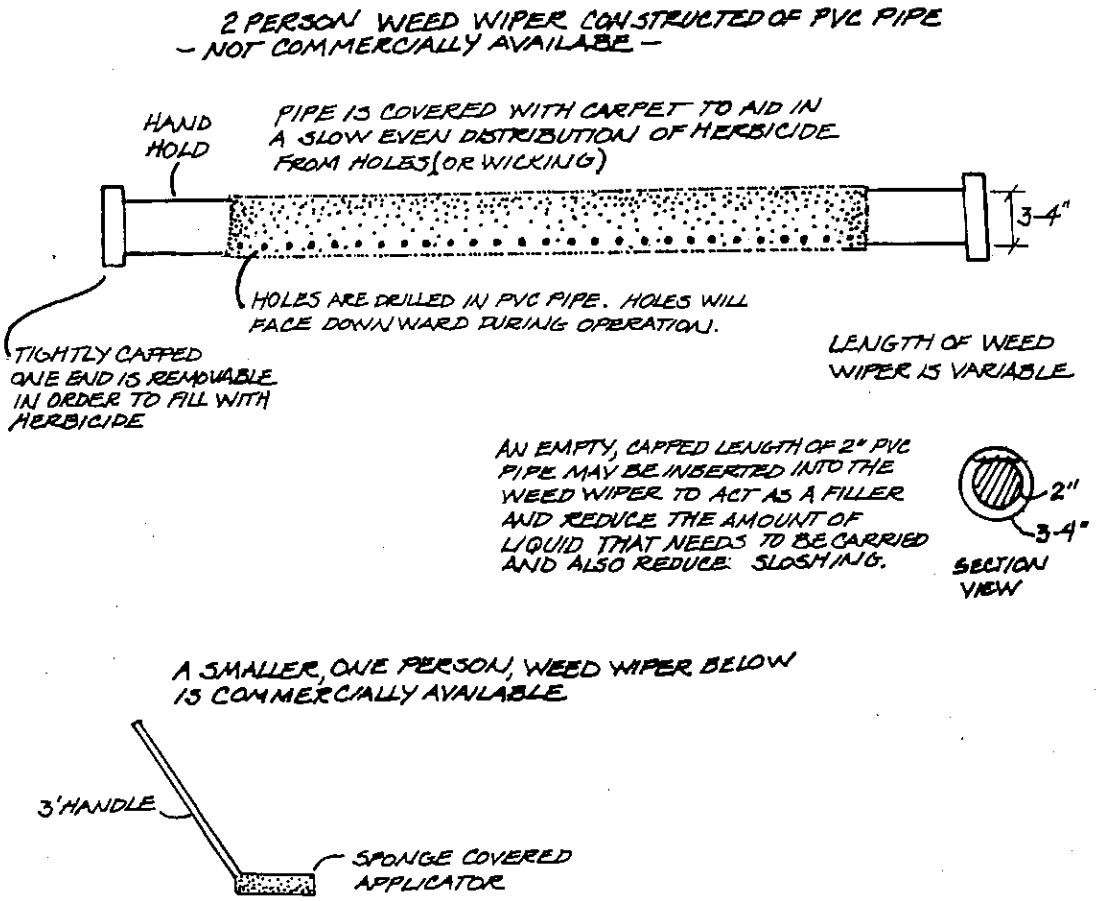


Fig. 45 Weed wiper.

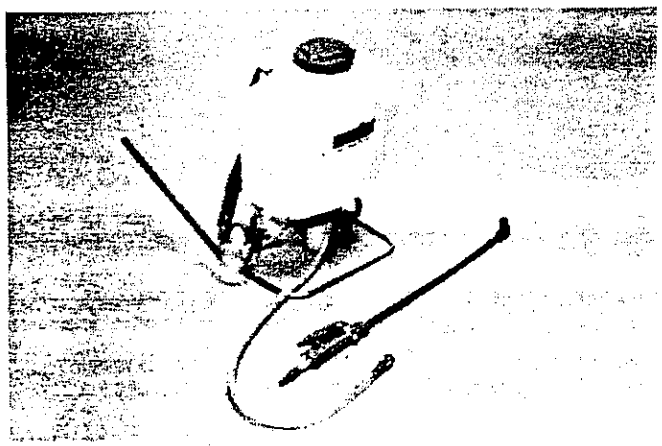
T-FLO OPTIONAL EQUIPMENT:

174: 0-60 psi diaphragm gauge and adapter for boom handle. **$14.40**

6V BAT: 6V-10 amp sealed battery 6"L x 2"W x 3.75"H. **$43.60**

624: 6V 2.4 watt charger with connections. **$19.95**

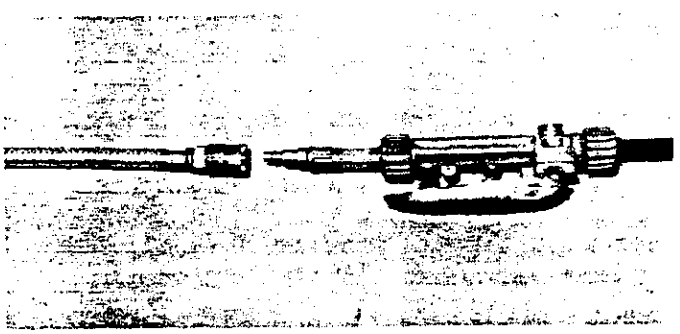
110-38: pressure relief valve. **$24.19**



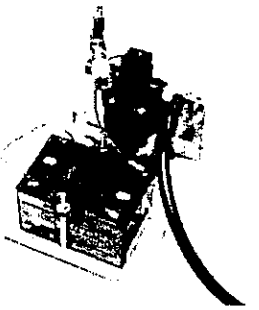
425: SOLO Back Pack Sprayer, 4 gallon capacity. Complete with piston pump and built in pressure regulating valve. Spray hose modified with disconnects to remove single nozzle boom from hose. **$129.00**

425-ST: Standard Solo Sprayer without quick disconnect.. **$121.00**

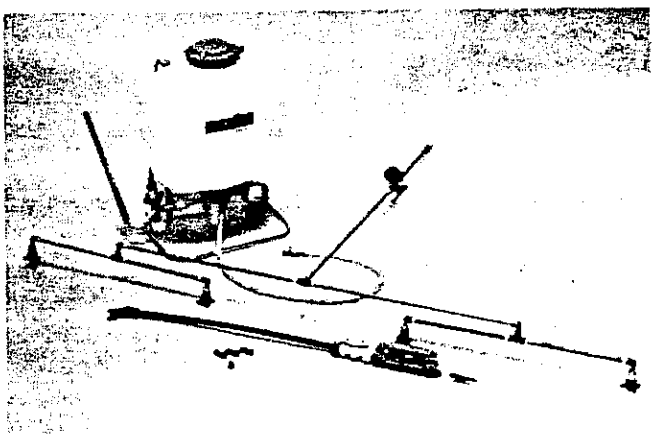
SOLO-AD



SOLO-AD: Quick disconnects for SOLO or other hand pump back-pack sprayers (38HB & 38 HN). Supplied with hose clamp. **$8.00**



Flo Pak: Flojet pump; pressure relief valve; aluminum mounting base; brackets to hold one or two 6 volt batteries; pump inlet hose; switch and wire harness. Attached to back frame with 2 bolts. (Priced without batteries) **$197.00**



425-601C: Same as Solo 425 but also equipped with 4 nozzle spray boom (601C) and 0-60 psi gauge on boom handle. Low pressure tips supplied in boom. **$270.50**

SITE PREPARATION GUN

SPG: Designed for forest application and directed spray. #30 valve, down pipe with three single nozzle swivels. **$84.00**

• USE THIS FORM FOR YOUR ORDERING CONVENIENCE •

R & D SPRAYERS

790 E. Natchez Boulevard
OPELOUSAS, LOUISIANA 70570
PHONE (318) 942-1001

SOLD TO _____

SHIPPED TO _____

Telephone # ( ) _____

VISA OR MASTERCARD PAYMENT ☐☐☐☐-☐☐☐☐-☐☐☐☐-☐☐☐☐ Exp. Date _____

SALES TYPE Cash ☐ Chg. ☐ C.O.D. ☐ P.R. ☐	CUSTOMER ORDER NUMBER	ORDER DATE		CARRIER

Seq. No.	Qty.	Part No.	Description	Unit Price	Ext. Price
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

☐ MASTERCARD ☐ VISA

MDSE.TOTAL _____

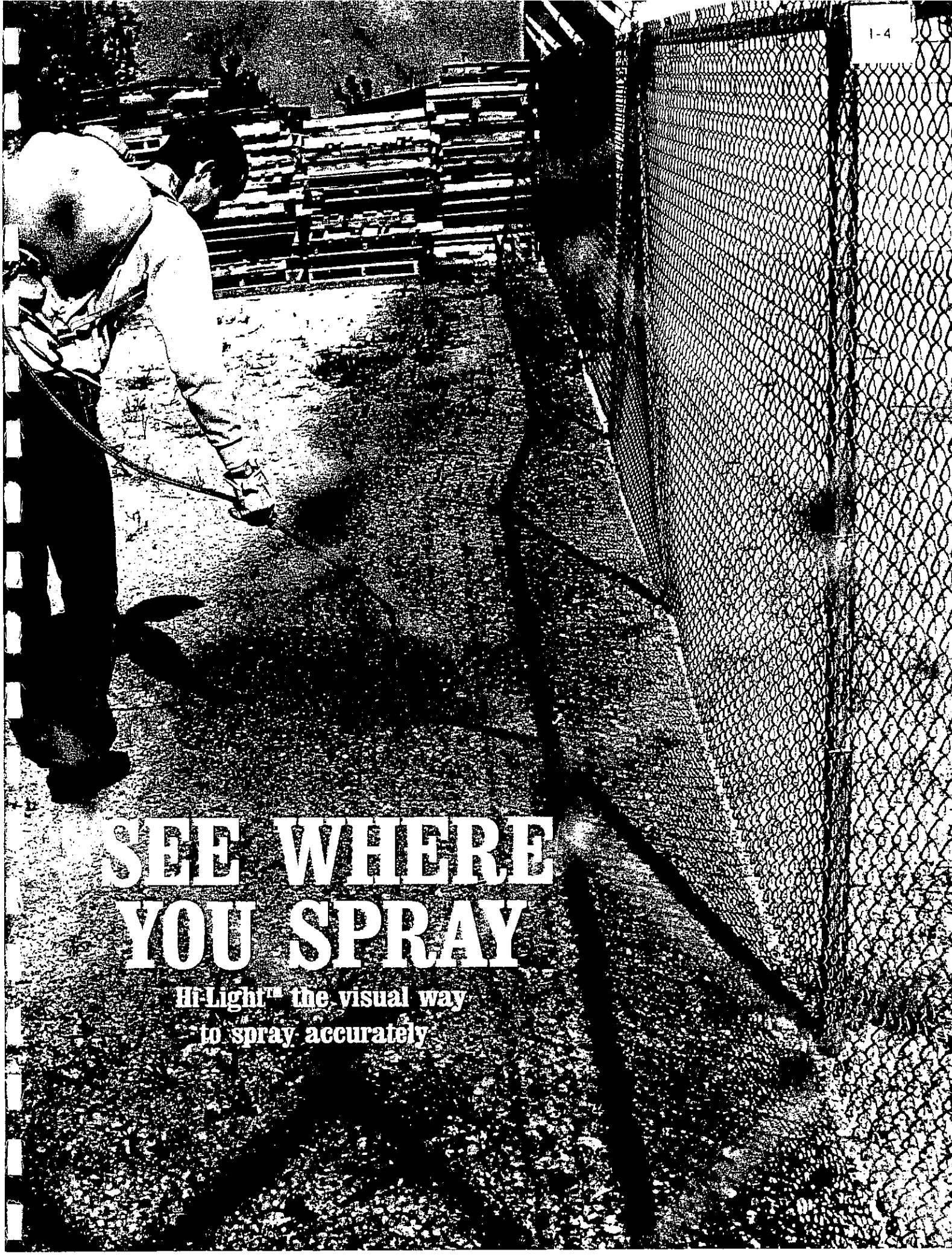
ALL PRICES F.O.B. OPELOUSAS, LA.

Due to cost increase of raw material, prices are subject to change without notice. All prices are F.O.B. Opelousas, Louisiana. United Parcel Service and Parcel Post will be added to invoice.

R & D SPRAYERS, INC.
790 E. Natchez Blvd.
Opelousas, Louisiana 70570

Bulk Rate
U.S. Postage
PAID
Permit #189
Opelousas, LA
70570

STEVEN A. DEWEY
UTAH STATE UNIV.
PLANT SCIENCE DEPT.
LOGAN, UT. 84322-4820



SEE WHERE YOU SPRAY

Hi-Light™ the visual way to spray accurately

HI-LIGHT™ HELPS ELIMINATE SKIPS, OVERLAP, DRIFT

HI-LIGHT defines treated areas in grasses, weeds and most any environment.

See where you spray with HI-LIGHT,™ a temporary colorant which indicates treated areas in blue. It helps eliminate guesswork on pesticide coverage and leaves a clear bold indication of treated spots, rows, swaths and spray patterns. Promotes uniform, accurate application of valuable and critical insecticides, herbicides, soil sterilants and plant growth regulators.

indicates intensity

HI-LIGHT™ also indicates application intensity. The darker the blue mark, the stronger the chemical application. Allows applicators to see the concentration of otherwise colorless chemicals on the target.

reveals patterns and drift

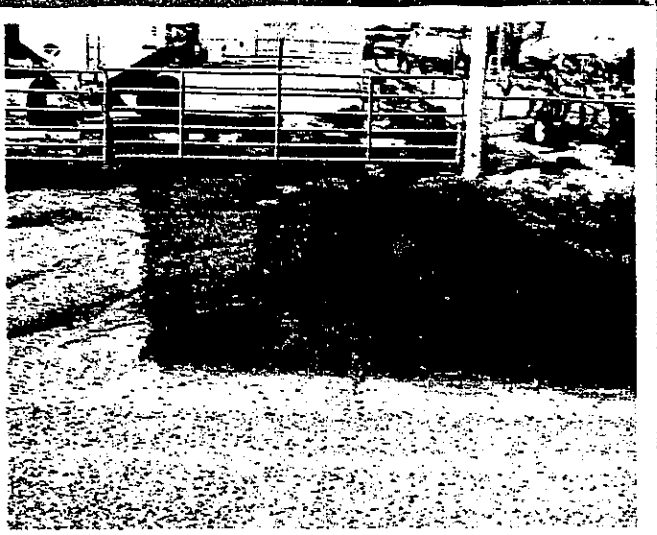
Application spray patterns and drift are now easier to see with a blue trace. Airborne spray droplets stand out — both in the air and on non-target environments. Enables applications near sensitive areas (homes, gardens, water, etc.) and helps applicators improve accuracy while reducing drift liability potential.

saves money

HI-LIGHT™ saves money. Often reduces the amount of actual chemical applied by 10% to 30%. It's economical too. The concentrated colorant requires as little as ¼ oz. to 1-gallon of chemical.

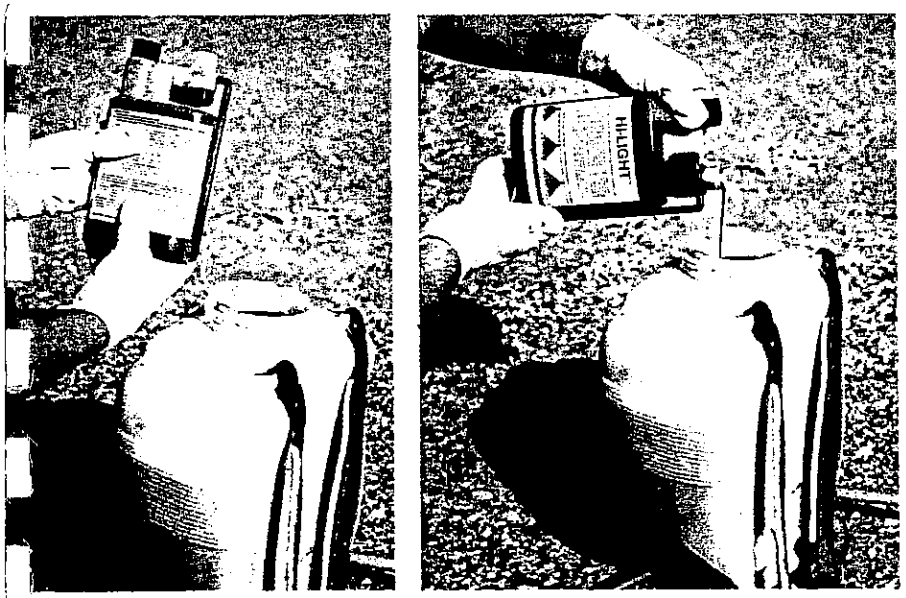
compatibility and easy clean-up

Non-toxic, water based HI-LIGHT™ breaks down in sunlight and washes away with rain. It's compatible with most chemicals and it allows easy clean-up with water.



HI-LIGHT color contrast easily indicates treated area.

On-target spot spraying is fast, easy and accurate with blue colorant indicator.



HI-LIGHT™ in calibrated bottles

HI-LIGHT™ 1-quart and 1-gallon break-resistant poly containers feature self calbrating pour spouts. The applicator simply squeezes the bottle (quart size) until the small calibration reservoir registers the selected amount of colorant. Colorant is then poured into the applicator tank. The gallon size container is tipped (with caps on) until the calibration reservior is filled to the determined level. Also available in 2½ gal., 30 gal. and 55 gal. containers.

about Becker-Underwood

Becker-Underwood is a specialized colorant and dye manufacturer providing products to enhance spray application accuracy for agriculture, industry, forestry and turf. Our goal is customer satisfaction both in performance and product quality. We have the ability to ship quickly, and we customer formulate most any color to the specification and/or need or our customers. If you have a proprietary need or requirement in colorants or dyes, call us. We'll help.

suggested rates

The following rates offer a range of colorant intensities. Applicators are encouraged to test the range to determine the exact rate best suited to a given chemical and application site.

large areas

application area	per 100 gals.
gravel, bare ground, parking lots	6 to 12 oz.
roadside ditch banks, highway rights of way, fence lines, weed control	10 to 16 oz.
lawns, parks, turf, edging	12 to 16 oz.
utility rights of way, brush, heavy weeds, forestry	16 to 32 oz.

small areas and spot work

tank size	suggested ounces	other unit measure
1 quart	less than 1/10	up to 1 teaspoon
1-gallon	1/4 to 1/2	2 to 3 teaspoons
3-gallons	3/4 to 1 1/2	1 1/2 to 3 tablespoons

distributor

SNAKE RIVER CHEMICALS, INC.
118 East 12675 South
Draper, Utah 84020
(801) 572-6843

Becker-Underwood
701 Dayton Road
Ames, Iowa 50010
(515) 232-5907
(800) 232-5907

printed in U.S.A.

SURFACTANTS

Environmental contamination has resulted in more emphasis being placed on efficiency in using pesticides. Over the last 25 years, many workers have shown that toxicity of foliar-applied herbicides is enhanced by the use of surfactants. Even with wide use of surfactants, the role they play is probably the least understood of all the agricultural chemicals used today. They increase pesticide performance in the field and also are an important aspect of the formulation.

There is an old, widely held idea that any substance that will increase wetting will serve as a surfactant for any pesticide. Nothing could be farther from the truth. Some of the confusion has arisen because of terminology used by growers and nontechnical users when discussing surfactants. The terms most commonly used interchangeably are activator, additive, adjuvant, detergent, soap, spreader, surface-active agent, surfactant, and wetting agent.

An additive is a material added to the spray solution and may or may not be a wetting agent or a surfactant. An adjuvant is a material that assists, aids, or modifies the spray solution in some manner. A detergent is a cleaning agent or solvent and does not necessarily enhance or modify a spray solution. A surfactant is a material which facilitates and accentuates the emulsifying, spreading, and wetting properties of a spray solution. A wetting agent is a compound which causes a spray solution to contact plant surfaces more thoroughly. It can easily be seen why confusion arises when discussing these compounds, but remember that to wet a surface only means to cover or soak that surface with a liquid.

Surfactants come in a wide variety of types and each is designed for a particular use. They may be manufactured from numerous hydrocar-

Dewey, Steven A. 1990. Utah weed control handbook 1990. Utah State University Extension Service, Logan, UT.

bon nuclei and polar functional groups. At present, there are several thousand trade-name surfactants available. For simplicity's sake, they may be grouped into three groups on the basis of their electrical charge: anionic--negatively charged, cationic--positively charged, and nonionic--neutral, or no charge.

The nonionic surfactants are most commonly encountered in agricultural sprays, because they are relatively unaffected by water hardness and are compatible with all types of herbicides. However, many commercially available surfactants are blends of the different surfactant types with other chemicals which is done in order to produce a high performance product. Buffering compounds are often used to prevent extremely hard water from interfering with a spray solution. Generally these surfactants are formulated and recommended only when those conditions prevail.

Once the proper surfactant has been selected, the next most important factor to consider for increasing herbicide phytotoxicity is the concentration of the surfactant. Wetting of plant surfaces is important to obtain coverage of the plant, and in situations where contact herbicides are used, this may be all that is desired. However, it has been found that the wetting of plant surfaces does not correlate with the increase in phytotoxicity. Maximum wetting occurs in the range of 0.01% to 0.1% concentration of the surfactant, and maximum increase in phytotoxicity occurs near 1.0% concentration. An idealized graph of increased phytotoxicity versus surfactant concentration would show that the main increase in activity occurs between 0.01% and 1.0% on a volume per volume basis (i.e., from 2 fl oz to 4 qts of 100% active surfactant ingredient per 100 gal of spray solution).

The average amount of surfactant used in most herbicide solutions

is approximately 0.1% to 0.5% (i.e., 1 pt to 2 qts per 100 gal of spray solution). The maximum effect obtained from a given concentration will vary with surfactant and herbicide. Phenoxy-type herbicides (2,4-D) generally show maximum increase around 0.2 to 0.5%, while most other types of foliar-applied herbicides (dalapon, amitrole, paraquat, etc.) show effects from 0.5% to 1.0%.

Use should be made of this range of surfactant concentrations by taking into consideration the environmental factors preceding and at the time of spraying. In areas or times of high humidity and cool temperatures, the need to include high surfactant concentrations in a herbicide spray solution is less than in areas or at times of low humidity and high temperatures. It must also be remembered that in very adverse weather conditions of extremely hot and dry periods, the benefits derived from the use of a surfactant will be lessened. Older plants are generally more difficult to control than are younger plants. Plants suffering from water stress, nutrient deficiency, or covered with dust and insect damage are more resistant to penetration and movement of herbicides.

Proper selection of the surfactant is of the utmost importance, and care should be used to correlate it with the use intended. In some herbicide products, the surfactant is formulated in the package sold to the consumer. The surfactant-herbicide choice has been made, but the concentrations when mixed for use are often not proper for maximum uptake. When this occurs, caution should be exercised in selecting and adding additional surfactant. Remember that even though phytotoxicity of the herbicide is increased by the use of surfactants, it may not always be desirable, as the surfactant may reduce selectivity, thus eliminating species selectivity.

Surfactants are no miracle chemicals, but when used properly, they will enhance herbicidal efficiency. They will assist in lessening the possibility of damage to desirable plants by allowing the use of lower rates of the herbicide, and will decrease the cost of the herbicidal application. Some surfactants and their formulators include:

Colloidal Products Inc.:

1. Tronic - an excellent "wetter" of water repellent plant surfaces and enhances the penetration of waxy cuticles on weed leaves. Suggested for use with atrazine, 2,4-D, Tenoran, dalapon, and Bladex.

2. Multi-film X-77 - used to increase the efficiency of many agricultural chemicals, including many herbicides.

Rohm and Haas:

Triton - for use with insecticides, fungicides and herbicides. It helps provide rapid wetting and improved coverage of the plant.

Amway Corporation:

1. Amway spray adjuvant - for enhancing the effect of atrazine for post-emergent application on corn.

2. Amway all-purpose spray adjuvant - a wetting agent for enhancing the effect of herbicides, insecticides, and fungicides.

Amchem:

Pace spray adjuvant - increases efficiency of postemergence herbicide and plant regulator sprays.

SPRAYER CALIBRATION

CALIBRATION IS EASY--AND ESSENTIAL. Failure to calibrate properly is probably the biggest reason for herbicide failure or damage. It is essential to know how much the sprayer is applying per acre to be able to know how much herbicide to place in the tank.

Calibrating a sprayer consists of determining the discharge, or output. Output refers to the number of gallons per acre the sprayer applies. Output depends on 1) ground speed, 2) pressure at the nozzles, 3) nozzle spacing, and 4) size of nozzle opening (orifice).

1. Ground Speed - Slow speeds are best (2-5 mph). Regular speedometers for cars or trucks will not measure slow speeds accurately. Get a tractor speedometer that will fit your truck or tractor. Cutting the speed in half will result in applying twice as much spray per acre. Always travel at a uniform speed for each spray job. The following information can also be used to help you determine miles per hour.

1 mph = 88 ft/min	4 mph = 352 ft/min
2 mph = 176 ft/min	5 mph = 440 ft/min
3 mph = 264 ft/min	

2. Pressure at the Nozzles - Speed of the power source for the pump (tractor PTO or auxiliary motor for truck-mounted sprayers) affects the pressure. A pressure regulator is installed on some rigs, allowing for pressure adjustment. A pressure gauge in the line allows you to read the pressure at that point. Due to friction, this will be somewhat less out at the nozzle. Pressure must be quadrupled (4 times) to double the output. Excessive pressure breaks the spray into very small droplets that will drift. Too low pressure may leave unsprayed strips between nozzles. About 30 pounds of pressure is good for most ground rigs.

3. Nozzle Spacing on the Boom - In designing the boom, the nozzle spacing can be chosen which best fits the spray jobs to be done. The angle of the spray pattern as determined by the nozzle orifice is taken into account, also the height of the boom above the weeds or soil to be sprayed. A popular spacing of nozzles on the boom is 20 inches.

4. Size and Shape of the Nozzle Opening - This is the easiest of the factors to change. It is possible, with a set of different nozzle sizes, to vary the gallons per acre over wide limits with only minor changes in ground speed and pressure. Leading manufacturers of spraying systems print numbers on the outside of their nozzle tips showing the angle of the spray pattern and the output in gallons per minute. For example - 8004 means 80 degree angle and a discharge of .4 gallons per minute. With Delavan nozzles, the numbers on the lower half of the tip

Dewey, Steven A. 1990. Utah weed control handbook 1990. Utah State University Extension Service, Logan, UT.

are the angle, and the code letters and number on the upper half of the tip refer to the gallons per minute discharged. Example: $\frac{LF2}{80}$ means an 80 degree angle and .2 gallons per minute. Be sure to consult the manufacturer's catalog for instructions on selecting and using nozzle tips best suited to your needs.

THINGS TO DO BEFORE YOU CALIBRATE YOUR SPRAYER

1. Rinse and fill supply tank with clean water.
2. Remove and clean all nozzles. An old toothbrush or a match is handy to clean a nozzle without enlarging the nozzle orifice. Do not use pocket knives or wire for cleaning.
3. Start sprayer and flush hoses and boom with plenty of clean water.
4. Replace the nozzles, and make sure all nozzles are spraying properly.
5. Check all connections for leaks.
6. Adjust the pressure regulator to 30 pounds pressure.
7. If everything is working properly, you are ready to calibrate the sprayer.

CALIBRATING BOOM SPRAYERS

The following is a simple two-step method. Before doing it, however, make sure you have prepared the sprayer as in the preceding paragraph.

Step 1: Turn on the sprayer and find the number of seconds required to collect 2 pints from a single nozzle. (Check several nozzles to be sure the output is nearly the same for all nozzles--if not, change those nozzles that vary.)

Step 2: Find that number in the following chart, which will show seconds required to collect 2 pints (32 ounces) of water from one nozzle to equal gallons per acre when nozzles are spaced 20 inches apart. The gallonage per acre is read off the top of the chart and the miles per hour is found down the far left column.

For example, you find it takes 40 seconds to catch 2 pints. That number is found in the 25 gal column if you drive 4.5 mph, in the 20 gal column if you drive 5.5 mph, or in the 15 column if you drive 7.5 mph. Let's say you decide to drive 4.5 mph, which means your sprayer will put out 25 gallons per acre. If you have a 200 gallon tank, you will be able to spray 200 divided by 25 = 8 acres.

MPH	5 gal	7.5 gal	10 gal	12.5 gal	15 gal	20 gal	25 gal	30 gal	35 gal	40 gal
4.0	222	150	111	88	75	56	44	37	32	28
4.5	200	133	98	79	67	50	40	33	28	25
5.0	178	118	89	71	60	44	36	30	25	23
5.5	162	107	81	65	55	40	33	27	23	20
6.0	148	98	74	60	50	37	30	25	21	19
6.5	136	91	68	55	46	34	27	23	19	17
7.0	128	85	64	51	43	32	25	21	18	16
7.5	118	79	69	48	40	30	24	20	17	15
8.0	111	74	56	44	37	28	22	19	16	14

CONVERSION CHART
(For Nozzle Spacing Other Than 20 Inches)
Multiply Gallons Per Acre by Conversion Factor

Nozzle Spacing	12"	14"	16"	18"	20"	22"	24"	30"	36"
Conversion Factor	1.67	1.43	1.25	1.11	1	.91	.83	.66	.56

For example, your nozzle spacing is 18 inches. As in the first example, you find it takes 40 seconds to catch 2 pints and you plan on driving 4.5 mph which will mean, according to the chart, an output of 25 gallons per acre. To determine the output from an 18 inch spacing, multiply 25 x 1.11 = 27.75 gallons per acre.

DETERMINING TRACTOR SPEED

Technique 1

Miles/hr	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
Seconds*	51	46	41	37	34	31	29	27	26

* Seconds required to travel 300 feet.

Technique 2

1 mph = 88 ft/min	4 mph = 352 ft/min
2 mph = 176 ft/min	5 mph = 440 ft/min
3 mph = 264 ft/min	

CALIBRATING LARGE HIGH PRESSURE SINGLE-NOZZLE SPRAYERS

Step 1. Measure off an area 20' x 22' = 440 sq. ft. (approximately 1/100 of an acre.

Step 2. Set the sprayer at the desired pressure and spray patter.

Step 3. Determine the time in seconds it requires to spray the area.

Step 4. Spray into a container for the same amount of time required to spray the measured area.

Step 5. Multiply the amount by 100 to determine the number of gallons per acre.

WEED CONTROL ON A SMALL AREA BASIS

Label recommendations are usually given in pounds per acre, or pints or quarts per acre. How does one convert that to a small area, say 1,000 square feet? The following table will help decide how much chemical to use on a small area.

CONVERSION TABLE FOR USE OF HERBICIDES ON SMALL AREAS WHEN RATE PER ACRE IS GIVEN

Liquid Materials

Rate of Commercial Formulation Per Acre	Approximate Rate Per 1,000 Square Feet
1 pint	3/4 Tbls*
1 quart	1 1/2 Tbls
2 quarts	3 Tbls
1 gallon	6 Tbls

* Tbls = Tablespoons

Dry Materials

Forumlation Per Acre	---- Approximate Rate/1,000 sq ft. ---- Wettable Powders	Granular Materials
1 pound	5 tsps**	2 1/4 tsps**
2 pounds	3 Tbls	4 1/2 tsps
3 pounds	5 Tbls	2 1/4 Tbls
4 pounds	6 Tbls	3 Tbls
5 pounds	8 Tbls	4 Tbls
10 pounds	1 cup	1/2 cup
100 pounds	2 1/4 pounds	2 1/4 pounds

* Tbls = Tablespoons (level)
** tsps = teaspoons (level)

Once you determine how much herbicide to apply on small areas, how do you determine how much water you should use? Mark off a known area, say 100 square feet. Starting with a full tank of water, spray the 100 square feet as you would if you were spraying with a herbicide. By measuring the water required to refill the spray tank, you determine the amount needed to spray the 100 square feet. Ten times that amount will be needed to cover each 1,000 square foot area.

A pamphlet entitled "Weed Control for the Homeowner" is especially useful for those who need small area coverage rates and recommendations. It is available from County Extension offices throughout the state.

APPENDIX J
PLANTING SPECIFICATIONS

The purpose of Appendix J is to provide guidelines for specifications in order to implement the planting project in this document. It is not intended to be a complete specification document. More detailed specifications and drawings will have to be developed when work is contracted.

PLANTING GUIDELINES AND SPECIFICATIONS
SITE WORK

SECTION 02490
PLANTS

PART 1 - GENERAL REQUIREMENTS

1.1.0 DESCRIPTION

1.1.1 Provide plant materials as shown and specified. The work includes:

A) Soil Preparation
B) Trees, shrubs and ground covers
C) Seed mixes
D) Plant acquisition
E) Existing tree care
F) Tree relocation
G) Maintenance and monitoring
H) Irrigation
I) Weed control
J) Fertilizers

1.2.0 QUALITY CONTROL

1.2.1 Plant material shall conform to the requirements of the "American Standard for Nursery Stock" (ANSI Z60.1 1986), except where superceded by contract specifications. Portions of that document pertinent to this work are attached (Appendix K). Plants shall be of specified species and shall have a normal habit of growth. They shall be sound, healthy, vigorous, and densely foliated when in leaf. They shall be free of disease and insect pests, eggs or larvae. They shall have healthy well developed, established root systems.*

1.2.2 The Contractor shall be responsible for all certificates pertaining to nursery inspection, plant quarantine regulations of State origin and destination, interstate movement of nursery stock may be required by Federal, State or other authorities. Valid copies of inspection certificates, where required, shall accompany each package, box, bale or load shipped or otherwise delivered.*

1.2.3 Seed shall be fresh, clean, and new-crop seed. The contractor shall furnish dealer's certification for required grass seed mixture, indicating percentage by weight, and percentages of purity, germination, and weed seed for each grass species. Grass seed shall not be delivered to the site until samples have been approved in writing by the Landscape Architect. Approval of samples, however, shall not affect Landscape Architect's right to reject seed upon or after delivery.*

1.2.3 Only plants and seeds of plants that are propagated and grown, either from seedling or vegetative cutting, and collected in areas that conform to the following environmental conditions, will be accepted:

A) 8"-16" precipitation
B) Elevation: 3500-6000 feet above sea level
C) States: Colorado, Idaho, Utah, Wyoming, New Mexico, Montana and Nevada.
D) Hardiness Zones 3,4 or 5. Hardiness Zones are defined in U.S.D.A. Publications and attached. (Appendix L)*

1.2.4 All plants shall conform, with branches in normal position, to the measurements specified in plant lists. Exceptions as follows:

1.2.4.1 Plants larger than specified in the plant list may be accepted, subject to approval by the Landscape Architect, but this will not increase the contract price. If larger plants are approved, the spread of roots shall be increased in proportion to the size of the plant.

1.2.4.2 Plants are subject to inspection by the Landscape Architect for conformity to specification requirements as to type, quality, quantity, and size.

1.2.5 Plant materials inspected and approved before planting by Landscape Architect is not considered final acceptance.

1.3.0 DELIVERY, STORAGE AND HANDLING

1.3.1 Deliver seed, fertilizer materials in original, unopened, and undamaged containers showing weight, analysis, and name of manufacturer. Store in manner to prevent wetting and deterioration.

1.3.2 Handle and pack each species and variety of plant in a manner approved by American Standards for Nursery stock.

1.3.3 Maintain delivered plants in good condition. Wilted plants, whether in place or not, will not be accepted and will be replaced at contractor's expense.

1.3.4 Cover plants transported on open vehicles with a protective covering to prevent wind burn.

1.4.0 SITE CONDITIONS

1.4.1 Work rapidly within the time frame of seasonal limitations that are specified.

1.4.2 Disturb only areas to be planted soon. All other areas are to be left undisturbed to decrease erosion, dust and soil compaction. Landscape Architect will mark boundary of disturbance area with flagging or temporary fencing.

1.4.3 Protect existing utilities, paving, and other facilities from damage caused by landscaping operations. Determine location of underground utilities and avoid damage. Hand excavate if necessary. Contact appropriate utility companies.

1.4.4 Work notification: Notify Landscape Architect at least 7 working days prior to installation of plant material.

1.4.5 The irrigation system will be installed prior to planting. Locate, protect, and maintain the irrigation system during planting operations. Repair irrigation system components, damaged during planting operations, at Contractor's expense.

1.4.6 All grading of work site will be completed before planting begins to avoid disturbing newly planted vegetation.

1.4.7 Sedimentation of surface water, including the Jordan River, will be minimized during site work.

1.4.8 Grading will not be done in extreme muddy conditions.

1.5.0 WARRANTY

1.5.1 Warrant plant material to remain alive and be in healthy vigorous condition for a period of one year after completion and acceptance of entire project.

1.5.2 Replace, or provide funding to Murray City for replacement, in accordance with the drawings and specifications, all plants that are dead or, as determined by the Landscape Architect, are in an unhealthy or unsightly condition, and have lost their natural shape due to dead branches, or other causes due to the Contractor's negligence. The cost of such replacement(s) is at Contractor's expense. Warrant all replacement plants for one year after installation.

1.5.3 Warranty shall not include damage or loss of trees, plants, or ground covers caused by fires, floods, freezing rains, lightening storms, or winds over 75 miles per hour, winter kill caused by extreme cold and severe winter conditions not typical of planting area; acts of vandalism or negligence on the part of Murray City.

1.5.4 Remove and immediately replace all plants, as determined by the Landscape Architect, to be unsatisfactory during the initial planting installation.

1.5.5 Lawn: Provide a uniform stand of grass by watering, mowing, and maintaining seeded areas until final acceptance. Reseed areas, with specified materials, which fail to provide a uniform stand of grass until all affected areas are accepted by the Landscape Architect.

PART 2 - SITE PREPARATION

2.1.0 DESCRIPTION

2.1.1 This item shall consist of preparing the soils and slopes for planting with seed or plant materials. It includes several different preparation techniques depending on the kind of plant material intended for the area, and conditions at each planting area. Other items that apply to this work are: Part 3 - Weed Control, and Part 5 - Planting.

2.2.0 MATERIALS

2.2.1 Topsoil shall be a friable loam, typical of cultivated topsoils locally, containing at least 2% of decayed organic matter (humus). It shall be taken from a well drained, arable site. It shall be reasonably free of subsoil, stones, earth clods, sticks, roots or other objectionable extraneous matter or debris. It shall contain no toxic materials.*

2.2.2 Representative samples shall be tested for acidity, fertility and general texture by a recognized commercial or government agency and copies of the testing agency's findings and recommendations shall be furnished to Murray City by the Contractor.*

2.2.3 No topsoil shall be delivered in a frozen or muddy condition.*

2.2.4 Wetland soils shall be obtained locally where approved by Landscape Architect subject to Corps of Engineers 404 Permit. Care shall be taken to maintain soil quality and viable seed bank.

2.3.0 WETLAND

2.3.1 Carp shall be removed by one of the following methods:

A) Live trapping carp and treat with Rotenone. The larger carp shall be live trapped. Rotenone shall be used to kill the remaining fish. This method is preferable.

B) A partial water drawdown with Rotenone treatment.

C) A complete water drawdown.

2.3.1.1 Live trapping shall be aided by a local organization that provides food for low income people. See Appendix H for contacts.

2.3.1.2 Rotenone treatment shall be approved and directed through the Utah Department of Wildlife Resources. See Appendix H for contacts.

2.3.1.3 Rotenone shall not be used when surface water is flowing into the Jordan River.

2.3.1.4 Rotenone shall not be used in spring to summer when amphibians are in the gill stage of their life cycle. Consultation with a biologist is required.

2.3.1.5 Rotenone shall be used concurrently with water drawdown to reduce the amount of chemical needed.

2.3.2 Ground water level monitoring wells shall be installed in areas where wetland creation and enhancement shall take place. See Fig. 24 for dimensions.

2.3.2.1 Ground water level monitoring wells shall be installed during the season of lowest water at a minimum depth of 18".

2.3.2.2 The wells shall be constructed from PVC pipe, and made in such a manner as to allow ground water to enter for accurate measure of water level.

2.3.2.3 Wells shall be inserted in such a manner as to prevent soil disturbance of the hole, and in such a way to prevent human disturbance.

2.3.2.4 Monitoring shall be of a frequency and duration as to facilitate the particular wetland enhancement or creation project.

2.3.3 Wetlands water control structures and dikes shall be installed for wetland enhancement and creation.

2.3.3.1 A culvert and riser shall be installed at locations indicated in the drawings for wetland water control. See Fig. 25 for dimensions.

2.3.3.2 A low dike shall be constructed in the location indicated in the drawings, and only where it is necessary to prevent overflow of wetland at anticipated high water level.

2.3.3.3 Ponds shall be constructed 6" to 18" deep and have a slope of 1:5. The ponds shall have an irregular edge and be of different sizes as indicated in the drawings. Ponds shall contain islands of different sizes as indicated in the drawings. The ponds shall be inundated at least part of the year to achieve the ideal ratio of 50:50 water to vegetative cover.

2.3.3.4 Fill ponds slowly to avoid erosion and sedimentation of the water.

2.3.4 A minimum of two years after installation of water control structures is required to determined the affects of the increased water table on upland plant communities adjacent to wetland before seeding or planting. Information shall be obtained from a visual assessment of plant community changes and ground water levels from observation wells.

2.3.5 Wetland soils shall be saved and the seedbank protected for use in wetland creation and enhancement projects.

2.3.6 Jurisdictional wetland, as identified in the drawings, will not be filled or excavated, including grading and topsoiling, unless permitted by the Army Corps of Engineers

under the 404 Permit. Agricultural practices are allowed including tillage, planting and irrigating.

2.4.0 UPLAND

2.4.1 Removal of Large Weeds: Large weed debris should be removed and disposed of in areas of no till seeding after successful treatment with herbicide according to Part 3 - Weed Control. Remove weeds too large to mow as a mulch, or if covering a ground area larger than one foot square that would inhibit drill seeding.

2.4.2 Disking: Disk with a heavy offset disk in irregular rows and patches in areas shown on drawings. Disk to a depth of eight inches, incorporating small vegetation matter into the soil in the process. Areas covered by rhizomatous grasses or weeds shall not be disked unless all vegetation is effectively killed with herbicide according to Part 3 - Weed Control. Disking shall be done on relatively dry soil and on the contour of the slope.

2.4.3 Mowing Grass Stubble: Existing grass stubble will be used as natural mulch and erosion control in areas where a suitable stand of grass is in place. Cut grass to a uniform height of 4-6 inches no sooner than 7 days after successful treatment with post-emergent herbicide according to Part 3 - Weed Control. Maintain grass stubble intact during planting operations.*

2.4.4 Seed Bed Preparation: Prepare soil for seeding to a depth of 2". Seed bed should be well pulverized and friable on top, not cloddy nor puddled, free from live resident competition, and free from seed of competitive species. Seed bed shall be firm below 2". Seeding must take place within 24 hours of seed bed preparation. If a crust has formed, repeat soil preparation procedures.*

2.4.5 Seed and Planting Bed Preparation of Bank Spoil and Compacted Road Base: Weeds shall be removed with post emergent herbicide according to Part 3 - Weed Control in the spring. Re-apply in late summer. Site preparation and seeding or planting shall occur in late fall when plants are dormant and there is ground moisture. A few inches of topsoil shall be added and ripped to loosen surface and and increase organic material and water infiltration.

2.4.6 Planting Bed Preparation: Areas to be planted shall be free of live roots and rhizomes a minimum of 2' from tubling, bare root and container stock. A weed and grass free buffer zone shall be left unplanted 10' between shrub and tree plantings, and grasses and weedy areas where practicable. Buffer zone shall remain until shrub and tree establishment. Perennial weeds shall be removed with post emergent herbicide according to Part 3 - Weed Control in the spring. Herbicide shall be re-applied in the late summer where necessary and mowed. Planting shall occur in late fall when plants are dormant and there is ground moisture.

2.5.0 RIVERBANK

2.5.1 Construction and vegetation of riverbank stabilization shall be approved by the Salt Lake County Flood Control, Salt Lake City and County Health Department, State Engineer's Office, the Army Corps of Engineers and and any other office with jurisdiction of the Jordan River and its tributaries.

2.5.2 Both the west and east banks of the Jordan River shall be equally considered for bank stabilization and protection from erosion.

2.5.3 Sections of the riverbank shall be graded into low terraces to an overall slope of 3:1 for bank stabilization and access as in Fig. 36. Construction shall be done during low water during fall or in early spring before planting when plants are dormant.

2.5.4 Sections of the riverbank shall be stabilized with bioengineering techniques as shown in Figs. 39 through 43, and shall be constructed in the early spring when plants are dormant and during low water.

2.6.0 UNDISTURBED AREAS

2.6.1 Areas that are to be undisturbed during landscape procedures include those areas that are shown on the drawings, and all areas not part of the immediate area to be seeded or planted. Landscape operations including those requiring foot traffic, moving equipment and vehicles, and application of herbicides will not be permitted in those areas. Access to treated areas requiring trespass on undisturbed areas will be permitted in limited cases with approval of the Landscape Architect. Disturbed areas shown on the plans as Undisturbed, and those not part of the immediate area to be seeded or planted shall be revegetated at the Contractor's expense as directed by the Landscape Architect.*

2.7.0 PROTECTION OF EXISTING VEGETATION

2.7.1 Existing native trees over 1" in caliper, and native shrubs over one foot in height or spread shall be protected during landscape operations wherever possible. Trees and shrubs designated for protection are identified on the plans, others not shown on the plans shall be protected. Approval of the Landscape Architect is required in order to remove existing vegetation described above.*

2.7.2 Protection does not include trees and shrubs that are classified as noxious or other non-native plants listed in Appendix D. These shall be controlled according to Part 3 - Weed Control.

PART 3 - WEED CONTROL

3.1.0 DESCRIPTION

3.1.0 Furnish and apply post-emergent and pre-emergent herbicide during site preparation and landscape installation. In lawn areas, furnish and apply herbicides during plant establishment period for control of competitive weeds. *

3.2.0 MATERIALS

3.2.1 For control of emerged, actively growing grasses and broadleaf plants and weeds before planting in upland areas: Roundup™ (glyphosate) manufactured by Monsanto - a nonselective herbicide containing a soluble concentrate of 4 lbs active ingredient per gallon. Applied as spray. No residual is retained in the soil. Follow label directions.

3.2.2 For control of actively growing whitetop (Cardaria draba), leafy spurge (Euphorbia esula) and dyer's woad (Isatis tinctoria) with grass and forb understory: Roundup™ (glyphosate) manufactured by Monsanto - a nonselective herbicide containing a soluble concentrate of 4 lbs active ingredient per gallon plus surfactant. Selectively applied with weed wiper. No residual is retained in the soil. Follow label directions.

3.2.3 For control of actively growing whitetop (Cardaria draba) and other forbs with grass understory: A mixture of 2, 4-D (various trade names and manufacturers), Escort™ (metsulfuron) manufactured by Dupont, and a surfactant (such as X77 by Ortho). Selective for broadleaf plants, but may also affect certain grass germination up to two weeks. Escort™ residual present in soil up to two years. 2,4-D residual present in soil for 6 weeks to 3 months. Applied with sprayer. Follow label directions.

3.2.4 For control of emerged, actively growing grasses and broadleaf plants and weeds before planting near or in water: Rodeo™ (glyphosate) manufactured by Monsanto - a nonselective herbicide without the toxic surfactant of Roundup™. Applied with sprayer or weed wiper. No residual is retained in the soil. Follow label directions.

3.2.5 For control of actively growing tamarisk (Tamarix sp.): Arsenal™ (imazaphyr) manufactured by American Cyanamid - a nonselective herbicide containing a soluble concentrate of 2 pounds per gallon active ingredient. Applied as paint or spray. Residual in soil is retained for 2 years. Follow label directions.

3.2.6 For control of actively growing annuals and non-rhizomatous perennials: Heavy, off-set disk plow, having two rows of serrated or circular disk blades. Each row is on a separate frame and axle; the frames are set at an angle to each other. When pulled through the soil, the first row of disks turns the soil one way and the second row turns it the other.

3.2.7 Use a pre-emergent that is suitable for control of pre-emerged, grasses and broadleaf weeds in non-irrigated and irrigated areas to be planted. Use a pre-emergent that is

suitable for control of broadleaf weeds only in irrigated areas to be planted with lawn grasses. Do not apply pre-emergent herbicide in seeded areas.

3.2.8 Weed Wiper: A herbicide applicator capable of selecting for whitetop and avoiding other desirable forbs. It is constructed from PVC pipe and short nap rug or sponge, as shown in Appendix I.

3.2.9 Backpack Sprayer: A hand held herbicide applicator that permits greater control of drift and over-spray, and minimizes the cost of chemicals. Recommended model has a four gallon capacity, with piston pump and built in pressure regulating valve, and single nozzle boom removes from hose, as shown in Appendix I.

3.2.10 Surfactant: A material which facilitates, and accentuates, the emulsifying, dispersing, spreading, wetting, or other surface-modifying properties of liquids. Surfactants shall be added to herbicides where not already contained in trade name product. Surfactant will not be added to herbicides used near or over water.

3.2.11 Herbicide Dye: A temporary dye that will increase visibility of areas covered by herbicide. The dye assures coverage, promotes uniform application, increases accuracy, reduces drift potential, breaks down in sunlight and washes away with rain. See Appendix I.

3.3.0 APPLICATION

3.3.1 Herbicides will be used only when necessary for noxious weed control to reduce competition for desirable species, and to eliminate competition for newly planted material. Use no weed control method that will inhibit or prevent germination of the required seeding or planting. Apply herbicide so no damage to protected vegetation occurs whether inside or outside of the Park. Diversity of native forbs will be protected in areas of weed control by using proper methods and herbicides. Damage to protected vegetation indicated on plans or vegetation outside the Park will be reimbursed to the Owner or replaced by the Contractor in a manner satisfactory to the Landscape Architect.*

3.3.2 Only herbicides approved for use near water will be used in wetlands. Care will be used near any water.

3.3.4 Mix and apply post-emergent herbicide according to manufacturer's recommendations indicated in the "Weeds Controlled" section of the label, and the following:

A) Calibrate the applicator according to the manufacturer's directions prior to use and check frequently during application to be sure the equipment is working properly and distributing uniformly. Do not apply more than the recommended amount.

B) Apply to actively growing vegetation.

D) Apply the spray and weed wiper mixture so that all undesired vegetation is uniformly covered, but avoid causing overspray and drift. Spray or wipe target vegetation so that it is wet, but short of dripping.

E) Prune all suckers at the base of any trees prior to application.

F) Do not apply post-emergent herbicide in any of these conditions: When rainfall is expected within 24 hours; when there is growth stress as a result of drought, insects, disease or plant damage; when there is heavy dust on plants; in extreme high temperatures; or in windy conditions.

G) Do not walk or permit other traffic on treated areas when they are wet from application. Shoes and equipment will track spray solution to areas where vegetation is not to be treated.

H) Repeat application as necessary to completely eradicate undesired vegetation.**

3.3.5 Mix and apply pre-emergent herbicide in irrigated lawn areas according to manufacturer's recommendations and information on the label, and the following:

A) Use suitable applicator designed to apply herbicide.

B) Calibrate the applicator according to the manufacturer's directions prior to use and check frequently during application to be sure the equipment is working properly and distributing uniformly. Do not apply more than the recommended amount.

C) Apply herbicide to clean-cultivated areas which have been tilled for seeding and planting according to Part 2 - Site Preparation. Apply to non-irrigated planting bed prepared according to Part 2 - Site Preparation.

D) The pre-emergent application must be followed within 8 hours with overhead watering or rainfall equivalent to 1/2". Late fall application to non-irrigated planting beds shall not be watered.

E) For non-irrigated plantings, pre-emergent herbicide shall be applied to planting beds when planting in the late fall when plants are dormant and the ground is moist. Pre-emergent application should be re-applied in the spring before the end of the spring rains. A third application should be applied the following spring with the approval of the Landscape Architect.

3.3.6 Noxious weeds: Whitetop (Cardaria draba), leafy spurge (Euphorbia esula) and dyer's woad (Isatis tinctoria).

3.3.6.1 Where noxious weeds are mixed with desirable species of grasses and other forbs, Roundup™ (glyphosate) shall be applied with the weed wiper method. A ratio of 3 parts water to 1 part Roundup™ shall be used. A herbicide dye shall be added for visibility. Application shall be in the spring before flower bud opening. Drag the wiper over weeds to saturate but not drip. Avoid contact with other forbs and grasses. Treated area shall be treated again the following spring if necessary. Allow 7 days after second application before mowing or seeding. Follow label directions.

3.3.6.2 Where noxious weeds have only grass as an understory and no desirable broadleaf understory, and no broadleaf species will be planted for two years, the following mixture shall be sprayed:

Escort™ - 60% active ingredient by weight: use 1/2 oz../acre; plus

2,4-D - 3.8 lbs. amines active ingredient per 1 gal.: use 12 oz. per acre; plus a surfactant - non ionic, 80% active ingredient: use 2 qts. per 100 gal. spray

A herbicide dye shall be added for visibility. A backpack sprayer shall be used for controlled spraying. Vegetation shall be thoroughly wetted but not dripping. Allow 2 weeks after application before seeding grass. Allow 2 years before planting or seeding broadleaf plants. Follow label directions.

3.3.6.3 Rodeo™ (glyphosate) is approved over water and shall be used where vegetation control is required near water or a wetland. Follow label directions.

3.3.6.4 Where small patches of leafy spurge exist with little or no desirable understory, plants shall be covered with black plastic for one entire year.

3.3.7 Tamarisk (Tamarix sp.): Tamarisk trunk and canes shall be cut approximately 12" from ground level in September. Stumps shall be immediately treated by painting with a mixture of 12 oz. Arsenal™ (imazaphyr) per 1 gal water. Herbicide dye shall be added for visibility. Cambium area of fresh cut shall be thoroughly wetted with paint brush or controlled spray. Tamarisk shall be treated again if necessary the following year. Follow label directions.

3.3.8 Turf Establishment: The herbicide Roundup™ (glyphosate) shall be applied to the existing vegetation before planting grass, or adding topsoil, to control annual and perennial grasses and broadleaf weeds. Weeds shall be actively growing and in the growth stage specified on the label. Apply 1.0 to 1.5 lbs active ingredient per acre for annuals, or 2.0 to 4.0 lbs active ingredient per acre for perennials. At least 5 days shall be allowed before tillage when controlling annuals, and at least 7 days when controlling perennial weeds. Caution: Glyphosate will kill or severely injure any desirable grasses present at the time of spraying.

3.3.9 Tree, Shrub and Native Ground Cover Establishment Without Disking: The herbicide Roundup™ (glyphosate) shall be applied before planting trees, shrubs or ground covers to control annual and perennial grasses and broadleaf weeds. Vegetation shall be actively growing and in the growth stage specified on the label. Apply 1.0 to 1.5 lbs active ingredient per acre for annuals, or 2.0 to 4.0 lbs active ingredient per acre for perennials. At least 5 days shall be allowed before tillage or mowing when controlling annuals, and at least 7 days when controlling perennial weeds. Mow grass where appropriate to a uniform height of 4 - 6 inches for mulch and erosion control.

PART 4 - PLANTING

4.1.0 DESCRIPTION

4.1.1 Furnish, install and maintain planted native trees, shrubs and ground covers.

4.2.0 MATERIALS

4.2.1 Order native plant materials from sources with enough lead time for the order to be filled and delivered.

4.2.2 Plant Source: All plants propagated, either from seed or vegetative cuttings, must conform to the following specifications.

4.2.3 Collected Varieties:

4.2.3.1 The Contractor will be responsible for obtaining all permits and approvals for access to public and private lands for the collection of plant material. Written evidence indicating such permission will be submitted to the Landscape Architect. The Contractor will perform all activities in such a manner that the least environmental damage results.*

4.2.3.2 Failure to meet specified source requirements will result in the rejection of plant material. Excessive damage to existing vegetation during collection will not be permitted.*

4.2.3.3 Plant material from commercial sources must satisfy the environmental criteria described in these sections. A written request and complete description of the source and its environmental conditions will be submitted and approved by the Landscape Architect before any collection or purchasing of said material can be performed.*

4.2.4 Tubling Stock: Plants will conform to the type, size and quantity specified. The growing medium, propagation methods and cultural techniques employed will be such as to promote vigorous and healthy growth characteristics of the plant species which will meet the required specifications.*

4.2.4.1 All tubling material will have good top growth of the minimum shown in the Plant Species and Size Schedule, Appendix G, be well rooted, and established in the containers in which they are grown. Established tubling stock will have been grown in the container long enough for the root system to have permeated throughout and bonded the potting medium so that the root mass remains intact when removed from the

container. No plants will be loose in the container. No bare root or root bound material will be accepted.*

4.2.4.2 The containers will be tube like in shape, non-dissolvable and sufficiently rigid to maintain the root mass shape during growing and transit. Containers will have the following capabilities:

A) Restrict root growth to the container (minimal root penetration into adjacent containers is acceptable).*

B) Provide adequate drainage and root pruning through one or more holes in container bottom.*

C) Provide air circulation across the bottom of the containers.*

D) The container will have antispiral ribs to prevent spiralling during root growth.*

E) Minimum tubling container capacity of 10 cubic inches and 7 inches depth.*

4.2.5 Bare root Stock: Provide shrubs that comply with the recommendations and requirements of ANSI Z60.1, 1986 "American Standard For Nursery Stock" and as further specified in the Plant Species and Size Schedule in this document.

4.2.5.1 Plants will conform to the type, size and quantity specified. The growing medium, propagation methods and cultural techniques employed will be such as to promote vigorous and heathy growth characteristics of the plant species which will meet the required specifications.*

4.2.5.2 Specified plants shall be grown one year in a nursery.

4.2.5.3 Plants shall be lifted during dormancy for planting in the early spring or late fall.

4.2.5.4 Bare root plants shall be dug with adequate fibrous roots, kept cool and packed in moist straw or peat moss.

4.2.5.5 Willow, poplar and dogwood cuttings: New growth shall be gathered in early spring in dormancy. The cuttings shall be cut into 5 inch lengths, treated with fungicide and hormones and planted in nursery beds. The cuttings shall be grown for one year.

4.2.5.6 Roots and canes shall not be trimmed.

4.2.5.7 Deciduous Shrubs: Provide shrubs of the height and size listed or shown and with not less than the minimum number of canes required by ANSI Z60.1 and according to the Plant Species and Size Schedule, Appendix G, for the type and height of shrub required.*

A) A cane shall be considered a primary stem which starts from the ground or close to the ground at a point no higher than one-fourth the height of the plant. All canes shall have sufficient, well spaced, side branches to give it weight and good bud qualities.

B) Shrubs shall be grown to maintain a natural habit.

C) Single stemmed or thin plants will not be accepted.

D) Plants shall be in a moist, vigorous condition, free from dead wood, bruises, or other root or branch injuries.

4.2.6 Containerized and Balled and Burlapped Stock: Provide trees, shrubs and other plants that comply with the recommendations and requirements of ANSI Z60.1, 1986 "American Standard For Nursery Stock" and as further specified in the Plant Species and Size Schedule, Appendix G.*

4.2.6.1 Plants will conform to the type, size and quantity specified. The growing medium, propagation methods and cultural techniques employed will be such as to promote vigorous and heathy growth characteristics of the plant species which will meet the required specifications.*

4.2.6.2 All container material will have sufficient top growth, be well rooted and established in the containers in which they are grown.*

4.2.6.3 Established container stock will have been grown in the container long enough for the root system to have permeated and bonded in the potting medium so that the root mass remains intact when removed from the container. No plants will be loose in the container. No bare root or root bound material will be accepted.*

4.2.6.4 The containers will be non-dissolvable and sufficiently rigid to maintain the ball shape during transit. Container will have the following capabilities:

A) Restrict root growth to the container (root penetration into adjacent containers is not acceptable).*

B) Allow for adequate drainage and root pruning through one or more holes in container bottom.*

4.2.6.5 All nursery grown stock, including plants established from transplants and cuttings, shall have been grown in the nursery for at least one growing season:

A) One gallon (#1) containers shall be of the sizes shown in the American Standard for Nursery Stock.

B) Five gallon (#5) containers shall be of the sizes shown in the American Standard for Nursery Stock contained in Appendix K.

4.2.6.6 Deciduous Trees: Provide trees of height and caliper listed or shown and with branching configuration recommended by ANSI Z60.1, 1986 for type and species required, and according to the Plant Species and Size Schedule in Appendix K. Provide single stem trees except where special forms are shown or listed.*

A) Provide container grown deciduous trees subject to the specified limitations for container grown stock according to ANSI Z60.1, 1986.

B) Balled and Burlapped (B & B) deciduous trees will be acceptable in lieu of container grown deciduous trees where approved by the Landscape Architect.*

4.2.6.7 Deciduous Shrubs: Provide shrubs of the height and size listed or shown and with not less than the minimum number of canes required by ANSI Z60.1 and according to the Plant Species and Size Schedule in Appendix G for the type and height of shrub required.*

A) A cane shall be considered a primary stem which starts from the ground or close to the ground at a point no higher than one-fourth the height of the plant. All canes shall have sufficient, well spaced, side branches to give it weight and good bud qualities.

B) Shrubs shall be grown to maintain a natural habit.

C) Container grown deciduous shrubs will be acceptable subject to the specified limitations for container grown stock according to ANSI Z60.1, 1986.

4.2.6.8 Coniferous Evergreens: Provide unsheared evergreens of the sizes shown or listed. Provide primary or A Grade quality evergreens with well balanced form according to ANSI Z60.1, 1986 and according to the Plant Species and Size Schedule in Appendix G.*

A) Provide container grown evergreens subject to the specified limitations for container grown stock according to ANSI Z60.1, 1986.

B) Balled and Burlapped (B & B) evergreens will be accepted.*

C) Anti-desiccant: Protective film emulsion providing a protective film over plant surfaces; permeable to permit transpiration. Mixed and applied in accordance with manufacturer's instructions. To be applied to all evergreens at transplanting.

4.2.7 Tubers: hardstem bulrush tubers shall be 4" to 5" across, collected any time in unfrozen conditions. If collected with leaves in the later part of the season, leaves shall remain intact. Height of leaves shall be tall enough to stick above the water line during the winter.

4.2.8 Sprigs: saltgrass sprigs shall be 2" plugs of root, containing at least 3 to 4 nodes, collected in May before dormancy breaks.

4.2.9 Failure to meet the above specification will result in the rejection of plant material or, at the option of the Landscape Architect, a negotiated reduced price for the item.

4.2.10 Labeling: Labels for tublings shall not be affixed to the plants but to the containers. In case of tublings of the same species, a consistent method of labeling shall be conspicuously present. Bare root, containerized and B & B plants shall have labels affixed to the plant.**

4.2.10.1 Each label affixed shall supply the following information:

A) Project number

B) Genus, species, common name

C) Height designation (See Appendix G, Plant Species and Size Schedule)

D) Place of growth*

4.2.10.2 The following items shall be documented in legible format for each plant and made available to the Landscape Architect on the available date.

A) Identification of source location for seed, cutting or wildling.

1. State and County
2. Elevation

B) Type of propagation material:

VC = Vegetative Cutting
S = Seed
T = Transplant Wildling*

4.2.10.3 Failure to provide above information will result in the rejection of plant material.*

4.2.11 Hardening Off: Hardening off will consist of a process of decreasing the amount of water a young plant receives and increasing its exposure to extremes of temperature, wind, and sun in preparation for planting in a natural condition.*

4.2.11.1 Contractor shall provide notification and certification from the grower the plants have been hardened off as required, and submit such information to the Landscape Architect.*

4.2.11.2 Plants scheduled for spring availability dates shall have dormant buds, and have been either overwintered or exposed to natural conditions for a minimum of 4 weeks prior to shipping.*

4.2.11.2 Plants scheduled for fall delivery shall be held under natural conditions for 6 weeks prior to availability date.*

4.2.11.3 Failure to comply with these hardening off specifications will be reason to reject plant material.*

4.2.12 Plant Sizes and Quantities: Plant species shall conform to the size specifications as listed in Plant Species and Size Schedule, Appendix G. *(Quantities are subject to the final plan and will be listed at that time.)*

4.2.12.1 Inspection and approval of plants before planting is not considered as final acceptance.*

4.2.13 Mulch: Mulch shall consist of a coarse slow-decomposing media such as shredded bark, wood chips, peat or compost. Do not use straw or uncomposted manure and mulches such as grass clippings and sawdust.

4.2.14 Fertilizer: For shrubs and trees, provide slow release fertilizer in tablet form at the rate recommended by the manufacturer for the size of the plants specified. Do not use a surface fertilizer.

4.2.15 Staking: Tree stakes are not required as a general rule; however the Landscape Architect may require staking on specific trees because of wind or other conditions affecting stability. Where staking is necessary, provide 2" X 2" wood stakes, straight grained and free of knots, 1" X 3" wood cross ties, and flexible nylon web belting. Length and number of stakes per tree will be determined by the specific staking method used as described in section 4.3.0 Execution.

4.2.16 Water: Water shall be free of substances harmful to plant growth. Hoses or other methods of transportation will be furnished by Contractor.

4.2.17 Substitutions: When plants of a specified kind or size are not available within a reasonable distance, substitutions may be made upon request by the Contractor, if approved by the Landscape Architect.

4.3.0 EXECUTION

4.3.1 Inspection: Installer must examine the subgrade, verify all land leveling, grading, shaping and subsoiling operations have been completed prior to seed bed preparation. Observe the conditions under which work is to be performed and notify Landscape Architect of unsatisfactory conditions.*

4.3.2 Plants: Notify the Landscape Architect at least 7 days in advance of plant delivery.

4.3.2.1 In no case will planting be allowed in frozen conditions. Planting in dry soils shall take place only if irrigation is provided. Irrigation shall not be used in the late fall.

4.3.2.2 Plant non-irrigated field collected plants during plant's dormant period - prior to April 1 and after November 1.*

4.3.2.3 Bare Root, Container and B & B supplied plants which are planted in irrigated areas may be planted any time during the normal planting season as soon as the irrigation system is operable between April 1 and November 15.*

4.3.2.4 Bare Root, Container and B & B supplied plants which are planted in non-irrigated areas shall be planted as follows: Deciduous and evergreen trees and all shrubs, wildflowers, and forbs - plant in late fall in a dormant stage after October 15, or spring in a dormant stage before May 1, when soil is damp.

4.3.2.5 Tubers shall be planted any time of the year in unfrozen conditions.

4.3.2.6 Sprigs of saltgrass shall be planted during dormancy in May when ground is still moist.

4.3.2.7 Cuttings shall be planted in the early spring, during plant dormancy when ground is moist, not saturated.

4.3.2.8 Handle and pack each species and variety of plant in the manner approved by American Standards for Nursery Stock.*

4.3.2.9 Maintain delivered plants in good condition. Wilted plants, whether in place or not, will not be accepted and will be replaced at the contractor's expense. Plants installed in spring must be watered at time of planting and again within 24 hours of planting and root zone must be moist throughout. Plants installed in the late fall, when the plants are dormant and ground is moist, shall not be watered.

4.3.2.10 Planting shall be performed only by experienced workers familiar with planting procedures under the supervision of a qualified supervisor.

4.3.2.11 Locate plants as indicated or as approved in the field after staking by the Landscape Architect. If obstructions are encountered that are not shown on the drawing, do not proceed with planting operations until alternate plant locations have been selected.

4.3.3 Tubling, Bare Root, Container, and B &B

4.3.3.1 Location of each planting to be brought to finished grade and approved before excavating plant holes or exposing plant roots and root balls.*

4.3.3.2 Planting Tublings: Plant tublings according to Fig. 29. Tublings are planted in non-irrigated areas.

A) Remove vegetation in a 48" planting bed by hand scalping or chemical as described in Part - 3, Weed Control.

B) Auger hole 3" minimum in diameter and the depth of the tubling root mass plus 2".

C) A 24" water harvesting/retaining basin shall be intact around each plant on slopes and in flat areas.

D) Tamp soil firmly around root mass to eliminate voids and air pockets.

E) Late fall planting, when plants are dormant and ground is moist, shall not be watered to avoid winter frost heave.

F) Early spring planting when ground is not moist, water as follows: Water thoroughly immediately after planting.

4.3.3.3 Bare Root Stock: Plant bare root stock according to Fig. 29.

A) Remove vegetation in a 48" planting bed by hand scalping or chemical as described in Part - 3, Weed Control.

B) Using a planting bar, insert the blade two inches deeper than the root length. Pull back bar, lifting dirt out of the ground, removing the rest with a hand. Drop the seedling into the hole and return a handful of loose dirt to the hole over the roots. The roots shall be suspended near the center of the hole and extended straight down in a natural arrangement. Pull seedling up so that the root collar is level with grade. Hold seedling and fill hole 1/3 and tamp with hand and repeat until soil is level.

C) A 24" water harvesting/retaining basin shall be intact around each plant on slopes and in flat areas.*

D) Seedling shall be immediately watered.

4.3.3.4 Planting 5 gallon and 1 gallon container grown trees and shrubs in non-irrigated areas: Plant as shown in Figs. 30 and 31.

A) Planting Trees and Shrubs: Dig planting hole twice as wide as the container. Set container stock on a layer of soil mixture in the locations shown with the soil line at finished grade. Remove container immediately after setting in pit and prior to backfilling. When set, place additional backfill and eliminate voids and air pockets.

B) Late fall planting when plants are dormant and ground is moist shall not be watered to avoid winter frost heave.

C) Early spring planting when ground is not moist, water as follows: When pit is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

D) Set Balled and Burlapped Stock as specified for container grown stock and completely remove burlap and wire.*

E) Cover root mass with 1/2" -3/4" of soil.*

F) A water harvesting/retaining basin shall be formed at the base of the tree or shrub.*

4.3.3.5 Planting larger caliper B & B and container trees: Plant as shown in Fig. 30 and 31, in irrigated areas.*

A) Dig planting hole twice as wide as the root ball. Set balled and burlapped stock on a layer of lightly packed, slightly elevated planting soil mixture, plumb and center of pit or trench with soil line at finished landscape grade. Remove all burlap, and cut and remove wire basket immediately after setting in pit and prior to backfilling. When set, place additional backfill and eliminate voids and air pockets. When pit is approximately 2/3-full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.*

B) Set Container Grown Stock as specified for balled and burlapped stock.*

C) A water harvesting/retaining basin shall be intact at the base of the tree.*

D) Cover root mass with 1/2" - 3/4" of soil.*

4.3.3.6 No trees or shrubs shall be pruned except broken and diseased branches or as directed by the Landscape Architect.*

4.3.3.7 Permit no harm to root system. Backfill planting holes with topsoil in loose finely divided and friable condition. Clods, rocky and lumpy soil not permitted.*

4.3.4 Mulch: Mulch shall be applied, with the approval of the Landscape Architect, two to three inches thick to soil surface around newly planted shrubs and trees. Mulches should not be placed directly against the tree truck or shrub stem.

4.3.5 Fertilizer: Slow release fertilizer tablets shall be set in the planting hole near the roots before backfilling. Do not use tablet fertilizer in soils that are saturated at any time of the year.

. 4.3.6 Staking is not generally required except where stability is jeopardized by wind or other factors. All support shall be removed after one year except where approved by the Landscape Architect.

4.3.6.1 Root anchorage and protection for trees. Three stakes shall be driven at least 18" into the ground at the edge of the root ball. The stakes shall be 3' tall from the surface and painted white. Tie the stakes to the truck as low as possible with a flexible nylon web belting (Fig. 35). Remove ties at the end of the first year, leaving the stakes to protect the trunk with the approval of the Landscape Architect.

4.3.6.2 Root anchorage for small trees, B & B, and container stock smaller than 10 gallons in size. Secure the root ball and support the tree with one stake (Fig. 34). Drive a 2 inch square, tree stake at a 45 degree angle into the direction of the prevailing south to southeast wind into the soil just missing the top of the root ball. Secure the trunk to the stake with a protective web belting tie 1 to 2 feet above the soil.

4.3.6.3 Trunk support for trees. Top support shall be as low on the trunk as possible but high enough to that the tree will return to an upright position after being bent. Wood support stakes, 2" X 2", shall be tall enough for the particular tree and driven into the ground 18". Two stakes shall be placed so that a line drawn between them is at right angles to the south wind. A 1" X 3" cross tie shall be placed on the leeward side of the stakes at the soil surface (Fig. 33).

4.3.7 Tree Relocation:

4.3.7.1 Designated trees shall be pruned, dug, balled and burlapped, and moved for relocation to the designated plant storage area for heeling-in of materials until final planting areas are prepared.

A) Plants shall be maintained in storage areas by bracing plants in vertical position and setting balls in an enclosed berm of topsoil or bark. Water as required to maintain adequate root moisture.

B) Trees shall be moved to final locations and planted in accordance with specified tree planting requirements.

4.3.8 Wetland: Wetlands shall not be planted or seeded except where wetland is created, or where a particular species is desired for habitat enhancement or aesthetics.

4.3.8.1 Tubers of hardstem bulrush shall be transplanted any time when the mud is not frozen. A hole shall be made on 3 foot centers with a stick in the mud and the tuber pushed into the mud until covered by a few centimeters. If tubers are collected and planted late in the season, when leaf growth has stopped, the tubers shall be planted so that the ends of the leaves stay above the water line through winter. Tubers shall be planted with or without surface water present.

4.3.8.2 Willows will be planted as rooted cuttings in the spring after ground thaw, during plant dormancy. The procedure shall be followed for bare root stock planting. Willows shall not be fertilized.

4.3.8.3 Sprigs shall be planted in tilled soil free from vegetation, on 1 foot centers, deep enough so that one end sticks above ground level. The soil shall be tamped by hand around the roots.

4.3.9 Riverbank: Unrooted cuttings and rooted cuttings shall be planted according to bioengineering techniques described in Bioengineering for Land Reclamation and Conservation by Hugo Schiechtl and Biotechnical Slope Protection and Erosion Control by Donald H. Gray and Andrew Leiser. Plant species are listed in the Plant Species and Size Schedule in Appendix G.

4.3.9.1 Riverbank treatment shall be done incrementally to avoid flood damage. Both sides of the Jordan River will be considered for treatment. Combinations of techniques shall be considered for any given site. Locations and techniques shall be determined by a hydrologist in consultation with other experts.

4.3.9.2 A source of cuttings shall be located in advance of the project. Rooted cuttings shall be nursery grown for one year.

4.3.9.3 Planting and site work shall be done in early spring when ground is not frozen, while plants are in dormancy, and water levels are low.

4.3.9.4 Wattle or Fascine: Wattles or fascines, bound bundles of live brush approximately 10" in diameter. Starting at the bottom of the slope, bundles shall be laid in shallow trenches along the slope contour and anchored with live or dead stakes (Fig. 39).

4.3.9.5 Brush Layering: Brush layering alternating layers of brush with layers of soil or rock held in place with wire mesh fiber material (Fig. 41). Cuttings of different ages and species shall be used. Rooted cuttings shall be incorporated where practicable.

4.3.9.6 Vegetated Gabion: Rock filled cylindrical gabions shall be planted with unrooted cuttings (Fig. 42). Gabions shall be placed for linear protection and at flood protection points. A brush layer shall be placed under the gabion along the riverbank.

4.3.9.7 Live Crib Wall: Crib wall shall be built from logs, filled with soil and planted with unrooted cuttings (Fig. 43). This technique shall be used where a critically endangered slope needs securing.

4.4.0 MAINTENANCE

4.4.1 Maintain planting for one year after completion of planting operations. Maintenance shall include the following routine procedures:

4.4.1.1 Chemical treatment and removal of all visible weeds in September and April.

4.4.1.2 Visual inspection and repair of water harvesting/retaining basins at each plant in the fall prior to snow fall, and in the spring or as needed because of damage.

4.4.1.3 Visual inspection of riverbank erosion plantings in the fall prior to snow fall, and in the spring or as needed because of damage due to flood water.

4.4.1.4 Visual inspection and repair of stakes and ties during the first year. Remove stakes and ties after one year.

4.4.1.5 Report insect, rodent or disease infestations to the Landscape Architect, or any other conditions detrimental to plant growth.

4.4.1.7 Water plants up to five times the first growing season depending on the condition of the plants and the weather. Deep water with truck or temporary drip irrigation system.

4.4.1.8 Temporary fencing will be placed and maintained around newly planted areas and posted with interpretive signs until establishment is achieved. Fencing shall be of a style that is effective and aesthetically compatible with Nature Park.

4.5.0 CLEANUP

4.5.1 Perform cleaning during installation of the work and upon completion of the work. Remove from the site all excess materials, debris, and equipment. Repair damage resulting from planting operation.

4.6.0 ACCEPTANCE

4.5.1 Two inspections to determine acceptance of planted areas will be made by the Landscape Architect, upon Contractor's request. Provide at least 10 working days before requested inspection date.

4.5.1.1 Upon completion of planting, planted areas will be accepted provided all requirements, including maintenance, have been complied with and plant materials are alive and in a healthy, vigorous condition.

4.5.1.2 One year from completion and acceptance of plantings, planted areas will be accepted provided all requirements, including maintenance, have been complied with and plant materials are alive and in a healthy, vigorous condition.

4.5.2 Upon final acceptance, Murray City will assume the plant maintenance.

PART 5 - SEEDING

5.1.0 DESCRIPTION

5.1.1 Furnish and apply seed, water and fertilizer.

5.2.0 MATERIALS

5.2.1 Water: Water shall be free of substances harmful to seed growth. Hoses or other methods of transportation will be furnished by Contractor.

5.2.2 Seed

5.2.2.1 Seed according to seeding schedule.

5.2.2.2 Request approval in writing to make seed substitution when specified seed is not available.

5.2.3 Fertilizer

5.2.3.1 Lawn: Provide proper fertilizer for establishment, and vigorous and healthy growth of lawn.

5.2.3.2 Non-irrigated areas shall not be fertilized

5.2.4 Labeling:

5.2.4.1 Each label affixed shall supply the following information:

A) Project number

B) Genus, species, common name

5.2.4.2 The following items shall be documented in legible format for each plant and made available to the Landscape Architect on the available date.

A) Identification of source location for seed:

1. State and County
2. Elevation

5.2.4.3 Failure to provide above information will result in the rejection of plant material.*

5.3.0 EXECUTION

5.3.1 Inspection: Installer must examine the subgrade, verify all land leveling, grading, shaping and subsoiling operations have been completed prior to seed bed preparation. Observe the conditions under which work is to be performed and notify Landscape Architect of unsatisfactory conditions.

5.3.2 Seeding:

5.3.2.1 Lawn: All seeding shall be done according to recommendations of seed supplier for the specific seed mix selected.

5.3.2.2 Non-irrigated: All seeding shall be done in fall or spring, and within 24 hours of soil and seedbed preparation. Seeding shall be done from September 1 to November 15, in the fall; or from February 1 to April 1, in the spring. Receive approval of work schedule by Landscape Architect prior to seeding.*

5.3.2.3 Seed indicated areas within contract limits and areas adjoining contract limits disturbed as a result of construction activities.

5.3.2.4 Seed into soil with method indicated on drawings and at depths listed in Appendix G, Seeding Schedule.

5.3.2.5 Hand broadcast seed only in areas of prepared cultivated soil. Follow seeding with light raking and weighted roller.

5.3.2.6 Drill seed with a grain drill on prepared cultivated soil. Follow seeding with light raking and weighted roller. Drill seed with a no-till grain drill in the areas indicated no-till.

5.3.3 Irrigation

5.3.3.1 Irrigated Areas: Water daily to maintain adequate surface soil moisture for proper seed germination. Continue daily watering for not less than 30 days. Thereafter apply 1 inch twice weekly or as often as needed until acceptance. Do not over water. Adjust for the time of year, temperatures, soil type, and weather conditions.

5.3.3.2 Non-irrigated areas: Irrigation shall be applied only when necessary, during establishment of seeds at the discretion of the Landscape Architect.

5.4.0 MAINTENANCE

5.4.1 Maintain seeding for one year after completion of planting operations. Maintenance shall include the following routine procedures:

5.4.1.1 Report insect, rodent or disease infestations to the Landscape Architect, or any other conditions detrimental to plant growth.

5.4.1.2 Lawn: Provide a uniform stand of grass by watering , mowing, and maintaining seeded areas until final acceptance. Repair, rework, and re-seed all areas that have washed out, eroded, or do not catch, with specified materials, which fail to provide a uniform stand of grass until all affected areas are accepted.

5.4.1.3 Mow lawn as soon as lawn top reaches a 3" height. Cut back to 2" in height. Repeat mowing as required to maintain at specified height.

5.4.1.4 Temporary fencing will be placed and maintained around newly seeded areas and posted with interpretive signs until establishment is achieved. Fencing shall be of a style that is effective and aesthetically compatible with Nature Park.

5.5.0 CLEANUP

5.5.1 Perform cleaning during installation of the work and upon completion of the work. Remove from the site all excess materials, debris, and equipment. Repair damage resulting from seeding operation.

5.6.0 ACCEPTANCE

5.6.1 Inspection to determine acceptance of seeded areas will be made by the Landscape Architect, upon Contractor's request. Provide notification at least 10 working days before requested inspection date.

5.6.1.1 Lawns: Seeded areas will be acceptable provided all requirements, including maintenance, have been complied with, and a healthy, uniform, close stand of the specified grass is established free of weeds, undesirable grass species, disease, and insects.

5.6.1.2 No individual lawn areas shall have bare spots or unacceptable cover totalling more than 2% of the individual areas, in areas requested to be inspected

5.6.1.3 Non-irrigated seeded grass areas will be accepted providing plant survival and vigor is sufficient to indicate establishment of the community.

5.6.1.3 Upon final acceptance, Murray City will assume lawn maintenance.

PART 6 - PLANTING CONCEPT AND LOCATIONS

6.1.0 PLANTING STRATEGY

6.1.1 Plant species will be selected that are adapted and indigenous to the Jordan River.

6.1.2 Irrigated areas:

6.1.2.1 Irrigated areas will be planted with trees and grass lawn.

6.1.2.2 Irrigated areas will be planted with larger container stock as shown.

6.1.2.3 Irrigated areas will form a safety and visual buffer between the Nature Park and the adjacent neighborhood.

6.1.3 Non-irrigated areas:

6.1.3.1 Areas will be planted with natural massings of shrubs, trees, grasses and forbs appropriate for the soil and water regime as shown in the drawings. Grasses and flowers will be planted as single species massing as shown. Grass species will be seeded as a mix as shown on the drawings.

6.1.3.2 A variety of vertical and horizontal structural characteristics will be used in natural massings that will be configured on the landscape to optimize habitat diversity.

6.1.3.3 Plant patches will be of mixed species stratified so that the tallest species are towards the center of the patch.

6.1.3.4 Spacing of non-irrigated plants will be variable according to water available, size of plant container, competition and site program. The smaller the container size, the closer they will be spaced as shown in the drawings.

6.1.3.5 In non-irrigated areas shown, young plants will be planted under larger established or newly planted "nurse plants" for protection.

6.1.3.7 Non-irrigated plantings will be watered the first 3 years only as necessary for establishment.

6.1.4 Water harvest basins will be formed around all plant material to aid in water catchment. Water harvest basins will be maintained for 3 years.

6.1.5 Competition: Live vegetation around shrubs and trees shall be removed and no grasses will be planted within specified range to reduce competition. Forbs will be allowed as indicated. Post-emergent and pre-emergent herbicides will be used to control weeds. A composted, weed free mulch shall be used.

6.2.0 TREES

6.2.1 Locations will be staked by Landscape Architect in the field in areas shown in the drawings.

6.2.2 Non-irrigated tree species will be located according to favorable site conditions to which they are adapted.

6.2.3 Non-irrigated trees will be planted as container stock in natural massings at spacings and in areas shown.

6.2.4 Irrigated trees will be located for shade of recreational activity areas and visual interest and harmony.

6.3.0 SHRUBS

6.3.1 Shrub species will be located according to favorable site conditions to which they are adapted.

6.3.2 Shrubs will be planted as tublings, container plants and bare root stock in natural massings at spacings and in areas shown.

6.4.0 GROUND COVERS

6.4.1 Flowers will be planted as tublings in single species masses with bunch grass masses or in association with non-irrigated shrub and tree plantings as shown in drawings.

6.4.2 Non irrigated grass species mix will be seeded in in patches as shown in the drawings.

6.4.3 Irrigated turf will be a species mix that is adapted to the site conditions, drought tolerant and require less water than typical bluegrass turf. It should be appropriate for high, moderate and low activity intensity and be visually acceptable.

6.5.0 HABITAT

6.5.1 Wetland habitat will be enhanced primarily through the use of water manipulation which controls plant germination, growth and die-off.

6.5.2 Upland habitats will be enhanced by planting areas to create vegetative structural diversity. The objective is to replant weedy areas to restore upland plant communities.

6.5.3 Riverbank habitats will be enhanced by planting a diverse riparian community. The objective is to stabilize the riverbanks while providing structurally diverse habitat.

reference: Those specifications followed by * are taken from the I-215 Planting project specifications, Jan Streifel, Landmark Design, Salt Lake City, 1990.

APPENDIX K
AMERICAN STANDARD FOR NURSERY STOCK

ANSI
Z60.1-1990
Revision of
Z60.1-1949 (R1986)

AMERICAN STANDARD FOR NURSERY STOCK

Sponsor:
American Association of Nurserymen

Approved 1990
American National Standards Institute, Inc.

ABSTRACT

Nurserymen, landscape architects, landscape contractors, and others trading in or specifying nursery plants have assisted in developing these standards for the various kinds of nursery plants to facilitate the commerce in nursery stock. Illustrations, examples, and written descriptions have been combined to clarify the standards.

TABLE OF CONTENTS

1 SHADE & FLOWERING TREES

This section applies to plants generally sold to the retail and landscape trade. For liner grades see section 6.

1.1 GENERAL SPECIFICATIONS

1.1.1 CALIPER AND HEIGHT MEASUREMENT

In size grading B & B trees, caliper shall take precedence over height.

In size grading bare root trees, height shall take precedence to 6 feet for Tree Types 3 and 4 and 8 feet for Trees Types 1 and 2; thereafter, caliper takes precedence.

Caliper of the trunk shall be taken 6 inches above the ground up to and including 4-inch caliper size, and 12 inches above the ground for larger sizes.

Seldom are tree trunks perfectly round. Caliper measurement may be taken with "slot" type caliper, "pincer" type caliper, or diameter tape.

For purposes of simplicity, only one size per "grade" will be listed. That size will be the minimum size allowable for that grade and shall include plants from that size up to but not including the next larger grade size.

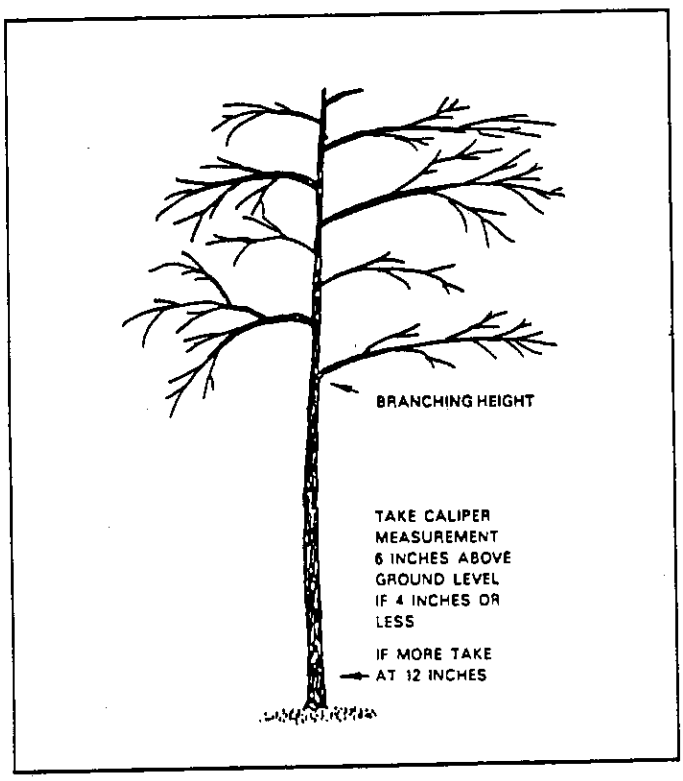
Example: *Acer rubrum,* 2-inch caliper. This could include *Acer rubrum* calipering 2 inches up to but not including 2½ inches in caliper, measured 6 inches above the ground line.

1.1.2 HEIGHT OF BRANCHING—STREET TREES

Bid specifications for trees for street plantings should specify the height to which the tree should be free of branching. Height of branching should bear a relationship to the size and kind of tree, also, so that the crown of the tree will be in good balance with the trunk as the tree grows.

Examples

Acer platanoides, 2-in. cal., 12 to 14 ft., branches 6 to 7 ft.



Quercus rubra 3½-in. cal., 14 to 16 ft., branched 7 to 9 ft.

Trees with ascending branches (example—*Ulmus americana* and *Tilia tomentosa*) may be branched 1 foot or more below the standard height and still provide proper clearance, which is the purpose of this specification.

1.1.3 HEIGHT RELATIONSHIP TO CALIPER BY TYPES

It is recognized that climatic conditions in different sections of the country produce trees of different caliper–height proportions. Trees from one region of the country may have less caliper in proportion to height while trees from another section may have greater caliper in proportion to height than shown in the following table.

The table shows the average height range and the maximum heights permitted (See 1.1.3.1).

1.1.3.1 Type 1. Shade Trees

The height relationship to caliper, for most standard shade trees, will be as follows:

Caliper	Average Height Range	Maximum Height
½ in.	5 to 6 ft.	8 ft.
¾ in.	6 to 8 ft.	10 ft.
1 in.	8 to 10 ft.	11 ft.
1¼ in.	8 to 10 ft.	12 ft.
1½ in.	10 to 12 ft.	14 ft.
1¾ in.	10 to 12 ft.	14 ft.
2 in.	12 to 14 ft.	16 ft.
2½ in.	12 to 14 ft.	16 ft.
3 in.	14 to 16 ft.	18 ft.
3½ in.	14 to 16 ft.	18 ft.
4 in.	16 to 18 ft.	22 ft.
5 in.	18 ft. and up	26 ft.

Sizes under one inch may be calipered if desired.

Examples:

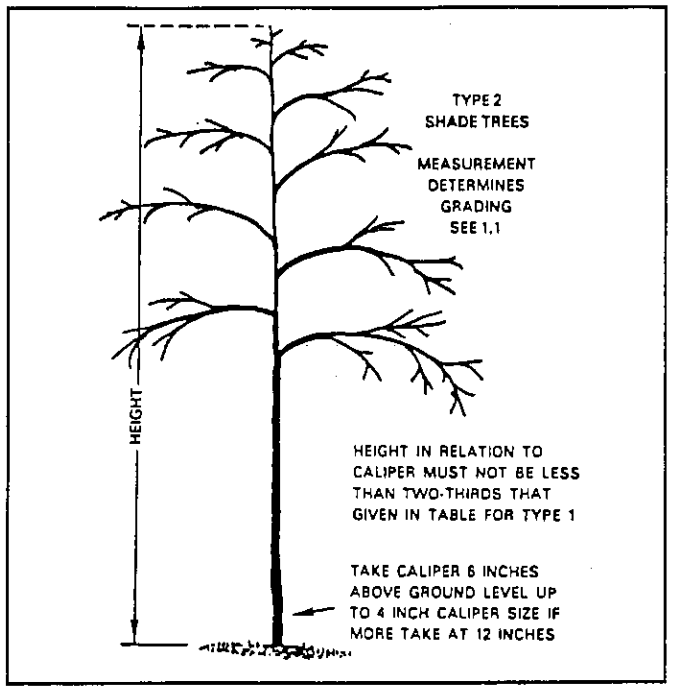
Acer rubrum, A. saccharinum
Betula
Cinnamomum camphora
Fraxinus americana, F. pennsylvanica, F. uhdei
Ginkgo
Gleditsia
Liriodendron
Platanus
Populus
Quercus macrocarpa, Q. palustris, Q. phellos, Q. virginiana
Salix
Tilia americana

1.1.3.2 Type 2. Shade Trees

Trees of slower growth which will not usually attain the height measurement in relation to caliper as in Type 1. The height, however, should not be less than two-thirds the height relationship given for Type 1. (See 1.1.3.1)

Examples:

Aesculus
Celtis
Cladrastis lutea
Fagus sylvatica
Koelreuteria
Laburnum
Liquidambar
Magnolia grandiflora
Nyssa
Olea europaea
Quercus alba
Sorbus
Tilia cordata, T. euchlora



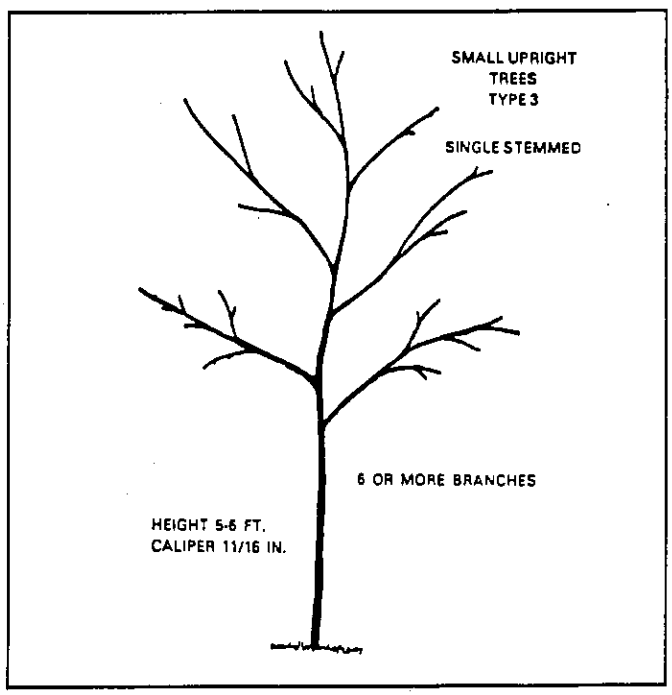
1.1.3.3 Type 3. Small Upright Trees

This is a broad group including small, upright trees which may be grown as single-stem plants, as clumps, or as shrubs.

Up to 6 feet, height shall be the governing measurement. Sizing shall be in 1-foot intervals. At 6 feet and over, caliper takes precedence. A height relative to caliper may be specified but shall not be considered in determining minimum diameter ball sizes.

For single-stem plants, the minimum relationship for height caliper and branching will usually be as follows:

2 ft., 5/16 in. caliper, three or more branches
3 ft., 7/16 in. caliper, four or more branches
4 ft., 9/16 in. caliper, five or more branches
5 ft., 11/16 in. caliper, six or more branches
¾ in. caliper, seven or more branches



Examples:

Acer campestre, A. circinatum
Cercis
Crataegus
Halesia
Malus (most crabapples)
Prunus cerasifera 'Thundercloud'
Prunus serrulata, P. subhirtella
Styrax
Syringa reticulata

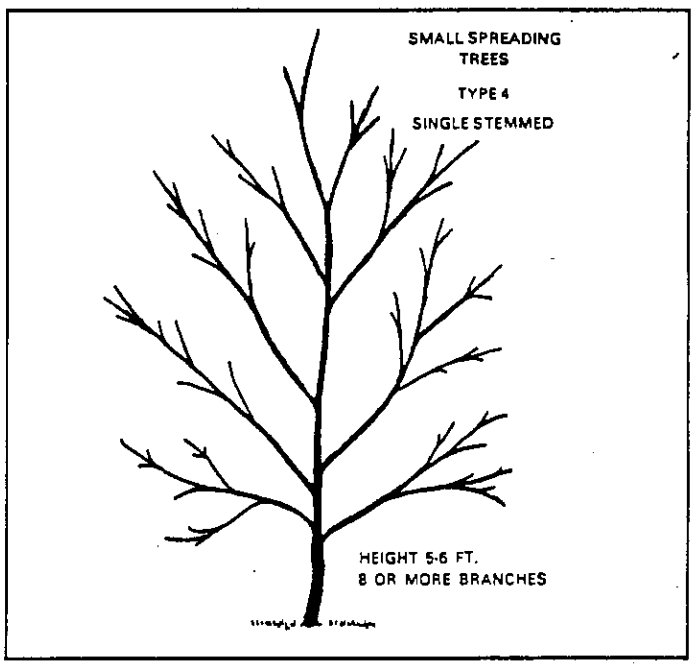
1.1.3.4 Type 4. Small Spreading Trees

This is a broad group including small, spreading trees of dwarf growth habit and certain large shrubs grown in tree or multi-stem form.

Up to 6 feet, height shall be the governing measurement. Sizing shall be in 1-foot intervals. At 6 feet and over, caliper takes precedence. A height relative to caliper may be specified but shall not be considered in determining minimum diameter ball sizes.

For single-stem plants, the minimum branching will be as follows:

2 ft., four or more branches
3 ft., five or more branches
4 ft., seven or more branches
5 ft., eight or more branches
¾-in. caliper, eight or more branches



Examples:

Acer palmatum, A. griseum
Cornus
Lagerstroemia indica
Ligustrum japonicum (tree forms), *L. lucidum*
Magnolia soulangiana, M. stellata
Malus sargentii
Viburnum prunifolium

1.1.4 TREES FOR OTHER USES

Trees for special uses should be branched or pruned naturally according to type. Where a form of growth is desired which is not in accordance with a natural growth habit, this form should be so specified.

Examples:

Cut back or sheared—trees that have been pruned back so as to multiply the branching structure and to develop a more formal effect.

Topiary—trees sheared or trimmed closely in a formal geometric pattern.

1.1.5 MULTI-STEM TREES

Multi-stem trees occur naturally in many genera, and other kinds may be grown multi-stem in the nursery. Multi-stem trees may be further defined as Clump form and Shrub form.

Clump form: Having two or more main stems arising from the root crown or from the main trunk not more than 6 inches from the ground level. The main stems shall have branching typical for the species or cultivar.

Shrub form: A tree with multiple stems arising from the root crown in the manner of a shrub.

Examples:

Clump form:
Acer ginnala, A. rubrum

Shrub form:
Amelanchier arborea, A. grandiflora

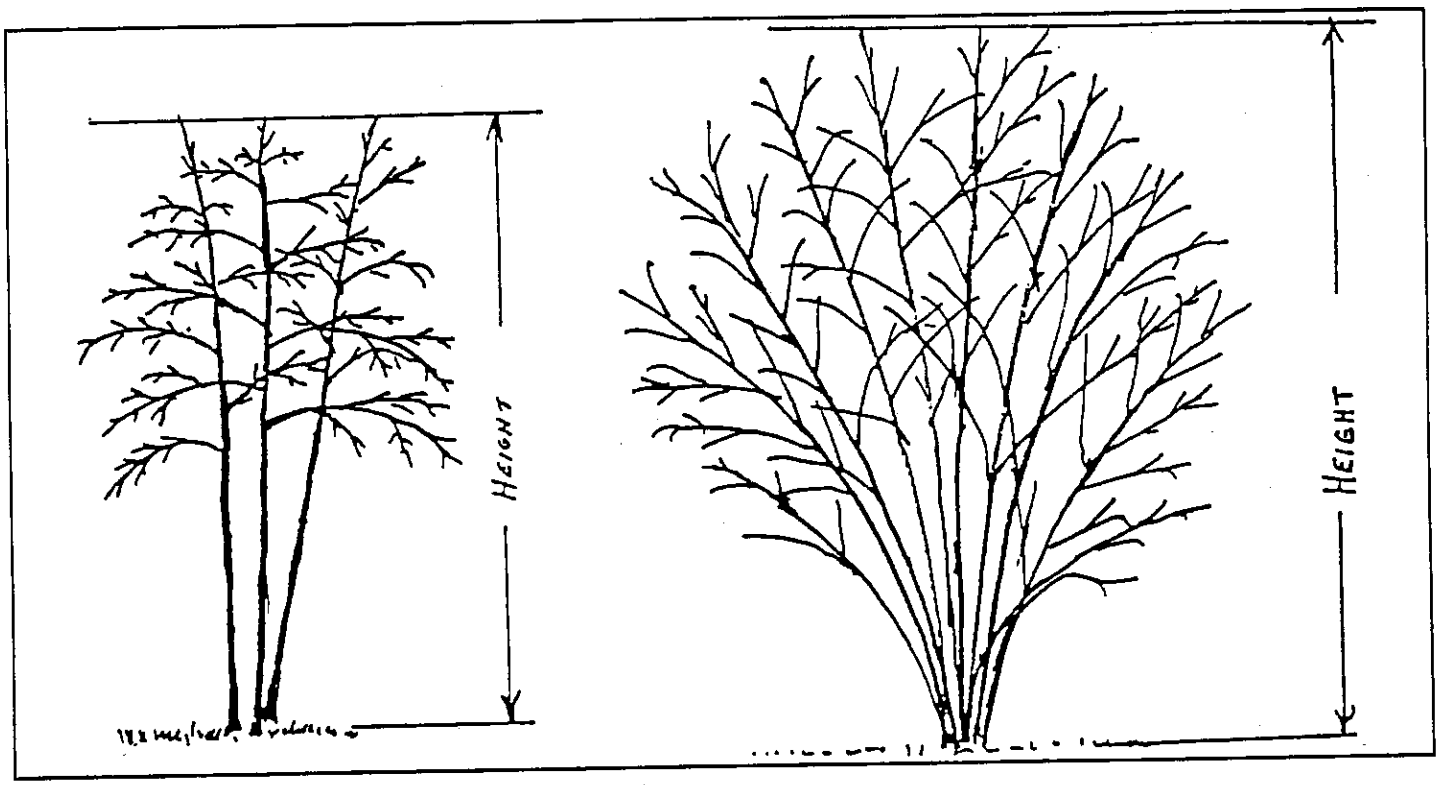
Clump form:
Alnus glutinosa
Amelanchier laevis
Betula nigra
Carpinus caroliniana
Cercic canadensis
Cornus alternifolio, C. florida
Corylus avellana
Crataegus punctata
Fraxinus pennsylvanica var. *lanceolata*
Gleditsia triacanthos inermis
Hamamelis virginiana
Magnolia soulangiana, M. virginiana
Malus floribunda
Prunus padus
Syringa reticulata
Tilia cordata, T. euchlora
Viburnum plicatum, V. prunifolium

Shrub form:
Cornus kousa, C. mas
Corylus americana
Cotoneaster multiflorus
Crataegus cordata, C. crus-galli
Hamamelis vernalis
Lagerstroemia indica
Magnolia stellata
Malus sargentii
Prunus cistena
Syringa vulgaris
Viburnum lantana, V. lentago, V. opulus

1.1.5.1 Measurement of Multi-Stem Trees

In size grading multi-stem trees, height shall be the governing measurement. Height shall be defined as the measurement taken from the ground level to the average uppermost point of growth of the plant.

Sizes shall be listed in 1-foot increments to 8 feet and 2-foot increments thereafter. For purposes of simplicity, only one size per "grade" will be listed. That size will be the minimum size allowable for that grade and shall include plants from that size up to, but not including, the next larger size.



Example: *Acer pinnala*, 6'. This would include *Acer ginnala* 6 feet high up to, but not including, 7 feet high from the ground level to the average uppermost point of growth of the plant.

Although height will be the determining factor, for landscape specifications other definitive measurements may be used to further "picture" the desired plant. Such added factors as a number of stems and plant width may be specified.

Multi-Stem Trees with Ascending Growth Habit

Average Height	Minimum Diameter Ball
4 ft.	14 in.
5 ft.	16 in.
6 ft.	18 in.
7 ft.	20 in.
8 ft.	22 in.
10 ft.	24 in.
12 ft.	28 in.
14 ft.	32 in.
16 ft.	38 in.
18 ft.	42 in.
20 ft.	48 in.

Exception:

Specifications for balling and burlapping multi-stem trees with a spreading growth habit shall provide for balls one size larger than sizes specified above for multi-stem trees with ascending growth habit.

1.1.6 PALMS

In size grading palm trees, height shall take precedence. Either of two heights may be specified: overall height or trunk height.

Overall height is the perpendicular height from the ground to the top of the arc made by the uppermost arching frond with the tree standing in natural position.

Trunk height is measured from the ground line to the base of the heart leaf.

1.1.7 SPECIMEN TREES

This recommendation for specification writers applies to both deciduous and evergreen trees. When "specimen" trees are called for in landscape specifications, the desired specimen characteristics must be stated, including deviations from standard minimums for caliper, height, fullness of branching, root-ball, etc.

1.1.7.1 Box Specimen Trees

	Box Size (Inches)						
	20	24	30	36	42	48	60
Caliper (Inches).							
Group I	1¼	1½	2½	3	3½	4	4½
Group II	1½	2	3	3½	4	4½	5
Group III	1½	1¾	2	2½	3	3½	4
Group IV	1½	2	2½	3	3½	4	4½
Group V	2	2½	3	3½	4	5	6

Examples:

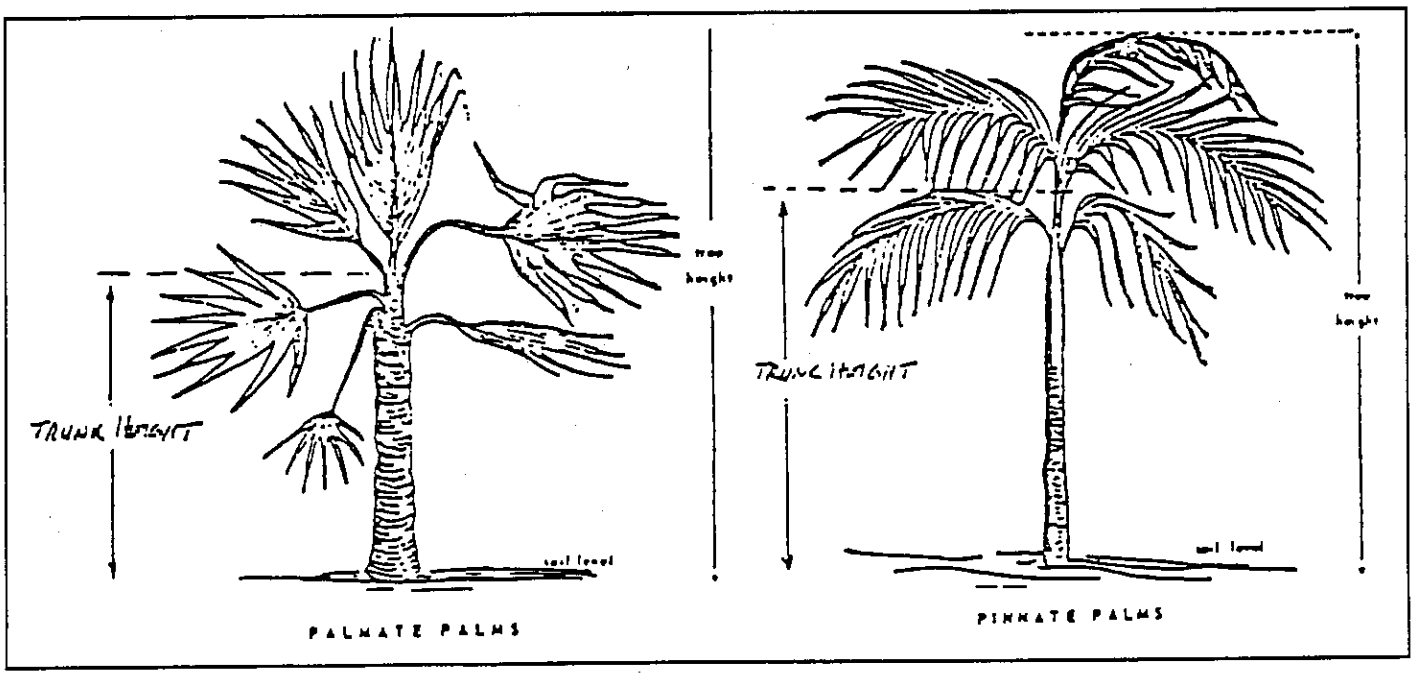
Group I: *Tipuana, Sophora, Ulmus parviflia, Zelkova, Parkinsonia*

Group II: *Acer, Albizzia, Alnus, Eroyobotrya, Cedrus, Celtis, Fraxinus, Liquidambar, Liriodendron, Magnolia, Platanus, Populus canadensis, Prunus, Lagerstroemia*

Group III: *Acer palmatum, Betula, Cercis, Cupania, Erythrina coralloides, E. numeana, F. retusa, Ficus rubiginosa, Gingko, Gleditzia, Jacaranda, Koelruteria, Nerium oleander, Photinia, Pistacia, Pittosporum undulatum, Raphiolepsis, Rhus lancea, Schinus*

Group IV: *Acacia, Arbutus, Ceratonia cinnamomum, Diosepis chilensis, Eucalyptus, Ficus florida, F. macrophylla, Harpehyllum caffrum, Pyrus, Quercus, Robinia, Salix umbraculifera*

Group V: *Erythrina caffra, Morus, Populus italica, Salix*



1.2 BARE ROOT SPECIFICATIONS

1.2.1 NURSERY GROWN—SPREAD OF ROOTS

All bare root trees shall have a well branched root system characteristic of the species. The following table represents the approved minimum root spread for nursery grown shade trees.

Caliper	Average Height Range	Minimum Root Spread
½ in.	5 to 6 ft.	12 in.
¾ in.	6 to 8 ft.	16 in.
1 in.	8 to 10 ft.	18 in.
1¼ in.	8 to 10 ft.	20 in.
1½ in.	10 to 12 ft.	22 in.
1¾ in.	10 to 12 ft.	24 in.
2 in.	12 to 14 ft.	28 in.
2½ in.	12 to 14 ft.	32 in.
3 in.	14 to 16 ft.	38 in.

1.2.2 COLLECTED—SPREAD OF ROOTS

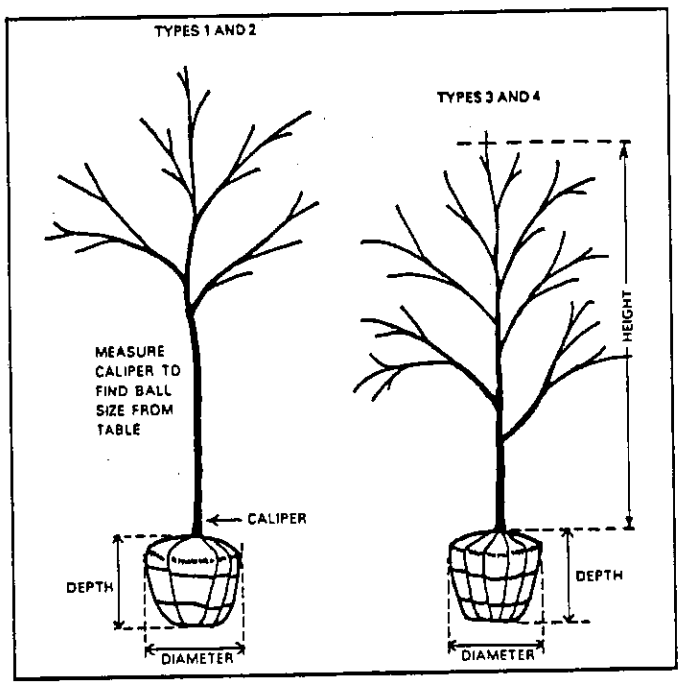
Trees collected from native stands or established plantings must be so designated. The spread of roots, bare root collected trees, shall be ⅓ greater than the spread of roots, bare root nursery grown, as tabulated above.

Trees collected from wild or native stands may be considered nursery grown when they have been successfully re-established in the nursery row and grown under regular nursery cultural practices for a minimum of two growing seasons and have attained adequate root and top growth to indicate full recovery from transplanting into the nursery row.

1.3 BALLING AND BURLAPPING SPECIFICATIONS

Ball sizes should always be of a diameter and depth to encompass enough of the fibrous and feeding root system as necessary for the full recovery of the plant.

It is recognized that balling of nursery grown stock can be accomplished by hand digging or by mechanical devices especially designed for nursery conditions. The use of digging machines is an acceptable nursery practice.



1.3.1 NURSERY GROWN

The following table represents the recommended minimum sizes of balls for trees which are being grown in the nursery under favorable growing conditions and which have received the proper cultural treatment to develop a well branched root system.

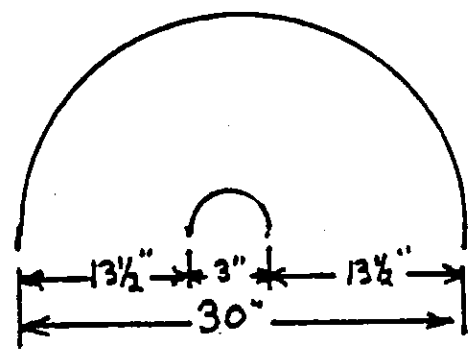
These specifications are for plants either hand dug or machine dug with the ball of earth in which they are growing.

Plants dug to specifications in the table should have the trunk or stem of the plant in the center of the earth ball. A tolerance of 10% of the diameter is the maximum deviation allowable.

Example: For a tree with a 30-inch rootball, the center of the plant at ground level must be within a circle 13½ inches from the outer edge of the ball.

It is recognized that plants having a coarse or widespreading root system because of natural habit of growth, soil condition, infrequent transplanting practice, or plants which are moved out of season, would require a size of ball in excess of the recommended sizes.

Shade Trees Types 1 and 2		Trees Types 3 and 4	
Caliper	Minimum Diameter Ball	Height (Up to 6 ft.) Caliper (6 ft. & over)	Minimum Diameter Ball
Inches	Inches	Feet/Inches	Inches
½	12	2 ft.	10
¾	14	3 ft.	12
1	16	4 ft.	14
1¼	18	5 ft.	16
1½	20	¾ in.	16
1¾	22	1 in.	18
2	24	1½ in.	20
2½	28	1¾ in.	22
3	32	2 in.	24
3½	38	2½ in.	28
4	42	3 in.	32
4½	48	3½ in.	38
5	54	4 in.	42
5½	57	4½ in.	48
6	60	5 in.	54
7	70	5½ in.	57
8	80	6 in.	60
		7 in.	70
		8 in.	80



1.3.2 COLLECTED

It is generally recognized that plants growing in their native state will sustain a much more severe shock when transplanted than the same kinds of plants when nursery grown. If collected material is moved, a considerably larger ball than that recommended for transplanted nursery stock is required, because of the unrestricted root development and the varying conditions of soil in which such material is found.

The minimum ball sizes shall be equal to those specified in 1.3.1 for the next larger size nursery grown stock.

Trees collected from wild or native stands may be considered nursery grown when they have been successfully re-established in the nursery row and grown under regular nursery cultural practices for a minimum of two growing seasons and have attained adequate root and top growth to indicate full recovery from transplanting into the nursery row.

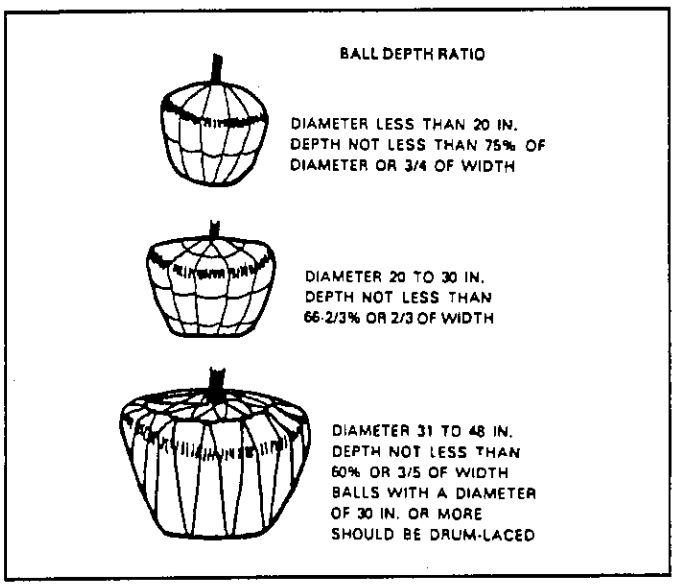
1.3.3 PLANTATION GROWN

Plants which have been systematically planted in fertile, friable soil which is relatively free of stones and foreign matter, but where plants have had a minimum of after-care.

The minimum ball sizes shall be equal to those specified in 1.3.1 for the next larger size nursery grown stock.

1.3.4 BALL DEPTHS

Under certain soil and regional conditions, plants have root systems of proportionately less depth and greater diameter. These require a more shallow but wider ball to properly encompass the roots. Conversely, in other soils and in certain regions roots develop greater depth and less spread, requiring an exceptionally deep ball which may be smaller in diameter and greater in depth than the size recommended.



For the greater part of the country, ball depths will carry the following ratios:

Balls with diameters less than 20 inches—depth not less than 75% of diameter.

Balls with diameters of 20 inches to 30 inches inclusive—depth not less than 66⅔% of diameter.

Balls with diameters of 30 inches to 48 inches inclusive—depth not less than 60% of diameter.

Balls with diameter over 48 inches will have the depth scaled down proportionately.

1.3.5 BURLAPPING

Burlap or other suitable material shall completely cover the root ball. This wrapping shall be between the earth ball and the lacing or ball supporting device.

1.3.6 BALL SUPPORTING DEVICES

Ball supporting devices, such as wire baskets, shall hold the ball in a firm, rigid condition.

1.4 CONTAINER GROWN SPECIFICATIONS

All container grown trees shall be healthy, vigorous, well rooted, and established in the container in which they are sold. They shall have tops of good quality and in a healthy growing condition.

An established container grown tree shall be a tree transplanted into a container and grown in that container sufficiently long for new fibrous roots to have developed so that the root mass will retain its shape and hold together when removed from the container.

The container shall be sufficiently rigid to hold the ball shape protecting the root mass during shipping.

Dwarf and light growing varieties may be 1 or 2 sizes smaller than standard for a given size container.

All shade and flowering trees in a container should be sold by both plant size and container size. The plant size shall agree with sizes specified in Section 1.1.1 of this chapter, and the container sizes shall agree with the plant container class table in the Foreword on page iii.

The following table gives tree sizes and acceptable container sizes:

Tree Height	Container Size
12 in.	#1
18 in.	
2 ft.	
3 ft.	
2 ft.	#2
3 ft.	
4 ft.	
4 ft.	#3
5 ft.	
6 ft.	

1.5 BALLED AND POTTED

Balled and potted plants are field-grown nursery plants, dug with a ball of earth still intact in which they are growing, and which, in lieu of burlapping, are placed in a container to retain the ball unbroken.

Ball sizes shall always be of a diameter and depth to encompass enough of the fibrous and feeding root system as necessary for the full recovery of the plant.

The minimum ball size specification for "balled and potted" plants shall be the same as for "balled and burlapped" plants. (See 1.3.1)

1.6 PROCESSED BALLED

A processed balled shade or flowering tree is one dug bare root, while dormant, to which a growing medium is added around the roots to form a ball designed to sustain plant growth.

The following table represents the recommended minimum sizes of processed balls for trees processed by machine or hand.

All trees shall have a root system which has been developed by proper cultural practices.

Single Stem Trees Types 1, 2, 3		Small Spreading Trees Type 4	
Caliper	Minimum Diameter Ball	Height; Caliper	Minimum Diameter Ball
Inches	Inches	Feet/Inches	Inches
½	10	2 ft.	10
¾	10	3 ft.	10
1	12	4 ft.	12
1¼	14	5 ft.	12
1½	16	¾ in.	12
1¾	18	1 in.	14
2	20	1½ in.	14
2½	20	1¼ in.	14
3	28	1¾ in.	18

2 DECIDUOUS SHRUBS

This section applies to plants generally sold to the retail and landscape trade. For liner grades see Section 6.

2.1 GENERAL SPECIFICATIONS

2.1.1 HEIGHT MEASUREMENT

For purposes of simplicity, only one size per "grade" will be listed. That size will be the minimum size allowable for that grade, and the grade shall include plants from that size up to but not including the next larger grade size.

Example: *Forsythia*, 2 ft. This could include *Forsythia* plants with not less than three 2-foot canes up to but not including four 3-foot canes.

2.1.1.1 Dwarf and Semi-Dwarf Shrubs

State height in inches up to 24 inches; 24 inches and up state in single feet. Grade in 3-inch series to 18 inches, 6-inch series 18–24 inches, and in ½-foot series over 24 inches. Example: 12 in.; 15 in.; 18 in.; 2 ft.; 2½ ft.

2.1.1.2 Strong Growing Shrubs

Grade in 6-inch series up to 24 inches tall (example: 12 in., 18 in.); over 24 inches, grade in single feet up to 6 feet tall; over 6 feet, grade in double feet. Example: 5 ft., 6 ft., 8 ft., 10 ft.

2.1.2 QUALITY DEFINITIONS

If a plant is well grown with single stem, well shaped and bushy, and has sufficient well spaced side branches to give it weight and good bud qualities, it should be an acceptable plant.

A cane shall be considered a primary stem which starts from the ground or close to the ground at a point not higher than one-fourth the height of the plant.

2.1.3 TYPES OF SHRUBS

2.1.3.1 Type 0—Shrubs Having a Tendency Not to Mature All Top Growth

It is an accepted nursery trade practice to prune the top growth of these shrubs back to live wood.

2.1.3.1.1 Type 0-1

6-in. shrubs should have no less than 2 canes, 6 in. and up of live top; 9-in. and up shrubs should have no less than 3 canes, 9 in. and up of live top.

Example: *Hydrangea macrophylla*

2.1.3.1.2 Type 0-2

9-in. shrubs should have no less than 2 canes, 9 in. and up of live top.

Examples: *Caryopteris, Hypericum* (shrubby types)

2.1.3.1.3 Type 0-3

12-in. shrubs should not have less than 2 canes, 12 in. and up of live top.

18 in. and up shrubs should not have less than 3 canes, 18 in. and up of live top.

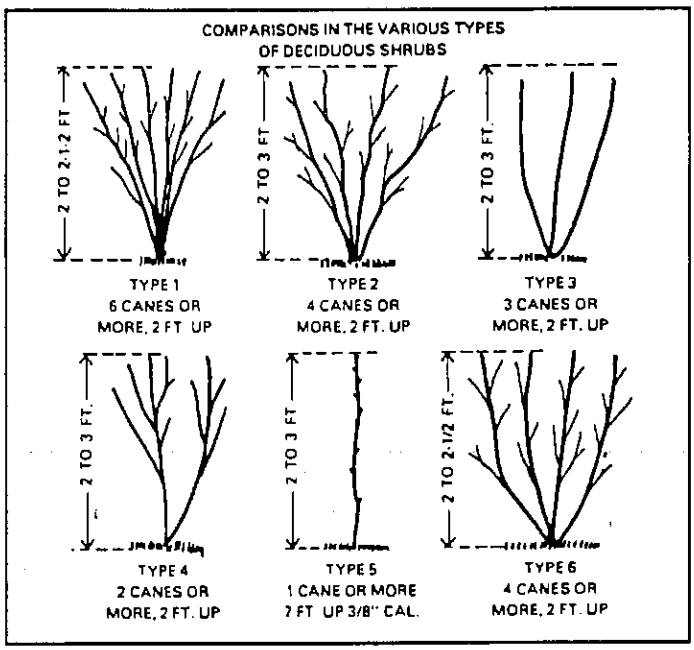
Examples: *Hydrangea arborescens, Buddleia, Vitex*

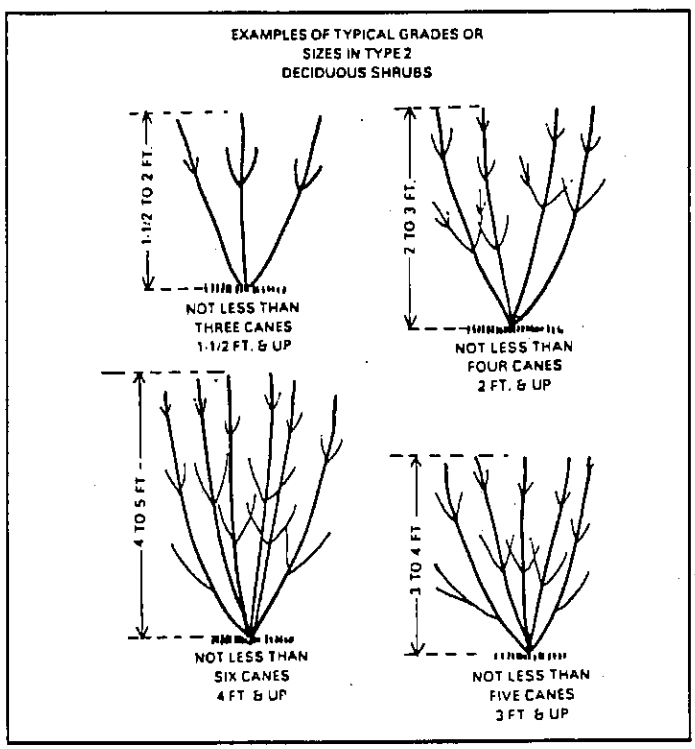
2.1.3.2 Type 1—Shrubs: Dwarf and Semi-Dwarf

12-in. shrubs should have not less than 4 canes, 12 in. and up.
15-in. shrubs should have not less than 4 canes, 15 in. and up.
18-in. shrubs should have not less than 5 canes, 18 in. and up.
2-ft. shrubs should have not less than 6 canes, 2 ft. and up.
2½-ft. shrubs should have not less than 7 canes, 2½ ft. and up.

Examples:

Berberis thunbergii var. *atropurpurea* 'Crimson Pigmy'
Deutzia gracilis
Euonymus kiautschovica 'Jewell'
Potentilla fruticosa
Ribes alpinum
Spiraea bumalda 'Anthony Waterer'





2.1.3.3 Type 2

18-in. shrubs should have not less than 3 canes, 18 in. and up.
2-ft. shrubs should have not less than 4 canes, 2 ft. and up.
3-ft. shrubs should have not less than 5 canes, 2 ft. and up.
4-ft. shrubs should have not less than 6 canes, 4 ft. and up.

Examples:

Azaleas (deciduous species)
Cephalanthus occidentalis
Cornus alba, C. racemosa, C. sericea
Diervilla sessilifolia
Itea virginica
Kolkwitzia amabilis
Lespedeza thunbergii
Philadelphus lemoinei
Rhodotypos scandens
Rosa setigera
Stephanandra incisa

2.1.3.4 Type 3

18-in. shrubs should have not less than 3 canes, 18 in. and up.
2-ft. shrubs should have not less than 3 canes, 2 ft. and up.
3-ft. shrubs should have not less than 4 canes, 3 ft. and up.
4-ft. shrubs should have not less than 5 canes, 4 ft. and up.

Examples:

Acanthopanax sieboldianus
Alnus rugosa
Amelanchier
Aronia arbutifolia, A. melanocarpa
Calycanthus floridus
Chaenomeles speciosa
Clethra alnifolia
Cornus amomum, C. sanguinea
Corylus americana, C. avellana
Cotoneaster acutifolius
Deutzia (tall growing species)
Euonymus americana
Forsythia
Hamamelis
Hibiscus syriacus
Hydrangea paniculata 'Grandiflora' (Peegee H)
Ilex laevigata, I. verticillata
Kerria japonica (single and double)
Ligustrum obtusifolium var. *regelianum*
Lonicera (bush form)
Myrica pensylvanica
Philadelphus virginalis
Prunus cistena, P. cerasifera, P. triloba (bush forms)
Rhus aromatica
Rosa blanda, R. rugosa
Sambuscus canadensis, S. nigra (variegated forms)
Sorbaria aitchisoni, S. arborea, S. sorbifolia
Spiraea (tall growing varieties)
Symphoricarpos albus, S. chenaultii, S. mollis, S. occidentalis, S. orbiculatus
Syringa chinensis, S. josikaea, S. persica, villosa, S. reticulata
Vaccinium corymbosum, V. stamineum
Viburnum cassinoides, V. dentatum, V. lantana, V. molle, V. opulus, V. plicatum, V.pf. tomentosum, V. trilobum
Weigela floribunda, W. florida

2.1.3.5 Type 4

18-in. shrubs should have not less than 2 canes, 18 in. and up.
2-ft. shrubs should have not less than 2 canes, 2 ft. and up.
3-ft. shrubs should have not less than 3 canes, 3 ft. and up.
4-ft. shrubs should have not less than 4 canes, 4 ft. and up.

Examples:

Amorpha fruticosa
Baccharis halimifolia
Caragana arborescens
Chionanthus virginicus
Colutea arborescens
Cornus alternifolia, C. mas
Cotinus coggygria, C. obovatus
Elaeagnus angustifolia, E. commutata, E. umbellata
Euonymus alatas, E. atropurpureus, E. bungeanas, E. europaeus
Exochorda racemosa
Halesia carolina
Lespedeza bicolor
Lindera benzoin
Rhamnus cathartica, R. frangula
Rubus odoratus
Sambucus pubens
Syringa vulgaris
Tamarix
Viburnum lentago, V. prunifolium

2.1.3.6 Type 5

18-in. shrubs with 1 or more canes 8 in. and up in height 5/16 in. cal.
2-ft. shrubs with 1 or more canes 2 ft. and up in height 3/8 in. cal.
3-ft. shrubs with 1 or more canes 3 ft. and up in height 1/2 in. cal.
4-ft. shrubs with 1 or more canes 4 ft. and up in height 5/8 in. cal.
5-ft. shrubs with 1 or more canes 5 ft. and up in height 7/8 in. cal.

Examples:

12-in. *Berberis thunbergii*, 3 canes or more, 12 in. and up.
15-in. *Berberis thunbergii*, 3 canes or more, 15 in. and up.
18-in. *Berberis thunbergii*, 4 canes or more, 18 in. and up.
2-ft. *Berberis thunbergii*, 4 canes or more, 18 in. and up.
2-ft. *Berberis thunbergii*, 4 canes or more, 2 ft. and up.
2½-ft. *Berberis thunbergii*, 5 canes or more, 2½ ft. and up.
3-ft. *Berberis thunbergii*, 6 canes or more, 3 ft. and up.

2.1.3.8 Type 7—Privet (Hedging)

18-in. *Ligustrum* in variety shall have 3 canes or more 18 in. and up.
2-ft. *Ligustrum* in variety shall have 4 canes or more 2 ft. and up.
3-ft. *Ligustrum* in variety shall have 5 canes or more 3 ft. and up.
4-ft. *Ligustrum* in variety shall have 6 canes or more 4 ft. and up.

Note: For *Ligustrum obtusifolium* var. *regalianum*, see Type 3.

2.2 BARE ROOT SPECIFICATIONS

2.2.1 NURSERY GROWN—SPREAD OF ROOTS

Roots of deciduous shrubs shall have a well-branched root system characteristic of the species. Bare root shrubs shall have minimum root spreads as follows:

Strong Growing Shrubs

Height of Plant:	18 in.	2 ft.	3 ft.	4 ft.	5 ft.	6 ft.
Minimum Root Spread:	10 in.	11 in.	14 in.	16 in.	18 in.	20 in.

2.2.2 COLLECTED—SPREAD OF ROOTS

Shrubs collected from native stands or established plantings must be so designated. The spread of roots, bare root collected, shall be one-third greater than the spread of roots of nursery grown shrubs as tabulated above.

Shrubs collected from wild or native stands may be considered nursery grown when they have been successfully re-established in the nursery row and grown under regular nursery cultural practices for a minimum of two growing seasons and have attained adequate root and top growth to indicate full recovery from transplanting into the nursery row.

2.3 BALLING AND BURLAPPING SPECIFICATIONS

Ball sizes should always be of a diameter and depth to encompass enough of the fibrous and feeding root system as necessary for the full recovery of the plant.

It is recognized that balling of nursery grown stock can be accomplished by hand digging or by mechanical devices especially designed for nursery conditions. The use of digging machines is an acceptable nursery practice.

2.3.1 NURSERY GROWN

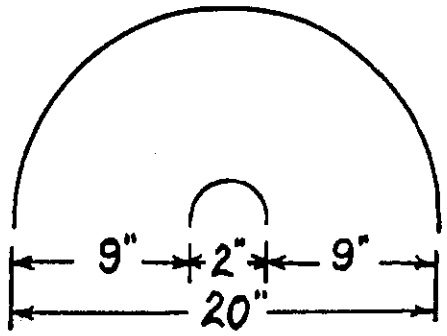
The following table represents the recommended minimum sizes of balls for shrubs which are being grown under favorable growing conditions and which have received the proper cultural treatment to develop a well-branched root system.

These specifications are for plants either hand dug or machine dug with the ball of earth in which they are growing.

Deciduous Shrubs

Height	Minimum Diameter Ball (Inches)
12 in.	8
18 in.	9
2 ft.	10
3 ft.	12
4 ft.	14
5 ft.	16
6 ft.	18
7 ft.	20
8 ft.	22
9 ft.	24
10 ft.	26

Plants dug to the specifications in the foregoing table should have the center of the stem or cluster of stems of the plant in the center of the earth ball. A tolerance of 10% of the diameter is the maximum deviation allowable.



Example: For a shrub with a 20-inch rootball, the center of the plant at ground level must be within a circle 9 inches from the outer edge of the ball.

2.3.2 COLLECTED

The minimum sizes of ball shall be equal to those specified in 2.3.1 for the next larger nursery grown stock.

Shrubs collected from wild or native stands may be considered nursery grown when they have been successfully re-established in the nursery row and grown under regular nursery cultural practices for a minimum of two growing seasons and have attained adequate root and top growth to indicate full recovery from transplanting into the nursery row.

2.3.3 PLANTATION GROWN STOCK

Plants which have been systematically planted in fertile, friable soil which is relatively free of stones and foreign matter, but where plants have had a minimum of after-care.

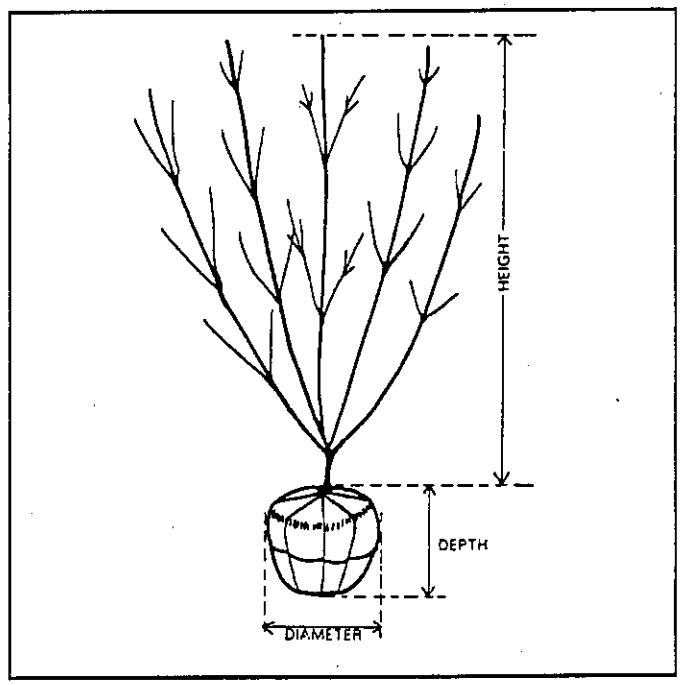
The minimum ball sizes shall be equal to that specified in 2.3.1 for the next larger size nursery grown stock.

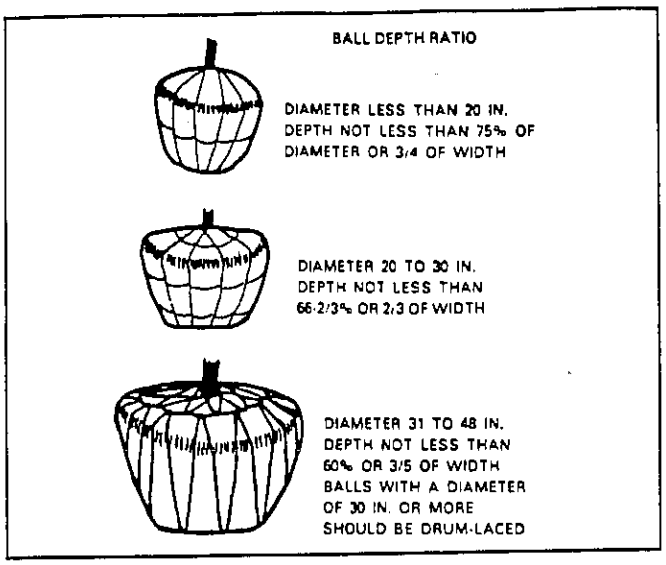
2.3.4 BALL DEPTHS

For the greater part of the country, ball depths will carry the following rations:

Balls with diameters less than 20 inches — depth not less than 75% of diameter.

Balls with diameters of 20 inches or more — depth is not less than 66⅔% of the diameter.





Under certain conditions, plants have root systems of proportionately less depth and greater diameter. These require a more shallow but wider ball to properly encompass the roots. Conversely, in other soils and in certain regions roots develop greater depth and less spread, requiring an exceptionally deep ball which may be smaller in diameter and greater in depth than the size recommended.

2.3.5 BURLAPPING

Burlap or other suitable material shall completely cover the root ball. This wrapping shall be between the earth ball and the lacing or ball supporting device.

2.4 CONTAINER GROWN SPECIFICATIONS

All container grown deciduous shrubs shall be healthy, vigorous, well rooted, and established in the container in which they are growing. They shall have tops of good quality and be in a healthy growing condition. A container shrub shall be in that container a sufficient time that fibrous roots are formed so the shape will remain and the medium will hold together when removed from the container.

Dwarf and light growing varieties may be 1 or 2 sizes smaller than standard for a given size container.

All deciduous shrubs sold in a container should be sold by both plant size and container size. The plant size shall agree with sizes specified in Section 2.4.1 of this chapter and the container sizes shall agree with the plant container class table in the Foreword on page iii.

2.4.1 SIZING INTERVALS

Use 2-in. intervals up to 12 in.

Use 3-in. intervals from 12 in. to 18 in. On some slow-growing plants 3-in. intervals may be used up to 24 in.

Use 6-in. intervals from 18 in. up to 3 ft. On special plants 6 in. may be extended above 3 ft.

2.4.2 TYPES OF PLANTS

Above measurement intervals apply to plant types in the following sections.

2.4.2.1 Spreading

Measurement designates spread (height not considered).

Examples:

Cotoneaster adpressa praecox
Genista pilosa
Salix prostrata

2.4.2.2 Semi-Spreading

Measurement designates spread. Spread usually is at least twice the height.

Examples:

Cotoneaster horizontalis apiculata
Potentialla f. 'Longacre'

2.4.2.3 Globe

Measurement designates height. Height will usually equal spread.

Examples:

Berberis thunbergii 'Crimson Pygmy'
Cotoneaster horizontalis 'Little Gem'
Spiraea 'Little Princess'
Hypericum calycinum
Lagestromia indica 'Victor'

2.4.2.4 Medium Upright

Measurement designates height. Height will usually be twice the spread..

Examples:

Barberis thunbergi
Euonymus alata 'Compacta'
Potentilla f. 'Hollandia Gold'
Magnolia kobus 'Stellata'
Azalea molle

2.4.1.2.5 Upright

Measurement may be designated by height. Width must be at least one-quarter of the height unless specified by height and number of canes.

Examples:

Magnolia s. 'Alexandrina'
Syringa 'Madame Lemoine'
Azalea 'Homebush'
Forsythia (tall varieties)
Lagestromia indica 'Potomac'

2.5 BALLED AND POTTED

Balled and potted plants are field-grown nursery plants, dug with a ball of earth still intact in which they are growing, and which, in lieu of burlapping, are placed in a container to retain the ball unbroken.

Ball sizes shall always be of a diameter and depth to encompass enough of the fibrous and feeding root system as necessary for the full recovery of the plant.

The minimum ball size specifications for "balled and potted" plants shall be the same as for "balled and burlapped" plants. (See 2.3.1.)

2.6 PROCESSED BALLED

A processed balled deciduous shrub is one dug bare root, while dormant, and a growing medium mechanically is formed in a ball around the root.

The minimum ball size specifications for "Processed Balled" shrubs shall be the same as "Small Spreading Trees — Type 4." (See 1.6.)

3 CONIFEROUS EVERGREENS

This section applies to plants generally sold to the retail and landscape trade. For liner grades see Section 6.

3.1 GENERAL SPECIFICATIONS

For purposes of simplicity, only one size per "grade" will be listed. That size will be the minimum size allowable for that grade, and the grade shall include plants from that size up to but not including the next larger grade size.

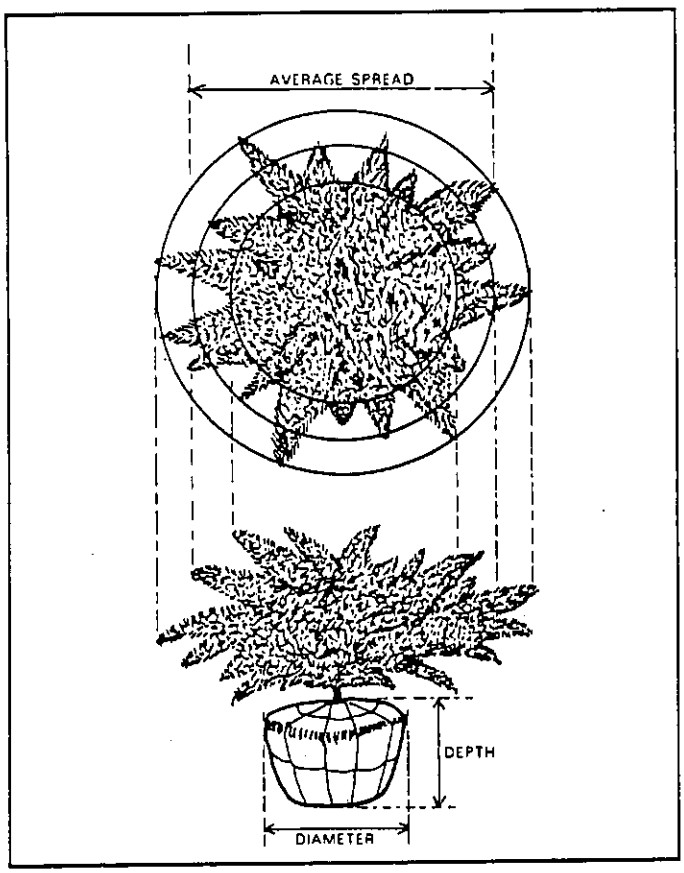
Example: *Taxus media* 'Brownii,' 15 inches. (This could include *Taxus media* 'Brownii' 15 inches in height up to but not including 18 inches and having a minimum spread of 12 inches.)

3.1.1 QUALITY DEFINITIONS

The quality of evergreens offered is assumed to be normal for the species or variety unless otherwise designated as:

Specimen (Spec.) This designation may be used to indicate exceptionally heavy, well shaped plants and is usually applied to the larger commercial sizes and plants which have been cut back or trimmed to form a perfectly symmetrical, tightly knit plant. The letters "X," "XX," or "XXX" may be used to designate the degree of heavy grades in place of using the word "specimen" (spec.).

Collected (Coll.) Natural seedling plants dug from native stands or forest plantings must be so designated. (Also see 3.2.2.)



3.1.2 TYPES OF CONIFERS

3.1.2.1 Type 1. Creeping or Prostrate Type

Measurement designates spread (height not considered).
Use 3-in. intervals up to 18 in.
Use 6-in. intervals from 18 in. to 4 ft.
Use 1-ft. intervals from 4 ft. up.

Measurement should be average of plant and not the greatest diameter. Plants properly trimmed and transplanted should measure the same in any direction. If a plant is uneven, for example, 15 inches the widest way and nine the narrowest, it should be classified as 12" stock.

Examples:
Juniperus horizontalis cultivars
Juniperus chinensis var. *procumbens*

3.1.2.2 Type 2. Semi-Spreading Type

Measurement designates spread.
Use 3-in. intervals up to 18 in.
Use 6-in. intervals from 18 in. to 4 ft.
Use 1-ft. intervals from 4 ft. up.
Measurement should average as in Type 1.

Height will be at least one-half the spread. Above 3 feet the height will be less than the spread, varying somewhat according to natural growth of the particular species and method of handling.

Spread	Height
6 in. up to 3 ft.	Same as spread
3 ft.	2½ to 3½ ft.
4 ft.	3 to 4 ft.

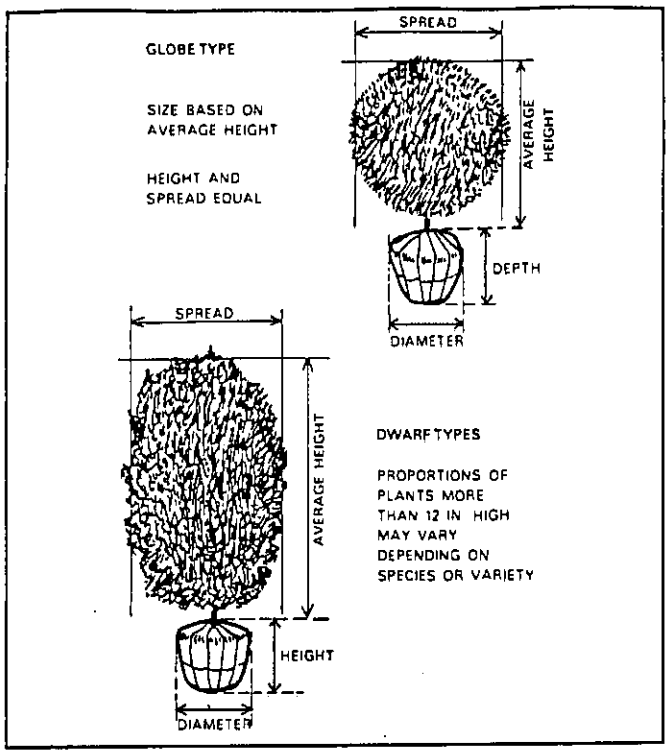
Examples:
Juniperus chinensis 'Pfitzerana', *J. sabina*
Taxus cuspidata, T. cuspidata 'Nana,' *T. media* 'Densiformis'

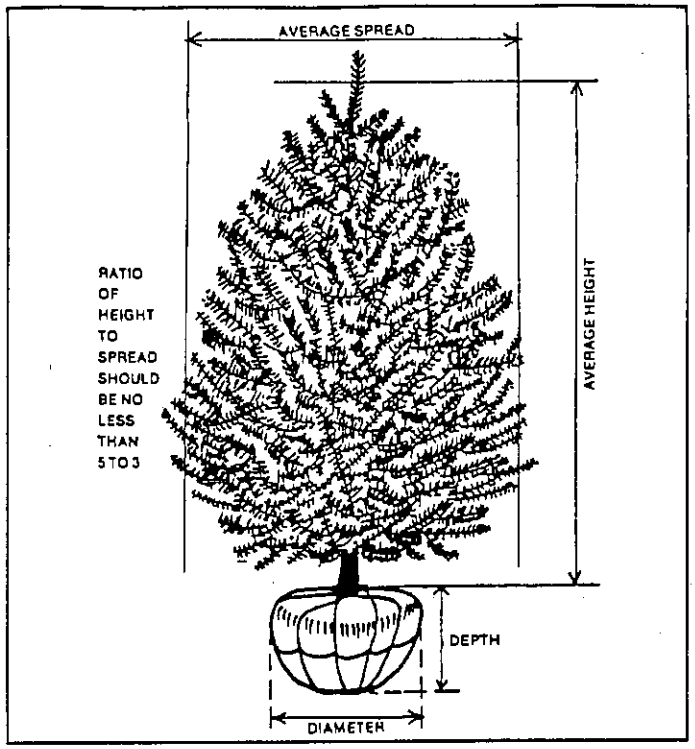
3.1.2.3 Type 3. Broad Spreading, Globe, and Upright Types

Measurement designates height.
Use 3-in. intervals up to 18 in.
Use 6-in. intervals from 18 in. to 4 ft.
Use 1-ft. intervals from 4 ft. up.

Spread will usually be equal to height in well grown material up to 12 inches. From there on there will be a variation of spread to height depending on the variety.

Height	Minimum Spread
6 in.	6 in.
9 in.	9 in.
12 in.	10 in.
15 in.	12 in.
18 in.	15 in.
2 ft.	18 in.
2½ ft.	21 in.
3 ft.	24 in.





Many broad spreading and globe types included in this classification will have the same or greater spread as height, even in the larger sizes.

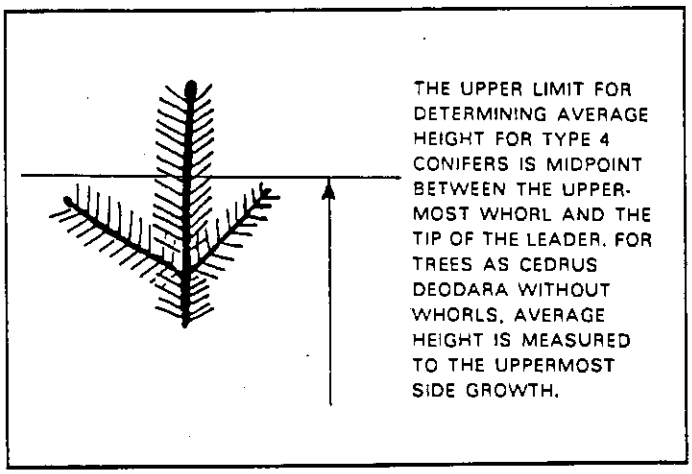
Examples:
Chamaecyparis obtusa 'Grecillis,' 'Nana,' *C. pisifera* 'Plumosa Nana,'
'Squarrosa Minima'
Juniperus squamata 'Meyeri'
Juniperus virginiana 'Globora'
Picea abies 'Nidiformis'
Taxus media 'Brownii'
Thuja occidentalis 'Globosa,' 'Little Gem,' 'Horeyi,' 'Compacta,' 'Woodwondii'; *T. Orientalis* 'Goldbush'

Upright growing dwarf types may approach the minimum dimensions above.

3.1.2.4 Type 4. Cone Type (Pyramidal)

Measurement designates height.
Use 3-in. intervals up to 18 in.
Use 6-in. intervals from 18 in. to 3 ft.
Use 1-ft. intervals from 3 ft. to 10 ft.
Use 2-ft. intervals from 10 ft. up.
The ratio of height to spread of properly grown material should not be less than 5 to 3.

Height	Spread
12 in.	8 to 12 in.
15 in.	9 to 15 in.
18 in.	12 to 18 in.
2 ft.	15 to 21 in.
2½ ft.	18 to 24 in.
3 ft.	21 to 30 in.
4 ft.	2½ to 3 ft.
5 ft.	3 to 4 ft.



Examples:
Abies
Cedrus deodara
Chamaecyparis pisifera and varieties (except dwarf types)
Picea abies (conical types)
Pinus (except dwarf type)
Pseudotsuga menziesii
Taxus cuspidata 'Capitata'
Thuja occidentalis, T. orientalis (conical types)
Tsuga canadensis, T. caroliniana

3.1.2.5 Type 5. Broad Upright Type

Measurement designates height.
Use 3-in. intervals up to 18 in.
Use 6-in. intervals from 18 in. to 3 ft.
Use 1-ft. intervals from 3 ft. to 10 ft.
Use 2-ft. intervals from 10 ft. up

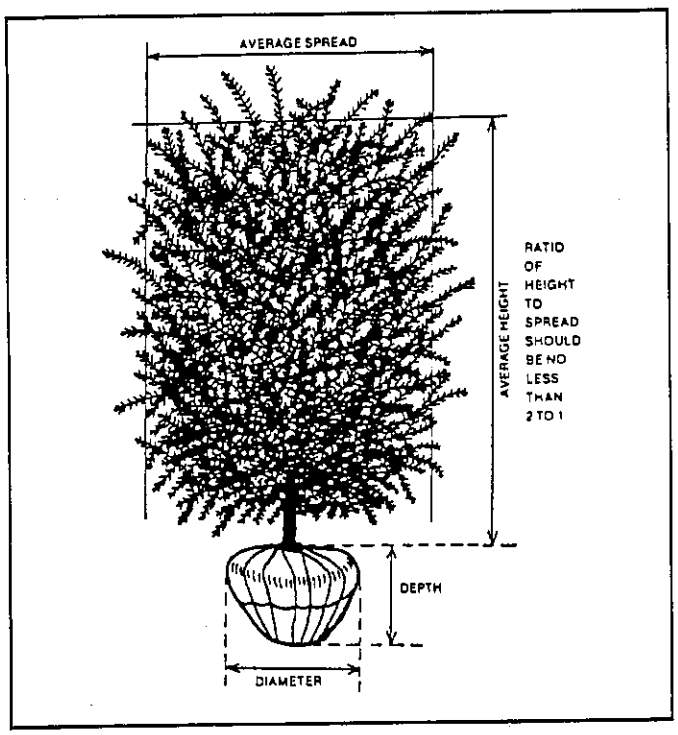
This group includes all the broader, upright growing evergreens which develop a straight sided form with many upright branches or "leaders."

The ratio of height to spread of properly grown material should not be less than 3 to 1.

Height	Spread
12 in.	8 to 12 in.
15 in.	9 to 15 in.
18 in.	12 to 18 in.
2 ft.	15 to 21 in.
2½ ft.	18 to 24 in.
3 ft.	21 to 30 in.
4 ft.	2½ to 3 ft.
5 ft.	3 to 4 ft.

Examples:

Chamaecyparis lawsoniana 'Alumii'
Juniperus chinensis 'Keteleeri,' *J. scopulorum*
Taxus media 'Hicksii,' 'Hatfieldii'



3.1.2.6 Type 6. Columnar Type

Measurement designates height.
Use 3-in. intervals up to 18 in.
Use 6-in. intervals from 18 in. to 3 ft.
Use 1-ft. intervals from 3 ft. to 10 ft.
Use 2-ft. intervals from 10 ft. up

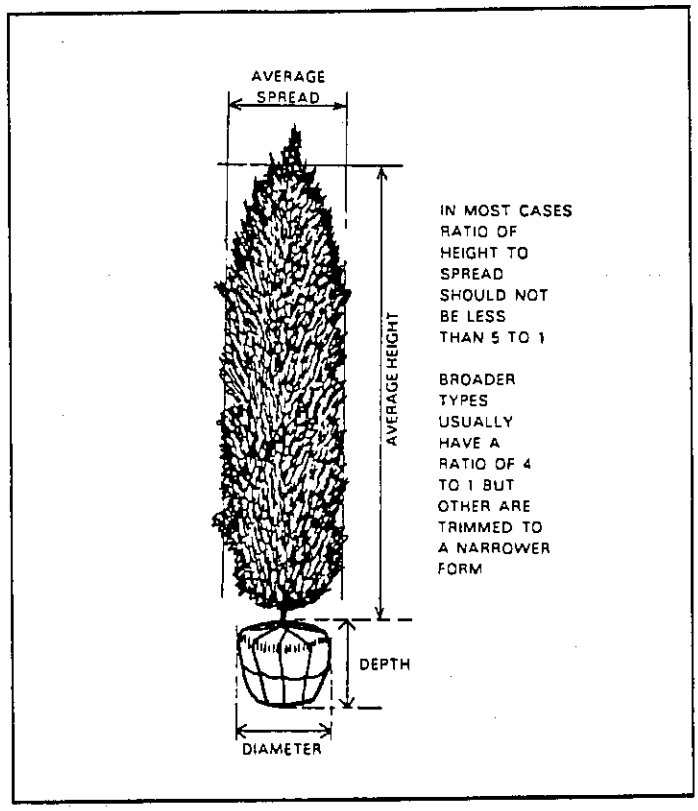
This group includes all the upright growing evergreens which naturally develop a straight sided form or one that tapers only slightly from the ground to a point more than half the height.

The broader types will usually have a ratio of height to spread of 4 to 1. Many forms, however, will not attain this ratio, and even those of broad habit may be trimmed to advantage into a narrowed form. However, in most cases the ratio of height to spread should be less than 5 to 1.

Height	Spread
12 in.	3 to 6 in.
15 in.	4 to 7 in.
18 in.	5 to 8 in.
2 ft.	6 to 9 in.
2½ ft.	7 to 10 in.
3 ft.	9 to 12 in.
4 ft.	12 to 15 in.
5 ft.	15 to 18 in.
6 ft.	18 to 21 in.
7 ft.	21 to 24 in.
8 ft.	24 to 30 in.

Examples:

Cupressus sempervirens
Juniperus communis, J. virginiana (columnar type varieties)
Taxus baccata 'Fastigiata'
Thuja occidentalis, T. orientalis (columnar type varieties)



3.2 BALLING AND BURLAPPING SPECIFICATIONS

Ball sizes should always be of a diameter and depth to encompass enough of the fibrous and feeding root system as necessary for the full recovery of the plant.

It is recognized that balling of nursery grown stock can be accomplished by hand digging or by mechanical devices especially designed for nursery conditions. The use of digging machines is an acceptable nursery practice.

3.2.1 NURSERY GROWN

The following table represents the recommended minimum sizes of balls for conifers which are being grown in the nursery under favorable growing conditions and which have received the proper cultural treatment to develop a well branched root system.

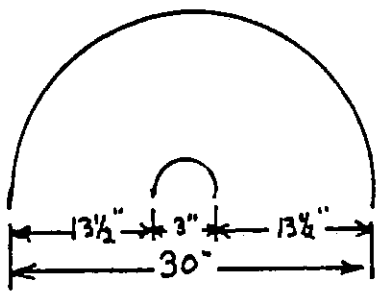
Where it has been a cultural practice to shear, prune, disbud or otherwise impede the natural growth rate of this group of plants, other than by root pruning, trunk diameter shall be used to determine the minimum ball size of trees.

Measurement of trunk diameter shall be made within 6 inches above ground level.

Minimum ball diameters shall be those established under Section 1.3.1 "Shade Trees," types 1 and 2. Ball depth shall also be established as in Section 1.3.4 (Ball Depths).

These specifications are for plants either hand dug or machine dug with the ball of earth in which they are growing.

Spreading, Semi-Spreading, and Globe or Dwarf Conifers (Types 1, 2, 3)		Conical and Broad Upright Conifers (Types 4, 5)	
Spread	Minimum Diameter Ball	Height	Minimum Diameter Ball
9 in.	8 in.	12 in.	10 in.
12 in.	8 in.	18 in.	10 in.
15 in.	10 in.	2 ft.	12 in.
18 in.	10 in.	3 ft.	14 in.
2 ft.	12 in.	4 ft.	16 in.
2½ ft.	14 in.	5 ft.	20 in.
3 ft.	16 in.	6 ft.	22 in.
3½ ft.	18 in.	7 ft.	24 in.
4 ft.	21 in.	8 ft.	27 in.
5 ft.	24 in.	9 ft.	30 in.
6 ft.	28 in.	10 ft.	34 in.
7 ft.	32 in.	12 ft.	34 in.
8 ft.	36 in.	14 ft.	42 in.
		16 ft.	46 in.
		18 ft.	50 in.



Plants dug to the specifications in the foregoing table should have the trunk or stem of the plant in the center of the earth ball. A tolerence of 10% of the diameters is the maximum deviation allowable.

Example: For a tree with a 30-inch rootball the center of the plant at ground level must be within a circle 13½ inches from the outer edge of the ball.

It is recognized that plants having a coarse or widespreading root system because of natural habit of growth, soil condition, infrequent transplanting practice, or plants which are moved out of season, would require a size of ball in excess of the recommended sizes. It is also recognized that special handling of certain material constitute cases where the sizes recommended may be excessive, for example, such as stock grown in pots or other containers, field plants recently planted out from containers or with smaller balls, or plants which have been frequently transplanted or root pruned.

Columnar Conifers (Type 6)			
Regular Growing		Rapid Growing*	
Height	Minimum Diameter Ball	Height	Minimum Diameter Ball
12 in.	10 in.	12 in.	8 in.
18 in.	10 in.	2 ft.	9 in.
2 ft.	12 in.	3 ft.	9 in.
3 ft.	13 in.	3 ft.	11 in.
4 ft.	14 in.	4 ft.	12 in.
5 ft.	16 in.	5 ft.	14 in.
6 ft.	18 in.	6 ft.	16 in.
7 ft.	20 in.		
8 ft.	22 in.		
9 ft.	24 in.		
10 ft.	27 in.		
12 ft.	30 in.		
14 ft.	33 in.		
16 ft.	36 in.		
18 ft.	40 in.		

*Rapid growing kinds as: *Thuja orientalis* (Oriental Arborvitae), *Juniperus communis* 'Hibernica' (Irish Juniper).

3.2.2 COLLECTED

The minimum sizes of ball shall be equal to that specified in 3.2.1 for the next larger size nursery grown stock.

Plants collected from wild or native stands may be considered nursery grown when they have been successfully re-established in the nursery row and grown under regular nursery cultural practices for a minimum of two growing seasons and have attained adequate root and top growth to indicate full recovery from transplanting into the nursery row.

3.2.3 PLANTATION GROWN

Plants which have been systematically planted in fertile, friable soil which is relatively free of stones and foreign matter, but where plants have had a minimum of after-care.

The minimum ball sizes shall be equal to that specified in 3.2.1 for the next larger size nursery grown stock.

3.2.4 BALL DEPTHS

For the greater part of the country, ball depths will carry the following ratios:

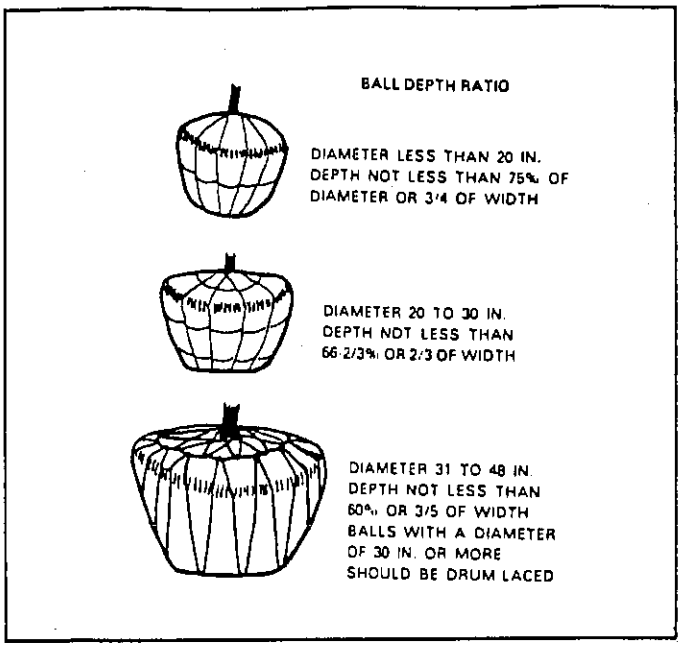
Balls with diameters less than 20 inches—depth not less than 75% of diameter.

Balls with diameters of 20 inches to 30 inches inclusive—depth not less than 66⅔% of diameter.

Balls with diameters of 30 inches to 48 inches inclusive—depth not less than 60% of diameter.

Balls with diameters over 48 inches will have the depth scaled down proportionately.

Under certain soil and regional conditions, plants have root systems of proportionately less depth and greater diameter. These require a more shallow but wider ball to properly



encompass the roots. Conversely, in other soils and in certain regions roots develop greater depth and less spread, requiring an exceptionally deep ball which may be smaller in diameter and greater in depth than the size recommended.

3.2.5 BURLAPPING

Burlap or other suitable material shall completely cover the root ball. This wrapping shall be between the earth ball and the lacing or ball supporting device.

3.2.6 BALL SUPPORTING DEVICES

Ball supporting devices, such as wire baskets, shall hold the ball in a firm, rigid condition.

3.3 CONTAINER GROWN SPECIFICATIONS

All container grown conifers shall be healthy, vigorous, well rooted, and established in the container in which they are sold. They shall have tops of good quality and in a healthy growing condition.

An established container grown conifer shall be a conifer transplanted into a container and grown in that container sufficiently long for new fibrous roots to have developed so that the root mass will retain its shape and hold together when removed from the container.

The container shall be sufficiently rigid to hold the ball shape protecting the root mass during shipping.

Dwarf and light growing varieties may be 1 or 2 sizes smaller than standard for a given size container.

All coniferous evergreen plants sold in a container should be sold by both plant size and container size. The plant size shall agree with sizes specified in Section 3.1.2 of this chapter, and the container sizes shall agree with the plant container class table in the Foreword on page iii.

3.3.1 TYPES 1, 2, AND 3

Spread (Type 1, Spreading Conifers and Type 2, Semi-Spreading Conifers)
Height (Type 3, Globe or Dwarf Conifers)

Height	Container Size
6 in.	#1
9 in.	
12 in.	
12. in.	#2
15 in.	
18 in.	#3
2 ft.	
2½ ft.	

3.3.2 TYPES 4, 5, AND 6*

(Conicals, Broad Upright, and Columnar Conifers)

Height	Container Size
6 in.	#1
9 in.	
12 in.	
15 in.	
18 in.	
12 in.	#2
15 in.	
18 in.	
2 ft.	
18 in.	#3
2 ft.	
2½ ft.	
3 ft.	
3½ ft.	

*Except for extreme columnar types as *Cupressus sempervirens* (Italian cypress), which is acceptable 1 or 2 sizes taller than standard for a given container.

3.4 BALLED AND POTTED

Balled and potted plants are field-grown nursery plants, dug with a ball of earth still intact in which they are growing, and which, in lieu of burlapping, are placed in a container to retain the ball unbroken.

Ball sizes shall always be of a diameter and depth to encompass enough of the fibrous and feeding root system as necessary for the full recovery of the plant.

The minimum ball size specification for "balled and potted" plants shall be the same as for "balled and burlapped" plants. (See 3.2.1.)

10 SEEDLING TREES AND SHRUBS

10.1 GENERAL SPECIFICATIONS

Forest, game refuge, erosion control, shelterbelt, or farm woodlot plantings, under natural conditions, shall come under the following classifications. Actual conditions of soil, climate, and environment will necessarily govern the minimum size that is required for a particular species.

It is recognized that unusual climatic conditions can influence the growth of small plants in this category. In these instances, tolerance shall be negotiated.

10.2 DECIDUOUS OR HARDWOOD

When caliper is important, measurements are taken **at** root collar or ground line.

Caliper	Min. Height	Min. Root Length
1/16 in.	6 in.	8 in.
1/8 in.	8 in.	8 in.
3/16 in.	10 in.	10 in.
1/4 in.	12 in.	10 in.

Tops or roots will not be trimmed unless specified by grower or requested by purchaser.

When height is important measurements are taken **from** root collar or ground line.

Height	Min. Caliper	Min. Root Length
6 in.	1/16 in.	8 in.
12 in.	1/8 in.	10 in.
18 in.	3/16 in.	10 in.
24 in.	1/4 in.	12 in.

Suggested for commercial nurseries furnishing or purchasing stock for the retail trade, and still comply with demands for calipered stock.

It should be understood that when heights are to govern, the caliper specification is minimum and when caliper is to govern, the height specification is minimum.

10.3 CONIFERS—EVERGREEN

Height	Min. Caliper
6 in.	1/16 in.
9 in.	1/8 in.
12 in.	3/16 in.

Age is not important when height or caliper is specified; however, it may be used in listings or demanded by purchaser.

KEY for use in indicating seedliing, root pruned, or transplants:

S, for seedling.

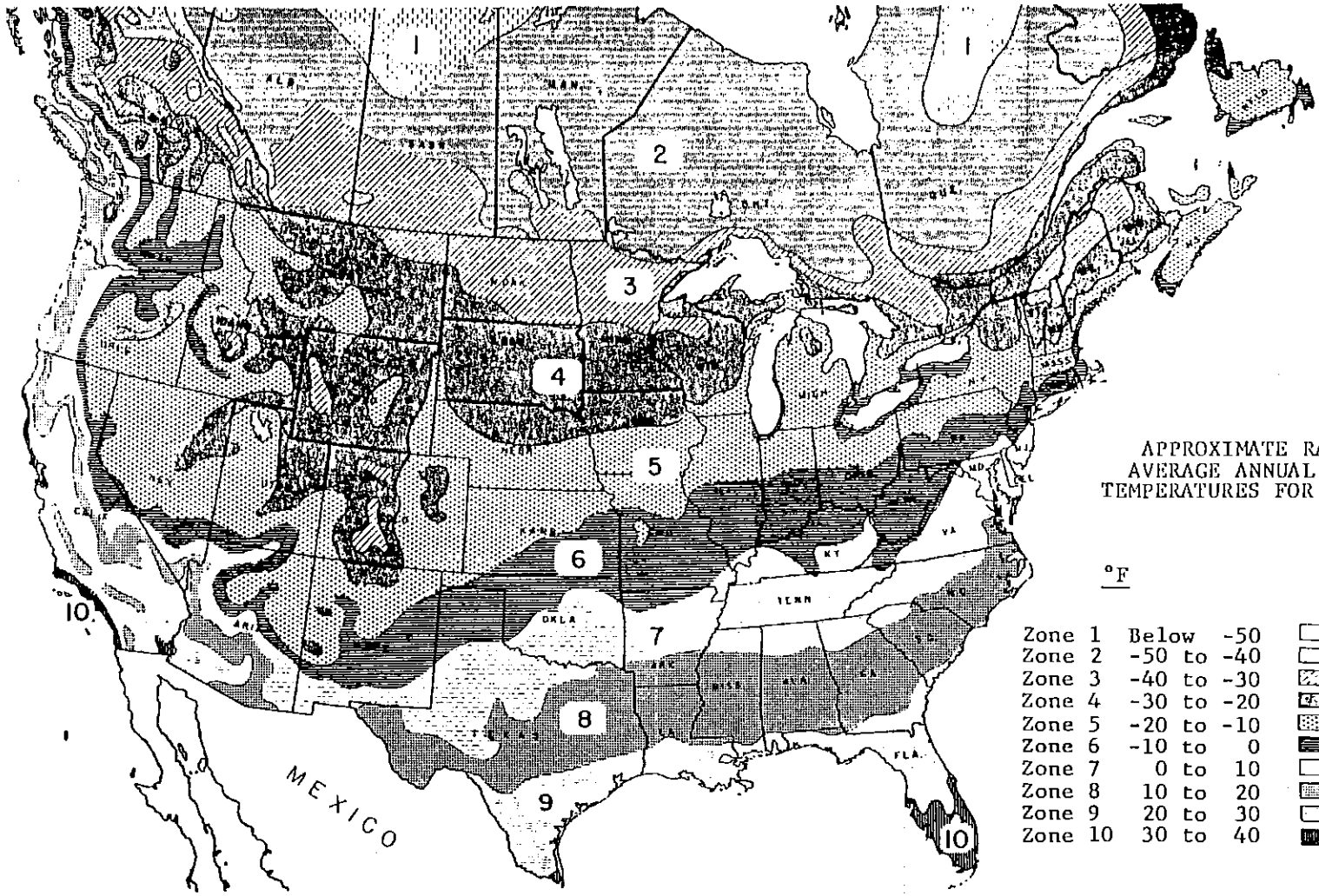
RP, root pruned (should not be root pruned deeper than 6 inches when applied to conifers).

T, one T for each time transplanted.

General: All plants are to have developed root systems, to be free of insects and diseases as well as mechanical injuries, and in all respects to be suitable for field planting. All conifers must have dormant buds (except in the South) and secondary needles.

At the option of the purchaser, other special restrictions may be specified.

APPENDIX L
PLANT HARDINESS ZONES



APPROXIMATE RANGE OF
AVERAGE ANNUAL MINIMUM
TEMPERATURES FOR EACH ZONE

	°F	°C
Zone 1	Below -50	-46
Zone 2	-50 to -40	-46 to -40
Zone 3	-40 to -30	-40 to -34
Zone 4	-30 to -20	-34 to -29
Zone 5	-20 to -10	-29 to -23
Zone 6	-10 to 0	-23 to -18
Zone 7	0 to 10	-18 to -12
Zone 8	10 to 20	-12 to - 7
Zone 9	20 to 30	- 7 to - 1
Zone 10	30 to 40	- 1 to + 4

BN-8914