Nursery Grown Plants for Wetland Mitigation Projects[1]

Glenn A. Beagle [2]

Abstract - Constructed wetland ponds are being utilized at Lone Peak State Nursery operated by the Utah Division of State Lands and Forestry to produce wetland plants for restoration projects. Restoration and creation of wetlands require a source of wetland obligate plant materials. Use of wetland filters in agricultural, urban and industrial applications provided a partnership to construct several sealed ponds. These ponds are treating water runoff from Lone Peak Nursery operations, filtering dissolved pollutants and providing a source of seed and methods for commercial production of Carex, Juncus, Scripus and Eleocharis plugs. As demand increases new infrastructure and methods of producing plants from seed germinants are being developed at Lone Peak Nursery.

INTRODUCTION

The demand for nursery-produced, non-woody riparian plants is increasing rapidly. The national policy of no net loss of wetlands has resulted in many wetland mitigation projects. Water quality improvement projects are also creating demands for wetland plants. Lone Peak State Nursery recognized these trends in 1991 and began looking at various economical methods of producing plugs of *Carex, Juncus, Scirpus,* and *Eleocharis* species.

Another problem facing many nurseries today is controlling point source pollution from greenhouse operations. In the near future all nurseries will have to address their runoff pollution problems because of stricter enforcement of current laws and passage of tougher new laws.

Lone Peak State Nursery developed one solution to these two problems: a constructed wetland. Formerly, the nursery's greenhouse runoff was drained into a bareroot production field. This field experienced a high incidence of disease and seedling mortality due to saturated soils and high nitrate levels. Greenhouse runoff would then leach into an irrigation canal outside the nursery. All greenhouse runoff is now piped into the constructed wetland ponds where various wetland plants are grown.

In 1992 we looked at the Nevada Forestry Division Washoe State Nursery's method of growing meadow plugs of field collected mix species in 10 cubic-inch-Ray Leach Super Cells. We modified Nevada's system by making initial field collections, sorting the collections into single species, transplanting each species into constructed wetland ponds, and then transplanting from the ponds into 10 cubic inch Ray Leach Super Cells for final growth and sale.

OBJECTIVES OF COMBINED PROJECT

A method of on-site production for wetland plants was desired because field collection of these plants is difficult.

To address the expanding need for wetland plants and improve water quality, Lone Peak set these objectives:

1. Develop commercial methods to propagate five obligate wetland species.
2. Produce and harvest seed from four selected wetland plants.
3. Generate sufficient revenue from wetland plant sales for a self-supporting program.
4. Treat greenhouse waste water before it leaves the Lone Peak property.
5. Grow and market single species by 1994 to support government and private riparian and wetland restoration efforts.

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[1]*Paper presented at the Northeastern and Intermountain Forest and Conservation Nursery Association Meeting, St. Louis, Missouri, August 2-5, 1993*

[2]*Lone Peak Conservation Center Coordinator for Utah State Lands and Forestry, 14650 So. Prison Rd., Draper, Utah 84020 (801) 571-0900*

SEARCH FOR POLITICAL AND FINANCIAL SUPPORT

Building support was necessary to fund the construction phase of the project. The Utah Department of Agriculture (UDA) was a strong advocate for the project. Because it could see benefit from a supply of wetland plants for agricultural filter strips, the UDA provided funding and collaboration with the USDA Soil Conservation Service (SCS) to design a collection and water storage system to Lone Peak's operational specifications.

Utah Power, a private utility company, had begun using native plant communities to effect water quality and soil stability. Utah Power saw the long-term benefit of creating a commercial source of wetland plants and became a principle donor to the project by providing a construction grant.

The USDA Forest Service, through state and private forestry programs also helped Lone Peak with funding to produce plants for the reclamation of riparian systems. Lone Peak's methods for production will provide wetland plants for out planting. This ability to commercially produce wetland plants assisted in building support for the project.

DESIGN AND CONSTRUCTION OF RUNOFF COLLECTION SYSTEM AND PONDS

The constructed wetlands consist of four ponds lined with a 30 mil plastic membrane with inlets for runoff and irrigation water. We wanted a sealed system to prevent any waste water from leaching out of the ponds and to allow monitoring of pollutant levels in water drained from the ponds. Each pond contains a French drain which allows adjustment of the water table depth and draining of all pond water for plant harvesting operations. A mixture of sandy loam topsoil

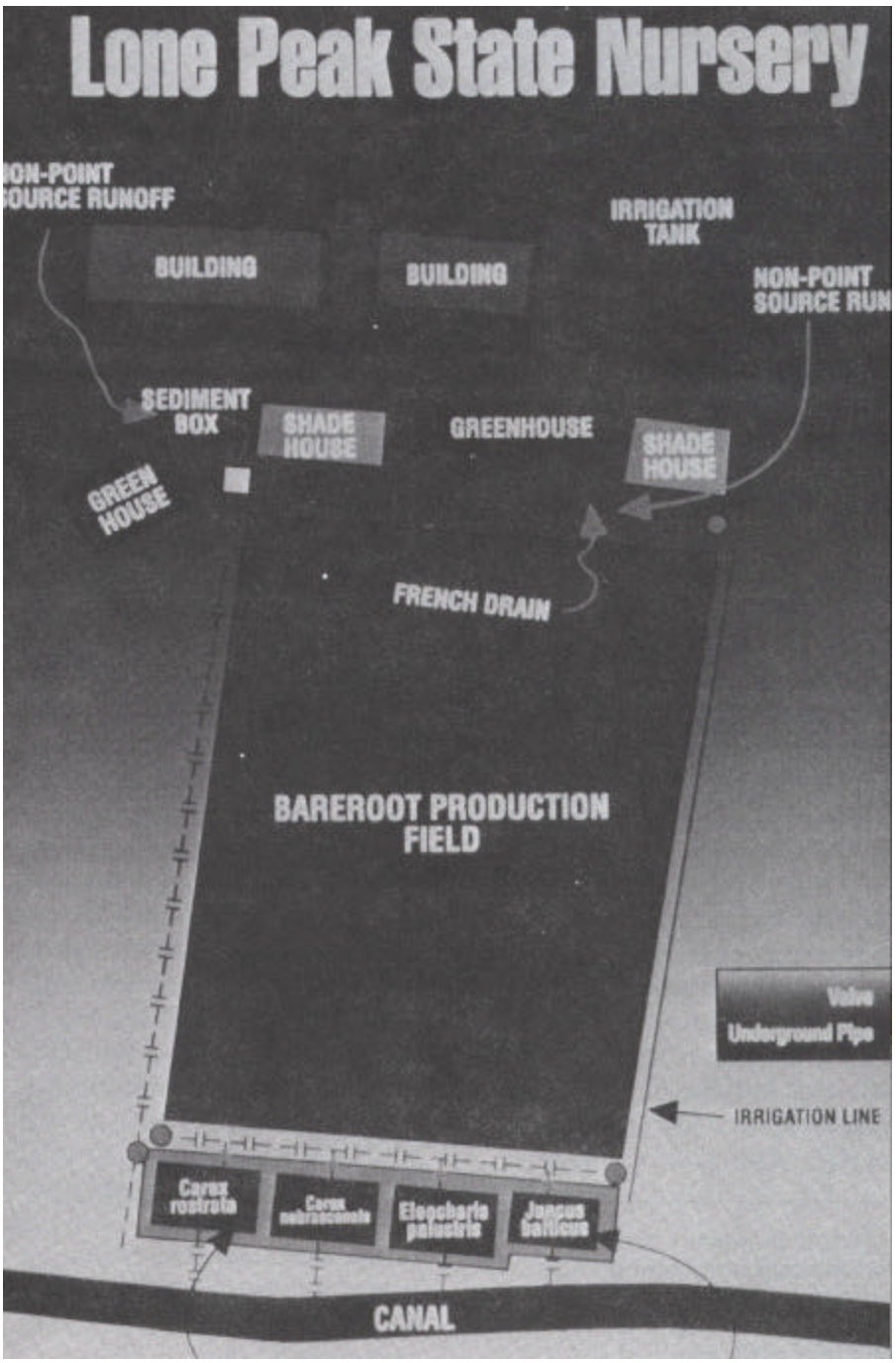

Figure 1 - Greenhouse and irrigated shadehouse above a 2-acre bareroot production field. The constructed ponds are at a lower grade at the bottom of the field. Water runoff is introduced through drainiage pipes and ditches.

and washed concrete sand was placed in the ponds to a depth of 2 ½ feet. This soil mix was selected to prevent introduction of weed seeds from nursery soils and to provide a coarse textured, easily drained soil.

Water enters the pond via two methods. Non-point source and greenhouse runoff are captured in a French drain and settling box below the greenhouse and piped underground to the ponds (Fig. 1) The field irrigation system is connected to the underground drains and pond inlet piping. This connection has proven valuable. Runoff sediment accumulates quickly in the underground pipes and the entire system can be flushed under pressure with irrigation water. Also, during dry summer months it has been necessary to supplement runoff with irrigation water to maintain proper water levels in the ponds.

The wetland design has been in use for one and a half years with very few problems. The only change in design we recommend is reducing the width (6 feet) and height (3 feet) of the pond dikes. They are over-designed for project needs and significant construction dollars could be saved with smaller dikes.

WATER QUALITY LIMITATIONS OF CONSTRUCTED WETLAND

Testing for different dissolved pollutants and analyzing the efficiency of ponding and filtering water through obligate plants proved expensive and not within the budget design. A further complication to water quality testing was the introduction of non-point source water to the system. The greenhouse and shadehouse runoff became a minor component as compared to the non-point source water that has been collected. Lone Peak's system required greater amounts of water than the greenhouse operation could provide. The collection of greenhouse run off by French drains proved ineffective. All greenhouse run off may not be captured by the French drains. We recommended that to make pipe connections from greenhouse floors drain to the ponds.

VEGETATIVE PROPAGATION SYSTEM FOR COMMERCIAL PRODUCTION

The propagation system developed for the ponds is designed to vegetatively produce single species riparian plant plugs. The design minimizes field collection costs, transplanting losses, and labor costs. The coarse textured pond soil easily falls away from plant roots during harvesting which limits soil loss. The soil is saturated to soften it for planting and harvesting.

Initial plants for the ponds are from wild collections. Collected plant material should be treated like bareroot tree seedlings. Wild collections do not store well and must be planted quickly. Cold storage of material for longer than 2-3 days appears to reduce transplant success. The wild collections are first potted and grown to maturity. When the plants are correctly identified, single species are planted in each pond. *Carex nebraskaensis, Carex rostrata, Juncus balticus,* and *Eleocharis palustris* are currently growing in the ponds.

The ponds are planted with plugs containing 2 - 3 shoots on a one-foot by one-foot spacing. After nine months when the ponds contain 20 - 25 shoots per square foot, 40 percent of the surface area is harvested. Individual shoots and rhizomes are divided out, and individual plants are potted into 10-cubic-inch Ray Leach super cells or 29-cubic-inch D-pots. Pond soil is replaced after each harvest to fill in holes and level the soil surface.

Potted plants are cultured outdoors for one-two months. When multiple shoots appear, these are divided into single shoots and re-potted. Several divisions occur each growing season with each division increasing the number of plugs by approximately 50 percent. (Fig. 2)

We are still experimenting with and learning about the best production methods for riparian plants. We are investigating the following methods:

- Trials have been conducted to determine the optimum growth container for *Carex* species. Four-inch-deep geranium pots, 29-cubic-inch D-pots, and 10-cubic-inch Ray Leach tubes have been tested. The geranium pots appear to allow the great-t rhizome development ecause they have the argest surface area. The -pots and geranium pots re used for initial potting. Ray Leach tubes are used at the final division.

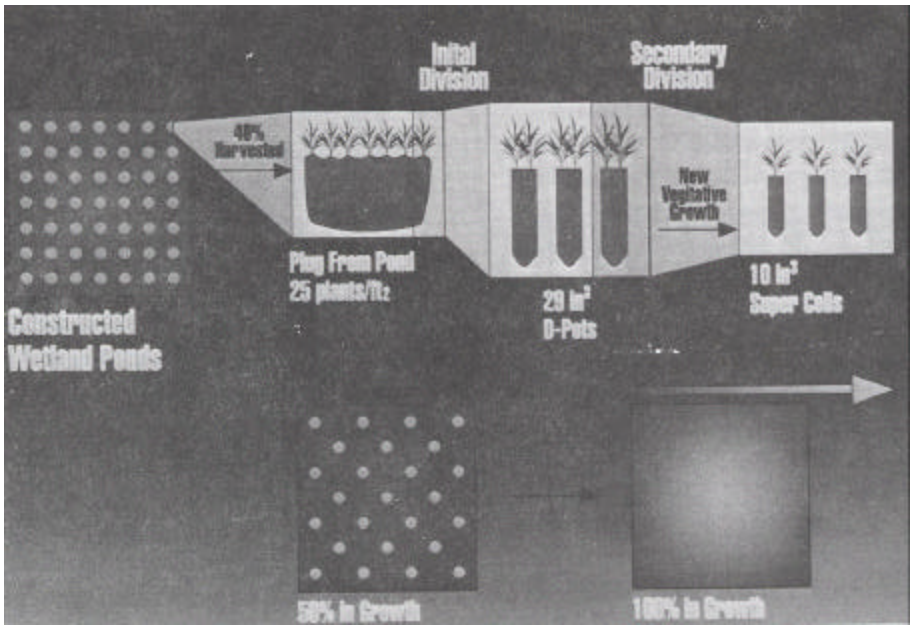

Figure 2 - Harvesting 40 percent of pond surface area for vegetative starts. Several growth periods and splitting of new material produced in tubes to increase the yield. Pond area recovers and is available for future harvests and seed collection.

- Managing the water levels in the ponds is very important for culturing different species. Our experience and information supplied by the Aberdeen PMC indicates that the optimal water level for *Carex rostrata* is at the soil surface, for *Carex nebraskaensis,* it is 1-2 inches above the soil surface, and for *Juncus balticus,* if 1-2 inches below the soil surface. Growth reductions occurred in these species under different water levels.
- Harvesting plants from dense, wet stands in heavy soils is difficult. We are currently evaluating several tools to ease this process.
- Labor costs can account for a large portion of the cost of wetland plant production. Field collection, transplanting, and plug division all require many worker hours. Any methods which may save labor dollars should be considered. The construction of a wetland on nursery grounds allows on-site collection of plants, thus reducing overall production costs.
- The potential exists to produce wetland plants from seed. Seed propagation has several advantages lower field collection costs, less required growing area; and no requirement for a constructed wetland. Obstacles to seed propagation include lack of knowledge on pre-germination treatments, and seed storage viability, and limited availability of local seed sources. Lone Peak's seed research as been concentrated on the propagation of *Scirpus acutis* and *Scirpus maritimus.* Initial plans called for planting *Scirpus acutis* in one constructed wetland pond. After working with this species it was apparent that vegetative propagation was not practical due to its large size. We are currently exchanging information on pre-germination seed treatments for wetland species with the SCS Aberdeen Plant Materials Center (PMC). Many treatments and stratifications have been tested with variable results.

NEED FOR MORE GROWING AREA

The demand for wetland plants for reclamation projects has exceeded our current vegetative production capabilities. Wetlands have been incorporated into agricultural, urban and industrial planning. Mitigation and conservation uses of wetlands for water development projects have created a demand for reasonably priced wetland plants.

Lone Peak State Nursery's existing greenhouse is partly utilized to grow wetland plugs after "division" and grow *Scirpus* spp. from seed. Additional greenhouse space is needed for future wetland plant production as we convert to the use of seed

germinants. A closed greenhouse irrigation system will allow the monitoring of nutrient uptake of individual plant species. Conversion of Lone Peak's existing wetland ponds to seed production has the advantage of providing a known seed source of single species. The ponds can continue to be a component for water treatment of our existing greenhouse and non-point pollution sources.

TRANSFER OF TECHNOLOGY

The production of wetland plants is a newly emerging aspect of the nursery field. Lone Peak State Nursery has been fortunate to receive assistance for this project from many agencies including the USDA Soil Conservation Service, USDA Forest Service, Nevada Division of Forestry, Utah Power Corporation, and the Utah Department of Agriculture. The constructed wetland project was developed to produce salable plants and develop practical propagation techniques. The resulting information and technology may be used by other public and private growers to address wetland production needs. Lone Peak State Nursery could supply plantlets or seed from our constructed wetland for private nursery propagation.

Many unknowns still exist in propagating wetland plants vegetatively and from seed. Development of seed collection, processing, and germination techniques may yield more economical production methods. Our wetland plant production will continue to be a cooperative project among federal, state, and private organizations.

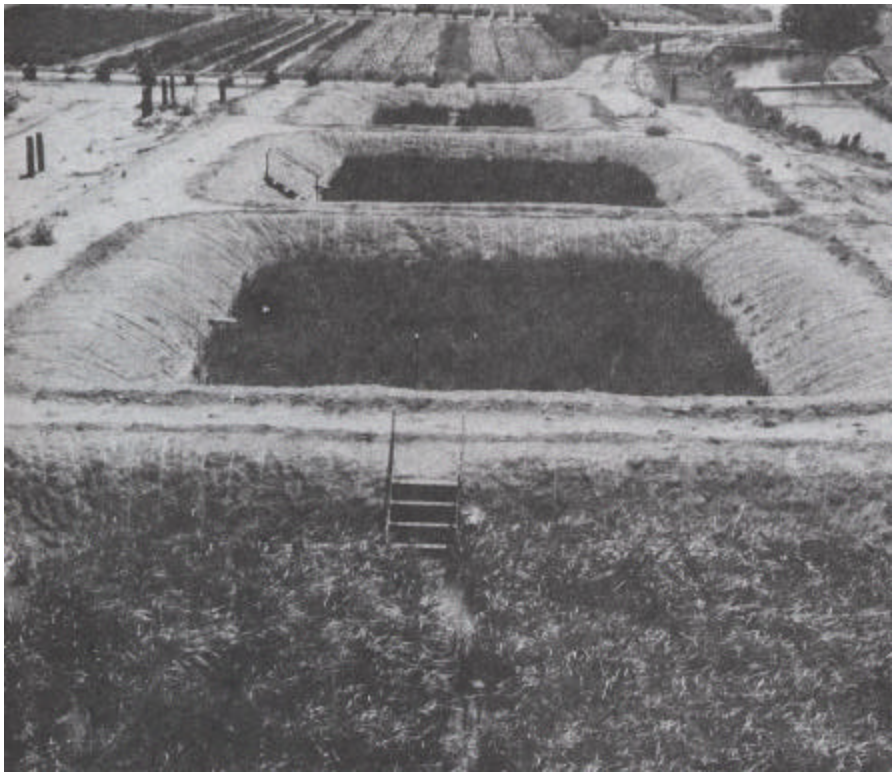

Figure 3 - Pond in foreground contained *Carex rostrata* after six months of ingrowth

For more information contact:

Glenn Beagle, Coordinator
Lone Peak State Forest Nursery
801-571-0900

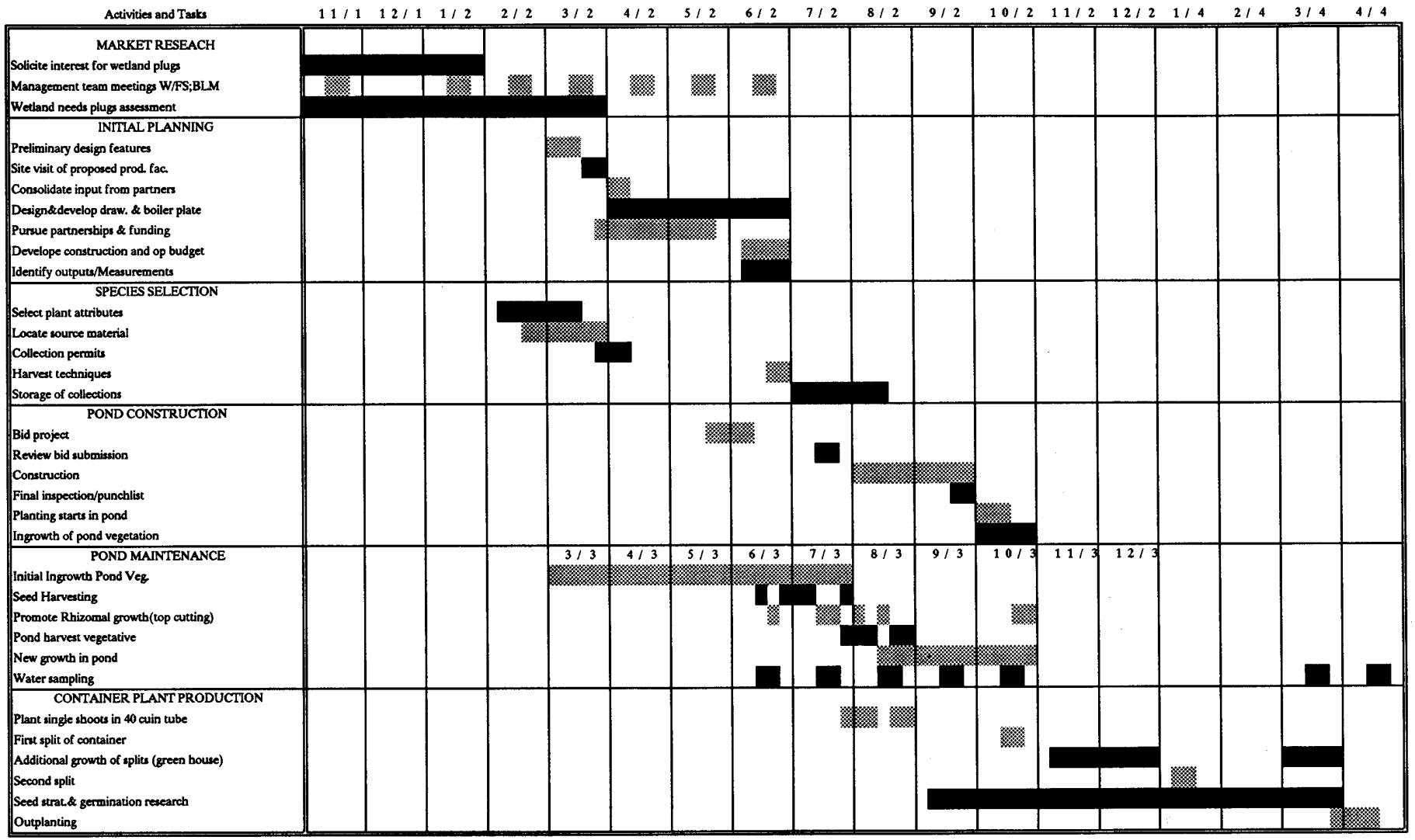

Figure 4 - Chart displaying project activities with a time line from the eleventh month of year one through the fourth month of year four