Center for Urban Horticulture
Children's Garden

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Selection and Management of Landscape Plants
EHUF 480

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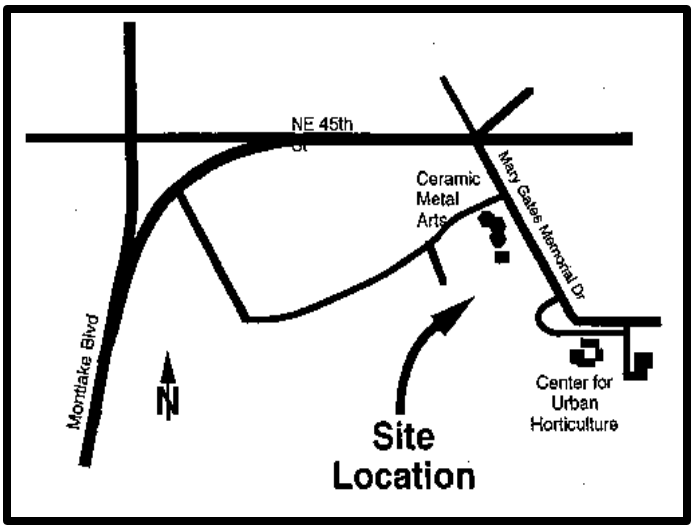
Site Analysis

History of site

Up until the early 1900's our site, the Soundscape Garden, was covered by lake water from Lake Washington. In 1917, the ship canal was built in order to connect Lake Washington and Lake Union and as a result, the lake's water level dropped 11 feet and drained the area of our site as well as all of the Union Bay Natural Area and Center for Urban Horticulture. Beginning in 1926, the City of Seattle and the University of Washington used the newly exposed lake bottom as a dumpsite for soil taken from construction sites and possibly household waste (). The dumpsite was closed in 1965 and then finally capped with three feet of silty clay in 1971 (University of Washington Montlake Fill Oversight Committee, 2002). The area was graded; topsoil was imported and laid onto the clay cap. Today our site is currently being used as a Soundscape Garden.



The Soundscape Garden is located along Mary Gates Memorial Drive between the University of Washington's Center for Urban Horticulture (CUH) to the south and the Ceramic Metal Arts building to the North. The garden was established in 1992 and was named 'Soundscape' in order to reference an ecologically 'sound' landscape. Soundscape Garden was originally an experimental demonstration garden with various turf grass plots. Each plot had different watering and organic amendment regimes. A mixture of compost from the Cedar Grove Composting Facility combined with native soil were used to grow an array of trees, shrubs, ground cover and two turf plots (CUH, date unknown). A control was used on one of the turf plots that contained only native soil and no compost in order to compare the Cedar Grove compost

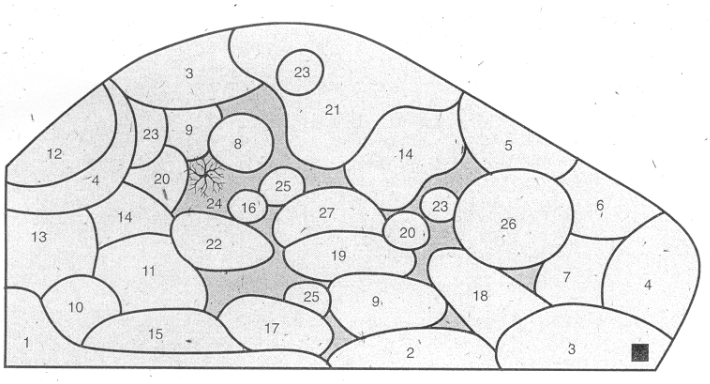
products. The Soundscape Garden was irrigated with recycled gray water for a period of approximately two years with a tank truck. The Cooperative Extension WSU was originally involved in the studies at the site, and stayed involved in the project for approximately 5 years. The intent of Soundscape Garden was also to demonstrate water saving techniques for home gardens (Brenton, 1997). The compost demonstration garden articulated visual differences that visitors would observe regarding plants grown under different soil conditions.

The Soundscape Garden is comprised of three general viewing areas: 1) Lawn Plot Exhibit (A1-A4 and B1-B4), 2) Perimeter Lawn Areas (L1 –L4) and 3) Ornamental Planting Areas (G1-G4) (see appendix I. Soundscape Site Plan). The Lawn Plot exhibit demonstrated the importance of soil amendments. The Perimeter Lawn Areas and Ornamental Planting Areas demonstrated the importance of utilizing various water irrigation techniques

Existing Vegetation

G1. Groundcover Garden

All vegetation in the G1 bed will remain intact as requested by our client Fred Hoyt. See Appendix II: Soundscape Garden Existing Vegetation for a larger version of the planting beds).

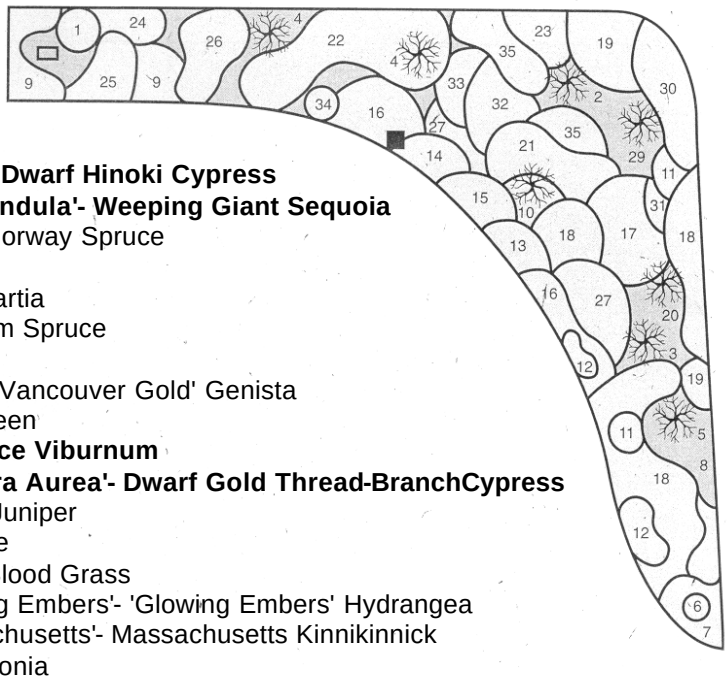


1. Potentilla nepalensis 'Wilmottiae' – 'Miss Willmott' Potentila
2. Thymus pseudolanuginosus 'Archer's Gold' – 'Archer's Gold' Thyme
3. *Fragaria chiloensis* – Wild Strawberry
4. *Rubus calycinoides* 'Emerald Carpet' – 'Emerald Carpet' Rubus
5. Lithodora diffusa 'Grace Ward' – 'Grace Ward' Lithodora
6. Festuca ovina glauca 'Elijah Blue' – 'Elijah Blue' Blue Fescue

7. *Lavandula angustifolia* – English Lavender
8. *Artemisia* 'Powis Castle' – 'Powis Castle' Artemisia
9. *Geranium cantabrigiense* 'Biokovo' – Biokovo' Geranium
10. *Scabiosa cauasia* 'Butterfly Blue' – Pincusshion Flower
11. *Teucrium chamaedrys* – Germander
12. *Ajuga reptans* – Ajuga
13. *Potentilla verna nana* – Spring Cinquefoil
14. *Heuchera sanguinea* ' Mt. St. Helens' – 'Mt. St. Helens' Heuchera
15. *Anagallis monelli* 'Pacific Blue' – 'Pacific Blue' Pimpernell
16. *Laurentia fluvatilis* – Blue Star Creeper
17. *Rosmarinus officinalis* – Rosemary
18. *Armeria maritime* 'Laucheana' – 'Laucheana' Armeria
19. *Helianthemum nummularium* – Sunrose
20. *Sedum telephium* 'Autumn Joy' – Autumn Joy' Sedum
21. *Arctostaphylos uva-ursi* 'Vancouver Jade' – 'Vancouver Jade 'Kinnikinnick
22. *Arabis caucassia* 'Variegata' – Variegated Rockcross –
23. Phalararis arundinaccea 'Picta' – 'Picta' Ribbon Grass
24. Magnolia grandiflora – Southern Magnolia
25. *Pennisetum alopecuroides* 'Little Bunny' – 'Little Bunny' Fountain Grass
26. Gaultheria shallon – Salal
27. *Hemerocallis* 'Stella d'Oro' – Daylily

G2 Mixed Garden

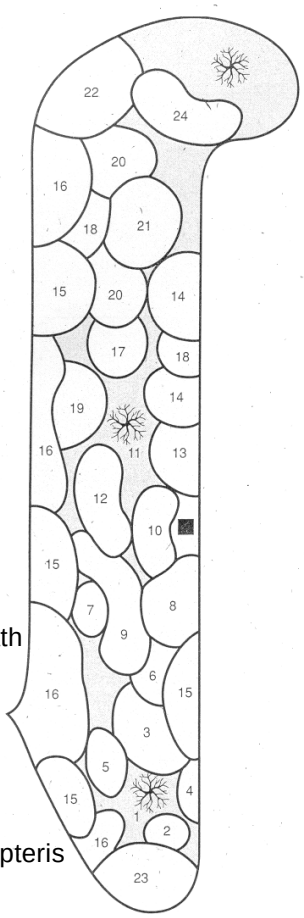
Our group intends to keep the highlighted species below and disperse more of the same species throughout the site in order to create a unifying theme:



1. *Chamaecyparis obtuse* 'Nana'- Dwarf Hinoki Cypress
2. *Sequoiadendron giganteum* 'Pendula'- Weeping Giant Sequoia
3. *Picea abies 'Pendula'*- Weeping Norway Spruce
4. *Acer circinatum*- Vine Maple
5. *Stewartia monodelpha*- Tall Stewartia
6. *Picea abies* 'Little Gem'- Little Gem Spruce
7. *Thymus vulgaris*- Red Thyme
8. *Genista pilosa* Vancouver Gold'- 'Vancouver Gold' Genista
9. *Gaultheria procumbens*- Wintergreen
10. *Viburnum carlesii*- Korean Spice Viburnum
11. *Chameacyparis pisifera* 'Filifera Aurea'- Dwarf Gold Thread-BranchCypress
12. *Juniperus squamata*- Blue Star Juniper
13. *Carex morrowii*- Japanese Sedge
14. *Imperata cylindrical*- Japanese Blood Grass
15. *Hydrangea macrophylla* "Glowing Embers'- 'Glowing Embers' Hydrangea
16. *Arctostaphylos uva- ursi* 'Massachusetts'- Massachusetts Kinnikinnick
17. *Mahonia nervosa*- Longleaf Mahonia
18. *Enkianthus campanulatus*- Enkianthus
19. *Rhododendron jacksonii*- Jackson Rhododendron
20. *Viburnum davidii*- Davidii Viburnum
21. *Euonymus alata* 'Compacta'- Dwarf Winged Euonymus
22. *Nandina domestica* 'Moyers Red'- Moyers Red Nandina
23. *Llex crenata* 'Aurora'- 'Aurora' Japanese Holly
24. *Oenothera*- Yellow Evening Primrose

25. *Campanula persicifolia*- Peach-leafed Campanula
26. *Mahonia repens*- Creeping Mahonia
27. *Pinus aristata*- Bristlecone Pine
28. *Fragaria frel* 'Pink Panda'- 'Pink Panda' Strawberry
29. *Hemerocallis*- Daylily
30. *Llex crenata* 'Glory'- 'Glory' Japanese Holly
31. *Hibiscus syriacus*- Rose of Sharon
32. *Potentilla verna nana*- Spring Cinquefoil
33. *Rubus calycinoides*- Rubus

G3 Mixed Garden



1. *Cotinus obovatus* – American Smoke Tree
2. *Hibiscus* 'Lord Baltimore' – 'Lord Baltimore' Hibiscus
3. *Berberis thungbergii* 'Aurea' – Golder Barberry
4. *Gaultheria procumbens* – Wintergreen
5. *Hebe pinguifolia* 'Pagei' Hege
6. ª *Buddleia davidii* 'Pink Charming' – 'Pink Charming' Butterfly Bush
7. *Abelia grandiflora* 'Edward Goucher' – Edward Goucher' Abelia
8. *Viburnum plicatum tomentosum* 'Mariesii' – Mariesii Viburnum
9. *Fothergilla gardenia* 'Blue Mist' – 'Blue Mist' Fothergilla
10. *Escallonia* 'Red Elf' – 'Red Elf' Escallonia
11. *Styrax japonicus* – Japonese Snowdrop Tree
12. *Abies balsamea* 'Nana' – Dwarf Balsam Fir
13. *Berberis thunbergii* 'Rose Glow' – 'Rose Glow' Barberry
14. *Weigela florida* 'Minuet' – 'Minuet' Weigela
15. *Rubus calycinoides* 'Emerald Carpet' – 'Emerald Carpet' Rubus
16. *Erica* – Heather
    Erica cinera 'Purple Beauty' – 'Purple Beauty' Heath
    Erica carnea 'Springwood Pink' – Springwood Pink' Heath
    Erica darleyensis 'Mediterranean White' –'Mediterranean White' Heath
17. ª *Buddleia davidii* 'Nanho Purple' – 'Nanho Purple' Butterfly Bush
18. **Enkianthus campanulatus* 'Red Bells' – 'Red Bells' Enkianthus
19. *Pieris japonica* 'Mountain Fire' – 'Mountain Fire' Pieris
20. *Viburnum tinus* 'Spring Bouquet' – 'Spring Bouquet' Viburnum
21. *Nandina domestica* – Heavenly Bamboo
22. *Spiraea bumalda* 'Goldflame' – 'Goldflame' Spiraea
23. *Caryopteris clandonensis* 'Longwood Blue'- 'Longwood Blue' Caryopteris
24. *Corylopsis pauciflora* – corylopsis
25. *Potentilla nepalensis* 'Wilmottiae' – 'Miss Willmott' Potentila
26. *Thymus pseudolanuginosus* 'Archer's Gold' – 'Archer's Gold' Thyme
27. *Fragaria chiloensis* – Wild Strawberry
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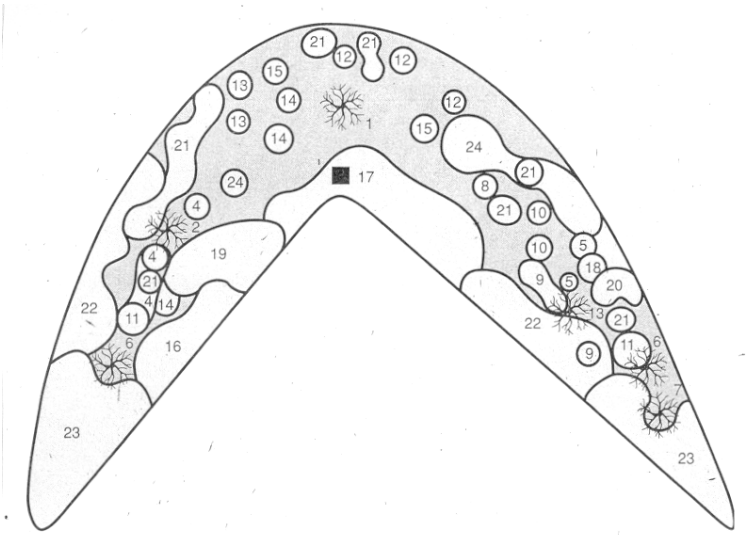
49. *Pennisetum alopecuroides* 'Little Bunny' – 'Little Bunny' Fountain Grass
50. *Gaultheria shallon* – Salal
51. *Hemerocallis* 'Stella d'Oro' – Daylily

G4 Native Garden



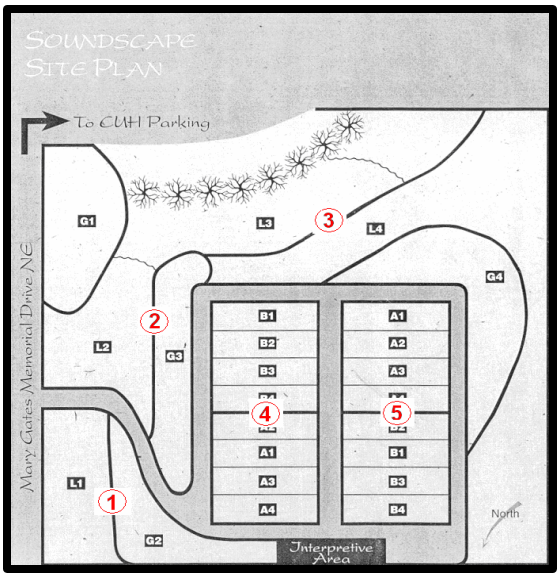
1. *Pinus contorta*- Shore Pine
2. *Acer glabrum*- Rocky Mountain Maple
3. *Betula papyrifera*- Paper Birch
4. *Ribes sanguineum* 'King Edward VII'- 'King Edward VII' Red Flowering Currant*
5. *Holodiscus discolor*- Ocean Spray
6. *Prunus virginiana*- Chokecherry
7. *Amerlanchier alnifolia* 'Honeywood'- 'Honeywood' Amelanchier*
8. *Acer circinatum*- Vine Maple
9. *Vaccinium ovatum* – Evergreen Huckleberry
10. *Crataegus douglasii*- Black Hawthorn
11. *Viburnum trilobum*- Cranberry Bush
12. *Lonicera involucrate*- Bearberry Honeysuckle
13. *Corylus cornuta californica*- Western Hazelnut
14. *Rosa woodsii*- Wood Rose
15. *Rosa nutkana*- Nootka Rose
16. *Fragaria chiloensis*- Wild Strawberry
17. *Cornus canadensis*- Bunchberry
18. *Vaccinium parvifolium*- Red Huckleberry
19. *Penstemon rupicolal*-Beard Tongue
20. *Aruncus diosus*- Common Goat's Beard
21. *Spiraea betufolia*- Shiny Spiraea
22. *Gaultheria shallon*- Salal
23. *Arctostaphylos uva-ursi Massachusetts'*-'Massachusetts' Kinnikinnick
24. *Mahonia repens*- Creeping Mahonia

** This species has been removed or replaced*

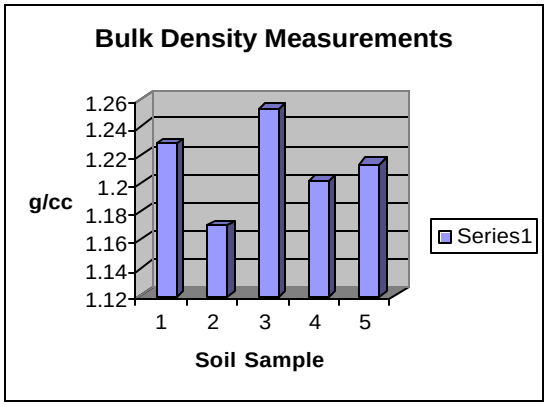
[a] *This species is known to spread invasively by seed*

Soils

The physical condition of a site's soil is a very important factor in facilitating plant health. Some of the key elements that soils provide for plants are physical support, temperature buffer, moisture moderator and supplier of essential nutrients. Due to the importance of soil health, our group collected five soil samples in January 2004 from distinct locations as indicated on the soil site map. The samples are labeled in red listed 1 through 5. The samples were then sent to the University of Massachusetts in Amherst to be tested for various soil properties such as macronutrient levels, pH and cation exchange capacity to name a few.

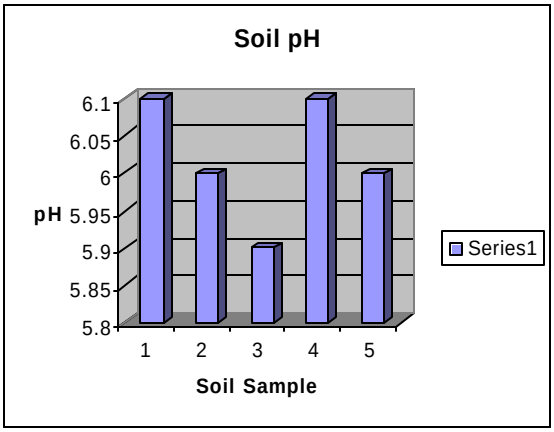


***Bulk Density*:** Bulk density measurements specify the amount of pore space to solids in a soil. The higher proportion of pore space to solids then the lower the bulk density. A lower bulk density translates into a less compacted soil. Thus, the lower the bulk density the more pore space for moisture and air to flow in the soil and is easily accessible to plant roots. Furthermore, a compacted soil inhibits infiltration and the permeability of the soil is decreased which can ultimately result in an increase in soil erosion and a decrease in soil moisture content. All five soil samples had low bulk densities for a silty clay textured soil. The graph illustrates the differences in bulk density measurements among our

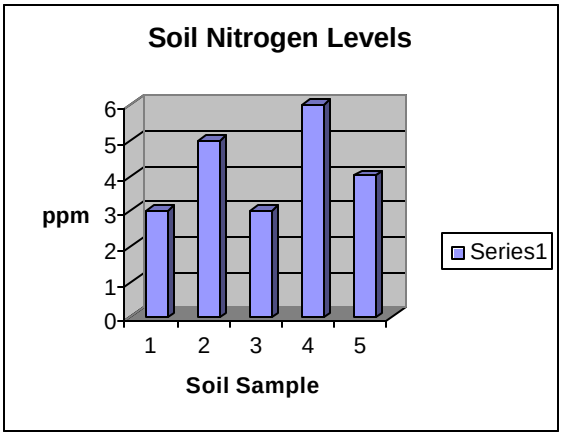


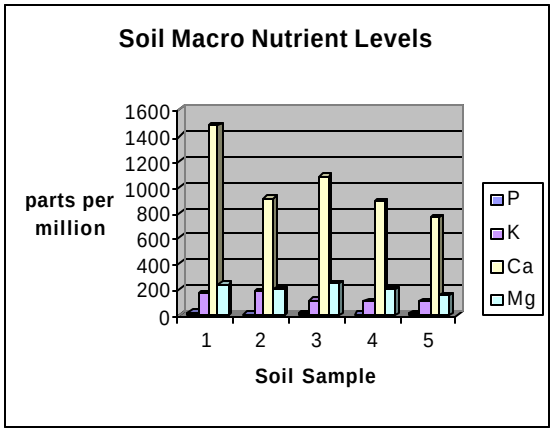
soil samples throughout our site. Samples 4 and 5 were most similar probably because they were taken from similar areas on the site. Sample 3 is the highest which may possibly be due to foot traffic.

***pH*:** The measure of a soil's acidity, pH, is an important soil consideration because pH is a primary growth factor for plant health. A soil's pH largely determines what nutrients are available to the plants. For example, if a soil has a very low pH, toxic levels of macronutrients such as aluminum, manganese and hydrogen as well as deficient macronutrient levels of calcium and phosphorus may occur (Brady, 2004). If an adequate pH can be maintained in the soil then soil nutrients will be at their maximum availability and important soil organisms will be most vigorous (University of Massachusetts, 2004). The pH of our five soil samples was moderately acidic and ranged between 5.9 and 6.1. Our pH measurements fall within the 5.5 to 6.5 pH range that will generally provide the most satisfactory amount of plant nutrients in the soil (Brady, 2004).



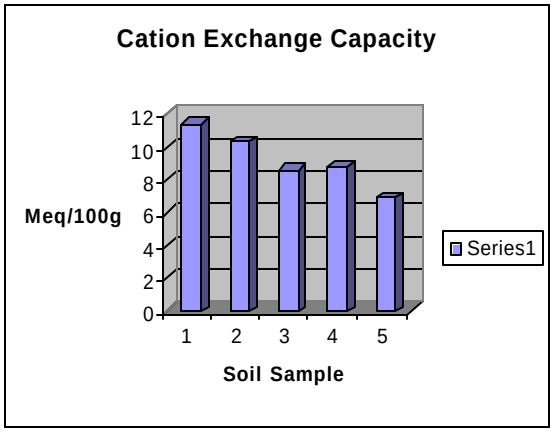
***Nutrients*:** The macronutrients measured in the soil analysis from UMass were Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca) and Magnesium (Mg). Nitrogen, an essential nutrient for plant health, is mainly supplied inorganically by nitrate and ammonium that plant roots take up (Marschner, 1995). Phosphorus is a vital element in plant growth that plays a critical role in the processes of photosynthesis, nitrogen fixation, flowering, fruiting, and maturation (Brady, 2004). According to the University of





Massachusetts soil analysis report, plants cannot live without Phosphorus and if a soil is deficient then vegetative growth will become impaired, roots will weaken and seeds and fruit will be of poor quality and produce a low yield. Potassium is important for helping plants to adapt to different environmental stresses such as drought tolerance, winter hardiness and better resistance to disease and insects (Brady, 2004). Calcium is a critical nutrient in order for plant's cell walls and membranes to function properly. And lastly, similar to Phosphorus, Magnesium works to power plant metabolism. The nutrient availability is relatively constant between our five samples throughout the site. Calcium by far has the highest nutrient levels present on the site. Magnesium and Potassium have the next highest nutrient amounts on the site ranging from medium to high levels ppm. Phosphorus and nitrogen have the lowest presence on the site.

***Cation Exchange Capacity*:** Cation Exchange Capacity (CEC) quantifies a soil's ability to maintain and supply nutrients such as Potassium, Calcium and Magnesium. Cation exchange occurs through the replacement of nutrient cations that reside on the root hairs of plants by hydrogen ions. As a result, the nutrient cations are then forced into the soil where they can be taken up by other root surfaces or washed away by soil water (Brady, 2004). The availability of these nutrients plays a large role in the uptake of these nutrients by plants. Across our five soil samples the CEC varied from 6.9 to 11.4 Meq/100g. Soils that are very rich in organic matter have exceedingly high CEC's that reach 40



and higher. However, a CEC that ranges from 10 to 15 is recorded as being typical as well as adequate in most soils (UMass, 2004). Three of our five soil samples did not reach high enough into the 10-15 CEC bracket which may be due to the lack of organic matter in our soils.

***Significant Soil Problems*:** In the Lawn Plot Exhibits at the Soundscape Garden, five soil problems have been observed. First, there is an unacceptable level of soil compaction of the site soil which thereby restricts the amount of water that newly established plants can consume (Brady, N.C. and Weil, R.R., 2002). Topsoil appears to have been applied over compacted clay loam soil, resulting in a perched water table (Craul, page 173, 1999; Harris et al., page 147, 2004). Additionally, water infiltrates the porous, loose topsoil on our site but is unable to infiltrate the compacted clay loam soil layer below and as a result the topsoil remains water-saturated. Lastly, due to prolonged poor drainage, the soil structure may not develop or may in fact deteriorate (Craul, page 173, 1999). Thus, a water-saturated soil looses oxygen from macropores and produces an oxygen deficiency in which (Kramer, page 166, 1983) plants will wilt (Arkin and Taylor, page 153, 1981), root penetration will be limited by a high water table (Craul, page 173, 1999), and plants can be more vulnerable for certain plant diseases (Craul, page 228, 1992). If prolonged for more than a few days, these unfavorable soil conditions will eventually compromise plant health and weaken the plants; ultimately causing a mortality spiral.

Hydrology Analysis

Existing hydrological conditions at Soundscape Garden are variable; soil texture is non-homogeneous in the Lawn Plot Exhibit (A1-A4 and B1-B4, see map in "site history") and the entire Soundscape Garden is underlain with a clay loam soil. This underlying soil is compacted and water saturated during the winter months (Brenton, 1997). In the Lawn Plot Exhibit there is a variety of soil types because the plots were originally set up to demonstrate the advantages of soil amendments as earlier stated. These plots are poorly drained because of the

underlying clay soil and the soil structure due to disturbance or manipulation appears to have contributed to soil compaction and the subsequent poor drainage conditions. In contrast, the Perimeter Lawn Areas (L1 –L4) and the Ornamental Planting Areas (G1-G4) are relatively well drained.

Site Proposal

Design Process

The Soundscape Garden is situated between the University of Washington Center for Urban Horticulture, the Laurelhurst community, and the Union Bay Natural Area. Therefore the design must fit into this context and serve the needs of the neighborhood as well as those of the university. Two meetings were conducted with Fred Hoyt, Manager of Forest Resources at the Center for Urban Horticulture. Mr. Hoyt reiterated the need for the garden to fit the neighborhood. In addition to this basic design requirement, Mr. Hoyt expressed that the garden should serve as a venue for environmental education and a play space for the children in the community, children enrolled at the Union Bay Childcare Center, and teens working with Seattle Youth Garden Works. Environmental site conditions gathered during the site analysis were considered in the grading and shaping of garden spaces and the plant selection process.

Design Narrative

With the above considerations in mind, the new design for the Soundscape Garden attempts to offer an enjoyable space for children from one to ninety-nine years of age. Interactive learning can occur throughout the garden through visual, tactile and audible experiences with nature and entertaining cause and effect features.

Design Proposal

To understand this section, it is helpful to refer to the site plan (see appendix III. Children's Garden Site Plan). From the street, the new design for the Soundscape Garden will look like any other small public park, with the exception of a whimsical kinetic sculpture and tile pavers decorated by local children at its entrance. The sculpture will move with the wind, however, children will also be able to operate the sculpture with a hand-operated crank. The faster they turn the crank, the faster the sculpture will spin. Down the garden path to the north, the tiles start to change to recycled glass tiles and another area opens to the right of the path. This space will be paved with recycled glass tiles to look like a disco floor. Lights under the tiles will be activated by motion or pressure sensors. This light sequence can be used to play games such as hopscotch, twister, concentration, or to simply dance. A bridge crosses a swale, which drains water from the site to the canal and ultimately to Lake Washington. Continuing along the path, the next garden feature that one will come to is a *Pinus strobus 'Pendula'*. This is to be trained as a tunnel entrance to a circular room of *Acer rubrum 'Columnare'*. The Acers will provide an intimate space amongst the trees, but remain visually permeable so parents can continue to watch their children. The path continues on to a covered seating area, which sits at the highest point in the garden at the top of a grass knoll. From this point, most of the garden will be visible. The path forms a loop, which will take visitors back to the entrance of the garden. At the base of the knoll, children will find the lily pad area, a water play area. Here children will activate several concrete frogs to squirt water from their mouths by jumping on pavers. While the garden has been designed with young children in mind, grown-ups will find the park a fun and interesting area to visit as well.

Hardscape Elements

The hardscape elements in the new Soundscape Garden are few, but will add greatly to a visitor's experience. The main hardscape elements include various path systems, a kinetic sculpture, disco floor, bridges and covered seating.

Pathways: The path systems will consist of a combination of informal gravel paths and more formal paths that utilize eco – paver technology to create a sustainable design. The pathway entering into the garden will consist of standard 3-1/8 x 9" x 4-1/2" eco-pavers which we will encourage the local daycare and elementary school children to decorate and paint before installation. This will immediately provide visitors with the impression that the theme of the garden is centered on children as well as present a very inviting atmosphere.

Kinetic Sculpture: Also located at the center of the entryway is a kinetic sculpture which will invite children to actively interact with it. The moving metal parts will be built in such a way to encourage children to hit and bang them together in order to achieve different auditory effects.

Disco floor: Moving on the pathway to the north, the eco-pavers slowly begin to change form into a new paving system in which translucent colored pavers will be intertwined. The pavers will have a pressure sensitive lighting system from underneath which will make the pavers light up when stepped on. This disco floor can lead to a variety of activities including hop-scotch, dancing, and other random games.

Bridges**:** Three bridges will be located onsite which will allow for easy crossing of the swale area. The two northern bridges will be standard 10’ x 4’ flat bridges with no hand rails. The construction of these can consist of two beams running lengthwise and having horizontal planks covering the top. The third bridge is a suspension bridge that will be located to the south. This bridge will encourage children to stand and shake it. This not only will act as a functional element for crossing the swale, but also as a play structure. A hand rail will need to be included on this bridge at a lower height in order to accommodate the use of children.

***Seating*:** The covered seating structure doubles as an elevated play structure for children as they are able to climb steps on either side to gain perspective over the entire site. The roof will double as the floor for the upper level and will be constructed out of a clear plastic so that the floor is visually permeable from above and below. This structure will also allow children to get up into the canopy of the surrounding trees and see the foliage up close.

Plant Selection

The Soundscape Garden was designed for children in the neighborhood, and as a result, certain considerations were important in the plant selection. Poisonous plants and plants with thorns were eliminated from consideration. Trees, which would develop large scaffold branches that children could climb upon, were also avoided. Plants, which have interesting or unusual plant parts, such as peeling bark and samuras on maples were used. Overall, however, plant selection did not focus solely on the interests of children. Aesthetics and site conditions also played a major role in which plants were chosen for the garden.

Children's Garden Safety

Gardens can be a place of enchantment, adventure, learning and fun for children; but a garden can also be a place of hidden dangers and a scene for accidents to happen if safety precautions are not taken (Bryan, 1986). Precautions to consider when constructing a children's garden are to protect the children from such dangers associated with trees that can be accessed and climbed, standing water in ponds, garden tools left unattended, power mowers and trimmers, pesticides, stinging and biting insects and poisonous plants.

Children can slip away from adult companions in an instant; if there is a potential hazard nearby a child seems to instinctively hone in on it. Children enjoy climbing trees; water holds a strong attraction for them - construction of sites, containing standing water of any kind. Pools and ponds should be avoided or

effectively barricaded in children's gardens. A small child can get into trouble in merely inches of water (Bryan, 1986).

Garden tools are a potential hazard for children (MacLatchie, 1977). When children are present, garden tools should be used with the utmost care (Bryan, 1986) and not be left lying around (MacLatchie, 1977). When gardening, tools must be moved from one site to another, and not be left unguarded - tools can be lethal to children. Lawnmowers, shears, weed pullers and trimmers are among the most dangerous tools for children to be around. Rocks hidden in the grass must be removed before the lawn is mowed to prevent stones from being thrown out by the blades (Bryan, 1986); gasoline is poisonous and should be safely stored away from where children can gain access to it. Even the mower itself while turned off can be dangerous. The mower engine's muffler can become very hot and produce burns on inquisitive children. Before moving from one site to another, gardeners must move their tools with them to keep them away from young children. It would safer, if possible to maintain the garden during times when children are not on site.

All garden chemicals have warning labels, but labeling is not an effective safety precaution for children. If possible, chemical application of pesticides should be avoided in children's gardens. A common danger for children is the ingestion of harmful gardening substances (MacLatchie, 1977). This potential danger may be eliminated in children's gardens by incorporating integrated pest management practices to substitute for chemical pesticide application. Gardens can be adequately maintained by hand and the utilization of some integrated pest management techniques. Insect pests may be adequately controlled in many gardens by the introduction of predaceous insects such as the ladybird beetles, praying mantis and lacewing flies. Weeds can be effectively managed by incorporating ground covers and mulches into the landscape.

Insects and arachnids that are merely annoying to adults can present real health problems for children. Wasps, bees, centipedes, certain garden spiders and ants can severely harm children. Bee stings can make a child ill, especially if the child is allergic to bee venom (MacLatchie, 1977).

Some plants produce chemicals to protect themselves from predation; and many of the chemicals are poisonous to children. Great care must be taken to insure that poisonous plants are never installed in children's gardens. Children, especially small children explore their world by putting things into their mouths. Children love picking berries off shrubs and placing them into their mouths and that is where the danger lies (Bryan, 1986). The castor plant is grown as an ornamental; but both the seeds and foliage of young seedlings are deadly poisonous (MacLatchie, 1977). Oleander is a beautiful flowering evergreen shrub; commonly utilized as a barrier hedge – and all parts from this plant are extremely poisonous (MacLatchie, 1977). Care must be taken that one avoids installing plants that produce enticing and dangerous berries. Plants such as laburnum, monkshood or arum lilies are beautiful, but these plants can be lethal to small children (Bryan, 1986). Great care must be taken by landscape architects, garden designers and gardeners when creating and constructing children's gardens. There are many beautiful and poisonous plants that must be identified and avoided. Gertrude Jekyll, was a very well known and respected gardening expert and artist during the late 1800's and early 1900's; and yet, in her book, Children and Gardens (on page 99), she describes the many beautiful flowers growing in her first garden and writes that "the cool face of the bank was a grand place for ferns, Foxgloves, Primroses and Columbines." Foxgloves and Columbines –are plants that are both beautiful and poisonous.

Here is a list taken from Byron, 1986, of some common plants that may be found in gardens that could prove to be dangerous to children.

- Common Monkshood (*Aconitum napellus*).
- Fools Parsley (*Aethusa cynapium*).
- Belladonna Lily (*Amarylis belladonna*).

- Columbine (*Aquilegia*).
- Arum Lily (*Arum maculatum*).
- Deadly Nightshade (*Atropa belladonna*).
- Autumn Crocus (*Colchicum*).
- Hemlock (*Conium maclatum*).
- Lily of the Valley (*Convallaria majalis*).
- Mezereon (*daphne mezereum*)
- Foxglove (*Digitalis purpurea*).
- Spindle Tree (*Euonymus europaeus*).
- Spurge (*Euphorbia*).
- Hellebore (*Helleborus*).
- Golden Rain (*Laburrnum*).
- Honeysuckle (*Lonicera*).
- Oleander (*Nerium olenander*).
- Solomon's Seal (*Polygonatum*).
- Rue (*Ruta*).
- Woody Nightshade (*Solanum dulcamara*)
- Yew (*Taxus baccata*).
- Mistletoe (*Viscum album*).

Installation

Site Preparation

Plant Salvage: Proper measures are to be taken in preserving the existing G1 planting bed. During plant removal and grading of this site, the G1 bed is to be fenced off to prevent trampling of the plants or compaction by workers and equipment. Similar fencing techniques are to be used on the row of Sweet Gum trees lining the entrance road to the Urban Horticulture building as well as the mature Liquid Amber tree onsite. After examining all existing plant species in the existing G2 planting bed, a list was made of plants to be saved and or retained and moved. Plants to be retained are as follows; Chamaecyparis obtuse 'Nana', Sequoiadendron giganteum 'Pendula', Acer circinatum, Viburnum cartesii, Chameacyparis pisifera, Enkianthus campanulatus, Rhododendron jacksonii, Euonymus alata 'Compacta', Pinus aristata. The plants will be removed from the present beds and stored on site in a moist soil or sawdust berm for the duration of the site work and then replaced when groundwork preparation allows

reinstallation of plant material. Plants should be well-protected to minimize loss - the plants are badly stressed as is.

Fortunately, this site is void of problematic invasive plant species which would require extensive remediation techniques to eliminate. Removal of existing plant species should be very straightforward. Plant material that we intend to remove can be donated or sold to local organizations in order to raise further funds for the new implementation of garden features. Due to the flat topography of this site, slope stabilization techniques such as live staking, contour wattling, or brush layering will not need to be used. The natural root structures of the installed vegetation will stabilize the soil quite well.

All woody plant material scheduled for removal is to be recycled and used as a wood-chip mulch to help new and existing vegetation establish itself by supplying various beneficial nutrients to the plant roots.

***Structure Demolition and Removal*:** The existing wood covered structure on-site is to be taken down and removed. The fact that this structure is tilting and twisting is evidence that there has been significant movement within the soil. Most likely the foundation was not adequate and this should be a reminder for the new covered structure that the foundation needs to be prepared correctly and compacted enough to allow for a safe environment.

***Grading and Drainage*:** The existing drainage swales are to be used and expanded upon, supplying a physical distinction between usable spaces within this garden which will be emphasized with vegetation differences. These swales are the low points of the site which will collect all rain runoff from the planting beds, paths, and grass areas. The swales will eliminate the need for underground drainage piping or other structural elements. In this way, the removal of water can become a visual teaching tool for children, making them aware of the water runoff issue in the northwest.

The soil removed from the drainage swales will be used on-site as the foundation for the raised mounds on the northwest side of the site which house the lawn areas and covered seating structure. In this way, the cut and fill can be utilized, eliminating the problem of soil removal. New soil will have to be brought in throughout the site as needed for plant health reasons or to reach desired grade.

The covered seating structure will need structural support in the sub-grade. A simple concrete foundation is to be laid at the base of all vertical structural supports to insure stability of users above and below the platform. No other sub-grade support is required.

***Irrigation*:** An irrigation system will be needed to during the summer and fall months to provide enough water for the grass and planting beds to remain healthy in their early years of growth. Once the plants have established themselves, they can be slowly weaned off the water until they adapt to the site conditions. Figuring a 30' diameter of each irrigation head and subtracting out the swale areas, 15-20 heads would be needed.

***Site Drainage Conditions*:** Prior to mechanical modification of site soil and in order conduct a thorough job of soil preparation and site management, we would recommend the investigation of the following five elements: (1) topography, to reveal slope, hydrography and potential drainage outlets; (2) a soil map, to reveal soil drainage classes, (3) a vegetative study on a nearby, undisturbed site, to indicate soil drainage conditions; (4) on-site permeability and percolation tests, and (5) installation of peziometers (Craul, page 181, 1999). We recommend the installation of the proper number of drainage systems to eliminate ponding, prevent prolonged water-saturation, and to accelerate water flow to an outlet with the minimum of erosion (Craul, page 181, 1999). Drainage can be accomplished by swales, a French drain (permanent stone filled trench), or buried drain pipes. Drainage pipes (we recommend the use of subsurface pipes), can be installed

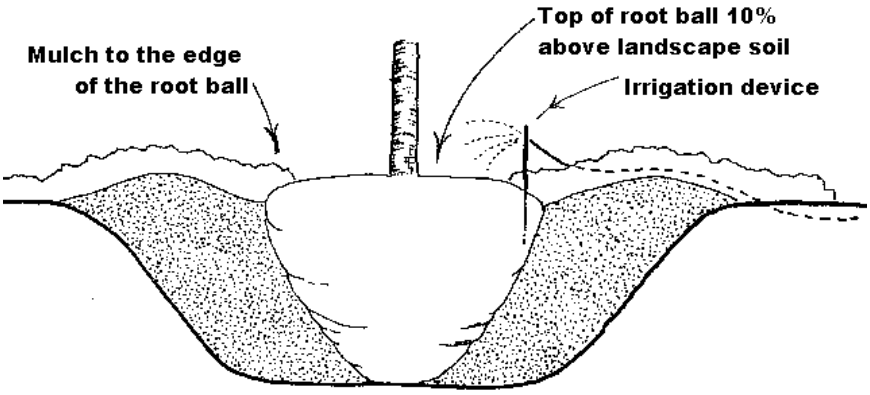
perpendicular to site contours, to collect the water and remove it from the site (Craul, page 183, 1999). We recommend the installation of the correct number of subsurface drains; thus removing excess water and thereby lowering site water table (Craul, page 185, 1999). Vertical Drains can be installed to drain water from a perched water table to a better drained soil below the perched water table (Craul, page 185, 1999). Interception drains may help to alleviate water-saturated soils. A buried gravel-filled pipe is installed perpendicular to the source flow and transports the water to a disposal site. In our site, the excess water can be collected from the building and drained toward the sidewalk, where the collection drain carries it to a suitable drainage collection outlet.

***Soil*:** For the renovation of this site, we recommend the implementation of three principals to improve soil drainage (Craul, page 175, 1999). These three principals include: a collection system that utilizes small channels, ditches, swales, and buried pipe to allow water to flow from the site; a disposal system that utilizes large channels or pipes to carry water to outlets; and an outlet which is the end point of the drainage system that may be an existing stream or a culvert. It is necessary to improve the internal drainage of this site soil. Compacted soil must be thoroughly broken up with deep ripping prior to final grade (Harris*, et al*., page 145, (2004). We recommend deep soil ripping, or utilization of a slip plow to dig through the compacted soil layer in order to auger through the impervious soil layer and then install internal drains (Arkin and Taylor, page 77, 1981; Harris*, et al*., page 147, (2004). Site work should consist of draining the water from the area by means of ditches and pipes, and collect the water via a collection drain that will allow the water to drain into an outlet.

Plant Installation Specifications

Once the site has been properly prepped the planting process can begin. The first step is to dig a hole. If any bark or other form of mulch has been placed on top of the soil, scrape this off before digging the hole. The hole should be one to one and a half times wider than the container or root ball. Be sure to retain the

soil that has been removed from the hole, it will be used to backfill around the plant later on. Next, the plant can be removed from the container or burlap surrounding the root ball. The root ball should be loosened by hand to allow the roots room to grow. If excessive root circling is found, these roots should be trimmed to eliminate circling roots from affecting new root growth. Now that the plant is ready it can be placed into the planting hole. No amendments should be placed in the hole. With the plant placed in the hole, the top of the soil surrounding the plant must be even with or slightly higher than the existing soil; if the hole is too deep, place soil under the plant; if the hole is not deep enough, remove the plant and dig the hole deeper. Once the plant is at the appropriate level, the hole should be backfilled with the soil that was removed from the hole. As soil is placed back into the hole, compact the soil slightly to remove excessive air pockets which can result in settling. Do not over compact the hole by stomping on the backfilled soil. After the soil has been replaced and is even with the surrounding ground, mulch should be placed around the plant. The mulch should only be placed up to the edge of the root ball. Be sure to leave open space around the trunk of the plant to reduce the chance of pathogen attack. This mulch layer should be at least three to four inches in depth. Lastly, the plant and surrounding soil should be watered. For the next couple days check the plant to make sure that the plant has not fallen over or is in need of watering. If the plant has moved, remove the plant and replant following the instructions above. If the soil around the plant is dry, add water accordingly. When these steps are followed, the death rate of new plantings should be minimized.



Aftercare and Maintenance

Plant Watering

The watering regime should be kept to a minimum because of the previously installed efficient irrigation system. However upon installation, the system needs to be adjusted and modified to ensure that the site is being watered appropriately for the plants that have been installed. During this time, spot watering may be required to counteract any problems with the irrigation system. After the plants have been installed, the site should be checked every couple days depending on climate conditions to ensure all the plants have sufficient water. If the soil is excessively dry or plants are showing signs of water stress by wilting, watering should be immediately applied to the offending plants. After the irrigation system has been adjusted, the site should be regularly monitored to ensure that the irrigation system is working properly. The irrigation system should not be solely relied on for site watering. If climatic conditions are unexpectedly bad, such as extended periods of hot weather without rain, the site may need to be watered in addition to the irrigation systems watering schedule. The same goes for the opposite case where the temperatures are cold and there is excessive rain. In this case the irrigation system can be changed to skip a watering to prevent excessive watering of the plants.

Plant Nutrition

Based upon the soil sample analysis preformed at the site no nutrient amendments will need to be added. However, this does not mean that particular plant species will not need their nutrient levels adjusted. Such species as the ericaceae family like acidic soil conditions. If any nutrient deficiencies are observed on any plant, nutrients should be added to correct for the deficiencies observed. After the first two to three years a nitrogen fertilizer should be applied to the site based upon manufacture recommendations. A nitrogen fertilizer regime should be created to add nitrogen every two to three years to replenish the nitrogen lost from weeding and leaf removal. Care should be taken to only

add nutrients when they are required due to the proximity to swales which could potentially carry any fertilizers into the nearby Union Bay.

Mulch

Based upon the design of the children's garden a wood chip mulch (2-3 inch wood chips) should be applied in at least a 3-4 inch layer to promote adequate weed control. Six inches of mulch would be desirable due to the high level of activity that will be occurring on the site. Due to the high traffic environment of the garden, frequent spreading or applying additional mulch may be required depending on the level of usage. A finer mulch such as chips or shreds is less desirable due to the ease with which it can be spread out of the designated area. Once mulch has been moved into an undesired area, the ease with which it can be removed decreases with a finer mulch. As the area gets used, children or animals may dig or scrape away the mulch causing the ground to be exposed. As the mulch degrades over time, more should be applied to keep at least a 3-4 inch layer at all times

Weeding

If a 3-4 inch layer of mulch has been successfully applied to the entire site, minimal weeding will be required. However, a thick mulch layer will not indefinitely keep all the weeds out of the site. A regular weeding regime should be implemented. At least once a month a crew should maintain the site by removing any visible weeds. Also this is an excellent time to monitor the site for any problems that may be occurring. If any plants have died they should also be removed. If an area has excessive weeds or the time between weeding visits needs to be extended, more mulch should be applied to further reduce the ability of weeds germinating and successfully growing on the site.

Pruning

Pruning should be done on an individual plant basis. However, a pruning regime should not be necessary for 2-3 years due to the age of the installed plants. If a

plant is growing too large for the available room, pruning or even removal may be required. Also dead branches should be pruned out when observed not only for plant health reasons but also for safety concerns. Proper pruning techniques should always be followed.

Insecticide/Herbicide/Fungicide

The plants at the site should be frequently monitored for any pest damage. If any plants are being damaged or infected with a pest, a countermeasure should be used to eliminate the pest. Once the pest has been identified, a book such as the 2003 PNW Plant Disease Management Handbook should be consulted for the proper applications of chemical insecticide, herbicide and fungicide. All insecticide/herbicide/fungicide applications must be done in accordance to manufacture specifications for application. However, the site manager reserves the discretion to remove a plant if it is deemed too expensive or unfeasible to apply the proper countermeasure. Herbicide usage must be limited to path or trail sections where manual weeding is too expensive and time consuming to eliminate weeds. As with the fertilizer application, great care should be taken to only apply insecticide/herbicide/fungicide in an appropriate manner when it is required due to the close proximity to swales which could potentially carry any insecticide/herbicide/fungicide into the nearby Union Bay. Also, any spray applications should be applied with care as to not allow any 'drifting' of the applied insecticide/herbicide/fungicide into the Union Bay Natural Area.

Integrated Pest Management

Integrated Pest Management (IPM) controls plant pests: horticultural insects, weeds and plant pathogens in an environmentally sensitive way (IPM, 2002). The IPM approach is an acceptable method to employ for the control of plant pests in a children's garden. The IPM approach utilizes plant monitoring to establish threshold levels of insect or pathogen damage to plants before control methods are implemented. The importance of IPM is controlling plant pests, not eliminating plant pests. Four methods can be employed for IPM: cultural,

mechanical, biological, and chemical methods may be effectively used to control plant pests in a children's garden. These methods may used individually or concomitantly. Pacific Northwest Landscape Management reported that it was possible to reduce pesticide application usage in a landscape by 50% to 90% without a noticeable reduction in plant quality (IPM, 2002). Four general control methods that can be well-utilized in children's gardens are cultural, biological, mechanical and chemical control.

Cultural Control: involves manipulating the environment to control pests. For example, begin a landscape project by selecting plants that are well adapted to a particular site (IPM, 2002). Plant rouging is an effective tool to minimize pest problems in a landscape (IPM, 2002). If one has a problem with a particular plant in a landscape, for example the particular plant is susceptible to a pathogen and is difficult to remedy. Don't spend an inordinate time in rectifying the problem - pull the plant out and select another plant that is more resistant. This will save a great deal of time and minimize the dependency of chemical pesticides.

Select plants that are healthy, and resistant to disease. If you are restricted to a site that has chronically wet, poorly drained soil and your landscape plans calls for the installation of rhododendrons – by all means – plant rhododendron cultivars that are bred for wet, slow warming soils.

By judicial and selective use of irrigation, one may minimize disease problems in the landscape garden. Sprinklers will adequately deliver water to plants, but with the constant wetting of the plant leaves, it may encourage tree growth of pathogens such as bacteria and fungi. Therefore, it is recommended that irrigation systems utilize drip irrigation versus sprinkler irrigation systems. If sprinkler irrigation is all that one has in the landscape and must be utilized, then align the sprinkler so that excessive water is not sprayed onto the plant foliage. Ideally sprinkler systems should be operative during the early hours of the day

rather than the late afternoon; earlier irrigations will allow for quick-drying of plant leaves during the day thus minimizing the development of pathogens.

In order to accomplish a successful IPM program for a children's garden, one must consider and implement five important principles: 1) Identification of landscape plants; 2) determining any plant problems; 3) understanding the landscape's ecosystem; 4) optimizing plant health; and 5) incorporating an IPM program (IPM, 2002).

Biological Control: involves the utilization of living organisms to control plant pests (IPM, 2002). Three effective strategies may be employed in three general biological controls: conservation, augmentation and introduction (IPM, 2002).

> ***1. Conservation:*** utilizes biological organisms that are already present in the environment to protect plants. For example, the bacterial insecticide *Bacillus thuringiensis* may be used to kill caterpillars and beetles (IPM, 2002).
>
> ***2. Augmentation:*** utilizes the introduction of predatory biological organisms to augment or restore a population. Insects such as green lacewings can be used to control aphids; predatory mites can be used to control spider mites; insect eating nematodes can also be used for biological control (IPM, 2002). Praying mantises and ladybird beetles have been used for many years to control destructive insects in landscapes. A side benefit for a children's garden would be the introduction of the ladybird beetles. Not only are they beautiful insects to observe, but they are harmless to children and when present in large numbers, present a spectacular and captivating visual experience for kids.

3. Introduction: utilizes government programs to use insects as a control method for pests such as weeds. The cinnabar moth has been effectively used to control the noxious weed, the tansy ragwort (IPM, 2002).

Mechanical Control: utilizes such methods as physical removal of insects from plant leaves. Washing plant pests from leaves instead of spraying with chemical pesticides and pruning out infested areas of the plants that have been colonized by plant pests (such as tent caterpillars) can be done rather than spraying with chemical pesticides. One may put up mechanical barriers to keep slugs and snails out of the landscape (IPM, 2002) in which case granular chemical pesticides can be avoided, chemical costs are reduced and visiting children are protected against the potential hazards of the pesticides.

Chemical Control: utilizes the selection of what some people call an "earth friendly" pesticide; meaning a pesticide that will adequately accomplish the job, but not excessively so. Pesticide selection is based on using the least toxic chemical pesticide that will do the job. Also, for chemical pesticides to work most efficiently one must use "the window of opportunity" to kill the plant pest during its most vulnerable time. For example, spraying the herbicide ROUNDUP® on weeds is much more effective when the application is sprayed on weeds that are young and rapidly growing as opposed to spraying them when the weeds have matured, slowed down their growth, set seeds and hardened off.

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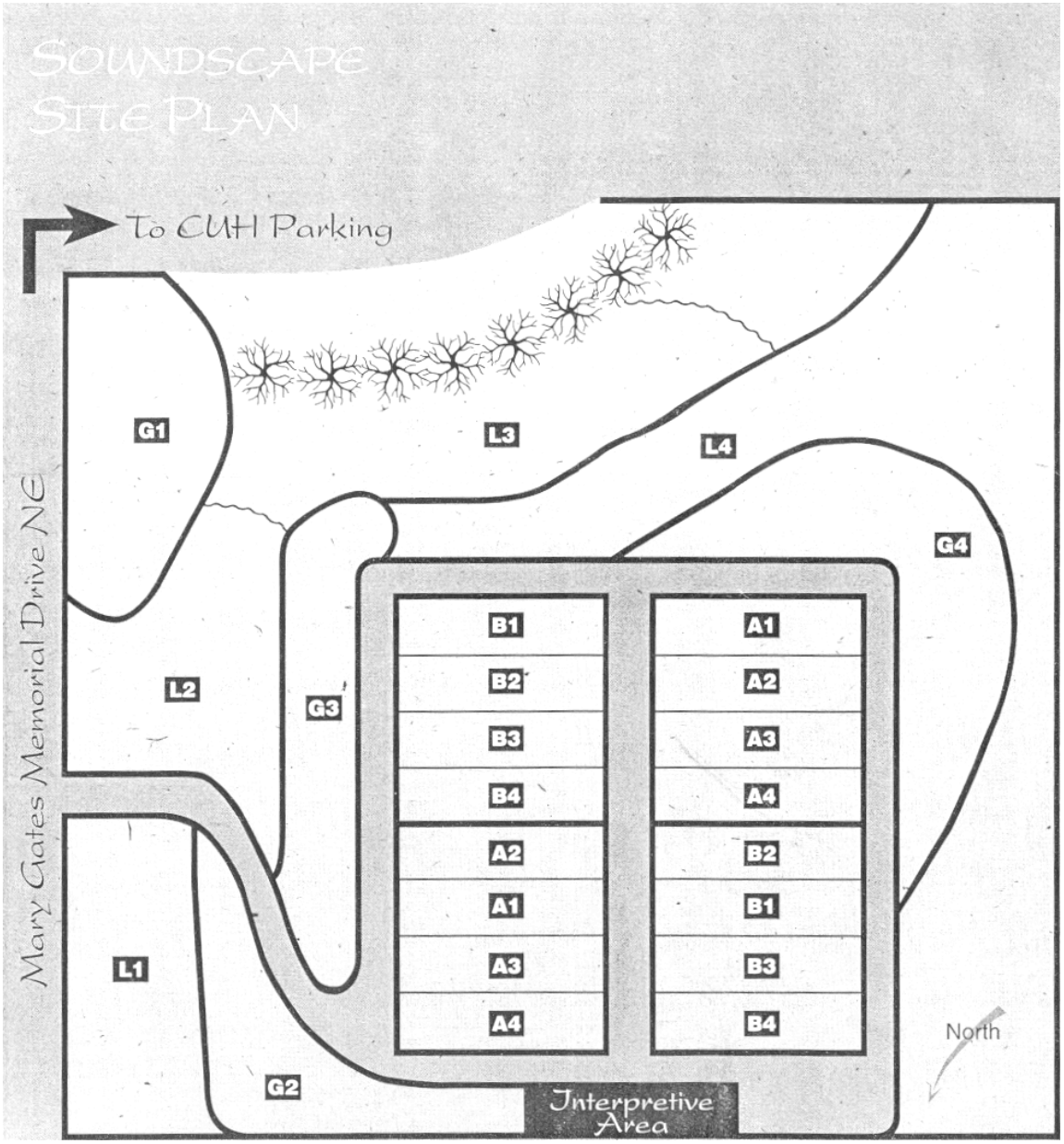
Appendices

1) Soundscape Site Plan

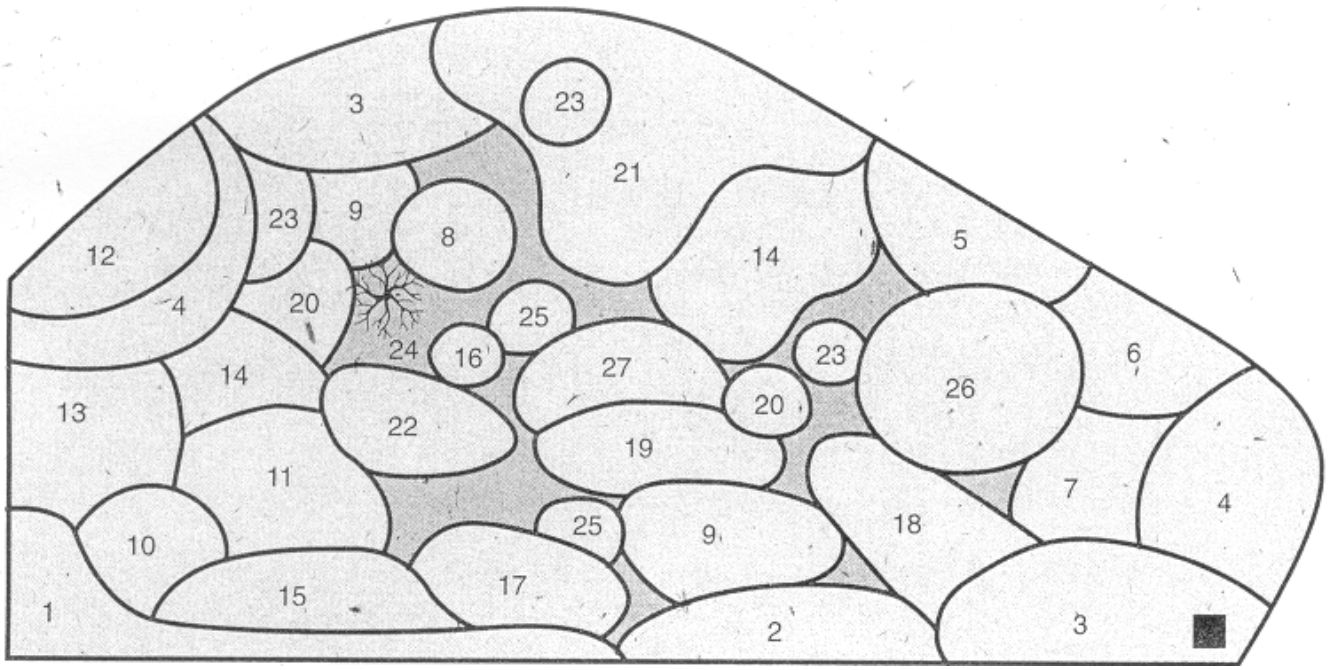


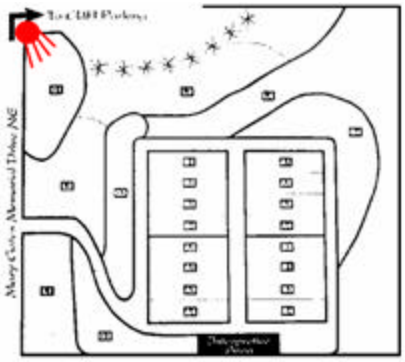
Lawn Plot Exhibits

A. Lawn Plots were watered according to **Schedule A*** (beginning spring, 1997).
B. Lawn Plots were watered according to **Schedule B*** (beginning spring, 1997).
1. **Untilled** – Untilled soil covered with two inches of a 'five-way soil mix.'
2. **GroCo** – Two inches of 'Groco' tilled into 6 inches of soil.
3. **Cedar Grove** – 2 inches of 'Cedar Grove' compost tilled into 6 inches of soil.
4. **Topsoil** – Two inches of natural sandy loam topsoil tilled into the soil, and then covered with 4 inches of topsoil.

2) Soundscape Garden Plants

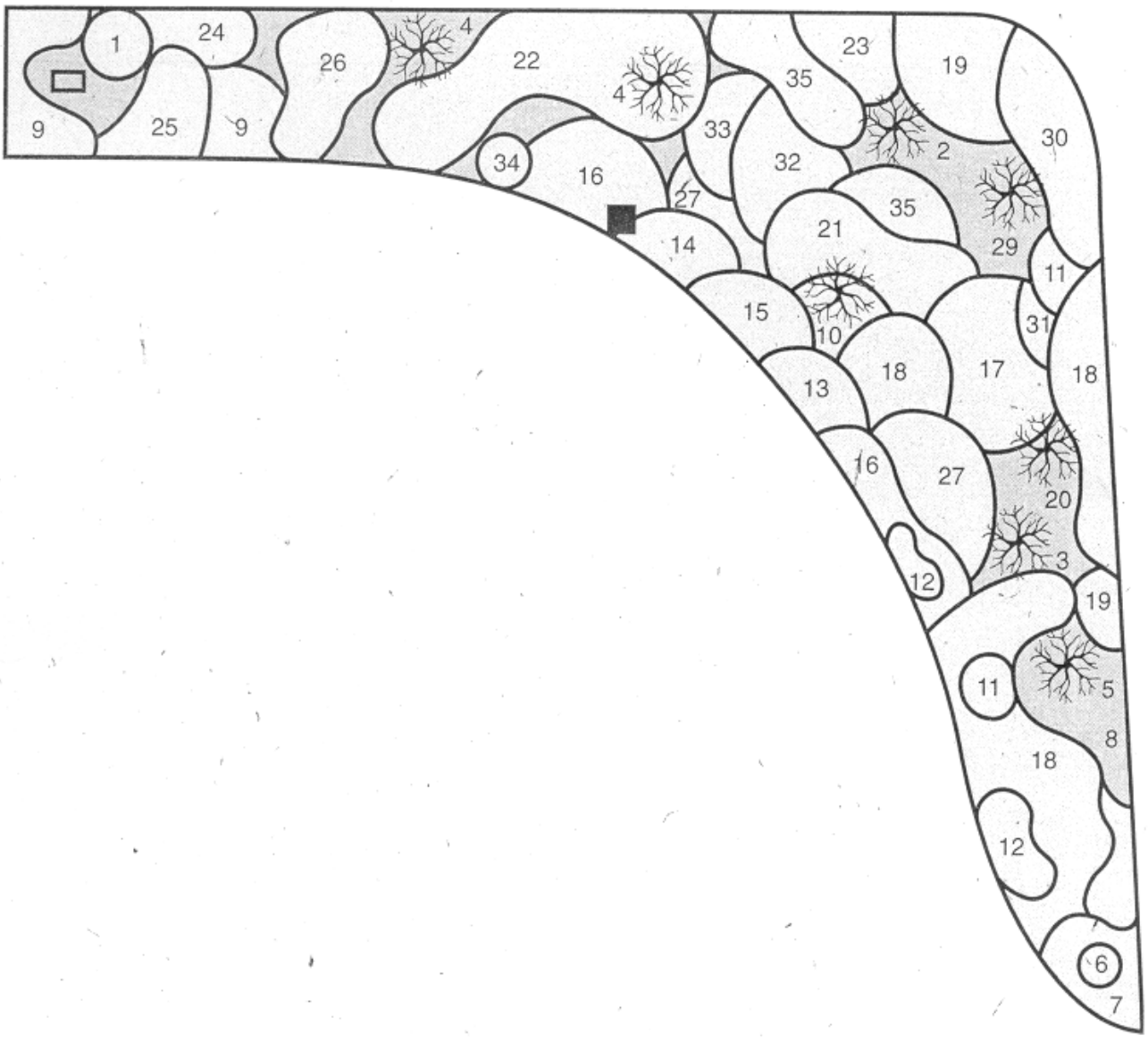
G1: Groundcover Garden – sponsored by King County Master Gardeners.

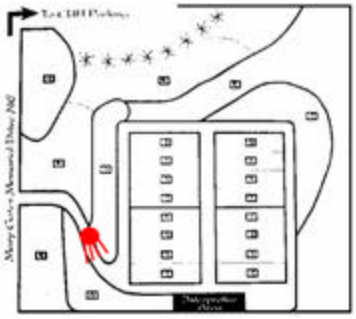




Picture of G1- This Photo was taken from the southeast corner looking towards the northwest as depicted in the map on the left

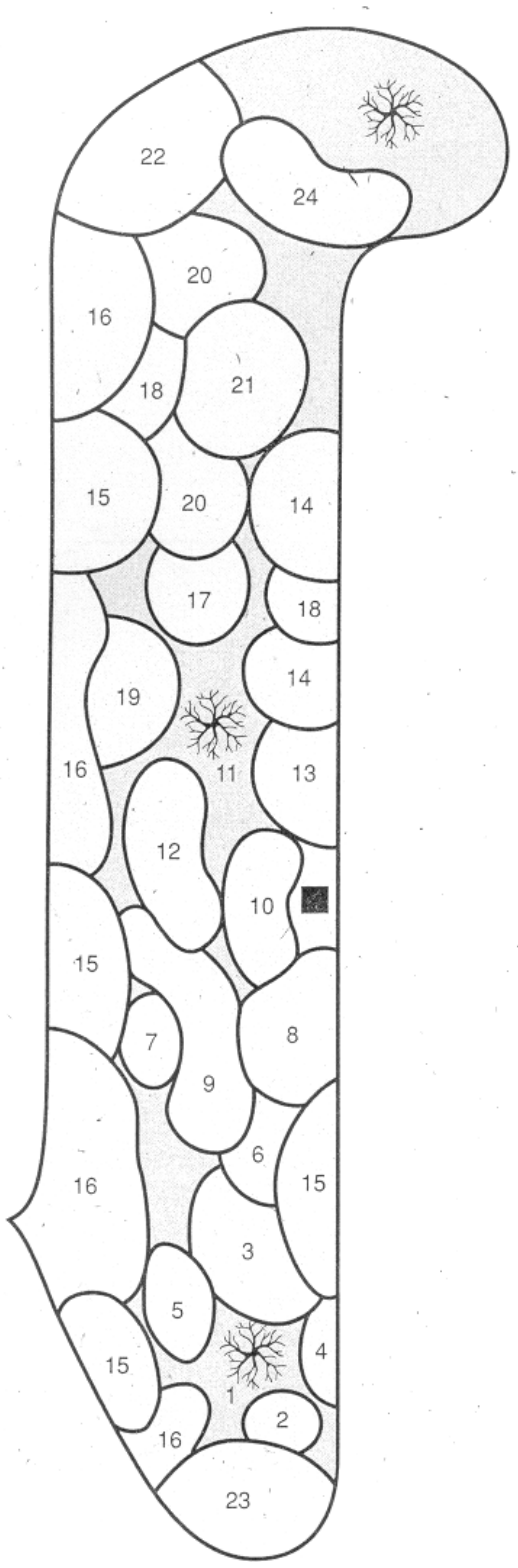
G2. Mixed Garden – sponsored by Washington State Nursery and Landscape Association (WSNLA).

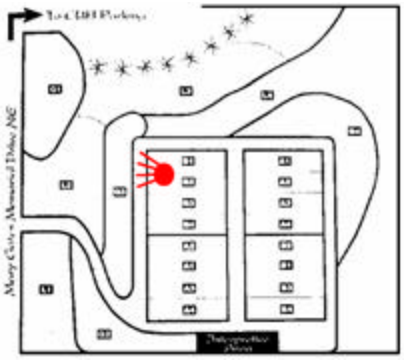




Picture of G2- This photo was taken on the pathway in front of G2 looking towards the north as depicted in the map to the left.

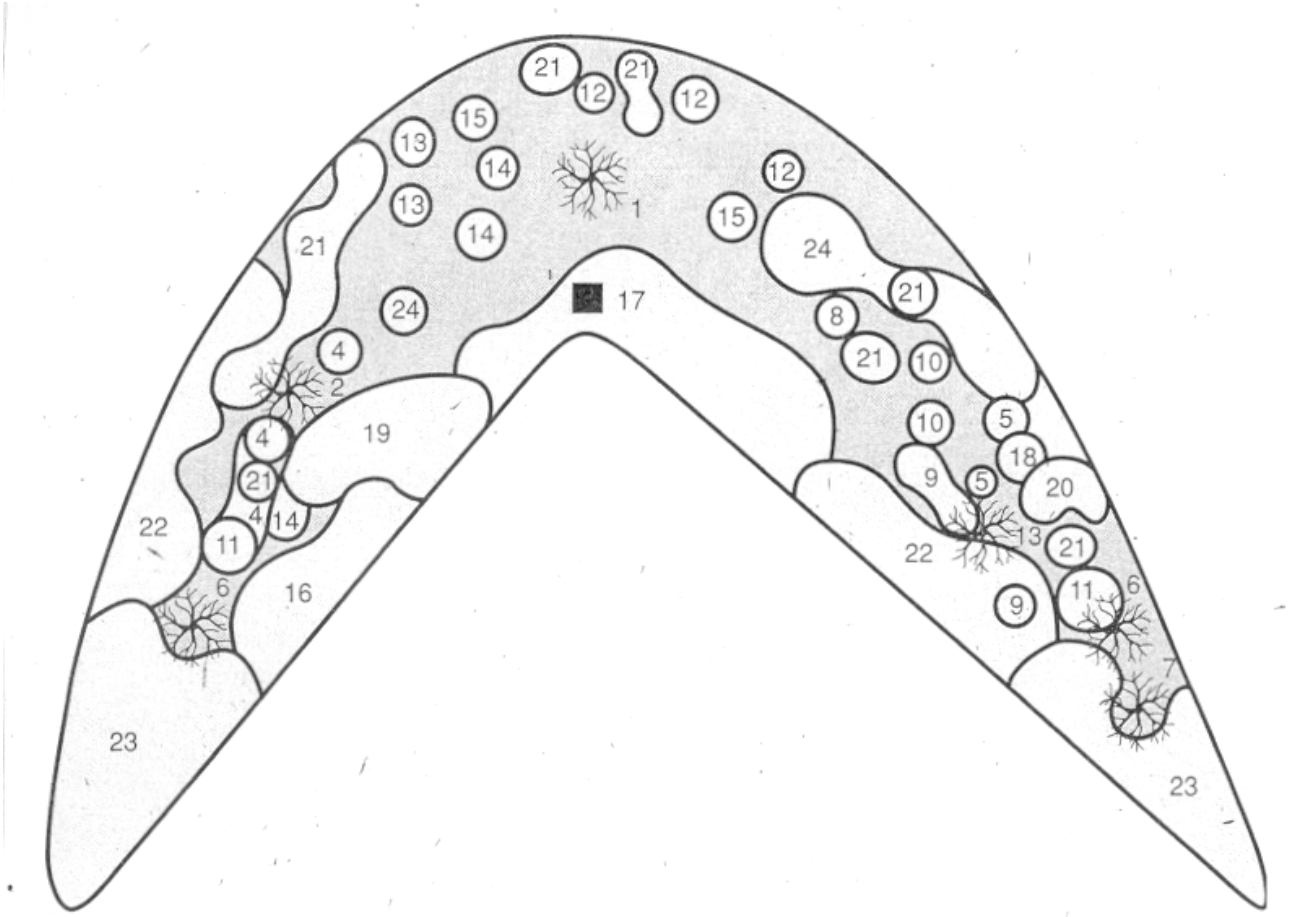
G3. Mixed Garden – sponsored by Washington State Nursery and Landscape Association (WSNLA).

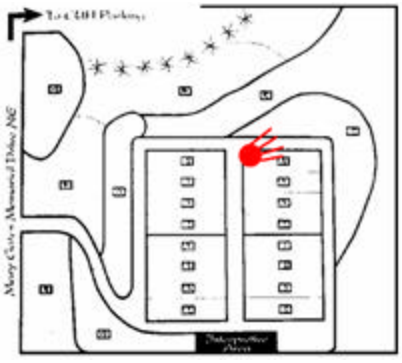




Picture of G3- This photo was taken on the east turf section looking towards the east as depicted in the map to the left.

G4. Native Garden – sponsored by the Association for Women in Landscaping (AWL





Picture of G4- This photo was taken on the path between the turf sections looking towards the west as depicted in the map to the left.

3) Children's Garden Site Plan

4) Plant Schedule

PLANT SCHEDULE

SYMBOL	SYM	QTY	BOTANICAL NAME	COMMON NAME	SIZE	REMARKS
			TREES			
	–	3	ACER GRISEUM	PAPERBARK MAPLE	8'	B & B
	–	5	ACER RUBRUM 'COLUMNARE'	COLUMNARE RED MAPLE	2" CAL.	B & B
	–	4	CERCIDIPHYLLUM JAPONICUM	KATSURA TREE	2" CAL.	B & B
	–	3	CERSIS CANADENSIS 'FOREST PANSY'	FOREST PANSY REDBUD	14–16'	B & B
	–	1	HAMAMELIS MOLLIS 'PALLIDA'	WITCH HAZEL	2" CAL.	B & B
	–	1	LIQUIDAMBAR STYRACIFLUA	AMERICAN SWEETGUM	8'	B & B
	–	1	PINUS ARISTATA	BRISTLECONE PINE	2" CAL.	B & B
	–	3	PINUS CONTORTA	STONE PINE	8'	B & B, 8' O.C.
	–	1	PINUS STROBUS 'PENDULUS'	WEEPING WHITE PINE	8'	B & B, 10' O.C.
			SHRUBS			
	–	37	CORNUS STOLONIFERA	RED-OSIER DOGWOOD	18–24"	2 GALLON
	–	8	EUONYMUS ALATUS 'COMPACTUS'	BURNING BUSH	18–24"	2 GALLON
	–	6	GARRYA ELLIPTICA	SILK TASSEL BUSH	18–24"	2 GALLON
	–	6	NANDINA DOMESTICA	FALSE BAMBOO	18–24"	2 GALLON
	–	5	OSMANTHUS DELAVAYI	DELAVAY OSMANTHUS	18–24"	2 GALLON
	–	16	RHODODENDRON 'BLUE DIAMOND'	DWARF BLUE RHODY	18–24"	2 GALLON
	–	5	RIBES SENQUINEUM	RED FLOWERING CURRENT	18–24"	2 GALLON
	–	2	VIBURNUM TINUS	SPRING BOUQUET	18–24"	2 GALLON
			GROUND COVER			
	–	–	ARCTOSTAPHYLOS UVA-URSI	KINNIKINNICK	24–30"	CONT., 4' O.C.
	–	–	ARUNEUS DIOSUS	GOATS BEARD	24–30"	CONT., 5' O.C.
	–	–	ASTILBE 'BRESSINGHAM BEAUTY'	ASTILBE	1 GAL.	CONT., 3' O.C.
	–	–	BERGINIA CORDIFOLIA	PIGSQUEAK	18–24"	CONT., 5' O.C.
	–	–	BLECHNAM SPICANT	DEAR FERN	18–24"	CONT., 5' O.C.
	–	–	CALLUNA VULGARIS	HEATHER	18–24"	CONT., 5' O.C.
	–	–	CAREX FLAGELLIFERA		18–24"	CONT., 3' O.C.
	–	–	ERICA CARNEA 'SPRINGWOOD PINK'	WINTER HEATHER	24–30"	CONT., 4' O.C.
	–	–	ERICA CARNEA 'SPRINGWOOD WHITE'	WINTER HEATHER	18–24"	CONT., 5' O.C.
	–	–	FESTUEA OVINA GLAUCA 'ELIJAH BLUE'	BLUE FESCUE	18–24"	CONT., 3' O.C.
	–	–	FRAGARIA CHILOENSIS	WILD STRAWBERRY	18–24"	CONT., 5' O.C.
	–	–	IMPERATA CYLINDRICA 'RUBRA'	JAPANESE BLOOD GRASS	18–24"	CONT., 5' O.C.
	–	–	IRIS DOUGLASIANA	DOUGLAS IRIS	18–24"	CONT., 5' O.C.
	–	–	LAVANDULA AUGUSTIFOLIA	ENGLISH LAVANDER	18–21"	CONT., 3' O.C.
	–	–	LITHODORA DIFFUSE 'GRACE WAND'	GRACEWAND	12–18"	CONT., 3' O.C.
	–	–	RODGERSIA PODOPHYLLA		12–18"	CONT., 3' O.C.
	–	–	RUBUS CALUCINOIDES 'EMERALD CARPET'	EMERALD CARPET RUBUS	18–21"	CONT., 5' O.C.
	–	–	SEDUM TELEPHIUM 'AUTUMN JOY'	AUTEMN JOY SEDUM	24–30"	CONT., 5' O.C.

5) Budget

CHILDREN'S GARDEN PROPOSED EXPENDITURES BUDGET	Number	Area	Container Size	Cost	Total Cost
Expenditures					
Total Area					
Topsoil @ 3" depth for 30,000 ft^2	30,000 $ft/^2$	450 $yards^3$	450	14.50	6,525
Grass sod @ 6,000ft2	6,000 ft^2	6,000 ft^2	6,000	0.27	1,620
1. Soil and Grass Sod for Area Subtotal					**8,145**
Hardscape					
Benches - Three teak on iron		**3**	6 ft width	600.00	1,800
2. Bench Totals					**1,800**
Entrance Area 720 $ft.^2$					
Entrance ECO Pavers @ 720 ft2/2		360 ft^2	100% of area	1.75 sq. ft.	630
Entrance Recycled GlassTile @ 720 ft2/2		360 ft^2	20% of area	14.59 each	1,050
3. Entrance Area Subtotal					**1,680**
Path Area					
Gravel for Path (one inch of sand) 2,200 ft^2	1 inch depth	2,200	11	24.50 /cu yd	539
Gravel for Path (3/8 minus) - 2,200 ft^2	3 inch depth	2,200	33	24.50 /cu yd	1,617
4. Gravel Subtotal					**2,156**
Swale Area					

Swale Area - (5000 $ft^{2)}$ get rock all sizes	1	5000 ft^2	50 yds^3		
River rock small 20% of 5000 ft^2	1	1000 ft^2	10	60.00	600
River rock medium 60% of 5000 ft^2	1	3000 ft^2	30	60.00	1,800
River rock large 20% of 5000 ft^2	1	1000 ft^2	10	60.00	600
5. Swale Area Subtotal		**5,000 ft^2**	**50**		**3,000**
Disco Floor Area @ 600 ft^2	1	600 ft2	20% of area	14.59 each	1,750
6. Disco Area Subtotal					**1,750**
Wood for Bridges		3		300.00	900
Concrete for Bridges		3		72.00	216
Hardware for Bridges		3		50.00	150
7. Bridges Subtotal					**1,266**
Fertilizer - Osmocote 18-6-12					300
Fertilizer 10-0-10					200
8. Fertilizer Subtotal					**500**
Low Shrubs & Groundcovers	**Number**	**Spacing**	**Size**	**Cost**	**Cost**
Iris douglasiana - Douglas iris	25	2' oc (on 100 ft2)	1 gallon pot	9.95	249
Astible 'Bressingham Beauty' - astilbe	25	2' oc (on 100 ft2)	1 gallon pot	12.95	324
Rodgersia podophylla	11	3'oc (on 100 ft 2)	1 gallon pot	14.95	164
Erica carnea 'Springwood White' - Winter Heath	44	1.5' oc (on 100 ft2)	1 gallon pot	7.95	350

Calluna vulgaris 'Springwood Pink' Winter Heather	44	1.5' oc (on 100 ft2)	1 gallon pot	7.95	350
Fragaria chiloensis - Wild Strawberry	3	18" oc	4" pot	3.90	12
Rubus calycinoides 'Emerald Carpet' Emerald Carpet Rubus	4	18 " oc	4" pot	3.90	16
Lithodora diffusa 'Grace Ward' - 'Graceward'	5	24 " oc	4" pot	3.90	20
Festuca ovina glauca 'Elijah Blue' 'Elijah Blue 'Blue fescue	6	12" oc	1 gallon pot	9.95	60
Lavandala angustifolia - English lavender	7	3' oc	2 gallon pot	9.95	70
Aictostaphylos uva-uris 'Vancouver Jade' - Kinnikinnk	21	18 " oc	4" pot	2.75	58
Sedum telephium 'Autumn Joy' 'Autumn Joy' Sedum	20	18 " oc	1 gallon pot	9.50	190
Aruncus diosus - Goat's Beard	1	3' oc	1 gallon pot	7.95	8
Blechnam spicant - Deer Fern	1	2' oc	1 gallon pot	7.95	8
Bergcuia cordifolia - Pigsqueak	9	24" oc	1 gallon pot	7.95	72
Carex flagellifera	16	30" oc	1 gallon pot	7.95	127
Imperiada cylindrica 'Rubra' Japanese Blood grass	44	1.5' oc (on 100 ft2)	1 gallon pot	7.95	350
9. Low Shrubs & Groundcovers Subtotal					**2,425**
Shrubs	**Number**	**Spacing**	**Size**	**Cost**	**Cost**
Cornus stolonifera - Red-osier dogwood	37		1 gallon pot	9.95	368
Euonymus alata 'Compacta' - Burning bush	8		5 gallon pot	35.00	280
Garrya elliptica - Silktassel bush	6		1 gallon pot	14.00	84
Nandina domestica - False Bamboo	6		1 gallon pot	7.95	47

				14.95	90
Osmanthus delavayi - delavay Osmanthus	5		1 gallon pot	10.95	55
Rhododendron 'Blue Diamond' - Dwarf Blue Boy	16		B&B	40.00	640
Ribes senquineum - red-flowered currant	5		5 gallon	40.00	200
Viburnum tinus - 'Spring Boquet' - 2 existing	2		1 gallon pot	12.95	26
10. Shrub Subtotoal					**1,790**
Trees	**Number**	**Spacing**	**Size**	**Cost**	**Cost**
Pinus contorta - Shore Pine	3		B&B	125.00	375
Acer griscums - Paperbark Maple	3		B&B	150.00	450
Acer rubrum "Columnare' - Columnare red maple	5		12 ft.	65.00	325
Cercis canadensis 'Forest Pansy' - 'Forest Pansy 'Redbud'	3		8 ft.	79.95	240
Liquidanbar styraciflua - Sweetgum + 1 exsiting	1		10 ft.	100.00	100
Hamamelis mollis 'Pallina' - Witchhazel	1		5 gallon pot	45.00	45
Cercidiphyllum japonicum - Katsura	4		6 ft. tree	175.00	700
Pinus aristata - Bristlecone Pine	1		6 ft. tree	295.00	295
Pinus strobus 'Pendulus' - Weeping White Pine	1		7 ft. tree	295.00	295
11. Tree Subtotal					**2,825**
1. Soil and Grass Sod Subtotal					8,145
2. Bench Subtotal					1,800

3. Entrance Area Subtotal					1,680
4. Gravel Subtotal					2,156
5. Swale Area Subtotal					3,000
6. Disco Area Subtotal					1,750
7. Bridges Subtotal					1,266
8. Fertilizer Subtotal					500
9. Low Shrubs & Groundcovers Subtotal					2,425
10. Shrub Subtotoal					1,790
11. Tree Subtotal					2,825
TOTAL ALL EXPENSES					**27,337**