THE WEST MERCER ELEMENTARY SCHOOL ENVIRONMENTAL LEARNING GARDEN

LANDSCAPE RESTORATION AND DESIGN

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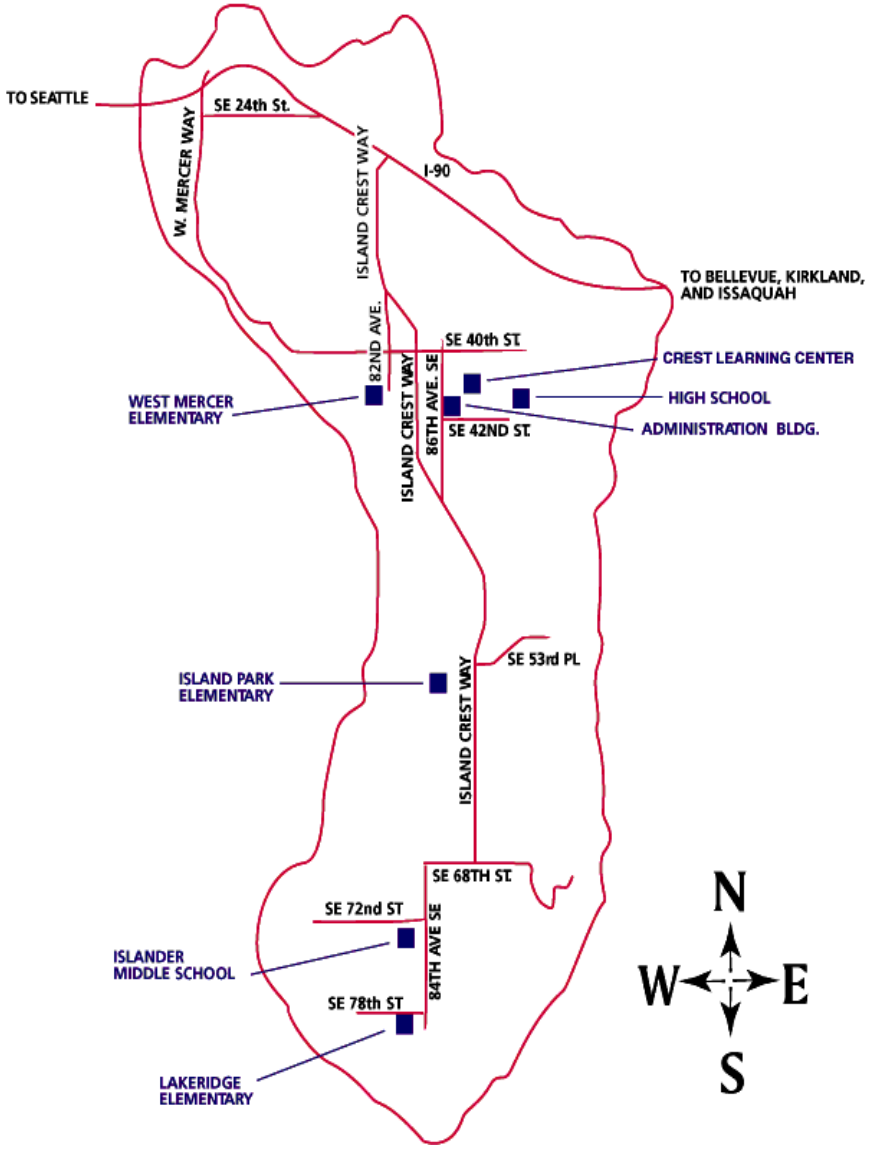
Introduction

West Mercer Elementary School is located on the north end of Mercer Island (See Figure 1). Approximately 600 students attend the school from 9:15 to 3:30 p.m. every day. The school provides instruction for first through fifth grade along with preschool and kindergarten.

As a part of their environmental learning program at West Mercer Elementary, the students, their parents, the staff and others have worked together to renovate the courtyard in the middle of the school. It will be divided into sections that represent different regions of Washington State such as the Puget Sound region and the east side of the Cascade Mountains. The principal, Jean Anthony also plans to enroll the fifth graders at IslandWood, an environmental learning center at Bainbridge Island Washington, just a half hour ferry ride from Seattle. The school experience would extend for three days and two nights. IslandWood staff seeks to "inspire environmental and community stewardship by providing hands-on learning experiences that link science, technology and the arts in a natural setting." Thus, the idea for our site is to create an environmental learning garden that will complement the learning in the courtyard and at IslandWood.

Figure1

Map courtesy of Mercer Island School District



Site Description

Site History

The school property was probably logged in the late nineteenth or early twentieth century, along with the rest of the island. Aerial photos show second growth vegetation cover by the 1930s and the school was built in 1962. Second growth trees on our site may have been cut down at that time. After the school was built, homes were constructed on neighboring properties. After the school was built, there was no construction or management on our site until last year, when a private developer installed a drainage pipe to remove water from house lots that are currently under development.

Overall Site Description

The site is to the east of the school and its parking lot. It is higher than the school and provides several views of Lake Washington to the west. There are residential lots to the east. These residents are concerned about their view and the school officials wish to maintain the neighbors' views by careful selection and location of new trees. Much of the site was covered with *Rubus discolor* until February 2004, when it was removed. Generally the site slopes from east to west with the school and parking located to the west of the site. There is a flat section at the top of the slope, beyond which the land slopes gently up to the property line on the eastern edge of the site. With the exception of one zone, soils on this site are well suited for planting ornamental trees and shrubs. The cation exchange capacity is sufficient in all areas. It is lowest in Zone 2, but will probably increase over time with plant establishment and addition of organic matter. Soil

pH was found acceptable for deciduous planting on the whole site; however it was too high in the Zone 2. Soil tests showed no presence of heavy metals or toxic substances. Findings from soil pits varied by zone, but none of the zones had compacted soil. This makes sense because the dense Himalayan blackberry canes prevented foot traffic and the site is inaccessible to vehicles.

Site Description by Zone

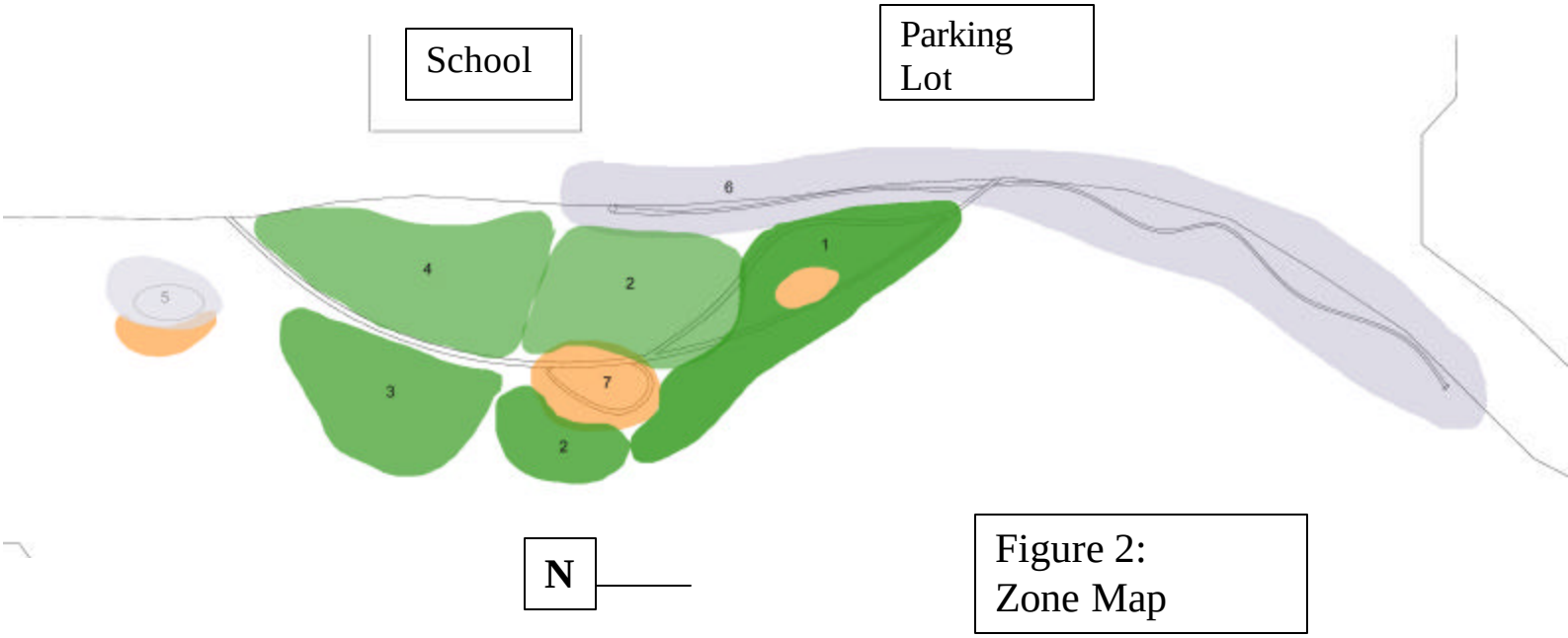


Figure 2:
Zone Map

We divided the sites into zones in order to accurately describe conditions in different parts of the site. We also used the zones to create a design which takes into account these varied conditions. The zones have unique soil, topographic, vegetation, hydrologic or disturbance characteristics, which require different preparation and management techniques and dictate plant selection.

Zone 1

Topography

This is the northernmost zone and is characterized by a gentle west-facing slope to the driveway and a flat area at the top.

Exposure

The clump of hawthorns and isolated alders that will not be removed provide shade in this zone. The rest is not shaded and receives full afternoon sun.

Soil

Soil nutrients and pH in this zone are within acceptable levels for planting ornamental trees and shrubs. When we dug a soil pit in this zone, we found that soil texture was silt loam and was not compacted. We found a 3" organic horizon and a 2" A horizon.

Hydrology

In periods with heavy rainfall, several seeps emerge near the bottom of the slope. When we dug a soil pit in the mid-slope we did not reach the water table in the first 18" of soil.

Vegetation

Zone 1 was completely overgrown with *Rubus discolor* (Himalayan blackberry) until February 2004, when it was mowed and covered with a thick layer of woodchip mulch. There are several alders near the driveway in this zone, which were recently topped by a neighboring property owner to preserve his view. Many of these lean over the driveway and can be classified as hazard trees. These alders will be discussed in more detail in the site preparation section. At the top of the hill, there is a small grove of *Crategus spp.* (hawthorn), which are in poor condition.

Zone 2

Construction History

In this zone, a developer recently installed a drainage pipe to divert water from property upslope from our site. Excavated soil was piled on top of the pipe, and the soil surface is now approximately a foot higher than the adjacent surface. In some areas, this pipe is only two feet below the surface.

Topography

The slope in this zone, which is contiguous to zone 1, is the steepest on the site. At the top there is a level area, then it gently slopes up to the property line. Erosion issues in this zone will be considered individually. The slope aspect is the same as zone 1.

Exposure

Same as zone 1, except there are no trees to provide any shade.

Soil

We dug a soil pit in this area and found the soil texture to be very silty, characteristic of the glacial till which underlies much of the Puget Sound region. Because it was so recently disturbed there was no organic layer or horizon formation. According to soil tests, the pH of this area is 6.6, which is too high for many conifers.

Hydrology

There was no visible water in this zone.

Vegetation

This zone is currently clear of all vegetation.

Zone 3

Topography

This zone starts at the flat area at the top of the slope and continues up to the eastern property line.

Exposure

Trees growing in this zone provide canopy cover so all of this zone is in full shade.

Soil

No soil samples were taken in this zone, but since it supports an array of native species, we can assume that soil properties are suitable for planting.

Hydrology

No water is visible in this zone.

Vegetation

There are many native species on this site. The trees on this site include Pseudotsuga menziesii (Douglas fir), *Acer macrophyllum* (big leaf maple), *Salix spp.* (willow) and *Alnus rubra* (red alder). The understory includes such plants as *Mahonia nervosa* (Oregon grape), *Gaultheria shallon* (salal), *Vaccinium parvifolium* (red huckleberry), and *Polystichum munitum* (sword fern). Invasive plants in this zone include *Hedera helix* (English ivy) and *Ilex aquifolium* (English holly) as well as *Rubus discolor* (Himalayan blackberry) in some areas.

Zone 4

In most respects this zone is similar to the lower (western) part of zone 1. The only differences are that Himalayan blackberry has not yet been removed and the tree species found in this area include *Arbutus menziesii (*madrone), *Corylus cornuta var. californica* (beaked filbert), and *Thuja plicata* (western red cedar). Invasive plants in this zone include *Cystius scoparius* (Scot's broom).

Zone 5

Topography

This zone is located in the flat area on the top of the hill, in the midst of zone 3.

Exposure

Tall trees provide deep shade.

Soil

The soil in this zone consists of an organic layer on top of a thin (4" thick) A layer on top of the C horizon. The C horizon is impenetrable to a shovel or soil corer, and is most likely a compacted glacial till. This appears to be the soil that is now at the surface due to construction in zone 2.

Hydrology

The compacted C horizon prevents water infiltration, so there is a small pool in this zone. It is not known whether this pool is the result of a perched water table or a seep, or whether it is a spring that originates deeper underground. In any case, this area appears to be wet all year round.

Vegetation

There is very little vegetation directly at the edge of the pool, the vegetation of zone 3 is at the edges.

Zone 6

Topography

This zone extends along the bottom of the slope, parallel to the edge of the parking lot.

Exposure

There is full sun in this zone in the afternoon.

Soil

This zone is relatively low in micronutrients but has ample nutrients overall. The pH is too high for conifers.

Hydrology

This are currently several drains in this zone, which drain the hill and the driveway to the parking lot.

Vegetation

The only vegetation in this zone is turf grass.

Zone 7

This zone is essentially identical to zone 2, but is a separate zone because it will be used as a gathering area in the garden and therefore designed separately.

Topography

The zone is located in the middle of zone 2 on the flat area in the middle of the slope.

Slope and Erosion Issues

Erosion is not currently an issue on most of the site, because the slope is relatively gentle and the roots of alders and Himalayan blackberry effectively hold the soil. While we are removing several of the trees and all of the blackberry, the thick mulch will be sufficient to hold the slope initially. As plantings become established, their roots will effectively hold the soil. In zone 2 however, where the slope is steepest and the soil most disturbed and exposed, mulch will not be sufficient. In this area, we recommend installing logs across the slope held in place with stakes to hold the soil for the first few years. After that, plant root systems will supplement the logs, and eventually will be sufficient to prevent erosion.

Project Goals

Goal 1: Create a landscape with native plants that requires less maintenance than the current vegetation.

Objective 1-1: Remove invasive species.

Objective 1-2: Install native plants that will eventually require less maintenance.

Goal 2: Create an educational landscape for the students, staff, families and neighbors of West Mercer Elementary School.

Objective 2-1: Install plants with habitat and food value for wildlife.

Objective 2-2: Design a trail through the site that has informational signs strategically placed throughout.

Objective 2-3: Design an area that will allow a group of students to gather for a lesson or other educational activity such as sketching.

Objective 2-4: Provide teachers with information about the site that they can incorporate in the curriculum.

Objective 2-5: Provide a learning experience that will complement the students' experience with the school courtyard and IslandWood.

Goal 3: Reduce erosion by stabilizing the slope.

Objective 3-1: Install plants with extensive, fibrous root systems.

Objective 3-2: Use large woody debris to reduce speed of water flowing down the slope. Large woody debris can be salvaged from trees that fall naturally or that were removed as a result of a hazard assessment.

DESIGN PROPOSAL

Concept

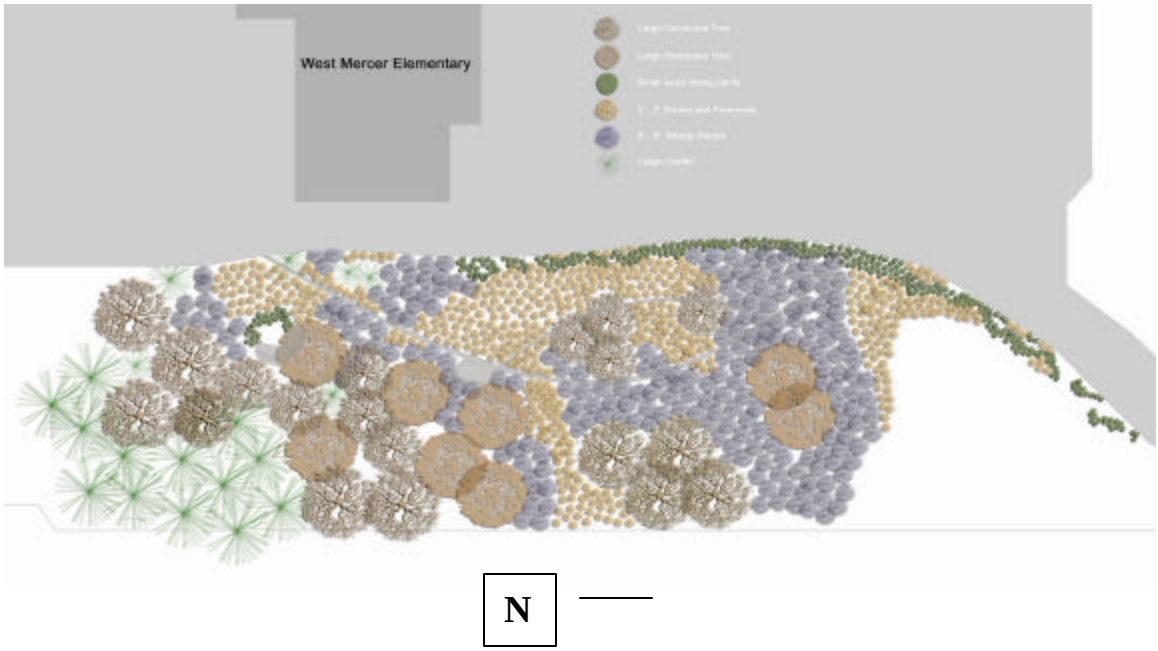
The guiding principles of this design are encapsulated in two words: "learning" and "garden." The site will be incorporated into the curriculum of the school and will be used to teach students about local ecosystems. Fifth graders will be participating in a environmental education at Islandwood Learning Center on Bainbridge Island. The Learning Garden will be incorporated into the curriculum of younger grades to provide a foundation for this experience. We have chosen plant species that are representative of native coniferous forests; fragments of this ecological community are extant on or near the site. Local Native American tribes used many of the selected for food or medicine. We have included an index of ethnobotanical uses for many of the plants with this report.

The garden will also educate parents and visitors to the school. Every day at 3 pm, when parents arrive to pick up their children from school, they get stuck in a line of cars in full view of the hillside that will be the first part of the site planted. As they wait, they will be able to read an educational sign and see the hillside planted with native plants.

The "garden" aspect of the design creates an aesthetically pleasing landscape using a palette of native plants. We will use a mix of textures and colors to draw the eye into the garden and delineate the trail. We have chosen plants that are adapted to soil, topographic, and hydrologic conditions on various parts of the site and will not require intensive management after establishment.

Design

Figure 3



The trail runs generally north-south and guides visitors through the garden. The meeting area is in the middle of the garden and provides a place for informal classes. Most parts of the garden are visible from this spot, so teachers can point out different aspects of plants. It also provides a wider view of the school surroundings and on clear days, Lake Washington. This can be used to illustrate the connection between this site and the broader landscape and ecosystem.

The placement of plants in this design is a suggestion and may be changed at the discretion of the client. The plants chosen should be adapted to the zone characteristics listed in the site description. Plant adaptability is enumerated in the plant list spreadsheet. Low shrubs line the trail to set it apart from the rest of the garden. Taller trees are sited

mainly in the southern part of the site in order to maintain view corridors for neighboring property owners. Shrubs and hardy ground covers will be planted on the slopes to reduce erosion.

For detailed plant placement information see attached plans. For detailed plant information, see plant list (Figure 4).

IMPLEMENTATION AND INSTALLATION

Installation Plan

We recommend that this site be planted in fall. This will reduce water stress for newly installed plants. For planting specifications, see appendix.

Site Preparation

The first step in the site preparation is invasive removal. Blackberry canes have already been mown on much of the site. The root masses have not been removed, but the site will be covered with a thick layer of woodchips and mowing repeated in order to suppress Himalayan blackberry growth in the future. Eventually, the native plants will form a canopy that will shade out the blackberry, but in the meantime, it will be necessary to cut the canes at least once a year. *Hedera helix* grows in the shadier parts of the site and should be pulled using hand tools. Any vines that are growing onto trees should be cut at the base. *Ilex aquifolium* should be cut using a handsaw or chainsaw. Stumps should be painted with a systemic herbicide such as glyphosate to prevent resprouting. There are only one or two *Cystius scoparius* on the site and these can be removed using hand tools.

After invasive plants are removed, a thick (8-12") layer of woodchips should be laid over all exposed areas of the site (in the area at the top of the hill with an established canopy of native trees and shrubs, mulch is not necessary). This will suppress regrowth of invasives, reduce erosion, and conserve water in summer. The thickness of the mulch layer will be reduced to 3-4" surrounding new or existing plants.

Approximately five *A. rubra* trees will be removed. These trees have been topped in the past and several are leaning over the heavily-used driveway that is the main entrance to the school parking lot. These trees are hazardous and not in particularly good condition from either a plant health or aesthetic stand point. Three small hawthorns in at the top of the hill should be pruned to remove dead or hanging branches and to improve their appearance. If, in the course of pruning, the trees are found to be in poor condition and cannot be improved, they may be removed. Before the completion of the project (though it does not have to be before planting) existing trees with branches over the proposed trail at the top of the hill should be pruned. The most prominent of these are several *Acer macrophyllum*, but before completion of the project a detailed inspection should be undertaken to ensure that there are no dead or hazardous branches above the trail.

We do not recommend extensive alterations to the soil on the site; however Zone 2 will require extra preparation and will be discussed individually. Nutrient levels were sufficient in all areas, but application of woodchip mulch will replenish soil nitrogen as it decomposes. Macro and micro nutrient levels are sufficient in all parts of the site and no high levels of heavy metals were found.

The soil above the drainage pipe is high in clay, but we will select plants that can survive in poor soil. Repeated mulch applications will slowly increase or maintain soil nitrogen levels, which were found to be low in the soil tests. One of the goals of this garden is to use native plants, which are adapted to low pH and low nitrogen levels. For this reason, it will not be necessary to make major changes to the soil. We dug soil pits in several parts of the site, and found that soil was not compacted. This makes sense

because the area was previously overgrown with blackberries, which made it inaccessible and prevented compaction.

Zones 2 and 7 are highly disturbed, and may prove more challenging in terms of site preparation. We are using several strategies to manage these zones. In zone 7, we plan a gathering area. We will cover this area with a thick layer of crushed gravel. This will prevent weed growth and create a dry, level surface for students and teachers to stand. We are using logs placed across the slope and held by stakes in order to control erosion in this area. Finally, we are selecting plants that can survive in clay soils and that are drought tolerant.

According to soil tests in this area the pH is higher than required for most conifers. However, conifers are well adapted to other site conditions and are an important part of the native landscape. In accordance with soil lab advice, we recommend incorporating six cups of sulfur per cubic yard of soil in conifer planting areas in this part of the site. Planting maps define conifer planting areas; soil should be amended with sulfur in those areas. Using pine needles as mulch in these areas will help maintain low pH in the future.

In zone 6 we recommend creating a bioswale. To accomplish this, the area must be excavated to form an open ditch, and the drainage pipe removed. We will install native wetland plants in this zone.

AFTERCARE AND MANAGEMENT

The soil conditions on most of the site are very characteristic of the Puget Sound region. The proposed landscape planting will require minimal maintenance because the recommended plants are native to this region and the site is very suitable for their development. The following management practices will be essential for the success of the plant material.

Irrigation is essential for plant establishment, especially in the first year after planting. It is recommended that for the first two years the plantings be watered every three to seven days during the dry season, which is usually from July through September. After the two-year period, watering should be done every twelve to sixteen days; additional watering may be needed during extremely dry summers.

Weeding is a fundamental practice for the management of any landscape because it not only gives a clean appearance but it also helps plants by reducing competition for nutrients. Weeding should be done at least once a month during the first two years. This will deplete the weed's seed bank and reduce their population size. Special care should be taken to eradicate Himalayan blackberry.

Monitoring plant health should be done twice a year to remove dead plants and to treat for possible disease. Monitoring also includes record keeping of management activities in order to make further recommendations about weeding, mulching, assessment of water needs, pruning and safety. Monitoring will also help on future project development by providing history of the site.

Mulching in the form of woodchips should be applied to a depth of 6-8 inches. Mulch, especially woodchips, is essential for water retention and as it decomposes it

releases nutrients promoting healthy soil conditions while improving soil structure. Mulch should be applied every one to two years as needed to maintain desirable qualities.

Pruning should only be performed by trained maintenance workers. In addition, pruning should only be done to enhance the overall appearance and health of the tree and to remove hazardous branches. A special effort should be made to educate the neighbors about the plantings and their function and how these tree species may even complement their view. This effort will help prevent illegal topping. If pruning for view purposes cannot be avoided it should only be performed by a trained arborist.

BUDGET

The budget for this project is very cost effective it involves using materials from other sites of the Mercer Island school district and employing them for the construction of the bench and the erosion control structures. The following summarizes the plant cost.

Plants

Item	**Cost**
Ground Cover	$729.75
Shrubs	$1,712.50
Trees	$94.50

Materials	**Quantity**	**Cost**
Mulch		Free from other school district landscaping projects
Crushed Gravel (for paths)	2 cubic yards	$40/ cu. yd
Logs and stakes (for erosion control		Free from other school district landscaping projects

Total cost of project: $2,6167

Labor:

The labor for this job will be provided by staff from the Mercer Island School District and volunteers.

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Appendix A

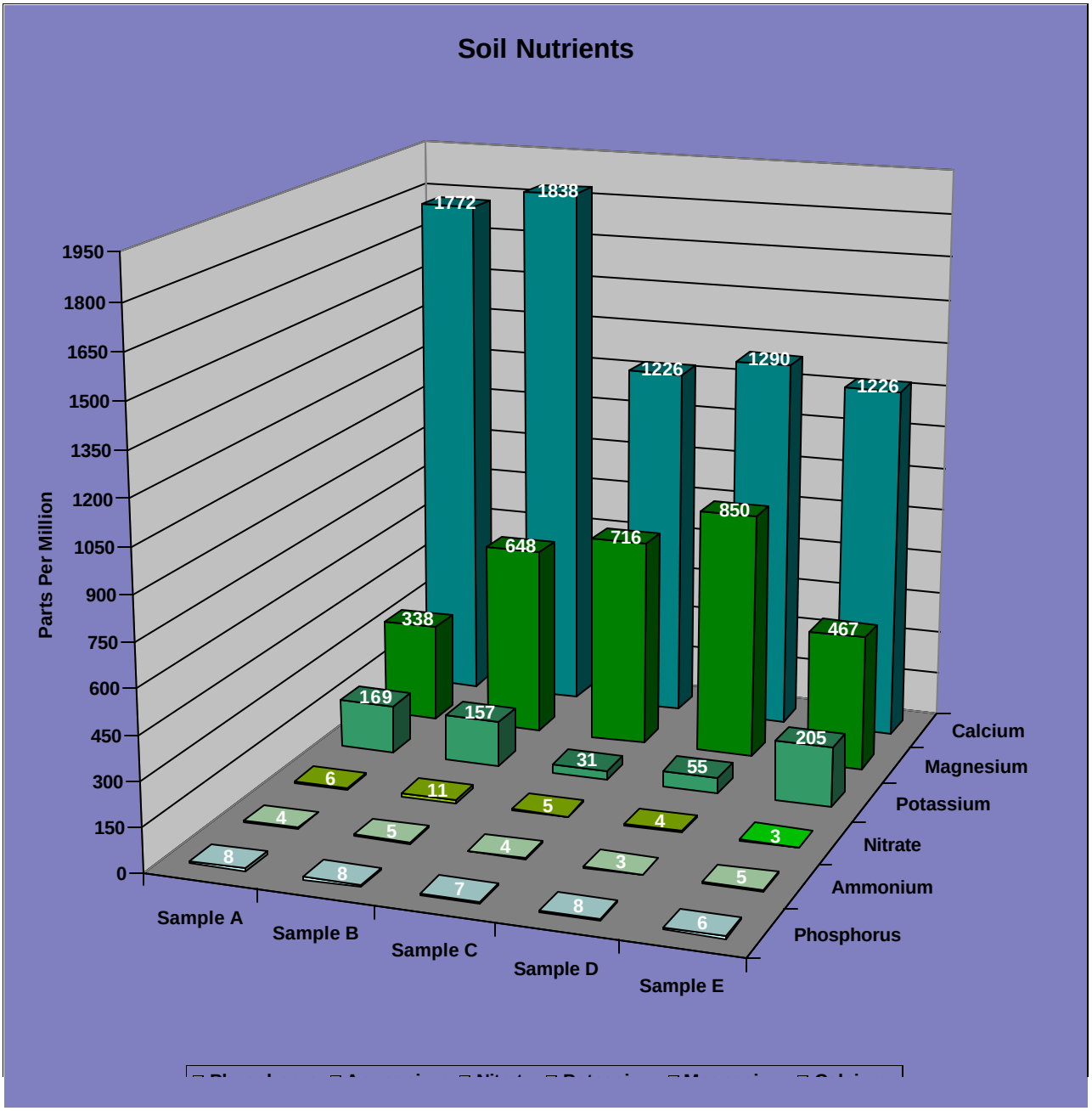
Soil

Soil samples were collected at five locations on the site. These correspond to Samples A-E in the following chart. Samples were collected at these locations because they had significantly different characteristics. Samples A and B were collected at the bottom of the slope. Sample A was taken near the outlet of a small pipe draining from a neighboring property, while sample B was taken near a drain at the base of the slope. Sample C is taken from the middle of the slope in an area previously covered by Himalayan blackberry. Sample D is from the highly disturbed area above the newly installed drainage pipe. And finally sample E is from the top of the slope in an area with a mix of native and invasive vegetation.

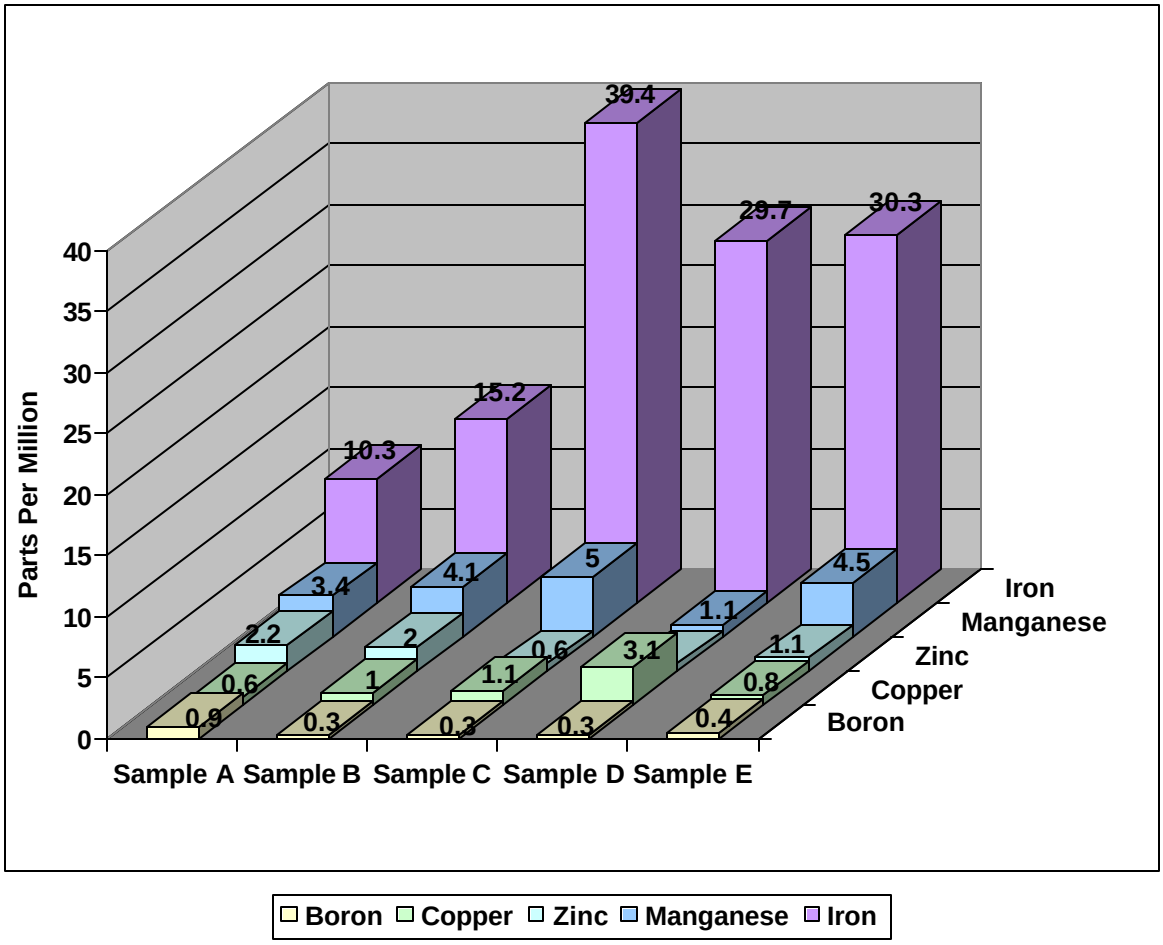
Sample	Zone	Location
A	6	Base of slope, near outlet pipe
B	6	Base of slope, near school building
C	1	Middle of slope
D	2	Middle of slope, drainage pipe corridor
E	4	Top of slope

Soil Nutrients

Soil nutrients are elements in the soil that plants require in order to survive and grow. If any is missing or at lower levels than the plant requires, the plants will exhibit deficiency symptoms. If the problem is not corrected, the plant will eventually die. The macronutrients are required in large amounts (>0.1% of dry plant tissue), while micronutrients are needed in only very small amounts (<0.1% of dry plant tissue) (Brady, 1999). None of these nutrients was deficient in any of the soil samples.



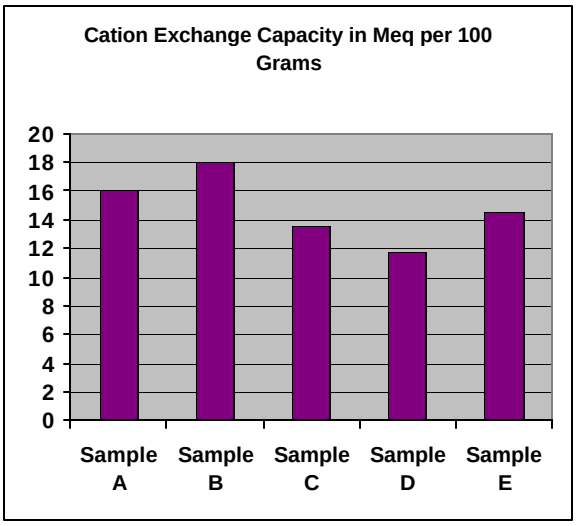
Micronutrients



Cation Exchange Capacity

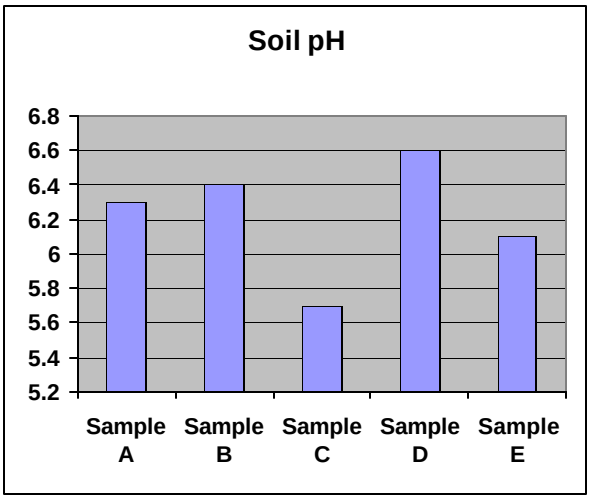
Cation Exchange Capacity ("CEC") is the degree to which a soil can adsorb and exchange cations. Soils with a high CEC are considered more fertile because they can hold more nutrients. It is highly dependent on how much clay and organic matter is in

the soil. CEC tends to increase as the percentage of organic matter or clay increases.



Soil pH

Soil pH is an expression of the acidity or alkalinity in the soil and is measured in pH units. Soil pH increases as the soil becomes more alkaline. As the soil pH decreases, the soil becomes more acid. Soil pH is important because it affects how a plant can absorb nutrients from the soil solution. Most nutrients are more soluble, and therefore more available to a plant, in acid soils than in slightly alkaline or neutral soils. Scientists consider soil pH readings of 5.7 to 6.0 to be moderately acid, 6.1 to 6.5 to be slightly acid and 6.6 to 7.3 to be neutral. So, on this site, the areas where the nutrients are most available are those where Sample A, B and E were taken. Sample C would be rated as moderately acid, while sample D would be rated as neutral.



Compaction

While we did not test the bulk density of the soil, the site has not been heavily used by people or vehicles for many years. Much of the site was covered with Himalayan blackberry which prevented any type of compaction. When we dug soil pits, the soil was quite easy to dig and there did not seem to be any compacted impenetrable soil layer in the top eighteen inches of soil.

Appendix B

Planting Specifications

The following specifications are taken directly from

Guide for Developing Planting Specifications
Section 02950
Landscape Planting
INTERNATIONAL SOCIETY OF ARBORICULTURE

Protection of existing features. During construction, protect all existing trees, shrubs, and other specified vegetation, site features and improvements, structures, and utilities specified herein and/or on submitted drawings.

Planting Season

Amendments required to be added as indicated on the soil test report shall be added by the contractor at the time of spreading and/or grading.

Plants

Plants shall be true to species and variety specified and nursery-grown in accordance with good horticultural practices under climatic conditions similar to those in the locality of the project for at least two years. They shall have been freshly dug (during the most recent favorable harvest season).

All plant names and descriptions shall be as defined in *Hortus Third*.

All plants shall be grown and harvested in accordance with the *American Standard for Nursery Stock*.

Unless approved by the landscape architect, plants shall have been grown at a latitude not more than 325 km (200 miles) north or south of the latitude of the project

unless the provenance of the plant can be documented to be compatible with the latitude and cold hardiness zone of the planting location.

(NOTE: Many tree species are sensitive to the photoperiod of their native provenance. For example, red maple stock from native southern stock will not harden off in time for northern winters.

Unless specifically noted, all plants shall be of specimen quality, exceptionally heavy, symmetrical, and so trained or favored in development and appearance as to be unquestionably and outstandingly superior in form, compactness, and symmetry. They shall be sound, healthy, vigorous, well branched, and densely foliated when in leaf; free of disease and insects, eggs, or larvae; and shall have healthy, well-developed root systems. They shall be free from physical damage or other conditions that would prevent vigorous growth.

Trees with multiple leaders, unless specified, will be rejected. Trees with a damaged or crooked leader, bark abrasions, sunscald, disfiguring knots, insect damage, or cuts of limbs over 20 mm (3/4 in.) in diameter that are not completely closed will be rejected.

Plants shall conform to the measurements specified, except that plants larger than those specified may be used if approved by the landscape architect. Use of larger plants shall not increase the contract price. If larger plants are approved, the root ball shall be increased in proportion to the size of the plant.

Caliper measurements shall be taken on the trunk 150 mm (6 in.) above the naturalground line for trees up to and including 100 mm (4 in.) in caliper, and 300 mm (12 in.) above the natural ground line for trees over 100 mm (4 in.) in caliper. Height and

spread dimensions specified refer to the main body of the plant and not from branch tip to branch tip. Plants shall be measured when branches are in their normal position. If a range of sizes is given, no plant shall be less than the minimum size, and no less than 50 percent of the plants shall be as large as the maximum size specified. Measurements specified are minimum sizes acceptable after pruning, where pruning is required. Plants that meet measurements but do not possess a standard relationship between height and spread, according to the *American Standards for Nursery Stock*, shall be rejected.

All plants shall be labeled by plant name. Labels shall be attached securely to all plants, bundles, and containers of plant materials when delivered. Plant labels shall be durable and legible, with information given in weather-resistant ink or embossed process lettering.

Trees designated B&B shall be properly dug with firm, natural balls of soil retaining as many fibrous roots as possible, in sizes and shapes as specified in the *American Standard for Nursery Stock*. Balls shall be firmly wrapped with nonsynthetic, rottable burlap and secured with nails and heavy, nonsynthetic, rottable twine. The root collar shall be apparent at surface of ball. Trees with loose, broken, processed, or manufactured root balls will not be accepted, except with special written approval before planting.

(NOTE: Some nurseries practice result in the root flare being buried several inches deep. The top of the root ball may be at ground level, but the root flare actually is too deep. Remove the excess soil on the top of the root ball. Proper planting depth requires the root flare to be at or slightly above the finished grade.)

Plants grown in containers shall be of appropriate size for the container as specified in the most recent edition of the *American Standard for Nursery Stock* and be free of circling roots on the exterior and interior of the root ball.

Container plants shall have been grown in the container long enough to have established roots throughout the growing medium.

Plants designated as bareroot or collected plants shall conform to the *American Standard for Nursery Stock*.

Bareroot material shall not be dug or installed after bud break or before dormancy.

Immediately after harvesting plants, protect from drying and damage until shipped and delivered to the planting site. Rootballs shall be checked regularly and watered sufficiently to maintain root viability.

Transportation and Storage of Plant Material

(*NOTE: No matter how good plant materials may be at a nursery, how that material is handled after it is dug is of critical importance.)*

Branches shall be tied with rope or twine only, and in such a manner that no damage will occur to the bark or branches.

During transportation of plant material, the contractor shall exercise care to prevent injury and drying out of the trees. Should the roots be dried out, large branches broken, balls of earth broken or loosened, or areas of bark torn, the landscape architect may reject the injured tree(s) and order them replaced at no additional cost to the owner. All loads of plants shall be covered at all times with tarpaulin or canvas. Loads that are not protected will be rejected.

All bareroot stock sent from the storage facility shall be adequately covered with wet soil, sawdust, woodchips, moss, peat, straw, hay, or other acceptable moisture-holding medium, and shall be covered with a tarpaulin or canvas. Loads that are not protected in the above manner may be rejected.

Plants must be protected at all times from sun or drying winds. Those that cannot be planted immediately on delivery shall be kept in the shade, well protected with soil, wet mulch, or other acceptable material, and kept well watered. Plants shall not remain unplanted any longer than three days after delivery. Plants shall not be bound with wire or rope at any time so as to damage the bark or break branches. Plants shall be lifted and handled with suitable support of the soil ball to avoid damaging it.

Mechanized Tree Spade Requirements

Trees may be moved and planted with an approved mechanical tree spade. The tree spade shall move trees limited to the maximum size allowed for a similar B&B root-ball diameter according to the *American Standard for Nursery Stock* or the manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller. The machine shall be approved by the landscape architect prior to use. Trees shall be planted at the designated locations in the manner shown in the plans and in accordance with applicable sections of the specifications.

IV. Materials for Soil Amendment

Pine Bark: *(NOTE: Pine bark is high in lignin and is a superior organic amendment to regular compost.)*

Horticultural-grade milled pine bark, with 80 percent of the material by volume sized between 0.1 and 15.0 mm.

Pine bark shall be aged sufficiently to break down all woody material. Pine bark shall be screened.

Sulfur: shall be flowers of sulfur, pelletized or granular sulfur, or iron sulfate.

Locations for plants and/or outlines of areas to be planted are to be staked out at the site.

Tree, shrub, and groundcover beds are to be excavated to the depth and widths indicated on the drawings. If the planting area under any tree is initially dug too deep, the soil added to bring it up to the correct level should be thoroughly tamped.

The sides of the excavation of all planting areas shall be sloped at a 45 degrees. The bottom of all beds shall slope parallel to the proposed grades or toward any subsurface drain lines within the planting bed. The bottom of the planting bed directly under any tree shall be horizontal such that the tree sits plumb.

Maintain all required angles of repose of the adjacent materials as shown on the drawings. Do not excavate compacted subgrades of adjacent pavement or structures.

For trees and shrubs planted in individual holes in areas of good soil that is to remain in place and/or to receive amendment in the top 150-mm (6 in.) layer, excavate the hole to the depth of the root ball and to widths shown on the drawing. Slope the sides of the excavation at a 45 degree angle up and away from the bottom of the excavation.

In areas of slowly draining soils, the root ball may be set up to 75 mm (3 in.) or 1/8 of the depth of the root ball above the adjacent soil level.

Save the existing soil to be used as backfill around the tree.

On steep slopes, the depth of the excavation shall be measured at the center of the hole and the excavation dug as shown on the drawings.

III. Installation of Organic Matter Layer

(NOTE: In Areas of Tree, Shrub, or Flower Planting but not in lawn areas, it is usually beneficial to increase the organic content in the very top layer of the soil. This effectively builds an O or A horizon in the soil, that may otherwise have been removed, without creating a shrinking soil that often results from adding high levels of organic matter in the entire soil depth.)

Plants shall be set on flat-tamped or unexcavated pads at the same relationship to finished grade as they were to the ground from which they were dug, unless otherwise noted on the drawings. Plants must be set plumb and braced in position until topsoil or planting mix has been placed and tamped around the base of the root ball. Improper compacting of the soil around the root ball may result in the tree settling or leaning. Plants shall be set so that they will be at the same depth and so that the root ball does not shift or move laterally one year later.

(NOTE: Proper planting depth requires the root flare to be at or slightly above the finished grade. It is important to determine how deep the root flare is in the ball before it is placed in the planting hole. Sometimes the top of the ball may need to be raised until the root flare is at the proper planting depth and/or soil must be removed from the top of the ball.)

Determine the elevation of the root flare and ensure that it is planted at grade. This may require that the tree be set higher than the grade in the nursery.

If the root flare is less than 50 mm (2 in.) below the soil level of the root ball, plant at the tree the appropriate level above the grade to set the flare even with the grade.

If the flare is more than 50 mm (2 in) at the center of the root ball the tree shall be rejected.

Lift plants only from the bottom of the root balls or with belts or lifting harnesses of sufficient width not to damage the root balls. Do not lift trees by their trunk or use the trunk as a lever in positioning or moving the tree in the planting area.

Remove plastic, paper, or fiber pots from containerized plant material. Pull roots out of the root mat, and cut circling roots with a sharp knife. Loosen the potting medium and shake away from the root mat. Immediately after removing the container, install the plant such that the roots do not dry out. Pack planting mix around the exposed roots while planting.

The roots of bare-root trees shall be pruned at the time of planting to remove damaged or undesirable roots (those likely to become a detriment to future growth of the root system). Bare-root trees shall have the roots spread to approximate the natural position of the roots and shall be centered in the planting pit. The planting-soil backfill shall be worked firmly into and around the roots, with care taken to fill in completely with no air pockets.

Cut ropes or strings from the top of shrub root balls and trees smaller than 3 in. caliper after plant has been set. Remove burlap or cloth wrapping and any wire baskets from around top half of balls. Do not turn under and bury portions of burlap at top of ball.

Completely remove any waterproof or water-repellant strings or wrappings from the root ball and trunk before backfilling.

Ensure that the backfill immediately around the base of the root ball is tamped with foot pressure sufficient to prevent the root ball from shifting or leaning.

Thoroughly water all plants immediately after planting. Apply water by hose directly to the root ball and the adjacent soil.

Remove all tags, labels, strings, etc. from all plants.

Remove any excess soil, debris, and planting material from the job site at the end of each workday.

Form watering saucers 100 mm (4 in.) high immediately outside the area of the root ball of each tree as indicated on the drawings.

Pruning

Plants shall not be heavily pruned at the time of planting. Pruning is required at planting time to correct defects in the tree structure, including removal of injured branches, double leaders, waterspouts, suckers, and interfering branches. Healthy lower branches and interior small twigs should not be removed except as necessary to clear walks and roads. In no case should more than one-quarter of the branching structure be removed. Retain the normal or natural shape of the plant.

All pruning shall be completed using clean, sharp tools. All cuts shall be clean and smooth, with the bark intact with no rough edges or tears.

Except in circumstances dictated by the needs of specific pruning practices, tree paint shall not be used. The use of tree paint shall be only upon approval of the landscape architect. Tree paint, when required, shall be paint specifically formulated and manufacturing for horticultural use.

Mulching

All trees, shrubs, and other plantings will be mulched with mulch previously approved by the landscape architect. The mulch on trees and shrubs shall be to the depths shown on the drawing. Mulch must not be placed within 8 cm (3 in.) of the trunks of trees or shrubs.

Appendix C: Ethnobotanical Information