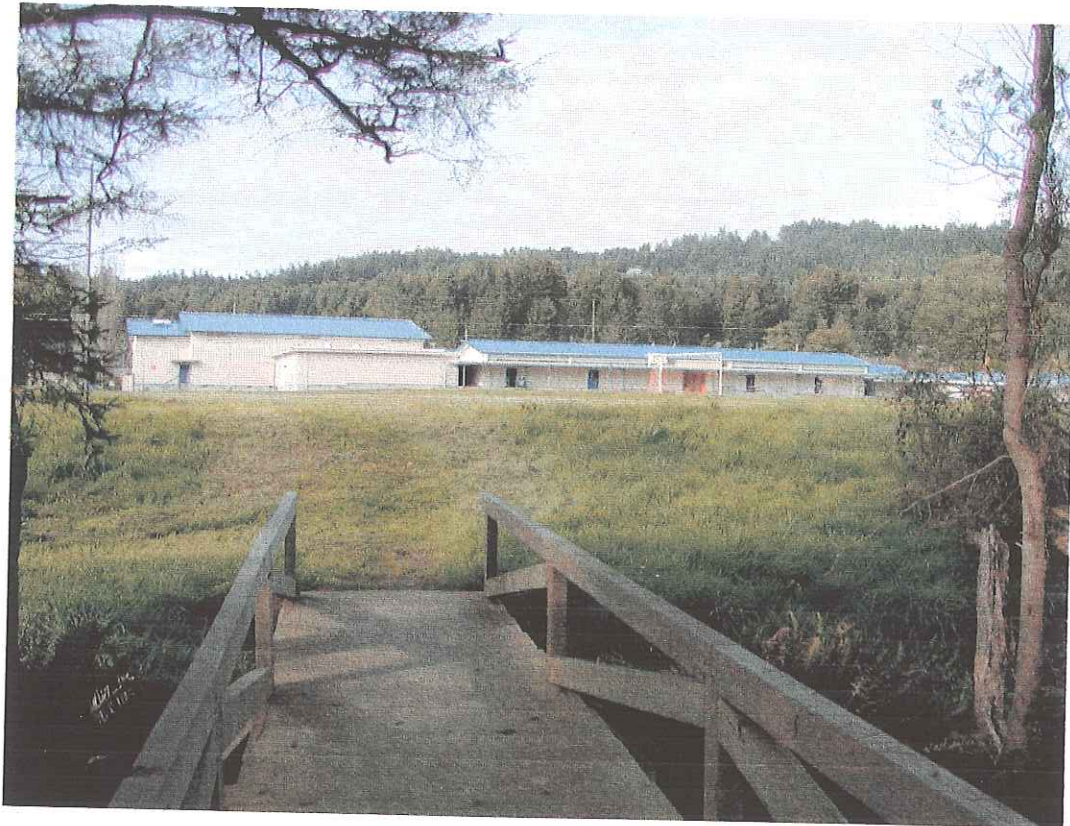


Sunny Brae Middle School Environmental Education Program



Designed by:
Maya Cavelti
Evonne Reese
Nat Waddington

Humboldt State University
Department of Natural Resources and Sciences

Table of Contents

Table of Contents	1
List of Tables.....	2
1 Problem Definition.....	3
1.1 Problem Statement	3
1.2 Context	3
1.3 Background	4
1.4 Project Objectives.....	5
2 Alternative Deliberation.....	6
2.1 Introduction	6
2.2 Criteria.....	6
2.3 Alternatives	8
2.4 Final Decision Justification	13
3 Implementation Plan	15
3.1 Implementation Plan Context.....	15
4 Preferred Alternative Implementation.....	16
4.1 Introduction	16
4.2 Habitat Enhancement Gardens	17
4.2.1 Riparian Woodland Areas	17
4.2.2 Coastal Temperate Forests	21
4.2.3 Wetlands.....	24
4.3 Signage.....	28
4.4 Curriculum	30
4.5 Usage of the Nature Site.....	32
4.6 Trails	33
4.7 Outdoor Classroom.....	35
5 Monitoring and Evaluation.....	36
5.1 Introduction	36
5.2 Monitoring.....	36
5.3 Evaluating.....	37
6 Conclusion.....	38
6.1 Conclusion Context	38
7 List of Preparers	39
8 References	40
Appendix A – Overhead Map of School Property	42
Appendix B – Brainstorming	44
Appendix C – Master Plan	46
Appendix D – Riparian Vegetation Planting Guide	48
Appendix E – Temperate Coastal Planting Guide.....	52
Appendix F – Wetland Vegetation Planting Guide	55
Appendix G – Fauna Species	59
Appendix H – Kiosk Blueprint and Material Evaluation	60
Appendix I – Directions for Construction of a Wood-Routed Sign	62
Appendix J – List of Resources for Instructors	63
Appendix K – Example Surveys	64

List of Tables

Table 2.1 Decision Matrix	13
Table 4.1 Existing Riparian Vegetation.....	20
Table 4.2 Native Riparian Vegetation for Inclusion.....	21
Table 4.3 Native Temperate Coastal Vegetation for Inclusion.....	23
Table 4.4 Native Wetland Vegetation for Inclusion	27
Table 4.5 Cost-benefit analysis for kiosk materials.....	30
Table 4.6 Cost-benefit analysis for trail materials.....	34

1 Problem Definition

1.1 Problem Statement

Sunny Brae Middle School has the need for a master plan outlining an educational nature program that will enable students, and ideally community members, to learn about their local ecosystem.

1.2 Context

The Arcata School Board (ASB) is working towards developing educational nature programs at three of the district's schools. One of these schools, Sunny Brae Middle School (SBMS), has been chosen to develop a pilot plan that explores the process of designing such a project. Based on the success of the SBMS scheme, it may then be used to model the implementation of educational nature programs at the two other schools. This document will review the viable options for such a program, and develop a master plan that outlines the preferred alternative.

The Arcata Foundation has provided the school board with a two-hundred-and-fifty-dollar grant that has been allotted to the implementation of the SBMS nature program. The appropriation of these funds will be considered in association with the board contact, David Narum. During the preliminary stages of this review process the ASB proposed that these resources would be best applied to the construction of a kiosk in coordination with a nature area composing the southeastern corner of the school's multi-purpose field. Such options will be explored in the alternative deliberation phase of the review process.

The design of this educational nature program will be coordinated with the Sunny Brae Middle School's long-term plans for both the school property and the environmental education components of the school curriculum. Matt Malkus, assistant principle of the Sunny Brae Middle School, has provided direction in meeting these guidelines, as has SBMS science teacher David Labolle. The success of an existing school nature area at Pacific Union Elementary School was also considered in this review process. That

program's manager, Carol Ralph, was consulted on the variable success of different implementation methods, and provided contacts for the acquisition of plant specimens.

1.3 Background

Sunny Brae Middle School is located at 1430 Buttermilk Lane in Sunny Brae, and serves 300 students attending the 6th through 8th grades. Located directly behind the school buildings is the SBMS multi-purpose field, approximately 100 yards wide (north-to-south) by 200 yards long (east-to-west). The field is primarily used for sport activities by the school and local community during the dry season, and is closed during the rainy season. The low elevation of this field, and its adjacent areas, serve as drainage for the surrounding watershed - this is evident by the presence of Beith Creek, which borders the southern edge of the field.

The multi-purpose field, and the property abutting it directly to the east, lie above a high water table and are subject to periodic inundation. This creates drainage problems for the entire property, especially in the southeastern corner. When the school field was initially constructed, the multi-purpose field grounds were raised as much as 3-4 feet in some areas to create a level surface. It was then graded, and the excess soil was constructed into an embankment on the eastern side of the grounds.

The embankment was an attempt to hold back the western flowing waters from the neighboring properties, and reduce the patterns of periodic saturation in the SBMS multi-purpose field. It has been moderately successful. During the winter months precipitation saturates the soil here, while the groundwater surface intercepts the soil surface. As recently as April 27th, 2002, water levels of 0-8 inches were observed in the southeastern edges of the field, both between the embankment and the fence-line, and at the field's lowest point, which also lies in the southeastern corner.

There is a bridge that crosses Beith Creek, connecting the school property with a neighboring community farm. Well-developed riparian vegetation extends roughly ten feet from either side of the creek. The existing vegetation is a mix of native and non-

native species and provides habitat for local wildlife. Beith Creek is within the range of several threatened salmonid species, though it is not known if these species still inhabit the waterway. There are six redwoods (approximately 75 feet) and two western red cedars (40 feet) on the eastern edge of the school property. South of the property there are several Sitka spruce trees (approximately 100 feet). An aerial view of the school property is provided in Appendix A.

1.4 Project Objectives

The educational nature program at Sunny Brae Middle School should strive to achieve the following goals:

- Incorporation of the educational nature program into the curriculum of all SBMS natural science classes.
- Provide an opportunity for self-paced learning to individual students.
- Utilization of the program by community members.
- Ninety percent of graduating students will be able to identify flora and fauna in their native habitat within and around the schoolyard.
- Ninety percent of students will understand water and nutrient cycles in their schoolyard ecosystem.

2 Alternative Deliberation

2.1 Introduction

The following alternatives explore viable options for establishing an educational nature program at Sunny Brae Middle School. These alternatives, and the criteria used to judge them, were developed after a brainstorming session appended at the end of this document (Appendix B). The decision criteria are derived in part from the project's objectives.

Once clearly defined these criteria were weighted on a scale from one to five, and each alternative received a criteria score ranging from zero to ten. The product of the criteria weight and criteria score, or the weighted criteria score, can then be used to compare the nature education program options in a manner that fully explores the strengths and weaknesses of each. This evaluation process is outlined in the decision matrix, displayed in Table 2.1, and serves as an attempt to clearly define the project's preferred alternative.

2.2 Criteria

These criteria were developed to evaluate and compare alternatives for an educational nature program at Sunny Brae Middle School. Criteria definitions and scoring methods are listed below.

Low Cost: This criterion evaluates the amount of funding required by the alternatives, including start-up and future costs. Low Cost also takes into account how effectively the alternative will inspire donations of both time and energy. The higher the score the lower the overall cost of each alternative. The nature education program should be cost effective.

Low Maintenance: The educational nature program should require relatively little maintenance. The criterion takes into consideration the amount of upkeep required. The higher the score the lower the amount of ongoing maintenance entailed.

Educational Effectiveness: The program should enable the students to understand how conservation and restoration of habitats are important to wildlife, environmental health, and their local community. It has been shown that by having more knowledge about the natural resources in their surrounding environment, a student's educational experience becomes more meaningful (Douglas et al. 1995). This criterion evaluates how well the alternatives are utilized as a teaching tool to enhance instruction and student achievement. The higher the score the more the alternative achieves these goals.

Ecological Awareness: This nature program should increase awareness and appreciation of the dynamic variety inherent in the surrounding ecosystem. It is believed that environmental education should strive to teach students the things that one might imagine the earth would teach us: connectedness, courtesy, restoration, obligation, and wildness (Orr 1998). The program should also familiarize students with native species that inhabit their local environment. The higher the score the better the alternative attains these goals.

Planning Investment: This criterion includes the initial and ongoing time which the teaching staff invests incorporating the program into their curriculum. The higher the score the less time invested in coordinating the program with an individual class's curriculum.

Community Accessibility: Community Access determines the availability of the educational nature program to the community. The higher the score, the greater is the level of community access.

Opportunity for Independent Learning: This criterion determines the quality of the access provided to students and community members. A student or community member should be able to gain sufficient levels of information on, and appreciation for, their local ecosystem when independently accessing the nature

program. The greater the score the better the quality of access for independent learning.

Space Utilization/Reduced Interference: The school grounds are used for numerous school, and community, sports and activities. The nature education program should not interfere spatially with other programs held on the school campus. The higher the score the less the project impedes on other school activities.

Weather Dependency: Humboldt County has very wet, and unpredictable, weather in the winter months. This criterion determines how the program will be affected by adverse weather conditions. The higher the score the more adaptable the program is to poor weather conditions.

2.3 Alternatives

An adequate decision making process requires the exploration of a reasonable range of viable alternatives. The following options are considered to be practical alternatives for developing an educational nature program master plan for the Sunny Brae Middle School. The final decision may include one or any combination thereof the listed alternatives.

Alternative 1: Classroom Nature Program

Under this alternative a master plan would be developed listing and describing various methods of in-class nature programs. This would include evaluations of the educational effectiveness of the materials involved, and their appropriateness within the existing classroom settings. In-class educational supplies would include reading materials, video presentations, slide shows, and guest lecturers, classroom assignments and computer programs. Teachers would need to incorporate these educational materials into their classroom setting.

The master plan would outline guest speakers who could bring a variety of perspectives and expertise to the classroom. Inventories of educational computer and video programs would be provided that introduce different biological and nutrient cycle processes within the classroom setting. Environmentally educational classroom exercises would also be evaluated, such as student assignments on topics relevant to their local environment, or in-class horticultural activities.

This alternative would have a high educational value do the diversity of materials that could be presented. However, there would be little contact between the students and their environment; this lack of a hands-on, learning experience to submerge students in their local ecosystem is a detriment to such an alternative. This option also underachieves in the community access and independent learning criteria, while requiring a significant input of cost, time and planning for teachers to incorporate the materials into their curriculum.

Alternative 2: SE Corner Nature Area

This alternative would involve developing a master plan for a nature area confined to the southeastern corner of the all-purpose field. The area would stretch roughly ten yards down the southern fence-line and twenty yards up the eastern fence-line. This setting will take advantage of, and enhance, two pre-existing plant communities: the wetland area in the southeastern corner of the property and the redwood trees abutting the eastern fence-line. Additional habitats would have to be created in this corner of the field so that a diverse range of environs would be represented.

The additional communities would then be established alongside pre-existing ones, and could include coastal scrub, coastal prairie, grassland, riparian, deciduous or oak woodland niches. Native plants would be selected, and habitat for appropriate wildlife encouraged. Exposure to the nature area, in both class and extra-curricular time, would enable students to learn how to identify native

flora and fauna. This direct exposure would help students to place themselves within local nutrient and water cycles.

This alternative facilitates community access; students, faculty and community members could be involved in creating and maintaining the nature site. However, this would require significant landscaping to create suitable areas for the imported communities, at a high cost. This alternative also requires that a significant section of the playing field be converted to a nature site, creating possible negative disruptions to the field's current uses.

In addition, it is important to note that the importation of habitats, and viable native plant communities for those habitats, has had a varying range of success at the Pacific Union Elementary School nature area (Ralph). It would follow that the introduction of habitats in one corner of the field would experience a likewise erratic range of successes and failures. In this area of the field the water table is also at its closest to the soil level, making a great majority of the proposed garden unsuitable for habitats other than wetland communities. Therefore, this alternative would require a high cost in the importation of filler soil, covered with a layer of topsoil, to bring the imported habitats above the water table.

Alternative 3: Off-Site Nature Areas

Sunny Brae Middle School has the distinct advantage of being located in an area with a diverse array of natural communities. This alternative would utilize the varied local habitats by taking students on field trips to such places as the Arcata Marsh, the Manila Dunes or the Arcata Community Forest. In addition to outlining potential destinations, the master plan would list educational activities that could occur in the field.

This option would successfully introduce students to local flora and fauna in their native environments, and visiting off-site nature areas would involve students in a hands-on learning experience that submerses them within their regional environs.

This alternative would therefore rate highly on the ecological awareness and educational criteria. However, this alternative may be unfeasible from a cost or liability standpoint, and would not meet the community access or independent learning criterion.

Alternative 4: Nature Path

Alternative 4 involves the construction of a path around the perimeter of the multi-purpose field's western, eastern and southern fence-lines. This will utilize three existing plant communities – the wetland community in the field's southeastern corner, existing components of a coastal temperate forest community along both the eastern and western fence-lines, and the riparian area along Beith Creek in the southwestern corner. This alternative will not attempt to import flora communities that do not naturally occur on the school property, but would simply develop the pre-existing communities.

Plant species native to the existing habitats would be planted alongside flora already present. Constructing appropriate habitats, such as woodpiles or birdhouses could encourage native fauna. Students, faculty, and community members could be involved in planting, creating and maintaining the nature site. Exposure to the nature path, in class and extra-curricular time, would enable students to learn to identify native flora and fauna. This direct exposure would aid students in gaining a greater understanding of local nutrient and water cycles.

This alternative would succeed from an educational and ecological awareness standpoint, while providing extensive community access. A nature path around the perimeter of the field would also conform to the long-term plans for grounds by not impeding ~~on~~ the construction of a running track around the all-purpose field. However, a nature path alone would somewhat underachieve from an independent learning perspective in that few educational materials would be provided on-site.

Alternative 5: Kiosk/Signage

Under this alternative an informational sign, or kiosk, would be erected so that educational materials could be displayed on-site. The kiosk would be a roofed structure that would protect the educational displays from the weather. This main sign would be accompanied by a series of smaller informational signs erected in close proximity to the schoolyard's pre-existing habitat niches, such as the riparian or wetland communities.

The main kiosk could display educational materials concerning nutrient and water cycles within the surrounding environment, while outlining an overall description of the habitats present. The kiosk could also provide space to display rotating information pertinent to the curriculum of the school's science programs - this could include information on native and non-native invasive plants, and display of in-class projects concerning the local environment. The smaller signs could be placed in strategic areas to enhance the understanding of different habitats and plants.

This alternative would succeed in respect to the educational and independent learning criteria; informational signs would allow a range of educational materials to be posted that would be accessible by students and community members. However, a signage program would provide a relatively low level of eco-awareness, in that the existing habitats would not be developed or enhanced, simply labeled. This would not create a visual learning capacity any different than already exists.

Table 2.1 A Decision Matrix displaying scores for the five alternatives in relation to the weighted criteria.

	W	Alt. 1		Alt. 2		Alt. 3		Alt. 4		Alt. 5	
		C.S.	W.C.S.	C.S.	W.C.S.	C.S.	W.C.S.	C.S.	W.C.S.	C.S.	W.C.S.
Low Cost	3	2	6	5	15	5.5	16.5	4.5	13.5	4	12
Low Maint.	2	9	18	8	16	9	18	7	14	8	16
Education	5	9	45	7	35	7.5	37.5	7	35	8	40
Eco-aware	5	5	25	7	35	8.5	42.5	9	45	6.5	32.5
Planning	3	4	12	5	15	6	18	4.5	13.5	7	21
Comm. Access	2.5	0	0	10	25	0	0	10	25	7	17.5
Ind. Learning	4.5	6	27	7	31.5	2	9	7	31.5	9	40.5
Space	3.5	10	35	3	10.5	10	35	9	31.5	9	31.5
Weather	1	10	10	4	4	4	4	4	4	4	4
Total			178		187		180.5		213		215

W = Criteria Weight (0-5)

C = Alternative Criteria Score (1-10)

W.C.S. = Weighted Criteria Score (W x C)

2.4 Final Decision Justification

In the final decision making process it was agreed that there were three defining criteria for environmental education options at the Sunny Brae Middle School. Foremost was educational quality, an essential component of any school program. Ecological awareness and independent learning accompanied this. Ecological awareness is instrumental in connecting students to the learned environment -- physically, conceptually, and aesthetically, while enabling an awareness of the fundamental concepts of ecology. It was agreed that independent learning would also be an important facet, enabling ongoing education by students and furthering community education. By making this program a more valuable commodity for the community, independent learning aspects may also increase the likelihood of the project's ongoing success by creating a support network for the environmental education project outside of the school. The preferred solution would have to score highly on all three of these defining criteria.

Alternatives Four and Five had total alternative scores that were very close to one another, yet neither had above average scores for all three defining criteria. Alternative Five was issued a high rating for independent learning, while Alternative Four was not.

It was believed that the educational materials provided by a series of informational signs would more fully enable someone with no previous knowledge of the school's surrounding natural environment to take part in an autonomous educational experience than other alternatives. However, Alternative Five received a lower score for ecological awareness than Alternative Four. This was based on the fact that constructing a nature area at the school could introduce a wider range of ecosystem niches than already exist on the schools property.

Therefore, Alternatives Five and Four will be combined to create the Alternative Six, which will be more fully outlined in the Preferred Alternative Implementation section of this paper. This preferred alternative would include the construction of a nature area on the perimeter of the multi-purpose field accompanied by a series of informational signs. The combination of these two alternatives will result in an interactive educational nature program by utilizing interpretive signs along a diverse nature trail that provides hands-on learning experiences. Research has shown that interactive exhibits of any sort are more effective than passive exhibits at attracting and holding attention, while enhancing the educational process (Cable and Beck 1998).

3 Implementation Plan

3.1 Implementation Plan Context

To complete the Preferred Alternative Implementation phase of this project, the Sunny Brae Middle School (SBMS) schoolyard has been divided into three existing habitats that are present on the property. The design team will gather information and answer questions about each of these three habitat areas. The following topics will be covered:

- 1) Description of the habitat.
- 2) What plant species are present?
- 3) What wildlife might this habitat attract?
- 4) What native plants would be viable additions to such a habitat?
- 5) How can a habitat garden be implemented in these sites?

The research responsibilities for the implementation of the SBMS educational nature area will be assigned to the design team members according to the following:

Maya Cavelti – Kiosks, interpretive signs, and riparian area habitats.

Evonne Reese – Coniferous forest habitats and class curriculum usage of the nature site.

Nat Waddington – Wetland habitats, trail materials, and the outdoor classroom.

The design team will collectively work on the following preferred alternative requirements:

- A blueprint for the nature trail on a map of the school grounds.
- A description of the schoolyard in detail.

4 Preferred Alternative Implementation

4.1 Introduction

This section explains the preferred alternative for the Sunny Brae Middle School (SBMS) environmental nature program, which consists of a nature trail with an accompanying kiosk and signage, as well as an "outdoor classroom". This educational nature program would provide students with the opportunity for applied learning in a familiar setting. The nature trail would be implemented in sections of habitat, with a long term goal of creating an undivided trail that follows the multi-purpose field's fence line. These habitats will take advantage of the site's pre-existing natural communities, including a riparian zone along Beith Creek, a seasonal wetland area in the southeastern corner of the property, and temperate coastal forest components along the eastern and western fence lines.

Habitat enhancement gardens within the school field should provide a native landscape, while the abutting southern and eastern properties can be utilized to display ecosystem processes and nonnative species. A kiosk would be constructed to display educational materials in conjunction with the nature trail, and gardens will be accompanied with plant signage. An outdoor classroom along the eastern stretch of the trail will also provide the opportunity for classes to hold educational sessions in the surrounding environment.

A master for the program is located in Appendix C. The feasibility of certain specifics of the conceptual plan cannot all be guaranteed at this time. For example, certain species proposed for planting may not be viable immediately in the converted sections of the multi-purpose field, but may "take" in several years as habitat enhancement progresses. The habitat enhancement gardens would evolve over time, being open to new ideas and interests of the school curriculum. For that reason, an exact, specific plan delineating exact locations to plant exact species of plants cannot be, nor should they be, committed to in the process of this review.

4.2 Habitat Enhancement Gardens

The varying habitats of the ecosystem sustain our way of life, regardless of our understanding of the biology or water and nutrient cycles involved. However, when people do not comprehend the basics of habitat functions and values, they make decisions that prevent ecosystems from fully functioning. Undermining the health of habitats can result in long term and irreversible changes that reduce the values of ecosystems. These changes can have grave effects on human and biological health, aesthetic values, and the economy.

A familiarity with the functions and values of an ecosystem can improve decision making today and protect values that may be held by future generations as well. Therefore, the educational nature program at SBMS should strive to enhance students', and community members', understanding of the natural processes and components of the habitats that compose their region. The natural communities that constitute SBMS and its surrounding properties will be the focus of this educational program. Discussion of the proposed habitat enhancement gardens follows, and while flora and fauna surveys were not extensively conducted, recommendations for species inclusion have been incorporated.

4.2.1 Riparian Woodland Areas

The vegetation along natural waterways is termed riparian areas. Riparian areas support a diversity of plants that wildlife are dependent on for food, shelter, and nesting. Only 5% to 10% of California's original (prior to European contact) riparian habitat exists today and much of the remaining habitat is in a degraded condition (Pt. Reyes Bird Observatory).

Sunny Brae Middle School is located in the Humboldt Bay watershed. It has a riparian area, along Beith Creek, which runs across the southern border of their property. There is a wide variety of native and some non-native vegetation along the banks of Beith creek.

This is a small stream that has a year-round flow, with lows of approximately two inches and average highs of two-and-a-half feet. The easiest access to the creek, and therefore the best site for a nature area that the children can have access to, is on the southwest corner of the property. There is a bridge in this area that connects Sunny Brae Middle School to the CSA farm.

Riparian areas provide habitat, riverbank protection, erosion control and improved water quality, as well as numerous recreational and aesthetic values (Pt. Reyes Bird Observatory). Riparian areas slow runoff that is accelerated by paving of urban areas, filter chemicals and excess nutrients coming from agricultural lands, and to some extent ameliorate the effects of increase sediment delivery from eroding hill slopes (Gregory et al. 1991).

Riparian Woodland Flora

The soils in riparian area are usually waterlogged; the water tables are close to the surface, which means that many of the trees have their roots in the water. They also have coarse sediments that are nutrient rich. Trees in riparian zones are typically short-lived, with catkin groups well represented, and they are typically tolerant of seasonal flooding. There is a diversity of herbs, shrubs, and trees (Jalbert).

Riparian trees shade the stream channel; cooling water temperatures and maintaining dissolved oxygen levels. Cool water and high levels of dissolved oxygen are critical to fish in the summertime. Riparian plants, such as willows or alders, drop insects and leaves into the stream providing food for the aquatic environment. When these trees fall into the stream they provide shelter and pools for various aquatic species. In an intact riparian corridor, there is a "layering" effect of plant sizes, shapes and ages that promotes wildlife diversity. (U. C. Berkeley).

Riparian Woodland Fauna

Riparian vegetation provides a habitat for fish, amphibians, bird, and animals. In part because of the loss of riparian habitat, several species are listed as threatened or

endangered in the North Coast. Examples include Steelhead, Coho, and Chinook salmon, Red-legged frog, Freshwater shrimp, and the Yellow-billed cuckoo. Beith Creek supports Steelhead and Coho salmon, Cutthroat trout, and Pacific Lampreys.

Over 135 species of California birds such as the willow flycatcher, yellow-billed cuckoo and red-shouldered hawk either completely depend upon riparian habitats or use them preferentially at some stage of their life history. Riparian habitat provides food, nesting habitat, cover, and migratory corridors. Another 90 species of mammals, reptiles, invertebrates and amphibians such as the Valley elderberry longhorn beetle and Riparian brush rabbit depend on these habitats (Pt. Reyes Bird Observatory).

Riparian Woodland Habitat Enhancement Gardens

Riparian restoration can involve both passive and active restoration. Passive restoration includes grazing exclusion fences and non-harvesting corridors. Active restoration includes planting native and removing non-native vegetation. A list of the existing vegetation around Beith Creek is in Table 4.1. The most invasive non-natives that were identified in May 2002 were English ivy (*Hedera helix*), and Himalayan blackberry (*Rubus discolor*).

Himalayan blackberry can be distinguished from the native relative by its leaflets (five on Himalayan blackberry, three on the Pacific blackberry) and courser arching stem. It forms dense thickets and shades out native plants. Dense thickets can be cut back and roots should be pulled out as best as possible. One should keep their eye on the area for any new sprouts, which should be pulled out immediately with as much of the root as you can get. Be careful not to disturb the native vegetation around the blackberry. (North Coast Chapter of the CNPS)

English ivy has waxy leaves that assume a more rounded shape when they climb up trees. Only the aerial parts produce fruit. It is problematic because it smothers ground cover, shrubs, and even tall trees. The most important place to start

removing it is around the base of trees that are being consumed by it, because the aerial parts produce berries that can be dispersed by birds. Cut through the stems, while being careful not to harm the tree. Pull up the ivy ground cover repeatedly, getting as much root as possible. Just like the Himalayan blackberry, one should keep their eye out for seedlings. (North Coast Chapter of the CNPS)

The riparian vegetation in the southwest corner of the school property should be extended out approximately fifteen feet. The lower area below the multi-purpose field is ideal for an expansion of the riparian buffer zone. One could do this by putting mulch over the grass to kill it off or pulling out the grass by hand. Scheduled planting days can be organized through the school with community volunteer's assistance. Most herbs can be planted in the fall or spring, but deciduous trees, such as willow or alder, should be planted in the winter. Cuttings can be taken from trees already growing by the creek or donations can be collected around the community. A list of native riparian trees, shrubs, and herbs that can be planted are in Table 4.2.

Table 4.1 An inventory of what was found growing in the riparian area of Beith Creek on May 1, 2002.

Common Name	Species	Comments
Elderberry	<i>Sambucus spp.</i>	Native shrub
Blackberries	<i>Rubus ursinus</i>	Native shrub
Thimbleberry	<i>Rubus parviflorus</i>	Native shrub
Alder	<i>Alnus rubra</i>	Native tree
Sword fern	<i>Polystichum munitum</i>	Native fern
Lady fern	<i>Athyrium felix-femina</i>	Native fern
Twinberry	<i>Lonicera involucrate</i>	Native shrub
Fairy-bells	<i>Disporum hookeri</i>	Native herb
Oso berry	<i>Oemleria cliftonii</i>	Native shrub
Willow	<i>Salix ssp.</i>	Native tree
California bay	<i>Umbellularia californica</i>	Native tree
Hedge nettle	<i>Stachys</i>	Native herb
Skunk cabbage	<i>Lystichiton americanum</i>	Native herb
Himalayan blackberry	<i>Rubus discolor</i>	Non-native invasive
Buttercup	<i>Ranunculus repens</i>	Non-native herb
English ivy	<i>Hedura helix</i>	Non-native invasive

Table 4.2. This table shows a brief compilation of native plants that grow in Northern Californian riparian areas; a more extensive list is shown in **Appendix D**.

COMMON NAMES	SPECIES	COMMENTS
Red alder	<i>Alnus rubra</i>	Tree
Red-flowering currant	<i>Ribes sanguineum</i>	Shrub
Stink gooseberry	<i>Ribes bracteosum</i>	Shrub
Dogwood	<i>Cornus spp.</i>	Tree
Hazelnut	<i>Corylus cornuta</i>	Shrub
Big-leaf maple	<i>Acer macrophyllum</i>	Tree
Vine maple	<i>Acer cicutatum</i>	Tree
Ninebark	<i>Physocarpus capitatus</i>	Shrub
Salmonberry	<i>Rubus spectabilis</i>	Shrub
Snowberry	<i>Symphoricarpos spp.</i>	Shrub
Thimbleberry	<i>Rubus parviflorus</i>	Shrub
Twinberry	<i>Lonicera involucrata</i>	Shrub
Willow	<i>Salix spp.</i>	Tree
Deer fern	<i>Dryopteris expansa</i>	Fern
Lady fern	<i>Athyrium felix-femina</i>	Fern
Alumroot	<i>Heuchera spp.</i>	Fern
California figwort	<i>Schrophularia californica</i>	Herb
Fringecups	<i>Tellima grandiflora</i>	Herb
Monkeyflower	<i>Mimulus spp.</i>	Herb
Stinging nettle	<i>Urtica californica</i>	Shrub
Cow parsnip	<i>Heracleum lanatum</i>	Herb
Pig-a-back plant	<i>Tolmiea menziesii</i>	Herb
Colt's foot	<i>Pedisesites spp.</i>	Herb

4.2.2 Coastal Temperate Forests

Coastal temperate forest habitats surround the Arcata community. Therefore, understanding the biological function of these vital ecosystems is crucial to future environmental protection in the area. The Arcata community itself was settled because of commercial logging and coastal fishery opportunities provided by these forest communities. It is important for the students of SBMS to learn how such activities affect temperate rain forest biotic activity.

High precipitation levels, a mild year-round temperature, close proximity to the coast, presence of coastal mountains, and infrequent fire distinguish coastal temperate forests from other coniferous forests. They are recognized as a distinct biome type and are one of the most biologically productive places on earth. Watersheds in the Arcata area empty directly into saltwater and are affected by the cycling of water and nutrients between land

and sea. Organic debris from the forests washes out to sea, enhancing the productivity of the marine ecosystem. The most abundant tree species in the coastal temperate forest of Humboldt County is the coastal redwood.

The coastal redwood's range is a narrow 450-mile strip along the Pacific Ocean from central California to southern Oregon (Inforain). It is generally believed that the last ice age limited the coastal redwoods to this ranges. In the redwood belt, moderate temperatures, heavy winter rains, and dense summer fog provide the trees with the water they need. Such a climate was far more common in earlier eras. Fossils of redwoods have been discovered by paleobotanists throughout what is now the western United States and Canada, and along the coasts of Europe and Asia. Some of these fossils are as much as 160 million years old. The modern coastal redwoods are not quite this old; the earliest fossil record in California has been found to be less than 20 million years old (Save the Redwoods).

A natural coastal temperate forest is a perfect recycling system. Because of high rainfall the soil contains few nutrients; most of the materials necessary for life is in the trees themselves, living and dead, and in the other plants and animals of the forest. When too many trees are removed, the forest is not allowed to die and decay naturally, and many nutrients are lost from the cycle (Save the Redwoods).

A great way to learn about ecosystems is through "hand-on" experiences, which local forests can provide. By learning about these local forests, students and community members have an opportunity to develop a personal connection to their surrounding environment. Developing a greater understanding of coastal temperate forest biological functions will help to protect the local and global environment.

Coastal Temperate Forest Flora

Humboldt County has several other types of coastal temperate forests in addition to redwoods. On the Sunny Brae Middle School campus there are many types of coniferous trees: coastal redwood (*Sequoia sempervirens*), Monterey pine (*Pinus*

radiata), Sitka spruce (*Picea sitchensis*), Western red cedar (*Thuja plicata*), and Douglas fir (*Pseudotsuga menziesii*). Most of these trees have grass beneath them because they are on the outside perimeter of the soccer field. In order to create a small authentic temperate rain forest, the grass underneath the trees could be removed and native plants could be added to the forest floor. There are many plant species that live on the floor of coastal temperate forests. Some native plants that could be added to the forest floor are included in Table 4.3.

Table 4.3 This table displays species that are common in temperate coastal forest biomes. A more extensive list is located in **Appendix E**.

Common Name	Species
Azalea	<i>Rhododendron</i>
Bracken Fern	<i>Pteridium aquilinum</i>
Coltsfoot	<i>Tussilago</i>
Cow Parsnip	<i>Heracleum lanatum</i>
Deer fern	<i>Blechnum spicant</i>
Elderberry	<i>Sambucus</i>
Fairy Bell	<i>Disporum smithii</i>
False Lily-of-the Valley	<i>Maianthemum dilatatum</i>
False Solomon's Seal	<i>Smilacina racemosa</i>
Huckleberry	<i>Vaccinium</i>
Lady fern	<i>Athyrium Filix-Femina</i>
Licorice fern	<i>Polypodium glycyrrhiza</i>
Redwood Sorrell	<i>Oxalis oregana</i>
Rhododendron	<i>Rhododendron</i>
Salal	<i>Gaultheria shallon</i>
Sword fern	<i>Polystichum munitum</i>
Trillium	<i>Trillium ovatum</i>
Wild Ginger	<i>Asarum caudatum</i>

Coastal Temperate Habitat Enhancement Garden

Habitat enhancement gardens will be located along the eastern and western fence lines of the SBMS campus. The grass will need to be removed and topsoil could be

added if desired. Small mounds could be formed with the added topsoil that would replicate a natural forest floor. After the native plants are added beneath the trees, a layer of mulch (duff) should be added to protect the topsoil from erosion and to resemble a top layer of humus.

Coastal Temperate Forest Fauna

Mammals found in the coastal temperate forest include raccoons, skunks, deer, squirrels, porcupines, weasels, mink, voles, rabbits, and the yellow banana slug. Coastal temperate forests provide habitat for threatened species such as the marbled murrelet and the northern spotted owl, both of which nest almost exclusively in old-growth redwood and Douglas-fir forest (Save the Redwoods). The banana slug is a land mollusk and the second largest slug in the world. They are invaluable decomposers, chewing up animal droppings and dead plant material with the several thousand teeth covering their tongue, helping to recycle into the soil (And Earth). A more extensive listing of animals that may use a habitat enhancement garden in this setting is shown in Appendix G.

4.2.3 Wetlands

Wetlands play a critical role in a number of ecological functions. They regulate the movement of water within watersheds, improve water quality through filtration of sediment and organic matter, and offer flood protection and erosion control. In addition, these communities present vital biological habitats to over one-third of the country's threatened and endangered species, while composing only 3.5 percent of the total land area (Mitsch and Gosselink 1993). Unfortunately, wetland resources throughout the United States have been, and continue to be, compromised and degraded by adjacent land use and habitat fragmentation.

Current estimates suggest that prior to colonization 215 million acres of wetlands existed in the lower 48 states, this number has now dwindled to 100 million acres (Audubon). Across the United States wetlands continue to be destroyed at an alarming rate of

100,000 acres per year (Audubon). It is consequently becoming increasingly important that the value of these fragile communities to wildlife, the water cycle, and overall ecosystem health, be illustrated, not only to younger generations, but older generations as well.

Sunny Brae Middle School has the unique advantage of having a seasonal wetland community in the southeastern corner of the school property. The juxtaposition of the wetland communities in the SMBS field, and the drainage zone of the neighboring field, presents a unique, first-hand educational opportunity for wetland education. This project should therefore strive to introduce the students of SBMS, and its surrounding community, to the importance and variety inherent in these disappearing habitats.

Wetland Habitat Enhancement Garden

The City of Arcata defines wetlands as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (City of Arcata 1994). The southeastern corner of Sunny Brae Middle School's multi-purpose field, and the property abutting it to the east, lie above a relatively high water table and are subject to periodic inundation. From the late Fall to early Spring this corner of the field experiences patches of standing water. This situation is compounded by a drainage conduit that channels precipitation and waters from the seasonal wetlands and natural depressions of the eastern-lying fields into a culvert underlying the multi-purpose field.

When the multi-purpose field was originally graded, the excess soil was constructed into an embankment on the eastern side of the field. This attempt to hold back the east-to-west flowing waters from the neighboring properties, and reduce the patterns of periodical saturation in the SBMS multi-purpose field, has been moderately successful. As recently as April 27th, 2002, water levels of 0–8 inches were observed in the southeastern edges of the field, both between the embankment

and the fence-line, and at the field's lowest point, which also lies in the southeastern corner.

During the winter months precipitation saturates the soil here, while the groundwater surface intercepts the soil surface. This creates viable habitat for a seasonal, inland wetland community, to complement the wetlands of the abutting properties, in the depression between the riparian zone surrounding Beith Creek and the drainage ditch for the eastern neighboring field. It is expected that a deepening of the garden plots in these areas will increase the likelihood of a diverse range of wetland species viability.

Wetland Flora

The underlying high water table, and the capability of water movement through the site, allows for depressions in the SBMS multi-purpose field to support hydrophilic vegetation. A widening of the zone along the eastern fence-line (12-18 inches) to create a wetland community, and a deepening of the field's southeastern depression (1-3 inches) to enhance the wet meadow, would expand and enhance the existing wetland habitat and increase the bio-diversity capabilities of the site. This expansion need not be extensive, for there are numerous limited methods that would aid propagation of wetland communities on-site.

Soil amendments can improve plant growth and survivability. Nutrient rich horse manure simulates wetland conditions, while acting as an organic plant growth material. It has been shown that with seeding this method can be extremely productive, resulting in high levels of wetland plant cover in relatively dry conditions (Borton-Lawson). In addition, wetland mulch, carrying the seeds from a natural wetland, could be used to supplement wetland plantings or establish vegetation. In this case the resulting foliage would be unknown.

A nursery stock of dormant rhizomes, bare rootstock, or live vegetation would be the most effective method of establishing a wetland community, while allowing for

landscape design and planning. However, this technique may entail the most expenses. The least expensive alternative would be to allow the wetland garden to colonize itself, but self-colonization allows for excessive levels of non-native species intrusion (Schueler 2000). Therefore, a slight expansion of the prescribed areas, with a soil amendment and combination of a nursery stock and seeding program is recommended for this enhancement garden.

Species noted on-site during the partial survey that could be incorporated into the wetland garden include bulrush (*Scirpus ssp*), common horsetail (*Equisetum arvense*), creeping buttercup (*Ranunculus repens*), and bent grass (*Agrostis ssp*). A brief listing of vegetation that would be viable additions to a habitat enhancement garden in this wetland setting are shown below in Table 4.4.

Table 4.4 This table lists a number of flora that would be viable inclusions in a wetland enhancement garden. A more complete list is located in **Appendix F**.

COMMON NAME	SPECIES	COMMENTS
Brown dogwood	<i>Cornus glabrata</i>	
California blackberry	<i>Rubus ursinus</i>	Aggressive
Coastal willow	<i>Salix hookeriana</i>	
Field mustard	<i>Brassica rapa</i>	
Broadleaf Cattail	<i>Typha latifolia</i>	
Red Alder	<i>Alnus rubra</i>	
Red flowering currant	<i>Ribes sanguineum</i>	
Baker's meadow foam	<i>Limnanthes bakeri</i>	Rare
Water plantain	<i>Alisma plantago-aquatica</i>	
California figwort	<i>Scrophularia californica</i>	
Howell's clover	<i>Trifolium howellii</i>	Uncommon
Lupine	<i>Lupinus bicolor</i>	Aggressive
Wolf's Evening Primrose	<i>Oenothera wolfii</i>	
Water parsley	<i>Oenanthe sarmentosa</i>	
Cow parsnip	<i>Heracleum lanatum</i>	
Stinging nettle	<i>Urtica dioica</i>	Irritant

Wetland Fauna

Diverse species of insects, reptiles, amphibians, birds and mammals depend on wetlands for food, habitat, or shelter, and migratory waterfowl rely on wetlands for breeding and nesting grounds. Wildlife use of the surrounding pastures is evident by the noted presence of numerous birds and mammals in the area during the partial

survey. A brief listing of animals that may exploit a wetland habitat enhancement garden in this setting are shown in Appendix G.

As a result of the proposed wetland enhancement there is a possibility that an increase in insect populations may occur on the immediate site. The effects of this, however, can be considered negligible due to the abundance of aquatic conditions contiguous with the field. Nevertheless, a bat house and swallow roost could be installed on-site in an attempt to manage what may be construed as nuisance species. An enhanced wetland environment would also provide habitat for amphibians that will balance insect populations. Additional wildlife attractions that could be incorporated with the wetland garden include a birdbath, and wood or rock piles; establishment of a pond habitat could also be a viable long-term goal for this section of the field.

4.3 Signage

A main kiosk should be constructed at the beginning of the nature trail, on the northwest corner of the field. A blueprint for a kiosk with a display case, and a cost analysis of the materials needed for its construction, are in Appendix H. Directions for building an inexpensive wooden sign are given in Appendix I. The placement of the main kiosk has been designated to maximize out-reach to community members that would use the educational nature area and the multi-purpose field; users could see the kiosk from the main community entrance to the schoolyard. This location is also out of the way of the multiple-use field's sporting areas. The main kiosk would be the largest of the information signs and would introduce the trail, the purposes that it serves, provide educational material, and outline how visitors could get involved with the project.

Smaller signage would be made for each of the three main habitats. They could show general information and highlight important features of the habitat, such as native vegetation, wildlife that uses the habitat, and water and nutrient cycling. A laminated or "plastic" paper sign on a post is recommended. A good temporary sign will serve

visually much better than none at all, when the best sign cannot be made in time. Laminated signs have low cost, medium durability, and are easy to replace. It is easy and cheap to make copies of these, and they can include pictures, text, and diagrams (Knudson et al. 1995). One problem might be that the signs are easy to remove and vandalize. When displays need to be edited or new material posted they have to be re-created and laminated once again.

Educational signs point out areas of interest that make the trail unique, including natural and historic features. One should avoid placing signs where they may detract from natural surroundings and diminish the trail experience, and balance the need for the signs and their functions with the impact they have on the overall aesthetic appeal of the trail. Another recommendation is that the signs be approximately four feet off the side of the path and raised at least four feet. The distance enables more than one classroom to use the trail at a given time. One class can be talking about the information on the sign, while the other class can easily get by the group without interference. The height of at least four feet is to make the sign easy to read. Table 4.5 shows a cost-benefit analysis of different materials that can be use to construct signage or kiosks.

Table 4.5 A cost-benefit analysis on common materials using to design a sign or kiosk.

Materials	Benefits	Costs
Plastics	Widely available Adaptable to many fabrication processes	Some expand and contract with temperature changes
Fiberglass	Durable Impact resistant Easily formed to custom shapes	
Wood	Range of costs Aesthetic value	Requires special treatment to protect against decay
Aluminum	Widely available Lightweight Does not rust	Requires specialized welding skills and equipment Some require a painted or anodized finish to protect against pitting
Steel	Increase strength Corrosion resistance Available in many forms Easy to cut, form, weld, or rivet	Requires galvanizing or special finished to inhibit rust High cost
Brass/Bronze	Durable	Expensive
Stone	Durable	Hard to work with Expensive Some are susceptible to damage and discoloring from airborne pollutants
Fabrics	Inexpensive	Short-lived Frequently need to be cleaned or replaced
Recycled materials	Economical Can be durable	

4.4 Curriculum

This nature trail design should provide the students and local community with a tool to teach themselves about the natural world around them. Understanding the surrounding ecosystem is an important educational foundation, which influences life choices. A nature area would help students to develop awareness and understanding of real-life environmental issues. Learning can be grounded in a sense of place through the study and investigation of surrounding natural and human communities. This type of instruction fits into the definition of Environmental Education.

According to the Environmental Protection Agency (EPA), environmental education is a learning process that increases knowledge and awareness about the environment and develops skills that enable responsible decisions and actions that impact the environment.

Environmental education enhances critical thinking, problem solving, and decision-making skills, while teaching individuals to make informed and responsible decisions on environmental issues (EPA). Environmental education can help to ensure the health and welfare of human beings by: protecting human health, advancing quality education, creating jobs in the environmental field, creating sustainable economies, promoting environmental protection, and encouraging stewardship of natural resources (EPA).

Aldo Leopold referred to what we now call Environmental Education, as “Ecological Education”. Ecological education means changing the substance and process of education contained in curriculum, changing how educational institutions work and changing the architecture within which education occurs, and most importantly, changing the purpose of learning. This requires breaking free of the confinement in classrooms and school buildings (Leopold 1966). Students will remember more about nature if they go out in it and get their fingernails dirty.

Perhaps with the basic understanding of the way ecosystems function students can have an elevated and realistic foundation for environmental concern. The nature trail will provide students with the concrete examples of many prominent native plants and with a resource to learn about several habitat types. Students will then be able to take this understanding and use it to understand the larger ecosystem they live in.

According to the National Wildlife Federation’s Schoolyard Habitats program, the design of educational habitats can contribute to:

- 1) awareness of habitat concepts,
- 2) knowledge of how habitats work and why they are important,
- 3) habitat investigation skills, and
- 4) skills and knowledge required to protect and restore habitats through action projects (NWF).

The nature program should strive to provide users a deeper understanding of, and a holistic concern for, the earth through positive outdoor experiences. Students will also gain the practical skills and knowledge needed to regenerate native natural environments.

4.5 Usage of the Nature Site

There are 300 students at Sunny Brae Middle School averaging 26 students per classroom. In order to determine that the nature trail will be useful in the school curriculum SBMS science teacher, David Labolle was interviewed (May 2, 2002). Labolle stated that the nature site would be very useful in environmental science instruction and could be used for creek projects, habitat study, and general ecology projects. It was felt that 100% of SBMS students would have some interest in outdoors environmental education projects conducted on the nature trail. By allowing the students to participate in the construction of the three different habitats, they will have an opportunity to explore the characteristics that are unique to each ecosystem. This would be a valuable learning experience for middle school students.

Sunny Brae Middle School currently has established outdoor environmental education programs that use Beith Creek for activities. The nature trail will allow for additional curriculum activities using the three distinct habitats. Some types of projects are simply activities students can do to familiarize themselves with local plants, animals, or biotic characteristics (wetland, riparian area, coniferous forest etc). The following are some brief ideas on how the nature trail can be used for environmental science activities:

- Students can keep personal field notebooks of observations.
- Flower presses or leaf presses.
- Scavenger hunts for plants or insects
- Identifying local flora and fauna
- Life Cycles of Plants by observation
- Learn about the water cycle by observation and recording

Other activity suggestions involve cultural connections to nature. The teachers and students could discuss the importance of salmon, sustainable forestry, sustainable agriculture, and healthy water to the people of the area. There are many other activities and curricula for environmental education that could use the nature trail and the natural world around SBMS. A list of resources for instructors is included in Appendix I.

4.6 Trails

An important component of a successful nature area is well-defined trails. A distinct system of paths delineating where to walk will protect plants from wandering feet, while providing an inviting landscape feature. In an educational setting such that exists at Sunny Brae Middle School a constant flow of traffic should be expected. Therefore, the nature program's trail system should be able to withstand a daily level of traffic comparable to SBMS's average class size of 26 students.

Because this alternative proposes three separate but contiguous garden habitats, it is not immediately necessary to build a continuous path around the perimeter of the multi-purpose field. Consequently, the installation of a trail component at each garden is suggested immediately, with a long-term goal of linking the three plots with an entire footpath. Established trails are subject to the continual erosive forces of rainfall, user traffic, water movement, wind, freeze and thaw cycles, and gravity (Coleman 1981), therefore maintenance factors and material longevity must be heavily considered when the gardens are to be connected.

A comparison of footpath materials is vital to the material decision process. Factors to be reviewed include cost, maintenance, permeability, longevity, and aesthetics. The materials considered for trail construction include gravel, wood chips, flagstone, wooden boardwalk, and recycled carpeting – the material of choice at the Pacific Union Elementary School nature area (Ralph). It is important that the paths located within the gardens be impermanent, so that as each garden evolves independently the paths can shift accordingly.

It must be noted that the physical characteristics at each garden site differ, and therefore one material may not be the solution for the entire trail. For instance the southern edge of the field is at a low elevation and experiences periodic saturation, therefore a material that will not allow the trail to degrade under these conditions should be employed.

Ratings of high, moderate and low, relative to one another, have been assessed for each trail material alternative in accordance to each determining factor; the resulting comparison is shown in Table 4.6. Local companies were consulted to determine the costs of the materials considered for the trails; these costs, however, do not include the cost of building the path. Materials with a high permeability are desired, as they increase rainwater infiltration and decrease erosive factors. Footpath materials such as wood chips and gravel are susceptible to trail erosion, requiring regular maintenance, and recycled carpet would have to be replaced every 2-3 years (Ralph). Some materials have a greater aesthetic appeal than others do; this determining factor includes the probability of unwanted plants growing through the path, and the material's susceptibility to damage by gophers, which are present on-site.

Table 4.6 This table displays the comparison of the trail materials considered, rankings are relative to one another.

Determining Factors	Gravel	Woodchips	Flagstone	Wooden Boardwalk	Recycled Carpeting
Cost¹	low ²	low ²	moderate ²	high ²	free ³
Maintenance	Moderate	high	moderate	low	moderate
Permeability	Moderate	high	low	high	moderate
Longevity	Moderate	low	high	high	moderate
Aesthetics	Low	moderate	high	high	moderate

¹ = These are the costs, relative to one another, of buying materials, not including construction

² = According to a customer representative of "Miller Farms" McKinleyville, California (personal interview, April 18, 2002)

³ = According to a customer representative of "Discount Carpets and Flooring" Arcata, California (personal interview, April 18, 2002)

The results of this review suggest that a gravel path is best suited for the section of wetland garden located at the field's lowest point of elevation. This material will present a trail surface that will not float in the standing water conditions that dominate this section of the field, as wood chips would. This material should also be used as the path expands in the areas of low elevation along the southern fence line, another area where the groundwater surface intercepts the soil surface line during periods of heavy precipitation. It was determined that flagstone and the carpeting may become submerged

here under these conditions, while the expense of the boardwalk alternative makes it unfeasible for such a large section of trail.

Recycled carpeting, the least expensive alternative, is suggested to implement the sections of trail located within the remaining sections of the habitat gardens. This material is preferred by Pacific Union Elementary School's nature area due to its impermanence and flexibility, weather resistance, and relative aesthetic appeal, while providing a dry, non-muddy surface to walk on even in wet weather (Ralph). Heavy carpeting without plastic backing and cut into 18-inch wide strips was suggested - laid upside-down with the edges tucked into the dirt (Ralph). While this material has a life span of only 2-3 years, it must be understood that all path materials present maintenance challenges, and the flexibility of this selection makes it the most desirable option.

4.7 Outdoor Classroom

The master plan delineates an area for an outdoor classroom, where a teacher could gather a group of students for discussion, at a mid-point along the eastern fence line. This site would have comparatively easy access for physically challenged students, and the redwood trees would provide shelter from weather conditions. Simple benches would provide seating, and a portable dry erase board could be brought out to the site. This spot, located at a point of high elevation in the multi-purpose field, presents a view of the eastern neighboring fields, the area's low water table, the riparian corridor along Beith Creek, and the planned educational nature trail.

5 Monitoring and Evaluation

5.1 Introduction

An outline for a monitoring and evaluation plan for the preferred alternative follows. This schedule is approximate, and the process should be evaluated and revised accordingly for the subsequent year.

5.2 Monitoring

Monitoring is the assignment of deadlines that need to be met throughout various stages of the project. The following is a tentative schedule for implementation of the schoolyard nature area. Each task is independent and doesn't necessarily have to be completed in the following order; however, this timeline is believed to be the most effective approach.

July 15, 2002	The kiosk, at the beginning of the nature trail, will be installed.
August 20, 2002	Prior to the 2002-2003 school year, trail fragments will be constructed for the three local habitats (riparian, wetlands, and coastal temperate forest). Habitat garden areas will be designated, and appropriate growing mediums will be established.
Fall Planting	Local flora that prefer a fall planting season will be incorporated into the nature area.
December 20, 2002	Smaller signage will be constructed and erected for each of the three local habitats.
Winter/Spring Planting	Local flora that prefer to be planted in the winter or spring will be incorporated into the nature site.
June 1, 2003	Surveys will be circulated amongst teachers, students, and community members. Each habitat will have some new plants growing in the area.

5.3 Evaluating

Depending on the success of the trails and plant survivorship, evaluation of the project will help determine the best way to increase the productivity of each of the habitats and encourage the educational value of the nature area. Surveys will be designed and distributed to teachers, students, and community members in order to determine the success of the nature area; example surveys are included in Appendix K. The involvement of students, faculty, and community opinions will help to establish the educational benefit of the program.

Graduating students should be targeted to test the educational effectiveness of the nature area and evaluate the level of ecological-awareness that they have gained. Additional comment cards could be posted at the kiosk to solicit on-going community member and student comments on the quality of independent learning and ecological-awareness that the nature area provides. Community member surveys could be conducted through mail, and phone or door-to-door interviews.

6 Conclusion

6.1 Conclusion Context

The successful implementation of this educational nature program will require a dedicated team of teachers, community members, parents and students committed to establishing and maintaining the habitat enhancement gardens. One of the shortcomings of the Pacific Union Elementary School (PUES) nature area has been the waning interest of the nature area's initial implementation team (Ralph). This has resulted in a virtual standstill in the development of the site, with all available efforts being directed towards garden maintenance. It is therefore important that community outreach programs, such as volunteer planting days, be an ongoing aspect of this program to supplement the involvement of teacher and student efforts.

It is the design team's belief that the grant provided by the Arcata Foundation would be best spent in the project's initial implementation phase of the main kiosk's construction. Any remaining funds should then be spent on either the sections of gravel trail in the wetland habitat enhancement garden, or on the importation of topsoil for the individual gardens. The remaining costs of the project will be in acquiring plant specimens. Carol Ralph, the PUES nature area contact, has offered her services (contact information in References) in helping to obtain plants from the Native Plant Society, and stated that plant donations and discounts would be possible for the SBMS nature program. Such plant donations and discounts are common for local educational institutions from the surrounding seed banks and nurseries.

7 List of Preparers

Persons who contributed to the preparing of the SBMS educational nature area master plan are listed below.

Maya Cavelti

(mayathebee78@hotmail.com)

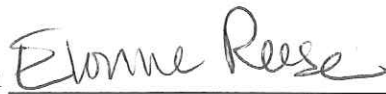
Riparian Area and Signage



Evonne Reese

(err15@humboldt.edu)

Coastal Temperate Forest and Curriculum



Nat Waddington

(nww1@humboldt.edu)

Wetland Area and Trails



8 References

- Arcata, City of. City of Arcata Municipal Code Arcata Land Use and Development Guide. Wetland and Creek Protection Combining. Section 1-0228, 1994.
- Borton-Lawson Engineering. Precision Machine & Tool Wetland Project. Accessed on 4/26/02. www.borton-lawson.com/projects/precisio.htm.
- Coleman, R. "Footpath Erosion in the English Lake District". Applied Geography, 1, 121-131, (1981).
- Environmental Protection Agency. Accessed on 2/6/02. www.epa.gov/enviroed.
- Flink, C.A., et al. Trails for the 21st Century: Planning, Design, and Management Manual for Multi-purpose Trails. Washington, DC: Island Press, 2001.
- Gould, S. J. September. "Enchanted Evening". Natural History, 1991. p. 14.
- Gregory, S. V., et al. "An Ecosystem Perspective of Riparian Zones". Bioscience 41(8). (1991): 540-550.
- Ham, S. H. Environmental Interpretation: A Practical Guide for People with Big Ideas and Small Budgets. Golden, CO: Fulcrum Publishing, 1992.
- Humboldt Water Resources. Conservation Easement Management Plan. Prepared for United Indian Health Services. Trinidad, CA, 1999.
- Inforain Information Network. Accessed on 4/22/02. www.inforain.org.
- Junge, K. "California Creeks: A Fourth Through Eighth Grade Activity-Based Science Curriculum". Master's Thesis. Humboldt State University, 1990.
- Knudson, D. M., et al. Interpretation of Cultural and Natural Resources. State College, PA: Venture Publishing, 1995.
- Leopold, A. A Sand County Almanac. New York: Ballantine, 1966.
- Mitsh, W.J. and J.G. Gosselink. Wetlands, 2nd Ed.; New York: John Wiley & Sons, 1993.
- National Audubon Society. What's a wetland anyway, and why are they so important to protect? Accessed on 4/19/02. www.audubon.org/
- National Wildlife Federation. Accessed on 3/27/02. www.nwf.org.

North Coast Chapter of the California Native Plant Society. Invasive Weeds of Humboldt County. Accessed on 4/13/02. <http://www.northcoast.com/~cnps>.

Orr, D. Earth in Mind. Washington D.C.: Island Press, 1991.

Point Reyes Bird Observatory. Riparian Habitat Joint Venture. Accessed on 4/24/02. www.prbo.org/calif

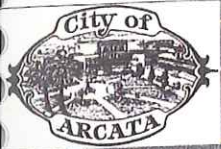
Ralph, Carol. Pacific Union Elementary School Nature Area Specialist. Personal Interview, 25 February 2002.

Riparian Vegetation Management for Pierces's Disease in North Coast California Vineyards. U.C. Berkeley. Accessed on 4/15/02. <http://www.cnr.berkeley.edu/xylella>

Save the Redwoods League. Accessed on 4/30/02. www.savetheredwoods.org .

Schueler, T. "Nutrient Dynamics and Plant Diversity in Volunteer and Planted Stormwater Wetlands". The Practice of Watershed Protection. Article 89. Ellicott City, MD: Center for Watershed Protection, 2000.





Appendix A – Overhead Map of School Property

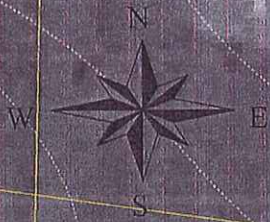


This map is for informational purposes only. The City of Arcata, including any employees or consultants, make no warranties, express or implied, as to the accuracy of the information contained in this map. The City of Arcata, including any employees and consultants, disclaims liability for any and all damages which may arise due to errors in this map and the user's reliance thereon. City of Arcata Project 190620300 - Spain station

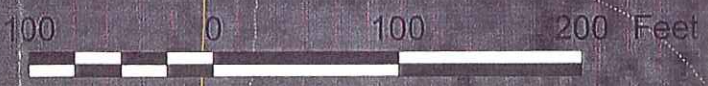
Buttermilk Lane

Sunny Brae Middle School

-  Sunny Brae Middle School
-  10' Contour Interval
-  Creeks
-  Parcels



1" = 100 Feet



Appendix B – Brainstorming

- trail going across creek - through fence
- trail staying with fence boundary \leftarrow building 2nd bridge
- transform whole field to nature area
- kiosk placement 3 sided Δ 1 side watershed, class interaction, 1 flora + fauna
- 2 sided -
- 1 sided
- kioskless - numerous four legged small short one-sided things
- incorporate marsh on other side of creek
- plant native - extend riparian areas from creek
- create diff. native plant habitats - oak woodlands, etc.
- create diff fauna nesting options, bird
 - bird bath
 - platform
 - wood piles / stone piles
 - bird feeder
 - bat box / bird house
- pond for plants
- fish hatchery
- include info on the creek
 - how to control
 - info on exotic + native sps
- schedule days to involve studs + comm. members in construction of nature area
- get volunteer comm based program for habitat planting / building
- class @ HSU dedicated to making / improving / evolving nature areas in Arcata School System
- labelling native + non-native plants
- quiz on native flora
 - plants that attract butterflies / hummingbirds
 - plants w/ medicinal ethnobotany uses
- list native plants
- paths + kiosks, videos, turning all schoolyard into habitat
- evaluate alternatives based on objectives
- solutions = alternative ways to meeting objective

Appendix C – Master Plan

N

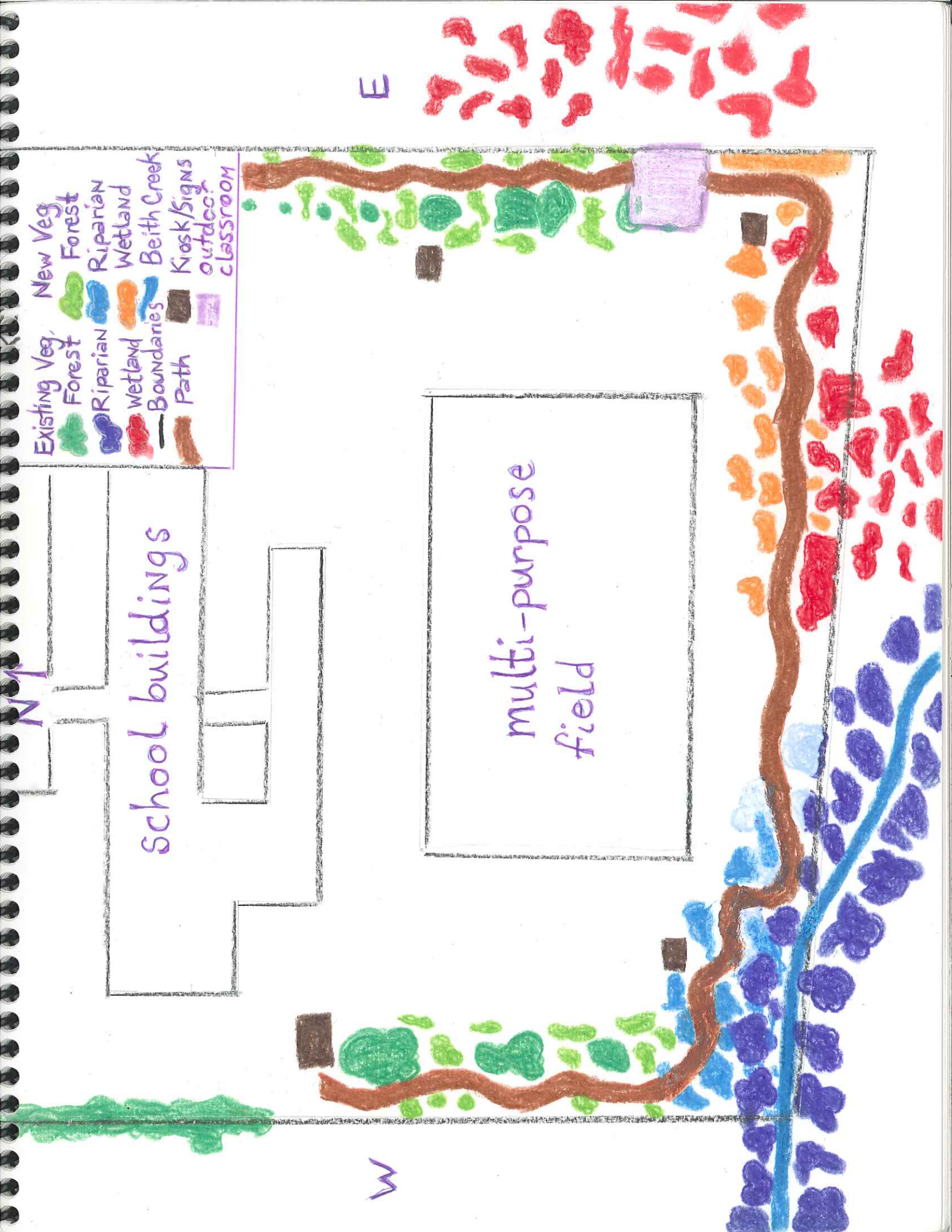
School buildings

multi-purpose field

W

E

- | | |
|---------------|-------------------|
| Existing Veg. | New Veg. |
| Forest | Forest |
| Riparian | Riparian |
| Wetland | Wetland |
| Boundaries | Beith Creek |
| Path | Kiosk/Signs |
| | outdoor classroom |



Appendix D – Riparian Vegetation Planting Guide

Appendix D. Riparian Vegetation Planting Guide. Adopted from Humboldt Water Resources 1999.

Riparian TREES SPECIES	COMMON NAME	PROPOGATION
<i>Acer circinatum</i>	Vine maple	Seeds: scarification 1-2 months, stratification 3-6 months cold Cuttings: taken prior to spring growth Pests: aphids, mildew, verticillium wilt
<i>Acer macrophyllum</i>	Big leaf maple	Seeds: 1-2 months stratification 20-30% of fruits contain fertile seeds Cuttings: taken prior to spring growth Pests: aphids, caterpillars, verticillium wilt
<i>Alnus rubra</i>	Red alder	Seeds: 1-2 months stratification may improve germination Cuttings: seedlings can be easily transplanted Pests: aphids, caterpillars
<i>Cornus nuttallii</i>	Western dogwood	Seeds: 3-4 months stratification, scarification in H2SO4 for 1 hour to improve germination Pests: aphids
<i>Populus balsamifera</i> ssp. <i>trichocarpa</i>	Black cottonwood	Seeds: no treatment, seed bed should be saturated for the first month Cuttings: stem cuttings in fall
<i>Salix exigua (hindsiana)</i>	Narrow-leaved willow	Seeds: no treatment needed Cuttings: grows easily from cuttings
<i>Salix hookeriana</i>	Hooker's willow	Seeds: no treatment needed Cuttings: grows easily from cuttings
<i>Salix lasiolepis</i>	Arroyo willow	Seeds: no treatment needed Cuttings: grows easily from cuttings
<i>Salix sitchensis</i>	Sitka willow	Seeds: no treatment needed Cuttings: grows easily from cuttings
SPECIES	COMMON NAME	MATURE HEIGHT HABITAT REQUIRED COMMENTS
<i>Acer macrophyllum</i>	Big leaf maple	5-30m Moist, well drained Fall color
<i>Alnus rubra</i>	Red alder	10-30m Moist shade
<i>Cornus nuttallii</i>	Western dogwood	<25m Moist shade White flowers
<i>Populus balsamifera</i>	Cottonwood	30m Moist, riparian
<i>Salix exigua (hindsiana)</i>	Narrow-leaved willow	<10m Moist well-drained

Riparian SHRUBS SPECIES	COMMON NAME	PROPOGATION		
<i>Cornus sericea</i> ssp. <i>serica</i>	Streamside dogwood	Seeds: soak in H2SO4 1 hour, cold stratified (3-5 °C) 60-90 days Cuttings: layering, cuttings in fall (not very successful)		
<i>Corylus cornuta</i> var. <i>californica</i>	Hazel, filbert	Seeds: 2-3 months warm stratification then 3-6 months cold, 35-41°F Cuttings: grows from cuttings, layering Pests: aphids, leaf hoppers		
<i>Lonicera involucrata</i>	Twinberry	Seeds: 2-3 months cold stratification Cuttings: grows from cuttings taken in winter		
<i>Oemleria cerasiformis</i>	Oso berry	Seeds: 4 months stratification Cuttings: grows from cuttings		
<i>Physocarpus capitatus</i>	Ninebark	Seeds: no treatment needed Cuttings: grows from cuttings, mid-winter Pests: aphids		
<i>Rubus parviflorus</i>	Thimbleberry	Seeds: no treatment needed Cuttings: grows from cuttings or rhizomes		
<i>Rubus spectabilis</i>	Salmonberry	Seeds: scarify with H2SO4 for 20-30 minutes, warm stratification followed by cold 4-6 months		
<i>Sambucus racemosa</i>	Red elderberry	Seeds: scarify with H2SO4 for 5 minutes, followed by a 2 day soak in water, warm stratification followed by cold Cuttings: grows from soft or hardwood cuttings		
SPECIES	COMMON NAME	MATURE HEIGHT	HABITAT REQUIRED	COMMENTS
<i>Rubus parviflorus</i>	Thimbleberry	0.5-2m	Moist shade	Berries
<i>Rubus spectabilis</i>	Salmonberry	0.5-2m	Moist shade	Berries
<i>Sambucus racemosa</i>	Red elderberry	1-3m	Moist shade	Berries

Riparian HERBS/GROUND COVER SPECIES	COMMON NAMES	PROPOGATION		
<i>Heracleum lanatum</i>	Cow parsnip	Seeds: no treatment needed, seed should be leached for 4 hours before planting		
<i>Lysichiton americanum</i>	Skunk cabbage	Seeds: no treatment needed		
<i>Mimulus cardinalis</i>	Cardinal monkey flower	Seeds: no treatment needed		
<i>Mimulus guttatus</i>	Golden monkey flower	Seeds: no treatment needed		
<i>Urtica dioica</i>	Nettle	Seeds: no treatment needed		
SPECIES	COMMON NAME	MATURE HEIGHT	HABITAT REQUIRED	COMMENTS
<i>Achlys triphylla</i>	Vanilla leaf		Moist shade	
<i>Angelica arguta</i>	Angelica	1-1.5m	Open/shade moist	
<i>Asarum caudatum</i>	Wild ginger	Ground cover	Moist, shade	
<i>Clatonia sibirica</i>	Miner's lettuce		Moist, shade	
<i>Heracleum lanatum</i>	Cow parsnip	1-3m	Sun, partial shade, moist	
<i>Urtica dioica</i>	Nettle	1m	Shade, moist	Stinging hairs

Appendix E – Temperate Coastal Planting Guide

Appendix E. Temperate Coastal Forests Vegetation Planting Guide. Adopted from Humboldt Water Resources 1999.

Temperate Coastal TREES SPECIES	COMMON NAME	PROPOGATION		
<i>Picea sitchensis</i>	Sitka spruce	Seeds: no treatment needed Pests: aphids, mites		
<i>Pseudotsuga menziesii</i>	Douglas fir	Seeds: 3-6 week stratification or no treatment Pests: aphids, mites		
<i>Sequoia sempervirens</i>	Coast redwood	Seeds: no treatment, 1 month stratification may improve germination Pests: cypress scale, bark beetle, flat-headed twig borer, needle blight, mites, bark canker, Botrytis		
<i>Thuja plicata</i>	Western red cedar	Seeds: 1-2 months stratification or soak in 0.2% Potassium nitrate, 12 hours, no treatment needed, may have satisfactory germination Cuttings: grows from cuttings Pests: borers, fungus		
TEMPERATE COASTAL SHRUBS SPECIES	COMMON NAME	MATURE HEIGHT	HABITAT REQUIRED	COMMENTS
<i>Cupressus lawsoniana</i>	Port Orford cedar	50m	Moist, cool, coastal	
<i>Picea sitchensis</i>	Sitka spruce	60m	Moist	
<i>Pseudotsuga menziesii</i>	Douglas fir	60m	Moist	
<i>Sequoia sempervirens</i>	Coast redwood	<110m	Moist	

Temperate Coastal SHRUBS SPECIES	COMMON NAME	PROPOGATION
<i>Gaultheria shallon</i>	Salal	Seeds: no treatment needed, plant in sphagnum moss Cuttings: grows from cuttings Pests: leaf spot, mites, thrips
<i>Vaccinium parviflorum</i>	Red huckleberry	Seeds: 4-6 months warm stratification then 3-6 cold, 35-41°F Cuttings: grows from cuttings
<i>Vaccinium ovatum</i>	Evergreen huckleberry	Seeds: no treatment needed, 1-3 month stratification plant in sphagnum moss Cuttings: 4-6 cuttings-difficult from cuttings or from sucker division

SPECIES	COMMON NAME	MATURE HEIGHT	HABITAT REQUIRED	COMMENTS
<i>Rhododendron occidentale</i>	Western azalea	1-1.5m	Sun/shade	Pink-orange flowers
<i>Vaccinium parviflorum</i>	Red huckleberry	0.5-2.5m	Shade	Berries
<i>Vaccinium ovatum</i>	Evergreen huckleberry	0.5-2.5m	Shade/sun	Berries

Temperate Coastal HERBS/GROUND COVER SPECIES	COMMON NAMES	PROPOGATION
<i>Aquilegia formosa</i>	Columbine	Seeds: no treatment needed
<i>Asarum caudatum</i>	Wild ginger	Divisions Pests: fungus leaf spot, slugs, snails
<i>Eschscholzia californica</i>	California poppy	Seeds: no treatment needed
<i>Heracleum lanatum</i>	Cow parsnip	Seeds: no treatment needed, seed should be leached for 4 hours before planting
<i>Oxalis oregana</i>	Redwood sorrel	Seeds: no treatment needed, divisions
<i>Petasites frigidus</i> var. <i>palmatus</i>	Colts foot	Seeds: no treatment needed
<i>Smilacina racemosa</i>	False salmons seal	Seeds: 6 months cold, 3 months warm, 6 months cold, make take up to 2 years to germinate Divisions of rhizomes
<i>Trillium ovatum</i>	Trillium	Seeds: 1 month stratification

SPECIES	COMMON NAME	MATURE HEIGHT	HABITAT REQUIRED	COMMENTS
<i>Aquilegia formosa</i>	Columbine		Sun/partial shade	Red flowers
<i>Asarum caudatum</i>	Wild ginger	Ground cover	Moist, shade	
<i>Eschscholzia californica</i>	California poppy		Sun	Orange flowers
<i>Heracleum lanatum</i>	Cow parsnip	1-3 meters	Sun/partial shade, moist	
<i>Oxalis oregana</i>	Redwood sorrel	Groundcover	Shade	
<i>Petasites frigidus</i> var. <i>palmatus</i>	Colts foot	0.5m	Shade-partial sun	White flowers
<i>Smilacina racemosa</i>	False salmons seal		Shade	
<i>Trillium ovatum</i>	Trillium		Shade	White flowers

Appendix F – Wetland Vegetation Planting Guide

Appendix F. Wetland Vegetation Planting Guide. Adopted from Humboldt Water Resources 1999.

Wetland TREES SPECIES	COMMON NAME	PROPOGATION	COMMENTS
<i>Alnus rubra</i>	Red alder	Seeds: 1-2 months stratification may improve germination Cuttings: seedlings can be easily transplanted Pests: aphids, caterpillars	
<i>Myrica californica</i>	Wax myrtle	Seeds: 2-3 months stratification Cuttings: seedlings can be easily transplanted Pests: mites, thrips	
<i>Salix hookeriana</i>	Hooker's willow	Seeds: no treatment needed Cuttings: grows easily from cuttings	
SPECIES	COMMON NAME	MATURE HEIGHT	HABITAT REQUIRED
<i>Alnus rubra</i>	Red alder	10-30m	Moist, shade
<i>Myrica californica</i>	Wax myrtle	5-15m	Moist, sun or shade

Wetland SHRUBS SPECIES	COMMON NAME	PROPOGATION	COMMENTS
<i>Corylus cornuta</i> var. <i>californica</i>	Hazel, filbert	Seeds: 2-3 months warm stratification then 3-6 months cold, 35-41°F Cuttings: grows from cuttings, layering Pests: aphids, leaf hoppers	
<i>Ledum glandulosum</i>	Labrador tea	Seeds: no treatment needed Cuttings: grows from cuttings, layering	
<i>Rhododendron macrophyllum</i>	California rose-bay	Seeds: no treatment needed, grow in sphagnum moss under lights Cuttings: grows from cuttings, soak in binomial solution Pests: mites, blight	
<i>Ribes sanguineum</i>	Flowering currant	Seeds: 3-5 months stratification Cuttings: grows from cuttings	
<i>Rosa californica</i>	California wild rose	Seeds: 3 months stratification Cuttings: poor success	
<i>Rubus parviflorus</i>	Thimbleberry	Seeds: no treatment needed Cuttings: grows from cuttings or rhizomes	

<i>Sambucus racemosa</i>	Red elderberry	Seeds: scarify with H ₂ SO ₄ for 5 minutes, followed by a 2 day soak in water, warm stratification followed by cold Cuttings: grows from soft or hardwood cuttings			
SPECIES	COMMON NAME	MATURE HEIGHT	HABITAT REQUIRED	COMMENTS	
<i>Rhododendron macrophyllum</i>	California rose-bay	2.5m shade	Shade	Red flowers	
<i>Rosa californica</i>	California wild rose	0.5-1m	Shade/sun	Pink flowers	
<i>Rubus parviflorus</i>	Thimbleberry	0.5-2m	Moist, shade	Berries	
<i>Sambucus racemosa</i>	Red elderberry	1-3m	Moist, shade	Berries	

Wetland HERBS/GROUND COVER SPECIES	COMMON NAMES	PROPOGATION			
<i>Heracleum lanatum</i>	Cow parsnip	Seeds: no treatment needed, seed should be leached for 4 hours before planting			
<i>Urtica dioica</i>	Nettle	Seeds: no treatment needed			
SPECIES	COMMON NAME	MATURE HEIGHT	HABITAT REQUIRED	COMMENTS	
<i>Angelica arguta</i>	Angelica	1-1.5m	Open/shade, moist		
<i>Camassia quamash</i> <i>ssp. quamash</i>	Camass		Open, moist		
<i>Heracleum lanatum</i>	Cow parsnip	1-3m	Sun, partial shade, moist		
<i>Urtica dioica</i>	Nettle	1m	Shade, moist	Stinging hairs	

Wetland GRASSES SPECIES	COMMON NAME	MATURE HEIGHT	HABITAT REQUIRED	COMMENTS	
<i>Alopecurus geniculatus</i>	Water foxtail	<36cm	Wetlands, standing		
<i>Calamagrostis canadensis</i>	Blue-joint reed grass	1m	Open, moist		
<i>Calamagrostis nutkaensis</i>	Reed grass	1m	Open, moist		
<i>Deschampsia cespitosa</i>	Tufted hairgrass	1m	Open, wetland edges	Perennial	
<i>Leymus triticoides</i>	Creeping rye grass (wild rye)	<36cm	Open, wetland edges		

Wetland WETLAND PLANTS SPECIES	COMMON NAMES	PROPOGATION		
<i>Carex obnupta</i>	Slough sledge	Seeds: stratify wet in a refrigerator 3-6 month		
<i>Darnera peltata</i>	Indian rhubarb/umbrella plant	Seeds: no treatment needed		
<i>Juncus effusus</i>	Pacific soft rush	Seeds: no treatment needed, divisions		
<i>Lysichiton americanum</i>	Skunk cabbage	Seeds: no treatment needed		
<i>Mimulus cardinalis</i>	Cardinal monkey flower	Seeds: no treatment needed		
<i>Mimulus guttatus</i>	Golden monkey flower	Seeds: no treatment needed		
<i>Scirpus acutus</i>	Bullrush	Seeds: store in refrigerator 35-39°F 6 months, germinate 86-89°F, continuous high light (180-200 foot candles), divisions		
<i>Scirpus americanus</i>	American bullrush	Seeds: store in refrigerator 35-39°F 6 months, germinate 86-89°F, continuous high light (180-200 foot candles), divisions		
<i>Typha latifolia</i>	Cattail	Seeds: 2 month stratification		
SPECIES	COMMON NAME	MATURE HEIGHT	HABITAT REQUIRED	COMMENTS
<i>Carex obnupta</i>	Slough sledge	1-1.5m		
<i>Darnera peltata</i>	Indian rhubarb/umbrella plant	0.5-1m		
<i>Eleocharis macrostachya</i>	Spikerush	30cm		
<i>Helenium bigelovii</i>	Sneezeweed	0.5m		Yellow flowers
<i>Juncus effusus</i>	Pacific soft rush	0.5m		
<i>Lysichiton americanum</i>	Skunk cabbage	0.5m		Large leaves
<i>Mimulus cardinalis</i>	Cardinal monkey flower	30cm		Orange flowers
<i>Mimulus guttatus</i>	Golden monkey flower	30cm		Yellow flowers
<i>Scirpus acutus</i>	Bullrush	1-1.5m		
<i>Scirpus americanus</i>	American bullrush	40cm		
<i>Sparganium emersum</i> ssp. <i>emersum</i>	Bur-reed	40cm		
<i>Typha latifolia</i>	Cattail	1-2m		

Appendix G – Fauna Species

The appendix lists several possible fauna species that can be incorporated into the nature area.

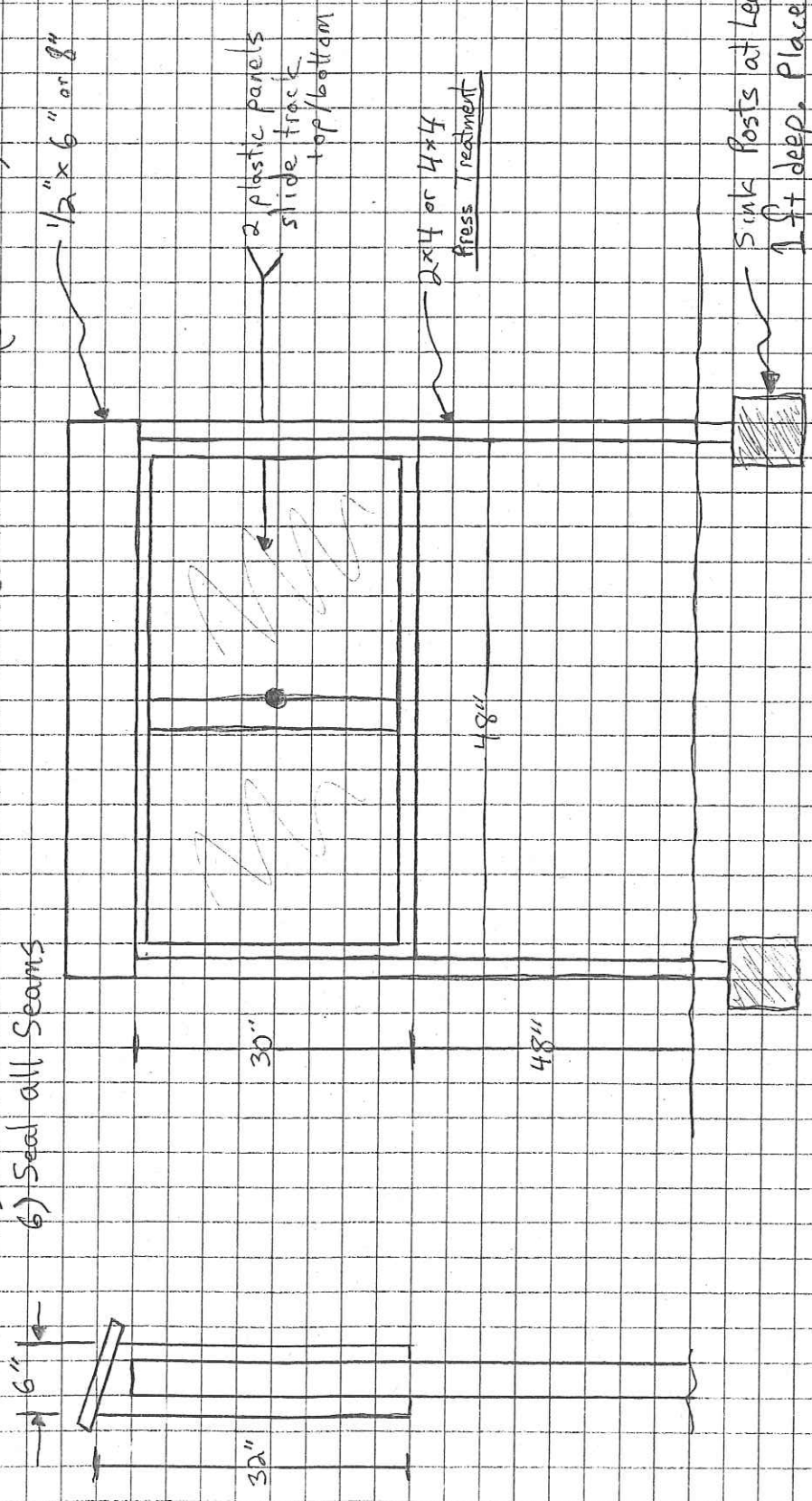
COMMON NAME	SPECIES
Song sparrow	<i>Melospiza melodia</i>
Barn swallow	<i>Hirundo rustica</i>
Common raven	<i>Corus corax</i>
Red-tailed hawk	<i>Buteo jamaicensis</i>
Red-winged blackbird	<i>Agelaius phoeniceus</i>
Marsh wren	<i>Cistothorus palustris</i>
Short-eared owl	<i>Asio flammeus</i>
Seagull	
Butterfly ssp	
Dragonfly ssp	
Bee ssp	
Red-legged frog	<i>Rana aurora</i>
Pacific tree frog	<i>Hyla regilla</i>
Common garter snake	<i>Thamnophis sirtalis</i>
Bat ssp.	
Skunk	
Gray fox	
Deer mouse	<i>Peromyscus maniculatus</i>
Valley gopher	<i>Thomomys bottae</i>
California meadow mouse	<i>Microtus californicus</i>
Deer	<i>Odocoileus hemionus</i>
Raccoon	<i>Procyon lotor</i>
Dog	<i>Canis familiaris</i>
Cat	<i>Felis domesticus</i>
Northwestern salamander	<i>Ambystoma gracile</i>
Rough-skinned newt	<i>Taricha granulosa</i>
California slender salamander	<i>Batrachoseps attenuatus</i>

Appendix H – Kiosk Blueprint and Material Evaluation

The following is a Material Evaluation for the accompanying Kiosk Blueprint.

Materials	Price							
	Fir		Cedar		Treated		Redwood	
Type of wood	High	Low	High	Low	High	Low	High	Low
Grade of plywood								
10ft. 4 X 4in. posts (2)	21.3	21.3	42.7	42.7	19.7	19.7	42.7	42.7
Cork Board 1/4in X 30 X 42in.	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4
1/2in. X 1ft X 4ft. plywood	5.5	3.6	5.5	3.6	5.5	3.6	5.5	3.6
3/8in. X 32" X 48" plywood	13.8	8.7	13.8	8.7	13.8	8.7	13.8	8.7
8ft. 2 X 6in. Framed box (2)	8.8	8.8	15.8	15.8	11.8	11.8	18.4	18.4
1/10in. X 24 X 30in. Plastic (2)	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
Miscellaneous	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Cost	92.6	85.6	121	114	94	86	123.5	116.5

- 1) Fabricate Box from 2" x 6" Board. Use 3/8" Plywood for the back
- 2) Add Vent Holes in Frame (2) at Top L+R (2) in bottom L+R
- 3) Use Double Metal Track - Top + Bottom
- 4) Use 3/16" Plexi - Glass Panels - must have lock
- 5) Mount Bulletin Board with Cork Surface Inside Box (30" x 42")
- 6) Seal all Seams



Draw by: Lou Lau

Appendix I – Directions for Construction of a Wood-Routed Sign

Step 1: Select the signposts and decide how you'll mount the sign to them, although you won't actually attach the sign until later. Pick sign posts that are long enough to support the sign at the desired level once they're put in the ground. Plan to submerge the posts at least 3 feet into the ground. The thicker and heavier the posts, the more resistant they'll be to weather and vandals.

Step 2: Cut and sand the wood you're going to use as the sign face. The thickness of the wood is also important. The minimum recommended thickness is 0.5 inches. If at all possible, it's a good idea to drill the mounting holes in the sign face and post(s) now.

If you're not going to carve into the wood and just want a display, skip to Step 7. The hardest part of having a display case is getting access under the plastic covering and protecting the displays from getting wet. There could be a groove in the posts that the covering fits into, a hinge-door that covers the display, or nails that can be easily removed and replaced. To prevent wetness inside the case a roof or small ledge could be constructed over the sign.

Step 3: Using a pencil, trace or transfer the desired words and illustrations onto the wood. To avoid a cluttered look, it's best to leave a left and right margin for the mounting holes and confine the design to the part of the sign face inside the margins. Avoid small letters and highly detailed artwork.

Step 4: With a router or gouging tool, carefully cut out (or carve) the letters and drawings. A good depth for most signs is 1/8 in. Be conservative in cutting. You can always deepen a groove that's too shallow, but you can't do the reverse.

Step 5: Choose a simple color scheme using the following guidelines:

- a. If the sign will be located in bright sunlight, consider painting the background a dark color and the letters and artwork lighter colors.
- b. If the sign will be located in strong shade, consider painting the background a light color and the letters and artwork darker colors.

Step 6: Paint the sign. It's usually easier to paint the background surface first and then to paint the letters and artwork. Exterior paints are best. If you plan to cover the painted sign with a varnish or sealer, be sure to select a paint that won't react with the type of coating you're going to use.

Step 7: Unless a rustic look is desired, it's a good idea to protect the sign face with two or more coats of varnish or wood sealer before installing it outdoors.

Step 8: The posts will need to be treated. If you can afford pressure-treated posts, buy them. They'll save money in the long run. If you can't afford them, you can treat each post by soaking it (or at least the part of it that will be underground) in a wood preservation for at least two days. Wear protective gloves at all times when using them, and dispose of it properly. If you plan to paint the posts, treat only the part that will be put underground.

Step 9: Mount the signs to the post(s). Use bolts and nuts (not nails). On the back of each post, drill a shallow but slightly wider hole over the top of the original bolt-hole. The second hole should be only wide enough for your socket to fit over the nut for tightening. Put the nut on the bolt and tighten it with the socket. You can then fill in each hole with plastic wood or other hardening filler and paint over it to hide the nuts.

Step 10: Install the finished sign. Put the signposts in holes that are at least 3 feet deep. If you are using more than one post, their holes must be the same depth or the sign won't be level. The only way to effectively prevent your sign from being stolen is to use cement. A gravel bed and a piece of rebar will help hold the post securely in the cement. Even if you don't use cement, putting rebar into the post is a good idea because it's harder to pull out of the ground. (Adopted from Ham 1992)

Appendix J – List of Resources for Instructors

The Streamkeepers Field Guide by Mudoch, T. Cheo, M., O'Laughlin K. Whittmore T., Larson, G., Horsey, D. Greenberg, S., Britt, C., Basset, B., Alexander, K., and T. Toles. (1991) Published by Adopt a Stream Foundation, Everett, WA.

Project Learning Tree Activity Guide for Grades 7-12 (1988). Published by the American Forest Council. Washington DC

Science for Children, Resources for Teachers (1988). National Academy Press. Washington, DC.

Western Urban Streams Conference. (November 15-17 1996) Arcata High School, Arcata, CA. Sponsored by the City of Arcata. (The city of Arcata Environmental Services Department is always a valuable resource locally)

Adopting a Stream, A Northwest Handbook. By Yates, S. and S. Noel. (1988) Adopt a Stream Foundation Publication distributed by University of Washington Press, Seattle and London.

Adopting a Wetland, A Northwest Handbook by Yates, S. and S. Noel. (1988) Adopt a Stream Foundation Publication distributed by University of Washington Press, Seattle and London.

Appendix K – Example Surveys

Nature Trail Survey for Community Members

Please circle the appropriate answer

- 1) How would you rate your overall experience using the nature trail?
(1) Excellent (2) Good (3) Fair (4) Poor (5) Terrible
- 2) Has your understanding of water/nutrient cycles improved after using the nature trail?
(1) Improved drastically (2) Improved greatly (3) Above average improvement (4) Average improvement (5) Not improved at all
- 3) Has your understanding of ecosystem interactions improved after using the nature trail?
(1) Improved drastically (2) Improved greatly (3) Above average improvement (4) Average improvement (5) Not improved at all
- 4) How many native plants have you learned to identify from using the nature trail?
(1) 20+ (2) under 15 (3) under 10 (4) under 3 (5) Not at all
- 5) How well did the signs along the trail convey appropriate information?
(1) Excellent (2) Good (3) Fair (4) Below average (5) Poor
- 6) Do you have any comments or suggestions on how the nature trail could be improved?

Nature Trail Survey for Sunny Brae Middle School Students

Please circle the appropriate answer

- 1) How would you rate your overall experience using the nature trail?
(1) Excellent (2) Good (3) Fair (4) Poor (5) Terrible
- 2) Has your understanding of water/nutrient cycles improved after using the nature trail?
(1) Extremely (2) Above average (3) Average (4) Below average (5) Not at all
- 3) Has your understanding of ecosystem interactions improved after using the nature trail?
(1) Extremely (2) Above average (3) Average (4) Below average (5) Not at all
- 4) How many native plants have you learned to identify from using the nature trail?
(1) 20+ (2) under 15 (3) under 10 (4) under 3 (5) None at all
- 5) How well did the signs along the trail convey appropriate information?
(1) Excellent (2) Good (3) Fair (4) Poor (5) Not at all
- 7) When using the nature trail for class work, do you find the activities enjoyable?
(1) Extremely (2) Somewhat (3) Average (4) Below average
(5) Not at all
- 8) Do you have any comments or suggestions on how the nature trail could be improved?

Nature Trail Survey for Sunny Brae Middle School Instructors

Please circle the appropriate answer

- 1) How would you rate your overall experience using the nature trail in your teaching curriculum?
(3) Excellent (2) Good (3) Fair (4) Poor (5) Terrible
- 2) Has the student's understanding of water/nutrient cycles improved after using the nature trail?
(1) Extremely (2) Above average (3) Average (4) Below average (5) Not at all
- 3) Has the student's understanding of ecosystem interactions improved after using the nature trail?
(1) Extremely (2) Above average (3) Average (4) Below average (5) Not at all
- 4) How well did the signs along the trail convey appropriate information?
(1) Excellent (2) Good (3) Fair (4) Below average (5) Poor
- 5) When using the nature trail for class instruction, do you feel the students find the activities enjoyable?
(1) Extremely (2) Somewhat (3) Average (4) Below average
(5) Not at all
- 6) Do you have any comments or suggestions on how the nature trail could be improved?

Educational Nature Program



Designed by:
Maya Cavelti
Evonne Reese
Nat Waddington

Background

- SBMS serves 300 students grades 6-8th
- Multi-purpose field
- CSA farm
- Beith Creek
- A variety of native vegetation is present
- The field is located on a high water table

Problem Definition

Sunny Brae Middle School has the need for a master plan outlining an educational nature program that will enable the students, and ideally community members, to learn about their local ecosystem.

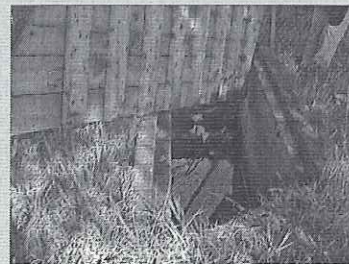
Eastern Neighboring Wetland



Context

- SBMS has been chosen by the Arcata School Board to develop a pilot plan for an educational nature program.
- The Arcata Foundation has donated \$250 to implement the project.
- Contacts:
 - Arcata School Board- David Narum
 - SBMS Assistant Principle- Matt Malkus
 - SBMS Science Teacher- David Labolle
 - Pacific Union Nature Area Specialist- Carol Ralph

Drainage Culvert



Objectives

- Incorporation of the educational nature program into the curriculum of all SBMS natural science classes.
- Provide an opportunity for self-paced learning to individual students.
- Utilization of the program by community members.
- 90% of graduating students will be able to identify flora and fauna in their native habitat within and around the schoolyard.
- 90% of graduating students will understand water and nutrient cycles in the schoolyard ecosystem.

Decision Matrix

	W	Alt. 1		Alt. 2		Alt. 3		Alt. 4		Alt. 5	
		C.S.	W.C.S.	C.S.	W.C.S.	C.S.	W.C.S.	C.S.	W.C.S.	C.S.	W.C.S.
Low Cost	3	2	6	5	15	6.5	16.5	4.5	13.5	4	12
Low Maint.	2	9	18	8	16	9	18	7	14	8	16
Education	5	9	45	7	35	7.5	37.5	7	35	8	40
Eco-awareness	5	6	25	7	35	6.5	42.5	9	45	6.5	32.5
Time/planning	3	4	12	5	15	6	18	4.5	13.5	7	21
Comm. Access	2.5	0	0	10	25	0	0	10	25	7	17.5
Ind. Learning	4.5	6	27	7	31.5	2	9	7	31.5	9	40.5
Space	3.5	10	35	3	10.5	10	35	9	31.5	9	31.5
Weather	1	10	10	4	4	4	4	4	4	4	4
Total			178		187		180.5		213		215

Alternative Deliberation Criteria

- Low Cost
- Low Maintenance
- Educational Effectiveness
- Ecological Awareness
- Planning Investment
- Community Accessibility
- Opportunity for Independent Learning
- Space Utilization/Reduced Interference
- Weather Dependency

Preferred Alternative

- The three most important criteria were educational effectiveness, independent learning, and eco-awareness.
- Combined Alternatives #4 and #5 met these three defining criteria.

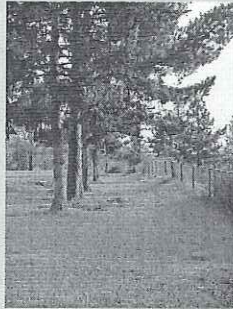
Project Alternatives

- Alternative #1: Classroom Nature Program
- Alternative #2: Southeast Corner Nature Area
- Alternative #3: Off-site Fieldtrips
- Alternative #4: Schoolyard Nature Path
- Alternative #5: Schoolyard Kiosk/Signage

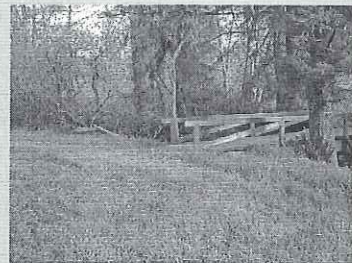
Project Implementation Outline

- Habitat Enhancement Gardens
 - Coastal Temperate Forests
 - Riparian Woodlands
 - Wetland
- Signage Design
- Trail Design
- Curriculum

Trail Beginning:
Coastal Temperate Forest



Bridge Connecting SBIMS to CSA Farm



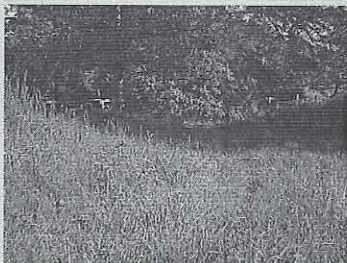
Forest View from Riparian Area



Vegetation Around Riparian Area



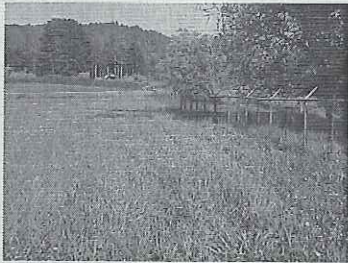
Riparian Habitat Enhancement Garden



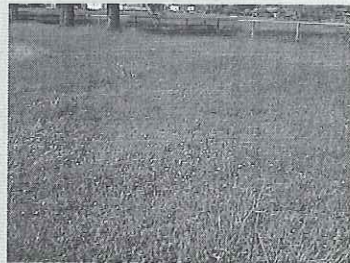
Pool for Fish Habitat



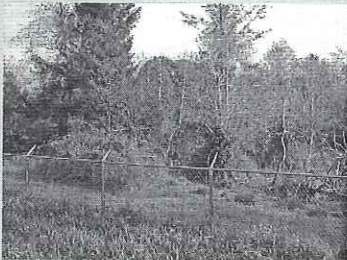
Wetland View from Riparian Area



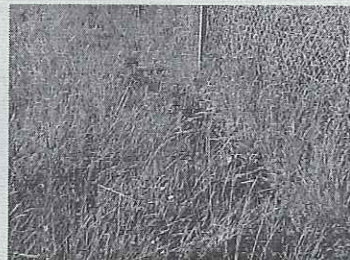
Point of Lowest Elevation



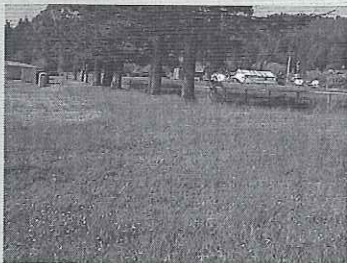
Existing Wetland Vegetation



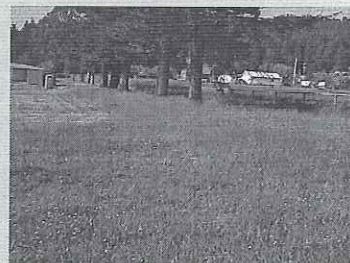
Wetland Garden



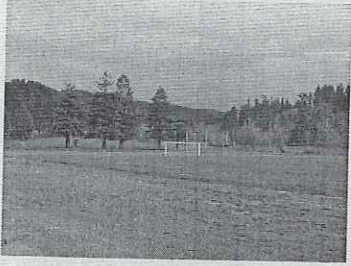
Wetland Enhancement Garden



Forest View from Wetland



Eastern Coniferous Forest



Cost- Benefit Analysis of Trail Material

Determining Factors	Gravel	Woodchips	Flagstone	Wooden Boardwalk	Recycled Carpeting
cost	moderate	moderate	moderate	high	low
maintenance	moderate	high	moderate	low	moderate
permeability	moderate	high	low	high	high
longevity	moderate	low	high	high	moderate
aesthetics	low	moderate	high	high	moderate

Kiosk/ Signage



- A main kiosk will be at the beginning of the trail.
- Smaller, cheaper signs will be posted at each of the three habitat enhancement gardens.
- Important native plants could be marked.

Curriculum



- Importance of Environmental Education
- Usage of the nature site for classroom activities

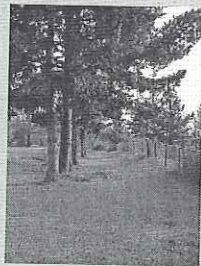
Trail

Overall Trail Design

Materials:

- ❑ Gravel
- ❑ Woodchips
- ❑ Flagstone
- ❑ Wooden Boardwalk
- ❑ Recycled Carpeting

Outdoor Classroom



Monitoring

- July 15, 2002: Main kiosk installation
- Aug. 20, 2002: Trail fragments constructed
- Fall Planting
- Dec. 20, 2002: Smaller signage put in ground
- Winter/Spring Planting
- June 1, 2003: Each habitat will have new natives plants growing

Evaluating

- We designed three different surveys for students, faculty, and community members.
- Surveys will be distributed at the end of the 2003 school year and as the project progresses.

Conclusion

- It will be important for the community and science classes to become involved in the implementation of the educational nature area in order to ensure it's long-term success.
- Ideally, this project will open lines of communication between HSU and SBMS, along with other schools in the Arcata community.

Fall 2002 Plan

Introduction

During the Fall Semester of 2002, an Environmental Education Program was designed for the Sunny Brae Middle School. The plan introduced the design of nature trail on the school property, used to enhance the existing environmental science curriculum. The trail would border the perimeter fence line, introducing various ecosystems and representative species to the students. The plan also outlined the design of an informational kiosk at the start of the trail, in addition to an outdoor classroom area which could be utilized by a group of students.

Pros:

- Detailed plan provided
 - Methods to enhance habitat
 - Display representative ecosystems and native species
 - Kiosk and trail design
 - Methods for monitoring and evaluation
- On campus site
 - Accessible to students and community
- Diversify curriculum
 - Display native plant species
 - Display representative ecosystems

Cons:

- Inappropriate site
 - Lack of existing vegetation on site
 - Possibility of future track construction
 - Existence of alternative site
- Lack of student involvement in trail construction

(Within preferred alternative)

Construction of a trail

Pros:

- Delineate existing path
 - Introduce native plants
 - Access to outdoor classroom area
- Limit growth of underbrush
- Connect to Community Farm and future Bayside Park
- Increase usage and educational opportunity

Cons:

- Increased labor and construction costs
- Labor required to maintain trail

No trail construction

Pros:

- Decreased labor and construction cost
- No maintenance to trail necessary
- Limited development to site

Cons:

- Area may become overgrown
- No improvement to site
 - Limits usage by students and community
 - Decreased opportunity for learning

Trail Materials & Maintenance (preferred: gravel/weed mat/wood chips)

Pros:

- Establish path
 - Introduce native plants
 - Connect to nature area
 - Provide access to Community Farm and Bayside Park
- Limit growth of underbrush

Cons:

- Expense of materials
- Labor and construction requirements
- Increased development of site
- Labor required to maintain trail

Stream Restoration & Access

Pros:

- Enhance access to stream
- Increased safety to students and community
- Provide access along stream corridor
- Enhanced learning opportunity to students

Cons:

- Infeasibility of stair construction
 - Steepness of slope
 - Close proximity to exposed roots
- Existing access by students to stream
- Expenses relating to construction materials and labor