

**Northwest Stream Center
Wetland Boardwalk**

Project Update November 30, 2014

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1.0 INTRODUCTION

It has been exciting (and much faster) to have an actual boardwalk to walk on at the site! We will soon be transitioning into a new phase with the project as we are close to completing the boardwalk loop and spring is just around the corner. Here is an update from the landscape design/plant department perspective.

2.0 BOARDWALK

The diagram (fig. 2.1) shows the current route of the boardwalk. The solid black lines show the route that has actually been constructed (although there are still areas that need toe rails and the rest of the screws put in to be completed). We were able to use the alternative route mentioned earlier in the April 2014 report as the route through the pond area, which is a much better route experience and will prevent problems with the Alderwood Water District easement along the old park road to the west of the Trout Pond. This area also showcases the scrub-shrub wetland type that was under-represented earlier.

The dashed lines on the diagram show the proposed route that still needs to be built. The “Cedar Cathedral Viewpoint” will soon be under construction, and is the only viewpoint being built and/or financed at the moment. The “Frog Pond Crossing” was built halfway across the pond, and will be completed when the west side of the boardwalk reaches the pond. The other two crossings, which are bridges, have not been rebuilt or funded as yet, although Tom is working hard to accomplish this.



The westside of the boardwalk flows between the 2 main ponds (UL) & currently ends just past the Cedar Cathedral (UR)



It includes the alternative route we proposed through the wetland meadow just south of the Detention Pond

Northwest Stream Center Elevated Nature Trail Map

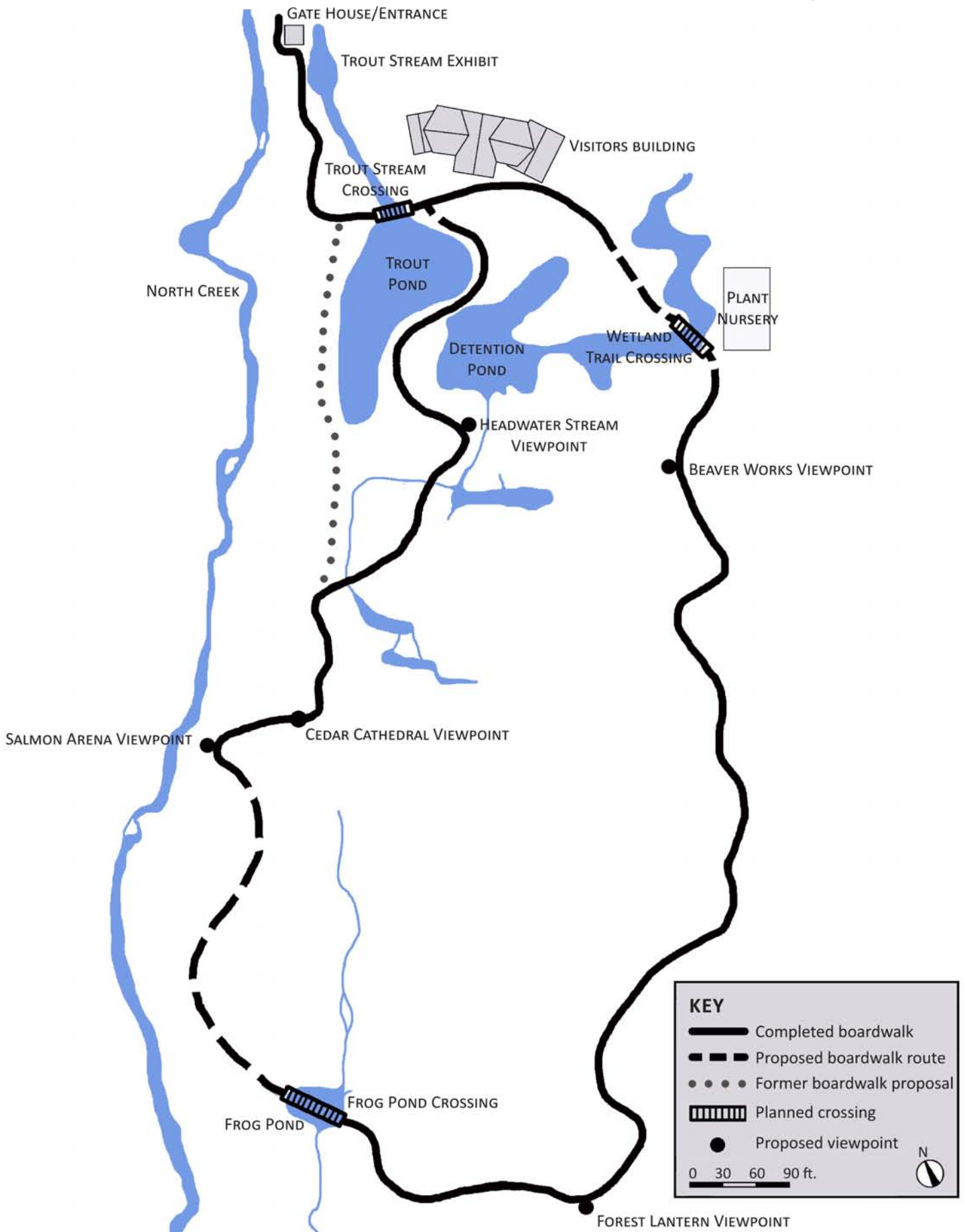


Figure 2.1: Current Proposed Route of the Northwest Stream Center Wetland Boardwalk (Hanson 2014)

3.0 INVASIVE PLANT REMOVAL

3.1 Progress on Invasive Plant Removal

Areas of invasive plant groups are located on the map (fig. 3.1). There are more invasives marked on this map than the April 2014 map to reflect conditions found while working out there. Sectors crossed off have had the invasive plants removed. The following is a summary of my current estimates.

Several small **holly** trees have been removed. While there is a large one just south of the plant nursery, most of the holly trees are small (under 1.5 feet) and usually thinly scattered around the site.

Ivy remains scattered throughout, but most of the heavier areas have been removed. The large area of ivy on the private chainlink fence just SW of the site and west of North Creek remains and is heading east towards the creek probably due to pruning debris left on their compost pile.

Most of the **Himalayan blackberry** south of the Trout/Duck Pond, and southeast of the Detention Pond has been removed (fig. 3.1). Some has also been removed from sectors in the north half of the site that are still marked, as these areas probably still have some left and need to be rechecked for remaining plants.

We have made a lot of progress on the **bittersweet nightshade**. You can see the difference between the before and after photos below of the more heavily invaded areas south of the detention pond. I concentrated on the areas along the boardwalk route and on the perimeter of the heavily invaded central area. I had the occasional volunteer groups work on the most heavily invaded central area and carry out the piles on tarps (which takes 2 people). I also went back and refined some of the areas the volunteers worked on previously.

My rough estimate is that we have removed 36% of the holly, 15% of the ivy, 65% of the nightshade, and 41% of the Himalayan blackberry. Overall, we have removed about 50% of the above mentioned invasive plants as a whole. These estimates were determined by area and how heavily they were covered (fig. 3.1).



Above: Bittersweet nightshade covered most of the plants just south the the two large ponds. Below: The area after the nightshade has been removed, a few native plants added, and the plants have had some sunlight for a few months.



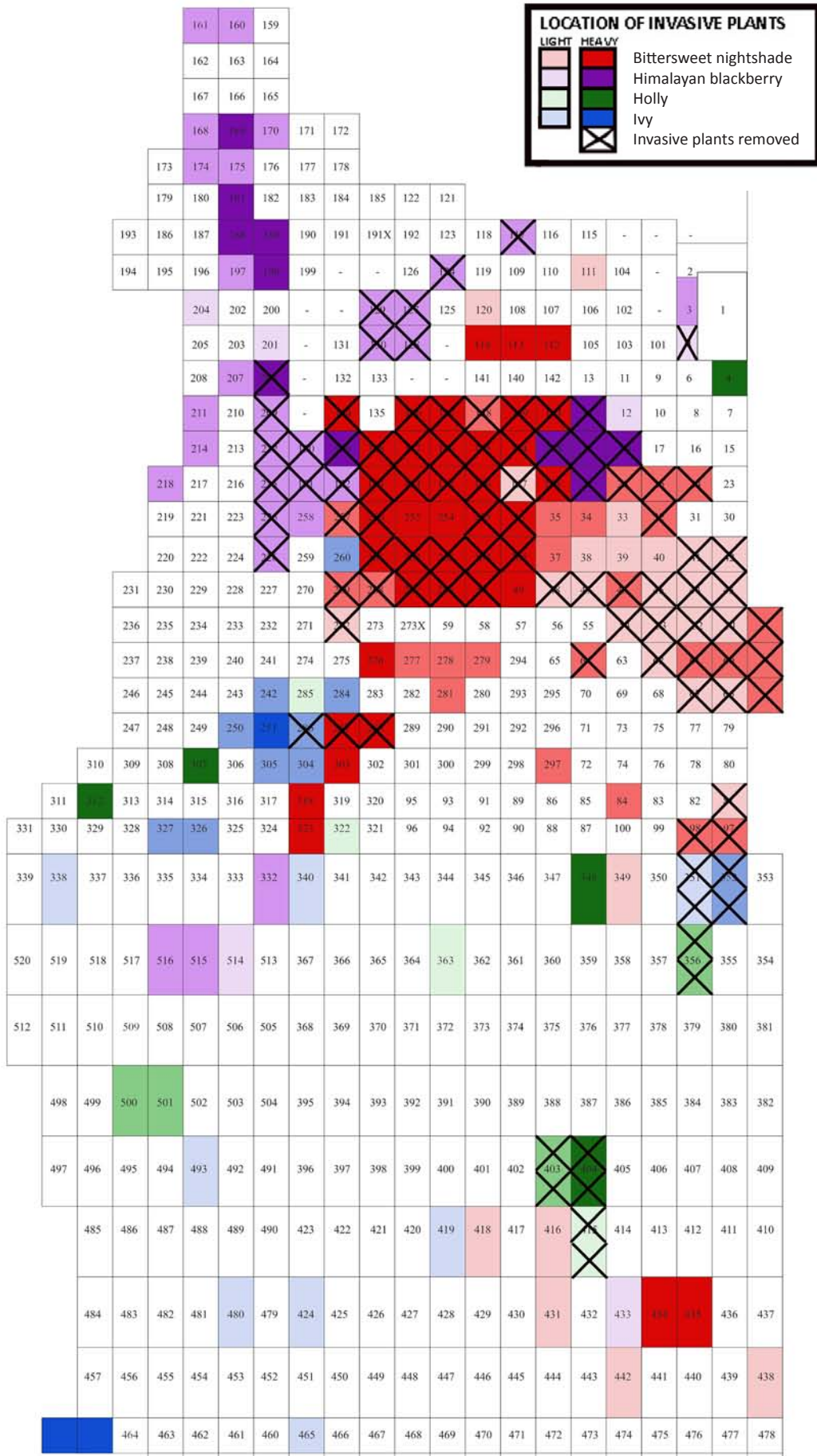


Fig. 3.1: Location of Invasive Plants (reed canary grass not included) from 2012 map, field notes & recent observation (Hanson 2014)
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Reed canary grass was widespread in the center of the east side, as well as scattered in other areas. We have pulled some of it, but not all. Much of it in the central area is mixed with the native fowl grass.

Herb Robert is found mostly north of the ponds and along the east side of the site. We pull it when we come across it while working. I did not account for it or the reed canary grass on the map or in my estimates.

Herb willow is a seedy, small flowered *Epilobium ciliatum* perennial which is thick in the east central open area of the site. I have removed some to improve visibility from the boardwalk and to allow some sun to reach the transplanted shrubs and groundcovers surrounding them. The butterflies that enjoy them shouldn't be concerned, however, since the large amount of seeds they produce ensures there will be plenty of them returning next year.

3.2 Disposal of Invasive Plants

The only debris that leaves the site is invasive plants and garbage. The rest gets reused on-site. That being said, there are a lot of invasive plants and sometimes they pile up when disposal bin space becomes a problem (which is usually the case). In the past, we piled them on tarps and the Navy volunteer crews would come once every week or two and move them to the front and/or to the big bin when we had one. More recently, the Navy is gone and I carry them out in garbage bags by myself. I pile them on the tarp in front where they add up or I take some home to my personal bin when it is empty. The Master Gardeners have not wanted us to use their bin (even though they used our large one when we had it) and have given our volunteers a bad time when they tried. Some have even dumped our recycling out of the recycling bin into the driveway when we put recyclable plastic into it. Fortunately, Penny, the Master Gardener in charge of paying for the yardwaste bin, has graciously offered to let us use the yardwaste bin this winter. I was able to dump a third of our pile a week ago into their bin and mine. This week they have a MG yardwork event and will need it, but we should be able to use it enough this winter to get through the pile. I should also mention that we need to be careful when yardwaste piles up that the invasives are kept on the tarp and separate from any other yardwaste debris, compost, woody debris or AAS yardwaste debris. Recently I had to separate a big pile and this can be a huge problem. Some of the yardwaste is compostable on-site, some is woody debris that can be used for habitat, and some is debris that can be shredded as mulch. If nightshade, ivy or any invasive plant seeds get mixed with the reusable yardwaste, the invasives will be spread around. Consider that each nightshade berry has around 10-15 seeds (or more), in a cluster of 8-12 and there can be several clusters per vine. Then think of how many vines we have to remove. Also consider that each piece of vine is covered with root nodes that can root easily if touching moist soil. It would be an invasion of large proportions. I have actually bagged some of the ripe berries separately and threw them in the trash to prevent them from scattering around. In addition, separating the invasives from the others will also keep the pile to haul out to a minimum size and lesson the bin space issue.

4.0 WOODY DEBRIS

4.1 Use of Woody Debris

There has been a lot of woody debris left along the route where hazard trees have been felled, or branches have been pruned to blaze the trail for the boardwalk. While some wood naturally falls from the trees, leaving large chunks of human-cut wood along the trail is an eyesore. Some of the smaller woody debris has been shredded to provide organic matter for planting and mulching, especially areas that were covered with false-lily-of-the-valley and western redcedar roots but were trampled during the building process or by earlier unauthorized campers. It covers the exposed roots and provides organic matter which the plants enjoy.



Mulch was used in this western redcedar forest where false-lily-of-the-valley covers the ground earlier in the season.

4.2 Woody Debris and Design

Woody debris can be used to enhance the design or provide interest along the route. In the photo below (LL) some of the dead wood was removed next to the trail to make it less dark and forboding for the human visitors, while the interesting woody piece (LR) was added to the water's edge to provide interest for those same visitors.





^ Larger woody debris was buried here to form a berm to plant twinberry, ferns and salmonberry where reed canary grass was removed.

Large woody debris accented with snow (photo below) was pruned to form a framework that allowed for habitat value, while paring down the large amount of woody debris left from clearing the trail that was causing a large eyesore along the route.



^ Here a dead western redcedar snag was left behind that should've been removed. While some curves in the route can be interesting, this part of the route would be better without so many of them.



< The logs left after blazing a trail through the downed trees in this area have left behind a lot of interesting debris that helps to provide understanding of the remodeling process of the wetland. The cut ends are a little obvious, however. We have begun camouflaging some with shrubs, mats of false-lily-of-the-valley and moss on the rotten wood. In the spring, I plan to plant red huckleberry plugs in holes drilled into the wood filled with compost. In the meantime, we may need to cut the logs back away from the boardwalk a little more for safety's sake.

4.3 Hazard Trees

Some of the large hazard trees have been cut from along the route, such as one of our favorites seen in the photo at right (before it was cut). There are a few more that still need to be removed, particularly the one in the SE area of the east meadow. Others may need to be evaluated by an arborist to determine if they really need to be cut down, as we try to save as many as we can, but also need to consider the safety of the visitors and the boardwalk.



5.0 NATIVE PLANTS

5.1 Transplanting Progress

The Transplanting Plan (fig. 5.1) shows the progress we have made with clearing the route and what the future plan is for the site as a whole. Currently we have approximately 300 feet of the route left to clear ahead of the boardwalk construction. As usual, I try to replant them where needed nearby if possible, then other areas if time permits. Some plants get repotted for later use, and we have set up our own section in the AAS plant nursery for these (see photo below left). Although we can't save every plant (even though I try), we do need most of them for areas where invasive plants were removed, areas were damaged by previous campsites, or as fillers for bare spots to provide more wildlife habitat, buffers and wetland function. In the diagram (fig. 5.1), the area we still need to clear for the route is marked next to the proposed boardwalk. The areas that could use more plants have been circled. The lines and circles are color-coded according to plant community types. For the most part, the plants that have been transplanted are doing well. A few struggled at first in the heat as some lost their leaves (vine maple, red elderberry, salmonberry and skunk cabbage in particular), but most rebounded quickly and should look much better next year.



Potted transplants waiting for spaces to open up for them.



These red huckleberry cuttings appear to be surviving.

5.2 Native Plant Propagation

While clearing the route for the boardwalk, we often need to cut back some tree and shrub branches. Since some root well from cuttings, I try to salvage what I can to reuse. The Pacific willow, red-osier dogwood, and salmonberry we use as live stakes in scrub-shrub areas. Twinberry and red flowering currant have rooted easily in pots. Vine maple, highbush cranberry, twinberry and western redcedar have often had branches that rooted through layering and we transplant or pot these. While salal, red huckleberry and vine maple propagate more easily using other methods, I am attempting to root cuttings that occurred from the clearing process. The first round of red huckleberry did not take well, but the second round (cooler season) seems to be doing better (see photo above). Piggy-back plants root well from their leaves and plantlets, so I plant them as well. Later, if we need more shrub cuttings to propagate, good sources for shrub cuttings are marked on the Transplant Plan (fig. 5.1) in solid light green. This would also help improve genetic diversity within our cuttings. In the following Table A is helpful information on plant propagation for many of the plants found at this site.

We haven't done much with seeds except to remove invasive plant seeds, but I have collected some sedge (*Scirpus microcarpus*) seeds that hung over the boardwalk, and scattered them in emergent wetland areas. They can easily be divided, however, and we have done so while transplanting. I have also collected seeds from two mature skunk cabbage flowers that Cheryl and her sons planted into paper cups. These will be transplanted to an area in the south end near the Forest Lantern Viewpoint to sprout next spring.

KEY TO TRANSPLANT PLAN

- Boardwalk
 - Proposed boardwalk
 - Proposed viewpoints
 - Social & work paths
 - Drier forest transplants
 - To receive DF transplants
 - Wet forest transplants
 - To receive WF transplants
 - Receive shrub-scrub plants
 - Cutting source for ss plants
 - To receive emergent wetland plants
- 0 30 60 90 ft.

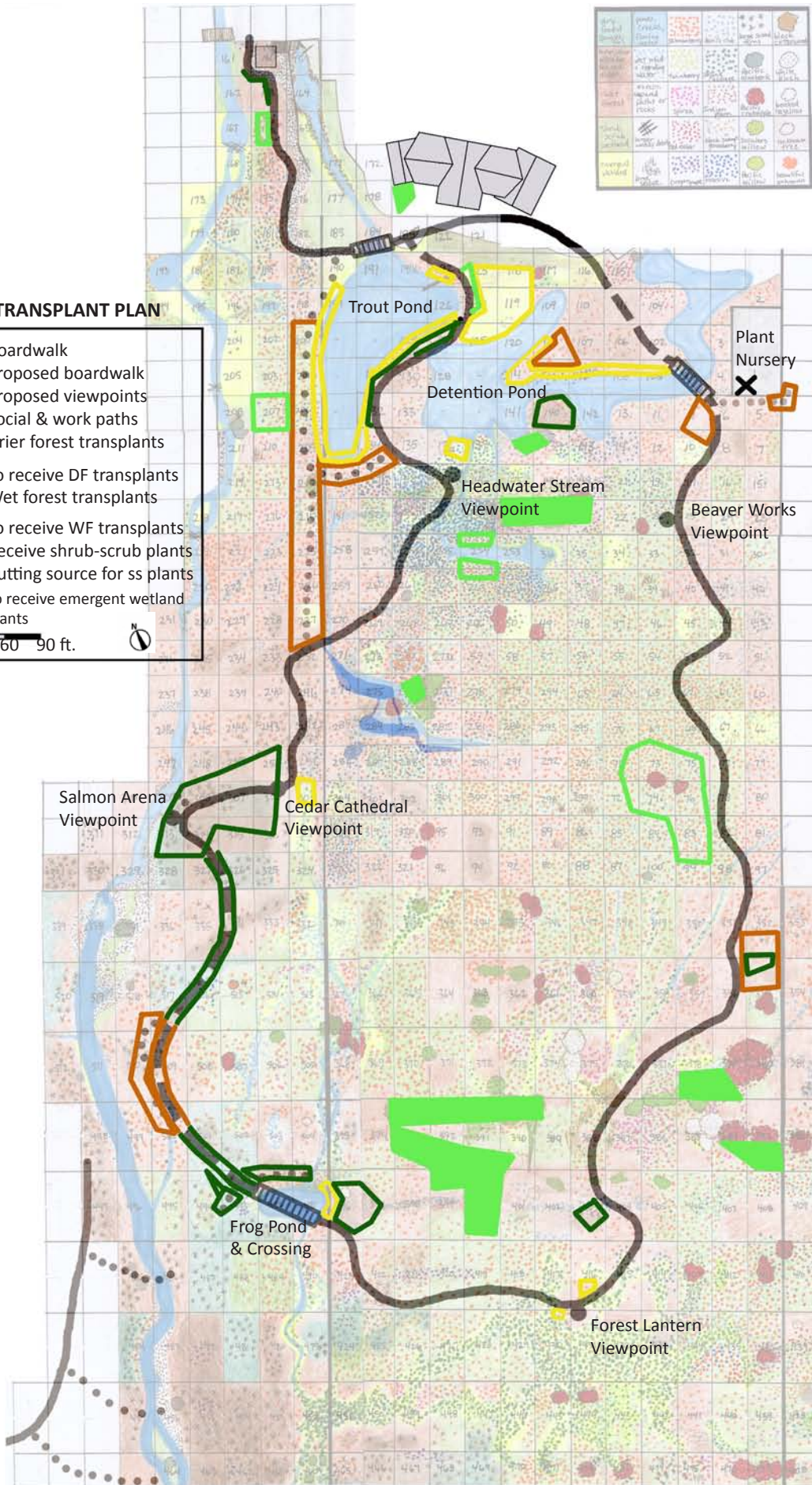


Figure 5.1: Transplant Plan (Hanson 2014)

VEGETATION		PROPAGATION TECHNIQUES				Division	Seeds
Botanical Name	Common Name	Cuttings	Layering	Transplant	Division	Seeds	
Tree Canopy:							
<i>Alnus rubra</i>	Red alder			X - small		X	
<i>Betula papyrifera</i>	White birch			X - small		X - easiest	
<i>Picea sitchensis</i>	Sitka spruce	X - maybe		X - small		X	
<i>Populus balsamifera</i>	Black cottonwood	X - hdwd or livestakes		X - suckers		X	
ssp. trichocarpa	Douglas-fir	X - varies		X - small		X	
<i>Pseudotsuga menziesii</i>	Western red cedar	X - slow		X - small		X - easy	
<i>Thuja plicata</i>	Western hemlock	X	X	X - small		X - easiest	
<i>Tsuga heterophylla</i>							
Shrubs & Small Trees							
<i>Acer circinatum</i>	Vine maple		X	X - seedlings-large		X	
<i>Cornus stolonifera</i>	Red-osier dogwood	X - hdwd or livestakes		X		X	
aka <i>C. sericea</i>							
<i>Corylus cornuta</i>	Beaked hazelnut	X - semi-hdwd	X - fall best	X - suckers		X - easiest	
var. <i>californica</i>	Salal	X - semi-hdwd	X - spring	No - difficult		Not easy	
<i>Gaultheria shallon</i>	Oceanspray	X - semi-hdwd & hdwd		X		Low germ	
<i>Holodiscus discolor</i>	Holly	INVASIVE - REMOVE					
<i>Ilex aquifolium</i>	Black twinberry	X - hdwd & young stem				X	
<i>Lonicera involucrata</i>							
<i>Mahonia nervosa</i>	Dwarf Oregon grape	Difficult bud or hdwd	Difficult	No - difficult		X - easiest	
aka <i>Berberis nervosa</i>	Pacific crabapple		X - slow			X - slow	
<i>Malus fusca</i>	Indian plum	X - hdwd & root	X	X		X - easy	
<i>Oemleria cerasiformis</i>	Devil's club	X - hdwd easy				X - slow	
<i>Opiopanax horridus</i>	Pacific ninebark	X - hdwd easy				X - low germ	
<i>Physocarpus capitatus</i>	Swamp gooseberry	X - semi-hdwd & hdwd				X	
<i>Ribes lacustre</i>	Red-flowering currant	X - semi-hdwd & hdwd				X	
<i>Ribes sanguineum</i>	Nootka rose	X - woody rhizomes or roots (stems more difficult)				X - rosehips	
<i>Rosa nutkana</i>	Evergreen blackberry	INVASIVE - REMOVE					
<i>Rubus laciniatus</i>	Himalayan blackberry	INVASIVE - REMOVE					
<i>Rubus procerus</i>	Thimbleberry	X - semi-hdwd & hdwd		X		X	
aka <i>R. discolor</i>							
<i>Rubus parviflorus</i>							

Table A: Plant Propagation (p. 1)

Botanical Name	Common Name	Cuttings	Layering	Transplant	Division	Seeds
Shrubs & Small Trees continued						
<i>Rubus spectabilis</i>	Salmonberry	X - semi-hdwd & hdwd		X	X - rhizomes	X
var. <i>spectabilis</i>	Trailing blackberry			X		X
<i>Rubus ursinus</i>	Pacific willow	X - easy hdwd or live stake		X	X - rooted sucker	X
<i>Salix lucida</i> var. <i>lasianдра</i>	Scouler willow	X - easy hdwd or live stake		X	X - rooted sucker	X
<i>Salix scouleriana</i>	European	X - easier hdwd				X
<i>Sambucus racemosa</i>	red elderberry	X - other cuttings		No - long roots		X
ssp. <i>pubens</i>	Douglas spirea	X - semi-hdwd & hdwd			X - rhizomes	X
<i>Spiraea douglasii</i>	Red huckleberry	X - tip & semi-hdwd	X	X - only small		X
<i>Vaccinium parvifolium</i>						
Herbs						
<i>Aster subspicatus</i>	Douglas aster			X	X	X
<i>Cornus canadensis</i>	Dwarf dogwood or bunchberry					X - easiest
aka <i>C. unalaschkensis</i>						
<i>Epilobium ciliatum</i>	Watson willowherb			X		X
aka <i>E. watsonii</i>	Cleavers bedstraw					X
<i>Galium aparine</i>	Large-leaf avens				X - clumps	X
<i>Geum macrophyllum</i>	Spotted touch-me-not					X
<i>Impatiens capensis</i>	Yellow iris				X - rhizomes	X
or <i>Impatiens noli-tangere</i>	Small duckweed					X
<i>Iris pseudacorus</i>	Birdsfoot trefoil				X - rhizomes	X
<i>Lemna minor</i>	Skunk-cabbage				X - rhizomes	X
<i>Lotus corniculatus</i>	False lily-of-the-valley					X
<i>Lysichiton americanum</i>	Water-parsley (poisonous)		X - nodes root			X
<i>Maianthemum dilatatum</i>	Creeping buttercup			X		X
<i>Oenanthe sarmentosa</i>	Bittersweet (climbing)					X
<i>Ranunculus repens</i>	nightshade			X		X
var. <i>repens</i>	Piggy-back plant					X
<i>Solanum dulcamara</i>	Stinging nettle			X	X - rhizomes	X?
<i>Tolmiea menziesii</i>						
<i>Urtica dioica</i> ssp. <i>gracilis</i> var. <i>lyallii</i>						

Table A: Plant Propagation (p. 2)

Botanical Name	Common Name	Cuttings	Layering	Transplant	Division	Seeds
Rushes, Sedges, Grass						
<i>Juncus effusus</i>	Soft rush	INVASIVE - REMOVE		X	X	X
<i>Phalaris arundinacea</i>	Reed Canarygrass					
<i>Scirpus microcarpus</i>	Small-fuited bulrush					
Ferns						
<i>Blechnum spicant</i>	Deer fern			X		X - spores
<i>Dryopteris expansa</i>	Spreading wood fern aka shield ferns			X		X - spores X - poss. spore
<i>Equisetum arvense</i>	Common horsetail					X - spores
<i>Polypodium glycyrrhiza</i>	Licorice fern					X - spores
<i>Polystichum munitum</i>	Sword ferns			X		X - spores
<i>Pteridium aquilinum</i> var. <i>pubescens</i>	Bracken fern				X - diff. to dig	X - spores

X - Info from *Encyclopedia of Northwest Native Plants for Gardens & Landscapes* (Robson, Richter & Filbert 2008; Timber Press, Inc.)
x - Info inferred from *Plants of the Pacific Northwest Coast* (Pojar, Mackinnon 2004; Lone Pine Publishing)
and my personal experience

5.3 Additional Plants

In Table B on the following page is a list of suggested additional plants that would be helpful to obtain for a few of the locations circled on the Transplant Plan (fig. 5.1). Some of them, the red huckleberry in particular, I plan to order this week through Snohomish Conservation District, and I have free sources for a couple of others listed. It would be nice to have a small budget for a few (especially the pond plants). We could wait for free donations, but unless someone knows someone who has them, we'd probably be waiting a long time. I have also listed some plants in sections 6.4 Trout Pond and 6.5 Frog Pond for the two ponds specifically, to improve their habitats. If anyone knows of free sources (besides our site) for the plants listed, please let me know. The names of good, reasonably priced, commercial nurseries to obtain the emergent wetland and aquatic plants listed for the pond habitats would also be helpful. I know Storm Lake Growers in Snohomish has a wide range of native plants, and I may take a peek at what they have one of these days when I have some time. I will also discuss this with the AAS ecologists who should know some sources. I actually have a few UW wetland student volunteers who helped me earlier (in exchange for a tour of our wetland) that said they would be interested in helping me plant in the spring. Remember, spring planting is just around the corner and we should plan ahead.

NWSC ADDITIONAL NATIVE PLANTS LIST BY PLANT COMMUNITY TYPES

Drier Forest Community Plants

	Common Name	Supply Source
<i>Acer circinatum</i>	Vine maple	Snohomish Conservation Dist.
<i>Amelanchier alnifolia</i>	Serviceberry	Snohomish Conservation Dist.
<i>Corylus cornuta</i>	Beaked hazelnut/filbert	Snohomish Conservation Dist.
<i>Gaultheria shallon</i>	Salal	Snohomish Conservation Dist.
<i>Mahonia nervosa</i>	Cascade Oregon-grape	Snohomish Conservation Dist.
<i>Oemleria cerasiformis</i>	Indian plum	Snohomish Conservation Dist.
<i>Polystichum munitum</i>	Sword fern	Snohomish Conservation Dist.
<i>Ribes sanguineum</i>	Red-flowering currant	Marian (rooted cuttings)
<i>Rubus parviflorus</i>	Thimbleberry	Bldg. perimeter & SCD
<i>Sambucus racemosa</i>	Red elderberry	Snohomish Conservation Dist.
<i>Vaccinium parvifolium</i>	Red huckleberry (on wood)	Snohomish Conservation Dist.

Wet Forest Community Plants

<i>Acer circinatum</i>	Vine maple	Cuttings &/or Snoh. Cons. Dist.
<i>Dryopteris expansa</i>	Shield/wood ferns	Marian
<i>Lonicera involucrate</i>	Twinberry	Cuttings &/or Snoh. Cons. Dist.
<i>Physocarpus capitatus</i>	Pacific ninebark	Cuttings &/or Snoh. Cons. Dist.
<i>Sambucus racemosa</i>	Red elderberry	Snoh. Cons. Dist. &/or cuttings
<i>Viburnum edule</i>	Highbush cranberry	Layering shrubs (on-site)
<i>Vaccinium parvifolium</i>	Red huckleberry (on wood)	Snohomish Conservation Dist.

Scrub Shrub Wetland Plants

<i>Cornus sericea</i>	Red-osier dogwood	Live stakes (on-site)
<i>Lonicera involucrate</i>	Twinberry	Cuttings & Snoh. Cons. Dist.
<i>Malus fusca</i>	Pacific crabapple	Snohomish Conservation Dist.
<i>Physocarpus capitatus</i>	Pacific ninebark	Cuttings &/or Snoh. Cons. Dist.
<i>Rhamnus purshiana</i>	Cascara	Snohomish Conservation Dist.
<i>Viburnum edule</i>	Highbush cranberry	Layering shrub (on-site)

Emergent Wetland & Wetland Meadow Plants

<i>Carex obnupta</i>	Slough sedge	On-site plant nursery & Master Gardener Penny
<i>Eleocharis palustris</i>	Creeping spike-rush	Commercial nursery
<i>Pteridium aquilinum</i>	Bracken fern	Commercial nursery or poss. MG home transplant
<i>Scirpus microcarpus</i>	Small-fruited bulrush	On-site transplants (east side)

Local wildflower seed mixes from reputable source (native plants & no substitutions permitted)
(Other emergent wetland & aquatics listed in tables for pond habitats)

6.0 Design Considerations

One purpose of design consideration is to think about spaces and whether they are designed to function well for the users. Determine what type of user is the priority for this space and this will determine what the needs of the space are. In the diagram of Primary User Zones (fig. 6.1) areas of the NWSC site are color-coded according to who the priority user should be. Orange represents humans, green represents wildlife, and yellow is both human and wildlife mixed.

Humans need access, circulation, safety, comfort, and facilities. The **human priority zone** includes the building, entrance, exits, sidewalk, outdoor lighting, windows, and boardwalk. Anything that interferes with these needs causes a problem. In the two photos is an example of not recognizing which zone a space is in. The windows, lights and building access are for humans, yet the plants block them. The office staff cannot see out the windows when the leaves are out because the shrubs are too large for this area. On the other end of the building, the plants often block access to the door, window views and the outdoor lights. The shrubs get pruned, but this is time-consuming for staff and volunteers. The pruning technique used actually encourages more branching which makes the task even more difficult the next time and it disfigures the shrubs and trees. It is a great way to get cuttings from shrubs, except cutting the same plant each time limits the genetic diversity of the cuttings and deforms the plant. I would suggest removing several plants and transplanting them to the proper plant community on-site. Then replace them with shorter plants such as salal, sword ferns and kinnikinnick, and limiting taller shrubs and small trees to areas away from the windows.



SW building entrance (UL) and SE entrance (UR)

Wildlife need food, water, shelter, breeding and hiding sites, protection, and a functioning landscape. In the **wildlife priority zone**, the humans are on the outside looking in. Their zone also includes the space underneath the boardwalk. When we take over their space, problems occur. In the photo (right) a group of campers were asked to leave and the site exploded with their debris including food, clothes, furniture and drug needles flung around. Tom is trying to do what he can, but this mess is just over the NWSC property line.



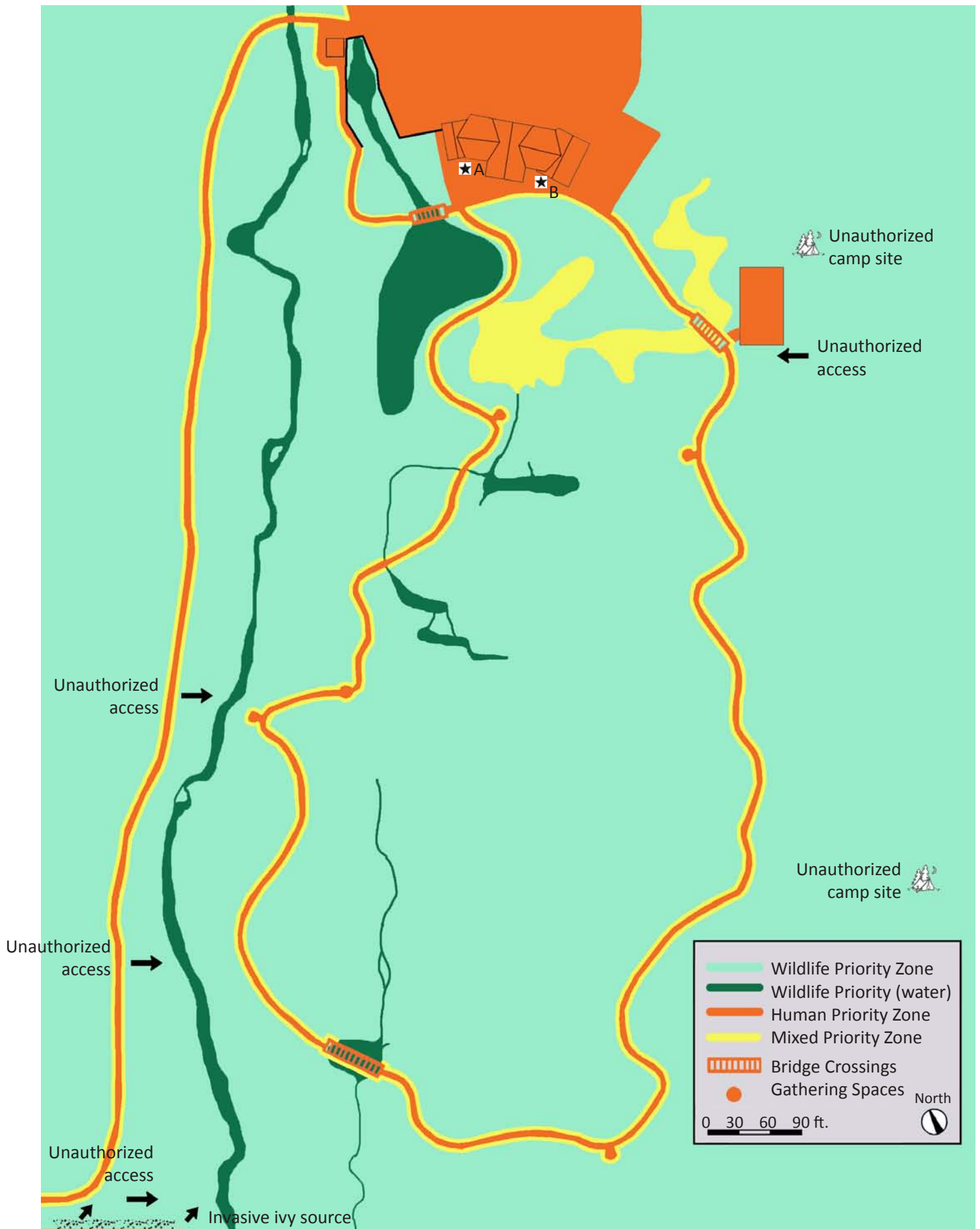


Figure 6.1: Primary User Zones (Hanson 2014)



As we are clearing the route and building the boardwalk, the space under the boardwalk where we have been working becomes a mess. Even so, some of the wildlife still like to hang out under there. One day 13 ducks surprised me by coming out from under the boardwalk right in front of me, slowly one by one. This wildlife zone under the boardwalk comprises over 15,000 square feet. There is water in many areas here and we have made a point to maintain the water flow patterns as much as possible. Some shade plants are still present in some areas or have the potential to spread underneath. Woody debris can be placed here for shelter, hiding and food for slugs and snails. Keep in mind this area can be seen by visitors from many points along the route.

The **mixed priority zone** is where the human and wildlife zones come together. Here close-up encounters with wildlife and plants occur, educational signs are placed, and windows are opened for views. This space needs buffers of different permeabilities to allow human education without leaving the boardwalk, while allowing movement for wildlife. A buffer of low plants with larger woody debris would help the space along the boardwalk between the Trout Pond and Detention Pond to keep people away from the shoreline while allowing views into the pond space. A few clumps of larger shrubs or small trees could be added to buffer the waterfowl habitat. The same treatment should be used for the temporary work paths (photo LL), **when the work is done** on the westside, to return the space to the wildlife and to discourage humans from using them. The unauthorized social paths access points from the west side of North Creek and by the southeast corner of the plant nursery could have larger woody debris and salmonberry shrubs (of which we have many) placed to deter their use.

This zone can also be affected by water flow issues. Water flow in the westside wetland just south of the stream may soon cause an erosion problem for one of the boardwalk foundation blocks (photo LR). The boardwalk construction crew threw a log in here to help divert the flow once we noticed it, but I do not think that will be adequate. I have mentioned it to Tom, but I think the AAS ecologists (who handle water flow issues all the time) should take a look at this and fix the problem before it erodes any further.



Work path shows muddy footprints currently, but will recover nicely once it is not needed.



Water flow under the boardwalk is eroding the soil at this pin foundation .

6.1 Viewscapes

Viewscapes open a window from the human zone to the wildlife zone. While clearing the route for the boardwalk we have come across many beautiful and/or interesting sites that help tell the wetland's story. Some needed more work than others and most still need some fine tuning and/or additional plants before they are ready. These areas will get more attention once the basic boardwalk is in. At the moment, clearing the route and salvaging plants is more important.



The view of the meadow south of the Detention Pond (left) was blocked with invasive plants. Now it shows the Beaver Pond and the stream connecting to it from the boardwalk that was rerouted through the alternative route.



A stream runs under the boardwalk on the east side of the route and forms a pool at the base of an overturned large tree. By removing some branches and a few seedy herb willows, the pond can be seen from the boardwalk.



The viewscape within this western redcedar area was opened up by removing a few branches and part of a dead Pacific crab apple laying next to the boardwalk. The dead tree made this area very dark and formidable for the human visitors. The mossy branches left behind glow in a neon green.



Nearby, I have started adding woody debris, mulch and plants to accentuate the streamflow-like appearance of the mud found here. I will return to this project and other viewscapes after the boardwalk is in and I have time to refine these spaces.

6.2 Proposed Viewpoints

There are five proposed viewpoints that are marked on the boardwalk route map (fig. 2.1). We chose these viewpoints as each provides an opportunity for a group to stop and see an interesting site with an educational lesson. While space needs to be added to the boardwalk at these points, the structures themselves are not the point (pardon the pun). We should make an effort to blend them into the boardwalk and the surroundings, while not blocking or burying what we are actually trying to see. The structure should ideally provide a gathering space for a group of 10-20 people, open a view of the desired scene while providing educational information, seating to rest while spending a little more time, and a buffer of some sort to protect the wildlife from wandering humans.

We should consider the shape of the boardwalk route already present (curves/straight) and how it will be affected by the location and shape of the viewpoint proposed. We should make an attempt to blend the construction of the platform into the construction of the boardwalk which may require unscrewing a few of the deck boards already present and repositioning them or staggering the ends. In the photo below (LL), this technique was actually used on my home deck remodel when the stairs were moved and space was added. You can't see where the changes were made, which is better than attaching a lump to the side of the deck. I think this would be the better choice for at least some of the viewpoint/gathering spaces.

Seating can be provided easily here as there will be the space for it and we have leftover pieces of boardwalk lumber that could be used for this without added expense. The seating could be designed in a manner that provides a barrier to keep humans out of the wildlife space. Woody debris and plants such as salal or other low-growing shrubs that don't block too much of the view could be planted along the edge of the gathering space which would also suggest staying on the boardwalk.

The educational value could also be promoted by the species of plants selected, type of woody debris used, careful pruning to enhance the view, and adding signage for further explanation. Tom has made or plans to make many educational signs.



Here the deck remodel at my house blends smoothly with the previous deck structure.



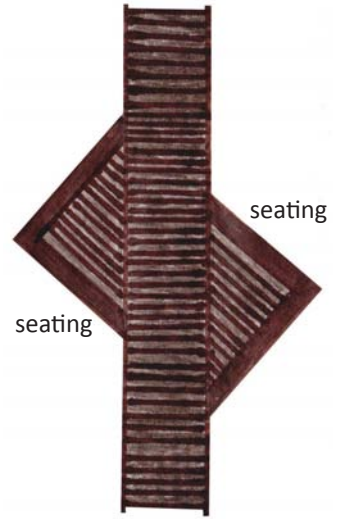
At the Mercer Slough Nature Park, the gathering space was added in a manner that went well with the space. While the addition is obvious and not blended, it is nice and flows well, not haphazard or just an afterthought.



Forest Lantern Viewpoint

The viewpoint's shape is marked in pink ribbon

Fig. 6.2: Diagram of a possible design for the **Forest Lantern Viewpoint** (right) with a gathering space that works well with the site conditions. The L-shaped seating along the platform edges doubles as a barrier to keep humans on the boardwalk.



Headwater Stream Viewpoint

Tom mentioned we could enhance the headwater itself to make it a little more visible.

Fig. 6.3: Diagram of a possible design for the **Headwater Stream Viewpoint** with a gathering space, seating, and a deck that can blend into the current boardwalk section.

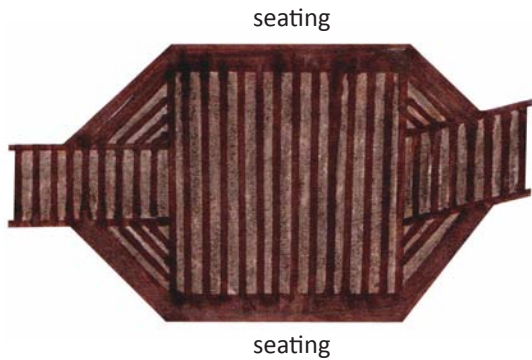


Fig. 6.3: Larry designed a nice gathering space for the **Cedar Cathedral Viewpoint** similar to the above diagram which provides seating that doubles as a barrier to prevent wandering.



Salmon Arena Viewpoint, an important point, but may not need an extra gathering space structure, as North Creek is very close, the boardwalk is positioned so visitors can spread out but still see, and the Cedar Cathedral Viewpoint gathering space is nearby.

6.3 Detention Pond

6.3.1 Description

The Detention Pond is a wonderful opportunity to showcase the idea of using landscape as infrastructure. By taking water from the impermeable surfaces of the park, moving it through the bioswale, and out into the open to be viewed by the public, the public can be educated on the importance of wetlands and their functions. Here we could demonstrate biofiltration, phytoremediation techniques, allow student research, and demonstrate plants that are known to improve water filtration for restoration sites. We could do this in a manner that improves the aesthetics of the pond's shoreline as well. Although the ducks use this pond, this is not the pond to showcase wildlife such as frogs and fish, as there are probably water quality issues here and frogs in particular can be easily poisoned through their skin (Link 2002). At the very least, I think we should use plants near the detention pond that are known to enhance biofiltration, and use educational signs to bring awareness to the filtration function of natural landscapes and the research that is happening in this field.



The Detention Pond looking west from the bridge.

6.3.2 Phytoremediation

Since we have discussed this topic a little in the past, I thought I would pass on what I learned from a class on the subject. **Phytoremediation** is the process of “decontaminating soil by using plants to absorb heavy metals or pollutants” (Microsoft 1999). **Organic** contaminants may be completely degraded inside plant tissues. However, some organic pollutants are difficult for plants to uptake and many are toxic to plants. Organic pollutants can be detoxified if the plants can overcome this. Through the use of plant gene over-expression, microbial genes, or inoculations of micro flora, researchers are able to help plants overcome these limitations (Dhankher et al. 2012, Prasad et al. 2009).

Inorganic pollutants such as heavy metals and excess nutrients can be altered by phytoremediation, but unlike organic pollutants, they can't be degraded (Doty 2012). These metals or metalloids depend on plant transporters for uptake and translocation. Phytoremediation of these contaminants may occur through phyto-stabilization which reduces the mobility and bioavailability of the pollutant, phytoaccumulation which collects metals in the plant biomass, phytoextraction which occurs in plant tissues that can be harvested and removed from the site, and phytovolatilization as the plant evapotranspires the contaminant as a gas (Dhankher et al. 2012). Biotechnological methods that have been successful in altering the ability of plants to phytoremediate inorganic pollutants have focused on plant tolerance and accumulation (Ruiz and Daniell 2009).

Both **organic** and **inorganic** phytoremediation can be enhanced through genetic engineering to improve root uptake of contaminants and move chemicals, and by genetically modified enzymes, endophytes and other microbial symbiotic processes that help break down contaminants. Future research will continue to consider ways to enhance detoxification of contaminants, plant tolerance to the chemicals, their ability to accumulate the contaminants, and move them from root biomass to above ground biomass so that they can be harvested if not degraded (Dhankher et al. 2012, Pilon-Smits 2005). I have included a list of selected articles on the subject of phytoremediation in Appendix B if you are interested in reading more about this topic.

6.4 Trout Pond

6.4.1 Description

The Trout Pond (which I formerly called the Duck Pond) is a great opportunity to showcase wildlife habitat. This pond is frequented by many types of wildlife including waterfowl, song birds, deer, beavers, racoons, dragonflies, water invertebrates, frogs, and of course trout from the Trout Stream Exhibit. Educational signs mentioning the wildlife will be important, but we should also intentionally use structures and plants in a manor that can call out specific habitat needs of the different types of wildlife found here. In this way we can give our human visitors some practical information and real examples of ways they can improve habitat value, while displaying the beauty and interesting features that will entice them to do so.



Trout Pond (a.k.a. Duck Pond) looking northwest from the boardwalk

6.4.2 Pond Habitat

The Trout Pond has many good features for wildlife habitat including floating logs, food sources, access routes for wildlife, and nearby woods. It does, however, lack some important aquatic and shoreline vegetation and woody debris. It also needs a buffer zone using woody debris and plants along the east and southeast shoreline since the boardwalk is so close here, while providing viewsapes also. Old paths on the west and south sides of the pond should also be replanted and woody debris placed to prevent people from using them, damaging the pond edges, or invading the wildlife zone. A limited educational staff access route will need to be provided. We should also examine the human maintenance activities to see how they affect the wildlife as a whole, and not just one or two target species only. Habitat ideas are provided in the following pages.

WILDLIFE POND HABITAT

Pond Vegetation*

<65% vegetation cover

Oxygen can enter the water's surface and it allows sunlight for algae, submerged plants, fish & amphibian eggs

Controlled algae growth

Food for fish, tadpoles, ducks, snails; provides dissolved oxygen

Submerged plants (1-4' water)

Release all their oxygen into the water; provide egg laying sites & hiding places for fish, frogs & others; seeds & plants eaten by ducks

Floating leaf plants (1-3' water)

Shade for fish, resting places for frogs & dragonflies, breeding sites for water beetles & snails, attachment sites for caddisflies & midges; food for ducks, shorebirds, deer & beaver

Marginal plants (6-12" water)

Prevents shoreline erosion; habitat for birds, amphibians & reptiles

Structures*

Floating log

Fish hide under them, ducks rest on them

Submerged brush shelter

In shallow water for turtles, amphibians & aquatic insects to attach eggs; hiding places for fish & tadpoles

Basking rock

Above water surface for turtles, frogs & butterflies to bask

Perching sticks

Songbirds & dragonflies

Rock shelter

Next to or in pond for amphibian & fish to hide

Mud or sandy bottom

Egg laying sites for dragonflies & damselflies; nymph burrowing

Gently sloping beach

In a portion of pond's edge, made of sand, small rocks or soil

Nest boxes

Nearby for cavity nesting birds (ducks & swallows)

Bat house

Bats control mosquito population

*Info from Link 2002

Table C: Wildlife Pond Habitat



The two photos above show wildlife habitat structures near the shoreline of Elbow Lake in Washington state. While not a pond, it is a good example of pond structures and a mixture of plants that contribute to a healthier wildlife habitat.

WILDLIFE POND HABITAT

Native Submerged Plants*

Ceratophyllum demersum
Elodea Canadensis

Common Name

Coontail
Elodae

Supply Source

Commercial nursery
Commercial nursery

Native Floating Leaf Plants*

Brasenia schreberi
Lemna minor
Nuphar lutea ssp. *Polysepala*

Watershield
Duckweed
Yellow pond lily
(can be aggressive)

Commercial nursery
On-site (Trout Pond)
Commercial nursery

Nymphaea odorata
Potamogeton natans

White water lily (naturalized)
Pondweed

Commercial nursery
Commercial nursery

Native Marginal Plants*

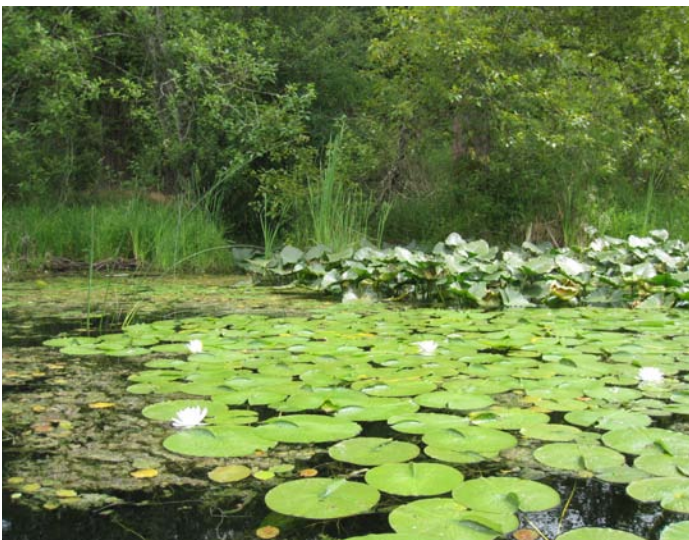
Alisma plantago-aquatica
Carex vesicaria
Eleocharis palustris
Sagittaria latifolia
Scirpus acutus
Scirpus microcarpus
Scirpus validus
Typha latifolia

Great water-plantain
Inflated sedge
Spike rush
Wapato (arrowhead)
Hardstem bulrush
Small-fruited bulrush
Soft-stem bulrush
Cattail (can be aggressive)

Commercial nursery
Commercial nursery
Commercial nursery
Commercial nursery
Commercial nursery
On-site (east side)
Commercial nursery
On-site (small patch in center)

*Info from Link 2002

Table D: Plants for Wildlife Pond Habitat



At Elbow Lake the aquatic plants include *Nuphar lutea* ssp. *polysepala* & *Nymphaeaceae odorata* in foreground. *N. tetragona* (pygmy water lily, the native white water lily is rare in Washington) (Robson et al. 2008). Native marginal plants above include *Scirpus lacustris* & *Typha latifolia*.



Above is a close-up of the aquatic plant *Nuphar lutea* ssp. *polysepala* (spatterdock or yellow pond lily) with its yellow flowers. This plant has large rhizomes (6 inches by 10 feet) and needs some space (Robson et al. 2008).

6.5 Frog Pond

6.5.1 Description

Our boardwalk crosses the middle of the Frog Pond in the south end of the site (thus the name Frog Pond Crossing). The pond is a beautiful and interesting addition to our route and the boardwalk gives a close-up view of different frog species found here. Consequently, this is a great spot to showcase amphibian habitat.



View of the Frog Pond structures and plants looking north before the boardwalk was put in.

6.5.2 Amphibian Habitat

While much of the Frog Pond habitat is already present, we should try to make the habitat more obvious to visitors for its educational value. Tables E and F on the following page contain useful information on amphibian habitat that we can use to improve the Frog Pond, including a list of plants that are not all present at this pond site. Educational signs on amphibian species, life cycles, habitat, and plant species for habitat value could provide information and encouragement for others who wish to develop amphibian habitat in other areas.



View of the Frog Pond and nearby forest looking southeast before the boardwalk was put in.

AMPHIBIAN HABITAT

Pond Conditions*

Provide both sun & shade	Keeps water cool to prevent dissolved oxygen deficiencies
4 to 24-inch water depth	Prevents egg dehydration & death
Clean water	Water permeable frog skin very sensitive to toxins/pollution
50% open water	Egg laying in open water near vegetation, aquatic tadpole stage
50% vegetation cover	Egg laying above spring vegetation, supplies for food source insects, hiding places from predators
Thin-stemmed emergent plants	For pond breeding species

Nearby Terrestrial Conditions*

Large, coarse woody debris	Cover (burying), food (snails, slugs, insects), shelter (moist)
Rotting logs, rocks, wood piles	Egg laying sites (terrestrial-breeding amphibians)
Areas of leaf & twig litter	Provide adult food and shelter sources

*Info from Link 2002

Table E: Amphibian Pond Habitat

AMPHIBIAN HABITAT

Plants for Spawning Habitat	Common Name	Supply Source
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Pacific treefrog & long-toed salamander*

<i>Eleocharis palustris</i>	Creeping spike-rush	Commercial nursery
<i>Juncus acuminatus</i>	Taper-tipped rush	Commercial nursery
<i>Scirpus microcarpus</i>	Small-fruited bulrush	On-site (east side)

Red-legged frog & Northwestern salamander*

<i>Carex obnupta</i>	Slough sedge	On-site (plant nursery) & Penny (Master Gardener)
<i>Carex rostrata</i>	Beaked sedge	Commercial nursery
<i>Juncus bufonius</i>	Toad rush	Commercial nursery
<i>Oenanthe sarmentosa</i>	Water-parsley	On-site (Frog Pond & central west side by boardwalk)

*Info from Link 2002

Table F: Amphibian Spawning Habitat Plants

8.0 CONCLUSIONS

Now that we are past the craziness of prepping for the Open House event and can proceed in a more organized way, here is my overall plan for the landscape aspect of the site. The plan is broken down into the following three stages.

The **first stage** is to get the rest of the route cleared for the boardwalk construction. While the boardwalk construction team continues to build the basic boardwalk route, I have my hands full staying ahead of them clearing this route. I am marking the path, salvaging plants, transplanting some of them nearby or potting up others for later use, pruning branches out of our way, and moving excess woody debris. While doing these tasks, I also remove invasive plants from the route perimeter, attempt to propagate the cut branches, transport excess woody debris to other areas for later use, and think about design opportunities as well as additional plants needed. That is all I have time for at the moment, as this stage needs to be done before the Christmas break.

The **second stage** is to continue developing individual sections of the west side in particular, by adding larger woody debris we have accumulated, removing all of the invasive plants and disposing of them, planting our potted salvage plants according to plant communities, adding additional plants, constructing necessary buffers, enhancing wildlife habitat, and repairing damaged areas (either from our efforts, campsites, or invasive plants). This is a good time to go back and check on areas that had particularly significant patches of invasive plants and remove the leftovers or seedlings that have sprouted. At this time the construction crew will probably be adding more toe rails and screws to the boardwalk and/or building the Cedar Cathedral Viewpoint. Tom will continue his efforts to get additional funds for the other viewpoints and the bridges. My aim is to get as much of the landscape in as possible before the spring wildlife breeding season starts. Amphibians can begin even earlier, breeding January through March (Link 2002), so I would like to stay out of the ponds at that time.

The **third stage** consists of enhancing habitat for target species if needed, completing artful design aspects, improvements to AAS functional spaces, building perimeter and main entrance landscape enhancements, and set up educational signs, and other fine tuning. I think we should stick to the human zones as much as possible at this time, and stay out of the wildlife zones to encourage wildlife to return after the construction activities and give them some space. At this time, the bridges should be built and Tom will be adding the rest of the pieces needed for facility operations to get this site open to the public. A maintenance plan should also be developed and evaluated to see if improvements are needed to minimize maintenance activities and protect wildlife habitat.

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APPENDIX A: Recommended References

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