APPENDIX C

APPENDIX C—BOWKER CREEK CHANNEL RESTORATION NEEDS AND PRESCRIPTIONS

By Tanis Gower, RPBio

INTRODUCTION

This assessment and recommendations were prepared in between October 2008 and November 2009 by the Bowker Creek Initiative Coordinator, to feed into the Bowker Creek Blueprint under preparation by the Bowker Creek Initiative Steering Committee and supporting consultants. The same reach breaks are used as defined by the Bowker Creek Watershed Proper Functioning Condition Assessment (Barraclough et al., 2007), and more detail is provided regarding current and potential vegetation conditions and restoration opportunities. This assessment addresses only those sections of Bowker Creek that are currently above ground

The original Watershed Assessment (Reid Crowther, 2000) and specific recommendations for sections in Saanich (P.A. Harder and Associates, 2002) were also reviewed in developing this document.

Please refer to chart below for reach numbers.

BLUEPRINT REACH NUMBERS	APPENDIX C
1	1A,1B and 1C
2	enclosed
3	3A and 3B
4	enclosed
5	5A and 5B
6	enclosed
7	7A and 7B
8	enclosed
9	9
10	enclosed
11	enclosed
12	12A and 12B
13	enclosed
14	enclosed
15	15A, 15B and 15C
16	enclosed
17	17A and 17B

GENERAL RESTORATION RECOMMENDATIONS

In general, the open sections of Bowker Creek are deeply incised with two to four meters elevation difference between top of bank and creek bottom. The incised (excavated) channel corridor typically measures between 5 to 13 meters from top of bank to top of bank, with the narrower sections supported by retaining walls. The average wetted channel width under low to moderate flow conditions is two to four meters. The natural floodplain has been removed or altered in all but the uppermost sections of the creek located on the UVic campus. In most locations without retaining walls or concrete sandbags/gabions, the banks are steeply sloping (ranging from an engineered 1:1 grade to vertical) and consist mainly of a clay substrate. The steep clay banks are unsuitable for the establishment of a diverse community of native vegetation (Reid Crowther, 2000), and where riparian vegetation exists it is often dominated by invasive species, particularly blackberry, ivy and yellow willow. In-stream habitat is extremely poor. The habitat type is mostly shallow runs, with little to no pool habitat, and short and infrequent riffle habitats. Substrates vary and where the creek bottom is not hardened with cement or asphalt, small gravels, sand, silt or and cobble overlay clay or bedrock substrates. In some areas the creek bottom consists of exposed clay. In many areas, root mats from the invasive yellow willow are seen on the channel bottom.

General restoration prescriptions that can be adopted in any open channel area, on an opportunistic basis as land use changes or as property owners decide to get involved are:

- Increase floodplain area by creating more gently sloping banks and/or removing fill to create a wide bench and lower the top of bank. Where benches are created, they should be one meter or less above the creek bed, as possible, to maximize floodplain area and the potential to plant floodplain vegetation.
- Remove invasive species;
- Plant native species; and,
- In selected appropriate areas, increase channel diversity by installing engineered rock weirs and groins. This is particularly recommended for those reaches with significant improvements and changes to the channel configuration and floodplain extent.

With respect to removing invasive species, yellow willow (*Salix lutea)* is not possible to remove without major channel reconstruction that includes excavating the root masses. For this reason most yellow willow should remain intact when short term restoration actions are taken.

For larger properties that may come available, the creek channel could be further restored by creating a new channel configuration with meanders of appropriate amplitude. The bankfull width, depth, channel and bank slope can be designed based on existing flows and desired flow conveyance (e.g. Keir Wood Leidal, 2007) as well as on the site conditions and the principles of natural channel configurations as found in Newbury and Gaboury (1994). Depending on design considerations and the site in question, the original channel could be maintained as an overflow channel for peak flows.

In areas where the ability to expand the floodplain is limited, retaining walls can be used on one or both sides of the creek, to enable the creation of a lower riparian bench alongside the creek. In addition to enabling the development of healthy riparian vegetation and a limited floodplain, this option will allow for increased flood conveyance. This option is less desirable than the development of a more natural floodplain, but represents a good compromise in areas where a significantly wider creek corridor will never be logistically feasible due to existing infrastructure.

Any significant changes to the creek and riparian area should be accompanied by interpretive signage and by points of visual access to the creek. Physical access to the creek is not required but is desired in some cases.

Detailed restoration prescriptions including the exact number and type of riparian plants should be prepared as restoration opportunities present themselves. A list of native plants that can be used as a starting point for detailed restoration planning is found in Addendum 1.

REACH SUMMARIES AND PRESCRIPTIONS

REACH 1A

— creek mouth to Kachan property above Beach Drive (one property above Beach Drive)

Width of riparian buffer each side (slope distance) and estimated slope

90 degrees slope, variable height (1–2+ m) concrete/rock retaining walls. As such there is no riparian buffer however there is a strip of vegetation on the north bank in particular, that is one tree/shrub wide. Yellow willow has colonized a short segment of deposited fine soil/sand within the concrete walls. Ivy covers parts of the concrete walls.

Streambank erosion issues (Y/N and H,M,L)

Y, M, on south bank just downstream of Beach Avenue. High, steep eroding bank, approx 7 meters long and up to 3 meters high, sparsely vegetated with blackberry

Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species

Trees, shrubs, grass. Dominant species: ivy, yellow willow,

Species list of all plants covering >5% of the area within vegetated streamside zone (see Addendum 2 for latin names)

Ivy, garry oak, blackberry, knotweed, daphne, poplar, yellow willow, ornamental trees (e.g. cherry, laurel, laburnum), morning glory, snowberry, big-leaf maple, weeping willow, cedar, fir, policeman's helment.

Percent coverage of invasive vs. native species

Approx 20% invasive, probably 80% non-native in total.

Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment)

Strip of trees/shrubs above retaining wall on north bank is 0–2 meters wide. Potential width with landowner involvement and removal of concrete wall could be ~5 meters wide.

On the south bank little change can be made with the current building footprint. Currently the vegetation along the concrete wall is mostly grass, ivy and ornamentals.

Short term riparian restoration potential and techniques

Remove knotweed growing from concrete wall on south bank below Beach Drive—high priority.

Remove ivy growing on private property along the south bank above and below Beach Drive. This would be particularly useful above Beach Drive where there is space for native plantings above the retaining wall. Remove blackberry and ivy along the Kachan property particularly where there is no bank hardening (no cement sand bags) and replace with native shrubs.

Use native tree and shrub species in landscaping

Address erosion just below Beach Ave by installing bioengineering terraces (willow wattles) if the property uses allow. This would require resloping the bank to a gentler angle and the existing land use in this area (front yard of an apartment building) would need to be assessed.

Short term channel restoration potential and techniques

Channel bed below Beach Drive is mainly bedrock and cobble with some sandy deposits. Good channel complexity (see Plate 5) as a result.

Long term channel and riparian restoration potential

Long term restoration will require redevelopment, particularly on the south bank. The current building footprint on the south bank is too close to the creek for any changes to be made to the creek channel. On the north bank, changes could be made if the property owners were willing to give some of their property to the creek.

In the long term with redevelopment and/or landowner involvement, the concrete/rock walls can be removed and the creek banks sloped back and planted with native vegetation. The ultimate configuration will be determined by the amount of space made available—ideally the entire creek corridor should be 15+ meters in width. If redevelopment constraints require the creek corridor to remain relatively narrow, parts of the relocated creek bank could be stabilized by developing bioengineering terraces as necessary. Bioengineering is best for shorter stretches of creek rather than extended creek sections, as the willow forms dense, tall stands of a kind not typically found in such abundance in nature. Another option for the south bank in particular is to move the concrete retaining walls back from the creek to allow a natural riparian area within these bounds.

Observations/Notes

The creek bed under and adjacent to Beach Drive is asphalt. This presents the first fish barrier in Bowker Creek, due to high velocities and shallow depths—fish passage would be possible only with high flows.

On north bank homeowners discard yard waste into channel.

North bank rock wall has a sinkhole behind it near the creek mouth.

Tidal influence extends up into this reach, and CRD water quality sampling is done just above the limit of tidal influence.

Reach 1A photographs

Plate 1: View of the creek mouth where it enters the ocean

Plate 2: Knotweed growing from south bank retaining wall in Reach 1A

Plate 3: Natural cobble line providing complexity in Reach 1A. Reddish substrate on the left is yellow willow root mats commonly found in Bowker Creek.

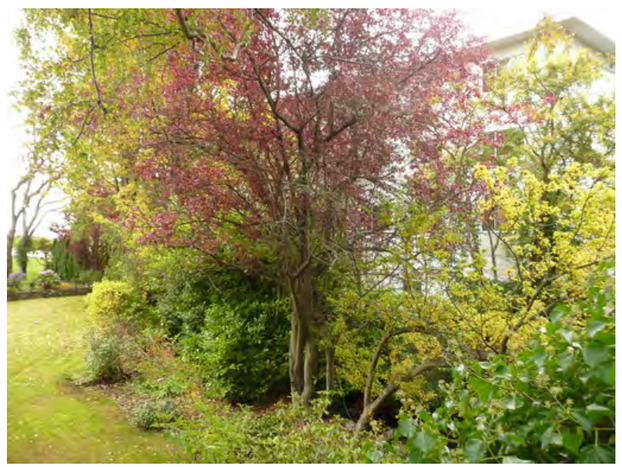

Plate 4: View looking downstream from Beach Drive. Note the narrow riparian 'strip' on north bank, apartment building on south bank

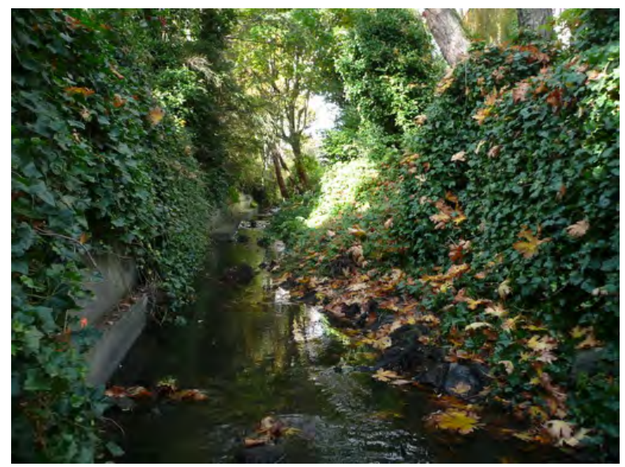

Plate 5: Reach 1A above Beach Drive. The Kachan property at 1776 Beach Drive is on the right hand side. Ivy and adjacent blackberry can be removed and native shrubs planted above the retaining wall on the south bank and in space on the north bank made available by blackberry removal.

REACH 1B

— one property above Beach Drive to eastern (downstream) edge of Monteith community gardens property

Width of riparian buffer each side (slope distance) and estimated slope
Concrete/rock walls are absent in part b of Reach 1. On part of the north bank the riparian 'buffer' consists of a steep (approx 2:1) blackberry-covered bank leading up to a fence at the slope break. Other areas have fences set further back or no fences. The south bank has up to a few meters of vegetation with significant native trees and shrubs present, and is lower elevation and more natural in some areas.

Streambank erosion issues (Y/N and H,M,L)
Y – M (fill known to have been lost to the creek at Kachan property)

Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species
Trees, shrubs – mix of species including dominant blackberry on the north bank and native trees and shrubs on the south bank.

Species list of all plants covering >5% of the area within vegetated streamside zone
Big leaf maple, alder, poplar, cottonwood, ivy, blackberry, morning glory, snowberry, laurel, mock orange, holly, rose, oceanspray, red-osier dogwood, vine maple, bracken fern, buttercup, water parsley, Daphne

Percent coverage of invasive vs. native species
40/60 with some fairly natural areas and others completely dominated by blackberry and morning glory

Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment)
There is up to a few meters of vegetated area on either side of the creek, with a buffer width up to 5 meters currently possible on the south bank. With private landowner involvement the creek corridor could be significantly improved via resloping the banks (north side), widening the riparian buffer and planting more native trees and shrubs. The current building footprints appear to leave enough room for this to occur.

Short term riparian restoration potential and techniques
Removing ivy and other invasives on south bank, and maintaining and improving the native plant mix in that area. Short-term action not recommended on the blackberry and morning-glory covered north bank.

Short term riparian restoration potential and techniques
Removing ivy and other invasives on south bank, and maintaining and improving the native plant mix in that area. Short-term action not recommended on the blackberry and morning-glory covered north bank.

Short term channel restoration potential and techniques
As in Reach 1A, the channel has a bedrock base, though it is less obvious in places. The substrate is bedrock/cobble/gravel/sand. No short term channel improvements suggested.

Long term channel and riparian restoration potential
Relocating or removing some fences, and removing fill in order to reslope channel banks further back into the private property. This applies particularly to the north bank but both banks will benefit from removal of invasives and planting native trees and shrubs. If the space available is limited, the north bank could be terraced using willow wattles (bioengineering). Any work of this sort should tie in with the erosion issues happening at the Kachan property.

Observations/Notes
As in many (if not most) places along the creek, streamside properties are built up with fill. The erosion problems at the Kachan property (1776 Beach Drive) are a result of a corner of the filled lot extending into the creek channel and causing a narrowing and a slight bend in the creek (Fig. 7). According to Lisa Kachan (pers. comm.), she would like to stabilize the property using 'soft' techniques like bioengineering if affordable, though it currently appears to be too expensive to accomplish without outside support. Lisa Kachan's two upstream neighbours also have some interest in doing something for the creek where it runs past their properties. Any action taken by the Kachans would be best accompanied by action by their upstream neighbours as well.

Reach 1B photographs

Plate 8: Kachan property at 1776 Beach Drive. The fence in the far distance marks the location where the creek narrows and bends around the fill that was historically used to create/extend the side yard on this property.

Plate 7: The steep north bank on reach 1B, covered in blackberry and morning glory. Fence shown is from panhandle of property at 1790 Cranmore Road.

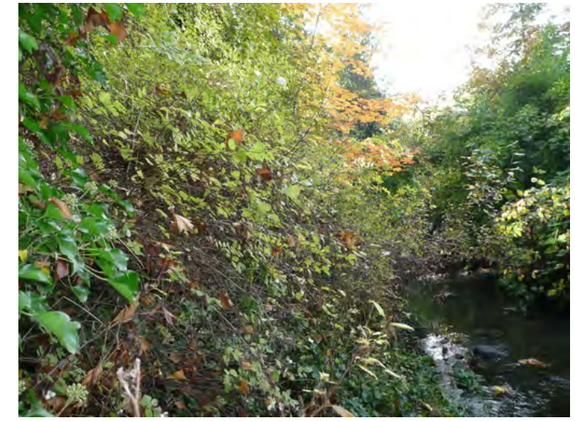

Plate 6: The more natural south bank of reach 1B is shown at left.

REACH 1C

— Monteith street community gardens and Oak Bay municipal lot

Width of riparian buffer each side (slope distance) and estimated slope

The buffer on the north (community garden) bank is approx. 1 meter wide and consists primarily of bioengineering completed in March 2007, with dominant individual yellow willow and cottonwood trees at either end and a concrete sandbag section at downstream end. The bioengineered area consists of a steep short (approx 1.5 m high) slope consisting of two tiers of willow wattles, with variable growth and survival. The buffer on south bank is variable in width (10-20 meters of unmanaged native/invasive vegetation), has a gentle slope and is dominated by red osier dogwood and ivy.

Streambank erosion issues (Y/N and H,M,L)

Y, M – addressed with bioengineering in March 2007. New creek braid artificially induced (see Plates 10 and 11)

Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species

Trees/Shrubs: Yellow willow, cottonwood, red osier dogwood, willow stakes, snowberry

Species list of all plants covering >5% of the area within vegetated streamside zone

Cottonwood, weeping willow, pacific/sitka/scouler's willow (bioengineering stakes), bigleaf maple, snowberry, ivy, water parsley, thistle, blackberry, Daphne, policeman's helmet

Percent coverage of invasive vs. native species

Approx 30% invasive. There is little to no blackberry currently along streambanks but the newly disturbed in-channel area (Plates 11 and 12) has blackberry shoots as well as low numbers of thistle/daphne.

Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment)

Oak Bay is the landowner. If community gardens were relocated from the north bank a buffer could be created that would be 10–25 meters in width (based on lot constraints) as compared to the current < 1 m buffer.

On the south bank, Oak Bay wishes to create community gardens. A currently planned project includes community gardens at a maximal distance from the creek, and a restored riparian buffer of 10–15 meters.

Short term riparian restoration potential and techniques

Remove occasional occurrences of policeman's helmet (*Impatiens glandulifera)* (Plate 12) from the community gardens on an annual basis until eradicated—high priority

For the south bank, funding is in place to purchase native plants to improve the riparian buffer (10–15 meter wide strip) and remove invasives. No short term riparian restoration is possible on the north bank unless community garden plots can be removed along the streambank. Note: the bioengineering treatment is not thriving as previously, particularly in the central section. Some areas have been clipped by the gardeners to control shade and in certain locations it is possible this may have affected the viability of the stakes.

Short term channel restoration potential and techniques

In-channel conditions have been altered (Fig. 11 and 12). The resultant 'point bar' needs to be treated to remove invasive species. Currently, the channel throughout the reach has some diversity with cobble, some boulders, and gravel in pockets.

Long term channel and riparian restoration potential

South bank as per previously prepared plans. North bank via relocating the community gardens elsewhere, resloping the bank (as appropriate) and reclaiming the riparian area with native plants. As per the proper functioning condition assessment, in-channel conditions could be improved with rock groins.

Observations/Notes

Aside from the wetland conditions at UVic, this is the only reach that has any significant amount of floodplain. Invasive species are less predominant here than in many reaches, though ivy is prominent on the south bank. This is a high profile location and restoration treatment on the south bank will be beneficial for the creek and the Initiative. Additionally, contact should be made with the community gardeners to ensure that willow wattle pruning is done appropriately. The overall structure of the bioengineering is holding up very well but as the dead parts decay erosion problems may resume.

Note: the Fireman's Park culvert is undersized and the resultant high flow velocities have caused channel widening at the top of the reach.

Reach 1C photographs

Plate 9: Downstream view of Reach 1C showing bioengineering on the left and a relatively new 'bar' in centre, created by an artificially dug channel.

Plate 10: Upstream end of point bar showing top end of excavated channel, and looking towards Fireman's Park culvert exit.

Plate 11: Policeman's helmet (Impatiens glandulifera) is an invasive annual plant that needs to be controlled before it establishes in the watershed. A few plants were found along Bowker Creek in the Monteith Street community gardens

Plate 12: Artificially created 'side channel'. This channel has been stable since its creation sometime in the winter of 2007/2008, presumably by an individual concerned about erosion and flooding at the community gardens. Invasive vegetation on the bar should be addressed.

REACH 3A

— Monterey Street to Oak Bay High School

Width of riparian buffer each side (slope distance) and estimated slope

N/A riparian area not connected due to vertical concrete walls

Streambank erosion issues (Y/N and H,M,L)

N

Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species

Concrete and rock-lined channel surrounded by grass with isolated pockets of landscaped native and non-native trees and shrubs. Some non-native shrubs overhang the channel and provide cover . There are some pockets of native landscaping but with no channel connectivity.

Species list of all plants covering >5% of the area within vegetated streamside zone

Scattered vegetation outside the channel includes: cedar, cottonwood, garry oak, birch, tulip tree, buddlea, red osier dogwood, mahonia, alder, big leaf maple, snowberry, oceanspray, and lawn variety grasses. Some Japanese knotweed occurs within the channel in one location (Plate 14), and another alcove location harbours some limited in-channel vegetation (Plate 15).

Percent coverage of invasive vs. native species

90% + invasive and non-native if lawn variety grasses included

Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment)

While there is little or no riparian connectivity, there are variable widths of land alongside the concrete armoured channel. This land is owned by the District of Oak Bay and was 'beautified' to support its current public use back in the 1980s. There is space to redevelop the channel without concrete walls and bottom, and to reconnect a riparian area, should there be the political will and public support.

Short term riparian restoration potential and techniques

High priority: remove Japanese knotweed spotted in two locations (see Plate 13 and 14).

Replace some grassed areas with overhanging vegetation.

In the one widened pond area within the concrete lined channel, plant more native vegetation such as spirea or cattails (Plate 15)

Over time increase the amount of native landscaping.

Short term channel restoration potential and techniques

n/a

Long term channel and riparian restoration potential

In some or all areas, remove the concrete lined bottom and sides, and grade the banks back and/or use terraces to support native vegetation along the banks. In locations where space is tighter, use setback retaining walls to create planting benches. Plant native vegetation. Recreate a natural-bottomed meandering creek bed. As per the PFC assessment (Barraclough et al., 2007), the general alignment and footprint of the channel and ponds can remain. Note: one area in particular that is not currently used by the public (west bank at south end of reach) has potential as a pilot project to create a naturalized bank and riparian area (Plate 16).

Observations/Notes

It is very important to eradicate knotweed from this reach. This is the largest occurrence seen to date.

Reach 3A photographs

Plate 13: Knotweed intermixed with other vegetation on the west bank south of Hampshire Road.

Plate 14: Partially vegetated in-channel area that could be enhanced with plantings of Spirea and/or other water-loving plants.

Plate 15: Typical concrete channel wall.

Plate 16: Large knotweed patch found within the channel boundaries, on the west bank north of Hampshire Road. All knotweed should be removed and monitored to ensure it is eradicated.

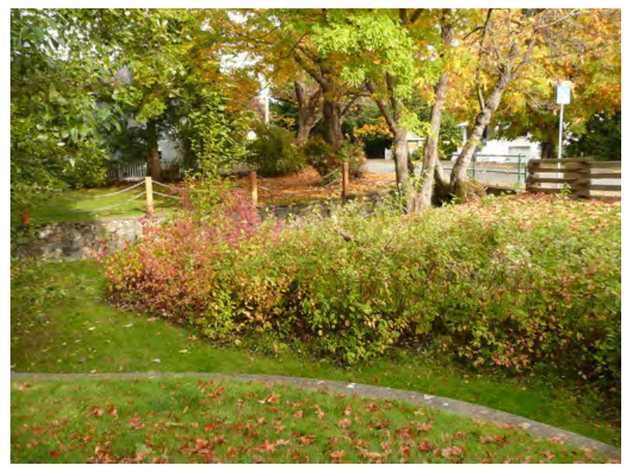

Plate 17: The area on the far bank (west bank north of Hampshire Road) is a potential candidate for a pilot project to create a more natural channel bank and riparian area due its lower public use and available space.

REACH 3B

— Oak Bay High School to tennis bubble

Width of riparian buffer each side (slope distance) and estimated slope

The channel is very narrow and deep. The south bank is a vertical retaining wall and the north bank is steep and vegetated. The vegetated width on the north bank is minimal (<2 m).

Streambank erosion issues (Y/N and H,M,L)

N (streambank not visible)

Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species

On the vegetated bank the dominant vegetation is young trees with some shrubs. Cottonwood, blackberry, yellow willow and European nightshade are predominant.

Species list of all plants covering >5% of the area within vegetated streamside zone As above.

Percent coverage of invasive vs. native species 50/50

Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment)

The entire creek corridor is very narrow, perhaps 5–6 meters wide. With redevelopment the north bank along the high school property could be set back and regraded to create a more gradual streambank and a riparian buffer, by reclaiming a minimum of 10 metres of the school property.

Short term riparian restoration potential and techniques

The vegetation on the north bank could be improved (remove invasives and plant more diverse native plants) but with great difficulty due to the steepness of the bank and the fencing. This is a relatively low priority and longer term channel restoration is preferred.

Short term channel restoration potential and techniques n/a

Long term channel and riparian restoration potential

As described above and in the PFC assessment, the channel conditions could be greatly improved by moving the north bank further into Oak Bay High School property by at least 10 meters. The channel itself would be widened and meanders created, and the current concrete-lined bank on the south side could have an earth-filled terrace installed alongside it to create a naturally vegetated streambank while leaving the adjacent property (athletic track) untouched. The creek bed may currently be concrete lined. If so, the concrete would need to be removed as part of the work. Appropriate sediments will likely colonize the reach, and larger rocks can be installed to create structure.

As part of the work, the north bank would be regraded (e.g. maximum 1:1) and vegetated with native species, and a new trail installed alongside the improved reach. This would greatly improve conditions and would be a high profile restoration site. This work could be accomplished as part of a redevelopment of the school property.

Observations/Notes

The school facility will be completely rebuilt due to the need for seismic upgrades and other issues. The School District is willing to work with the BCI to allow for restoration on their property.

Reach 3B photographs

Plate 18: Narrow creek corridor between athletic track (left) and school property (right). Tennis bubble is in the background.

Plate 19: The narrow band of streamside vegetation on the north bank is a mix of blackberry and young cottonwood and yellow willow.

REACH 5A

— Tennis bubble to Bee Street.

Width of riparian buffer each side (slope distance) and estimated slope

In the lower reach on the north side, the slope is approx. 1.5:1. On the south side and in the rest of reach it is approx 2:1. The riparian corridor is narrow and entrenched as per Reach 3B but it is less steep-sided and the creek is more accessible.

Streambank erosion issues (Y/N and H,M,L) Y, L. Small unvegetated patch on lower north side of reach.

Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species

As described in the PFC Assessment, the reach is different in upper and lower halves. In the lower half there is more species diversity and trees are dominant. In the upper half blackberry is dominant. Tree species in the lower half are big leaf maple and cottonwood. There is an unhealthy age structure – mostly mature trees with no replacements in the understory – and a lack of a vigorous and healthy riparian community.

Species list of all plants covering >5% of the area within vegetated streamside zone

Cottonwood, bigleaf maple, snowberry, Douglas-fir, ivy, blackberry, Daphne, alder, red-osier dogwood, scotch broom, yellow willow, English hawthorne, European bittersweet, laburnum, rose, water parsley, grass. Part of the reach is armoured.

Percent coverage of invasive vs. native species 50/50

Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment)

Narrow corridor currently—approx 5–8 meters. With Oak Bay involvement the creek could be given more room on the south side where the Oak Bay Rec Centre parking lot currently is.

Short term riparian restoration potential and techniques

Remove invasives and plant natives. It may be difficult to remove blackberry from this steep reach but this is a very accessible area where equipment could be brought in—and this could be instructive for other reaches affected by blackberry. If removing blackberry is not feasible, the Daphne, broom, hawthorne and European bittersweet could be removed and native shrubs planted in the lower half of the reach. However these short term actions are a low priority if any larger-scale actions are planned.

Short term channel restoration potential and techniques N/A

Long term channel and riparian restoration potential

This reach is behind the Oak Bay Recreation Centre and is high profile. People walk along the bank even in the absence of a safe trail. If the parking lot could be changed to make more room along the creek corridor (made into a two-tier structure) then the reach could be improved and a greenway trail installed. This would require at least 5 more meters of space along the creek corridor, and potentially more to incorporate a public walkway (detailed design required).

Observations/Notes

The District of Oak Bay is interested in treating this reach for bank stability but is waiting to see integrated recommendations from the BCI.

Reach 5A photograph

Plate 20: Reach 5A beside the Oak Bay Recreation Centre, looking downstream from Bee Street. Note the steep banks and mix of invasive and native vegetation.

REACH 5B
— Bee street to Cadboro Bay Road
Width of riparian buffer each side (slope distance) and estimated slope No buffer, vertical concrete walls
Streambank erosion issues (Y/N and H,M,L) N
Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species The only vegetation is that which can colonize inside the concrete walled (and bottomed) channel. Water parsley and cattails are two species which occur depending on recent flows.
Species list of all plants covering >5% of the area within vegetated streamside zone N/A
Percent coverage of invasive vs. native species N/A
Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment) No riparian corridor as this is a concrete channel. There is little opportunity to improve this short reach, given the land use constraints.
Short term riparian restoration potential and techniques N/A
Short term channel restoration potential and techniques Install baffles/boulders for in-channel complexity.
Long term channel and riparian restoration potential Install baffles/boulders for in-channel complexity. Review for restoration potential if major redevelopment occurs.
Observations/Notes This short (approx 45 m) reach is a low priority for treatments as little improvement can be realized without drastic land use changes.

Reach 5B photograph

Plate 21: Reach 5B looking upstream from Bee Street. Few options exist to improve this reach. One possibility is installing in-stream baffles for complexity and aeration.

REACH 7A

— Trent Street to Haultain

Width of riparian buffer each side (slope distance) and estimated slope

Above a restoration demonstration section which encompasses the lower 45 meters of the reach, there is a narrow buffer on each side—on the east bank it is 2+ meters and for the west bank 2–3 meters. The creek is incised 2+ meters throughout this section. Aside from the lower restoration demonstration section and small areas of the west bank, the banks are steep (e.g. 1:1 to vertical).

Streambank erosion issues (Y/N and H,M,L)

Y, M. There are short sections of eroding bank on the west bank across from the heliport, and at the Bishop of Victoria or Adanac ROW property.

Other erosion issues have been dealt with, with the restoration demonstration section and with bioengineering. However extensive sections of bioengineering are composed of dead willow stakes and will need to be observed over time to determine whether erosion will reoccur.

Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species

Upstream of the treated (restoration demonstration) section:

Deciduous trees (yellow willow and cottonwood) with grass and blackberry/shrubs. Yellow willow are very well established, and occupy the periphery of the channel bottom, particularly alongside St. Patrick's school (see Plate 24).

Species list of all plants covering >5% of the area within vegetated streamside zone

Yellow willow, grass (reed canary), cottonwood, blackberry, broom, ivy, black hawthorne, snowberry, rose, buttercup, cherry, holly

Native willows in bioengineering

In treated section: native willows, cottonwood, alder, red-osier dogwood, mock orange, red-flowering currant, rose, scirpus, swordfern, and others.

Percent coverage of invasive vs. native species

Approximately 80% invasives not including the restoration demonstration section.

Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment)

The riparian and creek corridor is approximately 9 meters.

With permissions of the landowners and some changes to land use, the corridor could be at least 15 to 20 meters wide. This would require a change in the school use plus involvement by VIHA, the District of Saanich, and the Bishop of Victoria.

Short term riparian restoration potential and techniques

Remove invasives on the west bank, and plant with a diversity of native trees and shrubs.

Monitor the areas with dead bioengineering wattles to determine whether problems with erosion will develop over time.

Plant native shrubs and trees on the upper reach east bank where no riparian vegetation currently exists (on triangle south of Haultain and on Bishop/Adanac ROW property).

Improve the water quality running off the hospital property, by improving their stormwater infiltration/channel design (see Plate 25).

Short term channel restoration potential and techniques

The following could be done in the short term or combined with longer term/larger scale actions: Use the triangle of land immediately south of Haultain, and the informal path on the west bank, to widen the creek corridor (Plate 27). This effort can result in a 15 meter wide corridor, even at the most narrow point. With the exception of the location where a fenceline comes directly to the streambank (see Plate 28), this would allow an opportunity to remove the gabions and create a terraced creek bank with native vegetation. This may require a retaining wall on the west bank and at the corner of the lot at 1875 Haultain—a detailed design would be required.

Long term channel and riparian restoration potential

With land use changes (i.e, if St. Patrick's school ever relocates and their land is taken over by the hospital or is otherwise redeveloped), and with involvement by VIHA, Saanich, and the Bishop of Victoria in the areas they currently own, the channel could be significantly reshaped to create a floodplain, to remove the yellow willow, and to create a healthy riparian community. This would entail creating a wider riparian corridor and more gradual banks (e.g sloped at 0.5 to 1 and less in places), a meandering channel (where possible) and potentially some small off-channel wetlands as space permits. Channel meanders should be designed based on land use constraints as well as for the appropriate amplitude for Bowker Creek flows (see Newbury and Gaboury 1994).

If the land use at St. Patrick's remains unchanged, there is still opportunity to improve the upper part of the reach as per suggestions above.

If widening the corridor is not feasible (e.g. through the St. Patrick's school property), the channel could be reconstructed within retaining walls as described in P.A. Harder and Associates Ltd. (2002), keeping within the same footprint but providing a small riparian area within the bounds of the retaining walls.

The upper part of the reach is constrained between lots. A long term option is to purchase the lot at 1875 Haultain Street (and/or at 1860 Adanac), to allow more room for the creek.

Any changes such as the above should be accompanied by interpretive signage and by points of visual access to the creek.

Observations/Notes

The above descriptions do not relate to the 45 m section that forms the lower part of Reach 7A. This restoration demonstration section was done opportunely when the north-east sewer trunk was upgraded, and improved conditions by resloping the banks, narrowing the channel, planting the riparian area terrace with wattles (willow and cottonwood) and with various native shrubs. The shrubs and willows are doing extremely well, and periodic blackberry removal is the only further maintenance required. This section is much improved with respect to riparian conditions, bank stability, and appropriate creek width, but still lacks in-stream complexity and a natural floodplain. If the area is ever redeveloped this section could be improved further by creating a reshaped, more complex channel in a wider floodplain, as described above.

Bioengineering done by Saanich above the footbridge has variable survival. On the east bank, little has survived. On the west bank, survival is moderately good, with the middle section having poor survival. The key section below the corner of the school gym is thriving. Immediately above the footbridge on the west bank, there is a rock retaining wall. This wall appears to be leaning and there is some erosion behind it.

The creek throughout this reach is shallow and lacking complexity, with the exception of large woody debris from a fallen yellow willow (see Plate 26), which is the only significant LWD seen in Bowker Creek outside of UVic. The creek substrate in this reach is variable, with exposed clay and small gravels, extensive yellow willow root mats, areas with cobble, and areas with a silty/sandy soft bottom.

VIHA at Royal Jubilee is interested in options that improve the creek running thorugh their property, and are most interested in options that also include the Adanac Street right-of-way and the Bishop of Victoria property, so that the entire triangle of land above St Patricks's school could be treated as a unit.

VIHA engineered the Royal Jubilee drainage so that no pipes drain directly from the property into the creek. However, their infiltration channel/area is not treating water quality sufficiently, and does not allow for significant infiltration. The original design of these features should be compared to their current functioning.

Reach 7A photographs

Plate 22: The 45-m long restoration demonstration section completed in 2005 is doing well and the willow/cottonwood wattles are thriving along with a variety of native shrubs (Photo October 2008).

Plate 23: One of two 'topped' cottonwood next to the hospital heliport

Plate 24: Upstream of the demonstration restoration section showing dead bioengineering along the east bank, behind thriving yellow willow growing on the channel bottom.

Reach 7A photographs, continued

Plate 25: Runoff from the hospital includes hydrocarbons. There is an opportunity to improve VIHA's Royal Jubilee stormwater runoff facilities next to Bowker Creek.

Plate 26: looking from the west bank to the triangle of land south of Haultain on the east bank. This area provides potential for widening the creek corridor.

Plate 27: Eroding unvegetated banks on the Bishop of Victoria and Adanac right-of- way property provide an opportunity for short and/or long term restoration actions.

Reach 7A photographs, continued

Plate 28: This fallen yellow willow offers rare large woody debris in Bowker Creek.

Plate 29: The property at 1875 Haultain comes to a point at the edge of Bowker Creek and is stabilized by gabions.

Plate 30: Gabions are controlling erosion at the top end of this reach, allowing for a streamside footpath on the west bank.

REACH 7B

— Haultain to Richmond: BC Hydro property

Width of riparian buffer each side (slope distance) and estimated slope

Vegetated 'buffers' are to top of bank, where vegetation exists. Banks are steep in most areas, with a height of up to three meters.

Streambank erosion issues (Y/N and H,M,L)

Y, H. Steep unvegetated and eroding banks in places, particularly in the top half of the reach, on the east bank where public access has eroded the vegetation, and on the west bank near the apartment building. One area on the east bank actually has a hole eroded into the streambank.

Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species

Blackberry and exposed soil with occasional trees, yellow willow and cottonwood, with a set-back row of coniferous trees along the streamside path.

Species list of all plants covering >5% of the area within vegetated streamside zone

Blackberry, yellow willow, cottonwood, grass, ivy, Daphne, holly, cherry, snowberry, daffodil and fennel.

A double row of planted conifers along the streamside trail, which include pine, fir, hemlock, cedar, spruce and other species.

Percent coverage of invasive vs. native species

95% invasive, non-native or unvegetated

Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment)

If the distance to the inner row of conifers along the path is included, the creek corridor is approximately 11 meters wide. With BC Hydro involvement, the creek corridor could be widened as much as necessary to create a meandering channel with appropriately sloped banks. On the west bank there is currently a chainlink fence at top of bank. To improve the channel, the expansion would need to be done to the east.

Short term riparian restoration potential and techniques

No short term actions recommended

Short term channel restoration potential and techniques

No short term actions recommended aside from removing yellow willow growing against the Richmond Road culvert, that could potentially pose issues during flood flows.

Long term channel and riparian restoration potential

Completely re-make the channel by moving it eastwards a minimum of 10 meters. Reslope the banks to a gentle grade (e.g. 0.5 to 1). Create some channel sinuosity at the appropriate amplitude (Newbury and Gaboury 1994). Plant native riparian species in buffers 5 to 15 meters wide (width can be variable), with key points for public viewing of the creek channel. Create a greenway path outside the riparian buffer. Create interpretive signage. Create one or two small off-channel wetland pockets with diverse emergent/riparian vegetation. These should be planted with adjacent shade trees so as not to create creek temperature issues.

Salvage harvest some of the abundant crayfish that live in this reach, and relocate them to the new channel. Provide woody materials to ensure crayfish habitat can develop in the new channel. Create artificial riffle habitat (rock groins) with rocks of sufficient size to withstand peak flows (Slaney and Zaldokas 1997)

Observations/Notes

This is one of the best locations for making significant changes to the creek channel.

Yellow willow currently growing against the culvert under Richmond Rd could pose issues during flood flows.

This section has a healthy population of crayfish.

Moving the channel would require removing the row of coniferous trees along the eastern creek bank, and community education to create support for these changes. Currently these trees are host to bird species (i.e. barred owl) not commonly seen in the watershed.

On the lower west bank there are gabions which extend upstream for approximately 25 meters, and the section below the apartment building on the west bank also has some concrete sandbags.

There are some minimal riffle habitats in this section, and this reach is one of the areas for benthic invertebrate sampling.

Substrates in this reach consist of gravel and cobble with sand and silt.

Reach 7B photographs

Plate 31: This reach is typified by steep, sparsely vegetated eroding banks and by blackberry on the west bank. It also has more riffle habitat than many sections of Bowker Creek.

Plate 32: The path along this reach is popular with neighbours and the mature conifer trees that line the path are important to the community.

Plate 33: Typical view of the east bank, with the row of conifer trees visible at the top of bank.

Plate 34: Looking toward the west bank. Bowker Creek is constrained along the west side of the Hydro property and restoration would entail expansion to the east.

REACH 9

— Newton to Pearl Street (Richmond school and Townley Street ROW)

Width of riparian buffer each side (slope distance) and estimated slope

The vegetated area extends only to the top of bank. The west bank is steeper and is approximately 2.5 meters wide. The east bank is approximately 4.5 meters wide.

Streambank erosion issues (Y/N and H,M,L)

Y, H

Erosion is extensive on both banks, particularly on the steeper west bank.

Additionally, the streamside fence is falling over due to erosion around its footings. See Plates 38 and 42

Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species

Trees and shrubs: mature yellow willow, blackberry, snowberry

Species list of all plants covering >5% of the area within vegetated streamside zone

yellow willow, blackberry, broom, cottonwood, red osier dogwood, black hawthorne, English ivy, holly, laurel. The west bank along the apartment complex has a short retaining wall with a laurel hedge.

Percent coverage of invasive vs. native species

90% invasive

Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment)

The entire, deeply entrenched creek corridor is approximately 13 meters wide. With school board involvement, the creek corridor and riparian buffers could be widened to an extent that would support a healthy creek channel.

Short term riparian restoration potential and techniques

There are serious erosion issues, but it is preferable to create a longer-term solution that involves resloping the banks, rather than attempting bioengineering on these steep banks.

Short term channel restoration potential and techniques

Fencing that is falling over could be replaced and set back further from the top of bank to avoid future issues.

Long term channel and riparian restoration potential

Redesign the creek channel by moving/widening the creek corridor to the west. It can also be moved east by a certain amount to reduce the east bank slope as necessary, but the distance the channel corridor can be moved east is constrained by the right of way above the sewer pipe line parallel to the east bank. Access for sewer maintenance needs to be maintained.

Design options will depend on the amount of land available in the triangle of land to the west of the current creek channel. If this entire area comes available for use, a meandering channel with a significant pond/wetland can be created. See specific design suggestions as per Reach 7B. If the land available is limited the creek corridor should be widened and its original alignment maintained, and the following options are possible:

Create a retaining wall along the east bank, to enable a planting bench 3–5+ meters wide along the east side of the channel, OR regrade the channel within the constraints of the right of way (detailed design required).

Regrade the west bank and remove volumes of fill in order to create a gently sloping bank. If space is limited this bank can be created in two tiers. Changing the west bank slope will require expanding the creek corridor at least X meters from the current top of bank.

There is currently a designated right of way along the east bank of the channel, above the north east trunk sewer line. The School Board has signed an agreement to create this right of way. Design options should use this corridor for greenway development.

At the top of the reach, options become more limited due to the apartment buildings on the west bank and the narrower right of way beside Townley street, which would need to incorporate a greenway path. In this section, the sewer line runs mainly below the street, but there is a Saanich water line in the road right of way. On the east bank, a retaining wall could be built set back from the creek to allow for a planting bench as described in Harder (2002).

Observations/Notes

This section has the worst erosion anywhere along the creek, and is the most entrenched. Working with the school district to restore this section will create excellent PR.

Substrate in this reach is variable and ranges from cobble and gravel to sand to silt to clay. Willow mats cover significant sections. There were two sinkholes encountered, one with an unknown depth.

Fish were seen in this reach. They appear to be sticklebacks but the species has not yet been identified.

There were hydrocarbons stirred up by walking in this reach, as well as gas from decaying leaves and sediment. On the day the reach was walked, Saanich had a single absorbent oil boom below the Pearl Street outlet.

At the top of the reach, there are some native shrubs planted as part of work done to control erosion. These require further maintenance.

Reach 9 photographs

Plate 35: The upper part of the reach below Pearl Avenue is the healthiest in terms of substrate, channel configuration and riparian vegetation. Benthic invertebrate sampling is done here.

Plate 36: The west bank is constrained in the upper two-thirds of the reach by an extensive apartment complex at 1702 Newton Street.

Plate 37: Extensive blackberry is a major feature of this reach.

Plate 38: Erosion is an issue through the school grounds. The fence footings have been eroding and public access is worsening the issue.

Plate 39: The school district has put extra fencing around eroding sections as a public safety measure.

Plate 40: The right-of-way along Townley Street is relatively narrow, but still allows an opportunity to widen the creek corridor.

REACH 12A

— North Dairy Road to McRae

Width of riparian buffer each side (slope distance) and estimated slope

Vegetated 'buffer' is narrow—to top of bank or with a narrow row of vegetation at top of bank. The bank height is up to two meters and ranges from 1:1 to vertical

Streambank erosion issues (Y/N and H,M,L)

Y, M. There are a few spots of significant erosion on the west bank between the two footbridges.

A significant portion of the reach has concrete sandbags, gabions, or rock walls, particularly the lower part of the reach.

Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species

Variable. It is mainly blackberry dominated with treed sections, and with sections that abut directly to lawns with and without armoured banks.

Species list of all plants covering >5% of the area within vegetated streamside zone

Blackberry, snowberry, yellow willow, native willows in bioengineering, hawthorne, ivy, holly, ornamental trees, big leaf maple, Indian plum, cottonwood, lamium, douglas fir, grand fir, cedar hedge.

Percent coverage of invasive vs. native species

95% invasive or unvegetated.

Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment)

Corridor width is approximately 8 meters or less, with a very narrow to no riparian buffer. The creek winds between residential properties, and without redevelopment significant restoration will be impossible. However, some worthwhile work could be done if certain property owners agree. The Wordsworth Street right-of-way also offers opportunity.

Short term riparian restoration potential and techniques

Remove the small patch of lamium on the west bank downstream of the upper footbridge.

Vegetate the west bank riparian zone along the Wordsworth Street right of way accessed from McRae Avenue. Reslope the bank to the degree possible while leaving room for a greenway path.

Work with the private property owner across from the right of way (1607 McRae Avenue), to vegetate the grassed terrace below their upper rock wall, and to reslope the bank as necessary. Part of the lower terrace is also armoured and part is a bare clay bank. See Plate 41.

Short term channel restoration potential and techniques

If the property owners at 1599 McRae Avenue agree, grade the bank back, and plant with native species to a buffer distance agreeable with the property owners. The backyard at this address is quite large and extends to the top of bank of Bowker creek with a cedar hedge and fence. The property comes to an angle here and this area is likely not much used. There is erosion all along this section. See Plate 42.

Long term channel and riparian restoration potential

Aquire several properties and/or rights-of-way along properties to create floodplain and a riparian buffer.

Move the creek into the right-of-way along Keats Street. This would depend on requirements for the electricity line currently in this space. The creek could gain four to five meters of space if this right of way could be made available. The gabions would be removed and the bank resloped, blackberry removed, and planted with native species.

There is a fenced property at the south end of Shelley Street, which is part of the lot at 1564 North Dairy. See Plate 46. This area is isolated and unused, and the concrete wall could be removed and a riparian buffer installed. The new streambank would have to be engineered however (e.g. with terraces), as the space is limited and the bank is high. It is unclear whether the city cares for this property or if it is the responsibility of the homeowner at 1564 North Dairy. This action could be taken in the shorter term but would make the most sense as part of a larger program.

Observations/Notes

The substrate in this reach is variable. Below McRae is a gravel/cobble section, followed by sandy substrate, then by a clay bottom with occasional cobble and extensive willow root mats, then by a gravel cobble section. In the cobble section there is more riffle habitat and the section above Keats Street is another possibility for benthic sampling.

The upper end of this reach has had bioengineering completed by the District of Saanich. The section nearest McRae is thriving but a significant portion, particularly on the east bank, is now dead.

Currently, the District of Saanich is planning limited riparian restoration on the Wordsworth ROW as part of their greenway creation.

Reach 12A photographs

Plate 41: Reach 12A looking north. The patch of grass on the left is the Wordsworth Street right of way accessed from McRae street. The lawn below the rock wall on the right has potential for riparian restoration if the property owner agrees. This could entail some bank resloping.

Plate 42: Erosion behind 1599 McRae Avenue. If the property owner agrees, the section along this property is a candidate for bank and riparian restoration.

Plate 43: Discrete areas on both banks, particularly the west bank, have erosion problems.

Plate 44: Upstream view. The creek does a sharp turn around this property. This would be a key property to acquire for creek restoration as the house footprint is very close to the creek.

Plate 45: Looking south along the right of way on Keats Street. Depending on whether the power line could be moved, the creek could be extended into the right of way, allowing the gabions on the east bank to be removed and natural riparian vegetation planted.

Plate 46: This streamside property appears to be part of the lot at 1564 North Dairy. It could be reconfigured as part of short or long term restoration plans

REACH 12B

— McRae to Knight – Browning Park

Width of riparian buffer each side (slope distance) and estimated slope

The upper and lower halves of the reach differ (above and below footbridge).

In the lower half on the west bank, grass extends to the creek bank in many places; in other areas the riparian vegetation is one tree or shrub deep. The bank on the west side is low (~ one meter). On the east bank the vegetated buffer is wider (0 to 5 meters) and the height of bank increases moving north. The east bank slopes back at approximately 1:1.

In the upper half of the reach, the riparian buffer consists of one row of trees on both sides, with shrubby undergrowth and ivy. The east bank is high and near vertical. The west bank is low and transitions to high and steep at the upper end of the reach. At the upper end, the creek is very incised, with tops of bank four or more meters above the creek.

Streambank erosion issues (Y/N and H,M,L)

Y, L. There is one patch of erosion on the east bank above the footbridge, where the bank is not armoured. Parts of the steep west bank are also unvegetated where there are access points to the creek.

In the upper reach the creek edge is armoured with one row of rocks set in concrete or asphalt, and the upper east bank is armoured with concrete blocks. In the bottom part of the reach, there is a low (one meter) rock retaining wall on both sides. In the middle reach the armouring varies.

The creek bottom is armoured with asphalt, though in the upper reach (below the culvert) this has been eroded into large chunks.

Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species

Deciduous trees (alder, cottonwood, yellow willow), shrubs and ivy with grassy areas in the mid/lower reach

Species list of all plants covering >5% of the area within vegetated streamside zone

North end: alder and ivy are dominant, with snowberry, blackberry, big leaf maple, cottonwood, holly, daphne

South end: yellow willow and cottonwood are dominant, with grass, Garry oak, snowberry, blackberry, Indian plum, alder, laurel

Percent coverage of invasive vs. native species

Approximately 40% invasive

Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment)

The vegetated riparian corridor is up to 13 meters wide, but width varies.

This park is owned by the District of Saanich and changes can potentially be made. At the north end the east bank is at residential property lines, is near vertical and, and is armoured. Assuming it is stable, it should remain as is. For the uppermost 38 meters of this reach (one property deep), options are limited due to limited available space. Below this point, the riparian buffer can be widened and changes can be made to the banks and to the creek location and/or configuration.

Short term riparian restoration potential and techniques

Vegetate the grassy riparian patches below the footbridge on the west bank with native shrubs and trees. However if changes to the channel are possible this action should be postponed.

Widen the riparian buffer along the east bank:

In the southern part of the reach where housing formerly stood (if longer term action not planned as per below)

In the area just south of the footbridge, by moving the footpath further east

On the east bank above the footbridge, install a delta loc system or bioengineering, to stabilize the bank at the corner of the property line at 1637 Knight Avenue (as per park plans)

Remove invasive species in all possible locations

Increase species and age class diversity with native plantings

Remove the mature yellow willow in the lower reach as feasible (together with a planting plan)

Vegetate open areas on the east bank (lower reach) and close off the informal trails

Short term channel restoration potential and techniques

Address house drainage coming through the west side of the park by building a demonstration rain garden for infiltration.

Create an upcreek oil capture device and/or determine the source of hydrocarbons to this reach.

Remove the concrete walls and asphalt bottom from the lower reach and reconfigure the banks at a stable slope.

Long term channel and riparian restoration potential

Parallel with the southern end of the lot line for the house at 1621 Knight Avenue (38 meters from top of reach), begin grading the west bank back to a gentler angle (1:1 at minimum), and move the footpath further west. Re-vegetate the bank with native trees and shrubs. Move the channel as far westward as practicable while still allowing space for a greenway and public use. Determine whether this move would allow the east bank to be reconstructed, or whether it should remain as is (if stable) or have a retaining wall constructed.

At the south end of the reach near McRae St., consider moving the channel further east, to allow space for both a greenway and a riparian buffer (there is a narrow point where the distance between the creek and the edge of the park is approximately 10 meters). The east bank in this area consists of former housing lots that were purchased by the District of Saanich to add to the park. These lots are likely on fill and the creek bank slopes down from the level fill. While there is some riparian vegetation here, there is also an opportunity to move the channel further east to make room for a greenway and a riparian buffer on the west bank. However there are a few mature cottonwoods and one mature Garry oak that would need to be considered. These are

approximately 5 meters away from the east bank. Regardless of whether the channel is moved, there is an opportunity to regrade the east bank and remove the rock wall, and plant with native trees and shrubs. Remove the asphalt chunks and paving from the channel bottom. Create engineered rock groins/riffles. All longer term changes to the channel need to consider removal of bank armour and creation of a diverse riparian buffer.
Observations/Notes The east bank above the footbridge to the top of the reach is covered in ivy but has limited restoration potential due to its steepness. In general, the riparian trees (particularly the alder in the upper reach) are even-aged with no younger trees in the understory. Discussions are ongoing with Saanich about making some of the above changes as part of greenway implementation and with Trees for Tomorrow funding.

Reach 12B photographs

Plate 47: Grassy area along west bank that is a candidate for riparian planting

Plate 48: The top of the reach looking across to the armoured east bank. The creek is highly incised here.

Plate 49: Looking south from the top of the reach. The current path curves towards the creek and with park redevelopment will be moved west to provide space for a riparian buffer, including a resloping of the creek bank.

Plate 50: looking across to the east bank where homes have been removed to expand the park. Even if the creek is not moved further east to accommodate a wider riparian buffer on the west bank, the east bank can be re-graded and have riparian buffer on the west bank, the east bank can be re-graded and have riparian vegetation planted, and the rock wall removed.

REACH 15A
— UVic Faculty Club pond and outlet channel
Width of riparian buffer each side (slope distance) and estimated slope Variable buffer width around pond. Narrow buffer width around outlet channel. Gentle slopes
Streambank erosion issues (Y/N and H,M,L) N
Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species Pond: Trees and shrubs (Douglas fir, alder, bigleaf maple, cottonwood, cedar, dogwood, cattail Exit channel: shrubs and groundcover (ornamental and native). Bark mulch.
Species list of all plants covering >5% of the area within vegetated streamside zone Douglas fir, alder, bigleaf maple, cottonwood, cedar, dogwood, cattail, Oregon grape, birch, swordfern, garry oak, pacific water parsley, rhododendron, salal, cattails
Percent coverage of invasive vs. native species 80 % native
Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment) The landscaped buffer zone around the pond is a few meters wide, more in spots. The buffer around the outlet channel is less than a meter wide. The configuration of this reach is unlikely to change, until such time as the building is demolished or redesigned.
Short term riparian restoration potential and techniques Plant more native species around pond edge and outlet channel. In particular, introduce dispersed willow stakes in a few pondside areas.
Short term channel restoration potential and techniques N/A
Long term channel and riparian restoration potential If the building is ever removed, this site could be converted into wetland
Observations/Notes Dam downstream of pond has been repaired. Some water pollution visible on pond surface. The pond area evidently used to be smaller and/or potentially not a year round feature. Currently, a stormwater pipe from across campus discharges into this pond.

Reach 15A photographs

Plate 51: The pond at the Faculty Club, Reach 15A. The pond edge is somewhat landscaped and native plantings could be increased.

Plate 52: The pond edge is the concrete patio at the Faculty Club. Looking downstream to beginning of outlet channel.

Plate 53: Pond outlet channel

Plate 54: Pond outlet channel as it goes into a culvert below parking and access roads

REACH 15B
— Faculty club to Gordon Head Road (description also includes the forested section of Reach 15C, Section B)
Width of riparian buffer each side (slope distance) and estimated slope Low gradient extensive buffer/floodplain
Streambank erosion issues (Y/N and H,M,L) N
Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species Widely spaced deciduous and coniferous trees with a shrub understory: Grand fir, douglas fir, bigleaf maple, cottonwood, alder, blackberry, rose, red-osier dogwood, salmonberry
Species list of all plants covering >5% of the area within vegetated streamside zone In addition to the above: bracken fern, ivy, holly, buttercup, snowberry, sword fern, piggyback plant, trailing blackberry, grass (reed canary?), trembling aspen, skunk cabbage, English hawthorne
Percent coverage of invasive vs. native species 60/40 native/invasive
Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment) This is the only section of the creek with abundant existing floodplain
Short term riparian restoration potential and techniques Remove ivy, starting with ivy covered trees. Remove the large blackberry patches. Remove the blackberry from the drainage channel coming from the parking lot (lot #10) to the south (see Plate 57) and install interpretive signage here about Bowker Creek and stormwater management. Identify and map epicentres or concentrations of invasive species and work from these outwards over a period of years until minimal maintenance is required. The section of creek beside the parking lot could have its riparian buffer extended out into the ROW. See Plate 56.
Short term channel restoration potential and techniques N/A
Long term channel and riparian restoration potential Same as short term

Observations/Notes

Note: the above description applies to Reach 15C as well, from the Fraser Parking lot to its confluence with reach 15B.

This forested area is protected until 2011 in the existing UVic campus plan and may be included in new sustainability planning.

This is a very wet area, with soft ground and silty fine soils.

There are various dead trees—maple and grand fir—which may relate to changes in hydrology due to parking lot construction south of this forested area.

A long term strategy to remove invasives in this area would be welcome and would ideally come from students and faculty members and be supported by UVic Facilities Management.

Reach 15B photographs

Plate 55: Creek channel behind Faculty Club parking lot

Plate 56: Location of creek channel beside Faculty Club parking lot. The riparian buffer could be extended into the grass ROW.

Reach 15B photographs, continued

Plate 57: Blackberry lined drainage channel from parking lot 10 (near Visual Arts building) to vicinity of Reach 15B. This presents an opportunity to create a more natural channel with native plants and interpretive signage about runoff and Bowker Creek.

Plate 58: ivy covered trees and blackberry mixed with native vegetation. This is in the area where the forested section of Reach 15C joins with Reach 15B.

Plate 59: Some pure blackberry patches (in the area of confluence between Reach 15B and 15C, close to the Fraser Building parking lot) are obvious targets for invasive species control

Plate 60: Much of the channel in Reach 15B and the forested area of Reach 15C is impenetrable and inaccessible, and its course has not been accurately mapped.

REACH 15C

— Tributary from Mackenzie/Stadium Section A. There are two very different sections:

Section A: Mackenzie to the Fraser Building Parking Lot, and Section B: Fraser Building Parking lot to Reach 15B. The below deals only with Section A as Section B has the same conditions as Reach 15B

Width of riparian buffer each side (slope distance) and estimated slope

Variable width, from 0 to 10 meters. Slope is very gradual and banks are low – the creek is unconfined in this reach.

Streambank erosion issues (Y/N and H,M,L) N

Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species

Deciduous trees and shrubs, grass and herbs. Cottonwood is dominant, with some alder. Dominant shrubs are salmonberry, native willow (likely pacific and sitka) and blackberry Some patches with a high water table are dominated by herbs especially buttercup.

Species list of all plants covering >5% of the area within vegetated streamside zone

Cottonwood, alder, salmonberry, native willow spp, blackberry, snowberry, red osier dogwood, reed canary grass and lawn grasses, sword fern, lodgepole pine, thistle, water parsley.

Percent coverage of invasive vs. native species

Approximately 70% native if grassed area is not included. Buttercup and blackberry are responsible for the greatest extent of invasive plant cover.

Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment)

The current corridor is 3 to 15 meters wide, and it could easily be extended without altering existing land uses.

Short term riparian restoration potential and techniques

Widen riparian buffer by planting diverse native vegetation up to a distance of 15 meters on each creek bank. Remove the invasive thistle and large blackberry thicket at the north end. Provide interpretive signage about the project and the reason for the changes.

Short term channel restoration potential and techniques

Add more structure with placement of large logs. Sediment trapping has been suggested (Barraclough, et al., 2007) to deal with fine sediments coming off the road system. At the time of inspection the problem of sediments was not evident. This area should be revisited to determine whether water quality and sediment inputs are issues here.

Improve the quality and quantity of runoff from the Fraser parking lot into the channel. This parking lot offers further opportunities for infiltration. Improvements could be made including a swale along the parking lot edge and infiltration features within the lot itself. This may allow the current ditch draining the lot to be returned to a naturally vegetated state.

Long term channel and riparian restoration potential

The short and long term options are similar, as there are no significant barriers to restoration in Section A of Reach 15C.

Observations/Notes

Flow emerging from the upstream blackberry thicket indicates that pipes are feeding into this reach. However the extent and location of this drainage network is not obvious, and would require more information from Facilities Management to determine.

Reach 15C photographs

Plate 61: Reach 15C, Section A, has no apparent barriers to restoration. The main restoration action is to increase the width of the riparian buffer.

Plate 62: The riparian buffer is quite narrow in some locations, due to mowing near to the creek edge.

Plate 63: Looking south down Reach 15C (Section A). Stormwater (or groundwater) emerges from inside the blackberry patch to water the reach.

Plate 64: Invasive buttercup occupies a significant area, in some cases mixed with pacific water parsley.

Plate 65: Runoff comes from the Fraser parking lot and is delivered to the channel both overland and through this ditch.

REACH 17A

— Tributary from Cedar Hill Golf course, lower section

Lower = A (Cedar Hill to 1st footbridge); Upper = B (Between 1st & 2nd footbridges)

NOTE: above the 600 mm pipe was not explored

Width of riparian buffer each side (slope distance) and estimated slope

Incised excavated channel with steep banks

Lower reach A: similar bank heights of 3-4 metres on each side. Slopes 1:1–1:2. Vegetated buffer 5–8 m wide.

Upper reach B: Very high banks ~5 m high on SW side; slopes 2:1–1:1; width of SW vegetated riparian buffer up to 12 m. Banks decrease on NE bank travelling upstream from 1.5–3 m; slope 1:3; vegetated buffer ~5 m wide.

Streambank erosion issues (Y/N and H,M,L) N

Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species

A: Canopy of western redcedar and Douglas-fir with thick Nootka rose and red-osier dogwood shrub layer.

B: Cottonwoods and red-osier dogwood at upper and lower ends of reach; Nootka rose throughout; middle section of Himalayan blackberry, reed canary grass and equisetum.

Species list of all plants covering >5% of the area within vegetated streamside zone

Note: all invasives (*) seen are listed, whether >5% or not, in order to target for removal.

A: western redcedar, Douglas-fir, Indian-plum, Nootka rose, *Himalayan blackberry, *reed canary grass, equisetum, red-osier dogwood, Pacific water parsley, *(bull?) thistle, *morning-glory, snowberry, hardhack, *poison hemlock, cherry cultivar (non-native), curly dock (non-native), *creeping buttercup, agricultural grasses.

B: : western redcedar, Douglas-fir, cottonwood, Oregon Ash, willow (likely native), red alder, grand fir, various mature and immature conifers, Indian-plum, Nootka rose, thimbleberry, red-flowering currant, *English hawthorn, *Himalayan blackberry, *reed canary grass, equisetum, red-osier dogwood, Pacific water parsley, *(bull?) thistle, *morning-glory, snowberry, hardhack, skunk cabbage, *golden chain tree (*Laburnum* sp.), *purple salsify/oyster plant (*Tragopogon* sp.), curly dock (non-native), *creeping buttercup, cattail (*Typha* sp.), *holly, agricultural grasses.

Percent coverage of invasive vs. native species A: 20% invasive:80% native

Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment)

Buffer varies. Pathways closely parallel creek on alternating sides. Vegetated corridor includes mown grass areas that could be utilized. This reach is on public (Saanich) golf course property and there is potential to reshape the banks and create a wider riparian buffer.

Short term riparian restoration potential and techniques

Plant more red-osier dogwood and native shrubs to shade out invasives in middle section of B. Remove invasive species, especially poison hemlock to prevent spreading. Remove invasive species and care for planted conifers. Increase plantings by adding cottonwood stakes.

Short term channel restoration potential and techniques

Coarse woody debris could add more creek complexity

Long term channel and riparian restoration potential

A has mature native trees on banks, thus banks are fine. Plant more native species. Consider sloping SW bank of B and planting increased native trees throughout this section. Consider Garry oak and associated meadow species for very dry and sunny area at top of bank on SW of B. Consider native-planted COIR-type logs for bio-engineering of SW bank of B. If necessary create a terrace and use bioengineering with willows to stabilize it.

Observations/Notes

There is a long and deep vegetated ditch between Cedar Hill Rd and the Recreation Centre parking lot that discharges into the lower end of Reach 17A just before the creek flows underground at Cedar Hill Rd. While mostly filled with invasive species currently, there is room to complex this section to create sinuosity. In the short term it could be planted with native trees and shrubs to create shade.

Note: the Quadra Cedar Hill Neighbourhood Association has hosted invasive species removal parties in this reach in 2007 and 2008.

Reach 17A photographs

Plate 67: Reach 17A downstream view from footbridge several years after removal of blackberry

Plate 68: downstream end of Reach 17A-A looking west from Cedar Hill

Plate 69: Map of Reach 17A-AB and 17B-CD

REACH 17B

— Upper part of tributary from Cedar Hill Golf course (past footbridge to baseball diamond)

Lower = C (2nd footbridge to north of baseball diamond and before footpath where creek channel is entrenched); Upper = D (entrenched channel to 600 mm pipe)

Width of riparian buffer each side (slope distance) and estimated slope

Lower portion of reach C is an unconfined, low-gradient floodplain with minimal slopes of mainly less than 1 m in height. Vegetated riparian buffer varies greatly from 2-5 m wide (NE bank) to up to 10 m (SW bank) with a large cattail/willow marsh of ~2500 m^2 and up to 60 m across.

Upper reach D: Creek consists of a linear ditch ~1 m wide and 0.5 m deep in a low-gradient field. W bank is manicured golf course to within <1 m of channel, E bank is infrequently/roughly mowed to 1 m the channel. Creek source discharges into a shallow, ~3-5 m wide pool from 600 mm concrete pipe emerging from steep hillock.

Streambank erosion issues (Y/N and H,M,L)

Y, low

Dominant vegetation structure (trees, shrubs or ground cover) and dominant and co-dominant plant species

C: Mainly mature willow (most likely native) marsh with portions of open cattail/reed canary grass marsh.

D: Mature cottonwoods tapering off to Himalayan blackberry and Scotch broom with open sections of creeping buttercup and Pacific water parsley.

Species list of all plants covering >5% of the area within vegetated streamside zone

Note: all invasives (*) seen are listed, whether >5% or not, in order to target for removal.

C: willow (likely native), cottonwood, *English hawthorn, immature Douglas-fir, mature alder, western redcedar, red-osier dogwood, hardhack, thimbleberry, cherry (maybe native), hawthorn (maybe native), equisetum, cleavers or bedstraw (*Galium* sp.), *(bull?) thistle, *reed canary grass, *Himalayan blackberry, cattail (*Typha* sp.), Pacific water parsley, *morning-glory, Nootka rose, *creeping buttercup, Scouler's willow (maybe), *holly, skunk cabbage, curly dock (non-native), agricultural grasses.

D: willow (likely native), cottonwood, immature conifers, *Himalayan blackberry, *holly, *Scotch broom, Pacific water parsley, *European bittersweet, equisetum, cleavers or bedstraw (*Galium* sp.), *creeping buttercup, cattail (*Typha* sp.), *morning-glory, *climbing rose (?), rush (*Juncaceae* family), mint (*?),curly dock (non-native), water-plantain (*Alisma plantago-aquatica*?), agricultural grasses, + 2 water plant (non-native) watercress (Rorippa micropylla) and American brooklime (Veronica beccabunga ssp. americana)

Percent coverage of invasive vs. native species

If willow = (Pacific?) willow, C: 5% invasive:95% native. D: 30% invasive:70% native

Current width of vegetated riparian corridor and potential width of riparian buffer with private landowner involvement/redevelopment (comment)

C: Riparian corridor ~2–10 m wide around marsh, <1 m at times in linear section adjacent to golf fairway (W side). Potential for expansion of corridor is limited only by the baseball diamond on the NE side and by the golf course layout. Both are publicly (Saanich) owned.

D: Riparian corridor currently is only 1 tree/shrub wide and has been mowed to the trench margin in some locations. Potential expansion is limited only on W side by gold green layout.

Short term riparian restoration potential and techniques

Remove invasive species immediately, especially at headwaters (Scotch broom, Himalayan blackberry, European bittersweet, creeping buttercup). Plant native shrub species in open trench section of D for shade.

Short term channel restoration potential and techniques

Coarse woody debris could add more creek complexity and sinuosity of linear section in D. Examine erosion at 600 mm pipe pool and armour bank with native willow wattling or native-planted COIR logs.

Long term channel and riparian restoration potential

D could be graded to reduce trenching and create more marsh habitat for water retention as at C, or narrow channel could be retained with added sinuosity, coarse woody debris and increased canopy coverage to prevent increased water temperatures.

Observations/Notes

The creek bed substrate is fine silty mud along all sections of the reach. Depending on the source of the water in the 600 mm pipe, gravel may make a good substrate at this small headwater pond for added complexity. There is a small tributary flow into the west end of the willow/cattail marsh in C immediately adjacent to a golf fairway. This flow emanates from a spring or, more likely, a buried pipe that has silted in. This tributary could potentially be daylighted and planted with native species.

Reach 17B photographs

Plate 70: Cattail marsh looking north to baseball diamond

Plate 71: Top of Reach 17B linear section, looking south

Plate 72: Pool at head of 600 mm culvert

Plate 73: Willow marsh at top of Reach 17B

Plate 74: Source flow from west tributary into cattail marsh

APPENDIX C-1: RECOMMENDED PLANT SPECIES FOR RIPARIAN RESTORATION PROJECTS ON BOWKER CREEK

Detailed restoration prescriptions including the exact number and type of riparian plants will be prepared as restoration opportunities present themselves. Plants should be spaced two to four meters apart (trees should be four meters apart). A list of native plants that can be used as a starting point for detailed restoration planning is as follows:

Wetter locations/bottom of bank

Tree species:

black cottonwood (*Populus balsamifera* ssp.*tricocarpa)*

western redcedar *(Thuja plicata)*

bigleaf maple (*Acer macrophyllum)*

Shrub species:

native willows (Scouler's, Pacific, Sitka, Hooker's). Note that depending on environment these species can grow into small trees, Pacific willow in particular. (*Salix* spp.*)*

Pacific ninebark (*Physocarpus capitatus)*

hardhack (*Spirea douglasii)* (wet floodplain sites only)

red-osier dogwood (*Cornus stolonifera)*

Indian-plum (*Oemleria cerasiformis)*

salmonberry (*Rubus spectabilis)*

Drier locations/top of bank:

Tree species:

bigleaf maple (*Acer macrophyllum)*

grand fir (*Abies grandis)*

Douglas-fir (*Pseudotsuga menziesii)*

Shrub species:

snowberry (*Symphoricarpos albus)*

nootka rose (*Rosa nutkana)*

oceanspray (*Holodiscus discolor)*

Indian-plum (*Oemleria cerasiformis)*

Recommendations:

In areas that are high visibility/high use, the following further species can be planted to increase the aesthetic appeal. These species are not typical riparian species and are more suited to the top of bank:

- Mock-orange (*Philadelphus lewisii)*
- red-flowering currant (*Ribes sanguineum)*

Planting should occur in fall, timed with the onset of first rains. Ideally, the plants should be irrigated over two summers. If this is not possible, deep mulching should be used instead, with emergency watering in very dry periods as needed. Removal of invasive species should be done until the plants are established (two to three years). Removal of problem species like blackberry and knotweed should be done on an ongoing basis as required.

The banks of Bowker creek often consist of clay. As the channel is modified based on restoration prescriptions, it may be necessary to import mulch or topsoil to support native plant growth, and/or fertilizers may be employed when planting.

APPENDIX C-2: COMMON AND LATIN NAMES FOR COMMONLY-OCCURRING BOWKER CREEK RIPARIAN VEGETATION

A star (*) indicates non-native vegetation, and two stars (**) indicates invasive non-native vegetation

Herbs/groundcover

bracken fern (*Pteridium aquilinum*)
buttercup (*Ranunculus repens*) **
Canada thistle (*Cirsium arvense)*
cattail (*Typha latifolia)*
English ivy (*Hedera helix)* **
horsetail *(Equisetum* spp.*)*
European bittersweet (*Solanum dulcamara)* **
morning-glory (*Ipomoea* spp.) **
Pacific water-parsley (*Oenanthe sarmentosa)*
policeman's helmet (*Impatiens glandulifera)* **
poison hemlock (*Conium maculatum)***
reed canary grass (*Phalaris arundinacea)*
skunk cabbage (*Lysichiton americanum)*
sword fern (*Polystichum munitum)*
trailing blackberry *(Rubus ursinus)*
yellow pond lily (*Nuphar polysepalum)*

Shrubs

dull Oregon-grape *(Mahonia nervosa)*
English hawthorne (*Crataegus laevigata)* **
English holly (*Ilex aquifolium)*
Himalayan blackberry (*Rubus discolour)* **
Japanese knotweed (*Polygonum cuspidatum)* **
laburnum (*Laburnum* spp.) *
laurel-leaved daphne (*Daphnea laureola)* **
laurel spp. (Lauraceae) *
mock-orange (*Philadelphus lewisii)*
Nootka rose (*Rosa nutkana)*
oceanspray (*Holodiscus discolour)*
salal (*Gaultheria shallon)*
Scotch broom (*Cytisus scoparius)* **
snowberry (*Symphoricarpos albus)*
red-osier dogwood (*Cornus stolonifera)*
rhododendron (*Rhododendron* spp.)
vine maple (*Acer circinatum)*

Trees

alder (*Alnus rubra)*
bigleafed maple (*Acer macrophyllum)*
birch (*Betula* spp.)
black cottonwood (*Populus balsamifera* ssp. *tricocarpa)*
black hawthorn *(Crataegus douglasii)*
cherry (*Prunus* spp.) *
Douglas-fir (*Pseudotsuga menziesii*)
Garry oak (*Quercus garryana)*
hemlock *(Tsuga heterophylla)*
Indian plum *(Oemleria cerasiformis)*
Oregon ash *(Fraxinus latifolia)*
pacific willow *(Salix lucida)*
poplar (*Populus balsamifera)*
shore pine (*Pinus contorta)*
trembling aspen *(Populous tremuloides)*
weeping willow (*Salix* x *sepalcralus)* *
western redcedar (*Thuja plicata*)
willows (*Salix* ssp.)
yellow willow (*Salix lutea)* **