ECVI Storage Feasibility Project

Environment Assessment Component

for

SHELTON AND HEALY LAKES

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EXECUTIVE SUMMARY

The British Columbia Conservation Foundation along with numerous partners are involved in a storage feasibility project being investigated at Shelton and Healy Lakes on eastern Vancouver Island. The primary goal of this project is to maintain or enhance summer discharge rates from the lakes into downstream rivers utilized by various fish species. Adequate discharge rates would be obtained via the installation of a weir in order to access top storage levels of 1 to 2 m. The main objective of the environmental assessment component of this project was to identify and mitigate potential impacts of the proposed operations on the flora and fauna associated with the lakes, especially provincially and federally listed amphibian, bird, small mammal, and plant species. Experts in each taxonomic group were recruited for the assessment.

Six Red and Blue listed plant communities were identified at the two lakes. Healy Lake contained the greatest diversity and richness of species and plant communities of the two sites and could be defined more as a wetland than a lake—two Red-listed wetland plant communities were identified at Healy Lake. At both sites, increased water levels would lead to greater inputs of woody debris as shoreline trees died off and a reduction in wetland habitat due to inundation during the growing season and limited upslope habitat. Some of the wetland and forest communities at Healy Lake are sensitive to disturbance, such as bogs and fens. Greater plant species / community loss and habitat disturbance would occur from increased water levels at Healy versus Shelton Lake.

One listed amphibian species was confirmed breeding at both sites from visual surveys and funnel trapping—the Red-legged Frog. Northwestern Salamanders also bred at both sites and Pacific Treefrog breeding was confirmed at Healy Lake. Although Red-legged Frog egg masses were observed at both sites, tadpoles were only captured at Healy Lake. No significant, long-term effects are expected for amphibians at either site as a result of increased water levels. However, Healy Lake appeared to have greater habitat "quality" for amphibians due to the area of shallow water and high habitat complexity, both of which provide refuge from introduced fish and other predators. Increased water levels at Healy Lake may give fish access to critical shallow-water refuge areas, reducing the ability of some amphibian species to breed successfully at the site.

Shelton Lake has low habitat diversity for birds compared to Healy Lake due to the latter site's large marsh area in the south and west end, more complex shoreline, and areas of shallow and deeper waters. The wetlands that occur at Healy Lake are rare in mountainous areas on Vancouver Island and although birds that may depend on them for nesting are likely common species, the wetlands should be considered a significant resource. Because of the topography of the surrounding uplands, forest condition, and lack of rare or special bird habitat at Shelton Lake, no impacts to birds are expected from raising water levels at that site.

Vancouver Island water shrew likely live in and around Shelton and Healy Lakes, where habitat is suitable, as an individual was captured within 2.5 km of the site in 2002. In general, the terrestrial habitat around Healy and Shelton Lakes was marginal for Vancouver Island water shrew because of a lack of vegetative cover. The best habitat was in riparian areas—along the creek inflows/outflows to the lakes and in wetlands. The outflow area from Shelton Lake and the inflow to Healy, as well as the entire channel between the lakes likely provides some of the

highest quality habitat to Vancouver Island water shrew of the habitat assessed at the site. Increasing the water level in the channel is not likely to negatively affect water shrew habitat. In addition, the outflow from Healy Lake contained very suitable habitat for Vancouver Island water shrew as a result of a beaver dam, which would likely be removed or disturbed as a result of the proposed development. Mitigation measures have been provided to reduce the impact of flow control structure (e.g., weir) construction and maintenance in this area.

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1.0 INTRODUCTION

The British Columbia Conservation Foundation (BCCF) along with numerous partners are involved in a storage feasibility project being investigated at Shelton and Healy Lakes in the Englishman River Watershed on eastern Vancouver Island. The primary goal of this project is to maintain or enhance summer discharge rates from the lakes into downstream rivers utilized by various fish species. Adequate discharge rates would be obtained via the installation of a weir in order to access top storage levels of 1 to 2 m.

Shelton and Healy Lakes are 36 ha and 33.8 ha in size respectively. The maximum depth of Shelton Lake is 19.5 m (average = 10.8 m), while Healy Lake is 6.5 m (average = 1.4 m). Shelton and Healy Lakes sit at 548 m and 531 m elevations respectively. The lakes are approximately 1 km apart and connected by the South Englishman River. Both lakes are surrounded by mature second-growth forest, and they were last stocked with trout in 2006 (stocking since discontinued). The main issue associated with the development that may impact flora and fauna is the alteration of water levels from the installation of a weir each spring and draw down through the summer. The proposed project would alter water depths and the timing and duration of high water during the spring (e.g., flooded shorelines in spring and early summer).

Shelton and Healy Lakes are on private forestry land owned by Timberwest. Partners involved in the project include the Ministry of Environment, Department of Fisheries and Oceans, local government, First Nations, and Ducks Unlimited.

1.2 Objectives

The main objective of the environmental assessment component of this project was to identify and mitigate potential impacts of the proposed operations on the flora and fauna associated with the lakes, especially provincially and federally listed amphibian, bird, small mammal, and plant species. BCCF staff and partners are examining impacts to fish and associated invertebrate prey as well as engineering-related aspects of the projects.

2.0 METHODS

The primary focus of work conducted in 2008 was to confirm the presence of listed species and identify areas where there is a high probability of occurrence based on a literature review and specific habitat features or elements. In addition, the best available information and expert opinion were used to assess potential impacts of the project and to suggest mitigation measures where species may be negatively affected by the proposed operations.

2.1 Species at Risk Locality Information

Prior to field surveys, the BC Conservation Data Centre (CDC) was consulted to determine whether any listed amphibian, bird, mammal, or plant species / communities have been found in the project area.

2.2 Field Work

Qualified, registered professional biologists that specialize in each of the taxonomic groups mentioned above conducted field surveys and /or assessed the potential impacts of the project. The First Nations in the area were contacted prior to the commencement of fieldwork to discuss the project and to provide an opportunity for band members to assist in the field.

2.2.1 Plants

(*Lead* – Michele Jones, B.Sc., R.P.Bio. 1623)

The primary objective of the vegetation assessment was to identify potential negative impacts that may arise due to altered water levels. Within the study area, plant species or communities that would be directly or indirectly affected by possible inundation were identified especially those are particularly sensitive to disturbance or have high ecological value.

Prior to field work, aerial photographs and current maps were analyzed to identify areas of concern, potential risks, and drainage issues. Plant communities were delineated on aerial photographs to facilitate ground-truthing and to ensure that all communities were represented in the field study. Field work was conducted at Shelton Lake on June 21, 2008 and at Healy Lake on July 25, 2008.

2.2.2 Amphibians

(*Lead* – Elke Wind, M.Sc., R.P.Bio. 1568)

A review of BC CDC records and Resources Inventory Standards Committee (RISC) sampling techniques were used to determine whether any listed amphibian species occur in the project area. A visual survey and funnel traps were used to sample amphibians at both lakes. A visual survey targeting eggs was conducted on May 28, 2008 and funnel trapping for larvae and adults was conducted on July 17/18 2008.

A kayak was used for sampling both lakes. During the visual survey, the entire shoreline of each lake was paddled searching for all life stages of amphibians. In addition, a total of 25 and 20 unbaited funnel traps were set throughout Shelton and Healy Lakes respectively, targeting shallow shoreline areas with emergent vegetation. The traps were left overnight and all captured individuals (amphibians and macroinvertebrates) were identified and released at the site of capture the following day.

The lakes and riparian habitats were assessed for habitat suitability and other factors that may influence the presence of amphibians (e.g., occurrence of fish).

2.2.3 Birds

(*Lead* – John Cooper, B.Sc., R.P.Bio. 394)

Birds and bird habitat were assessed at Shelton and Healy Lakes based on the proposed project description, habitat types identified in the area from air photos, and bird locality information. Terrestrial / riparian and aquatic habitat were assessed for suitability as foraging, roosting, and breeding habitat for birds. Bird communities were estimated by considering habitat types available (especially rare elements such as Wildlife Trees, emergent aquatic vegetation, islands, or other wildlife features) and knowledge of bird distribution on eastern Vancouver Island (both geographic distribution and habitat use). An assessment of probable impacts to bird habitat

(foraging, breeding, roosting) from changes in water management regimes was made by estimating impacts to habitat availability and quality caused by changes in water levels. Special attention was given to possible Species At Risk. No sites visits were conducted for birds in 2008.

2.2.4 Vancouver Island Water Shrew
(*Lead* – Vanessa Craig, Ph.D., R.P.Bio. 1459)

Natural History
The Vancouver Island water shrew, *Sorex palustris brooksi* (Anderson 1934), is a provincially red-listed subspecies of the American water shrew, found only on Vancouver Island. Provincially, the subspecies has a ranking of S2 (Imperiled). Globally the species is considered secure (G5) but the subspecies is considered Imperiled (T2).

S. p. brooksi have been reported across much of Vancouver Island (Fig. 1) at low elevation sites (up to approximately 600 m elevation). It is likely that the current known distribution reflects sampling effort more than the actual distribution of the subspecies (Craig 2003).

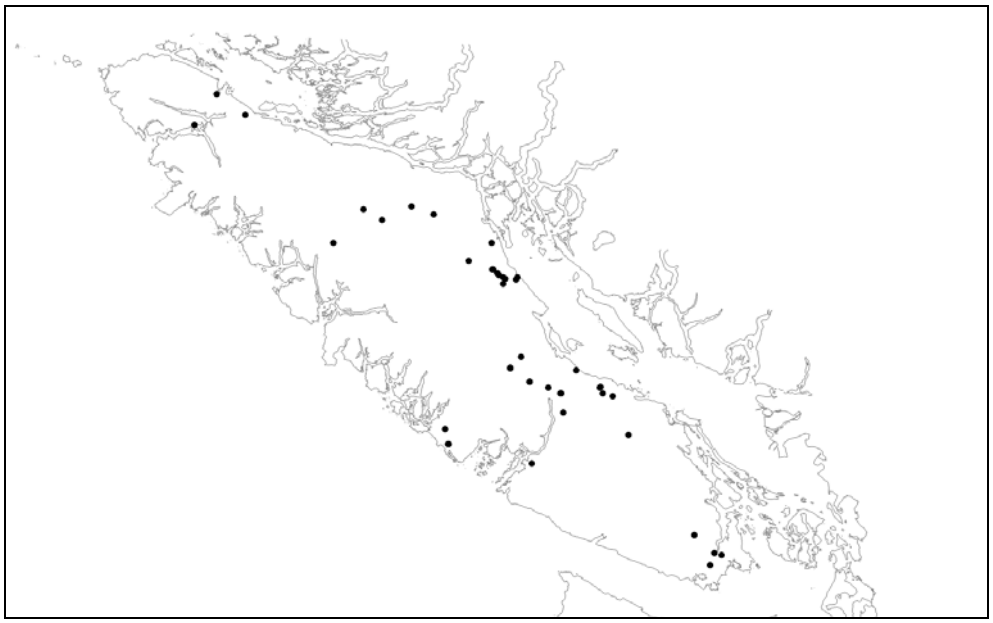


Figure 1. Location of Vancouver Island water shrew records from 1897 to 2008.

S. p. brooksi is considered a riparian habitat specialist, and is captured almost exclusively at the land-water interface. Water shrews hunt for food both on land and in water. In water, this species consumes aquatic invertebrates such as larvae and nymphs of caddisflies, mayflies, crane flies, and stoneflies (van Zyll de Jong 1983) as well as other aquatic food such as small fish, salamander larvae, snails and fish eggs (Conaway 1952, Sorenson 1962, Banfield 1974, Nagorsen 1996, Maser 1998). All prey is consumed on land.

Vancouver Island water shrews are considered to associate with high quality riparian habitat (Craig 2003), including the presence of an intact riparian corridor (including vegetation) and the presence of suitable water quality. The major threats to Vancouver Island water shrew are activities that degrade or remove suitable habitat. Removal or alteration of riparian habitat,

introduction of contaminants into the waterway, and channelization or changes to streambank stability can all affect habitat quality for Vancouver Island water shrew.

Most Vancouver Island water shrews have been captured along stream habitat, although there are nine records from wetlands. The majority of captures were associated with tributaries/channels of wetlands; wetland vegetation was present at most capture locations. In general, the wetlands had dense vegetation. Vancouver Island water shrews would be most likely to use the periphery of wetlands where they can move between the forest/wetland interface, or would move along channels within the wetland. Vancouver Island water shrews do not appear to be captured in new clear-cuts, but they have been captured in young stands (age class 1 and 2), second-growth, and mature/old forests (Craig 2003).

Vancouver Island water shrews have not been reported from lake margins, or along seeps, although this is likely due to a lack of sampling effort rather than habitat preferences. Although stream habitat is generally considered the best habitat for *Sorex palustris* (Conaway 1952, Wrigley et al. 1979, Beneski and Stinson 1987, Francl 2005), this species has been reported to use lake and pond margins as well (Conaway 1952, Wrigley et al. 1979, Francl 2005). Where they use this type of habitat, it is likely to occur along well-vegetated lake margins with a complex habitat (vegetation, downed wood), which permits easy movement between the terrestrial and aquatic habitats. In addition, the greatest use of lake margins would likely occur where other suitable habitat (as described above) is present, and a watercourse (inflow/outflow, creek, seep etc.) is near by. Research indicated that *S. palustris* will use small streams (less than 0.33 m wide and 2.5 cm deep), seasonal streams, and seepage areas (Kinsella 1967).

Assessment Methods

To assess potential impacts of changes in water levels and flow rates associated with the proposed project on the Red-listed Vancouver Island water shrew (*Sorex palustris brooksi*), suitable habitat features and communities were identified. Given the time constraints for the site assessments, the site assessments were not exhaustive or inventory-like. Instead, the emphasis was on identifying the general types of habitat around the shoreline of the areas, determining whether they would be suitable for Vancouver Island water shrew, and assessing potential impacts on Vancouver Island water shrew. Prior to a site visit, satellite imagery and maps provided by BCCF were reviewed to identify areas where potential water shrew habitat occurs, and areas of potential impact. A checklist of important habitat components was developed as a basis for the field assessment. The site was visited on September 14, 2008 to conduct a ground reconnaissance to assess habitat suitability for water shrews based on known habitat associations. Assessments were documented with photos.

3.0 RESULTS

3.1 Plants

Shelton and Healy Lakes are outside of the Sensitive Ecosystem Inventory study area so no SEI data are available. No listed plant species or communities were listed in the BC CDC database as occurring in the Shelton and Healy Lakes area (BCCDC 2008a & b). However, the site assessment revealed the presence of two Red and four Blue listed plant communities in the area (Appendix 1). There are three plant species of concern in the Shelton and Healy Lake vicinity;

small-fruited willowherb (*Epilobium leptocarpum*), snow bramble (*Rubus nivalis*), and white adder's-mouth orchid (*Malaxis brachypoda*) (BCCDC 2008b). None of these plants were observed during the surveys of the lakes. A complete list of plants found during the site visit to both lakes can be found in Appendix 2.

3.1.1 Shelton Lake

Shelton Lake is bordered by a wetland fringe with forested communities upslope (Fig. 2). Forests were composed of young second-growth coastal Douglas-fir (*Pseudotsuga menziesii var. menziesii*), western hemlock (*Tsuga heterophylla*), and western redcedar (*Thuja plicata*), with occasional yellow-cedar (*Chamaecyparis nootkatensis*). Common understory species included salal (*Gaultheria shallon*), red huckleberry (*Vaccinium parvifolium*), bracken fern (*Pteridium aquilinum*), sword fern (*Polystichum munitum*), dull Oregon-grape (*Mahonia nervosa*), vanilla-leaf (*Achlys triphylla*), trailing blackberry (*Rubus ursinus*), broad-leaved starflower (*Trientalis borealis ssp. latifolia*), baldhip rose (*Rosa gymnocarpa*), and twinflower (*Linnaea borealis*). Close to the lakeshore, where there was increased light and moisture, forest understories contained higher densities of salal, bracken, and baldhip rose. The forests sloped towards the lake with average slopes of 15%. Soils were sandy with moderate to high gravel content. Most of the forested communities were classified as CWHxm2-05 Western redcedar/sword fern Very Dry Maritime (Blue-listed; Appendix 1).

Shelton Lake contained Lake, Shallow-Water, Marsh, and Swamp ecosystems (MacKenzie and Moran 2004). Most of the lake was dominated by open water, without vegetation. There was distinct zonation (banding) of vegetation within the lake and shoreline vegetation communities. A series of narrow, shallow terraces occurred adjacent to and into the lake. These terraces formed benches that provided differing habitat for lower forest, floodplain, and wetland plant communities. During most of the year, the lower benches are flooded, with much of their vegetation submerged. However, during mid to late-summer, when lake water levels drop, various portions of these benches and their associated plant communities are exposed.

Most of the lakeshore was surrounded by a strip of wetland plant species colonizing substrates that were sandy with gravels and cobbles. The shoreline vegetation included sweet gale (*Myrica gale*), Pacific ninebark (*Physocarpus capitatus*), young red alder (*Alnus rubra*), willow (*Salix spp.*), rushes (*Juncus spp.*), sedges (*Carex spp.*), great sundew (*Drosera anglica*), and common horsetail (*Equisetum arvense*). At the time of the survey, vegetation growing at the water's edge and in shallow waters included skunk cabbage (*Lysichiton americanus*), buckbean (*Menyanthes trifoliata*), common cattail (*Typha latifolia*), yellow pond-lily (*Nuphar lutea*), and marsh cinquefoil (*Comarum palustre*).

Along some shoreline areas, wider benches allowed small swamps to establish within the shoreline wetlands. Their slopes were less than most of the surrounding forests, typically <5%. Sweet gale, willow, Pacific ninebark, hardhack (*Spiraea douglasii ssp. douglasii*), young red alder, rushes, and sedges were frequently observed in these swamps, with western redcedar located along the slightly drier perimeters. Frequently, logs were observed along the edges of these communities. In some instances, these woody structures might protect vegetation from wave action.

Located on the west side of Shelton Lake was a broad gravel area that was colonized by a floodplain plant community (see Fig. 2). On the upland areas of this bench were young deciduous and coniferous tree species. Along the lakeshore side of this community, little vegetation was observed on the gravel and cobble substrate. Many fallen snags and woody debris were observed along the shoreline. A shallow bench continued from the exposed gravel area into shallow waters. A few yellow pond-lilies, buckbean, and sedges were observed along the water's edge. Due to the composition of the substrate and vegetation pattern, it is likely water flows from the forest to the lake through this gravel area during wetter seasons.

There were two large wetland communities associated with Shelton Lake, one at the north end and one at the south end. Water flowing into Shelton Lake passed through the southern wetland. Water exiting the lake, passed outward through the northern wetland and into a stream channel. The southern wetland appeared to be a receiving area for inflows such as surface and ground water runoff from adjacent forests. The vegetation within the southern wetland had distinct zonation through which these inflow waters travelled prior to entering the lake. Young red alder, Pacific willow (*Salix lucida ssp. lasiandra*), western redcedar, yellow-cedar, western white pine (*Pinus monticola*), western hemlock, and Douglas-fir were often found in more upland regions of the wetland. Below this tall shrub community in the middle zones, were bands of hardhack with Pacific ninebark and sweet gale with sedges. Buckbean and yellow pond-lily grew along the lakeshore and into shallow waters, with pondweed (*Potamogeton sp.*) located in deeper waters.

Immediately west of the southern wetland, was a young mixed forest dominated by red alder. Other tree species within this community included Douglas-fir, western hemlock, western redcedar, and western yew (*Taxus brevifolia*). The understory was dominated by salmonberry (*Rubus spectabilis*) and hardhack, but also included huckleberries (*Vaccinium spp.*), black twinberry (*Lonicera involucrata*), salal, trailing blackberry, common horsetail, deer fern (*Blechnum spicant*), sword fern, beaked hazelnut (*Corylus cornuta*), and prince's pine (*Chimaphila umbellata*). The forest was situated on a 10% slope with sandy soils that had high coarse fragment content. Pondweed, yellow pond-lily, buckbean, and sedges had established on the lakeshore, which was composed of boulders and gravels. Although this was a seral community, it was best classified as CWHxm2-09 Black cottonwood-red alder/salmonberry (Blue-listed; Appendix 1).

The vegetation within the northern wetland had distinct zonation through which lake outflow waters travelled. A band of emergent bulrush (*Schoenoplectus sp.*) grew in the shallow lake waters at the lake edge of this wetland. Shoreward from the bulrushes, the wetland contained hardhack, sedges, sweet gale, rushes, buckbean, marsh cinquefoil, willow, and Pacific ninebark. This shrub-sedge wetland area contained an organic horizon over the mineral soils. Many logs (mainly old, wind accumulated logging debris) had accumulated within the wetland, which also provided substrates for epiphytic terrestrial plant species and microhabitats for vegetation species. Within the wetland were wet depressions that contained skunk cabbage, American speedwell (*Veronica beccabunga*), and wet-tolerant grasses. Along the drier perimeters of the wetland, red alder, western redcedar, western hemlock, western yew, white pine, and Douglas-fir had established. Water from the northern wetland eventually formed a channel and flowed northward. Due to the zonation within the site, there were several plant communities represented, including Great bulrush (Wm06), Sweet gale-Pink spirea-Sedge (Wf), and Pink spirea-Sitka

sedge (Ws50) (MacKenzie and Moran 2004). No site association fit the upper area of the northern wetland.

The classification of wetland plant communities is still fairly new in British Columbia. As a result, non-forested plant communities are not commonly described in provincial classification schemes. In British Columbia, forested communities are classified using the biogeoclimatic ecosystem classification (Green and Klinka 1994). Frequently, no site series fit the wetland plant assemblages due to their unique plant assemblage or disturbance. Such is the case for many of the wetland communities surrounding Shelton Lake.

Logging and recreation appeared to be the primary land uses occurring near Shelton Lake. Most of the forests surrounding the lake have been harvested and old logging roads were observed in the forests. Recreational users also frequent the lake and shoreline areas. Campers, boaters, and fishers were encountered during the field surveys. Seasonal camping sites were located near the lake. Two gravel roads that terminated at the lake's edge were used as boat launching sites.

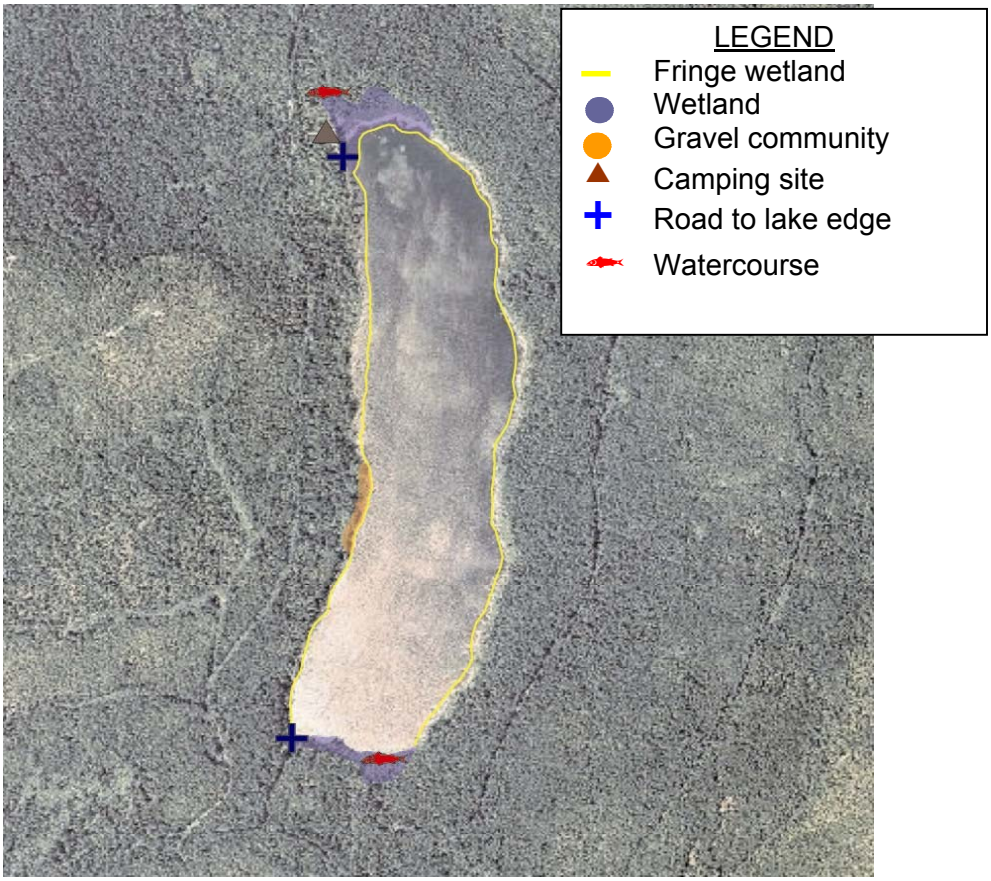


Figure 2. Shoreline types within Shelton Lake. Boundaries are approximate. Scale 1:15,000. 2005 Photo (CMN 2008).

3.1.2 Healy Lake

Healy Lake is surrounded by second-growth coniferous forests (Fig. 3). The forests were composed of western redcedar, western hemlock, and Douglas-fir, but some stands included yellow-cedar, mountain hemlock (*Tsuga mertensiana*), and western white pine (*Pinus monticola*). Evidence of past logging and fire included older stumps and charred wood. Understory in the forests was patchy. In many areas, the understory was very sparse. Near the water edge, understory species tended to grow more densely. Common understory species included salal, bracken fern, dull Oregon-grape, trailing blackberry, red huckleberry, Oregon beaked-moss (*Eurhynchium oreganum*), step moss (*Hylocomium splendens*), sword fern, western trillium (*Trillium ovatum*), vanilla-leaf, and lanky moss (*Rhytidiadelphus loreus*). The forests sloped towards the lake with average gradients ranging from 10% to 15%. Most of the forested communities were classified as CWHxm2-05 Western redcedar/sword fern Very Dry Maritime (Blue-listed; Appendix 1). However, at the south end of Healy Lake, the forest was considerably wetter, containing wet depressions with sedges and skunk cabbage. Also noted were highbush-cranberry (*Viburnum edule*), Alaskan blueberry (*Vaccinium alaskaense*), false azalea (*Menziesia ferruginea*), bunchberry (*Cornus canadensis*), five-leaved bramble (*Rubus pedatus*), clasping twistedstalk (*Streptopus amplexifolius*), and more cedar in the tree canopy. The forest had a very low gradient (<5%) and moderately mounded terrain. This forest-type fit best into CWHxm2-12 Western redcedar-Sitka spruce/skunk cabbage (Blue-listed; Appendix 1).

Healy Lake was a wetland complex, which contained a mosaic of Shallow-Water, Marsh, Bog, Fen, and Swamp ecosystems (MacKenzie and Moran 2004). Most of the "lake" contained standing water, with bulrush growing throughout most of the central portion of the wetland. Along most of the perimeter of Healy Lake were bands of wetland vegetation. Floating and submerged aquatic species grew in the deeper waters, emergent vegetation grew in shallower waters near the water's edge, and low to taller shrub species grew along the Healy shoreline. At the time of the survey, water depth within Healy Lake did not exceed four meters at the deepest point.

There were several wetland plant assemblages within Healy Lake. In this report, the plant groupings and names were for reference purposes, as non-forested plant communities are not commonly described in provincial classification schemes.

Bulrush

Bulrushes grew throughout Healy Lake. In some deeper areas, there were patches of open water. Most of the bulrushes were uniformly spaced. However, their densities did vary in different portions of the lake. Frequently, floating aquatic or submerged vegetation was growing amongst the bulrush stems. The most common species was yellow pond-lily. Occasional "islands" of sweet gale or three-way sedge (*Dulichium arundinaceum*) were observed toward the north end of the lake. At the time of the survey, most of the stems contained at least one dragonfly or damselfly exoskeleton from a recent hatch. This community was classified as Wm06, Great bulrush (MacKenzie and Moran 2004).

Along the perimeter of the bulrushes, the shoreline was vegetated with hardhack, sweet gale, Pacific crabapple (*Malus fusca*), salmonberry (*Rubus spectabilis*), and willow (*Salix spp.*) (see Healy Edge community description below).

Sweet gale/Sedge
A community of sweet gale and sedges was observed in the southern corner of Healy Lake. The plants were most dense at the southwest side of the community, where water levels were lower. Other species within this plant assemblage included yellow pond-lily, bladderwort (*Utricularia sp.*), hardhack, bulrush, pondweed, marsh cinquefoil (*Comarum palustre*), rushes, skunk cabbage, and three-way sedge. In some areas, the three-way sedge grew in distinct patches. These patches were often associated with buckbean, pondweed, bulrush, and yellow pond-lily. Site classification for the Sweet gale/Sedge community was Wf52, Sweet gale/Sitka sedge and the small communities of three-way sedge were classified as Wm51, Three-way sedge (MacKenzie and Moran 2004). Both of these community-types are Red-listed (BCCDC 2008a; Appendix 1).

Pine "Island"
Located within the Sweet gale/Sedge community was a small pine "island". This was a patch of higher ground that contained mature shore pine (*Pinus contorta var. contorta*) that was surrounded by the lower wetland. Many of the pine had diameters of greater than 60 cm, diameter at breast height. Other associated species included hardhack, Labrador tea (*Ledum groenlandicum*), Pacific crab apple, sedges, peat-moss (*Sphagnum sp.*), broad-leaved starflower (*Trientalis borealis ssp. latifolia*), false lily-of-the-valley (*Maianthemum dilatatum*), with buckbean and yellow pond-lily near the wetland edge. This plant community was classified as CWHxm2-11 Lodgepole pine/peat-mosses Very Dry Maritime (Blue-listed; Appendix 1).

South Swamp
South of and continuous with the Sweet gale/Sedge community, the South Swamp formed part of the southern border to Healy Lake. This community received waters from a series of interconnected wetlands to the southwest. Water flowed through the swamp as overland flow and through small channels into Healy Lake. Several snags were noted within the wetland, indicating a past change in water levels.

The terrain within the swamp was hummocky, containing shrubs and small tree species in higher, drier locations, and wet-tolerant shrubs and herbs in lower, wetter sites. Plant species within this wetland included western redcedar, western white pine, western hemlock, young red alder, black twinberry, Pacific crab apple, Pacific ninebark, hardhack, sweet gale, sedges, Nootka rose (*Rosa nutkana var. nutkana*), and common horsetail (*Equisetum arvense*). No site association was appropriate for this swamp community.

Bulrush/Aquatic
In the southwest region of Healy Lake, there was more standing water with floating and emergent vegetation. Bulrushes were the most common species within this wetland community. Rushes were observed floating in dense patches. Other species included yellow pond-lily, bladderwort, waterweed (*Elodea sp.*), and pondweed. Hardhack, willow, sweet gale, sedges and water-tolerant grasses lined the outer edges of this community.

Healy Edge
Between Healy Lake and the surrounded forests was a transitional plant assemblage that included wet-tolerant, as well as wetland plant species. Shrubs dominated the vegetation and

included hardhack, sweet gale, willow, Pacific crabapple, Pacific ninebark, salmonberry, black twinberry, and salal. Bracken fern, sedges, deer fern, common horsetail, and false lily-of-the-valley were also observed in these fringe communities. At the north end of Healy Lake, water flowed through this community, over a beaver dam, and into a watercourse flowing northwards. The dam was approximately 30 meters in length.

Logging and recreation appeared to be the primary land uses occurring near Healy Lake. Most of the forests surrounding the lake have been harvested, some within the past ten years, and old logging roads were observed in the forests. Recreational users also frequent the Healy Lake and its shoreline areas. On the north side of the lake, a gravel road terminated at the lake's edge and was used as boat launching site.

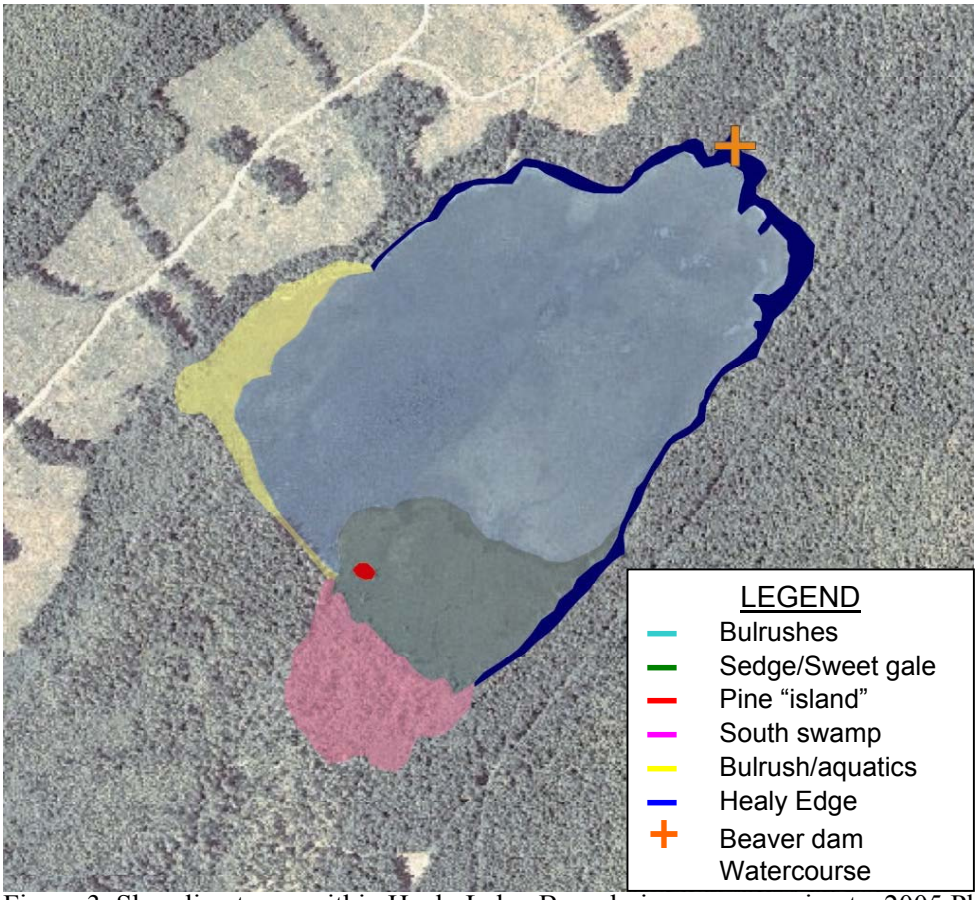


Figure 3. Shoreline types within Healy Lake. Boundaries are approximate. 2005 Photo (CMN 2008).

3.2 Amphibians

There are six possible native amphibian species that may occur in the Shelton and Healy Lakes area (Table 1).

Conditions were not ideal for visual surveys on May 28, 2008 (overcast and windy). However, breeding was confirmed for Red-legged Frogs and Northwestern Salamanders (*Ambystoma gracile*) at both lakes (Table 2). Pacific Treefrog (*Pseudacris/Hyla regilla*) breeding was also confirmed at Healy Lake. Egg masses were found in a number of areas within each lake, with more found of each species at Healy than at Shelton Lake (Fig. 4).

Only Northwestern Salamanders were captured in funnel traps at Shelton Lake (Table 3). A large, adult Red-legged Frog and three adult Rough-skinned Newts (*Taricha granulosa*) were observed incidentally during trapping. In contrast, Northwestern Salamanders, Red-legged Frogs, and Pacific Treefrogs were captured at Healy Lake.

Incidental captures included three crayfish at Shelton Lake and a salmonid at Healy Lake. The incidental capture rate of macroinvertebrates in the funnel traps at Shelton Lake was very low compared to Healy Lake and other sites surveyed on Vancouver Island (E. Wind, pers. obs; Table 4).

Table 1. Status of aquatic-breeding amphibian species that may occur in the Shelton and Healy Lakes area.

Common Name	Scientific Name	Provincial Listing	Federal Listing[a]	Global Rank
Northwestern Salamander	*Ambystoma gracile*	Yellow (S4S5)	NAR	G5
Long-toed Salamander	*Ambystoma macrodactylum*	Yellow (S5)	NAR	G5
Rough-skinned Newt	*Taricha granulosa*	Yellow (S4S5)		G5
Western Toad	*Bufo boreas*	Yellow (S4)	SC	G4
Red-legged Frog	*Rana aurora*	Blue (S3S4)	SC	G4
Pacific Treefrog	*Pseudacris regilla*	Yellow (S5)		G5
American Bullfrog	*Rana catesbeiana*	Exotic (SNA)		G5

[a] NAR = Not at Risk; SC = Special Concern

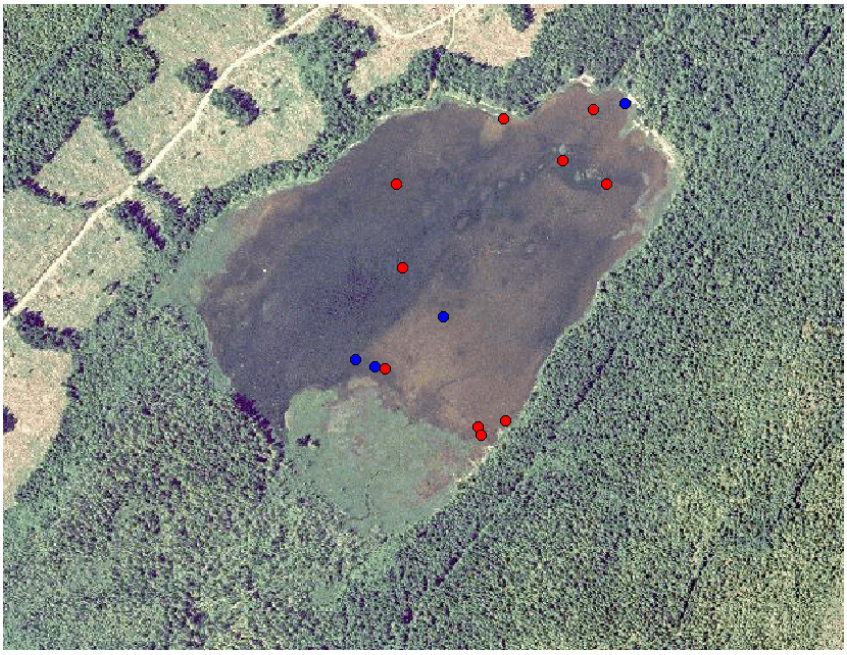
Table 2. Number of amphibian egg masses found at Shelton and Healy Lakes in May 2008.

Site	Red-legged Frog	Northwestern Salamander	Pacific Treefrog
Shelton	7	3	
Healy	10	5	22+

Table 3. Number and life stages of amphibians captured in funnel traps at Shelton and Healy Lakes.

Site		Northwestern Salamander larvae/neotenes	Red-legged Frog tadpoles	Pacific Treefrog tadpoles
Shelton (n=25)	total	9		
	#/trap night	0.36		
Healy (n=20)	total	2	1	3
	#/trap night	0.10	0.05	0.15

a) Shelton Lake



b) Healy Lake

Figure 4. Location of Red-legged Frog (red dots) and Northwestern Salamander (blue dots) egg masses found during visual surveys of Shelton and Healy Lakes.

Table 4. Macroinvertebrates captured at Shelton and Healy Lakes compared to other lakes on Vancouver Island in 2008.

Lake		Giant Water Bug	Water scorpion	Diving Beetle Larva	Damsel-fly	May-fly	Dragon-fly larva	Beetle	Water boatman	Backs-swimmer	Leech	Scud	Caddis-fly	Water strider	Spider	# grps
Quinsam	total	6	3			3	4	4	1	4	1		68	5	3	11
(n=100)	aver.[a]	0.06	0.03			0.03	0.04	0.04	0.01	0.04	0.01		0.68	0.05	0.03	
Wokas	total	4				2	15			8			1			5
(n=50)	aver.	0.08				0.04	0.30			0.16			0.02			
Shelton	total								1							1
(n=25)	aver.								0.04							
Healy	total		1	1	17		8		11	25						6
(n=20)	aver.		0.05	0.05	0.85		0.40		0.55	1.25						
Holyoak	total				1		1	3	2			1	1			6
(n=25)	aver.				0.04		0.04	0.12	0.08			0.04	0.04			
All sites	total	10	4	1	18	5	28	7	15	37	1	1	70	5	3	14
n=220	aver.	0.045	0.018	0.005	0.082	0.023	0.127	0.032	0.068	0.168	0.005	0.005	0.318	0.023	0.014	

[a] Number per trap night.

3.3 Birds

No information on bird communities at Shelton and Healy Lakes could be found. The assessment was based on satellite imagery and the expert's knowledge of bird communities and bird habitat use on Vancouver Island (largely summarized in Campbell et al. 1990a, 1990b, 1997, 2001 and Stevens 1995).

Healy and Shelton Lakes are small to medium-sized, mid elevation lakes surrounded by coniferous forest. As with most of eastern Vancouver Island, there has been a long history of timber harvesting around both lakes. The lake environments and adjacent forest seem typical of many mid elevation lakes on central Vancouver Island. Habitat diversity in Shelton Lake appears low and breeding bird community diversity is also likely low compared to lakes with shallower water, flatter shorelines and more diverse vegetation communities. Healy Lake has more diverse habitats for breeding birds compared to Shelton Lake due to its large marsh area in the south end, a more complex shoreline, and areas of shallow and deeper waters.

Healy Lake

The most notable bird habitat features at Healy Lake are the marsh habitats in the southern and western corners of the lake, which cover a relatively large area of the lake basin. These marshes provide more diverse habitats for birds than is usually found in mid elevation lakes on Vancouver Island (e.g., Shelton Lake). These wetlands are likely used by 2 or 3 marsh nesting bird species.

The north shore is heavily logged, except for a riparian buffer around the lake edge. This buffer is likely used by a few species of conifer-nesting songbirds. Forested areas along other shorelines are less fragmented and contain some large vet conifers. Upland areas adjacent to these shorelines are likely of higher quality for birds that need interior-forest conditions.

Osprey have been noted fishing at Healy Lake and a nest was observed at the south end (Fig. 5; J. Micksch, pers. comm.). Vet conifers along the lakeshore provide roosting and nesting habitat for large birds such as Bald Eagle and Osprey and nesting habitat for a few species of common songbirds. There is insufficient quantity of this habitat along the lake edge to be useful as nesting habitat for species that favour larger amounts of mature forest (e.g., Northern Goshawk).

Shoreline strips of riparian shrubbery may provide some nesting habitat for a few species of songbirds, but all of those species are common and widespread in coastal BC.

Shallow waters may provide foraging habitat for some dabbling ducks and shorebirds (if exposed mud occurs seasonally), but only during migration. These would not be significant habitats as few birds would be expected due to the mid elevation and small size of the lake.

Shelton Lake

Shelton Lake is deeper, has a less complex shoreline, and lacks shallow waters and wetland areas compared to Healy Lake. This lake likely provides habitat for species typical of coniferous forests on southern Vancouver Island. No special habitat features are visible from satellite imagery.

Shoreline strips of riparian shrubbery may provide some nesting habitat for a few species of songbirds, but all of those species are common and widespread in coastal BC. Forested areas along shorelines appear relatively unfragmented (in recent years) and are likely of higher quality for birds that need interior-forest conditions.


Figure 5. Osprey nest observed at Healy Lake (photo: J. Micksch).

Rare birds

A review of Red and Blue-listed birds that occur in the South Island Forest District provided a list of 29 species (Table 5). Healy and Shelton Lakes have suitable habitat for only the Northern Goshawk, Great Blue Heron, Northern Pygmy-Owl, Barn Swallow, Western Screech-Owl, Band-tailed Pigeon, and Pine Grosbeak; the other species would not normally occur.

Northern Goshawks likely forage and nest in the vicinity of the lakes. Habitat along lake edges are not normally used for nesting as nests are usually placed in mature forest on level or shallow-sloped benches in rugged areas. Great Blue Herons are not known to nest at the lakes, but may occasionally forage there. Northern Pygmy-Owls likely occur and nest in the vicinity of the lakes as they use cavities in trees and can utilize fragment landscapes, both of which were evident. Barn Swallows may occur and could nest on buildings. Western Screech-Owls likely do not occur at the elevations where these lakes are situated. Band-tailed Pigeons could use shoreline riparian, deciduous treed, and conifer forest areas for nesting and foraging but suitability looked low to medium at best. Pine Grosbeaks likely occur in very small numbers but would be associated with forest/clearcut edges.

Table 5. Red and Blue listed birds that occur in the South Island Forest District.

English Name	COSEWIC	BC Status
Northern Goshawk, *laingi* subspecies	T (Nov 2000)	Red
Western Grebe		Red
Great Blue Heron, *fannini* subspecies	SC (Mar 2008)	Blue
Short-eared Owl	SC (Mar 2008)	Blue
American Bittern		Blue
Marbled Murrelet	T (Nov 2000)	Red
Canada Goose, *occidentalis* subspecies		Blue
Green Heron		Blue
Yellow-billed cuckoo		Red
Horned Lark, *strigata* subspecies	E (Nov 2003)	Red
Peregrine Falcon, *anatum* subspecies	SC (Apr 2007)	Red
Peregrine Falcon, *pealei* subspecies	SC (Apr 2007)	Blue
Tufted Puffin		Blue
Northern Pygmy-Owl, *swarthi* subspecies		Blue
Barn Swallow		Blue
White-tailed Ptarmigan, *saxatilis* subspecies		Blue
Western Screech-Owl, *kennicottii* subspecies	SC (May 2002)	Blue
Lewis's Woodpecker	SC (Nov 2001)	Red
Lewis's Woodpecker (Georgia Depression population)		Red
Band-tailed Pigeon		Blue
Double-crested Cormorant	NAR (May 1978)	Blue
Brandt's Cormorant		Red
Pine Grosbeak, *carlottae* subspecies		Blue
Vesper Sparrow, *affinis* subspecies	E (Apr 2006)	Red
Purple Martin		Blue
Cassin's Auklet		Blue
Western Bluebird (Georgia Depression population)		Red
Western Meadowlark (Georgia Depression population)		Red
Barn Owl	SC (Nov 2001)	Blue
Common Murre		Red

T=Threatened, SC=Special Concern, NAR=Not At Risk

3.4 Vancouver Island Water Shrew

A Vancouver Island water shrew was captured along Dash Creek in 2002, approximately 2.5 km from Healy Lake. It is likely that Vancouver Island water shrew lives in and around Shelton and Healy Lakes, where habitat is suitable.

Shelton Lake had small pockets of bulrushes (*Schoenoplectus sp*.) and other aquatic vegetation (including yellow pond-lily, *Nuphar lutea*, and pondweed, *Potamogeton sp*.) and small areas of skunk cabbage, (*Lysichiton americanus*), along shore. There were large numbers of logs/dead trees along the lakeshore, often extending from the shore into the water. At the time of the site assessment the lake was at or below the shrub/sedge/grass zone. The shoreline of Shelton Lake was quite variable; in some areas there was a wide rocky shore between the lake and shrub zone, in others the shrub zone abutted the lake, although there were no areas of flooded shrub zone, as was seen at Healy Lake. The surrounding forest was young and dense, mostly cedar-hemlock (*Thuja plicata-Tsuga heterophylla*) forest with some alder (*Alnus rubra*) patches, with little

understory vegetation. The dense forest did not have very much vegetation in the understory, although there were abundant logs and stumps. In areas around Shelton Lake there were patches of deciduous forest (primarily alder), which were associated with creekbeds. The Vancouver Island water shrew typically uses forested habitat only when it is associated with water.

There were two main types of wetland associated with Shelton Lake that were visited during the site assessment (see Fig. 2). A wetland at the north end was similar to those seen at Healy Lake, with a dominant hardhack (*Spiraea douglasii ssp. douglasii*) community, abundant downed wood, and water in channels or pools. At the south end of Shelton Lake, there was a different type of wetland, which in addition to hardhack, alder and willow (*Salix spp*.) also had some regeneration of cedar and hemlock trees. The ground in that area was drier.

There were two areas of potentially concentrated seasonal runoff into Shelton Lake. On the east side of the lake there was a dry, rocky area that looked like a creekbed (see Fig. 2). It was fairly low gradient with a cobble substrate. Across the lake on the west side there was a wide creekbed that was dry at the time of the visit. The creekbed had large rocks and boulders and was steep; when water was flowing there would be waterfalls along sections of the creek. The understory vegetation was not very dense. Neither of these sites would be likely to provide habitat for Vancouver Island water shrew when water was absent, but both would likely be suitable when wet, particularly when associated with patches of riparian vegetation and/or downed wood.

The habitat along the channel between Healy and Shelton lakes was variable. At the outflow from Shelton Lake, the channel meandered through a large log jam and then heavy shrub cover in a hardhack wetland. Further north the creek had a rocky/boulder substrate with overhanging vegetation and little downed wood. At the time of the assessment the creek was mostly dry with small pools. This area provided suitable habitat for Vancouver Island water shrew, although the more northern section of the creek would be more suitable with more water in the creek.

Healy Lake has attributes of a wetland, and could be classified as such, rather than a lake (M. Jones, pers. comm.); it has extensive growth by bulrushes throughout, and only small patches of open water without vegetation (see Fig. 3 and 6). In addition to bulrushes, other vegetation is growing in the lake, typically close to shore such as: yellow pond-lily, various kinds of sedges, and pondweed. There is extensive growth of algae in portions of the lake as well. There is a dense shrubby perimeter to the lake, composed primarily of hardhack. During the site visit, the water level was quite high and often extended into the shrub zone, or the forest where the shrub zone was limited. Downed wood was often present along the shoreline, and often extended between land and water. The surrounding forest had little vegetation in the understory; cover was primarily provided by the abundant downed wood in the forest. Many areas around Healy Lake would provide suitable Vancouver Island water shrew habitat.

The outflow from Healy Lake to the South Englishman River is along a small, vegetated channel that is currently partially blocked by a beaver dam (see Fig. 3 and 7). The beaver dam has created a pool that has flooded some of the adjoining forest. Water trickled through the dam into a small slow-moving channel with abundant overhanging vegetation, in-stream vegetation, and downed wood. This dam has been present since at least summer 2007, and, based on low flows in the South Englishman River since 1998, it is likely that a dam has been present at the site in some

form for the last 10 years (J. Craig, pers. comm.). This site represented very good habitat for Vancouver Island water shrew.

Figure 6. Healy Lake is small, with properties of a wetland. It has bulrushes growing throughout the lake and the margins commonly consist of a flooded shrub zone.

Figure 7. Beavers have built a dam at the outflow of Healy Lake. The dam has created a pool with overhanging vegetation and abundant downed wood. The dam has resulted in the flooding of adjacent forest.

4.0 DISCUSSION

4.1 Plants

4.1.1 Shelton Lake

An increase in the water level of Shelton Lake of one to two meters would affect both forest and wetland vegetation communities, including two Blue listed riparian communities. As the water level of the lake will remain at a higher level for a longer period of time, existing plant community assemblages will change. Tree species generally are not well suited to long periods of inundation. Any trees at the lake edge, close to the water, or influenced by extended periods of a high water table, may become stressed. Impacts would include reduced growth and/or tree mortality. This would eventually create many new snags along the lakeshore, dead tops, or cause uprooting due to the inability to support themselves in wetter substrates. Consequently, there would be an increase in large woody debris. Trees currently growing upslope from the level of the new lakeshore would continue to mature, and would form part of the new lakeside buffer forest.

With increased water levels, most of the existing wetland communities will become inundated or submerged during the growing season and the response of the vegetation to this hydrological change will be similar in most lakeshore wetland communities. Current wetland species most likely will die back, creating more open water area within the lake. If suitable substrate is available, these wetland plants may be able to re-colonize upslope where waters would be shallower. Zonation of the shoreline wetland communities will be dependent on water depth, as well as the type and amount of suitable substrate for each species type.

An increase in water levels would reduce shoreline wetlands, due to limited upslope habitat. Re-establishment of many wetland species would be restricted due to limited rooting space, increased water turbidity, access to oxygenated soils, and light availability. The width of available substrates and depth of the water column will determine the amount of available rooting space for the re-establishment of plant species that are displaced by environmental changes. Along much of the shoreline, the existing wetland habitat tended to be narrow. A decrease in wetland plant community size and diversity should be expected in these areas. Forest slope gradients were moderate and soils were easily eroded. Wave action from storm events may eventually alter the hillside slopes, creating the lakeside terraces currently observed in this lake system. This may provide new substrates for wetland vegetation to colonize in the future.

At this time, Shelton Lake provides a wide diversity of wetland habitats. Along the lower edge of most lakeshore fringe wetlands were narrow bands of shallow-water wetlands. This wetland type provides some of the most important habitat for wildlife and fish (MacKenzie and Moran 2004). Floating and submergent wetland plants growing in these areas are often highly palatable for browsing species, including Beaver and Muskrat. These areas are also used by aquatic macroinvertebrates. The cover provided by the wetland vegetation and the food value provided by the aquatic macroinvertebrates attract both adult and juvenile fish.

If water levels are increased, it should be expected that waters would rise in the lake inflow and outflow wetlands. The water within the southern wetland (inflow area) would increase, flooding upstream areas. This could potentially increase the size of the wetland. As with most lakeshore

wetland communities, the areas with deeper water would suppress terrestrial woody species growth, encouraging the establishment of wetland shrubs, herbs, and emergent and submergent plants, with woody species colonizing the drier perimeters. Increased lake volume would also deepen and increase flow within the northern wetland (lake outflow area). This broad flat terrain would easily accommodate increased water levels and similar changes in community structure should be expected. Depending on the location of the dam, the existing lake outflow wetland would become submerged, creating a new lake outflow area further downstream. It is likely that there are several seepages leaving the northern wetland. With increased water levels, new drainages may form, depending on water volumes and flow rates.

In addition to the south wetland, it is likely that the majority of the inflows around Shelton Lake will be physically altered by the flooding of the current shoreline. As such, most (if not all) of the lake inflows would re-establish further inland. Sediment, sand, and gravel deposits at the outlets of these inflows would become inundated but may provide suitable habitat for wetland plants, including emergent and submergent species. Depending on seasonal flows, some substrates may not be well colonized due to flash flooding or high water flow.

As lake levels rise, the large woody debris should be expected to shift and shoreline vegetation could be disturbed by their movement. Floating logs could potentially crush or damage existing or newly colonizing vegetation. Currently, many of the logs were located at the lake outflow in the northern wetland. Abrupt changes to the water levels or major wind storms would increase the likelihood of damage from transient woody debris.

4.1.2 Healy Lake

An increase in the water level of Healy Lake by one to two meters, or even greater, would have a serious impact to wetlands and forests including two Red and three Blue listed communities. Changes to water levels would create a larger, deeper wetland with water levels remaining at a higher level for longer periods. The flooded / altered wetland may not have the diversity that currently exists in Healy Lake. With increased water levels, most of the existing wetland communities will become inundated or submerged during the growing season. The increased water depth would limit light availability and available rooting substrates for species currently established. Present wetland species most likely will die back, creating more open water within the lake. If suitable substrate is available, these wetland plants may be able to re-colonize towards the wetland perimeters where waters would be shallower. Zonation of the shoreline wetland communities will be dependent on water depth, as well as the type and amount of suitable substrate for each species type.

Due to the slopes of the surrounding forests, much of the additional water will spread into areas of low gradient, such as the South Swamp and the adjacent forest. In areas with steeper slopes, wetland plants will be limited by the width of available substrates and depth of the water column. Establishment will depend on rooting space, access to oxygenated soils, and light availability in the water column. In sloped areas, a decrease in wetland plant community diversity should be expected and the wetland communities adjacent to open water may become narrower than at present. Forest slope gradients were moderate and soils were easily eroded. It is possible that eventually hillside slopes will erode at the new water edge, creating flatter terrain in shoreline areas. This would allow the establishment of wetland bands along the new lake perimeter.

In addition, forested areas will also be impacted. Tree species generally are not well suited to long periods of inundation. Any trees at the lake edge, close to the water, or influenced by extended periods of a high water table, may become stressed. The forest south of Healy Lake will be particularly susceptible, as the water table in these areas was quite high and the slope gradient very low. Impacts would include reduced growth or tree mortality. This would eventually create many new snags along or in perimeter forests, dead tops, or cause uprooting due to the inability to support themselves in wetter substrates. Ultimately, there would be an increase in large woody debris. Trees currently growing upslope from the level of the new water edge will continue to mature, forming part of the new lakeside buffer forest.

Some of the wetland and forest communities at Healy Lake are sensitive to disturbance and some are listed by the CDC (see Appendix 2, Table 3). Bogs (i.e., Pine "Island") and fens (i.e., Sweet gale/Sedge) have very specific nutrient regimes and are not tolerant to long periods of flooding. Changes in water circulation can alter nutrient distribution within wetlands and substrate composition, causing the community to shift and develop into an alternate community type. Shallow-water wetlands and deep marshes provide some of the most important habitat for wildlife and fish (MacKenzie and Moran 2004).

4.2 Amphibians

Two and three amphibian species were confirmed breeding at Shelton and Healy Lakes respectively, including a listed species—Red-legged Frog. More egg masses were observed at Healy than at Shelton Lake. This is likely related to the greater surface area of shallow water present at the former site—amphibians prefer to lay their eggs in less than 1 m of water. There were few shallow water areas with emergent vegetation for egg laying and rearing in Shelton Lake and many areas were exposed to wind and wave action (eggs can easily become dislodged and crushed by logs). The lack of capture of Red-legged Frog tadpoles at Shelton Lake may reflect greater predation pressure on larvae at that site due to low habitat complexity (e.g., little to no cover from fish). The greater diversity of amphibians and macroinvertebrates captured at Healy versus Shelton Lake may also suggest that the former site is richer or more productive for these organisms.

Although both sites had breeding, the relative number of egg masses observed and individuals captured during trapping was low. Red-legged Frog eggs and larva develop relatively slowly compared to other native species so they tend to be most common below 500 m and are rare above 1,000 m on Vancouver Island (pers. obs.). Both sites also contained predators (e.g., neotenic Northwestern salamanders, crayfish, and fish). The low number of invertebrates and higher number of neotenic Northwestern Salamanders captured at Shelton may reflect greater predation pressure at this site.

The proposed 1 to 2 m increase in water levels may reduce the small amount of shallow water available for amphibians in Shelton Lake. However, flooding into riparian areas may balance out the lost habitat (e.g., water may back up into the beach and camping area on the northwest end of the lake). Increased water levels at Healy Lake may reduce the large amount of shallow breeding habitat available for amphibians at that site. Some flooding into the riparian area may compensate for this but until the canopy cover is reduced (e.g., as flooded trees die), these areas may not be attractive for breeding. The large number of downed trees that will fall into the lakes

once riparian areas are flooded may also reduce breeding site suitability due to shading and log movement. Also, increased water levels may make current rearing habitats accessible to larger predators, such as fish.

4.3 Birds

If water levels were raised above current maximums in spring and early summer, the following impacts on bird habitat are predicted:

Healy Lake
1. Raising water levels could flood and kill shoreline shrubs, emergents, and lakeshore forest from higher than normal annual high water levels which could reduce suitability for foraging, cover and nesting for a number of bird species.

2. The wetland areas in the south and west corners could be degraded or lost, depending on depth and duration of water storage. However, the wetland could realign with higher water levels and perhaps provide similar habitat to its current condition.

3. If water levels are raised beyond normal maximums during the bird breeding season (May to July), any ground or low nests that may occur in the wetland areas will be flooded.

4. Deepening of waters could negatively impact foraging habitat for dabbling ducks, herons and bitterns, and shorebirds and increase foraging habitat for diving ducks. But few birds would be affected so effects would be negligible.

5. Impacts to Red and Blue listed birds are predicted to be negligible due to the poor quality of habitat for most Red/Blue species, and/or the lack of occurrence at the site.

Shelton Lake
Because of the topography of the surrounding uplands, forest condition, and lack of rare or special bird habitat, no impacts to birds are expected from the proposed increase in water levels. Shelton Lake appears to be a good candidate for increasing storage capacity.

4.4 Vancouver Island Water Shrew

In general, the terrestrial habitat around Healy and Shelton Lakes was marginal for Vancouver Island water shrew because of a lack of vegetative cover. Where the forest is flooded and close to other suitable habitat, the shrews would likely use the pools in the forest (as in the area adjacent to the outflow of Healy Lake). The best habitat was in riparian areas—along the creek inflows/outflows to the lakes, and in wetlands where they would be associated with channels or pools or seeps with abundant vegetative cover. The lack of vegetative cover in the young forest was partially compensated for by the abundant downed wood, a habitat feature recorded at most previous capture sites of the subspecies (Craig 2003). The terrestrial invertebrate community composition is influenced by the composition (type, amount) of the vegetation and litter layers (Ehrlich and Murphy 1987). Insects may be more numerous on moist, nutrient-rich sites (Shvarts and Demin 1994). Decayed logs also serve as nesting and foraging habitat for shrews (*S. palustris*; Ingles 1965, Thomas 1979); as logs decay they provide habitat for different communities of invertebrates (Maser and Trappe 1984, Harmon et al. 1986). In addition, for

water shrews, downed wood is a structure that bridges the aquatic and terrestrial habitat, providing a physical connection between the two habitats. Especially in areas with steep banks, sudden drop-offs, or deep water, downed wood may be very important to the ability of *S. p. brooksi* to move in and out of water.

Flooded shoreline – Healy Lake
At the time of the site assessment, the shrub/forest zone of Healy Lake was close to the water, and in some cases, the shrub zone and/or forest was inundated by water. Numerous logs were in the lake, and often extended from shore into the lake. There was abundant vegetative cover along the shore, but there were openings in vegetation that would provide suitable places for water shrews to forage. Vancouver Island water shrews would potentially use these areas, particularly near the input/output creeks.

The proposed modification of the site to retain more water would result in greater flooding of the shoreline, resulting in the water level moving upslope and into the surrounding forest. The abundant downed wood in the forest would provide travel routes and water access for water shrews. Lack of vegetative cover might reduce the suitability of habitat for the Vancouver Island water shrew. Vancouver Island water shrews would likely associate primarily with the creeks, and with forest openings with riparian vegetation.

The raised water level would also flood some areas of wetland habitat, making it unavailable to the Vancouver Island water shrew. However, it is likely that wetland habitat will still remain once the lake levels are raised. If features such as channels or pools are available in the remaining wetlands, then suitable habitat will remain.

Flooded shoreline – Shelton Lake
The shrub/forest zone on Shelton Lake was quite close to the water at the time of the site assessment. Cover at the water's edge would be provided by the many logs that cross the land-water interface, or by the occasional clumps of sedges. However, many areas of the lake had exposed shoreline. Vancouver Island water shrews would use the channel connecting Shelton and Healy Lakes, and the lake edge where good downed wood and vegetative cover were available.

The proposed modification of the site will result in the lake water inundating the shrub zone and moving into the forest zone. Where the water's edge would be in shrubby habitat, the site could provide good habitat for water shrews, if there were openings or channels for *S. p. brooksi* to forage. In the forest the main cover would be from downed wood—little vegetation was present in the surrounding forest.

Channel between Shelton and Healy Lakes
The channel between Healy and Shelton Lakes had areas of very good habitat for Vancouver Island water shrew at the time of the assessment. The outflow area from Shelton Lake and the inflow to Healy, as well as the entire channel between the lakes would likely provide some of the highest quality habitat to Vancouver Island water shrew of the habitat assessed at the site. Increasing the water level in the channel is not likely to negatively affect water shrew habitat.

Inflows to Shelton Lake
The two areas of potential seasonal flow to Shelton Lake are also areas of potential habitat for Vancouver Island water shrew when water is flowing along the channels. The fact that the areas appear to dry up during the summer would likely minimize the number of aquatic invertebrates, although any muddy areas in the area would likely still support invertebrates. The proposed increase in water levels will not affect the suitability of these sites for Vancouver Island water shrew.

Outflow from Healy Lake
The outflow from Healy Lake contained very suitable habitat for Vancouver Island water shrew at the time of the assessment—a beaver dam created a pool at the outflow, flooding part of the adjacent forest. The area had very good water shrew habitat.

If raising the water level entails modifying the outflow to create a dam/spillway or other artificial water control system, the current suitable habitat for the water shrew could be destroyed or degraded. A water control system could create a barrier to movement of the shrew, and require the removal of riparian vegetation.

Harvesting in area
Vancouver Island water shrews have not been captured in clear-cuts (Craig 2003), but have been captured in young stands as long as vegetation is present. To minimize the effect of harvesting on travel routes of Vancouver Island water shrew, ensure that a riparian corridor is retained along all watercourses (including ephemeral or intermittent ones) that drain into the lake, and minimize the harvesting of long unbroken strips alongside the lake.

5. 0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Plants

Two terrestrial, Blue-listed plant communities were identified along the riparian area of Shelton Lake. A number of listed plant communities occur in and around Healy Lake that may be negatively affected by increased water levels—two Red listed wetland and three Blue listed terrestrial communities were identified.

The three main areas of concern regarding plant species and communities and increased water levels at Shelton and Healy Lakes relate to protection of listed plant communities, buffers, and non-native species:

- Protect Red listed wetland plant communities at Healy Lake by
    - not altering water levels at that site
    - consulting with a wetland botanist and conducting more specific field work to determine whether conditions can be created to facilitate the ongoing survival of wetlands in flooded shoreline areas

- Before development begins, thin the future flooded riparian area of trees to reduce the large influx of downed wood that will eventually fall into the lake, disturbing and eroding shoreline plant communities.

- Forest buffers are an integral part of maintaining the health of lake systems. In some places, only a narrow band of vegetation exists between the lake edge and roads around the lakes. Lake ecosystem management should include preserving a sufficient lake buffer. For more information on recommended buffers for sensitive habitat, refer to the Develop with Care: Environmental Guideline for Urban and Rural Land Development in BC, (pages 4-26, Table 4.2; BCMOE 2006).

- Management plans for the control of introduced species or noxious weeds should be created and implemented prior to changes in water level. Most of the weedy species were located near areas of human activity, such as the dam areas, roads, camping sites, and boat launch. With an increase in lake level, there is a greater opportunity for seeds and plants to be dispersed to different sites, providing new locations for opportunistic species to colonize. A monitoring program should encourage the removal of newly emerged weedy species at the first opportunity.

5.2 Amphibians

Although a listed amphibian species, the Red-legged Frog, was found to occur and breed in both Shelton and Healy Lakes, an increase in water levels at both sites would likely not have any long-term negative effects on amphibian species or populations that occur in the area. To increase the suitability of the site for amphibian breeding after flooding:

- Thin riparian trees and vegetation prior to flooding to make shoreline areas more attractive for breeding.
- Avoid the introduction of non-native species and disease that may be carried in on machinery and equipment.
- Monitor amphibians post flooding to confirm that species continue to use the site for breeding post development.

5.3 Birds

Because of the current habitat conditions, expected breeding bird community, and anticipated effects of altering water levels, no significant impacts to local or regional breeding bird populations are expected from the proposed changes to water levels in Shelton Lake.

To mitigate impacts of the proposed project on local bird populations:

- Recognize that the wetlands at Healy Lake are rare in mountainous areas on Vancouver Island and, although the birds that may depend on them for nesting are likely common species, these wetlands should be considered a significant resource. An additional assessment of the quality of the wetlands and their probable response to changed water levels is advised at Healy Lake.
- If water levels are raised beyond normal maximums they should not be raised during the bird breeding season (May to July) to avoid flooding nests that may occur in wetland

areas. Stop logs should be installed early in the spring runoff period, while lake levels are already somewhat high, in an effort to avoid a raising of levels later in spring that may lead to nest flooding.

5.4 Vancouver Island Water Shrew

To maintain habitat for Vancouver Island water shrew:

- If possible, maintain the characteristics of the current outlet from Healy Lake, which has suitable habitat for Vancouver Island water shrews. If the outlet area is modified, aim to retain important features to the Vancouver Island water shrew, such as the overhanging vegetation, in-stream vegetation, abundant downed wood, and pools of water;
- Beaver activity was evident on Healy Lake. A dam had been built at the outflow at the north end of Healy Lake, and beaver activity was also seen along the northwest edge of the lake. Beaver dams have the potential to create suitable Vancouver Island water shrew habitat. Pools created behind dams can be very productive and suitable habitat for water shrews (Wrigley et al. 1979), as long as there is water flow into and out of the pool. The beaver dam at the outflow created very favourable conditions for Vancouver Island water shrew. If possible, the beaver dam should be left alone. If, during the site modification, beaver dams are removed, consider creating pools/ponds and connect them to existing habitat;
- If a water control structure is built at the outflow, emphasize connectivity of the lake and channel habitat. Include a bridge (preferable) or culvert nearby, placed such that it includes a watercourse that connects the two habitats. Place vegetation at both sides to provide a completely covered travel route for shrews. Although small mammals, including shrews, will use culverts to cross barriers (Yanes et al. 1995, Clevenger et al. 2001) their use is negatively related to road width and length of culvert, and positively related to culvert width, height, and openness (Yanes et al. 1995). If a culvert it used, it should be an oversized open-bottom pipe arch with natural substrate, which will provide a suitable travel route for shrews. Where possible, the culvert should be <30 m.
- Place downed wood (preferably >6 cm in diameter, Craig 1995) that bridges the land-water interface to provide movement corridors for shrews, or ensure that banks along the channel provide opportunities for small mammals to move easily between the aquatic and terrestrial habitat. Creation of small pools connected to other habitat would also be useful to shrews (also include overhanging vegetation and downed wood);
- In areas which have been modified, plant native riparian vegetation;
- Ensure that any newly created habitat is connected to already existing habitat by aquatic corridors (preferable), a series of wet depressions or wetlands, and/or downed wood (if the habitats are close together). If possible, connect the new habitat with forest that has stream habitat;
- Where possible, avoid the use of riprap because large boulders are less suitable than gravel/cobble/mud substrates for water shrews;
- Ensure that connectivity is maintained between the lake and other creeks in the area. Connections should emphasize forested watercourses.

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APPENDIX 1. PLANT COMMUNITIES AT RISK IN THE CWHXM2 BIOGEOCLIMATIC ZONE IN THE NANAMIO REGIONAL DISTRICT, SOUTH ISLAND FOREST DISTRICT (BCCDC 2008A) THAT WERE RECORDED AT SHELTON AND HEALY LAKES.

Scientific Name	English Name	Shelton or Healy	Global Rank	Prov. Rank	BC Status
Dulichium arundinaceum / Herbaceous Vegetation	three-way sedge	Healy	GNR	S2	Red
Myrica gale / Carex sitchensis	sweet gale / Sitka sedge	Healy	G3	S2	Red
Pinus contorta / Sphagnum spp. Very Dry Maritime	lodgepole pine / peat-mosses Very Dry Maritime	Healy	GNR	S3	Blue
Populus balsamifera ssp. trichocarpa - Alnus rubra / Rubus spectabilis	black cottonwood - red alder / salmonberry	Shelton	GNR	S3	Blue
Thuja plicata - Picea sitchensis / Lysichiton americanus	western redcedar - Sitka spruce / skunk cabbage	Healy	G3?	S3?	Blue
Thuja plicata / Polystichum munitum Very Dry Maritime	western redcedar / sword fern Very Dry Maritime	Both	GNR	S2S3	Blue

APPENDIX 2. PLANTS SPECIES FOUND AT SHELTON AND HEALY LAKES. THESE ARE NOT CONSIDERED COMPREHENSIVE LISTS.

Shelton Lake:

Common Name	Scientific Name
Trees	
Coastal Douglas-fir	*Pseudotsuga menziesii var. menziesii*
Pacific crab apple	*Malus fusca*
Pacific willow	*Salix lucida ssp. lasiandra*
Red alder	*Alnus rubra*
Western hemlock	*Tsuga heterophylla*
Western redcedar	*Thuja plicata*
Western white pine	*Pinus monticola*
Western yew	*Taxus brevifolia*
Willows	*Salix spp.*
Yellow-cedar	*Chamaecyparis nootkatensis*
Shrubs	
Baldhip rose	*Rosa gymnocarpa*
Beaked hazelnut	*Corylus cornuta*
Black huckleberry	*Vaccinium membranaceum*
Black twinberry	*Lonicera involucrata*
Dull Oregon-grape	*Mahonia nervosa*
Hardhack	*Spiraea douglasii ssp. douglasii*
Oval-leaved blueberry	*Vaccinium ovalifolium*
Pacific ninebark	*Physocarpus capitatus*
Red huckleberry	*Vaccinium parvifolium*
Salal	*Gaultheria shallon*
Salmonberry	*Rubus spectabilis*
Sweet gale	*Myrica gale*
Trailing blackberry	*Rubus ursinus*
Herbs	
American speedwell	*Veronica beccabunga*
Bracken fern	*Pteridium aquilinum*
Broad-leaved starflower	*Trientalis borealis ssp. latifolia*
Buckbean	*Menyanthes trifoliata*
Bulrush	*Schoenoplectus sp.*
Bunchberry	*Cornus canadensis*
Common cattail	*Typha latifolia*
Common horsetail	*Equisetum arvense*
Dagger-leaf rush	*Juncus ensifolius*
Deer fern	*Blechnum spicant*
Great sundew	*Drosera anglica*
Marsh cinquefoil	*Comarum palustre*
Pondweed	*Potamogeton sp.*
Prince's pine	*Chimaphila umbellata*
Rushes	*Juncus spp.*
Sedges	*Carex spp.*
Skunk cabbage	*Lysichiton americanus*
Sword fern	*Polystichum munitum*
Twinflower	*Linnaea borealis*
Vanilla-leaf	*Achlys triphylla*
Wall lettuce	*Lactuca muralis*
Yellow pond-lilly	*Nuphar lutea*

Healy Lake:

Common Name	Scientific Name
Trees	
Coastal Douglas-fir	*Pseudotsuga menziesii var. menziesii*
Mountain hemlock	*Tsuga mertensiana*
Pacific crab apple	*Malus fusca*
Red alder	*Alnus rubra*
Shore pine	*Pinus contorta var. contorta*
Western hemlock	*Tsuga heterophylla*
Western redcedar	*Thuja plicata*
Western white pine	*Pinus monticola*
Western yew	*Taxus brevifolia*
Willows	*Salix spp.*
Yellow-cedar	*Chamaecyparis nootkatensis*
Shrubs	
Alaskan blueberry	*Vaccinium alaskaense*
Black twinberry	*Lonicera involucrata*
Dull Oregon-grape	*Mahonia nervosa*
False azalea	*Menziesia ferruginea*
Hardhack	*Spiraea douglasii ssp. douglasii*
Highbush-cranberry	*Viburnum edule*
Hooker's willow	*Salix hookeriana*
Labrador tea	*Ledum groenlandicum*
Nootka rose	*Rosa nutkana var. nutkana*
Pacific ninebark	*Physocarpus capitatus*
Red huckleberry	*Vaccinium parvifolium*
Salal	*Gaultheria shallon*
Salmonberry	*Rubus spectabilis*
Sweet gale	*Myrica gale*
Trailing blackberry	*Rubus ursinus*
Herbs	
Bladderwort	*Utricularia sp.*
Bracken fern	*Pteridium aquilinum*
Broad-leaved starflower	*Trientalis borealis ssp. latifolia*
Buckbean	*Menyanthes trifoliata*
Bulrush	*Schoenoplectus sp.*
Bunchberry	*Cornus canadensis*
Clasping twistedstalk	*Streptopus amplexifolius*
Common horsetail	*Equisetum arvense*
Deer fern	*Blechnum spicant*
False lily-of-the-valley	*Maianthemum dilatatum*
Five-leaved bramble	*Rubus pedatus*
Grasses	
Mannagrass	*Glyceria sp*.
Marsh cinquefoil	*Comarum palustre*
Pondweed	*Potamogeton spp.*
Reedgrass	*Calamagrostis sp.*
Rushes	*Juncus spp.*
Sedges	*Carex spp.*
Skunk cabbage	*Lysichiton americanus*
Sword fern	*Polystichum munitum*
Three-leaved foamflower	*Tiarella trifoliata var. trifoliata*
Three-way sedge	*Dulichium arundinaceum*
Vanilla-leaf	*Achlys triphylla*
Waterweed	*Elodea sp.*
Western trillium	*Trillium ovatum*

Yellow pond-lilly	*Nuphar lutea*
Mosses and Liverworts	
Heron's-bill moss	*Dicranum sp.*
Lanky moss	*Rhytidiadelphus loreus*
Leafy moss	*Plagiomnium sp.*
Oregon beaked-moss	*Eurhynchium oreganum*
Peat-moss	*Sphagnum spp.*
Step moss	*Hylocomium splendens*