

Review of Environmental Issues for the Development of the Grafton Lake Lands, Bowen Island, BC



Prepared by:

Claudia Schaefer and Nick Page
Raincoast Applied Ecology

Prepared for:

Bowen Island Conservancy

June 29, 2015

SUMMARY

The Bowen Island Conservancy commissioned this review to identify environmental issues associated with the proposed development of the Grafton Lake Lands in the centre of Bowen Island. A concept plan has been developed which proposes to rezone the Grafton Lake properties and construct a number of residential housing clusters with around 100 dwellings, a wellness institute, and a small farming area. The total development area in the concept plan is 56 ha or 36% of the total property, plus an additional area for agriculture (3 ha; 2%). A large nature preserve (90 ha; 57% of the study area) is proposed encompassing Grafton Lake, shoreline wetlands, and hillside forests. A smaller nature reserve (8 ha; 5% of the property) would be designated adjacent to the Bowen Island Ecological Reserve. The concept plan has been used for an extensive community-based public engagement process.

The strength of the current concept plan from an ecological management perspective is the scale of protection proposed for the lake, wetlands, and surrounding forests. Indeed, over 60% of the total land area is proposed for protection as nature reserve. Additional areas will be protected as greenways and riparian areas.

Ecological Values

The Conservancy recognizes the value of Grafton Lake and its surrounding wetlands, forests, rock bluffs, and streams for biodiversity and ecological functions of Bowen Island. This includes:

- The Grafton Lake area is a critical piece of Bowen Island's ecological network and provides connections both north and south between Mt Gardner and Mt Apodaca, as well as east and west through the central valley.
- Grafton Lake and the surrounding wetlands are a regionally significant example of a healthy lake ecosystem; there are few, if any, small lakes in Metro Vancouver that have an equal range and quality of wetlands.
- Grafton Lake and its stream network is a water source for about 48% of the island's residents through the Cove Bay Water System, and helps support fish and other aquatic species in Terminal Creek (including the fish hatchery) and lower Killarney Creek.
- The Grafton Lake Lands contain provincially recognized Sensitive Ecosystems including wetlands, forests, riparian ecosystems, and rock outcrops. Sensitive Ecosystems are ecologically fragile or at risk ecosystems which are sensitive to human disturbance. It also contains some species at risk, but no thorough surveys have been undertaken.

Potential Impacts

Potential impacts to ecological values identified by this review include:

- Changes to hydrology and/or water quality which could affect the ecological health of Grafton Lake and associated wetlands, impact drinking water quality or quantity, and impair water quality and hydrology in Terminal Creek and lower Killarney Creek. Sedimentation of wetlands and streams during land clearing and construction is a specific concern.
- Loss or disturbance to Sensitive Ecosystems including forest removal, edge effects from adjacent development, introduction of invasive species associated with development, and disturbance from recreation.
- Loss or disturbance to species and ecological communities at risk including habitat fragmentation or increased disturbance from human use.
- Habitat fragmentation and loss of landscape connectivity for wildlife through forest removal, construction of roads, and increased human use.
- Disturbance to wildlife and ecosystems from increased recreation use around Grafton Lake.

Outstanding Issues

Additional information is needed to refine this review of environmental issues including:

- The proposed character and configuration (e.g., density, road networks, etc) of land use within the development nodes.
- Proposed strategies to protect hydrology and water quality during both the construction phase and over the long-term including sediment, nutrients (particularly phosphorus), pathogens from septic systems, etc.
- The proposed size and character of the recreation trails and any associated viewpoints, bridges, boardwalks, and parking areas around Grafton Lake.
- The proposed riparian (streamside) protection around small watercourses within Development Node 1 and through the proposed agricultural area.
- The width and character of the proposed greenways within the development nodes, as well as edge treatments along the boundary of the ecological reserve.
- More information about the occurrence of species and ecological communities at risk within the overall study area, as well as information about any specific wildlife habitats and features (e.g., breeding, roosting or denning sites, old trees, etc) which may be affected by the proposed development activities or trails.

INTRODUCTION

Purpose

The purpose of this report is to identify potential environmental issues related to the proposed development of the Grafton Lake Lands on Bowen Island, BC. A conceptual development plan has been developed to support the rezoning of the property and is being used for community engagement. In addition, an environmental overview was completed by Whitehead Environmental Consultants which summarizes information on existing environmental conditions and identifies potential environmental impacts. We anticipate further assessment of environmental impacts will be undertaken during the detailed planning phase. This review was based on existing information sources (see Appendix 1), as well as approximately 4 days of field surveys in spring 2015. Detailed field surveys or wildlife inventories were not undertaken. The issues and concerns identified in this report should be considered preliminary at this time.

Study Area

The Grafton Lake study area, situated in the central portion of Bowen Island, encompasses Grafton Lake and the lands surrounding it (Appendices 2 and 3). They are also known as the Rennison Lands, and are owned by Primex Investments Limited. John Reid (Evergreen) is leading the community discussion on behalf of the owners as to the proposed rezoning of six parcels encompassing 158 hectares (390 acres).

The study area contains part of the major central valley of the island, with the lake and associated valley bottom, and slopes to the north and east to Crown land and Conical Hill (Duncan's Hat), respectively. The topography also includes slopes of Mt Apodaca on the south side of the study area, connecting the development lands with the Bowen Island Ecological Reserve. The lake is bordered by extensive wetlands, riparian zones surrounding small streams, and large tracts of young and mature conifer forest. Grafton Road traverses east/west roughly through the centre of the property. Existing and old logging roads are found throughout the area.

Grafton Lake is the supply for the largest water distribution system on the island, municipally operated as the Cove Bay Water System (48% of island residents). Water levels are regulated by a dam at the lake's outlet to ensure consistent and sufficient water release into Terminal Creek; the water supply pipeline and chlorination system are within the study area. Other watersheds present in the study area are Terminal Creek (the central and eastern portions that lie south of Grafton Road and the northeast corner of the project lands) and Killarney Creek watershed, which occurs across a small area on the northern edge of the property.

Most of the study area is currently zoned as Rural Residential 1 (RR1) which permits a single dwelling on a 4 ha (10 ac) parcel. Three smaller parcels (see zoning map [here](#)) are zoned as Rural Residential 2 or 3 (RR2 or 3) which permits a single dwelling on parcels with a minimum

lot area of 2 ha (5 ac) or 1 ha (2.5 ac) depending on water supply and average lot area. The current zoning allows for approximately 70 dwellings. Grafton Lake is zoned as WP1 (drinking water). Approximately 17.5 hectares (49 acres) of the study area are designated as part of the provincial Agricultural Land Reserve (ALR), some of which is cleared and has been used for agricultural purposes in the past (on the south side of Grafton Road), while a large portion is currently swamp, other wetland habitat, or young forest.

While the study area is private land, it is used for recreation: there is a popular swimming spot on the southeast side of Grafton Lake, there are numerous trails providing access to lake and forest area, and the Cross Island Trail bisects the northern portion of the property. Residents on the eastern side of the lake have maintained some access routes and there is one small floating dock. ATV use is also common.

Proposed Development

The concept plan (Appendix 3) would rezone and subdivide the Grafton Lake Lands and construct a number of residential housing clusters, a wellness institute, and a farming area on a portion of the areas designated for agriculture. The total development area in the concept plan is 56 ha or 36% of the property, plus an additional area for agriculture (3 ha; 2%). The proposed number of dwellings is approximately 100. The concept plan is labeled as both a “possible land use plan” and a “proposed land use plan” at this time. The majority of the housing clusters would be located south of Grafton Road (Development Node 1), with another portion on the east side of Grafton Lake. A parcel in the western sector would be sold off to another developer. Their plans for the parcel are not known. The cement dam, community water supply pipeline and chlorination station would continue to operate for the community water supply. A large nature preserve (90 ha; 57% of the study area) is also proposed within the plan encompassing Grafton Lake, shoreline wetlands, and hillside forests. A smaller nature reserve (8 ha; 5% of the property) would be designated adjacent to a portion of the Bowen Island Ecological Reserve. Conceptual greenways with trail linkages are indicated on the plan but it is noted that future detailed planning as to their precise location, width, and configuration is needed.

KEY ENVIRONMENTAL ISSUES

We identified five key issues that should be considered in evaluating the development proposal for the Grafton Lake Lands. They are:

1. Changes to hydrology (water flow) and water quality;
2. Loss or disturbance to sensitive ecosystems;
3. Loss or disturbance to species or ecological communities at risk;
4. Habitat fragmentation and loss of landscape connectivity; and
5. Disturbance to wildlife and ecosystems from increased recreation use.

Each is described in more detail in the following sections.

Issue 1: Changes to Hydrology and Water Quality

Grafton Lake and the stream network that supports it is both an important ecological feature on Bowen Island, as well as a water source for about 48% of the island's residents through the Cove Bay Water System. It is about 15 ha in area and fed by numerous small streams (see Appendix 3) with the primary flow from the east through Bowen Brook. The total watershed upstream from the lake outlet (the drinking water catchment) is approximately 699 ha (see Appendix 2). The portion of the study area properties included within this catchment is about 101 ha, or approximately 14%. Note that about 2/3rds of the proposed development lands south of Grafton Lake (Appendix 4: Development Node 1) contribute flow into Terminal Creek downstream of the lake outlet. This avoids impacts to drinking water supply system but does not avoid potential impacts to fish and other aquatic ecosystem values in Terminal Creek and lower Killarney Creek. The total area of the Grafton – Killarney watershed area is 1,520 ha or about 31% of Bowen Island.

Most of the changes associated with hydrologic disturbance affect small streams, as well as shoreline wetland communities which are closely controlled by seasonal water levels. Small lakes are sensitive to changes to hydrology and water use which influence seasonal water levels. Increasing water use from an expanding Bowen Island population, and potential long-term changes in rainfall associated with climate change are likely more important risks to lake hydrology than development proposed for the Grafton Lake Lands. The Cove Bay Water System provides water to about 620 service connections at present which is expected to increase to about 730 by 2030. Changes to hydrology may affect water quality by accelerating decomposition of wetland soils during summer drawdown. Hydrologic changes associated with development include reduced interception of rainfall by forest vegetation, loss of storage in upper soil layers, increased surface runoff and reduced infiltration, and modification of drainage patterns (pipe, ditches) which increase the rate of runoff. The effects of these changes on small streams include erosion and increased sediment movement from larger storm flows, and lower summer base flows from reduced infiltration and shallow groundwater storage. The streams that flow through the lands south of Grafton Road (Development Node 1) (Rennison

Creek, Raven Brook, and Warbler Creek) are more at risk than other streams in the study area because of the extent of proposed development. Approximately 4 km of mapped watercourses within Development Node 1 contribute flow to Terminal Creek including the fish hatchery. Riparian areas are essential for maintaining both hydrology and water quality.

Water quality is much more of a concern for small lakes in developing watersheds. Small coastal lakes are generally very low in nutrients because they drain from forested areas with little movement of sediment or nutrients. However, nutrients, primarily phosphorous (both dissolved and bound to sediment and organic particles), can increase algae productivity and lead to systemic changes to lake health and water quality. Many small lakes in the Metro Vancouver area (e.g., Como Lake in Coquitlam, Deer Lake in Burnaby, Trout Lake in Vancouver) have rapidly infilled because of water quality changes accompanying urbanization of their watersheds. Increased sediment loading from land clearing and poor riparian management is already apparent in Bowen Brook upstream of Grafton Lake. In addition, microbiological contamination (typically measured by concentrations of *E. coli* and/or fecal coliform bacteria) can be elevated in rural catchments because of run-off from hobby farms and poorly functioning septic fields. Beavers, which are present in Grafton Lake, may also increase the risk of microbiological contamination. A 2009 study by Dayton & Knight reported that turbidity (cloudiness), high colour (mainly organic compounds that give lake water its tea-like colour), and total organic carbon exceed the Canadian Drinking Water guidelines at times. More extensive surveys of water quality in the Grafton Lake watershed (see Whitehead Environmental, 2003; 2010) concluded that water quality is generally good but that human fecal contamination and the release of fertilizers (nutrients), metals, and hydrocarbons from inadequate land use practices is a concern.

While these are general concerns for lake water quality, they will be important considerations for development of the Grafton Lake Lands, particularly since there are few effective mitigation measures for addressing all water quality impacts. Sediment movement and turbidity typically accompany construction phase activities (vegetation removal and soil disturbance) even with careful planning and mitigation measures. Increased sediment concentrations in Terminal Creek have the potential to impact the fish hatchery. Similarly, the concentrations of nutrients (including phosphorus) increase with the amount of developed land. A watershed education program as part of the 2010 Grafton Lake Watershed Study recommended addressing septic system failure, swimming, animal and livestock activities, and pesticide and chemical use to better protect water quality.

Lake water quality may also be affected by increased recreation use: swimming, fishing, and boating increase the potential for pathogens from human or animal (dog) waste to be introduced into the lake. Monitoring in 2008 found human fecal contamination in Grafton Lake near the swimming area (rocky point). Trails may also be a source of fine sediment although this is likely an insignificant issue relative to other sources of sediment in the Grafton Lake watershed.

Issue 2: Loss or Disturbance to Sensitive Ecosystems

Sensitive Ecosystems are ecologically fragile or at risk ecosystems which are sensitive to human disturbance. Ecosystems identified in a Sensitive Ecosystems Inventory are often the remnants of natural ecosystems that once occupied a much larger area. The BC provincial government identifies eight main benefits of Sensitive Ecosystems (more [here](#)):

- Provide critical habitat for species at risk and/or include ecological communities at risk
- Provide biological diversity to a landscape
- Provide wildlife habitat, corridors and linkages
- Bring nature into communities
- Provide recreational opportunities
- Support learning environments
- Create economic benefits (e.g. land values /tax revenue increase near greenspaces)
- A legacy for future generations.

The Bowen-Gambier Sensitive Ecosystem Inventory (SEI) mapped three categories of Sensitive Ecosystems in the study area: (1) wetlands; (2) riparian areas; and, (3) terrestrial herbaceous (includes rock outcrops). Second growth forest (60–100 years in age) was mapped during the SEI not as a Sensitive Ecosystem but as an additional ecosystem with general biodiversity values. In recent years, the categories of Sensitive Ecosystems have changed (e.g., as in the Sunshine Coast SEI). This report's lead author worked with the BC Conservation Data Centre staff to refine the categories. Changes relevant to the present study area are:

- Cliffs have been added as their own category; subclass 'inland' for Grafton Lake Lands;
- Rock outcrops are mapped as such, rather than as terrestrial herbaceous;
- Second-growth forest is no longer mapped as an ecosystem with general biodiversity values; instead,
- Mature forest (80–250 years in age) is mapped as an additional 'Important Ecosystem'.

The following sections describe the Sensitive Ecosystems and Important Ecosystems in more detail. For this report, Sensitive Ecosystems were identified using the existing data from the Bowen – Gambier Sensitive Ecosystem Inventory (Appendix 5). While it is considered relatively coarse in scale, it captures most of the important sensitive ecosystems. Whitehead Environmental also mapped ecosystems in more detail as part of the 2015 environmental inventory (Appendix 6).

Wetlands

Grafton Lake and the surrounding wetlands are a regionally significant example of a healthy lake ecosystem. There are few, if any, small lakes in Metro Vancouver that have an equal range and quality of wetlands: marsh, fen, and swamp are common. Even Killarney Lake in Crippen Regional Park has been modified by water level change caused by the outlet dam. Most of the

wetlands are associated with the shoreline of Grafton Lake where different shoreline conditions promote wetland diversity. Cattail and bulrush marshes are found along several sides of the lake, as are hardhack thicket swamps. Along the southwest shore of the lake and extending further west, is a sizeable, forested swamp. Approximately 12 ha of wetland surround the 15 ha lake.

The study area has the following wetland types (see Figure 1 for representative photos):

- Hardhack thicket swamps
- Forested swamps
- Cattail marshes
- Bulrush marshes
- Shallow open water with submerged and floating aquatics
- Poor fen
- Sedge meadows

Of conservation significance is the diversity of swamp ecosystems located along the lake shore (Golinski 2002). Pacific crabapple – Sitka spruce swamps are uncommon in the Islands Trust Area (Ward et al. 1998) and occur on the Grafton Lake Lands. Grafton Lake is also the only known location of velvet-leaf blueberry in the Islands Trust Area (Golinski 2002). There are few records of this species from the Lower Mainland and Vancouver Island, therefore its occurrence in a mixed shrub swamp on Bowen Island is of conservation significance.

One of the most sizeable wetlands is a forested swamp (Figure 2). It is a mature forest composed mainly of western hemlock, western redcedar and red alder, with the occasional Sitka spruce. Coarse woody debris (downed trees and branches) is abundant, as are large snags (dead, standing trees). Skunk cabbage is common in the understory. Small creeks run through the swamp, emptying to the lake.

Issues of Concern regarding Wetlands

Wetlands and their associated riparian areas are considered Sensitive Ecosystems and Environmentally Sensitive Areas (ESAs). They are particularly sensitive to changes in water quality and hydrology. The quality of fish-bearing streams for fish species is particularly sensitive to water inputs. The wet soils of wetland habitats are easily compacted by machinery and even foot traffic, decreasing their oxygen levels.



Figure 1. Wetland habitats of the Grafton Lake lands: (a) hardhack thicket swamp; (b) sedge wetland; (c) bulrush marsh; (d) cattail marsh; (e) wetland vegetation along the edges of the lake; and (f) sphagnum in a pocket poor fen.



Figure 2. Forested swamp on west side of Grafton Lake: (a) typical vegetation and standing snag (wildlife tree); (b) overturned root mass colonized by sword fern; (c) wetter areas are colonized by skunk cabbage (*Lysichiton americanum*) in later spring; and (d) veteran Sitka spruce are found in the swamp.

The majority of wetlands occur within the proposed nature preserve, lending them some security. However, as noted, wetlands are sensitive to changes in water quality and quantity. Development in the watershed needs to be conducted in a manner that prevents erosion and stops siltation from entering the wetland systems. Stormwater treatment and channeling included in the proposed development must follow best practices to ensure that water quality entering the system of wetlands is high and amounts and flow after heavy precipitation events do not negatively affect their hydrology.

Access through trail placement and hiking is an issue to be considered when crossing through or adjacent to wetlands. Human, and particularly dog presence, can disturb wildlife using the wetlands for foraging, breeding or resting.

Riparian Ecosystems

Riparian ecosystems are found adjacent to water bodies such as rivers, lakes, ponds and wetlands. They are protected under the Riparian Areas Regulation (RAR) of the B.C. Fish Protection Act and the Watershed, Aquifer and Stream Protection (WASP) Bylaw No. 301 of Bowen Island Municipality. The bylaw also protects surface water and groundwater resources that are for human use.

Streams are common in the study area, particularly flowing down from the slopes of Mount Apodaca. Larger streams include Terminal Creek, Bowen Brook, Clink Brook and Raven Brook (see stream network in Appendix 5). Riparian vegetation typically occurs along these stream and creek corridors, sometimes referred to as fluvial fringe vegetation. Portions of the lakeshore are also described as fluvial fringe systems as they experience short duration flood events. A riparian gully system occurs along the southeast side of Conical Hill, where a more steeply incised gully has formed by slow erosion through the bedrock. The south side of the gully flows into Grafton Lake, while the north-facing gully is within the Killarney Creek watershed. Some streams occur within treed swamp ecosystems where the vegetation is considered forested swamp rather than riparian.

Only one riparian ecosystem was mapped by the Bowen – Gambier SEI Inventory (Appendix 5), however, additional riparian ecosystems would be mapped based on updated stream mapping.

Issues of Concern regarding Riparian Ecosystems

Riparian ecosystems are highly sensitive to disturbance. As with wetlands, their wet soils are easily compacted by machinery and even foot traffic, becoming oxygen poor. Riparian areas are also sensitive to the quality and quantity of water inputs. Input effects are not necessarily localized, but can be carried downstream and affect plants and wildlife much further along the corridor.

Several streams fall in part within the proposed nature preserve. Many others are within the borders of proposed development areas including 4 km of mapped watercourses within Development Node 1. Sufficient setbacks must be employed to ensure the protection of riparian vegetation and meet the requirements of the Riparian Areas Regulation (RAR). The quality and quantity of water inputs (including eroded soil) into the streams on site must not adversely affect the conditions of the streams, or the wetlands and lake downstream. Best practices for stormwater treatment must be employed.

Trail positioning and surface substrate must be carefully decided, as wet, riparian soils are easily compacted.



a



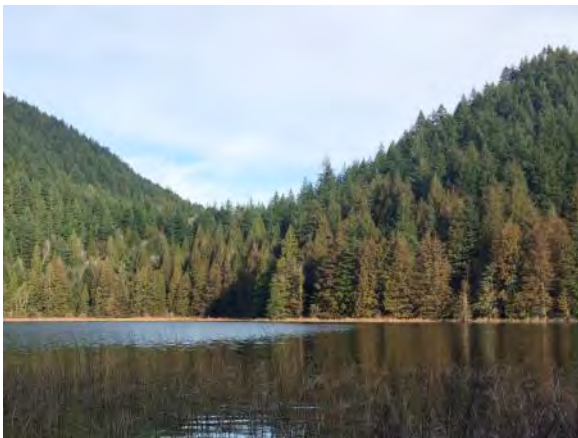
b



c



d



e



f

Figure 3. Streams and riparian areas of the Grafton Lake lands: (a-d) one of the larger creeks, Bowen Brook; (e) gully between Conical Hill and Mount Gardner; and (f) one of the numerous smaller streams that pass through the study area.

Cliffs and Rock Outcrops

Vertical rock faces (cliffs) and steep rocky bluffs (outcrops) are Sensitive Ecosystems with extreme environmental conditions, experiencing drought, little or no soil availability and extreme summer heat. The plant species that have adapted to these conditions are rare or uncommon on the landscape. They are discussed together here because of their similarities.

Some cliffs and numerous rock outcrops are found on the Mount Gardner slopes on the north side of Grafton Lake, and the crown of Conical Hill. One rocky outcrop occurs at lake level.

Due to the severe environmental conditions in these habitats, plants must be adapted to extreme water deficits during the summer months, wind exposure, and lack of nutrient availability due to little or no surface soil. On cliff faces, plant cover is very low but may be found on some ledges and rooted in crevices where some soil and moisture exists. Rock outcrops may have scattered trees of arbutus and lodgepole pine. Ocean spray, salal and Oregon grape can be found in the understorey, as well as some native grasses. Moss species may be common and lichens can be found on the exposed rock surfaces.

Issues of Concern regarding Cliffs and Inland Bluffs

The large majority of rocky areas in the study area occur either within the proposed nature reserve or remote from the proposed development footprint, lending them a significant level of protection. Increased recreational access to the climbing bluff could result in disturbance to the ecosystem, as climbers often remove or cut back small trees eking out an existence in crevices or cracks. Wildlife is less likely to use the bluffs if climbers using the rock face become frequent or regular.

Mature Forests

In our area of BC, mature forests are defined as generally >80 years of age and < 250 years. Those forests over 250 years in age are considered 'old-forest' (or old-growth). Mature forests are currently mapped during Sensitive Ecosystem Inventory as additional important ecosystems in the landscape. More relevant than age is the vertical structure of the forest, amount of coarse woody debris and number of snags.

The north side of the lake and Duncan's Hat (Conical Hill) support forests with mature characteristics. South of Grafton Road, and above the ALR area, are areas of mature forest with clearings due to past disturbance. The swamp along the south edge and extending westward is mature, however its classification as a wetland ecosystem takes priority due to its greater sensitivity. Maturity must be assessed based on vertical structure and complexity. Age class maps for the area do not align well with the areas of mature forest noted through aerial photography interpretation. Mature forests have therefore not been mapped with the other SEI classes (although second-growth forest has), as more on-the-ground field verification is needed

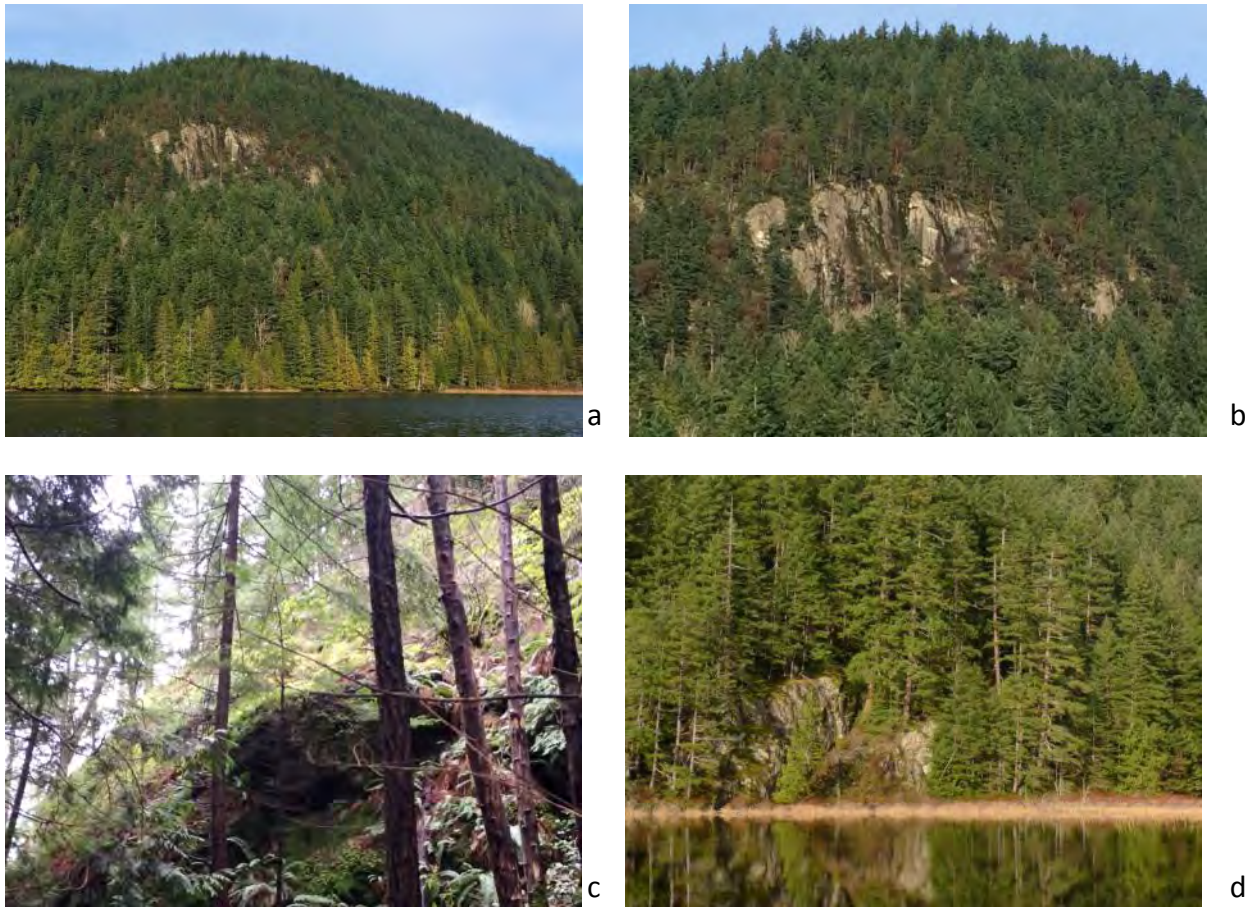


Figure 6. Rocky habitats in the study area: (a) cliffs on the north side of Grafton Lake; (b) close-up of Mount Gardner cliffs; (c) a moss-covered rocky bluff; and (d) a small rock outcrop at the lake's edge.

The mature forests of the study area are coniferous. On drier sites, such as the slopes along the north side of the lake, Douglas-fir is the main tree of the canopy. The understorey is mainly composed of salal, Oregon-grape, and scattered mosses. On moister sites, Douglas-fir is joined by western red cedar, hemlock and the occasional big leaf maple, adding a deciduous component to the canopy. The main species in the understorey is sword fern; some areas have a well-developed shrub layer consisting of red huckleberry and/or salmonberry.



Figure 3. Wildlife presence in Grafton Lake area forests: (a) Northwestern Salamander adjacent to Raven Brook; and (b) Black-tailed Deer tracks.

Issues of Concern regarding Mature Forests

Mature forests are sensitive to changes in hydrology and structure, e.g. water inputs from upslope or elsewhere can change the hydrology of the site, resulting in the species that are adapted to the previous conditions dying out and being replaced by a different suite of species. Changes to structure, such as the removal of downed woody debris or snags, results in the loss of important characteristics that have evolved over time.

Mature forests in the study area may harbour red- or blue-listed forested ecological communities. Once the footprint of development is known, surveys can be completed.

When clustering home sites, care should be taken to avoid the clearing of mature forest, favouring locations in previously cleared or young forests where possible. Snags and older, veteran trees (>1m in diameter at breast height) should be retained during development. Disturbance in the root area of veteran trees should be avoided.

Issue 3: Loss or Disturbance to Species and Ecological Communities at Risk

Species and ecological communities at risk are defined as plants, animals, and ecological communities that are of conservation concern because of rarity, restricted range, and/or population decline. Most occur in natural ecosystems.

The provincial government maintains a list of all species and ecological communities known to be at risk. These include threatened (blue-listed) and endangered (red-listed) species and communities. Endangered means at risk of becoming extinct while threatened indicates the species or community is at risk of becoming endangered. The Species at Risk Act (SARA) is a Canadian-wide act that lists nationally endangered species of plants and wildlife. SARA species have legal protection where they occur on Crown-owned land.



a



b



c



d



e



f

Figure 4. Mature forest representative photographs: (a-d) vegetation typical of mature forests; (e) coarse woody debris (such as downed trees) is common; and (f) old-growth trees are scattered through the study area.

No thorough surveys of plants or animals have been conducted in the study area. Timing of the reconnaissance surveys for this report did not allow for rare species documentation, nor was it a focus of this assessment. A blue-listed Northern Red-legged Frog was encountered during one field visit, occurring in a young to mature forest near the lake edge. A full list of plants and animals that are designated at risk within the Metro Vancouver Regional District is available through the BC Conservation Data Centre (BCCDC) (see [here](#)). Note, this list includes species clearly not on Bowen Island such as Wolverine, Green Sturgeon, and Short-eared Owl. However, it does show the range of species which may occur and need more thorough assessment including birds, butterflies, dragonflies, and wetland plants (sedge, rushes, and emergent vegetation).

Ecological communities at risk within the biogeoclimatic subzone CWHdm, in which the Grafton Lake Lands fall, are also listed by the BCCDC. Common cattail marsh is blue-listed and is found within the study area. It is located within the proposed nature reserve lending it some security, however, the ecosystem is still susceptible to changes in water hydrology and quality. Many of the mature forests of the study area exhibit characteristics of forested red- and blue-listed ecological communities and a more thorough examination of potential occurrences of at risk communities should be conducted once the development footprint is known. Golinski (2002) identified Pacific crabapple-Sitka spruce swamps in the Grafton Lake area. They are considered uncommon in the Islands Trust but are not ranked by the BC Conservation Data Centre.

The nature preserve provides some security to rare species and ecological communities, whether their occurrence is known or not. However, once designs are confirmed and before development begins, areas to be cleared, new roadbeds and trails should be examined by qualified professionals to ensure that nationally or provincially-listed species or ecological communities are not negatively affected.

Issue 4: Habitat Fragmentation and Loss of Landscape Connectivity for Wildlife

Wildlife populations are sustained by resources (access to food, water, shelter, and breeding areas) that vary through time and space across the landscape. For example, Northern Red-legged Frogs may spend most of the year foraging in moist forests but return to larger wetlands to breed in the spring. Small carnivores like American Mink may have a home range of 15 ha encompassing wetlands, riparian areas, and forests, while larger species such as Raccoon may have a home range of 115 ha. Land clearing, road building, and other changes in land use accompanying rural or urban development fragment habitat and reduce connectivity, particularly where the wildlife community is primarily forest or riparian/wetland dependent species.

The Grafton Lake Lands are situated in Bowen Island's central valley between the island's two largest natural areas: Mt Gardner to the north and Mt Apodaca and the Bowen Island Ecological Reserve to the south. While these are critical large natural areas it is important to note that they are predominantly upland forest with relatively few wetlands or riparian areas. The central

valley is proportionately a richer habitat for wildlife because of varied topography, forest diversity, forested and open wetlands (including Grafton Lake), and riparian areas, even with a higher concentration of roads and rural development.

There are several challenges in assessing the effect of incremental rural and urban development on wildlife populations on Bowen Island. First, patterns of wildlife movement are poorly understood and difficult to assess even with adequate resources. Second, most wildlife on Bowen Island (e.g., forest birds such as Barred Owl, Black-tailed Deer, small mammals such as Douglas' Squirrel, and amphibians (Northern Red-legged Frog, Northwestern Salamander, and Pacific Tree Frog)) are resilient to habitat change as long as there are large natural areas to sustain populations. Third, the development patterns on Bowen Island are highly variable with forests and other natural features incorporated into the matrix of rural land use. This reduces some of the impacts associated with habitat fragmentation.

The conceptual development plan for the Grafton Lake Lands can be divided into two areas for assessing potential impacts to landscape connectivity (see Appendix 4). The northern portion (north of Grafton Road including the lake, Conical Hill, and forested lower slopes of Mt. Gardner) shows three development nodes (Appendix 4: development nodes 2, 3, and 4). These are modest development areas relative to the extent of the forested natural areas proposed for protection that surround them; changes to landscape connectivity are expected to be relatively minor in this area. The area south of Grafton Road (Appendix 4: development node 1) has more continuous development proposed with three diagrammatic greenway locations shown bisecting the developed area. Riparian protection areas are not shown despite an extensive network of headwater streams flowing into Rennison Creek, Raven Brook, and Warbler Creek. As well, there is no continuous buffer shown adjacent to the Mount Apodaca ecological reserve (there is a proposed nature reserve in one area). The scale and location of development in this area has more potential to impact wildlife movement. However, more details on the type of development, the size and location of greenways and riparian areas, and the proposed road network are needed to comment more fully. Greenways need to be large (50 to 100+ m) to be useful for most wildlife species; smaller greenways, particularly if they are used for recreation, lack the interior conditions needed for many wildlife species.

To summarize, we make three general comments about landscape connectivity as it pertains to the Grafton Lake lands at this early stage of development planning:

1. The study area is a critical piece of Bowen Island's ecological network and provides connections both north and south, as well as east and west (through the central valley).
2. Most wildlife species on Bowen Island are resilient to some level of habitat fragmentation as long as they retain some connection to larger natural areas.
3. The conceptual development plan shows four development nodes: development nodes 2, 3, and 4 are unlikely to affect landscape connectivity, while development node 1 is more extensive and more information is needed to assess its potential impacts.

Issue 5: Disturbance to Wildlife and Ecosystems from Increased Recreation Use

The proposed development and the addition of trails in the lake area will result in increased use of the Grafton Lake area for recreation by residents and visitors. Indeed, one of the main features for new residents in the proposed development will be access to natural areas through an expanded trail network.

Increased recreation may have three effects. First, as noted in the discussion of water quality, trails may be a source of fine sediment to the lake and small streams, although this is considered minor relative to other sources. Trail use may result in trampling of vegetation and compaction of soils. Trails should be as narrow as possible, and positioned in less sensitive habitats. Where trails cross streams, boardwalk and bridges should be employed. A qualified biologist should be involved in the positioning of new trails, to ensure sensitive habitat features and rare plants are avoided.

Second, the presence and noise of humans and dogs will likely have a negative impact on sensitive wildlife that use the area such as nesting waterfowl. Currently, there are edges of the lake that receive little or no visitation from humans. This will change if a ring trail around the lake is constructed, resulting in a loss of 'undisturbed' habitat areas for wildlife using the lake and its associated habitats.

Third, swimming and boating use of Grafton Lake will likely increase with the proposed development which will increase the risk that drinking water supplies are impaired. The southeastern shore is already a popular swimming location and this use is likely to expand. There are few regulatory methods for restricting this use although education, bylaw enforcement, and access barriers may reduce swimming use.

SUMMARY

Changes to Hydrology and Water Quality

- Grafton Lake and the stream network that supports it is both an important ecological feature on Bowen Island, as well as a water source for about 48% of the island's residents through the Cove Bay Water System.
- Small lakes are sensitive to changes to hydrology and water use which influence seasonal water levels. However, increasing water use from an expanding Bowen Island population, and potential long-term changes in rainfall associated with climate change are likely more important risks to lake hydrology than the development proposed for the Grafton Lake Lands.
- Hydrologic changes associated with development on small streams include erosion and increased sediment movement from larger storm flows, and lower summer base flows from reduced infiltration and shallow groundwater storage. The headwater streams that flow through the lands south of Grafton Road (Development node 1) (Rennison Creek, Raven Brook, and Warbler Creek) are more at risk than other streams in the study area.
- Water quality is an important concern for small lakes in developing watersheds. Increased sediment movement and turbidity typically accompany construction phase activities even with careful planning and mitigation measures. Similarly, the concentrations of nutrients increase with the amount of developed land. Phosphorous can increase algae productivity and lead to systemic changes to lake health and water quality.
- Lake water quality may also be affected by increased recreation use: swimming, fishing, and boating increase the potential for pathogens from human or animal (dog) waste to be introduced into the lake.

Loss or Disturbance to Sensitive Ecosystems

- Sensitive Ecosystems are recognized provincially as ecologically fragile or at risk ecosystems which are sensitive to human disturbance.
- The Bowen-Gambier Sensitive Ecosystem Inventory (SEI) mapped four ecosystem types in the study area: (1) wetlands; (2) riparian areas; (3) terrestrial herbaceous; and (4) second-growth forests (as an additional important ecosystem, not a Sensitive Ecosystem per se).
- Provincial SEI in more recent years (e.g. Sunshine Coast SEI) re-classified some of the categories of Sensitive Ecosystems and Other Important Ecosystems. Terrestrial

herbaceous was replaced with Rock Outcrop. Cliffs (inland) were added as a Sensitive Ecosystem. Second-growth forest (60-100 years old), originally mapped not as a Sensitive Ecosystem but as an ecosystem with other biodiversity values, was no longer mapped; Mature Forest (>80 years old), was instead mapped under the category 'Other Important Ecosystems'.

- Grafton Lake and the surrounding wetlands are a regionally significant example of a healthy lake ecosystem. There are few, if any, small lakes in Metro Vancouver that have an equal range and quality of wetlands: marsh, fen, and swamp are common.
- One of the most sizeable wetlands is a forested swamp south of Grafton Lake and north of Grafton Road. It is a mature forest composed mainly of western hemlock, western redcedar and red alder, with the occasional Sitka spruce.
- Riparian areas are found along streams, wetlands, and Grafton Lake. They are transitional between aquatic and terrestrial ecosystems. They are important wildlife habitat and also provide movement corridors. While some riparian areas will have some security within the proposed nature preserve, there are numerous streams on the south side of Grafton Lake and within Development Node 1.
- Rock outcrops are typically steeply sloped non-forested ecosystems that provide habitat for a different suite of species than surrounding habitats, increasing the biodiversity of the landscape. Most of the rock outcrops and cliffs in the study area will have protection from loss if the proposed nature preserve is created. Some disturbance from increased recreation use is likely.
- Forests with mature characteristics are found in the study area. Age class mapping (older datasets) does not align with air photo interpretation of where these forest areas are located. Further on the ground verification is needed. Outside of the development nodes, mature forest will be relatively well protected within the proposed nature preserve. Once the development footprint is known, a site assessment is needed to determine if significant amounts of mature forest will be impacted, particularly in Development Node 1.
- Development may increase the risk that invasive species will be introduced to sensitive ecosystems. Some invasive species such as English holly are already present in many areas.

Loss or Disturbance to Species and Ecological Communities at Risk

- Species and ecological communities at risk are defined as plants, animals, and ecological communities that are of conservation concern because of rarity, restricted range, and/or population decline. Most occur in natural ecosystems.

- No thorough surveys of plants or animals have been conducted in the study area, and species at risk presence is based on lists published by the BC Conservation Data Centre and habitat conditions. Species groups that require more thorough assessment include birds, butterflies, dragonflies, Western Painted Turtle, and wetland plants (sedge, rushes, and emergent vegetation).
- Likely species at risk in the study area include: Northern Red-legged Frog (confirmed) Coastal Cutthroat Trout (confirmed), Western Screech Owl, and wetland plants.
- Most of the species at risk are likely associated with Grafton Lake and the surrounding wetlands.
- Common cattail marsh is a blue-listed ecological community and is found within the study area.
- Mature forests of the study area likely exhibit characteristics of forested red- and blue-listed ecological communities and a more thorough examination of potential occurrences of at risk communities should be conducted once the development footprint is known.
- Other than isolated large trees, we observed no areas of old-growth forest.

Habitat Fragmentation and Loss of Landscape Connectivity for Wildlife

- Wildlife populations are sustained by resources (access to food, water, shelter, and breeding areas) that vary through time and space across the landscape. Land clearing, road building, and other changes in land use accompanying rural or urban development fragment habitat and reduce connectivity.
- The study area is a critical piece of Bowen Island's ecological network and provides connections both north and south, as well as east and west (through the central valley). The central valley is proportionately a richer habitat for wildlife because of varied topography, forest diversity, forested and open wetlands (including Grafton Lake), and riparian areas, even with a higher concentration of roads and rural development.
- Most wildlife species on Bowen Island are resilient to some level of habitat fragmentation as long as they retain some connection to larger natural areas.
- The northern portion (north of Grafton Road including the lake, Duncan's Hat, and forested lower slopes of Mt. Gardner) shows three development nodes (Appendix 4: Development Nodes 2, 3, and 4). These are modest development areas relative to the

extent of the forested natural areas proposed for protection that surround them; changes to landscape connectivity are expected to be relatively minor in these areas.

- Development Node 1, south of Grafton Road, is more extensive and more information is needed to assess its potential impact. More details on the type of development, the size and location of greenways and riparian setback areas, and the proposed road network are needed to comment more fully.

Increased Recreation Use

- The proposed development and the addition of trails in the lake area will result in increased use of the Grafton Lake area for recreation by residents and visitors.
- An expanded trail network may be a source of fine sediment to the lake and small streams, although this is considered minor relative to other sources. Trail use may result in trampling of vegetation and compaction of soils.
- The increased presence and noise of humans and dogs associated with increased recreation use will likely have a negative impact on wildlife that use the area. A ring trail will result in a loss of 'undisturbed' habitat areas for wildlife using the lake and its associated habitats.
- Swimming and boating use of Grafton Lake will likely increase with the proposed development which will increase the risk that drinking water supplies are impaired.

Literature Cited

B.C. Conservation Data Centre. 2015. BC Species and Ecosystems Explorer. B.C. Minist. of Environ. Victoria, B.C. Available: <http://a100.gov.bc.ca/pub/eswp/> (accessed Apr 21, 2015).

Block, J. (ed). 1978. Bowen Island: a resource analysis for land use planning. The Islands Trust and Ministry of Municipal Affairs and Housing.

Brayshaw, T.C. 1996. Trees and Shrubs of British Columbia. UBC Press, Vancouver, B.C. in collaboration with the Royal British Columbia Museum, Victoria, B.C.

Golinski, G.K. 2001. Bowen Island Wetland Inventory. Report prepared for the Bowen Island Conservancy, Bowen Island, BC, with financial assistance from Islands Trust Fund, Victoria, BC.

Ministry of Environment. 2009. Sensitive Ecosystems Inventory (SEI) of Bowen – Gambier Trust Areas. Ecocat: (<http://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=3154>).

Ministry of Environment. Benefits of Sensitive Ecosystems (<http://www.env.gov.bc.ca/sei/>).

Voller, J. and S. Harrison. 1998. Conservation biology principles for forested landscapes. University of British Columbia Press, Vancouver, British Columbia, Canada.

Ward, P., G. Radcliffe, J. Kirkby, J. Illingworth and C. Cadrin. 1998. Sensitive Ecosystems Inventory: East Vancouver Island and Gulf Islands, 1993-1997. Volume 1: Methodoogy, Ecological Descriptions and Results. Technical Report Series No. 320, Canadian Wildlife Service, Pacific and Yukon Region, Delta, BC.

Whitehead Environmental Consultants Ltd. 2003. Grafton Lake Watershed Study 2002-2003. Prepared for the Cove Bay Water System, Bowen Island Municipality. 96 pp.

Whitehead Environmental Consultants Ltd. 2010. Grafton Lake Watershed Study Report No. 2: 2007-2009. Prepared for the Bowen Island Municipality (Cove Bay Water System) in association with Blair Whitehead & Associates. 120 pp.

Whitehead Environmental Consultants, Ltd. 2015. Environmental overview: Grafton Lake rezoning project, Bowen Island. 20 pp.

Appendices

APPENDIX 1.

Background Information Sources

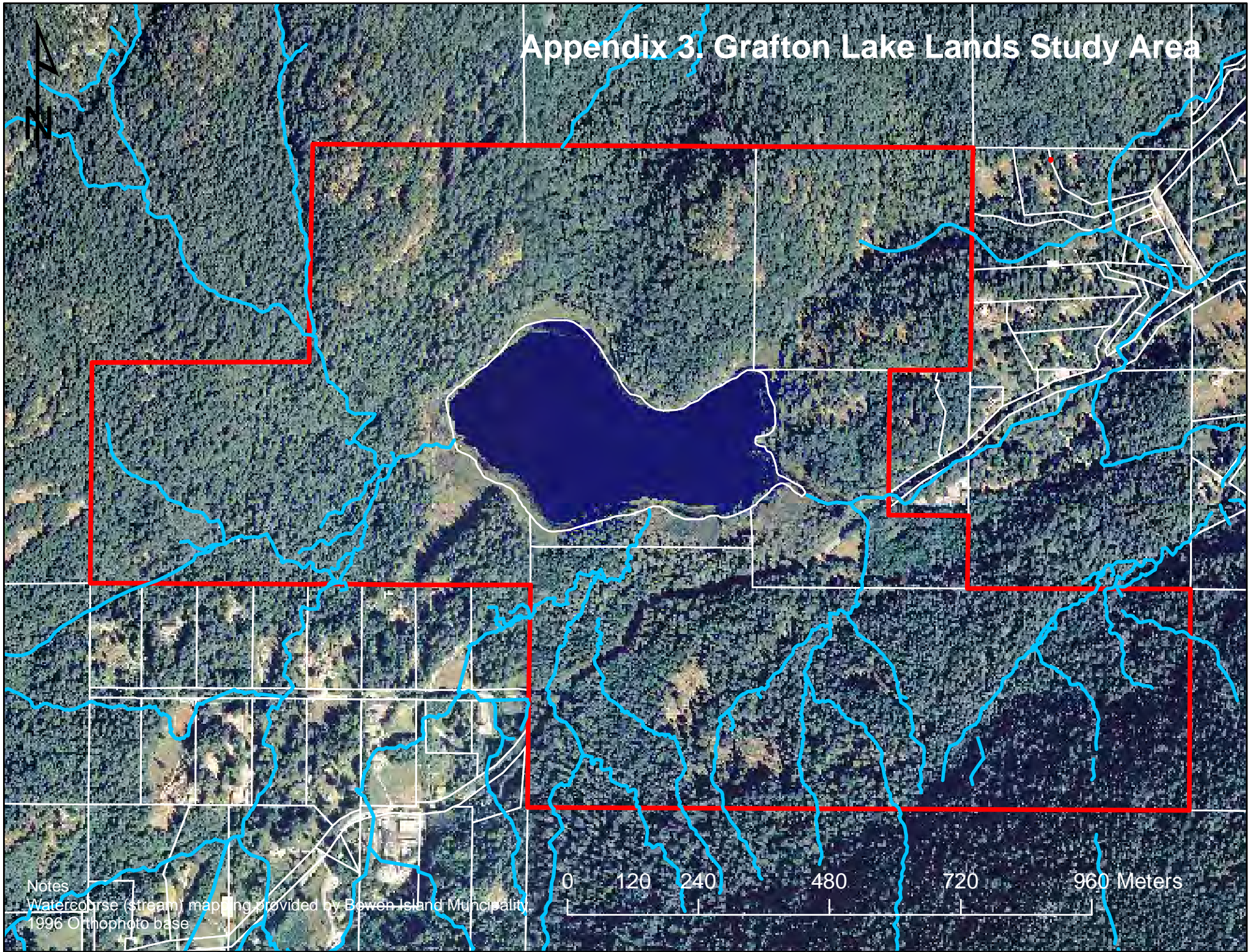
- Grafton Lake Lands website including maps and photos (see [here](#)).
- Whitehead Environmental Consultants Ltd. (2015) Environmental report on the conceptual development plan and map (GIS) data (see [here](#)) and excerpted ecosystems mapping in Appendix 6.
- Bowen – Gambier Sensitive Ecosystem Inventory (SEI) produced by the Islands Trust (see [here](#)).
- Information on the Cove Bay Water System available through the Bowen Island Municipality website.
- Records of species and ecological communities at risk available through the BC Conservation Data Centre Species and Ecosystems Explorer.
- GIS mapping by J. Dunster including data on forest cover, trails, watercourses, and wetlands.
- Golinski (2001) made a reconnaissance survey and summary of the wetlands surrounding the lake for the Bowen Island Conservancy.
- Bowen Island Information System Report (2000): summary report including maps on biophysical attributes of Bowen Island (see [here](#)).
- Drainage maps, cadastral (property), and other maps.
- Aerial (ortho) photographs (1986, 1996, and 2012).
- Grafton Lake Watershed Study: 2002–2003 (Whitehead Environmental Consultants).
- Grafton Lake Watershed Study No. 2: 2007–2009 (Whitehead Environmental Consultants).

Appendix 1. Location of the Grafton Lake Lands.



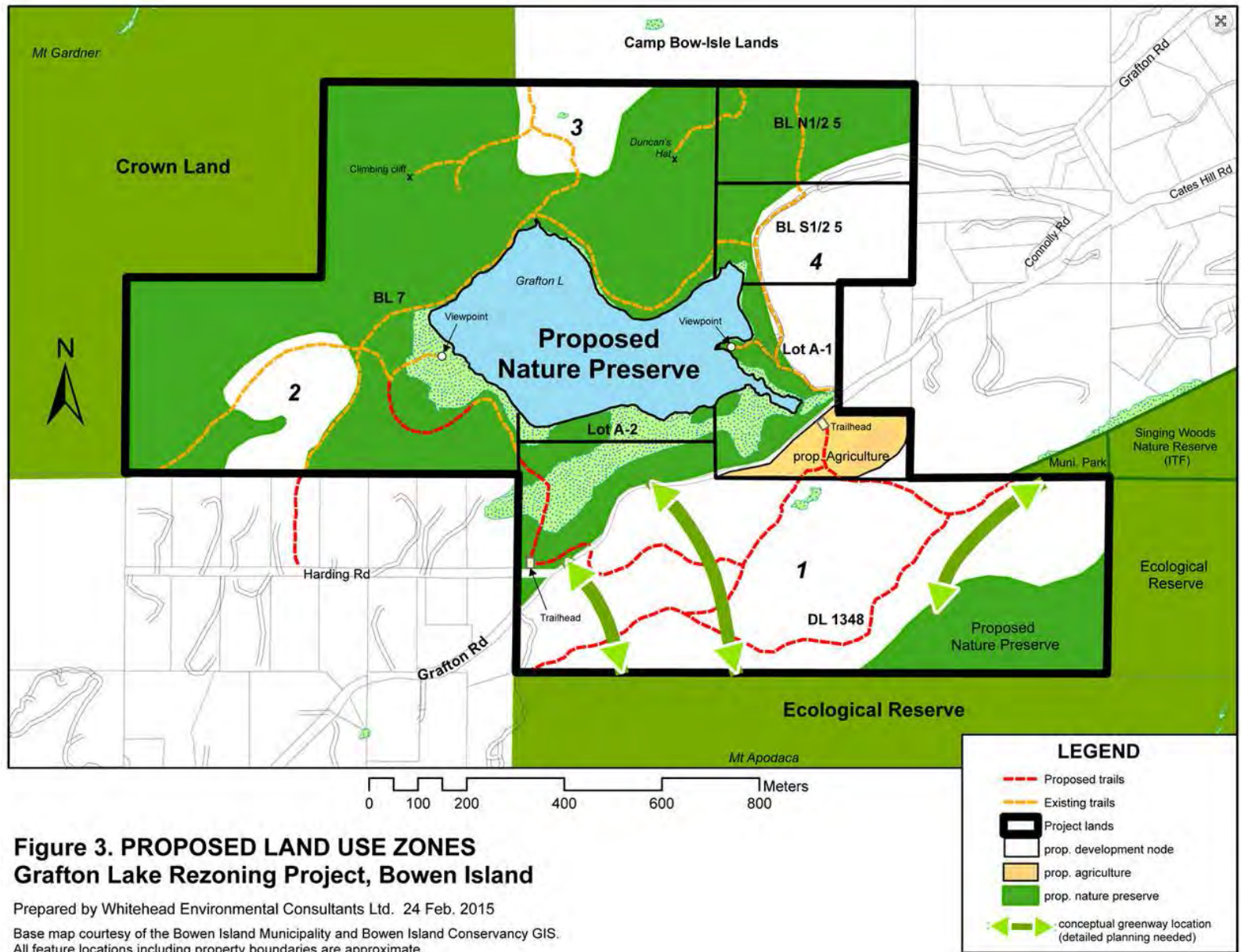
0

Appendix 3. Grafton Lake Lands Study Area



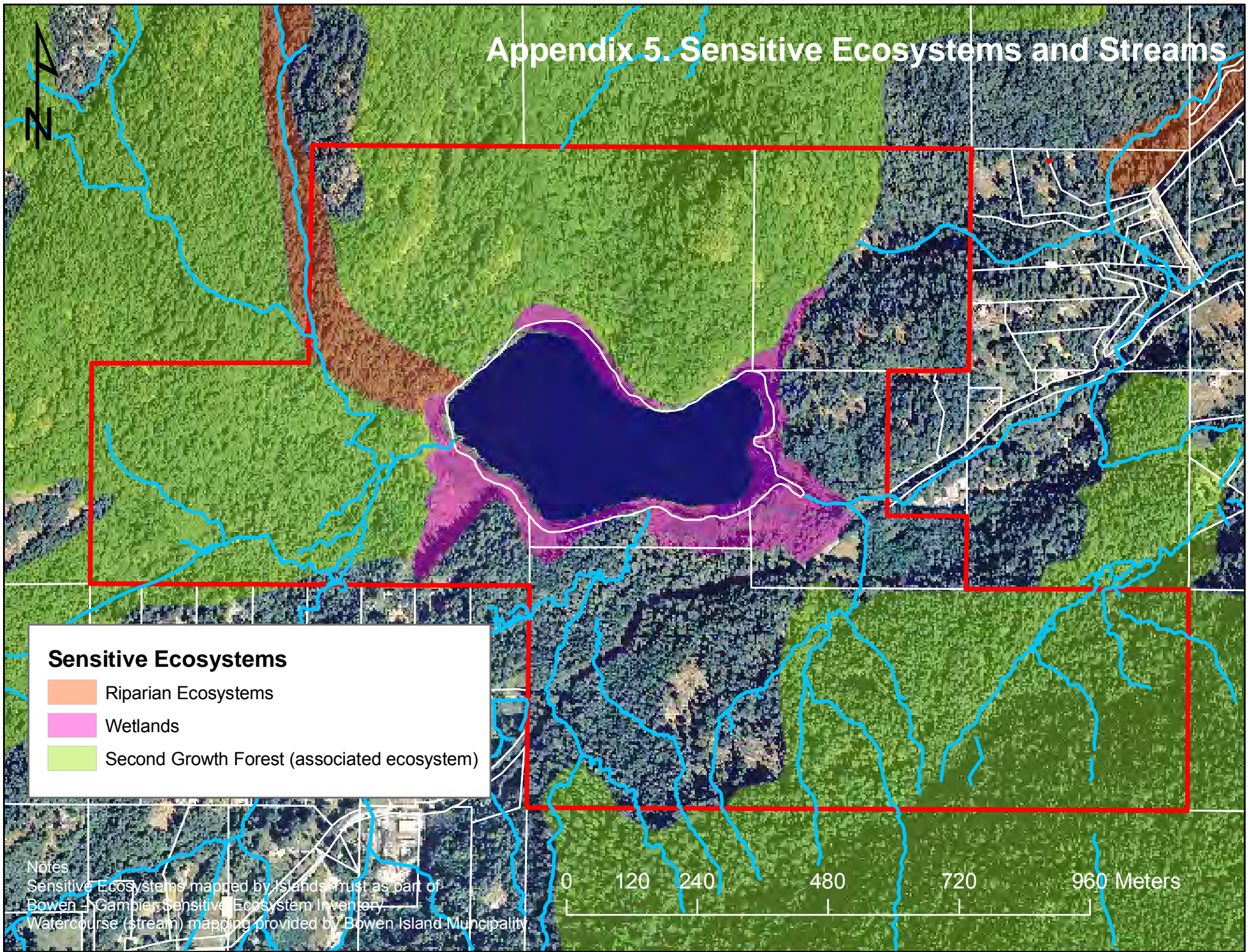
Notes
Watercourse (stream) mapping provided by Bowen Island Municipality
1996 Orthophoto base

0 120 240 480 720 960 Meters






Appendix 4. Grafton Lake Lands concept plan (March 2015 draft).

Appendix 5. Sensitive Ecosystems and Streams

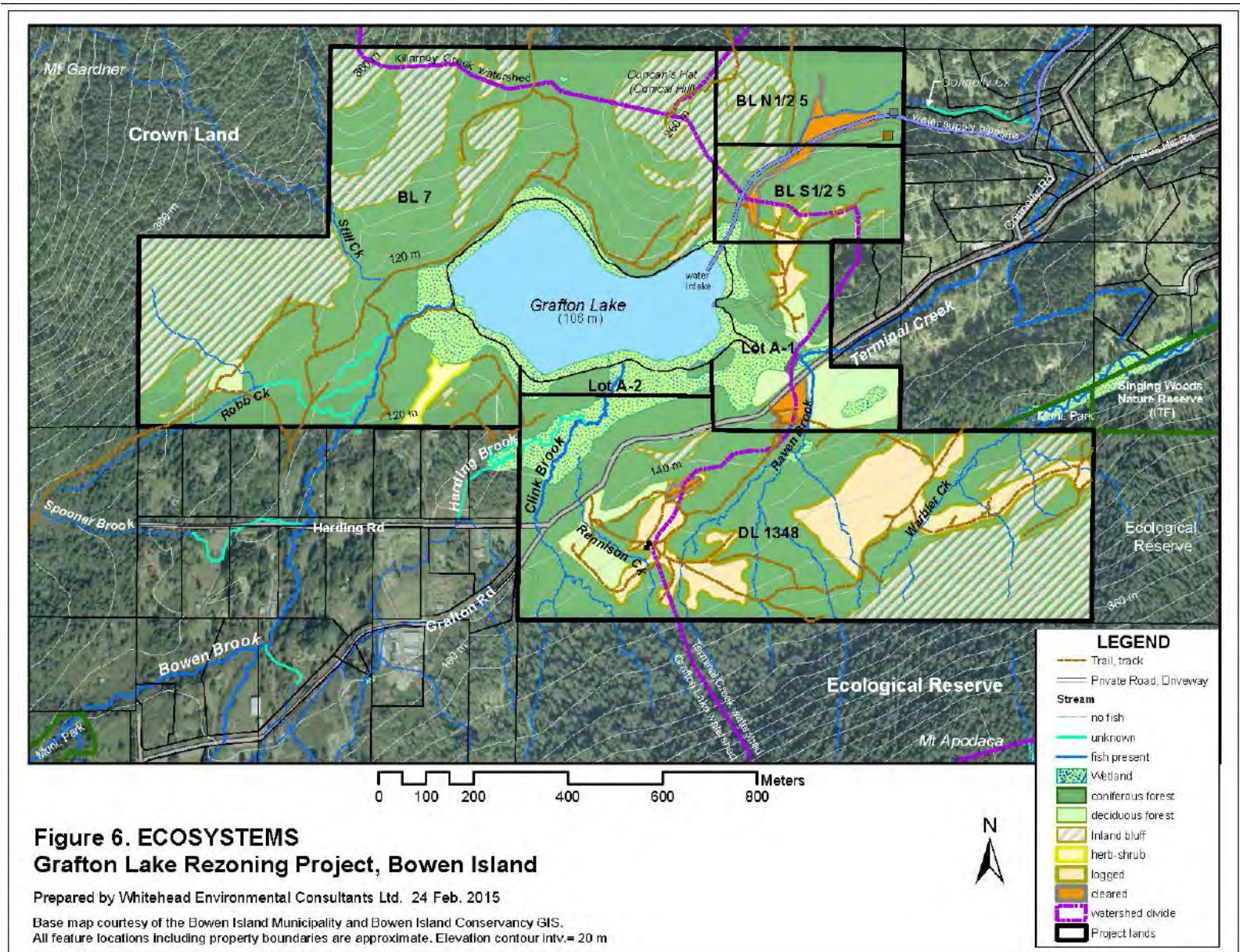


Sensitive Ecosystems

-  Riparian Ecosystems
-  Wetlands
-  Second Growth Forest (associated ecosystem)

Notes
Sensitive Ecosystems mapped by Islands Trust as part of
Bowen-Gambier Sensitive Ecosystem Inventory
Watercourse (stream) mapping provided by Bowen Island Municipality

0 120 240 480 720 960 Meters



Appendix 6. Grafton Lake Lands ecosystem mapping (Whitehead Environmental, February 2015).