SHAWNIGAN LAKE QUARRY
RESTORATION PLAN

Prepared for
Land Owners & Cowichan Valley
Regional District

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1.0 Introduction

1.1 Background

The site to be restored is located in the District of Shawnigan Lake, just north of the lake body itself (Fig. 1).

Figure 1 Satellite image of quarry (Google Maps, 2010)

Historically, the land was owned and used by the BC Cement Company as a source of limestone. A large open-pit mine was established in 1953 and multiple cement roads were paved in order to transport rock to the Bamberton manufacturing site (Bamberton Historical Society, 2010). During this process, pumps were needed to remove water flowing in from aquifers. When the company shut down in 1980, the pit (rumoured to still contain equipment) was allowed to fill with water (creating Kingzett Lake) (Shawnigan Lake Museum, 2010). Following this, a fish farm was established on the body of water for a short period of time (Fig. 2).

Figure 2 Arial view of Knigzett Lake (Google Maps, 2010)

Currently the 568 acres are privately owned through 11 different but contiguous legal titles and used by the public for recreation (Fig. 3). In 2005, the owners applied for rezoning (from F-1-Primary Forest) to develop a large

subdivision. However, conversations with the CVRD are on hold because of identified site contamination. The owners are now trying to sell the property (Unique Properties, 2010).

Figure 3 Walking trail along perimeter of Kingzett Lake

1.2 Factors Influencing Restoration Plan

This lake and its surrounding land are of great import to the community: it serves as a place for communing with nature as well as for recreation. Table 1 outlines important ecological, social and cultural factors associated with this site.

Table 1 Ecological, Social and Cultural Factors

Ecological	Social	Cultural
Lack of soil biota due to compaction, disturbance and weathering	Recreation: swimming, hiking, dog walking, 4X4ing, mountain biking, dirt biking	Important area for social activities
High calcium levels in lake due to mining activities	One house (recently burned in fire) occupied by one tenant	Potential area for increased biodiversity which is important for those who love walking in area
Low aquatic biodiversity	Potential habitat for valued wildlife and rare and endangered plant species	Research site--mine reclamation and water testing
Low wildlife density due to habitat fragmentation (trails and human activity)	Provision of habitat for predaceous arthropods (specifically important for agriculture in the vicinity)	Area for communion with nature

Abundance of invasive species	Potential habitat for pollen vectors	
Minimal native pioneer species to help with organic matter formation	Once used as fish farm (stopped after algal bloom)	
Site contamination – details unknown	Vandalism (large party scene in summer months)	

2.0 Targets

Restoration targets associated with the Shawnigan Lake quarry site cannot be established by using one particular model or approach. To use "climax" ecosystems as the only reference for determining reasonable targets would be unrealistic due to the extreme changes in environmental conditions associated with open-pit mining. However, using knowledge of adjacent, relatively undisturbed ecosystems can help to establish effective successional, pioneering and novel ecosystem targets. In this case, the surrounding forest falls into the Coastal Douglas-fir Biogeoclimatic Zone. Although this site has not been mined since 1980, it has also not received any beneficial human intervention in terms of restoration efforts. Because of this, targets are based primarily on establishing a functional, integrated, resilient and self-sustaining pioneering ecosystem (Aronson & Clewell, 2007). If planned and implemented effectively, these pioneering targets will help build soil and provide habitat for biota, thereby creating a foundation for suitable successional ecosystems. Ecosystem functions targets must also be established in order to meet the needs of the Shawnigan Lake human population. When a community is involved in setting and achieving these targets it will likely feel more dedicated to maintenance and protection. The ecosystem functions target for this site is the development of an ecosystem that functions as a low-impact recreational area because it is already highly valued for this type of use (Fig. 4).

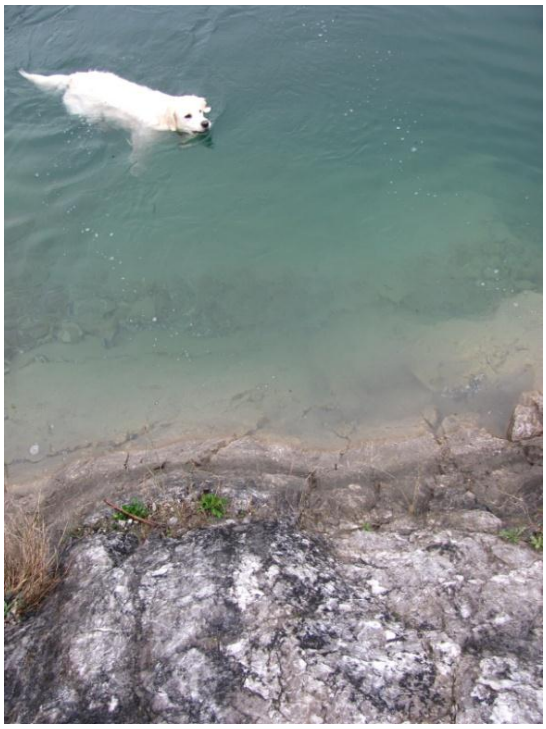

Figure 4 Lack of vegetation and steep, weathered banks around lake

3.0 Disturbances and Filters

The following table describes disturbances (past and present) that have/are impacting this area. The ecological impacts and filters associated with these disturbances are also detailed in order to identify the most effective restoration treatments.

Table 2 Type of Disturbance and Ecological Impact

Disturbances	Ecological Impact and Filters
Blasting to create open-pit limestone quarry as well as flat areas for equipment	High calcium and other mineral concentrations in lake (need water tests). Steep slopes into water with little to no vegetation (no gradation enabling sedimentation and plant growth). Low aquatic biodiversity. Heavy rainfall leading to solution, raindrop and rill erosion actively occurring on slopes surrounding lake. Exfoliation occurring in winter. Major compaction around lake due to heavy machinery and possibly chemicals, preventing plant growth.
Removal of top-soil and vegetative ground cover	Adverse texture: large, widely dispersed boulders and loose, continuously moving rocky material provides no place for seeds to establish. Rocks roll down slopes and prevent anything from growing. Lack of essential nutrients and humus layer. Muddy slopes in winter, actively eroding.
Cement road construction (Fig. 4)	Habitat fragmentation resulting in low wildlife density. Compaction resulting in lack of soil biota, low porosity, and slow water infiltration/ filtration rate. Plants unable to establish; water runs-off during heavy rain causing erosion; biodiversity low. Previously hydro-seeded agricultural grasses and legumes along haul road preventing natural succession trajectory for this area.
Logging to clear mining site and areas for trucks and machines	Compacted, nutrient deficient soil colonized by abundance of invasive species such as *Cytisus scoparius* (Scotch Broom), *Rubus discolour* (Himalayan Blackberry), and *Hypochaeris radicata* L. (Hairy Cat's Ear). Active rill, sheet and raindrop erosion occurring. Hydro-seeded grasses along road and other large areas are preventing other plant species, such as *Alnus rubra,* from establishing
Dispersion of limestone dust in dry, summer months due to wind (often covers plants on edges of trails)	CaCO3 dust decreases photosynthesis efficiency when coating leaves (Cook *et al.*, 1995). Dust can also cause respiratory irritation in humans and other wildlife (USDL, 2010). Deposition can create hardened pockets of soil after heavy rains preventing plant growth.
Use of the area by humans, dogs, white tailed deer, 4x4s, mountain bikers and dirt bikes	Creation of numerous compacted and severely degraded trails through forest and grassy areas. Results in habitat fragmentation, habitat loss for potentially rare species, loss of biodiversity, erosion. Major change in usage of this area may result in vandalism, or community's unwillingness to participate in restoration effort. White-tailed deer increasing number of trails and eating seedlings as well as established plants.
Site contamination due to mining operations	Adverse chemical properties of soil surrounding mine site. High concentrations of calcium as well as other unknown chemicals from mining process. (Soil remediation will not be addressed in this report).

Fires	Camp fire pits surrounding Kingzett Lake as well as human-caused brush fires in area. Youth use dry grasses and wood to start fires during summer months. Burning often destroys any vegetation trying to establish on rocks surrounding quarry (ex/ lichens).
House fire debris on edge of lake	Possible toxins leaching into lake and soil. Could be influencing biodiversity in lake and surrounding area.

4.0 Proposed Treatments

4.1 Abiotic Treatments

Figure 5 Cement haul road

1. The treatment that would be most widely implemented at this site is the establishment of rough and loose earth. Using an excavator, large tracts of soil could be turned in order to decrease compaction and serve as the first level of defence against erosion. In almost all target areas (except those that would become trails and pathways), this treatment would be used to increase the likelihood of native plant colonization, reduce impacts of erosion and provide a hospitable area for plantings. The old, cracked cement haul road (Fig. 5) would be removed and this treatment would be used on the compacted soil beneath.

Figure 6 4x4ing area (major compaction and minimal biodiversity)

2. If within the property owner's budget, the bare, steep rock surrounding the quarry could be blasted in order to re-grade the slope. Currently, very few plant species are able to establish in this area because of lack of topsoil and erosion resulting from the steepness of the slope. Blasting would create boulders of different sizes that could be manipulated by an excavator and placed in piles along the slope in order to facilitate the introduction of soil and plant species and reduce the flow of water along the slope surface. Top soil with a substantial amount of humus could be brought in from a local source (Central Landcaping or Shawnigan Specialty Topsoil for example).

3. Another important abiotic treatment that would be employed in conjunction with the planting of new, vulnerable plants and seedlings is the construction of fences around all areas of concern. Fences would have to be at least 7.5 ft tall in order to prevent coastal black-tailed deer from entering the sites and eating all new plant growth. Maintaining this fence for the first five years of this project would be essential to the success of all restoration efforts.

4. A trail plan that takes into account wildlife routes, human, dog and mountain bike use should be created. Because one of the goals of this restoration project is to limit habitat fragmentation, 4x4s and dirt bikes would not be permitted inside this park. Motorized vehicles cause widening of trails, soil compaction, degradation and erosion, and pose a safety risk to those walking on trails (Fig. 6). Undesirable trails would be blocked off by planting *Holodiscus discolor*, *Rosa nutkana* and/or *Symphoricarpos albus* and soil would be made rough and loose. This would improve water infiltration rates and increase air availability in soil. Alder seeds could then be spread and allowed to establish. High-use trails could be lined with wood chips or gravel. Signs could be erected in order to ensure people are on the right trail to get to the lake, enabling use of desired trails and preventing "bush whacking."

Figure 7 Garbage from active quarry site

5. Removal of all trash will also be a priority. Garbage surrounding the burned structure next to the lake would be removed (Fig. 7). During the process of making soil rough and loose, it is predicted that a great deal of garbage will be unearthed and will have to be trucked away from the site. Not only will this help the ecosystem to recover, but also make it safer for people using the space.

6. All fires on this property will be banned. Once the area begins to move towards restoration targets, it will be difficult for the local fire department to access the area. For this reason and for the damage fires cause to all proximal vegetation, they will not be permitted in this area.

4.2 Biotic Treatments

1. After making soil rough and loose, all areas that would not be used for pathways and trails would be scattered with woody debris. Using ground cover that closely mimics that of natural systems, the soil

could be effectively protected from wind and raindrop erosion. The dead wood would also provide a long-term, slow-release nutrient source for plants and soil organisms. Woody debris also serves as habitat for small animals, such as squirrels and birds, which help distribute seeds and mushroom fruiting bodies within the forest. Fungi essential to the establishment of forest ecosystems would colonize debris piles, beginning the process of biodegradation. Birds would bring seeds from plants such as salmonberry and salal, which would begin to establish in the nutritious mulch being created by the fungi. If the budget permits, Oregon grape, salal and sword fern could be planted in rough and loose soil within woody debris to speed up this process. These smaller shrubs would provide soil protection while the alder seeds, caught in the rough and loose soil, establish.

Figure 8 Broom colonizing disturbed areas

2. Removal of invasive species along roads and in open areas is an important biotic treatment for the quarry. Scotch broom is well established in all previously logged areas (Fig. 8). Removal of this plant is essential to re-establishing a biodiverse, self-sustaining ecosystem. Scotch broom plants can be cut at ground level during or immediately prior to flowering. Choosing this stage in the plant's life cycle reduces the chance that seeds will spread and that the plant will be able to recover from its injuries during the hot, summer months. Upon removal, other native plant species should be densely planted in order to ensure that the broom will not be able to re-establish. Rapidly growing plants such as *Alnus rubra*, *Acer Macrophyllum* Pursh., *Gaultheria shallon,* and *Mahonia nervosa* would provide dense shade that would kill this shrub (Polster, 2004). The same technique should be used for removal of blackberry bushes (Fig. 10). Along roadways, where agronomic grasses were hydroseeded, the soil should be made rough and loose by an excavator and seeded with *Alnus rubra* (Fig. 9). Other plants, such as those mentioned above, could also

Figure 9 Agronomic grasses along haul road

be planted in order to prevent erosion while the alder establishes.

3. Mulching is another effective biotic treatment that could be used in conjunction with making the soil rough and loose. Spreading leaf detritus or needles to mimic the natural mulch layer in the surrounding forested areas would help to introduce bacteria, fungi and other microorganisms lacking in the compacted soil. It is rare that soil is left bare in nature; applying mulch not only provides nutrients and microorganisms, but also acts as a protective layer against erosion and temperature extremes. If native plant species are planted within this mulched area, they would be healthier and have a greater chance of survival. Areas within the Shawnigan Lake Quarry that have been severely compacted (such as those along roadways) would greatly benefit from the use of mulch after rough and loose treatment. By including mulch as a biotic treatment, the desired successional trajectory of an area can be more efficiently achieved.

Figure 10 Blackberry colonizing disturbed areas

Figure 11 Steep slopes surrounding lake

4. Pocket planting of cuttings, seedling plugs and seeds in steep areas can prevent erosion (Fig. 11). Species such as *Salix scouleriana*, *Alnus rubra, Cornus stolonifera, Holodiscus discolour, Populus trichocarpa* and *Arctostaphylos uva-ursi* can be planted in soil placed between rocks to stabilize the slope and eliminate erosion. Other plants such as *Mahonia nervosa* and *Gaultheria shallon* could also be planted to protect the soil during winter and while other species become established. Planting should be done in early fall to ensure that enough moisture will be present to prevent desiccation. Over time, leaf detritus will accumulate in surrounding rock cracks and different plant species will colonize the area.

5. Another biotic treatment that would help in reducing costs associated with this project is the help of volunteers. Creating a 'Friends of Shawnigan Lake Quarry' group would allow the community to become involved in restoration efforts. From planting native species to recording data, the project could instil a sense of belonging and "giving back" by providing a means for cooperation and involvement. Personally contributing to a project like this would create a sense of stewardship and responsibility. Not only would the help of volunteers reduce costs, but also would ensure the long-term success of the project.

4.3 Restoration Plant Species

The following table (Table 3) lists the plant species that will be used in restoration efforts. Possible plant sources include:

- **Streamside Native Plants** (wholesale)
  Division of Viking Marine/Outdoors Ltd
  7455 Island Highway West
  Bowser, British Columbia
  Canada, V0R 1G0
  Phone/Fax: 250-757-9999
  Toll Free: 877-570-3138
- **Russell Nursery**
  1370 Wain Road
  North Saanich, BC
  V8L5V1
  Phone: 250-656-0384
- **Western Seed and Erosion Ltd.** (wholesale)
  17802 66th Avenue, Building B
  Surrey BC V3S 7X1
  T: 604.595.2456
  F: 604.628.7231
- **Yellowpoint Propagation Ltd.**
  13735 Quesnel Road
  Ladysmith BC V9G 1G5
  T : 250.245.4635
  F: 250.245.5935
- **N.A.T.S. Nursery Ltd.** (wholesale)
  24555 32nd Avenue
  Langley BC V2Z 2J5
  T: 604.530.9300
  F: 604.530.9500
- **Mayo Creek Gardens** (wholesale)
  6596 McLean Road, Box 351
  Lake Cowichan BC V0R 2G0
  T: 250.749.6291
  F: 250.749.6291

Table 3 Re-vegetation Species List

Species	Notes on Establishment	Maintenance
Salix scouleriana (Scouler's Willow)	Will be used in construction of brush layers in steeply sloped areas with fine-textured material as well as pocket plantings. Can be planted as cuttings. Requires moisture for rooting and growth therefore should be planted in Spring or Fall.	None required if fences are constructed properly and willow has enough moisture to become established.
Alnus rubra (Red Alder)	Will be seeded directly onto rough and loose ground. Fast germination and growth rate should allow alder to become established as a pioneer species before other invasive species encroach.	Fences must be constructed to protect seedlings from marauding deer population.
Cornus stolonifera (Red Osier Dogwood)	Will be planted as cuttings in wet areas with poor drainage. Can also be used as a pocket planting species to help stabilize soil on steep slopes. Plant cuttings in Spring.	No maintenance. Should grow rapidly in right conditions.
Rosa nutkana (Nootka Rose)	Seeds can be started in containers and planted out. Can also transplant when dormant in fall/winter. Will be planted in trail head areas to deter traffic.	No maintenance. Should grow rapidly and form thickets.
Symphoricarpos albus (Common Snowberry)	Can cut underground runners and transplant suckers in winter dormancy stage or plant out those in pots. Will be used to edges of trails and trail heads to deter traffic.	No maintenance. Should form thickets that need no pruning if placed in appropriate locations.
Holodiscus discolor (Oceanspray)	Can transplant plant divisions or whole plants grown from seed in pots. Will be used in pocket plantings and at edges of trails.	None
Arctostaphylos uva-ursi (Kinnikinick)	Can plant whole plants into pockets on rocky slopes.	None
Populus trichocarpa (Balsam Poplar)	Seedlings can be planted in soil pockets created between rocks on loose slopes. Should be planted in Fall.	None
Polystichum munitum (Sword Fern)	Good umbrella plant. Can transplant if big enough root ball is extracted. Whole plants from pots can also be planted. Will be planted with Alder and Balsam Poplar to protect ground from raindrop erosion.	No maintenance. Will eventually spread out through distribution of spores.
Mahonia nervosa (Cascade Oregon Grape)	Good umbrella plant. Difficult to transplant. Can distribute seeds or plant out of pots. Will be planted with Alder and Balsam Poplar to protect ground from raindrop erosion.	None
Gaultheria shallon (Salal)	Can distribute seeds or plant out of pots. Will be planted with other species to protect ground from raindrop erosion while other plants establish.	None
Acer Macrophyllum (BigLeaf Maple)	Can distribute seeds or plant plugs with Red Alder in areas invaded by blackberry. Once blackberry is cut back, these trees should be able to colonize area and choke out new shoots.	None

5.0 Monitoring and Management

5.1 Monitoring Program

- Location of sample sites must be marked and recorded (GIS). Because this is such a large area, at least 30 sample sites should be located.
- Key variables must be identified: vegetative ground cover, canopy cover, species diversity, soil compaction, humus layer, number of dead or dying plants, and number of volunteer plants. Ecosystem field forms will be used to record qualitative and quantitative data from sites (BC Ministry of Environment Lands and Parks and BC Ministry of Forests - Research Branch, 1998).
- A team of volunteers must be trained to accurately follow sampling protocol in order to eliminate observer bias.
- Prior to any work being done in the project area, Before-data must be collected as well as photographic evidence from specific photo monitoring points (GIS). Surveying should be conducted immediately following the Spring flush as well as early Winter to view all changes in vegetation patterns.
- During restoration efforts, trained personnel will monitor the implementation of the Quarry's management plan. These professionals will continually monitor whether the steps described in the implementation plan are being followed.
- An adaptive management approach will be used to address restoration issues. Routine visual evaluations and photographic recordings during the pilot year will allow early detection of problems and facilitate possible changes or maintenance necessary to reach restoration goals.
- Area should be monitored annually for the first five years then every five years thereafter.

5.2 Restoration Success

In order to determine whether the restoration project was a success, the goals and targets established at the beginning of the project must be considered. Because of the extreme environmental degradation in this area, the main restoration target was to establish a functional, integrated, resilient and self-sustaining pioneering ecosystem that also serves as a low-impact recreational area for the community. Creating an area that people, dogs and mountain bikers can use and enjoy while natural successional processes take place would be deemed a restoration success. Using public input surveys as well as qualitative and quantitative analyses (as described above) will help elucidate whether the goals and targets for this project were met. Ultimately, restoration efforts cannot be considered from one temporal perspective—only when the project's outcomes are considered in the context of long-term, dynamic successional trajectories, can we truly appreciate whether the restoration efforts were successful.

5.3 Implementation Plan

The implementation of this restoration plan completely depends on the property owner's motivation. Because they seem inclined to develop the area into a subdivision of single family homes, they may not be interested in creating a recreational park area for the community. The property is for sale, however, and the Cowichan Valley Regional District (CVRD) may be persuaded to see this as a community parkland acquisition opportunity. An aggressive campaign would need to be implemented in order to raise public awareness and help advocate for the preservation of this recreational space. Several public meetings could be arranged to discuss goals and targets for this area. Help from volunteers and school groups as well as donations of monetary and material goods from different interest groups would reduce overall costs. Only with the Cowichan Valley community on board, could this restoration plan ever be realized.

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