Wetland Restoration Design Report

For Proposed Subdivision for Affordable Housing of:

Lot B, Section 7, Mayne Island, Plan 27091
Civic Address: 375 Village Bay Road

Miner's Bay from above 375 Village Bay Road. Photo by Leh Smallshaw, Wetland Restoration Consulting.

March 8th, 2021

Prepared for the Mayne Island Housing Society

By Robin Annschild, Wetland Restoration Consulting with

Appendix A: Wetland & Stream Restoration Techniques
by Thomas R. Biebighauser

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Introduction

The Mayne Island Housing Society is planning an affordable housing project at 375 Village Bay Road on Mayne Island. An ecosystem report by Keith Erickson who reviewed the proposed Lot 3 recommended further analysis of site hydrology to "implement ecological and hydrological restoration in areas outside of the development footprint"[1] in portions of the property impacted by past land clearing, grazing, and logging activities. This report includes site disturbance history, restoration strategies for the site, a proposed restoration design, details of wetland restoration techniques and a cost estimate to complete the proposed work for both Lots 3 and 2.

1. Traditional Territory

The land at 375 Village Bay Road is within the consultative area of Lyackson First Nation, Halalt First Nation, Penelakut Tribe, Lake Cowichan First Nation, Stz'uminus First Nation, Cowichan Tribes, Semiahmoo First Nation, Tsawwassen First Nation, Tseycum First Nation, Tsartlip First Nation, Pauquachin First Nation and Tsawout First Nation.

The Mayne Island Tsartlip Reserve No. 6 is 350 metres to the west of the property boundary.

2. Project Objectives

1. Restore valuable forested cedar wetland habitat that has become rare in the Coastal Douglas Fir biogeoclimatic zone and in the southern Gulf Islands.
2. Create open water wetland habitat, most of which has been lost on Mayne Island through conversion of wetland-rich valley bottoms to agricultural use.
3. Create breeding habitat for amphibians species in decline in BC and globally such as: tree frog, long-toed salamander, newt and potentially for Northern Red-legged frog.

[1] Erickson, Keith. 2021. Ecological Assessment Report for Proposed Affordable Housing Property. Report prepared for the Mayne Island Housing Society. p. 3

4. Restore nesting and foraging habitat for Western Screech Owl.
5. Sequester carbon through restoring habitat for cedar forested wetland.
6. Restore watershed functions such as water storage capacity in soil and vegetation.
7. Mitigate the impacts of the development of 10 units of affordable housing by restoring and protecting the remainder of the lot with a conversation covenant.
8. Add beauty and enjoyment to the landscape that will be inhabited by the new residents of the affordable housing development.

3. Site Design

This report is based on a visit to the site by Robin Annschild and Leh Smallshaw of Wetland Restoration Consulting on January 25th, 2021, with Deborah Goldman, Brian Crumblehulme, David Brown, Directors of the Mayne Island Housing Society.

The following actions were taken to examine, identify, and address restoration needs for the site:

1. Available background information was read, and Google Earth location information was reviewed prior to the field visit.
2. Potential wetland restoration areas were examined on the ground to determine how water enters the site and how water leaves the site. Water entry and exit points were monitored for evidence of past disturbance and erosion and actions (if) needed to control this erosion were identified.
3. The presence or absence of standing water and water depths were recorded.
4. Slope and elevation survey data was collected using a Spectra Precision LL300N laser level and rod.
5. The locations of drainage ditches, fields, clearings, roads, and culverts were recorded using a Garmin Oregon 650 hand-held GPS.
6. Site maps were prepared using QGIS.
7. A 1.22 metre tile probe was used to determine soil depth, saturation, and texture at key locations.
8. Existing percolation test-holes and their spoil piles were examined to determine soil texture and the elevation of the water table at key locations.
9. Locations where wetlands may be built were identified.

10. Areas where soils may be disturbed during construction, and where soil removed from excavating wetland ponds may be spread were identified.
11. Potential access routes for heavy equipment and the type and size of heavy equipment needed to complete the project was determined.
12. A Phantom 4 Pro drone (loaned by the BC Wildlife Federation) was used to take ortho-images of the site using Pix 4D software. The images were processed into a high-resolution orthophoto using Web-ODM software. These orthophotos are used as the basemap in the map included in this report.

13. Historical air photos of the site from the years 1932, 1946, 1948,1950, 1951, 1962, 1967, 1972, 1975, 1980, 1985, 2005, were reviewed to prepare this report.

4. Site Description

A more detailed description of ecosystem types, ecological values, hydrology, and disturbance history of Lot 1 can be found in the September 21st, 2020 Ecological Assessment Report[2] prepared by Keith Erickson. The property is on a north-facing slope at the base of Mount Parke, which rises to an elevation of 260 metres approximately 970 metres to the southeast. The subject property ranges in elevation from approximately 30 to 50 metres and has an average slope of 25%. It has a high and fluctuating water table, with water at and above the surface in the winter in the wettest areas and dropping to approximately 1 metre below ground in late summer and early fall.[3,4] A Douglas Fir stump with a 1.3 metre diameter at the edge of Village Bay Road near the proposed entrance driveway to the affordable housing development illustrates how productive the site is for growing large trees (Figure 1).

[2] Erickson, Keith. 2021. Ecological Assessment Report for Proposed Affordable Housing Property. Report prepared for the Mayne Island Housing Society.
[3] *Ibid*.
[4] Crumblehume, Brian. 2020. Personal communication.

The attached Map shows the current proposed lot boundaries and the affordable housing project on Lot 3. This report includes a review of wetland restoration potential on both Lots 3 and Lot 2.

Figure 1. David Brown and Brian Crumblehulme, board members of the Mayne Island Housing Society stand near the entrance to the proposed driveway for the affordable housing development beside a Douglas fir stump that is 1.3 metres in diameter.

5. Site Disturbance History

5.1 Cross-cut Logging

375 Village Bay Road is 300 metres south and 30 – 50 metres uphill of the shoreline of Miner's Bay. Vancouver Island miners gathered in Miner's Bay beginning in 1858 – 1860 before rowing across Georgia Strait to the mainland to join the Fraser Canyon Gold Rush.[5] The earliest European homesteaders registered land claims in Miner's Bay in 1859.[6] The

[5] Mayne Island's History, Mayne Island Resort. https://www.mayneislandresort.com/history/
6 *Ibid*.

subject property was first logged around this time, as there is evidence of cross-cut saw logging with springboard notches on old cedar stumps. One cedar stump was measured at 1.47 metres in diameter (Figure 2). The size of the stumps indicates the potential productivity of the site for growing large cedar trees. Such sites are rare in the Southern Gulf Islands. Cedar has great cultural importance for Coast Salish people, and provides important habitat features for a wide variety of species, including nesting habitat for the Western Screech Owl, a species at risk. Most sites in the southern gulf islands that historically supported large cedar swamps (or forested wetlands) have been cleared, drained and converted to agricultural use, with no prospect of restoration in a timeframe that is meaningful with respect to climate change. In this context, any opportunity to restore and provide permanent protection to a forested cedar wetland is significant.

Figure 2. Brian Crumblehulme stands beside a cedar stump 1.47 metres in diameter. This cedar was cut using a cross-cut saw. Springboard notches are visible on the back of the stump.

5.2 Grazing

The earliest available air photo of 375 Village Bay Road is from 1932 (Figure 3). It shows an intensively farmed area around Miner's Bay. In the area where 375 Village Bay Road is located, the outline of an old field that has mostly been allowed to grow up to shrubs is visible, as is what appears to be an old road leading from the shoreline farms. A small portion of the old field is still clear of vegetation. This suggests that early settlers cleared a field for agricultural use – probably for use as a pasture to graze cattle. Livestock compact moist soils with their hooves and flatten areas that previously had complex micro-topography of pits and mounds. By 1932, the field was already mostly abandoned, with only a small portion still in use at that time, again likely for grazing. Current site conditions suggest the field was abandoned and allowed to grow up to trees because it was too wet for agricultural use.

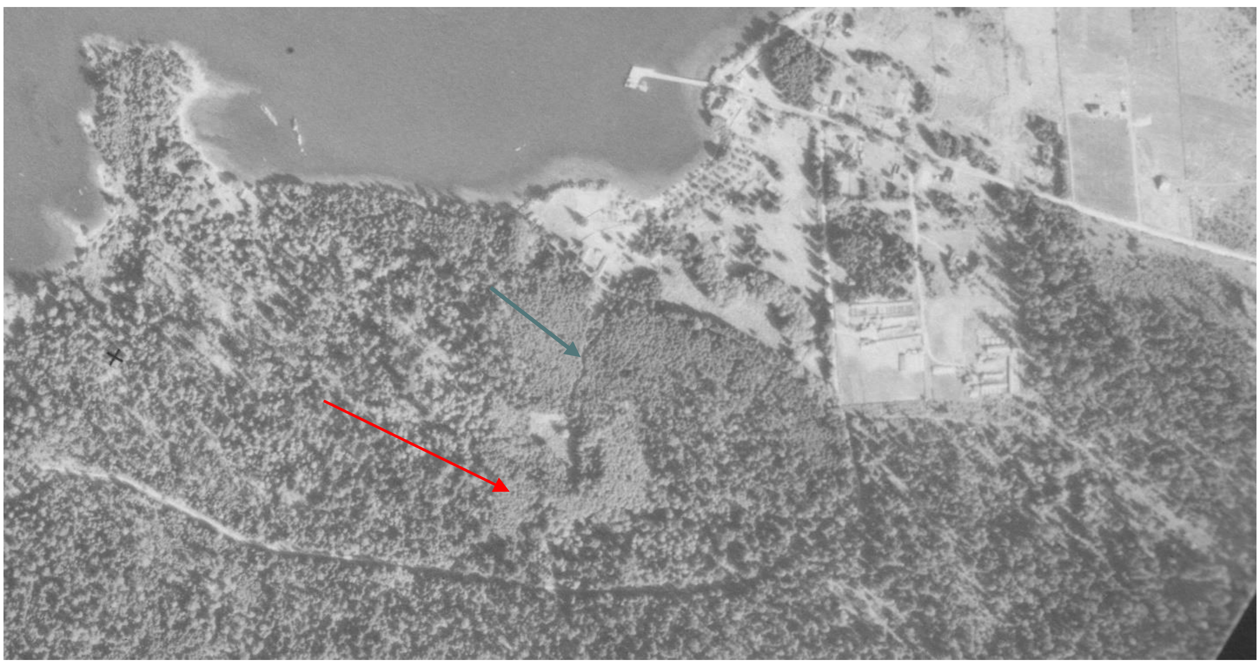

Figure 3. This 1932 air photo of the area shows the outline of an old field that has mostly been allowed to grow up to shrubs (red arrow) and a road leading to it from the farm on the shoreline of Miner's Bay (blue arrow).

5.3 Roadbuilding for 2004 logging

The next significant disturbance visible in the air photos is selective logging that occurred prior to the 2005 photo, perhaps in 2004. The network of old logging roads on the property (see Map) was likely built to provide logging access.

It can take many years for vegetation to become re-established on old forest roads. Road surface conditions combined with vehicle traffic which may carry in weed seeds can create growing conditions that favour introduced and invasive species, making it difficult for native species to re-establish. Compaction in the road surfaces prevents water from percolating and roots from penetrating into the soil. These roads interrupt and divert surface flow and can act like a series of intersecting dams across the landscape. Where road surfaces are left unmaintained on slopes, they can channel water, resulting in erosion and sediment transport that pollutes watersheds. Unless old roads are necessary and well-maintained, they are a liability for site hydrology and productivity and they further the presence of invasive species. While old roads will slowly become re-vegetated over time, the compacted road-base stunts the growth of vegetation for decades and potentially centuries.

Figure 4. This road leads from the existing driveway west across proposed Lots 2 and 3. It was likely built to provide access for the 2004 logging.

5.4 Ditching

It is likely that ditches were dug to drain the property after it was first logged in the late 1800s or early 1900s. That the drainage was not particularly successful is evidenced by the fact that by 1932, the site had already been abandoned for farming for long enough to allow a canopy of shrubs (possibly alder) to develop. That the site was abandoned so early in the 20th century indicates that the effort required to maintain the site as a pasture was not worth the benefit. Moisture conditions on the site today confirm that the is very difficult to drain. The presence of an artesian well or spring as well as numerous ditches spaced closely together and crossing each other at right angles, the largest of which flow with water year-round[7] indicates that groundwater emerges from the ground at this location. The size and shape of some of the ditches suggest they have been dug more recently, perhaps at the same time as the land was selectively logged prior to 2005.

Figure 5. David Brown measures a ditch that is 1.5 metres deep and over 2 metres wide on the east side of the existing driveway on proposed Lot 1. The red arrow shows the direction of water flow in the ditch.

[7] Goldman, Deborah. 2021. Personal communication.

Ditches remove water from the soil in two ways: they remove surface water and lower the elevation of groundwater. By lowering the elevation of groundwater, ditches lower site productivity for growing trees, reduce storage capacity for water in the soil, and increase flashiness in the watershed by accelerating the rate at which water flows through the property and onto neighbouring properties. The number, density, and depth of crisscrossing ditches on the subject property show how much effort has been put into draining this very wet site.

Figure 6. Ditches at right angles to each other that flow all year round indicate a wetland that is actively being drained. Red arrows show the direction of flow.

6. Restoration Strategies

The strategies proposed for this site are designed to mimic natural systems and work with site conditions to restore hydrological functions and biological productivity. They are designed to be low-cost and require little if any maintenance. No drains, pumps, dams or diversions would be built. The techniques that will be used to implement these strategies are described in detail in Appendix A.

The wetland ponds shown on the map would have seasonally fluctuating water levels. This is important to support native amphibian populations who are adapted to wetlands that dry in the fall.

Heavy equipment contractors would be hired by the hour to complete the project, greatly reducing construction costs. Coordinating heavy equipment restoration work with site clearing and roughing in the building sites could result in cost savings.

6.1 Remove compaction & roads

Given the intention to protect the wettest areas of the property with a conversation covenant, all the old logging roads that are no longer needed may restored to a forested wetland by removing the compaction from the road surface. This will restore the ecological productivity of the forested wetland areas that are currently networked by roads. Removing compaction ("fluffing up the soil") will allow moisture from rain and snowmelt to penetrate the soil, reducing the risk of erosion. Loosening the soil also makes it easier for tree and plant roots to penetrate, increasing the rate and size of vegetation that may grow on the site.

Dave Polster pioneered this technique, called "rough and loose" in British Columbia for use in road restoration and mining reclamation. The technique consists of using the digging bucket on an excavator to deeply dig into the road surface and then allow the material to fall back into place in soft, uncompacted mounds. The technique may be adapted to site-specific needs and can be used on landings and in any area where soil has become compacted due to vehicle use.

6.2 Restore micro-topography

The smooth surfaces of roads, former pasture, old landings and other disturbed areas have reduced the variety of microsites available for different species of vegetation. As compaction is removed, the soil will be left in naturally appearing, undulating mounds and ridges to restore habitat diversity.

Figure 7. Old logging roads, compacted soil surfaces, and a deep ditch with flowing water (red arrow) could be removed to restore a forested cedar wetland in this location. The ditch concentrates and directs runoff onto the neighbouring properties to the north.

6.3 Remove Ditches

Ditches are a lot of work to dig, and the work pays off, because they are so effective at removing water. Natural streams are sinuous and dotted with pools. Ditches are straight, concentrating and accelerating the flow of water, removing surface water quickly and effectively, and lowering the elevation of groundwater. Where ditches are present, soil saturation is reduced.

The ditches at 375 Village Bay Road accelerate and concentrate the flow of water, taking it rapidly across the property toward the neighbouring properties to the north. The ditch both drains surface water and lowers the elevation of ground water, shortening the hydro-period of what was formerly a forested cedar wetland. The ditches were dug for this purpose, and they continue to fulfil this purpose, even though there are no longer efforts being made to farm the land around them.

Ditch removal requires cleaning vegetation, roots and organic matter from the ditch and packing it with soil of a similar texture and level of compaction. A large volume of soil is required to fill ditches. Combining ditch removal with wetland construction makes sense. The soil removed from the wetland basins can be used to fill the ditches. To ensure water does not continue to flow through the soil where the ditch used to be, the ditch can be interrupted with core trenches at a 90-degree angle to the direction of the ditch. Filling the trench with compacted soil will prevent water from following the path of the ditch. The ditch may also be disabled by building a series of wetland pools along it, alternating with sections of filled ditch as described and illustrated in Appendix A, Wetland and Stream Restoration Techniques.

Concern has been expressed about the volume of water that leaves the property in a northwesterly direction from the north property boundary. The main source of this flow appears to be the deep ditch that was dug in a north and northwesterly direction from the artesian well, towards the property boundary (Map). Removing this ditch and the network of ditches that drain the forested wetland would have multiple benefits. It would regulate flows, reducing the speed at which water leaves the property after a rainfall event. It would also restore the storage capacity to the top layers of soil that are currently drained by the ditch. This would support alder and cedar to germinate and grow in the disturbed areas. Allowing a forested wetland to develop in areas impacted by past disturbance will increase the amount of water absorbed by vegetation, helping to reduce stormwater runoff.

Two smaller, roughly parallel ditches were dug close to the location of the well (Map) . These ditches would be disabled and removed as part of the construction of dwelling units 5-6 and 7-8, as well as through the construction of pond #1. This will help to restore the site’s water storage capacity, moderate runoff and restore site’s capacity to grow large cedar and other species of trees.

Figure 8. The ditch (red arrow) that crosses this open area near the well (blue arrow) would be disabled. The existing opening in the foreground would be used to build pond #1.

Note that not all ditches observed on the site were added to the map, as time did not allow them all to be recorded in the field. As well as the ditches that were observed and not mapped, there are likely additional ditches on the property that are not easy to see, as old ditches readily become overgrown and hidden by vegetation. However these can readily be found while the restoration work is taking place, by searching along existing roads as they are being removed.

Once the ditches are removed, there will still be surface flow through the area in the winter months. The flow of water will be across the surface, dispersed, and winding its way around and through trees. Figure 9 shows an example from a level area close to the northern boundary of Lot 2 that is beginning to function this way. Here the old ditches appear to have filled with sediment, and surface winter flows have returned to what would be expected for a forested wetland under high winter flows: shallow, dispersed, and at the surface.

Figure 9 shows dispersed surface flow close to the northern boundary of Lot 2. This shows how water would flow through the forested wetland in periods of high flow after the ditches are removed.

6.4 Build Wetland Ponds

Two sites were identified where small open water ponds 23 m x 16 m (Pond #1) and 9m x 17m (Pond #2) could be built (Map). It is not likely that this type of pond existed here before the forest was cleared, so this is not restoration in the sense of returning the site to a previous state, but rather the restoration of habitat that amphibians, bats and other wildlife need, and that has been lost from the larger landscape.

Figure 10. This wetland pond was built to in an old logging road at Snk'Mip Marsh in Hills, BC. It is one year old in the photo.

Figure 9 shows a pond that was built in a compacted gravel landing at the end of a logging road Snk'Mip Marsh near Hills BC. This wetland pool has a lot of good woody debris for wildlife and would be a suitable style for pond #2. For pond #1, which is close to the dwellings and where children will be playing, pieces of coarse woody debris that are child-friendly Would be selected and placed to allow children to explore the pond. The pond would be shallow, no more than 1.2 metres deep, with features like peninsulas and bays to help children closer to the water to explore the life of the pond.

Figure 11. This wetland was designed and built by the author in Jubilee park in Rossland, BC. A peninsula was incorporated into the design to allow children to get close to the water and learn about pond life.

6.5 Add Coarse Woody Debris

Organic material was removed from the site through logging, clearing, grazing and erosion. Woody debris that will be generated from site clearing for construction is typically burned on site. This contributes carbon to the atmosphere, as well as removing nutrients and absorptive capacity from the site. Wetland restoration is an opportunity to re-purpose woody debris from site clearing to a necessary material for site restoration. Larger pieces of wood and smaller branches may be used in pond construction to provide habitat (Figures 11, 12) and incorporated into the former road surfaces when compaction is removed.

Figure 12 Adding coarse woody debris sourced on site to a wetland pond in September 2020 at Xwaaqw'um (Burgoyne Bay Provincial Park), Salt Spring Island.

Figure 13. The same pond 2-weeks later after it filled with fall rains.

6.6 Prioritize Forested Wetland Restoration

If a density if placed on Lot 2, it will be important to delineate the building envelope within the covenanting process, and to keep the building site on higher and drier ground. If it is possible to place the building site south of the artesian well without impacting older forest, that would support restoring and protecting the rare, forested cedar wetland ecosystem on the northern part of both lots 3 and 2. If the building site is placed within the existing cleared area, the current level of drainage and associated lowering of the water table would likely need to be maintained if not enhanced to create a dry building site and access. Doing so would impact and reduce the benefits of restoration work taking place on Lot 3, because the two lots are hydrologically connected. Placing the building site in the existing cleared area is challenging with the current lot boundary because only a 13m wide portion of the existing cleared area falls within Lot 2 as currently drawn. The restoration plan proposed in this report and on the map prioritizes ecological and conservation values on the undeveloped portion of Lot 3 and on Lot 2 and includes all the cleared area of Lot 2 in the restoration plan.

7. Conclusions

There are opportunities for both forested wetland and open water wetland restoration at 375 Village Bay Road. The restoration project will provide short and long-term benefits including: re-purposing woody debris generated from clearing the building sites and driveway, restoring the site's capacity for detention and retention of stormwater, carbon fixing through growing large trees in a forested wetland, providing breeding and foraging habitat for amphibians and western screech owl, mitigating the impacts of the development of 10 units of affordable housing, and adding beauty to the landscape for the new residents of the subdivision. The project may be completed at a low cost, will require little or no maintenance and may provide a model for other communities for balancing community housing needs with conservation priorities.

8. Recommendations:

1. Mayne Island Housing Society is invited to review this report and contact Robin Annschild with any questions.

2. If a building site is planned for Lot 2, delineate the building envelope within the covenant document, and place it on the higher, drier ground south of the artesian well and close to the existing driveway and Village Bay Road.

3. Seek funding to implement the project, using the budget estimate provided below as a guide. Please contact Robin Annschild with any questions.

4. Obtain an authorization under the Water Sustainability Act to complete the project. This requires as much lead time as possible. It is best to apply 8 – 12 months ahead of anticipated start dates. Robin Annschild is available to help with this.

5. Schedule construction well in advance to ensure Robin Annschild, Tom Biebighauser or their associates are available to direct construction.

9. Construction Cost Estimate

The cost estimate below is based on estimated hourly costs for equipment and mobilization and demobilization of equipment to the site. Costs are estimated for the restoration of an area of land at 375 Village Bay Road estimated at to be 3600 m^2 as shown on the Map. Cost savings may be achieved by combining restoration work at 375 Village Bay Road with site clearing and the roughing in of the driveway and building sites if the heavy equipment used is suitable for both projects.

375 Village Bay Road Wetland Restoration Cost Estimate	Units	Rate	Cost
Construction Contractors			
Excavator 1 (CAT 320) or equivalent with operator	34	$ 180	$6,127
Dozer (CAT D6T-LGP) or equivalent with operator	34	$ 150	$5,106
Construction Supervison & Engineering Tools (R. Annschild)	42	$ 100	$4,153
Labor for spreading seed and planting			$1,180
Subtotal			**$16,565**
Mobilization / Demobilization & Travel			
Excavator 1 Mobilization & Demobilization	2	$ 1,000	$2,000
Loader with grapple Mobilization & Demobilization	2	$ 1,000	$2,000
Travel, travel meals & travel accomodation (R. Annschild)			$1,198
Subtotal			**$5,198**
Materials			
Winter wheat cover crop (4-25 kg bags) x ($30.00/bag)	10	$ 30	$300
Native plant plugs	1400	$ 4.00	$5,600
Miscellaneous field supplies (marking paint, pin flags, flagging tape, batteries)			$50
Subtotal			**$5,950**
Professional Fees			
Archaeology			$10,000
Cultural monitoring of construction			$2,500
Project Planning (R. Annschild)	20	$ 100	$2,000
Construction layout (R. Annschild)	5	$ 100	$500
Construction Report & Map Preparation (R. Annschild)	30	$ 100	$3,000
Project Administration (MIHS)			$5,000
Subtotal			**$23,000**
Construction Phase Total			**$50,713**
Post-Construction Phase			
Year 1-2 Monitoring			$2,000
Year 2-5 Monitoring			$2,000
Subtotal			$4,000
Total Estimated Cost			**$54,713**
375 Village Bay Road Wetland Restoration Project			
The prices listed are estimates based on similar projects that have been completed			
Heavy equipment hourly rates includes 5-percent GST			
Large woody debris to be placed in wetlands may be obtained onsite as well as offsite, and delivered to the worksite.			
Native plant seed will be gathered from an existing wetland nearby and sown by hand.			

10. About the Author

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Robin Annschild has directed the construction of 275 wetlands on 33 sites across British Columbia and has completed 4 stream restoration projects in the East & West Kootenay and the Cowichan Valley.

Since 2014, Robin has completed over 1560 hours of wetland restoration field training with Tom Biebighauser and has assisted Tom with the construction of 103 wetlands in BC, California, Arizona & South Carolina.

Robin uses low-cost, low-maintenance restoration techniques developed by Tom Biebighauser over 35 years to design and built groundwater and surface-water supplied wetlands using core trenches, compacted clay liners or aquatic-safe synthetic liners.

Robin developed project management and program planning skills in her former role as a conservation director for the Salt Spring Island Conservancy. Under Robin's leadership, the conservation program raised $4.8 M dollars in program and acquisition funds to protect and restore habitat for multiple species at risk on Salt Spring Island.

11. Map: 375 Village Bay Road Proposed Hydrological Restoration