

Twin Rose Ecological Documentation and Assessment

Prepared for:

Summer Villages of Sylvan Lake Administration

Requested by:

The Jarvis Bay Council

Prepared by:

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Purpose

The purpose of this project is to assess and document the current state of vegetation along the Twin Rose Environmental Reserve and Easement and Crown Land surrounding the Sylvan Creek outlet, on Sylvan Lake's shoreline.

This document has been produced as a record of the area's flora community. In the case of accidental or purposeful destruction of protected areas, the information and photos in this report should be used to ensure vegetation and habitats are properly and thoroughly restored.

Site Description

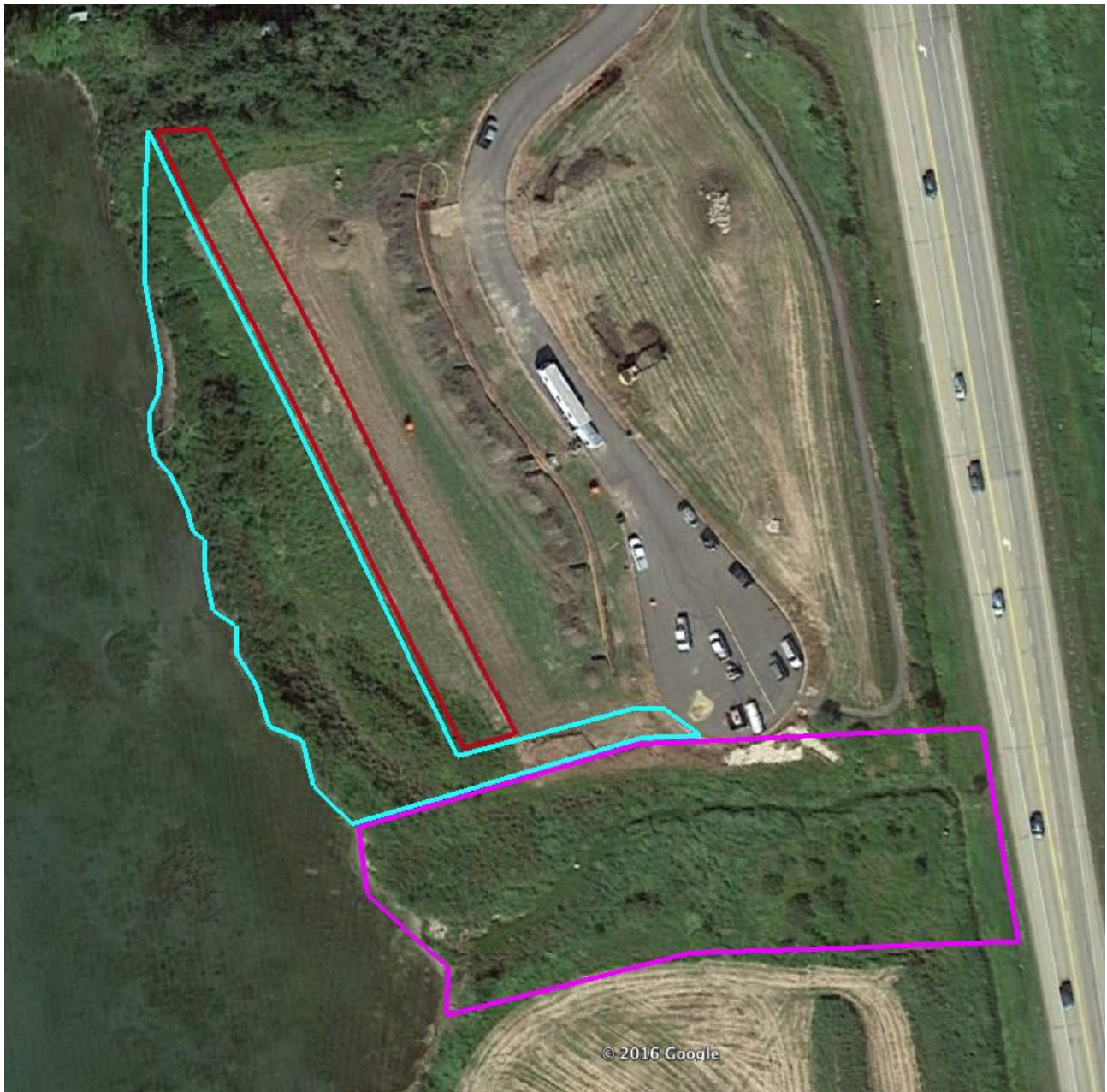
The Twin Rose site is located on southeast shore of Sylvan Lake, west of Highway 20, and south of Jarvis Bay Drive. The GPS coordinates to the entrance of the site are: 52.329764, -114.071702.

The area is developed, with lots zoned for private residence. Currently, utilities have been established for each lot, and one lot has been purchased. The North end of the site is to be developed into a road and communal dock.

Two important, protected ecological areas border the Twin Rose site: the Environmental Reserve and Easement, and the Crown Land protecting the Sylvan Creek outlet [1]. The Ecological Easement and Reserve protects important riparian environment along the Sylvan Lake shoreline; this area is habitat for wildlife and migratory birds [1], filters pollutants and sediments from Sylvan Lake, and protects the shoreline from erosion [2]. The Crown Land is the spawning habitat for Sylvan Lake's population of Northern Pike, and is protected as fish habitat under the Fisheries Act [3].



Figure 1: Map of the Twin Rose site [7]



Legend

- Environmental Reserve
- Environmental Easement
- Crown Land

Figure 2: Protected Areas within the Twin Rose site. [7]

Methods

→ Photographs

In order to establish reference records of the site, photographs were taken from evenly spaced locations along the property.

Photo locations were measured and staked along both the Environmental Reserve and Easement and Crown Land boundaries, with GPS coordinates recorded. GPS coordinates for each stake are listed in Appendix A. Stakes were placed at twenty (20) foot intervals, and fifteen (15) feet behind the Environmental Easement boundary, or ten (10) feet away from the Crown Land boundary.

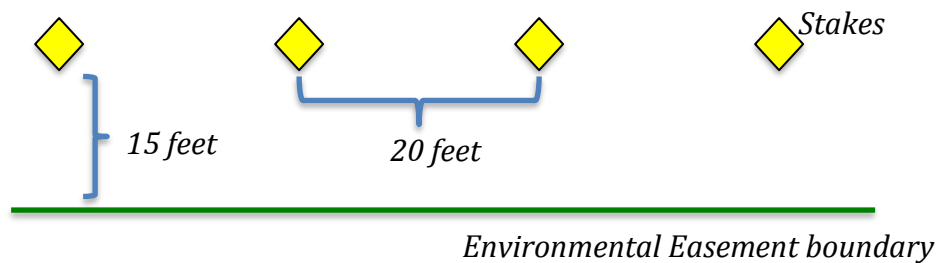


Figure 3: Stake spacing in regards to Environmental Easement boundary - Stakes # 1-21

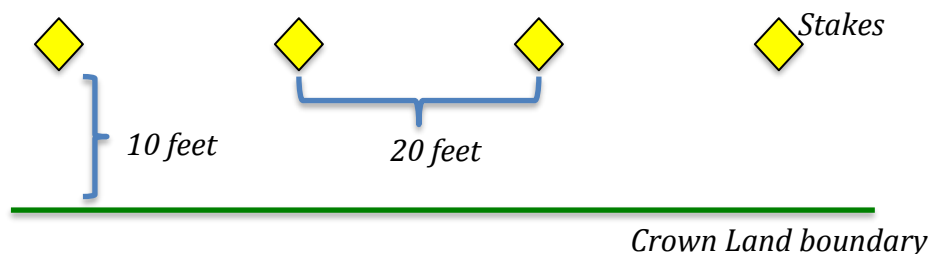


Figure 4: Stake spacing in regards to Crown Land boundary - Stakes #22-34

Two sets of exceptions to the stake placement exist:

Stake #22, which was located on the corner between the Environmental Easement and the Crown land, was placed at a 10-foot distance from stake 21.

The stake was located 15 feet from the Environmental Easement boundary, and 10 feet away from the Crown Land boundary.

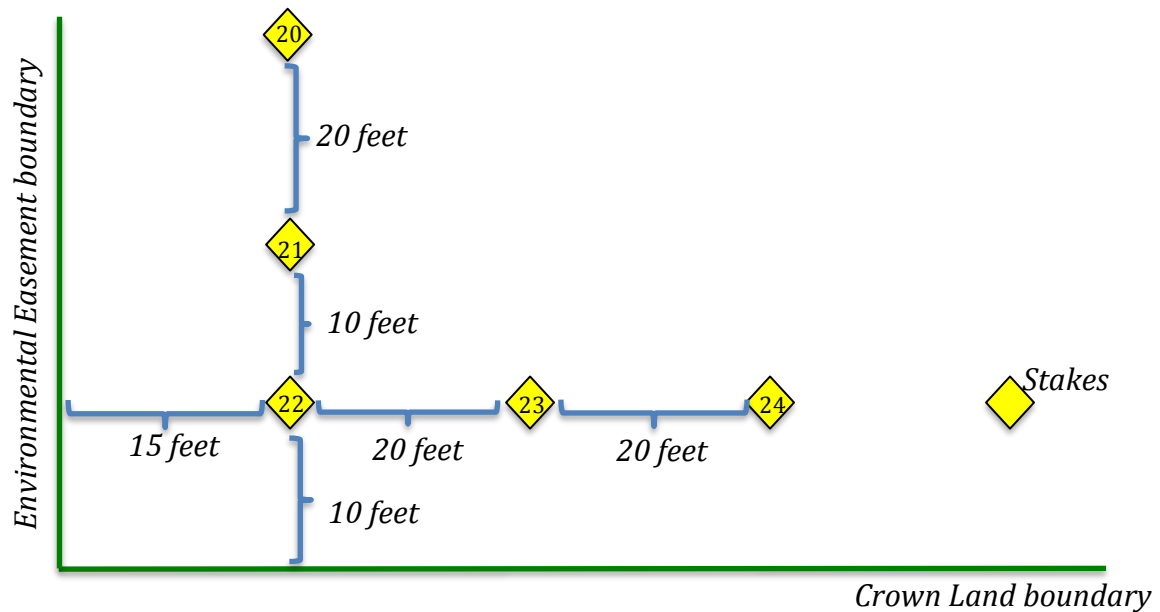


Figure 5: Stake placement exceptions, with regards to Stake 22

Stakes 31, 32, and 33 required additional stakes, due to photographic point of view being impeded by a vegetation growing directly in front. The additional stakes were placed directly on the Crown Land boundary (10 feet in front of the original location), and labeled 31a, 32a, and 33a, respectively.

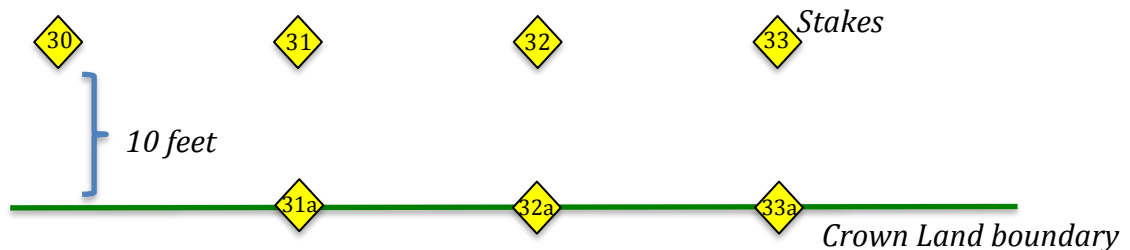


Figure 6: Additional stakes required for photographs - Stakes 31a, 32a, and 33a

Photos were also taken from additional locations to provide supplementary perspectives of the vegetation growth and structure on the site.

- 1) Panoramic photos were taken from 9 of the staked sites, with photo start and end directions recorded.

- 2) Reference photos were taken from the lake using kayaks, to document vegetation growth and structure from the opposite side. GPS coordinates for four locations, and directions faced to take photos were recorded to aid with future comparisons. Additional panoramic photos were also taken.
- 3) Photos of the Crown Land were taken from two locations along Highway 20, facing west towards Sylvan Lake. GPS coordinates were recorded.
- 4) Photos were taken from the electrical utility boxes on site, as the only permanent structures currently in place. Each utility box is identified by size description, and GPS coordinates. Four panoramic photos were taken at each utility box, as well as two additional photos, facing East and West.

The map on the following page illustrates all staked locations.



Figure 7: Map of staked locations [7]

→ Vegetation Assessment

Line-intercept sampling was completed to provide a general understanding of the plant communities present in both of the protected areas.

Transects originated from stakes 1, 5, 10, 15, 20, 22, 25, 30, and 34. All vegetation occurring within 1m on each side of the transect was recorded.

Three transects were performed at stake 22, to capture information regarding 1) the Environmental Reserve and Easement, 2) the Crown Land, and 3) the land between which both areas intersect.

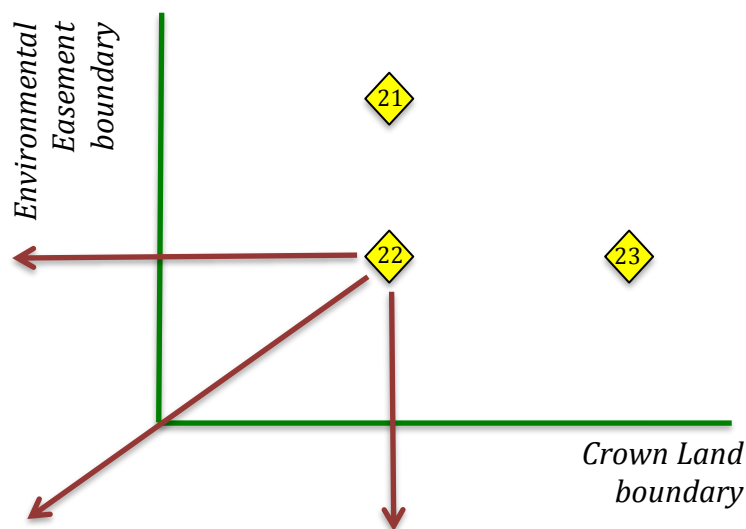


Figure 8: Transect directions from Stake 22

The length of transects walked did vary, based on depth access. If vegetation was too dense to walk through, the remainder of the transect was completed with binoculars, so as to minimize habitat damage. Visual assessment by binocular was completed to opposite boundaries where visible.

Weed classifications were designated using an Alberta-specific list, provided as an Appendix in the Cows and Fish Riparian Health Assessment booklet.

This vegetation assessment was performed to provide a general idea of the types of vegetation found on the site. Species were identified where possible, and where it was not possible, plants were identified to the genus level. This assessment was not intended to replace a full vegetation inventory.

→ Riparian Health Assessment

A Riparian Health Assessment, from the Cows and Fish *Riparian Health Assessment for Lakes, Sloughs, and Wetlands Field Workbook*, was completed on the Environmental Reserve and Easement, and the Crown Land. The procedure for the Riparian Health Assessment was completed as per the provided instructions. This will ensure that scoring can be completed in a uniform manner during future assessments.

Please reference the *Field Workbook* for full assessment instructions.

Additional copies of the Cows and Fish workbook can be ordered from:
http://cowsandfish.org/order_tools.aspx

Findings/Summary:

→ Photographs

Photographs are included in Appendix B, and are identified by stake number or site location.

A digital copy of all site photographs will be submitted with this printed report. The photos in the printed report have been compressed to 220ppi, therefore the printed report will only be most useful for initial comparisons. Digital versions of the photos will display more information, aiding any future assessments, or to ensure vegetation and habitats are properly and thoroughly restored.

Photographs taken from the permanent structure sites (utility boxes) are only provided digitally as auxiliary reference.

All photos were taken at the end of August, 2016.

→ Vegetation Assessment

The vegetation assessment found the Twin Rose site to be populated by many native and non-weed plant species. However, due to the amount of human alteration of the area, many weeds of both the Invasive Plant Species (IPS) and Disturbance-Caused Undesirable Herbaceous Species (DCUHS) categories were also found in the Environmental Reserve, Environmental Easement and in the Crown Land.

The table on the following page summarizes the plant species observed on the Twin Rose site at the time of assessment.

	Native Species and Species not designated as weeds	Invasive Plant Species	Disturbance-Caused Undesirable Herbaceous Species
Trees	<ul style="list-style-type: none"> Aspen poplar Balsam poplar 		
Shrubs	<ul style="list-style-type: none"> Willows * (bush and thicket types) Wild red raspberry 		
Grass-like Plants	<ul style="list-style-type: none"> Cattail Great bulrush – soft stem Reed canary grass Sedges * Other grasses * 		<ul style="list-style-type: none"> Kentucky bluegrass Other grasses *
Broad-leaf Plants	<ul style="list-style-type: none"> Aster * Canada goldenrod Cow parsnip Meadow horsetail Narrowleaf hawkweed Purple aven Purple milkvetch Siberian Yarrow Western dock Wild vetch Wild rose* 	<ul style="list-style-type: none"> Thistles * Scentless chamomile Sow thistle * White cockle 	<ul style="list-style-type: none"> Alsike clover Black medick Common dandelion Common plantain Hemp Nettle Lamb's-quarters Red clover Rough cinquefoil or Silverweed Stinkweed Tansy mustard White clover Wild buckwheat Yellow clover

** Species were identified where possible, and where it was not possible, vegetation was identified to the genus level.*

For a full list of vegetation recorded at each transect, see Appendix C.

A vegetation assessment was not completed from the lake side. However, a list of additional species observed in the lake and along the shoreline is included as an addendum at the end of Appendix C.

The vegetation assessment was completed at the end of August, 2016.

→ Riparian Health Assessment

A Riparian Health Assessment, based on the Cows and Fish *Riparian Health Assessment for Lakes, Sloughs, and Wetlands* was completed on the Environmental Reserve and Easement and the Crown Land. Vegetation growth patterns and structure for the Environmental Reserve and Crown land were observed to be similar, and were therefore assessed together as one reach.

The protected riparian areas on the Twin Rose site were assigned a Riparian Health Assessment score of 66.67% (42 points of out 63). The Environmental Reserve and Easement and Crown Land would therefore be considered a riparian area that is “healthy with problems”.

Notes made regarding the assessment include:

Vegetation Cover:

Vegetation covers more than 95% of the soil surface, with less than 5% bare soil. Canopy cover was scored at 95% as well, with grasses, broad-leaved plants, shrubs, and trees considered.

It should be noted that a low percentage of the Environmental Reserve and Easement and Crown Land has canopy cover by trees and shrubs. The vegetation density score was derived based on a high percentage of vegetation in grass-like and broad-leaved plant categories; trees and shrubs would account for no more than 40% of total vegetation on the site. In comparison to other riparian areas around Sylvan Lake, the site's percent tree and shrub coverage is lower, and the site's average age and size for trees and shrubs is younger.

Invasive Plant Species and Disturbance-Caused Undesirable Herbaceous Species:

Although the vegetation cover score is high, a large number of the plant species in the Environmental Easement and along the North edge of the Crown Land are considered IPS or DCUHS [2]. These species are spreading into both the Ecological Reserve and Crown Land; due to their aggressive growth patterns, there is potential that IPS could out-compete native species in the protected areas if no mitigation efforts are employed.

Canopy cover of IPS was scored as “between 1% and 15% of the reach” [2], with density/distribution varying between 20-75% of the areas assessed. IPS

were found in “a few patches, plus several sporadically occurring plants” [2] along the Environmental Easement. Within the Environmental Reserve itself, IPS were observed at highest densities in grassy areas without trees or shrubs. The highest distribution of IPS along the Crown Land was found on the the northernmost border, between stakes 22 and 26.

The riparian area was scored as having “25-50% of the reach covered by DCUHS” [2]. This score was assigned due to high density of DCUHS observed throughout the Environmental Easement, the portions of the Environmental Reserve without trees or shrubs, and the northern edge of the Crown Land.

Preferred tree and shrub establishment and regeneration:

Some woody plants exist on the site, especially in younger age classes (seedling and sapling). No mature woody plants exist directly along the shoreline, except along the area that is to be developed into Rose Street.

Preferred tree and shrub establishment and regeneration score was “more than 15% of the total canopy cover of preferred trees/shrubs is seedlings and/or saplings” [2]. However, the majority of the trees and shrubs on site fall within the seedling and sapling categories. Less than 15% of trees and shrubs on the site could be considered mature.

Browse of preferred trees and shrubs on the site was graded as “Moderate”. This score was based on randomly assessed trees and shrubs, and with consideration of the area’s history as grazing land. Several willows in the Crown land demonstrate an ‘umbrella’ shape due to heavy use as browse.

Human alteration to trees and shrubs on the site falls under “Other use, other than browse”. This would include the small area of willows that was affected by installation of the walking path, and the area of vegetation damaged by the public trying to gain access to the lake between stakes 3 and 4. Mowing also occurs within the area identified as Environmental Easement. The designated score for this category was deemed “light (5% to 25% of live woody vegetation expected on site is lacking due to removal by humans or beavers)” [2].

Human alteration of the vegetation:

Anthropogenic causes of vegetation alteration on the Twin Rose site include native plants being replaced by non-native plants, and removal of vegetation. Alteration was rated as “5% to 15% of reach vegetation is altered by human activity” [2]. Non-native plants were introduced to the site as fill was added

over time. Installation of a permanent walking trail overtop of vegetation, and the vegetation damage due to bushwhacking between stakes 3 and 4 were considered removal of vegetation. The bushwhacked area was considered in this category based on the fact that root damage was observed, and has resulted in erosion of the shore bank.

Physical changes caused by humans:

Due to compacted trails caused by humans, and the construction of a gravel walkway, human alteration of the physical site was deemed to be “5% to 15% of the reach has been physically altered by human activity” [2]. The severity of the physical alterations was recorded as “slight” [2], as there is minimal impact to plant communities and hydrological function of the altered area [2]. As the pathway is gravel, and therefore semipermeable, hydrological functions should only experience minimal impact.

Human caused bare ground:

Human activity on the site has resulted in areas of the site to be recorded as bare ground. “1% to 5% of the reach is human-caused bare ground” [2], including the bushwhacked trail, and developed trail. The semipermeable nature of the gravel, and bare soil of the bushwhacked trail are both prone to erosion, and also represent an opportunity for invasion by disturbance-caused and weed species [2].

Artificial addition/removal of water:

At the time of assessment, the degree of artificial water level change was recorded as “minor” [2] based on the vegetation and amount of exposed soil observed on the site. However, two mentions must be made:

- 1) Historic photos of the area show higher water levels than those observed at the time of assessment. Photos show kayakers navigating through the Crown Land, and the culvert channels south of the Sylvan Creek outlet.
- 2) After the riparian health assessment was completed, water was pumped from Sylvan Lake, decreasing water levels. Water was pumped mechanically to the culvert channels south of the Sylvan Creek outlet, during the month of October.

Wildlife observations:

During the assessment, a female mule deer was observed using the site. Osprey were also observed frequenting the area, using the mature trees in the area that is to be developed into Rose Street, and power poles near Highway 20 as feeding sites. Migratory birds observed on the site throughout the spring and summer of 2016 included: Baltimore Oriole, American Goldfinch, House Finch, Bohemian Waxwing, Yellow Warbler, House Wren, Tree Swallow, American Robin, Black-Capped Chickadee, Red Crossbill, Lesser Scaup, Mallard, Common Goldeneye, Canada Goose, Common Merganser, Black and Common Terns, and numerous types of gulls. The area is also known as a spawning site for Northern Pike [3].

Human activity observations:

The area is used by the public for fishing, kayaking and canoeing. Several vehicles were observed driving into the site along the paved road, stopping for a few minutes, and then leaving. Several other individuals were seen using the area on foot and on bicycle, presumably looking for recyclables. The area between stakes 3 and 4 was used earlier in the year by an individual looking for lake access. This caused bare ground and vegetation disturbance. As of August 2016, the vegetation has started to grow back, but bare, compacted soil is still visible.

Continued Health and Protection of the Riparian Areas

Updated reference photos and riparian health assessments should be completed annually for both the Environmental Reserve and Easement and the Crown Land. Doing so will ensure proper representation and documentation of the site.

A copy of the *Riparian Health Assessment for Lakes, Sloughs, and Wetlands* will be included with submission of this report, and can be used to complete future assessments. The workbook includes the score sheet for the initial Riparian Health Assessment described in this report.

Assuming no alteration to the Environmental Easement is to be performed by lot owners [1], the Invasive Plant Species (IPS) and Disturbance Caused Undesirable Herbaceous Species (DCUHS) problems should be addressed prior to lots being sold or developed. Due to the proximity to open water, reference Section 16 of the Environmental Code of Practice for Pesticides [4] to ensure compliance (pages 15-19). Chemical-free methods of weed control, such as Target Browsing [5] are available in Alberta. As a suggestion, native Albertan plant species (a variety of trees, shrubs, grass-like plants, and broad leaved vegetation) should be planted in the Easement following the removal of IPS and DCUHS.

In order to communicate the importance of the riparian area to Sylvan Lake's aquatic health, informational signage could be installed at public access points. Once designed, the informational signs could also be installed at other Summer Village locations around Sylvan Lake, educating lake users about the importance of natural riparian areas. These signs would educate the area's users about some of the key ecological functions of a healthy wetland, such as:

- **Purifies Water:** Riparian areas remove sediment, excess nutrients, and toxins from the water. Vegetation and microbes are able to absorb, store, remove or neutralize contaminants including hydrocarbon molecules, heavy metals, and organic compounds. [6]
- **Provide Habitat and Maintain Biodiversity:** Habitats are maintained and connected by riparian areas, providing escape cover, food, and shelter to many species of wildlife, invertebrates, fish, birds, and plants [2]. This area is especially important to Sylvan Lake's population of Northern Pike, who use it as a spawning ground [3].

- **Helps control Floods and Erosion:** Riparian areas are a shoreline buffer, reducing the effects of erosion [2]. Roots of riparian vegetation like cattails, sedges, and willows stabilize banks and protect nutrient rich topsoil, while foliage slows wind down, keeping soil from being carried away [6]. Water is slowed as it flows through wetland vegetation, increasing groundwater recharge, and decreasing risks of flooding [6].

Clear identification of where the Environmental Reserve and Crown Land boundaries are located would also serve to protect the areas. Several members of the Jarvis Bay community have expressed willingness to fund the installation of a boundary marker for the Environmental Reserve. Their offer includes the installation of a rail fence that will clearly indicate the area is protected.

Review of the Rose Street location is recommended. A communal dock for Twin Rose residents is also planned for the end of this roadway. Although it is clearly beneficial to decrease the number of residential docks, and therefore shoreline impacts, the location identified for the roadway is the only area with mature trees growing on the Twin Rose site currently. This map identifies the area to be developed, outlined in orange:



Figure 9: Proposed location for Rose Street development.

Mature trees are essential to riparian areas as their roots stabilize shore banks and uptake nutrients to maintain water quality. Canopies of mature trees protect soil from erosion and act as a windbreak for residents. Mature woody vegetation provides essential shelter for wildlife, and dead trunks add structure and nutrients to habitats. Most importantly, mature trees provide a seed bank for regeneration of woody growth. [2]

Cows and Fish explains “a good indicator of ecological stability of a riparian reach is the presence of woody plants in all age classes...” [2]. The Twin Rose site was compared to other shoreline areas along Sylvan Lake, including:

- The south end of Marine Drive at Sunbreaker Cove,
- The area along View Drive and Range Road 23,
- The Sylvan Lake Natural Area,
- The north end of Range Road 21, on the South side of Sylvan Lake, and
- Along the Jarvis Bay Provincial Campground.

When compared to these sites, which have of similar ecological conditions and climate, it is evident that the Twin Rose site hosts a very low percentage of mature trees. By leaving this mature woody vegetation on site, the protected areas of Twin Rose would receive a higher Riparian Health Assessment score. In order to maintain the health of the area, this stand of mature woody vegetation should be allowed to continue to grow, and the Rose Street location revised. Alternate locations were not investigated at this time, doing so was outside the purpose of this assessment. Further evaluation of the road and dock location is recommended to ascertain merits of the current proposed site, in comparison to possible alternates.

Appendix A – GPS Coordinates of Staked Locations

Stake Number or Site Location	Latitude	Longitude
1	N 52.32926°	W 114.07297°
2	N 52.32921°	W 114.07294°
3	N 52.32917°	W 114.07290°
4	N 52.32912°	W 114.07286°
5	N 52.32907°	W 114.07284°
6	N 52.32903°	W 114.07279°
7	N 52.32898°	W 114.07275°
8	N 52.32893°	W 114.07270°
9	N 52.32888°	W 114.07268°
10	N 52.32883°	W 114.07263°
11	N 52.32878°	W 114.07259°
12	N 52.32874°	W 114.07256°
13	N 52.32868°	W 114.07252°
14	N 52.32864°	W 114.07248°
15	N 52.32858°	W 114.07243°
16	N 52.32854°	W 114.07240°
17	N 52.32848°	W 114.07236°
18	N 52.32843°	W 114.07232°
19	N 52.32838°	W 114.07227°
20	N 52.32833°	W 114.07221°
21	N 52.32828°	W 114.07218°
22	N 52.32825°	W 114.07216°
23	N 52.32826°	W 114.07208°
24	N 52.32827°	W 114.07199°
25	N 52.32828°	W 114.07190°
26	N 52.32827°	W 114.07182°
27	N 52.32828°	W 114.07172°
28	N 52.32828°	W 114.07164°
29	N 52.32827°	W 114.07153°
30	N 52.32828°	W 114.07146°
31	N 52.32829°	W 114.07137°
31a	N 52.32826°	W 114.07137°
32	N 52.32830°	W 114.07130°
32a	N 52.32826°	W 114.07128°
33	N 52.32829°	W 114.07118°
33a	N 52.32826°	W 114.07118°
34	N 52.32831°	W 114.07110°

GPS Coordinates of Staked Locations, continued:

Stake Number or Site Location	Latitude	Longitude
Lake Site 1	N 52.32776°	W 114.07282°
Lake Site 2	N 52.32811°	W 114.07304°
Lake Site 3	N 52.32848°	W 114.07335°
Lake Site 4	N 52.32911°	W 114.07372°
Highway 20 Ref 1	N 52.32820°	W 114.07087°
Highway 20 Ref 2	N 52.32811°	W 114.07086°
Small Utility Box	N 52.32922°	W 114.07251°
Medium Utility Box	N 52.32891°	W 114.07198°
Large Utility Box	N 52.32876°	W 114.07214°

Appendix B – Photographs

Stake 1

Photographs: 2

Direction facing: 240° SW



Directions facing: 142°SE -331 °NW



Stake 2

Photographs: 1

Direction facing: 224° SW



Stake 3

Photographs: 1

Direction facing: 241° SW



Stake 4

Photographs: 1

Direction facing: 240° SW



Stake 5

Photographs: 2

Direction facing: 218° SW



Directions facing: 140° SE - 331° NW



Stake 6

Photographs: 1

Direction facing: 207° SW



Stake 7

Photographs: 1

Direction facing: 248° SW



Stake 8

Photographs: 1

Direction facing: 237° SW



Stake 9

Photographs: 1

Direction facing: 242°SW



Stake 10

Photographs: 2

Direction facing: 230° SW



Directions facing: 138° SE - 328° NW



Stake 11

Photographs: 1

Direction facing: 236° SW



Stake 12

Photographs: 1

Direction facing: 225 ° SW



Stake 13

Photographs: 1

Direction facing: 237° SW



Stake 14

Photographs: 1

Direction facing: 232° SW



Stake 15

Photographs: 2

Direction facing: 232° SW



Directions facing: 141° SE - 320° NW



Stake 16

Photographs: 1

Direction facing: 231° SW



Stake 17

Photographs: 1

Direction facing: 226° SW



Stake 18

Photographs: 1

Direction facing: 227° SW



Stake 19

Photographs: 1

Direction facing: 238° SW



Stake 20

Photographs: 2

Direction facing: 226° SW



Directions facing: 124° SE - 330° NW



Stake 21

Photographs: 1

Direction facing: 226° SW



Stake 22 – Facing Environmental Reserve and Easement

Photographs: 1

Direction facing: 241° SW



**Stake 22 – Facing the intersection of Crown Land and
Environmental Reserve and Easement**

Photographs: 2

Direction facing: 200° S



Directions facing: 95° E - 303° NW



Stake 22 Facing Crown Land

Photographs: 1

Direction facing: 161° S



Stake 23

Photographs: 1

Direction facing: 161° S



Stake 24

Photographs: 1

Direction facing: 162° S



Stake 25

Photographs: 2

Direction facing: 151° SE



Directions facing: 70° E - 248° SW



Stake 26

Photographs: 1

Direction facing: 166° S



Stake 27

Photographs: 1

Direction facing: 158° SE



Stake 28

Photographs: 1

Direction facing: 167° S



Stake 29

Photographs: 1

Direction facing: 150° SE



Stake 30

Photographs: 2

Direction facing: 161° S



Directions facing: 73° E - 249° SW



Stake 31

Photographs: 1

Direction facing: 168° S



Stake 31a

Photographs: 1

Direction facing: 170° S



Stake 32

Photographs: 1

Direction facing: 160° S



Stake 32a

Photographs: 1

Direction facing: 168° S



Stake 33

Photographs: 1

Direction facing: 159° S



Stake 33a

Photographs: 1

Direction facing: 170° S



Stake 34

Photographs: 2

Direction facing: 150° SE



Directions facing: 159° S - 240° S



Lake site 1

Photographs: 6

Direction facing: 48° NE



Direction facing: 7° N



(Lake Site 1 continued)

Direction facing: 336° NW



Direction facing: 309° NW



(Lake Site 1 continued)

Direction facing: 272° W



Directions facing: 60° NE - 250° W



Lake site 2

Photographs: 4

Direction facing: 95° E



Direction facing: 68° E



(Lake Site 2 continued)

Direction facing: 13° N



Direction facing: 311° NW



Lake site 3

Photographs: 5

Direction facing: 80° E



Direction facing: approximately 55° NE (inaccurate compass read)



(Lake Site 3 continued)

Direction facing: 28° NE



Direction facing: 348° N



(Lake Site 3 continued)

Direction facing: 104° E - 345° N



Lake site 4

Photographs: 5

Direction facing: 129° SE



Direction facing: 91° E



(Lake Site 4 continued)

Direction facing: 68° E



Direction facing: 46° NE



(Lake Site 4 continued)

Direction facing: 342° N - 175° S



Highway 20 Reference Site 1

Photographs:

Direction facing: 250° W



Highway 20 Reference Site 2

Photographs:

Direction facing: 255° W



Appendix C – Vegetation Assessment

This vegetation assessment was performed to provide a general idea of the types of vegetation found on the site. Species were identified where possible, and where it was not possible, plants were identified to the genus level. This assessment is not intended to replace a full vegetation inventory.

Location	GPS Coordinates	Vegetation recorded along transect
Stake #1	Start: N 52.32916° End: W 114.07330°	<ul style="list-style-type: none"> ▪ Balsam poplar ▪ Grass * (including reed canary grass) ▪ Sow thistle * ▪ Willow * (including bush and thicket types) ▪ Western dock ▪ Siberian yarrow
Stake #5	Start: N 52.32899° End: W 114.07312°	<ul style="list-style-type: none"> ▪ White cockle ▪ Black medick ▪ Scentless chamomile ▪ Stinkweed ▪ Tansy mustard ▪ Aster * ▪ Thistle * ▪ Alsike clover ▪ Grass * (including timothy tribe, reed canary grass) ▪ Meadow horsetail ▪ Goldenrod ▪ Siberian yarrow ▪ Willow * (including thicket types)
Stake #10	Start: N 52.32872° End: W 114.07294°	<ul style="list-style-type: none"> ▪ Alsike clover ▪ White clover ▪ Scentless chamomile ▪ Black medick ▪ White cockle ▪ Stinkweed ▪ Sow thistle * ▪ Grass * (including reed canary grass) ▪ Siberian yarrow ▪ Willow * (thicket type) ▪ Aspen poplar ▪ Balsam poplar ▪ Common dandelion ▪ Meadow horsetail ▪ Thistle * ▪ Wild buckwheat ▪ Lamb's quarters

Stake #15	Start: N 52.32843 ° End: W 114.07288°	<ul style="list-style-type: none"> ▪ Scentless chamomile ▪ Grass * (including timothy tribe, reed canary grass) ▪ Thistle * ▪ Meadow horsetail ▪ Sow thistle * ▪ Hemp nettle ▪ Common dandelion ▪ White cockle ▪ Alsike clover ▪ Black medick ▪ Stinkweed ▪ Willow * (including thicket and bush types) ▪ Cattail ▪ Balsam poplar ▪ Goldenrod ▪ Wild rose * ▪ Wild red raspberry ▪ Purple milk vetch
Stake #20	Start: N 52.32829° End: W 114.07238°	<ul style="list-style-type: none"> ▪ Grass * (including barley tribe) ▪ Black medick ▪ Thistle * ▪ Alsike clover ▪ Scentless chamomile ▪ Vetch * ▪ Common dandelion ▪ Meadow horsetail ▪ Stinkweed ▪ Willow * (including thicket type) ▪ Balsam poplar ▪ Goldenrod
Stake #22 Facing Environmenta l Reserve and Easement	Start: N 52.32823° End: W 114.07231°	<ul style="list-style-type: none"> ▪ Thistle * ▪ Alsike clover ▪ White cockle ▪ Scentless chamomile ▪ Black medick ▪ Common dandelion ▪ Grass * ▪ Sow thistle * ▪ Stinkweed ▪ Willow * (including thicket type)

Stake #22 Facing intersection of Environmenta l Reserve and Easement and Crown Land	Start: N 52.32815° End: W 114.07240°	<ul style="list-style-type: none"> ▪ Thistle * ▪ Black medick ▪ Grass * ▪ White cockle ▪ Scentless chamomile ▪ Hemp nettle ▪ Red clover ▪ Goldenrod ▪ Sow thistle * ▪ Grass * (including reed canary grass) ▪ Sedges * ▪ Cattails ▪ Siberian yarrow ▪ Wild rose * ▪ Common dandelion ▪ Rough cinquefoil or silverweed ▪ Purple aven ▪ Willow * (including thicket and bush type)
Stake #22 Facing Crown Land	Start: N 52.32816° End: W 114.07211°	<ul style="list-style-type: none"> ▪ Thistle * ▪ Grass * (including reed canary grass) ▪ Scentless chamomile ▪ Alsike clover ▪ Rough cinquefoil or silverweed ▪ Sedges * ▪ Thistles * ▪ Goldenrod ▪ Cattail ▪ Narrowleaf hawkweed ▪ Hemp nettle ▪ Common dandelion ▪ Willow * ▪ Wild rose *
Stake #25	Start: N 52.32816 ° End: W 114.07211°	<ul style="list-style-type: none"> ▪ Grass * (including fescue tribe and reed canary grass) ▪ Sow thistle * ▪ Cattail ▪ Meadow horsetail ▪ Lamb's quarters ▪ Thistle * ▪ Hemp nettle ▪ Wild buckwheat ▪ Scentless chamomile ▪ Alsike clover ▪ Stinkweed ▪ Willow * (including bush type) ▪ Aster *

Stake #30	Start: N 52.32801 ° End: W 114.07143°	<ul style="list-style-type: none"> ▪ Narrowleaf hawkweed ▪ Scentless chamomile ▪ Common dandelion ▪ Black medick ▪ Grass (including barley tribe and reed canary grass) ▪ Hemp nettle ▪ Meadow horsetail ▪ Wild buckwheat ▪ Stinkweed ▪ Cattail ▪ Willow * (including bush type) ▪ Sedges * ▪ Thistle * ▪ Cow parsnip ▪ Wild rose * ▪ Great bulrush – soft stem ▪ Wild vetch ▪ Alsike clover ▪ Common plantain ▪ Goldenrod
Stake #34	Start: N 52.32821° End: W 114.07108°	<ul style="list-style-type: none"> ▪ Willow * (including bush type) ▪ Grass * (including reed canary grass) ▪ Thistle * ▪ Stinkweed ▪ Hemp nettle ▪ Sow thistle * ▪ Great bulrush – soft stem ▪ Alsike clover ▪ Lamb's quarters ▪ Wild rose * ▪ Golden rod
Addendum: Additional vegetation observed from the lake	n/a	<ul style="list-style-type: none"> ▪ Common great bulrush ▪ Arum-leaved arrowhead ▪ Pondweed species * (Thread leaved or Frie's) ▪ Richardsons pondweed ▪ Hornwort ▪ Pale persicaria ▪ Nodding beggarsticks ▪ Yellow sweet clover

** Species were identified where possible, and where it was not possible, vegetation was identified to the genus level.*

Works Cited

- [1] Summer Village of Jarvis Bay and Twin Fawn Holdings Ltd., *Development Agreement*, Jarvis Bay: Summer Village of Jarvis Bay and Twin Fawn Holdings Ltd., 2014, p. 48.
- [2] Cows and Fish, Caring for the Green Zone - Riparian Health Assessment for Lakes, Sloughs and Wetlands, Lethbridge: Graphcom Printers Ltd. , 2014.
- [3] Alberta Stream Watch Conservation Coalition, Jarvis Bay Habitat Study, Jarvis Bay, 2005.
- [4] Alberta Government, "Environmental Code of Practice for Pesticides," 12 May 2010. [Online]. Available: <http://www.qp.alberta.ca/documents/codes/PESTICIDE.pdf>. [Accessed 28 Oct 2016].
- [5] BAAH'D Plant Management & Reclamation, "How Target Browsing Works," 2016. [Online]. Available: <http://organicweedcontrol.ca/hitting-the-target/>. [Accessed 28 Oct 2016].
- [6] City of Calgary, "Wetland Conservation Plan," 14 May 2004. [Online]. Available: http://www.calgary.ca/CSPS/Parks/Documents/Planning-and-Operations/Natural-Areas-and-Wetlands/wetland_conservation_plan.pdf. [Accessed 28 October 2016].
- [7] Google Maps, "Jarvis Bay," 23 Aug 2015. [Online]. Available: <https://www.google.ca/maps/@52.3289955,-114.0738042,324m/data=!3m1!1e3>. [Accessed Sept 2016].