

Gabriola Streamkeepers—Water levels and quality

## Observations at Coats Marsh, Gabriola Island

—with notes on Coats Marsh Creek, East Path Creek, and Stump Farm Streams.

### Brief history of the weir

#### *Master file:*

[Observations at Coats Marsh RP](#) , File 673 .

The master file, begun on July 18, 2015, is no longer regularly updated but measurements of water levels made after July 17, 2020 when the master file was closed continue to be reported in the individual Field Observation files and the summary file File: [673b](#). The intention is to continue making measurements and to keep this summary file current.

#### *Background files:*

[Coats Marsh 2011–2021 Management Plan](#)

(Section 1.1 Park Overview and Section 2.3 Property History)

Coats Marsh 2011–2021 Management Plan [Appendices](#)

[Published in August 29, 2011, these two documents are in places in need of revision.]

[Coats Marsh hydrogeology](#), File 668.

Coats Marsh [Water balance and catchment area calculations](#), File 673u.

Coats Marsh [Notes on evaporation and evapotranspiration](#), File 673t.

#### *Observation files containing field notes are:*

2015: Supplementary file “[Field Observations 2015](#)”, File 673d.

2016 (Jan. - Mar.): Supplementary file “[Field Observations 2016-1](#)”, File 673e.

2016 (Apr. - June): Supplementary file “[Field Observations 2016-2](#)”, File 673f.

2016 (July - September): Supplementary file “[Field Observations 2016-3](#)”, File 673g.

2016 (October - December): Supplementary file “[Field Observations 2016-4](#)”, File 673h.

2017 (Jan. - Mar.): Supplementary file “[Field Observations 2017-1](#)”, File 673j.

2017 (Apr. - September): Supplementary file “[Field Observations 2017-2](#)”, File 673k.

2017 (October - December): Supplementary file “[Field Observations 2017-3](#)”, File 673m.

2018: Supplementary file “[Field Observations 2018](#)”, File 673n.

2019: (Jan. - June): Supplementary file “[Field Observations 2019-1](#)”, File 673q.

2019: (July - December.): Supplementary file “[Field Observations 2019-2](#)”, File 673r.

2020 (Jan - June): Supplementary file “[Field Observations 2020-1](#)”, File 673s.

2020 (July - December): Supplementary file “[Field Observations 2020-2](#)”, File 673v.

2021 (Jan. - July): Supplementary file “[Field Observations 2021-1](#)”, File 673w.

2021 (July - Sept. ): Supplementary file “[Field Observations 2021-2](#)”, File 673x.

2021 (Oct. - Dec. ): Supplementary file “[Field Observations 2021-3](#)”, File 673y.

2022 (Jan. – Dec. ): Supplementary file “[Field Observations 2022](#)”, File 673z.

2023 (Jan. – Apr. ): Supplementary file “[Field Observations 2023-1](#)”, File 673za.

2023 (May –Aug.): Supplementary file “[Field Observations 2023-2](#)”, File 673zb.

2023 (Sept. – ): Supplementary file “[Field Observations 2023-3](#)”, File 673zc.

## Brief history

*Note: references in parentheses are to the annotated photograph at the end of this article.*

The shallow-water wetland in Coats Marsh (often known as the “lake” though this is technically incorrect) has existed since the end of the last ice-age, albeit while sometimes being dry. Its ancient history is evidenced by it having a thick bed of clay, the result of the weathering of accumulations of glacial-flour rich in plagioclase, and traces of the diatomaceous earth that probably date back to the Holocene Climatic Optimum period in BC’s climate. Beavers have likely lived here off and on since about 5000 years ago when the rainforests first developed.

The lake is basically a shallow saucer less than two metres deep and once partially retained by a sandstone ridge at the western end of the lake. It has no inflows from creeks or springs in summer, but lives almost entirely on its accumulation of winter precipitation. This is something it manages to do despite evapotranspiration and low rainfall throughout the summer because its clay-rich bed helps retain water by severely limiting infiltration into the underlying bedrock. In winter, the lake drains into Coats Marsh Creek, which leads down to Hoggan Lake, and then to the sea. The bed of the creek is sandstone bedrock and so is able to resist erosion by floodwater.



Survey 1874/5 showing the NW¼ and NE¼ of Section 10 owned at the time by William Hoggan. Coats Marsh is outlined and shown as unforested swamp in the centre, straddling the two quarter-sections as it does today. Early maps were careful to include swamps because land unsuitable for agriculture did not count toward the area being pre-empted. East Path Creek (the solid wavy line) is traceable all the way back to McGuffies Swamp, but no similar outlet from the marsh down to Hoggan Lake on the left is apparent.

The significance of the lightly dotted line running E-W through the middle of the marsh, parallel to, and north of, the bold dotted “Road to Easson’s” heading off NE, is unclear. If a trail, then was it used when the swamp was dry or very shallow in summer, or when it was iced over in winter? This marking is copied in some later maps.

Draining the lake for agricultural purposes was accomplished by blasting and trenching a deep narrow gully, a fissure, through the sandstone ridge. (5) This was probably done by Bill Coats who acquired the land in the early 1940s after a massive wildfire in the summer of 1938.<sup>1</sup> He would have had access to black powder (gunpowder) through his former millstone operations. It was Bill who ploughed a drainage ditch through the marsh, the path of which, although now underwater, can still be seen in satellite pictures, and once this was done, he used it to graze cattle and grow hay. (9)

Sometime *circa* 1968 according to Gordon McDonald,<sup>2</sup> the fissure was blocked by an 18-foot-wide weir. This weir had two concrete columns bonded to the sandstone and spanning the fissure except for a two-foot-wide gap mid-way between them. This gap was closed by a baffle, a simple sluice gate, which consisted of 2 X 12-inch wooden planks stacked one on top of the other and held in matching vertical grooves in the columns and sealed by the pressure of the water. The height of the baffle could thus be adjusted, a foot at a time, by adding and removing a plank to either hold back water or allow water to drain through the gap into the creek. Because the fissure is over three metres deep (10 ft.), removing all the boards allowed the marsh to be drained completely, but in his day, Bill was often frustrated by the island's duck hunters who for their own reasons preferred to keep the baffle stacked with planks and the marsh flooded.

The weir remains today much as when it was first constructed. Clyde Coats, Bill's son, used it to drain stored water down into Hoggan Lake to augment his hydro-electric power generation plant. For a brief period when it was a meadow and pasture,<sup>3</sup> there were radio antennas there, and you still come across junk if you auger down through the bed of the lake. There was talk at one time of the area being used as a cranberry farm but that remained just an idea.

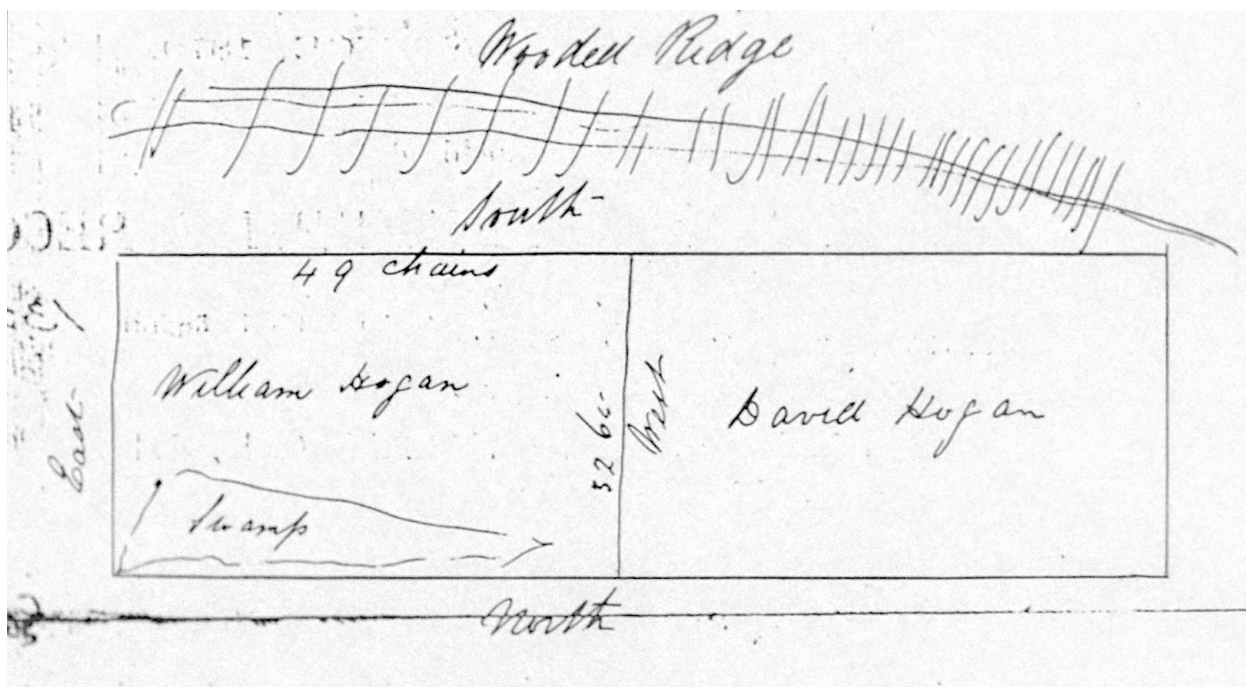
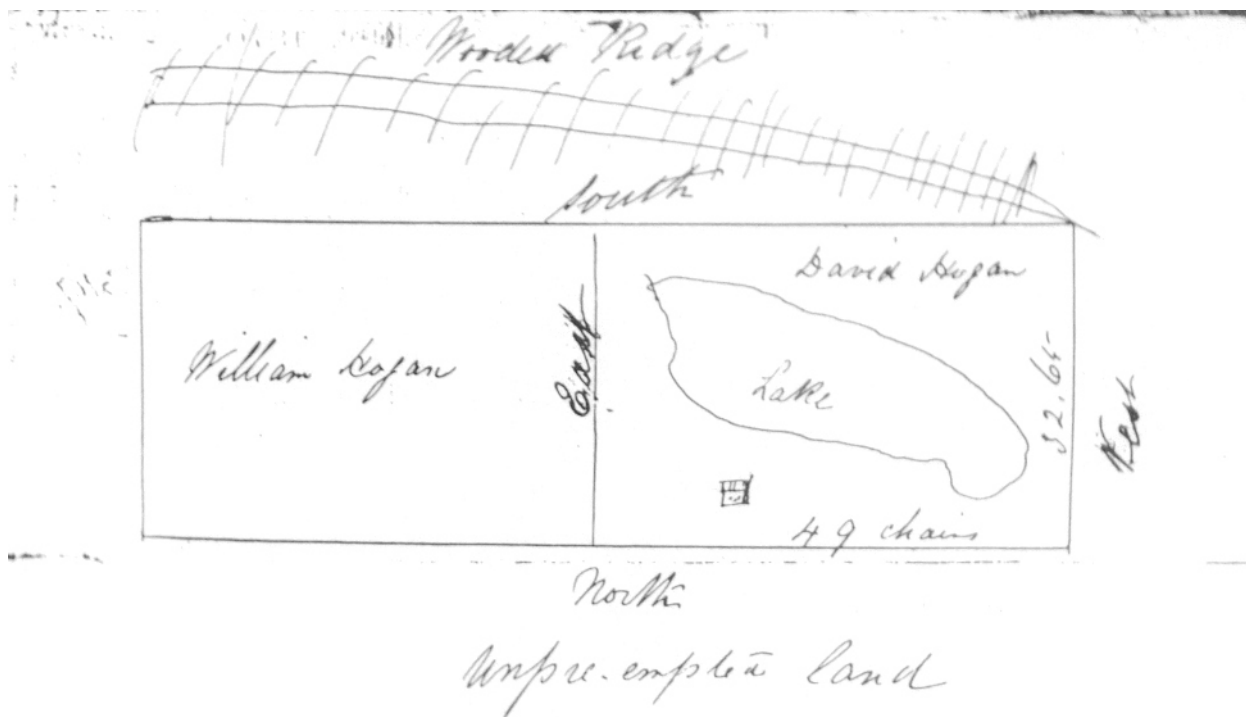


NRC topographical map 92G/4 Nanaimo, Edition 5 from 1989 data. The 140 presumably is the height of the top of the antenna(s) above sea level. The four tower foundation remnants are usually submerged.

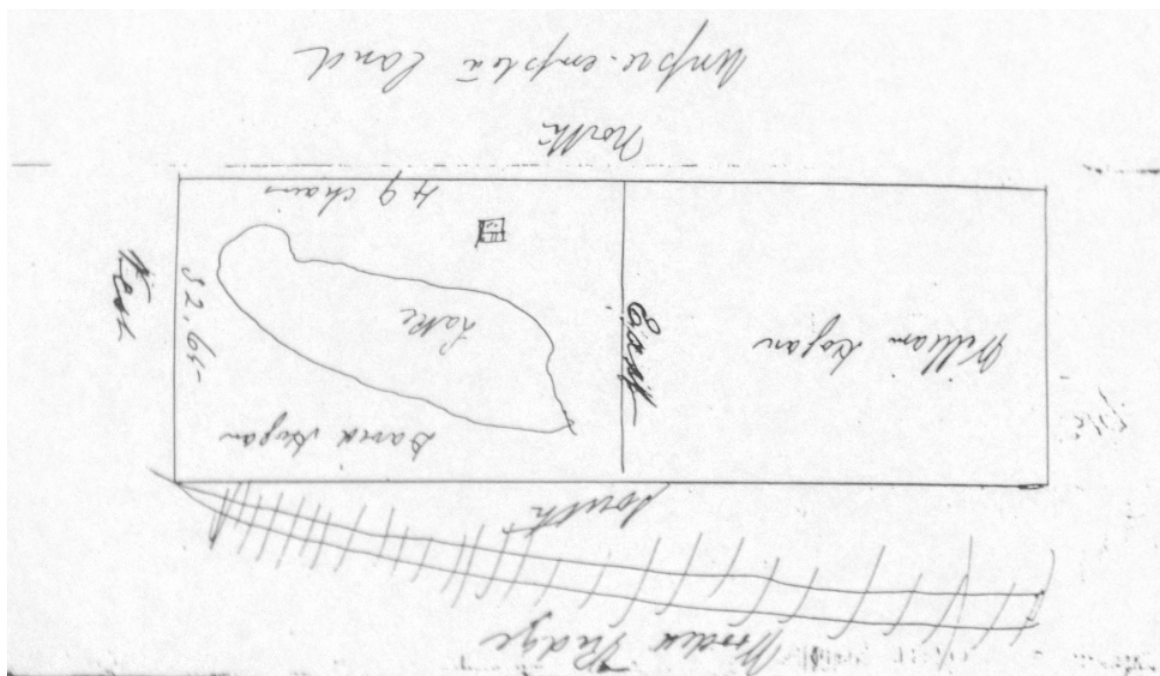
<sup>1</sup> Bill Coats bought the land from John Olsen who used to cut poles for telegraph lines. John's pile of poles at the Stump Farm site was destroyed in the fire. (Aula Bell & Neil Aitkin, Gabriola Island Place Names, 1996)

<sup>2</sup> Clyde Coats inherited the marsh in 1963 according to the RDN Management Plan, but his father Bill Coats did not die until 1980 and he was, according to those who knew him, an enterprising land manager.

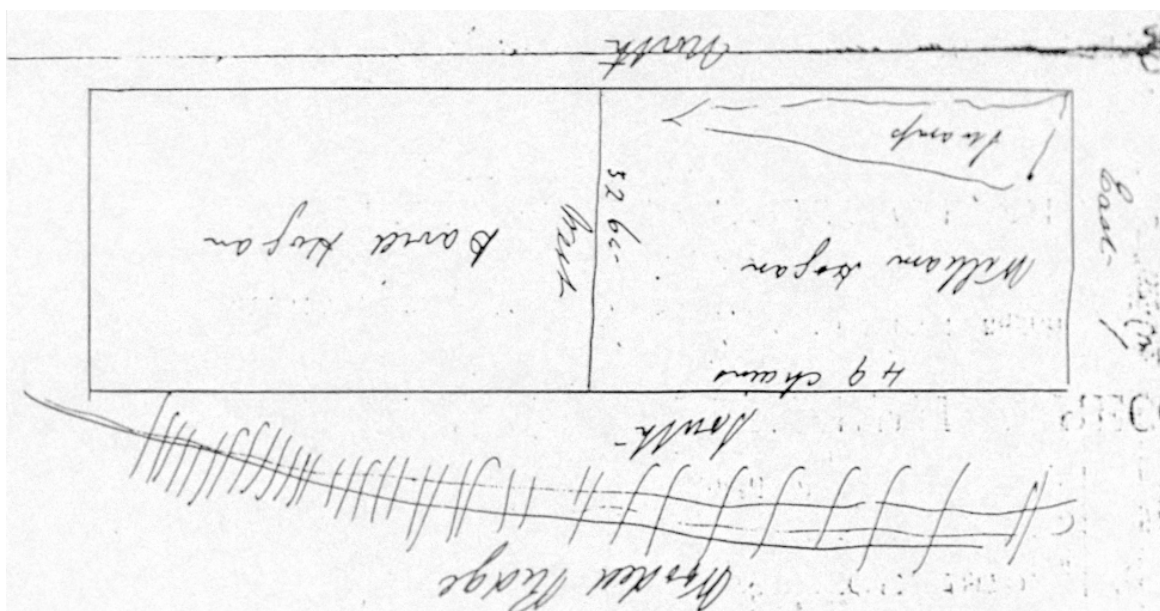
<sup>3</sup> The whole present-day "lake" area was surrounded by a barbed-wire fence, remnants of which are still visible.



Sketches from the pre-emption claims of David Hoggan (*above*) and William Hoggan (*below*) dated July 20, 1872. The two claims show identical tracts of land and differ only in the depiction of waterbodies. David Hoggan's claim shows a lake (Hoggan Lake), and William Hoggan's claim shows a swamp (Coats Marsh). The orientation of these sketches is unusual and needs to be rotated 180° to put north at the top (see next page). The dimensions of the claims are also unusual, being 49 x (1600/49=32.65) chain<sup>2</sup> instead of the shortly-after standardized 40 x 40 chain<sup>2</sup> = 160 acres (a ¼ Section in a cadastral map).



David Hoggan's claim re-orientated with north at the top, though I'm not sure that the orientation of Hoggan lake is as he intended. Certainly the Hoggan homestead was on the north side of the lake. David was granted both the NE¼ of Section 11, the E½ of the NW¼ of Section 11, and some remainders so he owned all the land surrounding Hoggan Lake. His 1½ Sections amounted to  $60 \times 40 = 49 \times 49$  chain<sup>2</sup>. A possibility is that this "extra" acreage was allowed because Hoggan Lake was deemed to be unsuitable for development. Hoggan Lake actually remains public, albeit with no public access.



William Hoggan's claim similarly re-orientated with Coats Marsh (swamp) in the NE corner of the claim. William was granted both the NW¼ of Section 10 and the W½ of the NE¼ of Section 10 so he owned all of the land surrounding Coats Marsh. A possibility again is that this "extra" acreage was allowed because Coats Marsh was deemed to be unsuitable for development.



Snags at the margin of the lake killed when the site was re-flooded. Picture taken September 2009 near the weir. The then newly-constructed beaver lodge is just visible in the bottom right-hand corner of the picture.

*Courtesy Liz Ciocea and Christine McKim.*

During the period when it was drained, there would have been no beavers at the lake but I remember being told that a beaver from Hoggan Lake was re-introduced to the marsh by Clyde after draining operations ceased, which was sometime between 2002 and 2005.<sup>4</sup> I'm not sure if this is true or not as I never spoke to Clyde about this.<sup>5</sup> The beaver these days can make the journey to Hoggan Lake and back by itself along the course of Coats Marsh Creek which it does from time-to-time. The beaver is a solitary male and has no family in residence in the marsh.<sup>6</sup>

<sup>4</sup> Jethro Baker recalls riding a dirt-bike at the site when he was a kid *circa* 1986. Dates are from air photos.

<sup>5</sup> At the park opening ceremony in May 2009, *The Flying Shingle* (June 5, 2009, p.2) reported Clyde as remarking that "...a beaver had taken up residence in the park, building a 15.5-foot dam immediately in front of the 15-foot human made concrete dam that was there previously". This casts a little doubt on the idea that it was Clyde who introduced the beaver. I take his remark to mean that the "beaver dam" at that time was much closer to the weir than the present-day large dam further out into the wetland..

<sup>6</sup> Beavers living alone in this way are not that unusual.

When the RDN and TNT/NTBC acquired the park in 2008, they committed to alleviating the flooding of Lot 5 at the western end of the marsh. This was due to high water flowing through a dip in the land level on the south side of the weir, inundating an area in Lot 5 before running off into the creek below the weir. A beaver-proof Clemson 8-inch pond leveller was installed in October 2009, after the then topmost baffle plank was removed.<sup>7</sup> The debris accumulated just a few metres upstream of the baffle was removed.<sup>8</sup>

When this proved inadequate to control the flow of flood water, in 2013 a berm was built over the low-lying land to the south of the weir, raising the surface there ~~several inches~~ 0.3 metres above the top of the weir. (4) The tops of the columns were at that time connected with a wooden walkway known now as the deck, File: [6104](#).

The leveller was set above the baffle, but below the top of the columns. The theory was that the summer level would be set by the sill of the baffle and the winter level by the leveller. However this was predictably unsuccessful.

In summer, evapotranspiration, which is normally around 3.5 mm/day but can reach as high as 5mm/day, always reduced the lake level to below the sill, and in winter, the capacity of the pond leveller was insufficient to handle the volume of flood water, and the weir and its deck were regularly inundated, fortunately with no flood damage downstream. Flooding the deck significantly limits the rise in the water level in the weir pool by effectively widening the sill from 2 feet to 20 feet.

The berm however has never been breached though there is probably some minor leakage underneath it in winter. Coats Marsh Creek drains very rapidly and harmlessly into wetland in the northwest corner of the park and from there down into Hoggan Lake. There are no bottlenecks in its watercourse beyond one slightly undersized (24") culvert, which flood water flows around.

Flash flooding is a well-known phenomenon in warmer and drier climates than ours and has many causes, but the “flash flooding” that occurs some winters at the marsh is due to the uncommon configuration of the bedrock fractures on the island. There is a detailed technical analysis of this in File [673u](#), but briefly the bedrock in the catchment area to the east of the lake is sandstone that is anisotropically fractured. The deeper tectonic Eocene fractures (the ones that hold groundwater on Gabriola) run sub-vertically; while the much shallower glacial fractures that are due to deformation during the Pleistocene and subsequent post-glacial relaxation run sub-horizontally.

In the early part of the wet season a large fraction of the groundwater is accumulated in the vertical fractures that are only poorly interconnected. Once these are full however, the groundwater level rises to that of the horizontal fractures which are highly interconnected. Some time in mid-winter after a couple of days of continuous rain, there is therefore a rather sudden increase in run off into the marsh, and the volume of this water can and has been significantly greater than the capacity of the pond leveller.

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<sup>7</sup> In 2015, the top of the baffle was 0.64 m below the top of the concrete weir, but if during installation of the pond leveller one of the planks was removed, the old top of the baffle would have been *circa* 0.34 m below the top. One more plank would have completely closed it.

<sup>8</sup> In historical documents this is sometimes referred to as “removal of the beaver dam” but this should not be taken to mean removal of the much larger dam upstream spanning the width of the waterbody.

The subsequent "flooding": which has in the past flowed over the weir and deck, runs down into the outlet fissure where it rapidly drains away to wetland in the northwest corner of the park with no damage to residents' property or to the structure of the weir. Neither of the residents subject to this flooding have any complaints or concerns about it since the berm was built. The only significant infrastructure at risk during a hypothetical catastrophic flood, such as has never occurred, is a log cabin on Lot 5 that is built on stilts that allows high water to flow beneath it. Flooding generally lasts for just a few days.

Ironically, the beaver dam helps alleviate flooding on by holding back the run-off (making it available for maintaining a healthy water level in the height of summer) and by relieving the intensity of the flow by three major spillways in its dam. A sudden overflow of the rim of the beaver dam has never been observed, nor has flooding of the weir since the beaver dam reached its current stable height (but see File: [673z](#), July 14, 2022 for an update on the largest rise in water level ever recorded). Given that the current leveller is too small to handle the flood water, it is unlikely that one of the same size at the beaver dam would be able to either.

The increase in the volume and depth of water stored in the lake has significantly enhanced the ecology of the lake. In the past two or three years, I have had great pleasure in observing that tree-cavity nesting ducks (hooded mergansers and wood ducks) have begun to use the marsh for breeding as have pied-billed grebes that use for nesting aquatic vegetation, not the agricultural exotic grasses that will replace it and used to grow there if the level is reduced to 2015 levels or less. There are now summer resident waterfowl, while before, watershield completely covered the surface in summer and there were rarely any ducks to be seen. Ducks have recently started to use the lake as a refuge during their annual post-breeding moult in late-summer during which they are at times flightless and vulnerable. Swans and geese regularly use the lake in foul winter weather.

There has been much talk of the perceived damage that a catastrophic failure of the beaver dam could cause. It should however be remembered that:

- (i) beaver dams are very robust and the probability of a complete simultaneous failure of all parts of the dam has been assessed by experts in beaver technology as zero;
- (ii) damage to downstream infrastructure is in the opinion of the landowners likely to be minimal. There is no endangerment of humans as the log cabin downstream would not be in use in winter when a serious flood would occur if it were to occur at all;
- (iii) the debris released by several breaches of the dam would quickly choke the channel and hold back floodwater;
- (iv) the siphon system installed to relieve pressure on the dam in flood conditions has proved inadequate. Flood volumes are far more than the siphons can handle.
- (v) the bed of Coats Marsh Creek is sandstone bedrock so scouring by floodwater is not much of an issue;
- (vi) removing the dam would likely result in it being later re-built either by the same beaver or by another;
- (vii) the beaver has survived in the marsh for over twenty years and has not run-out of food. He remains active in maintaining the dam.

The following photograph of the marsh is *Courtesy Libby Gunn*.





The picture was taken from a helicopter above the west end of the marsh (Lot 5) on October 13, 2022. The view is close to being due east, with the northern shore on the left. The key to the points identified are as follows:

1. the beaver dam dividing the wetland into two sections. The dam is mature and given the lake-like setting, very stable.
2. the beaver lodge. The beaver sometimes goes absent for a few weeks at a time, presumably down to Hoggan Lake, but he always comes back. He was seen at the lake on September 28, 2022.
3. the embayment at the western end of the wetland created by the beaver dam (1). Now known as the weirpool, although in the past it has also been written weir pool and weir-pool, and named weir bay, west-end bay, or just the west end. The residents (Lot 5, visible at the bottom of the picture) refer to it, or used to refer to it, as the “inner marsh”.

4. the berm built to protect the private property from flooding from the weirpool (3).
5. site of the Clemson leveller and concrete weir. Headwater of Coats Marsh Creek.
6. the shallow-water wetland, often called informally and technically incorrectly as the lake. Includes the weirpool (3). The green-beige surface is watershield (*Brasenia schreberi*), the dominant aquatic surface plant in summer. The residents at the western park boundary refer to, or used to refer to the wetland beyond the beaver dam (1) as the “outer marsh” as distinct from the “inner marsh” (3).
7. the inlet from the channels draining the NE Arm wetland. There is a hydrological map in File [668](#). Watercourses from the NE Arm wetland down to the lake are mostly irregularly strewn. The beaver regularly spends time here, perhaps attracted by the red alder trees.
8. the western burn-pile clearing. Quote from the Management Plan: “For approximately 20 years prior to park designation [in 1989], woody debris [mainly stumps], was stockpiled on the northern margins of the wetland in the Coats Marsh RP property and burned annually in the autumn under permit from the BC Ministry of Environment. There are no known incidents of wildfire on the property.” See footnote 1.
9. track of the ditch dug by Bill Coats in a time when the wetland was completely drained. It is now too deep to support watershield (6), which is rooted in the lake bed.
10. the eastern burn-pile clearing. See 8.
11. the concrete cistern built for watering cattle at the east end used now as a lake-level datum.
12. the Stanley Place entrance. The lake is far too small for footpaths, observation posts, boardwalks and the like to be built around it without destroying its seclusion and without seriously disturbing wildlife, particularly in the waterfowl breeding season.
13. the inlet from the East Path Creek (and two associated springs) that flows through the SE Arm wetland in the wet season. There is a hydrological map in File [668](#).
14. Beaver Bay. So called because of intensive beaver activity there. It has become a favourite secluded resting area for waterbirds, and it remains relatively ice-free in winter.

## The flood of March 10, 2016 (day +236)

Photographs and text here are supplementary to those in Files [673](#) and [673e](#).

This is not the highest flood event known to have occurred but it is the highest where the creek flow was measured.



View from the NW corner.



*Left:* View from the SW corner.

*Below:* The berm is all above the water level.





## The flood of November 15, 2021 (day +2312)

Photographs and text here are supplementary to those in Files [673](#) and [673y](#).

No measurement was made of the flow in Coats Marsh creek. The berm was not breached except where water circles harmlessly around the ends of the weir and adds to the flow into the creek. There was a higher flood on March 14, 2014 but it too failed to breach the berm.







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