

David Patriquin

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Tue, Oct 1, 2024 at 7:30 AM

Oct 1, 2024

To: Honourable Tim Houston, Premier, Province of Nova Scotia,
Mayor John Savage, Halifax Regional Municipality

Honourable John Lohr, Minister of Municipal Affairs and Housing

Honourable Timothy Halman Minister of Environment and Climate Change

From: **David Patriquin**, Prof. of Biology, Dalhousie University (retired)

Subject:

The precarious state of Sandy Lake (Sandy Lake Special Planning Area)

I am writing to you as key decision-makers in relation to a major challenge that faces us in HRM and Nova Scotia at large: the need to address the housing crisis and the combined Climate/Biodiversity crisis simultaneously, and as much as possible with approaches that are not compromises, that are win-win for both housing and our environment.

Specifically I want to bring to your attention a key issue pertaining to the state of Sandy Lake which lies within the Sandy Lake Special Planning Area in HRM. I suggest it is serious enough to warrant not proceeding with the development as currently envisaged, if at all; that if we do, we are very much addressing housing at the expense of Climate/Biodiversity, and also in the intermediate to longer term, the well being of the surrounding communities.

On the other hand, I suggest that we can place the currently proposed development on some of the already degraded lands or lands of much lower ecological value in the same general area and that by doing so we would be addressing both the Housing Crisis and the combined Climate Biodiversity Crisis simultaneously; and conserving a significant natural heritage/outdoor recreation area for the benefit of very many folks in a major growth area.

The details are in the letter and two related documents attached.

I am very grateful for your consideration of this issue.

Respectfully,

- *David Patriquin*

David G Patriquin
Professor of Biology (retired)
Dalhousie University

cc: Waye Mason (my HRM Councillor); Stantec (Halifax branch); OurHRMAlliance; Clayton Developments; Sandy Lake Conservation Association; Halifax Field Naturalists*; NS Wild Flora Society*

*Members of these societies have contributed observations at Sandy Lake & Environs

[Download all attachments as a zip file](#)

- PatriquinLetterSandyLakeSPA1Oct2024.pdf 558.5 kB
- PatriquinInConclusion1Oct2024.pdf 895.9 kB
- PatriquinFootnotes1Oct2024.pdf. 770.5 kB

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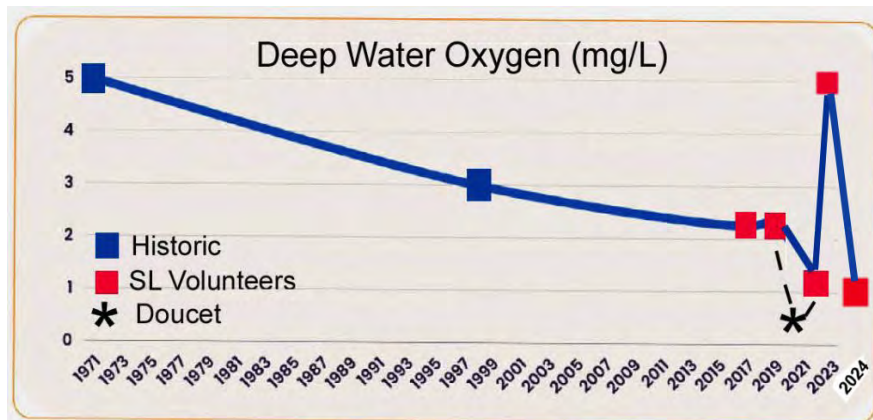
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Specifically I want to bring to your attention a key issue pertaining to the state of Sandy Lake which lies within the Sandy Lake Special Planning Area in HRM. I suggest it is serious enough to warrant not proceeding with the development as currently envisaged, if at all; that if we do, we are very much addressing housing at the expense of Climate/Biodiversity, and also in the intermediate to longer term, the well being of the surrounding communities.

On The “key issue”. With the help of volunteers from the Sandy Lake Conservation Association, I conducted a set of limnological (lake) observation in 2017, 2018, 2022, 2023 & 2024. Those observations, together with independent observations on Sandy lake in 2021 by Casey Doucet in relation to her Masters of Applied Science research at Dalhousie University and some historical data (1971, 1998), illustrate very clearly a long term decline in the deep water, near-the-bottom oxygen levels. Since 2021, with the exception of 2023, values they have been well below 2 ug/L; such low lvalues are usually associated with anoxia (no oxygen) at the sediment surface, a condition that is conducive to release of P (phosphorus) from the sediments, or what's termed “Internal P loading”.



That can set off a “run-away” process of P-enrichment and deterioration of lake health, and we have now some evidence of that occurring. More details including what was involved in the curious exception of 2023 are in the attached documents.

So Sandy Lake is in a highly precarious state *now* and likely highly sensitive to processes in the watershed that increase inputs of P, sediment, and oxygen-consuming organic materials. Against this backdrop, we have the prospect of a new residential development to support 6000 units (or even 9000 according some comments) placed not only in the watershed but directly on headwaters and associated wetlands close to Sandy Lake, a location where it would be most harmful. I suggest no amount of Best Management Processes could prevent significant impacts on the lake, and in its precarious state, its rapid deterioration. More details, evidence etc are in the attached documents.

I am fully aware that a new Watershed Study is in progress and should be available sometime this fall. I hope that will address, critically (with rigor), the issues I cite above. I chose not to wait for the Watershed Study because I have no idea when it will come out (except sometime this fall) and it seems likely or at least many people are anticipating that it will be accompanied by or be followed shortly afterwards by some sort of final decision about the Sandy Lake development. So I felt these concerns needed to be brought to the attention of decision-makers as early as possible after we completed the final limnological observations for this year, which was on Aug 12, 2024.

From early on I have communicated with the consultants conducting the Future Serviced Communities Studies for the Sandy Lake Study Area, given them all of the results and my interpretations and I discussed earlier results with them in two online meetings in 2023. So I was somewhat shocked when the [Draft LSA](#), issued in April 2024, referenced only the “LakeWatcher observations” at Sandy Lake, i.e. only to those from 2022 onward conducted in collaboration with the HalifaxLakeWatchers program, and not our earlier 2017 & 2019 results nor those in 2021 by Casey Doucet. Further, they concluded from a narrow interpretation or narrow selection of the data they did look at that “Sandy Lake is not significantly affected by urban runoff or erosion within the watershed”. That assertion is simply at variance with our observations, with a lot of science and particularly with the evidence and assumptions underlying the use of phosphorus load models to anticipate or estimate impacts of development on receiving waters so routinely used by HRM and many other jurisdictions.

I appreciate that the [Draft LSA](#) document was indeed a DRAFT and hopefully the final report will be more rigorous in these regards – as I would expect of Stantec. As well as for decision-makers, I wrote the attached document for consideration by the consultants as they prepare those final reports.

So I am asking you to consider seriously these issues, to ask your experts to address my comments and critique them as they might wish or have them critiqued by an independent 3rd party. I am very willing to discuss them further. I am a scientist, retired, and while the observations were done voluntarily without support from grants etc., and are not formally published, I have applied scientific rigour to the observations and interpretations and believe they will stand up to peer review and I would be happy to see it. (I have, informally, discussed these issues and received and responded to comments from two research scientists and one limnologist/engineer.)

Beyond the issue of the state of Sandy Lake itself, there are many reasons why the development as envisaged is highly problematical from an ecological perspective, notably (i) the loss of habitat in what is essentially a hotspot of bioiversity (13 Species-At-Risk), and (ii) the loss of a now more-critical-than-ever wildlife corridor, albeit pretty well reduced to a “stepping stone” corridor, between the lands of the Chebucto Peninsula and the greater NS mainland.

Finally, if this development goes ahead as envisaged, it will eclipse the prospect of realizing a Sandy Lake-Sackville River Regional Park first elucidated in 1971 (with a fairly detailed conceptual map produced in 1979). It made sense then, and given the rapid growth in the surrounding communities, it makes even more sense today and into the future.



Fig 5. The proposed Sandy Lake – Sackville River Regional Park lies between growth areas on all sides. What a precious gift to future generations that would be. Map from Appendix L in the **RP+10 Submissions (2020) from the Sandy Lake – Sackville River Regional Park Coalition. This version of the park is not very different from that detailed in 1979 – surely its time has come.**

Surely for the sake of Sandy Lake & Environs remaining a precious recreational and ecological asset within a 'Growth Landscape', we can place the currently proposed development on some of the already ecologically degraded lands or lands of much lower ecological value in the same general area – and there appear to be `ample of them - and take the steps needed to finally realize a Sandy Lake – Sackville River Regional Park.

Most importantly, by doing so we would indeed be addressing both the Housing Crisis and the combined Climate/Biodiversity Crisis simultaneously; and conserving a significant natural heritage/outdoor recreational area for the benefit of very many folks in the future.

Respectfully,

– David Patriquin

<p>cc: Waye Mason (my HRM Councillor) Stantec (Halifax branch) OurHRMAlliance Sandy Lake Conservation Association Halifax Field Naturalists* NS Wild Flora Society* *Members of these societies have contributed observations at Sandy Lake & Environs</p>	<p>Attached: - PatriquinFootnotes1Oct2024.pdf - PatriquinInConclusion1Oct2024</p> <p>These two documents can be viewed online: Go to www.versicolor.ca/sandylakebedford Go to Quicklinks on the Main Menu Select – In Conclusion... & – Footnotes</p>
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Sandy Lake & Environs (Bedford, Nova Scotia)

A Natural History Perspective

In Conclusion...

The conclusion from our latest (Aug 12, 2024) limnological profiles: they further confirm a long term trend of decline in the health of Sandy Lake (Bedford, NS) suggested by our previous and some historical observations, and underscore why a major new development on its headwaters could "do it in". The evidence and rationale for that assertion is provided in detail in many separate pages on this website. This page provides a concise overview of the key facts and arguments.

by David Patriquin [1]



Volunteer Ed S with YSI instrument and probe on Sandy Lake

NAVIGATION

Where this page resides; related pages

www.versicolor.ca/sandylakebedford

Website for Sandy Lake & Environs (Bedford, Nova Scotia)

...[Surface Waters](#)

.....[Sandy Lake](#)

.....[Limnological Profiles](#)

.....[2024 Limnological Profiles](#)

.....[Addendum 1: Trends in Conductivity/Salt Content](#)

.....[Addendum 2: On Wetlands](#)

.....[On wetland Benefits \(WESP\)](#)

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Some basic limnology:

– [Lake Stratification](#)

– [Trophic States of Lakes](#)

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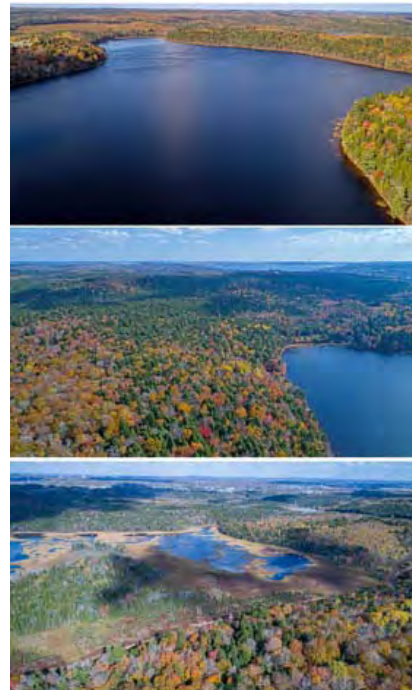
1. [Introduction](#)
2. [AECOM 2014 Predictions](#)
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4. [A concerning anomaly: a Metalimnetic Oxygen Minimum](#)

- 5. [Water Quality Objectives of AECOM 2014 are not adequate to protect Sandy Lake](#)
- 6. [A major development on the headwaters of Sandy Lake is not compatible with reversing current trends](#)
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1. Introduction

Sandy Lake is the diamond in a remarkable piece of land sandwiched between four growth areas (Lower and Middle Sackville-Bedford-Hammonds Plains-Lucasville Road) just NW of Bedford and the top of the Bedford Basin. The Sandy Lake watershed is the largest or second largest sub-watershed of the Sackville River Watershed, depending on how the sub-sub-watersheds are aggregated. That's the watershed, Sandy Lake included, where salmon are coming back thanks to the efforts of the Sackville Rivers Association and its many supporters.

The large, still undeveloped area includes a wildlife corridor, now mostly a "stepping stone" but still critical for movement of wildlife/genetic transfer (plants included) between the Chebucto Peninsula and the greater Nova Scotia Mainland. It supports great swaths of Wabanaki/Acadian forest, most of it old forest with many pockets of Old Growth; there are even bear in the forests by the Sackville River. Marsh Lake, downstream from Sandy Lake is a "[Treasured Wetland](#)". Thirteen Species-at-Risk make use of this landscape. [2]



Great swaths of mixed Wabanaki/Acadian forest by Sandy Lake; bottom, Marsh Lake [View more aerial vistas.](#)

Click on images for larger versions



Left: old logging road

Right: Informal trail

The landscape is riddled with old logging roads and foot trails, enjoyed in all seasons by many but with a potential to serve many more. Sandy Lake Beach Park, founded by the Bedford Lions Club and now managed by HRM, is a magnificent, family oriented facility with a long shallow area safe for swimming, kids walk the beaches by adjacent wetlands fascinated by the tadpoles and frogs, others catch fish and paddle. Through all seasons, dog walkers frequent a trail/old logging road that skirts Sandy Lake Beach Park.





A Sandy Lake-Sackville River Regional Park, envisaged in some form or another since 1971, would provide a magnificent natural park/recreational area for the surrounding communities, conserve the biodiversity and the local and regional wildlife corridors and most importantly, the health of Sandy Lake and the downstream waters all the way to the Sackville River and thence to its mouth on the Bedford basin.

The many ecosystem services the area currently provides and the current and much greater potential social and recreational services would be severely reduced if the proposed major development to the west/southwest of Sandy Lake [3] goes ahead, none more so than the health of Sandy Lake itself. Below, I outline the basis for that assertion, detailed in other pages on this website [4].

To reduce clutter, I am minimizing the in-line links, and placing footnotes with explanatory details, critical references etc. on a [separate page](#). Clicking on the reference to a footnote [#Footnote] takes the reader to the particular item on the footnote page.

2. AECOM 2014 Predictions

The question of how a major development to the west/southwest of Sandy Lake could affect Sandy Lake was first addressed in "AECOM 2014", short for:

Halifax Regional Municipality Sandy Lake Watershed Study Final Report

Prepared by AECOM Canada Ltd., submitted August 25, 2014. 64 pages + Appendices (66 pages). "This body of work represents our current understanding of the environmental conditions in the watershed with a focus on lake water quality. The application of a phosphorus load model (Lake Capacity Model) provides a numerical narrative of how development may impact water quality. We identify several methods that can be utilized to mitigate water quality impacts."



Except for a few samples of lake water, AECOM 2014 was entirely a desktop study (as requested by HRM). See [About AECOM 2014](#) (a page on this website) for more about the study.

AECOM 2014 concluded from their modelling that residential development in the watershed as proposed at the time would be compatible with maintenance of acceptable Water Quality in Sandy Lake if certain mitigation measures were implemented.

However, AECOM 2014 also recognized that "the degree of influence of urbanization on water quality in Sandy Lake can only be approximated using the phosphorus load model because of limitations arising from assumptions and uncertainty in the application of the model". They

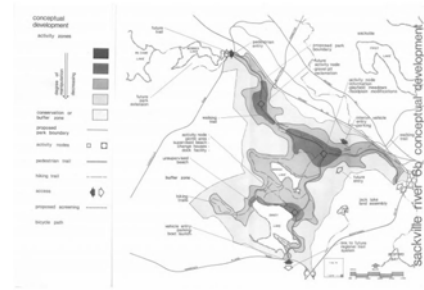


Fig. 1 **Sackville River Regional Park as envisaged in a 1979 report.** ([Click on image for a larger version](#)). [View 1979 Report](#). View website for the [Sandy Lake – Sackville River Regional Park Coalition](#) for the current vision of this park.

proposed a water quality monitoring plan for the Sandy Lake in order to “provide a further assessment of current conditions and to evaluate the impacts of development on the water quality.”

Such a plan was NOT implemented following acceptance of the AECOM 2014 Report.

3. Post-2014 monitoring reveals significant Water Quality issues

Beginning in 2017, I worked with two volunteers from the Sandy Lake Conservation Association, Ed G and Derek S, to obtain limnological profiles in the deepest area of Sandy Lake during the latter end of the summer stratification period in 2017, 2019, 2022, 2023 and 2024 and during the mixing period that follows spring turnover in 2022, 2023, 2024 [5].

Independently, Casey Doucet obtained limnological profiles from Sandy Lake in 2021 in conjunction with her research for a Masters of Applied Science degree at Dalhousie University [6]. Her observations are entirely comparable and complementary to ours, and provide some independent validation of our observations.

In a report on February of 2021 [7], I listed 4 major concerns about the state of Sandy Lake based on information gathered or made available after the AECOM 2014 report. The most immediate concern was “Low oxygen in deep water” about which I commented:

Our observations in 2017 and 2019 illustrate that deep-water oxygen levels were approximately half of the value observed in 1971 and were below levels required by salmonids. This difference is consistent with the lake having moved from an oligotrophic state to a mesotrophic state, and raises concern that the elevated deep water Total P levels noted by AECOM (2014) for two of three samplings in 2008, 2010 and 2011 is likely recurring and thus speeding eutrophication.

Subsequent observations further underscore that concern: in 3 of the 4 years (including 2024) in which late summer sampling was conducted after 2019, deep water (1 m from the bottom) oxygen levels were roughly half of those in 2017 and 2019 and well below 2 mg/L which is the approximate threshold value for occurrence of anoxic (lack of oxygen) conditions at the sediment surface [8].

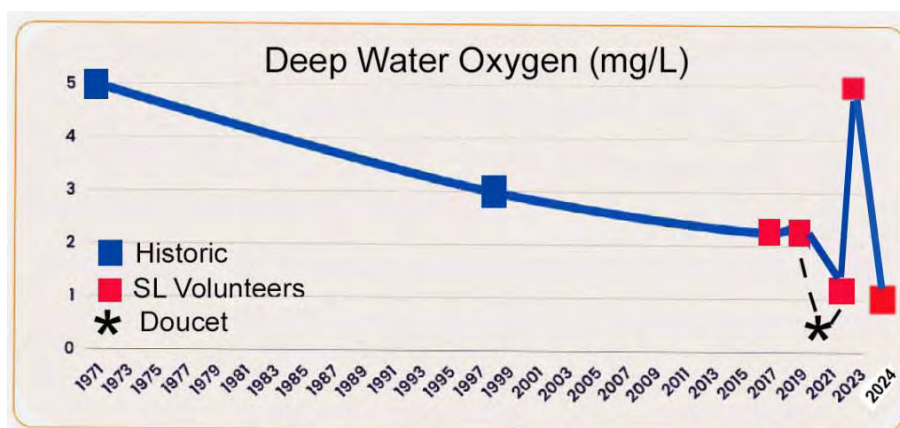


Fig. 2 **Deep water oxygen levels at Sandy Lake 1971-2024. A continuous trend of decline in deep water* oxygen** was interrupted in 2023, apparently due to flushing (turnover) of the lake brought on by heavy rains in Aug 2023. **“Deep water” is 1 meter off the bottom at the deepest spot in the lake which is circa 20-21 m depth

The 2023 value was highly anomalous and was close to the 5 mg/L observed in 1971; the conductivity values in 2023 were also anomalous and suggest that the extreme precipitation in the summer of 2023 essentially flushed the lake and re-aerated the deeper waters[9]. The phenomenon was not repeated in 2024 when we had more close-to-normal rainfall and the deep water oxygen was again very low. Further, the deep water total P value in August of 2024 was highly elevated (40 ug/L), indicating occurrence of “internal phosphorus loading”, also observed in 2021 and in some earlier years [10]; this phenomenon can accelerate deterioration of the lake [11].

4. A concerning anomaly: a Metalimnetic Oxygen Minimum

In addition to the decline in deep water oxygen, since 2021, we have observed an odd phenomenon in the late summer sampling, a “Metalimnion oxygen Minimum”. I first observed it in the August 2022 sampling: a dip in the oxygen to 2.4 ug/L centering at 5 m depth in the zone of sharp change in temperature (the Metalimnion or Thermocline). I was skeptical about its reality as the oxygen readings were taking too much time, I felt, to equilibrate; I wrote a note to the organization from which we had borrowed the equipment to suggest that perhaps the sensor membrane needed to be replaced.

In the late fall of 2022, Casey Doucet reported on limnological observations she had conducted on a suite of lakes in HRM, including Sandy Lake, in 2021, for her Masters of Applied Science research at Dalhousie University [6]. Her plot of oxygen versus depth for Sandy Lake in mid August 2021 showed almost exactly the same thing: a dip in oxygen to approx. 3.2 mg/L at 6 meters, in the metalimnion [12].

So I knew this dip was real. Then we observed the dip again in Aug 2023 and again in 2024 – 4 years in a row altogether (2021, 2022, 2023, 2024). [13].

I checked my “bible” on lakes – Wetzels Limnology, 3rd ed. (2001). It turns out that *increases* in oxygen in the metalimnion or “Metalimnetic Oxygen Maxima” are relatively common, *dips* in oxygen or “Metalimnetic Oxygen Minima” much less so. It appears they have not been previously reported to occur in NS lakes [14].

The precise cause of Metalimnetic Oxygen Minima may vary; they are more commonly observed in eutrophic (nutrient rich) lakes than in oligotrophic (nutrient-poor) lakes*. Interestingly, of the 4 lake profiles presented by Doucet 2022 [6] that were 15 m depth and greater, distinct dips in the metalimnion were present in the two (one of them Sandy Lake) that also exhibited very low oxygen and highly elevated total P levels near the bottom.

Metalimnetic Oxygen Minima in 2021 (Casey Doucet), 2022, 2023 and 2024 (our observations) were below 5 mg/L, and thus represent significant deterioration in the Water Quality of Sandy Lake for both both warm water and cold water aquatic life [15] beyond that associated with low deep water (hypolimnion) oxygen. Because Metalimnetic Oxygen Minima are usually associated in some way or another with enhanced respiration in shallower waters, they may also accelerate nutrient cycling and production in the upper waters (i.e. speed eutrophication)[16].

5. Water Quality Objectives of AECOM 2014 are not adequate to protect Sandy Lake

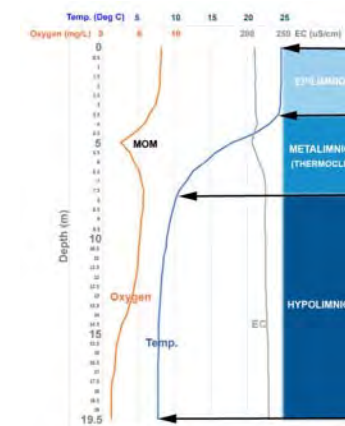


Fig. 3 Limnological profile in deepest area of Sandy Lake on Aug 22, 2022. “MOM”: Metalimnetic Oxygen Minimum.” EC: Electrical Conductivity

The trophic status of Sandy lake predicted by spring Total P values is in the oligotrophic to lower mesotrophic state [17]. However, the post 2014 observations of low oxygen levels in shallow (re Metalimnetic Oxygen Minimum) and deep (hypolimnion) waters, and evidence for internal phosphorous loading indicate that, regardless of the spring Total P values, in actuality Sandy Lake is exhibiting some critical features characteristic of lakes in more advanced trophic states [18].

In other words, our monitoring, combined with those of Doucet 2022, provide at least some of the “further assessment of current conditions” called for by AECOM 2014 [19] and the results clearly do NOT support the predictions and assumptions of the Lake Capacity Modelling conducted by AECOM 2014. In particular, the monitoring calls into question the AECOM 2014 assumptions or inferences based on Total P values alone, that (i) current lake water quality is “good” & (ii) the WQO (Water Quality Objective) for total phosphorus should be the upper limit of the mesotrophic range, or 20 ug/L [20].

In fact, the recent (2017-2024) observations combined with the historical data demonstrate that Sandy Lake has been on a downward trajectory since at least 1998 and is *currently* in a highly precarious state, the relatively low spring Total P values notwithstanding and let alone any consideration of significant new development within the watershed.

From a limnological perspective, the apparent contradiction between the trophic state based on Total P values (AECOM 2014) and the state of the lake based on the oxygen profiles and deep water P levels (Observations subsequent to AECOM 2014) is not unexpected in shallower and smaller lakes [21]. Deep water anoxia is becoming more common with climate warming [22], and could be further exacerbated by Internal Phosphorous Loading [11]. That does not make the Sandy Lake in its current state ‘normal’ and a condition we must accept, rather it behooves us to be even more stringent in our efforts to protect our lakes – and in the case of Sandy Lake, to take steps to reverse current trends *now*.

6. A major development on the headwaters of Sandy Lake is not compatible with reversing current trends

The precarious state of Sandy Lake currently, the increasing stresses on Sandy Lake anticipated with climate warming, and stresses that will accrue as already approved development in Sub-area 12 (Bedford West) proceeds, are factors that must be taken into account in any future assessments of the suitability of undeveloped lands in the Sandy Lake watershed for future development.

There is an additional, major factor at play that makes the currently proposed development – to the extent it has been described – even more of a threat to the health of Sandy Lake: it would be placed in an area of concentration of headwater watercourses and associated wetlands for Sandy Lake:

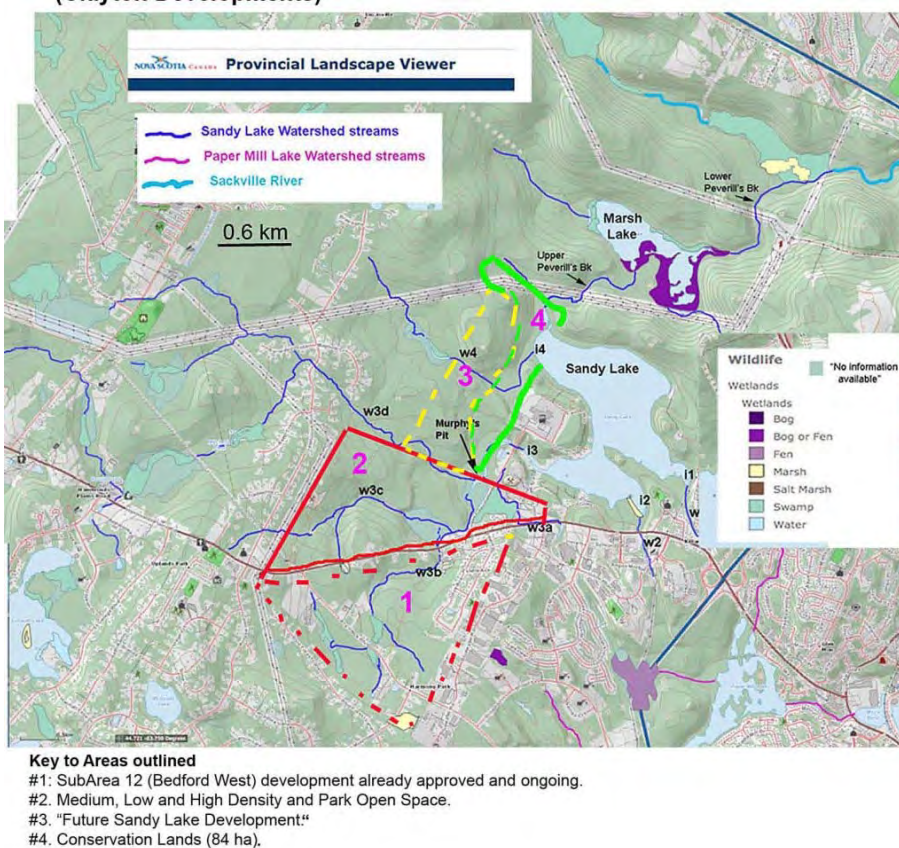


Fig 4 NS Provincial Landscape Viewer map with rough overlay of Sandy Lake Holdings (Clayton Developments) plans for development within Sandy Lake watershed as indicated in Fig 9 in Document C030 – Sandy Lake, Request [to HRM] by Sandy Lake Holdings (Clayton Developments) for a new serviced mixed-use (residential/ commercial) community, dated 2021[23]. Note that most of the watercourses in the area to be developed converge in the area of Murphy's Pit and then enter Sandy Lake at its SW corner. View the [Draft LSA](#) page 5 for a map showing the wetlands more clearly.

Those watercourses have a disproportionately large influence on the Water Quality of Sandy Lake.

In 2020 I made an estimate of the proportion of water going into Sandy Lake that comes from settled landscapes, versus water coming from intact (unsettled) landscapes based on my measurements of the EC (salt) values for lake water, surface waters coming from settled areas, and surface waters coming from intact (unsettled) landscapes [24]. My estimate: 78% comes from settled areas, those mostly to the west and southwest of Sandy Lake; and 22% comes from currently intact landscapes. This conclusion is consistent with the comment in AECOM 2014: "The greatest flow into Sandy Lake is from Bobs Brook and other tributaries from the western portion of the watershed" [25].

Further, because the new developments would be placed towards the lower end of those watercourses, i.e close to Sandy Lake, the length and area of downstream watercourses and wetlands that might remove some of the sediment and phosphorous generated in the new developments is very reduced.

Most concerning is the possibility that the wide watercourse and wetland buffers as advised in the Sandy Lake



View of Murphy's Pit area from road looking south.
Several streams converge in this area; open water is bordered by marshes and some of the forest is likely wet riparian forest. This area is important habitat and local migration corridor for snapping turtles. Photo Aug 20, 2020. View [Murphy's Pit Convergence](#) for more photos.
Click on images for larger versions.

Ecological Features Assessment (June 27, 2022) and recommended unanimously by HRM Regional Council [26] will not be recommended if a significant development is given the go-ahead and some wetlands may even be removed – at least that is what I have to conclude from the Draft LSA.

In the Draft LSA [27], the consultants identified 24 wetlands within their Sandy Lake Study Area, total area 48.6 ha. They conducted WESP Assessments on 13 of the 24 wetlands, their studies limited by “Multiple extreme weather events throughout the 2023 field season (i.e., wildfires and floods” and because field observations revealed many more wetlands than anticipated from desktop studies.”

I have visited most of these wetlands [28]. There are wetland fringes along much of the lengths of watercourses leading into Sandy Lake and some large expanses of wetlands that drain into these watercourse which are flooded during high precipitation periods and events.



Examples of substantive wetlands within the area of proposed development. IIG: Stream coming from below Hammonds Plains Road (subArea 12) flowing north; extensive riparian forest occurs to the left in photo, and looking towards the left/NW, the landscape opens up into a large, open wetland. II.14: On the bank of a stream to the northwest of photo II.14, the stream flows west to east and eventually into Sandy Lake. We (myself and volunteer) could walk right up to it, but sunk up to our waists more than once. This area holds a lot of water and sediment. These wetlands lie within the large block of wetlands identified as SL5 in the Draft LSA: “Mixedwood Treed Swamp, Graminoid Freshwater Marsh, Tall Shrub Swamp/Approximate Wetland Area (ha): 23.06/Evaluated using WESP-AC: Yes/WSS: No/Ecological Condition Ranking: Moderate” – from pages 5,6 and 8 in the [Draft LSA](#). View Photo Albums W and SW of S. Lake Part II [28] for more photos.

The area of wetlands identified in the [Draft LSA](#), 50.8 ha just in the Sandy Lake Study Area [29], is an impressive amount given that they all lie on watercourses leading into Sandy Lake which itself is only 74 ha in area. There can be little doubt that the wetlands in the Study Area and more specifically in the area of the proposed initial development (to the extent we know about it) currently improve the water quality of surface waters before they finally enter Sandy Lake. Although not investigated specifically for Sandy Lake, removal of sediment and phosphorous is a well known benefit of watercourse wetlands [30].

Remarkably this benefit was not considered in [AECOM 2014](#) even though there was a large unidentified sink for phosphorous in their budgeting for the *Lake Capacity Model* [31].

Nor is removal of sediment and phosphorous by wetlands cited as a “Benefit” in the application of the WESP

assessments to wetlands in the Sandy Lake Study Area in the [Draft LSA](#) released earlier this year.

Likewise, there is no Benefit Score for Water Storage by wetlands in the [Draft LSA](#); that's a remarkable error, oversight, or deliberate omission, given the recent history of flooding in the Sackville River watershed. As I commented in Addendum 2: Wetlands [32], "The Sackville River Floodplain area, subject to repeated and severe flooding in recent years ... lies well within the 5 km distance [of areas where buildings or infrastructure downriver or downslope from the wetland have been damaged or are in a mapped floodplain]. So on that basis alone, it could be expected that a Water Storage Benefits Score for the WESP-rated wetlands – were it reported – would be high."

In fact no "Benefit Scores", a normal output of WESP assessments and normally applied when WESP scores are used to assess WSS status, are given for any of the wetland functions cited in the [Draft LSA](#). It's a remarkable omission, made without any explanation [33] and clearly has to be addressed.

Two questions need to be answered:

1. Could the potential negative impacts of pre-construction & construction phases on watercourses and wetlands be ameliorated/prevented/reduced to a level that would not impact WQ of Sandy Lake? It simply seems very unlikely given

(i) The precarious state of the lake now – any increase in phosphorus loading, loading of oxygen-consuming organics, and of fine sediment would worsen the current condition. Particularly worrisome is the possibility or even likelihood that a positive feedback loop between phosphorus loading and hypolimnion anoxia [11] is already at play, thereby magnifying the negative effects of even small increases in phosphorus inputs, or intensification of other processes that increase oxygen consumption in deeper waters.

(ii) Observations of increased sediment loading on surface waters associated with pre-construction site preparation even when "Best Management Practices" are applied – e.g. at the Eisner Cove wetland site [34].

2. Could the long term benefits lost due to removal of wetlands be compensated for by artificial swales, constructed wetlands etc.? A major constraint in this regard is the very limited area downstream from the locations of the proposed development, i.e. between the development and Sandy Lake itself. Also, depending on how efficient the existing natural wetlands are in removing phosphorous and sediments and how any CWs (constructed wetlands) installed to compensate for losses of or degradation of the existing wetlands are constructed and maintained, they could be less efficient than the natural wetlands; I think we lack much of the information we would need to make confident predictions in this regard [35]. Wetlands do not remove salts, which would increase with development and cause further degradation in lake health [36].

Under the NS Wetland Policy [37], objective #1 is "To manage human activity in or near wetlands, with the goal of no loss in Wetlands of Special Significance and the goal of preventing net loss in area and function for other wetlands." No wetlands were rated WSS in the Draft LSA. Related to Wetland Policy Objective #1 and "the goal of preventing net loss in area and function for other wetlands": there is no discussion in the Draft LSA of how that might apply if wetlands at Sandy Lake are significantly altered, which it appears they will be, i.e. whether any

compensatory wetlands be placed in the same landscape or elsewhere [38].

7. The Exceptional Option we have to Save Sandy Lake

Section 9 (p 42) in [AECOM \(2014\)](#) provided specific recommendations for robust Water Quality Monitoring. Such monitoring was not subsequently pursued by HRM, but now we have sufficient data from the volunteer observations (2017-2024) validated and augmented by those of Doucet (2022) to indicate that a Water Quality Objective in the mid-mesotrophic range (AECOM 2014) will not protect Sandy Lake.

Indeed, the observations illustrate that Sandy Lake is in a precarious condition *now*.

That's not exceptional, especially given that Sandy Lake is a relatively shallow lake which makes it more susceptible than lakes deeper lakes or lakes with a more extensive hypolimnion to trophic degradation; and given trends of declining hypolimnion oxygen levels in temperate lakes associated with climate warming – in fact a climate warming signal for Sandy lake was identified from paleolimnological studies early in 2015 [39].

What is exceptional is that *at this time* Sandy Lake watershed is still not highly developed, and that there is still a possibility of limiting the biggest threat to the future of Sandy Lake: a major new development in the area of most of the headwaters and their associated wetlands as being currently considered.



An unpleasant algal bloom in Sandy lake in early August of 2019 was an “early warning sign” that the lake is in a precarious state [40].

If we don't take serious steps to reverse the current trends, we can expect to lose entirely the habitat for salmonids including the Atlantic salmon that the SRA is working so hard to bring back, the lake to be subject to repeated closures to swimming due to algal blooms such as the green algal bloom which occurred in 2019 and possibly BGA blooms as well [40], and for periodic extreme flooding downstream to be accentuated even more. Not to mention the loss of some local habitat for a range of species including Snapping Turtle, a Species-at-Risk and degradation of its local migration corridors [41]; and degradation of the wildlife corridor west of Sandy Lake [42].

If we truly value Sandy Lake for the ecological and recreational qualities the area provides in the midst of a rapidly urbanizing landscape and not just pay lip service to them, we must (i) make efforts to ameliorate the current state of the lake and (ii) show such steps to be effective before any major new development in its watershed should even be – if ever – considered.

Surely for the sake of Sandy Lake remaining a precious recreational and ecological asset within a 'Growth Landscape', we can place the currently proposed development on some of the already ecologically degraded lands in the same general area, and take the steps needed to finally realize a Sandy Lake – Sackville River Regional Park.

By doing so we would be helping to address both the Housing Crisis and the combined Climate/Biodiversity Crisis simultaneously; and conserving a significant natural heritage/outdoor recreational area for the benefit of very many folks in the future.

That's what's called for in 2024.

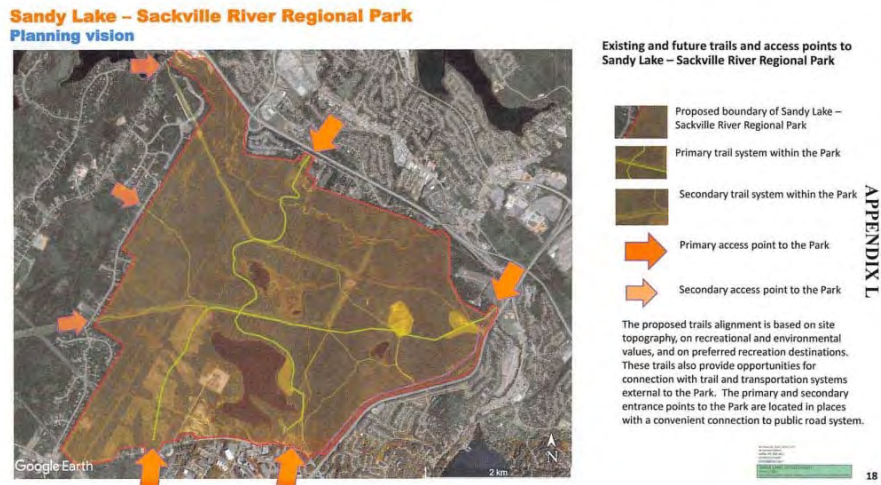


Fig 5. The proposed Sandy Lake – Sackville River Regional Park lies between growth areas on all sides. What a precious gift to future generations that would be. Map from Appendix L in the *RP+10 Submissions* (2020) from the Sandy Lake – Sackville River Regional Park Coalition. This version of the park is not very different from that detailed in 1979 – surely its time has come.

Postscript I am fully aware that a new Watershed Study is in progress and should be available sometime this fall. Hopefully that will address, critically (with rigor), the issues raised above. I chose not to wait for the Watershed Study because I have no idea when it will come out (except sometime this fall) and it seems likely or at least many people are anticipating that it will accompanied by or followed shortly afterwards by some sort of final decision about the Sandy Lake development. So I felt these concerns needed to be brought to the attention of decision-makers as early as possible after completing the final limnological observations for this year, which was on Aug 12, 2024.

From early on I have communicated with the consultants conducting the Future Serviced Communities Studies for the Sandy Lake Study Area, given them all of the results and my interpretations and I discussed earlier results with them in two online meetings in 2023. So I was somewhat shocked when the *Draft LSA*, issued in April 2024, referenced only the “LakeWatcher observations” at Sandy Lake, i.e. only to those from 2022 onward. Further, they concluded from a narrow interpretation or narrow selection of the data they did look at that “Sandy Lake is not significantly affected by urban runoff or erosion within the watershed”. That assertion is simply at variance with a lot of science and particularly with the evidence and assumptions underlying the use of phosphorus load models to anticipate/estimate impacts of development on receiving waters so routinely used by HRM and many other jurisdictions.

I appreciate that the *Draft LSA* document was indeed a DRAFT and hopefully the final report will be more rigorous in these regards – as I would expect of Stantec. As well as for decision-makers, I wrote this ‘In Conclusion’ document for consideration by the consultants as they prepare those final reports.

- david p Sep 27, 2024

Sandy Lake & Environs (Bedford, Nova Scotia)

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Sandy Lake & Environs (Bedford, Nova Scotia)

A Natural History Perspective

Footnotes

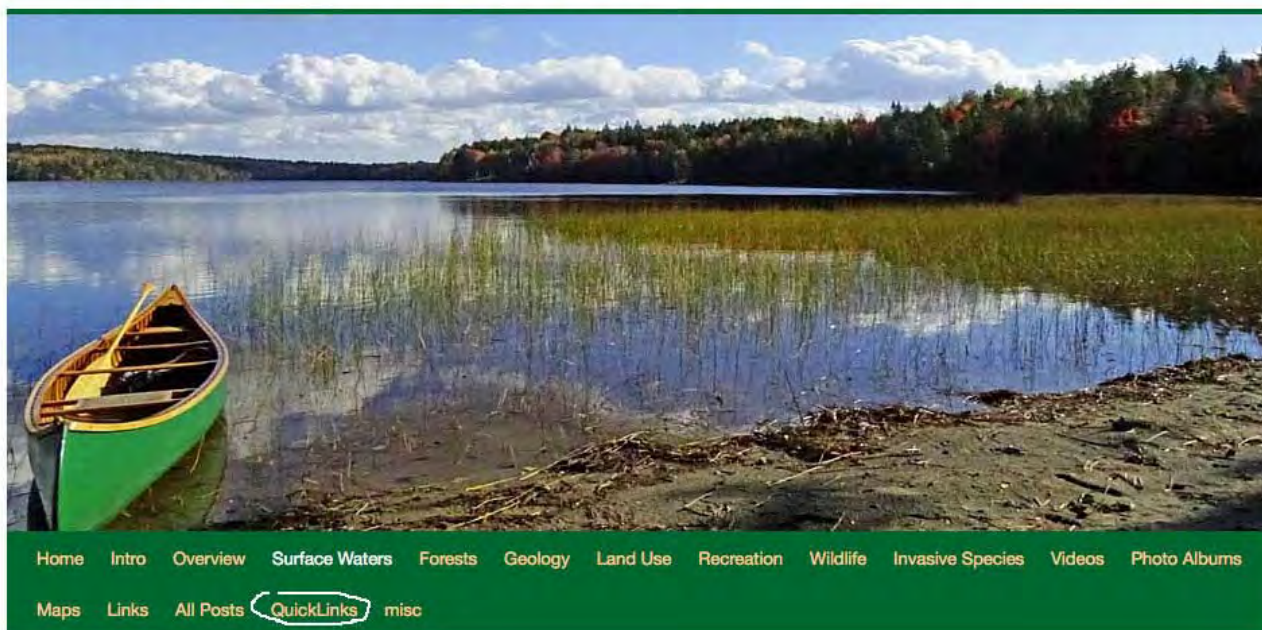
Footnotes for [In Conclusion...](#)

Info. for Print Versions of this Page:

This page is posted on the website Sandy Lake & Environs (Bedford, Nova Scotia) at <http://versicolor.ca/sandylakebedford>. The Full URL: <https://versicolor.ca/sandylakebedford/waters/lakes/limnol-profiles/2024-limnological-profiles-return-to-historic-trends/in-conclusion-the-precarious-state-of-sandy-lake/notes/> This page provides the footnotes for a page "In Conclusion..." at this URL: <https://versicolor.ca/sandylakebedford/waters/lakes/limnol-profiles/2024-limnological-profiles-return-to-historic-trends/in-conclusion-the-precarious-state-of-sandy-lake/>. The one line Summary for In conclusion...: "In conclusion, our latest limnological profiles further confirm a long term trend of decline in the health of Sandy Lake (Bedford, NS), and underscore why a major new development on its headwaters could "do it in". This Footnotes page contains hyperlinks which in most cases are not spelled out, but should be active in PDF versions of this page when viewed on a computer or smartphone, however they may not be functional depending on the the particular device/its configuration. If not, the reader should go directly to the Sandy Lake website at this URL: <https://vesicolor.ca/sandylakebedford> (paste it in the navigation box at the top of the web browser); then on the navigation menu on that page go to "Quicklinks", where you can click on links to the pertinent pages.

Sandy Lake & Environs (Bedford, Nova Scotia)

A Natural History Perspective



THE FOOTNOTES

1. Some background to my (David Patriquin's) involvement. I am writing as a retiree in my eighties, a long time resident of HRM living in peninsular Halifax, an active member of several natural history and trail groups, and a Prof. of Biology at Dalhousie University (retired 2008). Politically, I like to think I am open minded, having voted for candidates in all of the three major parties, plus the Greens. Related to development in HRM, as a representative of WRWEO (Woodens River Watershed Environmental Organization, past co-chair) and the Halifax Field Naturalists (past president) I participated in the earlier days of [Our HRM Alliance](#) when I learned about and became an advocate of "densification", and remain so even though it is now impacting "my backyard" on peninsular Halifax. So I am not "anti-development", just pro smart development. More trivia about me [here](#). In the late spring of 2017, I was asked by the [Sandy Lake Conservation Association](#) if I would do a "floral survey" of Sandy Lake and Environs in relation to their efforts to see more of the land around Sandy Lake protected in some way or another. They asked me specifically because I had conducted [the study](#) that convinced even the Clayton folks that the land they were proposing to develop in the "Williams Lake Backlands" was better protected, which it now is as the "Shaw Wilderness Park". I agreed and conducted field trips on 22 days over the period June 14 to Nov 1, 2017; a few were mostly on water (paddling), most were on land. It was a volunteer activity, there was no payment and no contract. As a component of that study and because I was familiar with limnological techniques and out of curiosity, on Oct 3, 2017 I conducted limnological observations at 3 points in Sandy Lake with the help of a local volunteer. The results raised some concerns. In the late fall of 2017, I realized that far more observations – and time – were needed to adequately describe "Sandy Lake & Environs" at large. So rather than submit a single final report, I would post observations and related info on a website – [Sandy Lake & Environs \(Bedford, Nova Scotia\)](#) – on an ongoing basis. (Toward my final years at Dalhousie University, I collaborated with computer science folks to develop online tools for teaching and whole classes on the web, so I am fairly conversant with the related technology.) The website was launched on [Dec 20, 2017](#). I posted a "A DRAFT Report On the State of Sandy Lake, the Historical Trends and its Future Trajectory" on [Feb 23, 2021](#) which integrated all limnological observations to that point, but observations have been continuing and are reported in the section [Surface Waters](#) and its subpages.

2. "13 Species At Risk", for documentation, See

[Avian & Species at Risk Surveys of the proposed Sandy Lake – Sackville River Regional Park](#)
Report by Natural Wonders Consulting Firm to Sandy Lake Conservation Association, March 2020.
20 pages. "Species at Risk living within the proposed park boundaries include: Barn Swallow, Canada Warbler, Common Nighthawk, Common Snapping Turtle, Eastern Painted Turtle, Eastern Wood-Pewee, Evening Grosbeak, Little Brown Myotis, Monarch, Moose (Mainland Population), Olive-sided Flycatcher, Rusty Blackbird and Wood Turtle. The information on these species is found in this report under Species of Concern and in Table 2. Several important wildlife corridors were identified during the surveys, including two major wildlife corridors. The locations of these two major corridors along with a dozen smaller but important wildlife corridors are marked on Map 2: Wildlife Corridors"

Not in that list, but present in Sandy Lake and downstream waters are American Eel and Atlantic Salmon. The American Eel was assessed as of Special Concern by COSEWIC in April 2006. The status was re-examined by COSEWIC in May 2012 and designated Threatened. It currently has no status under the federal Species at Risk Act. It is listed by ACCDC as S3N (Non-breeding population: Threatened) in Nova Scotia. Some populations of Atlantic Salmon have SAR status federally; Atlantic Salmon is listed by ACCDC for Nova Scotia as SIB and SIN (Both Breeding and Non-breeding populations Critically Imperiled).

3. re: "the proposed major development to the west/southwest of Sandy Lake "

The Sandy Lake area is one of 15 "Provincial Special Planning Areas". (It was included in the initial set of nine such areas announced on [Mar 25, 2022](#).)

From the [Provincial Special Planning Areas](#):

The Province of Nova Scotia has created an Executive Panel on Housing to address housing challenges in the capital region. As part of this initiative, the Minister of Municipal Affairs and Housing has designated fifteen (15) Provincial Special Planning Areas (SPAs) in the Halifax Regional Municipality to support the development of as many as 46,245 new residential units and approximately 380 long term care beds. To help accelerate an increase in the supply of housing, as outlined in the Housing in the Halifax Regional Municipality Act, the designation allows the Minister to make decisions on planning matters in those areas. The eleven Provincial Special Planning Areas (SPAs) are:

Former Penhorn Mall lands

Southdale/Mount Hope

Bedford West 10

Bedford West 12 and 1

Port Wallace

Indigo Shores

Morris Lake Expansion (Eastern Passage)

Dartmouth Crossing

[Sandy Lake](#)

Musquodoboit Harbour

Fall River Site C

Clicking on the Sandy Lake link brings up this info:

^ Sandy Lake

Request by Sandy Lake Holdings (Clayton Developments) to initiate the secondary planning process for a new serviced mixed-use (residential/ commercial) community to the west of Sandy Lake, Bedford/ Hammonds Plains. The proposal is requesting amendments to applicable planning documents to support the development of a new mixed-density neighbourhood consisting of new streets and public parks, multi-unit buildings and a variety of ground-based units. Before a Master Plan is considered a series of studies must be completed which include a Watershed Study, Land Suitability Analysis (environmental and cultural constraints) and an Infrastructure Master Plan (Water/ Wastewater/ Stormwater/ Transportation capacity).

Future development of this site is being considered through the [Future Serviced Communities Studies](#).

[View a map of the area.](#)

Expected Units: 6,000

Status: Study work is being undertaken to inform decision-making regarding the development of the site.

Questions, concerns, or feedback about this site? Contact 311


As of Sep 27, 2024 a Draft LSA (Landscape Suitability Analysis) had been released in Apr 2024; the Watershed Study and Infrastructure Master Plan, and a final LSA had not yet been released.

The page goes on to give details of a Public Feedback and Approval Process and then this:

The Province is also investing \$2.3 million to enable the municipality to conduct critical environmental, land-use suitability, transportation and infrastructure studies to inform future planning and development decisions. These areas have been identified as **Future Serviced Communities** that require further study. [View additional information on these sites.](#)

Further details on Project Status etc are given on the [Future Service Communities](#) Page. From that page, items dealing specifically with the Sandy Lake SPA:

The Future Serviced Communities identified include:



Sandy Lake

Description: Approximately 400 hectares of land located west of Sandy Lake and north of Hammonds Plains Road, Bedford.

Special Considerations:

- Identified as a [Special Planning Area](#) by the Province of Nova Scotia.
- Located west of the Sandy Lake Regional Park.
- Located in an area with limited existing regional transportation connections.

and links:

- [Draft Sandy Lake LSA April 18 2024.pdf \(38.5 MB\) \(pdf\)](#)
- [Sandy Lake Study Area \(2.49 MB\) \(pdf\)](#)

As of Sep 27, 2024, the only publicly available document (that I know of) providing some details on the location of the development, number of units etc is [CO30 – Sandy Lake](#) (Request by Sandy Lake Holdings (Clayton Developments) for a new serviced mixed-use (residential/commercial) community). It includes this map (screen capture):

FIGURE 9 - SANDY LAKE GENERALIZED FUTURE LAND USE PLAN



SUB AREAS 1+12+13

BEDFORD, NOVA SCOTIA
JULY 2020
PWS



The coloured areas below Hammonds Plains Road are in Sub Area 12, not part of the Sandy Lake development, but most of the area lies within the Sandy Lake watershed. It is not, however, included in the Sandy Lake Study Area, so is not considered in the related Watershed study and LSA.

From the C30 document, italics inserted:

Regional Plan Review Considerations

- The Preliminary Population and Housing Analysis has shown that there is a need for additional land to accommodate HRM's growing population. Population growth since 2016 and expected continued growth has put pressure on the HRM's housing market availability.
- Future development must consider the objectives of the Integrated Mobility Plan to support transit-oriented development, *support the Halifax Green Network Plan's objectives to adequately protect wilderness area and connections*, and follow policy guidance found in HalifACT2050, Sharing Our Stories and Halifax Water's Infrastructure Master Plan.
- *There is public support for greater protection of the lands for their ecological value and the water quality of Sandy Lake.*
- Proposed housing units (estimated): 6006 units (estimated at 9 units per acre, as proposed by Clayton Developments)

4. Details of the 2024 Limnological Observations are presented in these four pages on this website:

(i) versicolor.ca/sandylakebedford/Surface Waters/Sandy Lake/

[Limnological Profiles](#)

and

(ii) [...Limnological Profiles/](#)

[2024 Limnological Profiles – return to historic trend of declining oxygen](#)

and its subpages:

(iii) [Addendum 1: Trends in Conductivity/Salt Content](#)

(iv) [Addendum 2: On Wetlands](#)

b. The limnological profiles consist of measurements made with a Water Quality Multimeter of temperature, conductivity (a measure of salt content), oxygen and (sometimes) pH at 1 meter or shorter depth intervals at the deepest spot in the lake.

Beginning in April of 2022, we conducted our observations under the umbrella of the newly formed [HRM LakeWatchers program](#), which allowed us to make the observations within more consistent time intervals – prior to that, the equipment was borrowed from community equipment banks and we could not always get it at the desired sampling times.

Sandy Lake is one of 72 Lakes that had been “assessed as either highly vulnerable or moderately vulnerable through a [previous study](#)” and were selected initially to be included in the LakeWatchers Program. The Vulnerability Class for Sandy Lake was “Class A – High Vulnerability” and the Priority Concerns concerns were identified as “Eutrophication” and “Bacteria Contamination (Beaches)” – Table 9, p 53 in HRM Water Quality Monitoring Policy and Program Development (AECOM 2020)*. As Sandy lake is a “Class A – High Vulnerability Lake”. 2 sampling events per year are prescribed (Table 12, p 66)

– once in spring during mixed-water column conditions [our samplings have been in April which is at or following spring turnover of the water column]

– once at the end of summer [our sampling have been in the latter part of August which is close to the time of peak summer stratification]

In addition to the limnological profiles at the deepest spot in the lake, the observations at the deepest spot under the LakeWatchers program include a secchi disk measure of water transparency, top and near-bottom water samples analyzed for TP (Total Phosphorous, and chloride (near bottom sample only). Also, surface water near the outlet is sampled: measurements are made with the Multimeter as described above but there is only one surface water measurement ; and a water sample is taken and analyzed for TP (the spring sample only) and chloride. Measurements of chlorophyll-a in water samples are sometimes made for some or all samples or none; likewise E.coli counts are sometimes made on some surface water samples.

* [Halifax Regional Municipality Water Quality Monitoring Policy and Program Development](#), Prepared by: AECOM Canada Ltd., September 2020, 99 pages + Appendices, 505 pages total. Also view [Environment & Sustainability Standing Committee June 3, 2021](#) SUBJECT: Water Quality Monitoring Policy & Program Development (14 pages)

6. [Identifying lake water quality trends and effective monitoring strategies in a rapidly urbanizing region](#)

Doucet, C., 2022, [Master of Applied Science, Dalhousie University]. <http://hdl.handle.net/10222/82119>. The thesis has two Results Chapters. CHAPTER 2 – SYNOPTIC SNAPSHOTS: MONITORING LAKE WATER QUALITY OVER FOUR DECADES IN AN URBANIZING REGION. This chapter is the basis of a significant paper for which Doucet is first author: [Synoptic snapshots: monitoring lake water quality over 4 decades in an urbanizing region](#) C. Doucet et al., 2023. In Lake Reservoir Management. “Synoptic water quality surveys—measuring major ions, nutrients, pH, organic matter, and trace elements—have been conducted in ~50 lakes in the Halifax Regional Municipality (Nova Scotia, Canada) once per decade since 1980. In this study, lake water quality over 40 yr was examined and urban development was evaluated as a possible driver of observed changes.” Sandy Lake (Bedford) was one of those 50 lakes.

CHAPTER 3 – TRACKING TROPHIC STATE IN URBAN LAKES IN A CHANGING CLIMATE: ARE EXISTING MONITORING PROTOCOLS STILL EFFECTIVE? This chapter has not yet been published. From the Abstract: Trophic state parameters were tracked over the 2021 open-water season in fifteen lake basins in the Halifax Regional Municipality (HRM), Atlantic Canada, to examine

relationships among productivity, nutrient dynamics, thermal stratification, and hypolimnetic anoxia.” Two of those lake basins were in Sandy Lake (Bedford).

7. See [A DRAFT Report On the State of Sandy Lake, the Historical Trends and its Future Trajectory](#) (Page on this website). There is also an [extended summary](#).

8. See [Quantified Hypoxia and Anoxia in Lakes and Reservoirs](#)

by Gertrud K. Nürnberg in *The Scientific World Journal* (2004) 4, 42–54. “2mg L⁻¹ measured by a DO probe about 1 m above the sediment usually coincides with anoxic conditions at the sediment surfaces located at that depth.”

9. See [2024 Limnological Profiles – return to historic trend of declining oxygen](#) (Page on this website)

10. See discussion under [2024 Limnological Profiles – return to historic trend of declining oxygen](#) “(ii) There is increased likelihood that intervals of hypoxia (low oxygen) in deep water could result in anoxic conditions (no oxygen) at the sediment surface and associated mobilization of phosphorous, accelerating eutrophication and marked deterioration of water quality...”

11. See, e.g., [Anoxia begets anoxia: A positive feedback to the deoxygenation of temperate lakes](#) by A. Lewis et al., 2023 in *Global Change Biology*,

12. Casey Doucet’s profiles for Sandy Lake in late August 2021 are shown at right. Note in the middle figure the dip in oxygen at about 6 m depth.

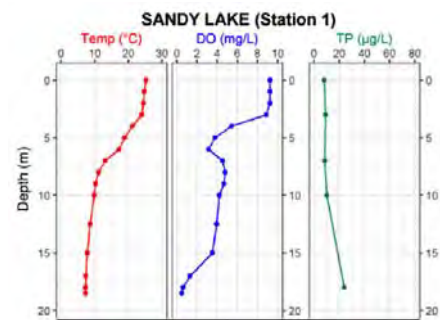


Fig. 1. Profiles for Temperature, Dissolved Oxygen and Total P at the deep site in Aug 2021 shown in Doucet (2022), reproduced with permission. [Identifying lake water quality trends and effective monitoring strategies in a rapidly urbanizing region](#). Doucet, C., 2022, [Master of Applied Science, Dalhousie University] Profiles for Sandy Lake are shown in Electronic Supplement 3.

13. See [2024 Limnological Profiles – return to historic trend of declining oxygen](#)fourteen

14. See [Metalimnetic Oxygen Minima](#) (page on this website) for an extract from Wetzel's Limnology, 3rd ed. (2001), pp159-160. B. Metalimnetic Oxygen Minima; "The converse condition [to a metalimnetic oxygen maximum] a metalimnetic oxygen minimum exhibiting a negative heterograde curve (Fig. 9-5b)*, is much less frequently observed..." Other literature on the MOM (Metalimnetic Oxygen Minima) is also cited on this page. In regard to Nova Scotia: "I have not been able to locate any studies specifically referencing Metalimnetic Oxygen Minima in Nova Scotia which may indicate that to date it has not been a common phenomenon. Regardless, climate warming and increasing urbanization could lead to its more common occurrence. In [Brylinski's 2002 report](#) on the Nova Scotia Lake Hypolimnion Project, Metalimnion Oxygen Minima appear to present in 4 of the 20 lakes surveyed (profiles are given in [Appendix III](#)). As mentioned above, of the 4 lake profiles for HRM area lakes presented by [Doucet 2022](#) that were 15 m and greater, distinct dips in the metalimnion oxygen were present in the two (one of them Sandy Lake) that also exhibited very low oxygen and highly elevated total P levels near the bottom." – from [2023 Limnological Profiles, effects of episodic precipitation, and occurrence of a Metalimnetic Oxygen Minimum in Sandy Lake \(Bedford, NS\)](#) (page on this website). As well, I discussed the phenomenon with the late Don Gordon and with Shalom Mandeville, both did not know of any formal documentation of MOMs in Nova Scotia.

15. See: [Canadian Water Quality Guidelines for the Protection of Aquatic Life DISSOLVED OXYGEN \(Freshwater\)](#). Canadian Environmental Quality Guidelines Canadian Council of Ministers of the Environment, 1999. From that document:

"The Canadian water quality guidelines for the lowest acceptable DO concentrations are 6 and 5.5 mg·L⁻¹ for the early and other life stages, respectively, in warm-water ecosystems, and 9.5 and 6.5 mg·L⁻¹ for the early and other life stages, respectively, in cold-water ecosystems. The guidelines were derived from the U.S. Environmental Protection Agency's "slight production impairment" estimates (USEPA 1986), with an additional safety margin of 0.5 mg·L⁻¹ to estimate threshold DO concentrations."

16. "The intensive metalimnetic respiration in lakes forming a MOM can be expected to accelerate nutrient cycling close to the photic zone and thus, may further stimulate primary production." – from Krelling et al., [The importance of physical transport and oxygen consumption for the development of a metalimnetic oxygen minimum in a lake](#). Limnol. Oceanogr. 62, 2017, 348–363.

17. Spring Total P values in Oligotrophic to low Mesotrophic range: View (i) values of Spring Total P for Sandy Lake 1980 to 2021 in [Synoptic snapshots: monitoring lake water quality over 4 decades in an urbanizing region, Supplemental Material](#) by Doucet et al. 2023 in [Lake and Reservoir Management](#); (ii) Values for Total P 1979-2014 in [AECOM 2014](#), Fig 8, page 22 (spring values only) & Fig 9, page 24 (all values) (iii) Total P spring values, 2022 onward: 2022 – 5.3 ug/L; 2023 – 10 ug/L; 2024 6.6 ug/L at the outlet (see [Limnological Profiles](#)).

18. See [Trophic States of Lakes](#) (page on this website) for a description of features associated with different lake Trophic Levels.

19. From [AECOM 2014](#), page iii, bolding inserted:

The predictions from the phosphorus load model are consistent with observations of urbanization in other watersheds. However, the degree of influence of urbanization on water quality in Sandy Lake can only be approximated using the phosphorus load model because of limitations arising from

assumptions and uncertainty in the application of the model. Therefore a robust water quality monitoring plan is proposed for the Sandy Lake watershed to provide a further assessment of current conditions and to evaluate the impacts of development on the water quality.

20. From [AECOM 2014](#), p. 21:

Total phosphorus in Table 3 ranged from 2 ug/L to 43 ug/L between 2006 and 2013 (Figure 8). The median concentration of total phosphorus is 12 ug/L, which places the current water quality of Sandy Lake in the lower end of the mesotrophic range. This indicates the lake water quality is good and has moderate biological productivity.

From [AECOM 2014](#), p. 31:

For the Sandy Lake watershed AECOM recommends the use of Environment Canada's trophic status classification to set WQOs for total phosphorus. As noted in section 1.2.1, an objective of the 2006 HRM Regional Plan is to "maintain the existing trophic status of our lakes and waterways". This suggests that both Sandy and Marsh Lakes should be maintained in their current mesotrophic state and so the WQO for total phosphorus should be the upper limit of the mesotrophic range, or 20 ug/L. However, since both lakes are currently at the lower end of the mesotrophic range, considerable water quality degradation could occur before the lakes were at risk of exceeding such a WQO

21. 'Shallower and Smaller Lakes are more prone to oxygen deficiency than Deeper and Larger lakes', see for example,

– For a set of Ontario lakes, [Malot et al., 1992](#) observed that "lake morphometry exerts a large influence on profiles and this influence is particularly evident in shallow (<20 m maximum depth) oligotrophic lakes" and that "Predictions of O₂ profiles are sensitive to changes in TP concentrations, with all study lakes predicted to have severely O₂-depleted hypolimnions by the end of summer at an epilimnetic TP of only 15 ug.L⁻¹."

– Extracts from the comprehensive review of [Nutrients and Algae Water Quality Guidelines](#) by the B.C. Ministry of Environment and Climate Change Strategy:

A small lake which is stratified and has a phosphorus concentration greater than 10 or 15 ug/L generally has some degree of hypolimnetic oxygen depletion which may be a constraint to fish habitat (loss of cool water refuge) or food supply (particularly change in benthos)...

Some lakes may have marginal hypolimnetic oxygen concentrations at concentrations of phosphorus as low as 7 or 8 ug/L ([Nordin and McKean 1984](#)).

22. See: [Longer duration of seasonal stratification contributes to widespread increases in lake hypoxia and](#)

[anoxia](#), by Jane et al. 2023 in *Global Change Biology*

23. [Document C030 – Sandy Lake](#), date 2021. Posted on HRM website

“Request by Sandy Lake Holdings (Clayton Developments) for a new serviced mixed-use (residential/commercial) community”

24. See [Sandy Lake Water Sources](#) (page on this website),

25. See [AECOM 2014](#), Appendix A Section 3: Hydrology (PDF page 81)

26. “Ecological Features Assessment and Unanimous...” See:

Sandy Lake Ecological Features Assessment

72 page document prepared for HRM by McCallum Environmental Ltd. June 27, 2022

View [announcement and document](#)

– [July 12, 2022 Halifax Regional Council Agenda](#)

[15.1.10 Case 23952: Sandy Lake Ecological Features Assessment \[Large 10 Mb PDF\]](#)

Motion:

That Halifax Regional Council direct the Chief Administrative Officer to:

1. Incorporate the analysis and findings of the Sandy Lake Ecological Features Assessment in the planning and development of Sandy Lake Park.
2. Review and use the findings of the Sandy Lake Ecological Features Assessment in the background studies being undertaken for the Sandy Lake Special Planning Area, including organizing the form and location of development to best protect:
 - a. the suggested widths for important corridors,
 - b. the suggested riparian and watercourse buffers, and
 - c. the identified areas of predicted old or mature forest.
3. Explore the use of conservation easements as part of the Sandy Lake Provincial Special Planning Area background studies to manage ecological features or corridors that extend outside of the conceptual park boundary.
4. Assess how to best organize land use and green infrastructure as part of the Sandy Lake Provincial Special Planning Area Background Watershed Study to mitigate any downstream impacts to the Sackville River and Sackville River Floodplain.

Council passed the boundary study motion unanimously (moved by Counc. Blackburn, Seconded by Counc. Outhit)

It was MOVED by Councillor Blackburn, seconded by Deputy Mayor Lovelace

THAT the motion be amended to include the words “at least” to the beginning of sections 2(a) and 2(b).

MOTION TO AMEND PUT AND PASSED. (12 in favour, 3 against)

Link to [Minutes](#)

Link to Council discussions vote: https://www.youtube.com/watch?v=Lc_IcYMRJ44

In regard to item 2a above (the suggested widths for important corridors), from page 3 of Item No. 15.1.10 [Halifax Regional](#)

Council July 12, 2022:

Landscape Connectivity

Corridors that allow wildlife to move through the study area were also analyzed. The relationship to wildlife movement at a regional scale is considered through the Halifax Green Network Plan, the Sandy Lake Ecological Features Assessment also considered the Wildlife Corridor Landscape Charette, which can be found on the Regional Planning website, and is catalogued as submission C1142. The Sackville River was identified as an important and essential corridor for its role in providing aquatic connectivity downstream. An important corridor was also identified along the west side of Sandy Lake that provides a connection for wildlife from the south of the study area to the Sandy Lake Regional Park. The Green Network Plan identifies that wherever possible, a width of 100 m should be maintained for Important Corridors and 1,000m for Essential Corridors.

In regard to item 2 b above, (the suggested riparian and watercourse buffers) were respectively 100 m and 50 m (re: page 3 in Item No. 15.1.10 Halifax Regional Council July 12, 2022; and page 33 in the Sandy Lake Ecological Features Assessment attached to Item No. 15.1.100

In regard to item 2c above, (the identified areas of predicted old or mature forest), Fig 7 on page 28 in the [Sandy Lake Ecological Features Assessment](#) identifies areas of predicted old and mature forest.

27. Draft LSA:

A link to the Report is posted on [Halifax Future Service Communities](#) (<https://www.shapeyourcityhalifax.ca/futureservicecommunities>)

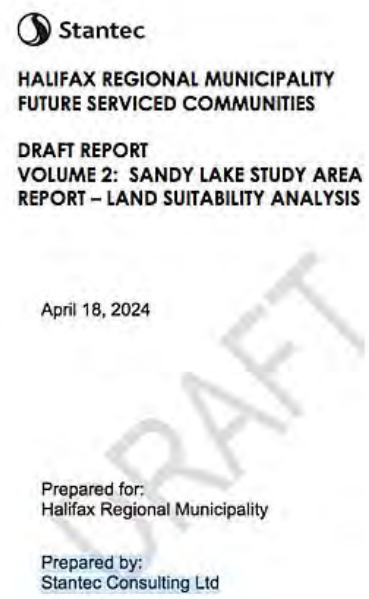
From the Introduction to that page:

“The [Regional Plan Review](#) has identified the need for additional serviced lands to accommodate population growth. With [provincial funding support](#), the municipality is conducting a series of technical studies to inform decisions about potential serviced development in four study areas. Stantec has been awarded the contract to conduct the Future Serviced Communities Studies through a request for proposals process. The four locations being studied are: </small>

- Lands to the west of Sandy Lake in Bedford;
- Highway 102 West Corridor lands in Halifax;
- Lands southeast of Morris Lake in Dartmouth and Cole Harbour; and
- Lands including and immediately surrounding the former Nova Scotia Home for Colored Children (now owned by Akoma Holdings) in Westphal.”

Under Project Status:

“Stantec has made significant progress on the study’s environmental, servicing, and transportation study components. Fieldwork and stakeholder consultations are now complete and drafts of study components are being provided to the Municipality for technical review. The draft land suitability analyses (LSAs) are being published as they are completed to share the study’s progress and provide an



Click on image for the Report

opportunity for review of the technical information. While the LSAs are of high quality, they are early drafts for review, subject to change, and do not yet provide the full picture of the suitability of the lands for development pending the completion of the remaining watershed, servicing, and transportation components of the study.”

The Study Areas

The areas being studied as part of this project are the remaining Future Serviced Communities identified for development by the [Regional Municipal Planning Strategy \(Regional Plan\)](#) and the [Road to Economic Prosperity for African Nova Scotian Communities](#). Three of the study areas have been designated by the Minister of Municipal Affairs and Housing as [Special Planning Areas](#) to help accelerate an increase in the supply of housing, as outlined in the [Housing in the Halifax Regional Municipality Act](#).

The Future Serviced Communities identified include:



Sandy Lake

Description: Approximately 400 hectares of land located west of Sandy Lake and north of Hammonds Plains Road, Bedford.

Special Considerations:

- Identified as a [Special Planning Area](#) by the Province of Nova Scotia.
- Located west of the Sandy Lake Regional Park.
- Located in an area with limited existing regional transportation connections.

Screen Capture from Halifax Future Service Communities [webpage](#)

28. I have visited most of the larger wetlands and watercourses associated with Sandy Lake, on Sandy Lake itself, some of those associated with with Peverill’s Brook and Marsh Lake downstream. I routinely measured Electrical Conductivity of the watercourses/waterbodies to get a sense of where urban pollutants are coming from. View descriptions, photos etc. on these pages:

– [Sandy Lake Wetlands Photo Albums: Sandy Lake \(Bedford, NS\): Wetland Fringe, SL: Marsh Lake/Peverill’s Brook](#)

– [Uplands Park WWTF](#)

Photo Albums: Sandy Lake: [Wetlands and Riparian areas to W & SW Oct 2, 2020 PART III](#)

– [Murphy’s Pit Convergence](#) “an area of significant marshes/swamp and floodplain forest, also identified in the [Natural Wonders Consulting Avian & Species at Risk Surveys](#) as an area of Snapping Turtle movement and attempted, if not successful, breeding.”

– [W and SW of S. Lake](#)

Videos and GPS tagged photos of Wetlands and Riparian areas to W & SW of Sandy Lake, Oct 2, 2020 posted in Google Photo Albums:

[PART I](#) – Johnson’s (Bob’s) Brook & Murphy’s Pit area;

[PART II](#) – Confluence of the “HPR South Watercourse” & the “UPWWTF Watercourse” within a Big Wetland/Riparian area (NIA1)

[PART III](#) – Uplands Park Waste Water Treatment Facility and associated stream; small adjacent watercourse beginning near

HPR

PART IV – Junction of two of the tree major source streams for the HPR South Watercourse, on Larry Utech Blvd. Also View [South of HPR 20Aug2020](#) and the associated [Photo&Video Album](#) to view info on a significant wetland and riparian corridor in the HPR South Watercourse.

PART V – Two streams draining intact landscapes on the east side of Sandy Lake in the vicinity of Sandy Lake Beach Park, were sampled to compare with values for streams in disturbed landscapes in Parts I to IV. (Earlier data for both sides of the lake are available [here](#).)

– Upper Peverill's Brook, Photo Albums: [SL: Marsh Lake/Peverill's Brook, Sandy Lake Bedford Beaver Dams on Upper Peverill's Brook Aug 3, 2018](#), [Upper Peverill's Brook Aug 15, 2017](#)



W and SW of S. Lake: Map showing locations of the respective Video Albums, watercourses, wetlands, electrical Conductivity values (uS/cm) on Oct 2, 2020.

29. 50.8 ha: See [Draft LSA](#), Table 3.1, page 5

30. "Removal of sediment and phosphorous is a well known benefit of watercourse wetlands:", see, e.g., [Economic valuation of suspended sediment and phosphorus filtration services by four different wetland types: A preliminary assessment for southern Ontario, Canada](#) by Tariq Aziz & Philippe Van Cappellen 2021 in *Hydrological Processes*

31. "...large unidentified sink for phosphorous in their budgeting for the Lake Capacity Model": See [Critique of Predictions/No Followup Monitoring](#) (page on this website): "(iv) Varying the phosphorus export coefficient, rather than increasing the lake retention coefficient would be a more realistic "fix" to make the model work and would likely increase the predicted impacts of development on Total P..."

32. [Addendum 2 Wetlands](#), page on this website

33. No Benefit Scores in the Draft LSA: See [Addendum 2: On Wetlands](#) (page on this website), Section III If [Wetland Function Scores are reported but not Wetland Benefits](#).

34. On siltation at Eisner's Cove



View YouTube Video [Siltation Barrier fail](#) by ProtectEisnerWetland "This is suppose to keep silt out of the wetland during deforestation... the barrier isn't even buried"
Posted Aug 28, 2022



Siltation in Eisner Cove Wetland visible on July 24, 2023. View [Video](#) The uplands were clearcut by [earlier on](#); The LSA/EAs failed to recognize any connections between the upland and the fen (View [comments](#)).
Photo & Video courtesy of Bill Zebedee/[Protect Eisner Cove Wetland](#)

35: On efficacy of CWs (Constructed Wetlands). NS has quite a lot of experience with CWs, especially via Ducks Unlimited programs which have been going on for a long time, however I am not aware of much documentation of their efficiencies and comparisons with natural wetlands. Published studies have shown both higher and lower efficiencies of CWs compared to natural wetlands.

Some relevant papers:

– [Evaluation of Treatment Potential and Feasibility of Constructed Wetlands receiving Municipal Wastewater in Nova Scotia](#)

by Leslie Gray, 2008. Earth and Environmental Sciences Undergraduate Honours Thesis, Dalhousie University

– [Source or sink? Meta-analysis reveals diverging controls of phosphorus retention and release in restored and constructed wetlands](#)

Ury et al., 2023 in *Environmental Research Letters*

– Efficiency of mitigation measures targeting nutrient losses from agricultural drainage systems: A review

Carstensen et al., 2020 in *Ambio*.

36. Salts: see [Addendum 1: Trends in Conductivity/Salt Content](#)

37. [NS Wetland Policy](#)

38. See the NS Gov. document [Wetland Compensation: What's Required and What Are My Options](#)

39. [Establishing realistic management objectives for urban lakes using paleolimnological techniques: an example from Halifax Region \(Nova Scotia, Canada\)](#) Ginn et al., 2015 in *Lake and Reservoir Management*. Sandy Lake was one of the 19 with observations most closely linked to climate warming.

40. Re: "...the lake to be subject to repeated closures to swimming due to algal blooms such as the green algal bloom which occurred in 2019 and possibly BGA blooms as well":

I happened to be at Sandy Lake Beach Park on the morning of Aug 6, 2019, shortly after the beach area was inundated with an unpleasant suspended, reddish, soapy material. View details in this post: [Sandy Lake inundated by unpleasant, suspended, reddish, soapy material Aug 6, 2019; and lake level falling quickly](#). It was a green algal (diatom) bloom, not a BGA (Blue-Green Algae), and the evidence suggest it followed removal of a beaver on upper Peverills Brook, and I speculate that the sudden rush of water led to some breakdown in the thermal stratification, bring phosphorus-rich water from the epilimnion to the surface. It subsided within a few days, once the water level stabilized at a lower height.

There has been some controversy about this bloom and whether there have been any BGA Blooms in Sandy Lake to date. (BGA are Blue-Green Algae, more correctly Cyanobacteria.) At a meeting of the [NW Community Council](#) on June 12, 2023 at which I made a presentation about the State of Sandy Lake, Councillor Tim Outhit said that I was wrong in attributing the 2019 bloom to green algae (diatoms) when in fact, he said HRM tests showed it was due to pollen. However, my follow-up with HRM staff (see Post [Mar 21, 2023](#)) confirmed that the 2019 event was consistent with the presence of diatoms as I had understood from HRM via Tim Outhit and my own observations at the time (Post, [Aug 7, 2022](#)).

At that meeting I also mentioned the BGA *warning* for Sandy lake that was cited in the Chronicle Herald on June 27, 2022. (See post [Blue-green algae warning for Sandy Lake \(Bedford\) underscores concerns about ongoing and proposed development around the headwaters 28Jun2022/](#) Councillor Outhit said that testing subsequent to the the BGA *warning* had shown that in fact there were not BGA present, admonishing me for citing it. My response was that I was not aware of any reports on subsequent testing. (Following the warning, I had asked the lifeguards about subsequent testing and they didn't know of any, nor did residents on the lake that I questioned at the time as I liked to take grandchildren there to swim.) In followup correspondence with HRM staff, I received this reply: "...The bloom that NSECC reported in Sandy Lake in 2022 was observed in late June. I went out and checked it because it was within a week of our beach season opening, and was able to confirm it wasn't toxin-producing cyanobacteria. HRM wouldn't have made any notice regarding this bloom, because we only monitor and issue notices at our supervised beaches during the time they are supervised, July 1 – August 31." So there were no public notices at the time, and Councillor Outhit did not share this information with me nor apparently with lakeshore residents I had questioned at the time.

Subsequently, I learned that the province "only inspect/confirm BGA reports that are in lakes that supply a public water supply...We take the report from the public and identify it on the web as a report but we do not confirm. We alert recreational facilities located on or associated with the lake (guarded beaches, boat clubs, camps etc) of the report and they follow their own procedures for verification and management." More details, documentation at the bottom of this post:[Deep water oxygen levels in Sandy Lake \(Bedford, NS\) fall to precariously low levels 21Mar2023](#)

So there have been no confirmed BGA warnings to date at Sandy Lake. However, BGA blooms are becoming more widespread generally, and we are seeing the conditions in Sandy Lake – warmer summer water temperatures, alterations in lake mixing and water levels, declines in dissolved oxygen – thought to be conducive to increased occurrences of BGA:

A striking consequence of climate change on aquatic ecosystems is that many are experiencing shorter periods of ice cover, as well as earlier and longer summer stratified seasons, which often result in a cascade of ecological and environmental consequences, such as warmer summer water temperatures, alterations in lake mixing and water levels, declines in dissolved oxygen, increased likelihood of cyanobacterial algal blooms, and the loss of habitat for native cold-water fisheries. – [Lakes in Hot Water: The Impacts of a Changing Climate on Aquatic Ecosystems](#) by Woolway, Sharma

and Smol 2022 in *Bioscience*

41. "...the loss of some local habitat for a range of species including Snapping Turtle, a Species-at-Risk and degradation of its local migration corridors": Documentation in [Sandy Lake Ecological Features Assessment](#) (2022), or pertinent extracts [here](#).

42. "degradation of the wildlife corridor west of Sandy Lake":
See [Wildlife Corridors](#) on this website.

Sandy Lake & Environs (Bedford, Nova Scotia)

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