WEST HANTS REGIONAL MUNICIPALITY REPORT

Information ☐	Recommendation X	Decision Request ☐	Councillor Activity ☐

To: Mayor Zebian and Members of West Hants Regional Municipality Council

Submitted by: _____
Sara Poirier, Director of Planning and Development

Date: May 28, 2024

Subject: WHMPS and WHLUB Amendments: Large-scale wind turbine setbacks; File# 24-10 A

LEGISLATIVE AUTHORITY

Part VIII, *Planning and Development, Municipal Government Act.*

RECOMMENDATION

Staff do not recommend increasing the minimum setback for large-scale wind turbines from dwelling units to 4 km, however, should Council wish to increase the setback for large-scale wind turbines from dwelling units to 4 km, the following motion would be in order:

> …that Council gives First Reading and will hold a Public Hearing to consider amending the text of the West Hants Municipal Planning Strategy and West Hants Land Use By-law to increase the required minimum setback for large-scale wind turbines to dwelling units to 4 km in a manner substantively the same as Attachment A of the report #24-10 to the Planning and Heritage Advisory Committee dated May 9, 2024.

BACKGROUND

Property X	Public Opinion ☐	Environment X	Social ☐	Economic ☐	Councillor Activity ☐

Staff received an application in November 2023 from a Vaughan resident requesting West Hants Municipal Planning Strategy (WHMPS) amendments to Section 4.24 to further evaluate

wind farm development proposals within the Municipality. This began a staff investigation and Council discussions on appropriate setbacks for large-scale wind turbines. Following discussions about setbacks for large-scale wind turbines from dwelling units, Council approved a motion on February 27, 2024 to direct staff to *"follow the planning process to amend the planning documents to include a 4 km setback".*

A Public Information Meeting was held on April 2, 2024. Numerous public comments were received at the meeting and during the public comment period that followed. To summarize:

- comments were received in support of the existing 1,000 m. setback between wind turbines and dwellings. These comments were submitted from existing and proposed wind farm developers, companies/landowners, and the Ellershouse Windfarm Sponsorship Society and Community Liaison Committee;
- comments were received from residents in support of increased setbacks between wind turbines and dwellings. Many of these comments also requested that the setback be measured from property lines instead of from dwellings. The proposed setback distances suggested varied. One respondent believed the setback distances should be based on turbine height (i.e., 1 km for a turbine 100 m or less in height, 2 km for a turbine between 100 – 200 m in height, etc.), whereas others suggested 1.69 km, 2 km, or 2.5 km setback from property lines. Another respondent also noted that the setback should be the same for dwellings and woods camps. The comments from residents cited concerns with the increased size of turbines being proposed, the impact on the use of their private property, perceived property value impacts, and concerns with noise and visual impacts of wind turbines.

As requested by Council in the original motion, the proposed amendments show the potential planning document amendments that would establish a minimum 4 km setback requirement from large-scale wind turbines to dwelling units. As the 4 km setback requirement is very restrictive, staff believe the development agreement process would become unnecessary, and have included in the proposed amendments, the removal of the policy requirement for any large-scale wind turbine projects to be considered by development agreement. These amendments also establish a Wind Turbine Overlay where the underlying zoning would still apply and wind turbines would be permitted as-of-right instead of going through a development agreement process.

On May 9, 2024, staff presented a recommendation report to the Planning and Heritage Advisory Committee (PAC/HAC) (Appendix A). The Committee discussed the original direction from Council, the proposed amendments, and public comments in detail. Many felt more information and deeper discussions should be held and asked if there could be a pause on any new wind farm applications at this time. Staff noted that the Municipal solicitor had explained that as wind farms are allowed to be considered by development agreement within the current

planning documents, Council could not act inconsistently from their planning documents by pausing the acceptance of applications. Several members agreed with measuring setbacks from property lines instead of dwellings. Others felt a 4km setback was far too restrictive. It was noted that the proposed Wind Turbine Overlay may not even be in areas with optimal wind conditions or transmission connections. One Committee member was concerned about moving to an as-of-right approval process within the Wind Turbine Overlay.

Following the PAC/HAC discussion, a motion was made to *"…recommend that Council give First Reading and hold a Public Hearing to consider amending the text of the West Hants Municipal Planning Strategy and West Hants Land Use By-law to increase the required minimum setback for large-scale wind turbines to dwelling units to 4 km in a manner substantively the same as Attachment A of the report #24-10 to the Planning and Heritage Advisory Committee dated May 9, 2024"*. The motion was defeated with a vote of 2 in favour and 6 opposed.

In relation to this file, Council should consider:

1. Where should the wind turbine setback be measured from (i.e., from dwelling or from property line)?
2. What distance should be used for the setback (i.e., 1km, 2km, 3km, 4km, etc.)?
3. What approval process should be used for wind turbine or wind farm applications (i.e., as-of-right or development agreement)?

NEXT STEPS

The process for this application is as follows.

Process

Staff Review

▼

Public Information Meeting – April 2, 2024

▼

PAC/HAC Review and Recommendation – May 9, 2024

▼

Regional Council First Reading – May 28, 2024

▼

Public Hearing & Second Reading – June 25, 2024*

Note: MPS amendments require a majority vote of the maximum number of members that may be elected to Council

▼

Ministerial Approval

▼

Notice of Approval in Local Paper

*anticipated dates; final dates set by Council

Note: Any applications that are received for wind farm developments prior to Council holding Second Reading on amendments to the setback requirements for wind turbines would be subject to the current WHMPS and WHLUB requirements. This includes Bear Lake and Ellershouse 3, as completed applications have already been received. Applications received after Second Reading but prior to Minister Approval would be considered using the existing planning documents and the approved amendments, until the approved amendments come into effect.

FINANCIAL IMPLICATIONS

There are no financial implications to the Municipality or residents with regard to the filing of this report. There may be financial implications associated with proposed amendments to the WHMPS and WHLUB if additional staff resources, training or specialized equipment is required to evaluate wind projects. There may also be financial implications to wind turbine developers if the setback restricts project development.

ALTERNATIVES

In response to this report, Council may decide to:

- hold First Reading and authorize a Public Hearing to approve the amendments as drafted or as specifically revised by direction of Council; or
- provide alternative direction such as requesting further information on a specific topic.

APPENDICIES

Appendix A	2024-05-09 Staff Report – WHMPS and WHLUB Amendments: Large-scale wind turbine setbacks; File# 24-10

CHIEF ADMINISTRATIVE OFFICER REVIEW

Pending Review and Comments

Report Prepared by: _____

Sara Poirier, Director of Planning and Development

Report Reviewed by: _____

Mark Fredericks, Senior Planner

Report Approved by: _____

Mark Phillips, Chief Administrative Officer

Appendix A

WEST HANTS REGIONAL MUNICIPALITY REPORT

Information ☐	Recommendation X	Decision Request ☐	Councillor Activity ☐

To: Members of Planning and Heritage Advisory Committee (PAC/HAC)

Submitted by: _____
Sara Poirier, Director of Planning and Development

Date: 2024-05-09

Subject: WHMPS and WHLUB Amendments: Large-scale wind turbine setbacks; File# 24-10

LEGISLATIVE AUTHORITY

Part VIII, *Planning and Development*, *Municipal Government Act*

RECOMMENDATION

Staff do not recommend increasing the minimum setback for large-scale wind turbines from dwelling units to 4 km, however, should the Planning and Heritage Advisory Committee wish to follow the original direction of Council to increase the setback for large-scale wind turbines from dwelling units to 4 km, the following motion would be in order:

> …that the Planning and Heritage Advisory Committee recommends that Council give First Reading and hold a Public Hearing to consider amending the text of the West Hants Municipal Planning Strategy and West Hants Land Use By-law to increase the required minimum setback for large-scale wind turbines to dwelling units to 4 km in a manner substantively the same as Attachment A of the report #24-10 to the Planning and Heritage Advisory Committee dated May 9, 2024.

BACKGROUND

Property X	Public Opinion ☐	Environment X	Social ☐	Economic ☐	Councillor Activity ☐

Following discussions about setbacks for large-scale wind turbines from dwelling units, Council approved a motion on February 27, 2024 to direct staff to *"follow the planning process to amend the planning documents to include a 4 km setback".*

Staff received an application in November 2023 from a Vaughan resident requesting West Hants Municipal Planning Strategy (WHMPS) amendments to Section 4.24 to further evaluate wind farm development proposals within the Municipality. This began a staff investigation and Council discussions on appropriate setbacks for large-scale wind turbines.

Additional information can be found in the following staff reports:

2023-12-14 WHMPS and WHLUB Amendment Request: Wind Farm Policies; File# 23-43
2024-02-08 WHMPS and WHLUB Amendment Request: Wind Farm Policies; File# 23-43B
2024-02-27 WHMPS and WHLUB Amendment Request: Wind Farm Policies; File# 23-43C

DISCUSSION

Section 4.24 of the WHMPS discusses the policies for wind turbines. The preamble in Section 4.24 of the current planning documents states that *"Council wishes to encourage the use of technologies that reduce dependence on non-renewable resources and do not contribute to greenhouse gas emissions."* The policies require the West Hants Land Use By-law (WHLUB) to distinguish between a small wind turbine and large or utility-scale wind turbine. The policies require standards to be established in the WHLUB for the development of small wind turbines including minimum lot size, setback, height, and similar requirements to ensure public safety and to minimize the potential for land use conflicts. Temporary large wind turbines for exploration or test purposes are permitted outside the Growth Centre, Village and Hamlet designations as-of-right, and permanent or long-term installations of large wind turbines or wind farms outside the Growth Centre, Village and Hamlet designations are considered by development agreement. The preamble of Section 4.24 acknowledges that *"utility-scale turbines may have towers ranging from 165 to 400 feet (50 to 120 meters) in height*". A development agreement application for a wind farm is only considered by staff once the Provincial Environmental Assessment approval has been received by the applicant.

West Hants Land Use By-law

Section 5.52 of the WHLUB outlines the regulations for wind turbines which includes zones where wind turbines are permitted, required setbacks, and maximum height and minimum lot area for small wind turbines. For large-scale turbines, or wind farms, the regulations outlined in the WHLUB, the Provincial Environmental Assessment approval, previous development agreements and public feedback are used by Planning staff to negotiate the parameters of a proposed development agreement to consider a wind farm in a particular area. For example, where the WHLUB requires a minimum setback of 200 ft. (60.96 m.) for a small-scale turbine from a dwelling on an adjacent lot, all approved development agreements for wind farms

within WHRM require a minimum setback of 1,000 m. (3,280.8 ft.) from the base of the tower to any dwelling, hotel, motel, or apartment hotel existing as of the date of the agreement, and a minimum setback of 550 m. (1,804.5 ft.) from the base of the tower to any woods camps existing as of the date of the agreement.

Existing Wind Farms in WHRM

Table 1 outlines the details of the existing wind farms in West Hants Regional Municipality. Applications received in 2023 and 2024 include turbines with much larger energy capacity and taller turbine heights than previous wind farm projects approved in 2014.

Table 1: Wind Farms within WHRM

Wind Farm Name	Martock	Ellershouse	Benjamins Mill
Development Agreement Registration (year)	2014	2014	2023
Number of Turbines Permitted	3	10	24
Total Project Capacity	6 MW	16.1 MW	150 MW
Status	Operational	Operational	Under Construction; Operational by 2025
Tower Height	100 m. (328 ft.)	98 m. (322 ft.)	131 m. (430 ft.)
Total Height	150 m. (492 ft.)	144 m. (472 ft.)	216 m. (709 ft.)
Minimum Setback Requirements in Development Agreement	• 2 x turbine height from Fall Brook, Mill Lakes and the Water Treatment Plant • 1,000 m. (3280.8 ft.) from a dwelling, hotel, motel or apartment hotel • 550 m. (1,804.5 ft.) from woods camps • 150 m. (492 ft.) from external lot boundary	• 1,000 m. (3,280.8 ft.) from a dwelling, hotel, motel or apartment hotel • 550 m. (1,804.5 ft.) from woods camps • 1 x turbine height from external lot boundary	• 1,000 m. (3,280.8 ft.) from a dwelling, hotel, motel or apartment hotel • 550 m. (1,804.5 ft.) from woods camps • 1 x turbine height from external lot boundary

Proposed Wind Farms in WHRM

Table 2 outlines the details of the proposed wind farms in West Hants Regional Municipality that staff have received completed applications for. Fewer of the larger-scale wind turbines are required to reach the proposed total project capacity, because taller turbines can generate more energy than smaller turbines.

The setbacks for these proposed projects have yet to be negotiated. For large-scale turbines, or wind farms, the regulations outlined in the WHLUB, the Provincial Environmental Assessment approval, previous development agreements and public feedback are used by Planning staff to negotiate the parameters of a proposed development agreement to consider a wind farm in a particular area.

Table 2: Proposed Wind Farms in WHRM

Wind Farm Name	Bear Lake	Ellershouse 3
Proposed Number of Turbines	15	12
Total Project Capacity	89 MW	66 MW
Status	Provincial Environmental Assessment approval received on October 24, 2023; Public Information Meeting on April 7, 2024, under Municipal staff review	Provincial Environmental Assessment approval received on May 16, 2023; Upcoming Public Information Meeting on May 7, 2024
Proposed Tower Height	125 m. (410 ft.)	125 m. (410 ft.)
Proposed Total Height	206.5 m. (677.5 ft.)	206.5 m. (677.5 ft.)

Municipal Government Act

Section 220 of the *Municipal Government Act* discusses content of a Land Use By-law. Section 220 (3) states that "*A land-use by-law may regulate or prohibit development, but development may not be totally prohibited, unless prohibition is permitted pursuant to this Part."* Council is unable to prohibit wind farm developments within the Municipality. However, Council can review and amend the current planning documents with respect to:

- the zones where wind farms are permitted;
- the setback requirements for wind farms;
- application requirements for wind farms;

- the approval process for wind farm developments; and
- the criteria required to be evaluated when considering an application for wind farm developments.

West Hants Municipal Planning Strategy

Policy 16.1.1 of the West Hants Municipal Planning Strategy states that *"It shall be the policy of Council to review and make amendments to this Strategy:*

> *(a) when there is a requirement to change the Generalized Future Land Use Map (Map 1);*
>
> *(b) to bring the Strategy in line with Provincial Statements of Interest; or*
>
> *(c) when Council deems it necessary because of a change in policy intentions or the development environment."*

Council can consider amendments to the setback requirements for wind turbines based on Policy 16.1.1 (c) as the amendments reflect a change in the development environment in relation to large-scale wind turbines.

As requested by Council in the original motion, the amendments drafted in Attachment A show the potential planning document amendments to establish a minimum 4 km setback requirement from large-scale wind turbines to dwelling units. As the 4 km setback requirement is very restrictive, staff believe the development agreement process would become unnecessary, and have drafted a removal of the policy requirement for any large-scale wind turbine projects to be considered by development agreement. These amendments also establish a Wind Farm Overlay (Figure 1) where the underlying zoning would still apply and wind turbines would be permitted as-of-right instead of going through a development agreement process.

Public Comments

Staff received numerous comments from the public during the Public Information Meeting (PIM) comment period. All comments received were considered by staff when drafting this report and amendments. A copy of the complete comments can be found in Attachment B. To summarize:

- comments were received in support of the existing 1,000 m. setback between wind turbines and dwellings from existing and proposed wind farm developers, companies/landowners, and the Ellershouse Windfarm Sponsorship Society and Community Liaison Committee;
- comments were received from residents in support of an increased setback between wind turbines and property lines, instead of the setback being measured to individual dwellings. The proposed setback distances suggested varied. One respondent believed the setback distances should be based on turbine height (i.e., 1 km for a turbine 100 m

or less in height, 2 km for a turbine between 100 – 200 m in height, etc.), whereas others suggested 1.69 km, 2 km, or 2.5 km setback from property lines. Another respondent also noted that the setback should be the same for dwellings and woods camps. The comments from residents cited concerns with the increased size of turbines being proposed, the impact on the use of their private property, perceived property value impacts, and concerns with noise and visual impacts of wind turbines.

For discussion purposes, the Municipal GIS Technician developed the mapping in Figures 2-5 by creating buffers of 1-4 km from any property line with a civic addressing point identified as a residential land use. As illustrated by the mapping, the 1 km setback from property lines leaves a portion of the communities of Leminster, Upper Vaughan, Panuke Lake, and the Riverside-Cogmagun-Pembroke-Cambridge-Bramber area available for wind development. This area reduces in size as the buffer from property lines increases. Additionally, using a 4 km setback from property lines would almost completely prohibit wind farm developments within the Municipality.

Staff Discussion

Council needs to have a clear intent as to why they are increasing the setbacks for wind turbines. If Council's intent is to increase the setbacks to address perceived health and environmental effects of wind turbines, staff recommends the setback remain the same at 1,000 m. from dwelling units and 550 m from woods camps as a project does not receive Provincial Environmental Assessment approval unless the requirements of the Province in relation to health and the environment are met. As required in the criteria for a development agreement application for a large-scale wind turbine/wind farm, the Provincial Environmental Assessment approval must have been received prior to Council considering the project. For wind projects that require an Environmental Assessment, proponents must describe the biophysical environment (i.e., geology, surface water, habitat, etc.) and socioeconomic conditions (i.e., property values, human health, etc.) within the project submission. The Environmental Assessment submission is evaluated by experts with the Department of Environment and Climate Change and a final decision is made by the Minister. Numerous terms and conditions are included in an Environment Assessment approval including timelines for commencement, shadow flicker assessments and noise modeling requirements, setbacks from watercourses, a wildlife management plan, a bat study and monitoring program, an adaptive management plan, a complaint resolution plan, a contingency plan, and a decommissioning and site reclamation plan two years prior to the end of operation.

If Council's intent is to increase the setbacks to reduce the visual impact due to the increased height of turbines currently being requested for consideration, staff recommends increasing the setback proportionally to the increased height of the turbines. The preamble of Section 4.24 in the current WHMPS acknowledges that *"utility-scale turbines may have towers ranging from*

165 to 400 feet (50 to 120 meters) in height". As the turbines currently being requested to consider are almost double that height (i.e., up to 216 m (709 ft.) in one application), staff would recommend increasing the setback to a minimum 2,000 m. (6,562 ft.) from large-scale wind turbines to dwelling units. Staff note that visual impact can vary, where those closest to the turbines may not see the turbines due to topography or vegetative cover.

If Council's intent is to increase the setbacks in relation to safety (i.e., potential ice throw, blade failure, tower collapse), staff recommends requiring a setback of at least 1.1 times the height of the turbine from the abutting property lines not included in the project site.

CONCLUSION

To conclude, Council has directed staff to draft amendments to the planning documents to increase the setback for large-scale wind turbines from dwellings to 4 km. The amendments drafted in Attachment A create a Wind Turbine Overlay where wind turbines would be permitted as-of-right instead of through a development agreement process. Staff do not recommend Council increase the setback to 4 km and instead have recommended a 2 km setback for large-scale turbines to dwelling units if Councils intent is to address visual impact and a setback of at least 1.1 times the height of the turbine from abutting property lines not included in the project site.

MUNICIPAL CLIMATE CHANGE ACTION PLAN

The Municipal Climate Change Action Plan (MCCAP) for West Hants was developed in 2013. There is no mention of wind development in the MCCAP as the document focuses more on the impacts of climate change on the Municipality versus options to reduce greenhouse gas emissions.

NEXT STEPS

The process for the amendments would be as follows:

Public Information Meeting – April 2, 2024

▼

Staff Review

▼

PAC/HAC Review and Recommendation – May 9, 2024

▼

Council First Reading – May 28, 2024*

▼

Public Hearing & Second Reading – June 25, 2024*

Note: MPS amendments require a majority vote of the maximum number of members that may be elected to Council

▼

Ministerial Approval

▼

Notice of Approval in Local Paper

*anticipated dates; final dates set by Council

Note: Any applications that are received for wind farm developments prior to Council holding Second Reading on amendments to the setback requirements for wind turbines would be subject to the current WHMPS and WHLUB requirements. This includes Bear Lake and Ellershouse 3, as completed applications have already been received. Applications received after Second Reading but prior to Minister Approval would be considered using the existing planning documents and the approved amendments, until the approved amendments come into effect.

FINANCIAL IMPLICATIONS

There are no financial implications to the Municipality or residents with regard to the filing of this report. There may be financial implications associated with proposed amendments to the WHMPS and WHLUB if additional staff resources, training or specialized equipment is required to evaluate wind projects. There may also be financial implications to wind turbine developers if the setback restricts project development.

ALTERNATIVES

In response to this report, the PAC/HAC may recommend that Council:

- hold First Reading and authorize a Public Hearing to approve the amendments as drafted or as specifically revised by direction of PAC/HAC; or
- provide alternative direction such as requesting further information on a specific topic.

ATTACHMENTS

Figure 1	Proposed Wind Turbine Overlay
Figure 2	Buffers from Property Lines with Residential Civic Address Points – 1 km
Figure 3	Buffers from Property Lines with Residential Civic Address Points – 2 km
Figure 4	Buffers from Property Lines with Residential Civic Address Points – 3 km

Figure 5	Buffers from Property Lines with Residential Civic Address Points – 4 km
Attachment A	Draft WHMPS and WHLUB Amendments
Attachment B	PIM Notes

Report Prepared by: _____
Sara Poirier, Director of Planning and Development

Report Reviewed by: _____
Mark Fredericks, Senior Planner

Report Reviewed by: _____
Alex Dunphy, Planner

Figure 1

West Hants

Pembroke
Cambridge
Walton
Bramber
Walton-Woods-Rd
Cheverie
New-Cheverie-Rd
Highway-215
Cogmagun
Kempt Shore
Riverside
Summerville
Lower Burlington
Mosherville
North-River-Rd
Highway-236
Scotch Village
Centre Burlington
Hantsport
Upper Burlington
Hants Border
Glooscap 35
Mount Denson
Belmont-Rd
Belmont
Woodville
Highway-14
Union Corner
Avondale
Highway-101
Poplar Grove
Ashdale
Bishopville
Falmouth
Mantua
Brooklyn
McKay Section
Wentworth Creek
Sweets Corner
Windsor
Highway-14
Greenhill
Garlands Crossing
Gypsum Mines
Newport Corner
Curry's Corner
Highway-102-WB
St. Croix
Highway
Hillsvale
Upper Falmouth
Martock
Newport Station
Highway-101
Ardoise
Three Mile Plains
Mines-Rd
Highway-102-EB
Windsor Forks
Leminster
St. Croix 34
Mill Section
Ellershouse
Panuke Lake
Vaughan
New-Ross-Rd
Wile Settlement
Upper Vaughan

Proposed Wind Turbine Area

N

Base data derived from the Nova Scotia Property Records Database (NSPRD) and the Nova Scotia, Geomatics Centre (NSGC), Copyright Her Majesty The Queen in Right of the Province of Nova Scotia.

This map is a graphical representation only. It is not a land survey and is not intended for used for legal descriptions or to calculate exact dimensions or area.

Prepared by: West Hants Regional Planning and Development Department May, 2024.

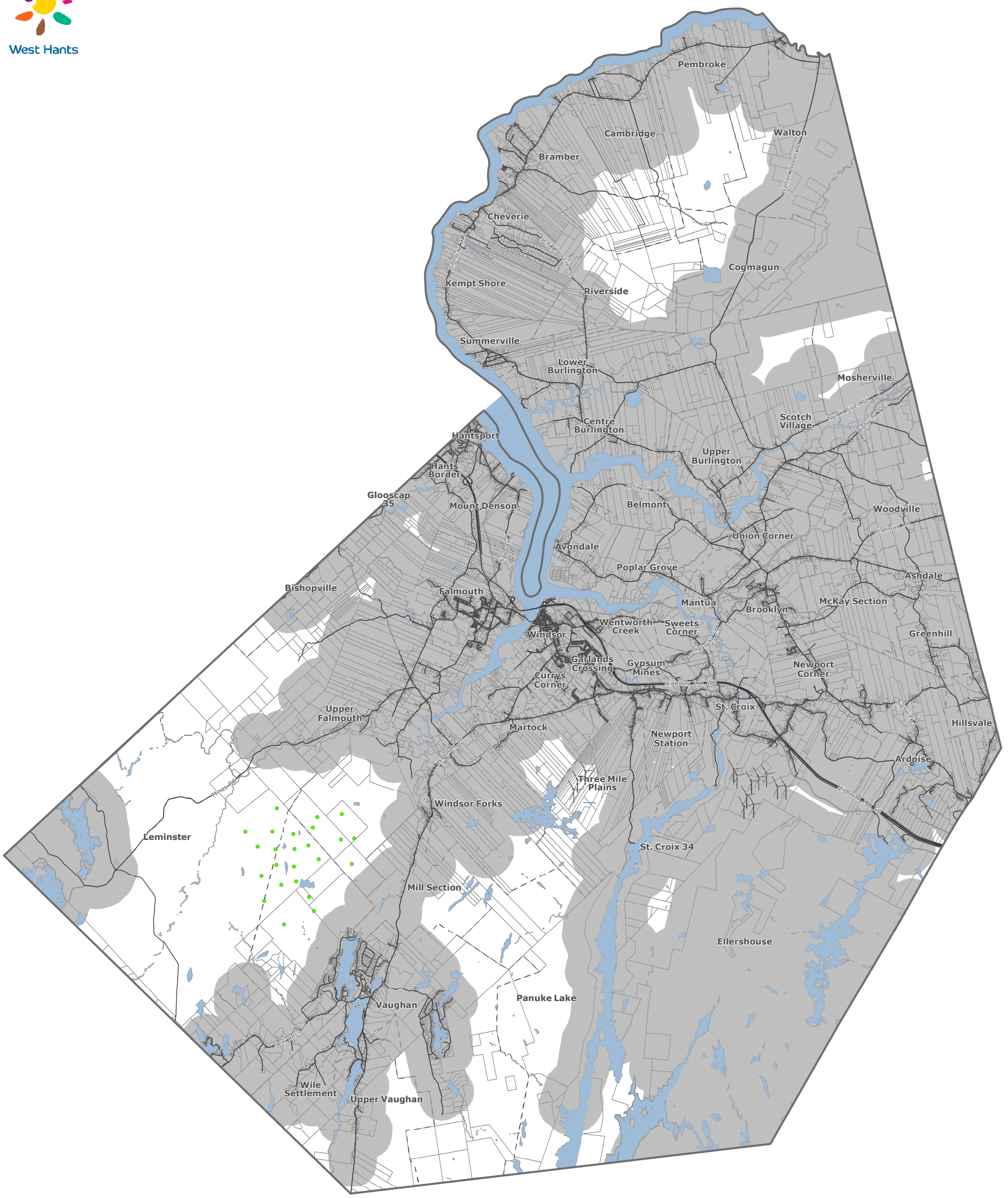
Proposed Wind Turbine Overlay

0 3,000 6,000
Metres
Scale:1:165,000

- Civics
- Estimated Benjamins Mill Wind Turbine Locations
- Wind Turbines 2023
- Municipal Boundary
- Communities
- Roads
- Water

West Hants

Figure 2



Km Radius from Land Parcels with Civics

1

N

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Prepared by: West Hants Regional Planning and Development Department April, 2024

Buffers from Land Parcels with Civics 1 Kilometer

0 3,000 6,000

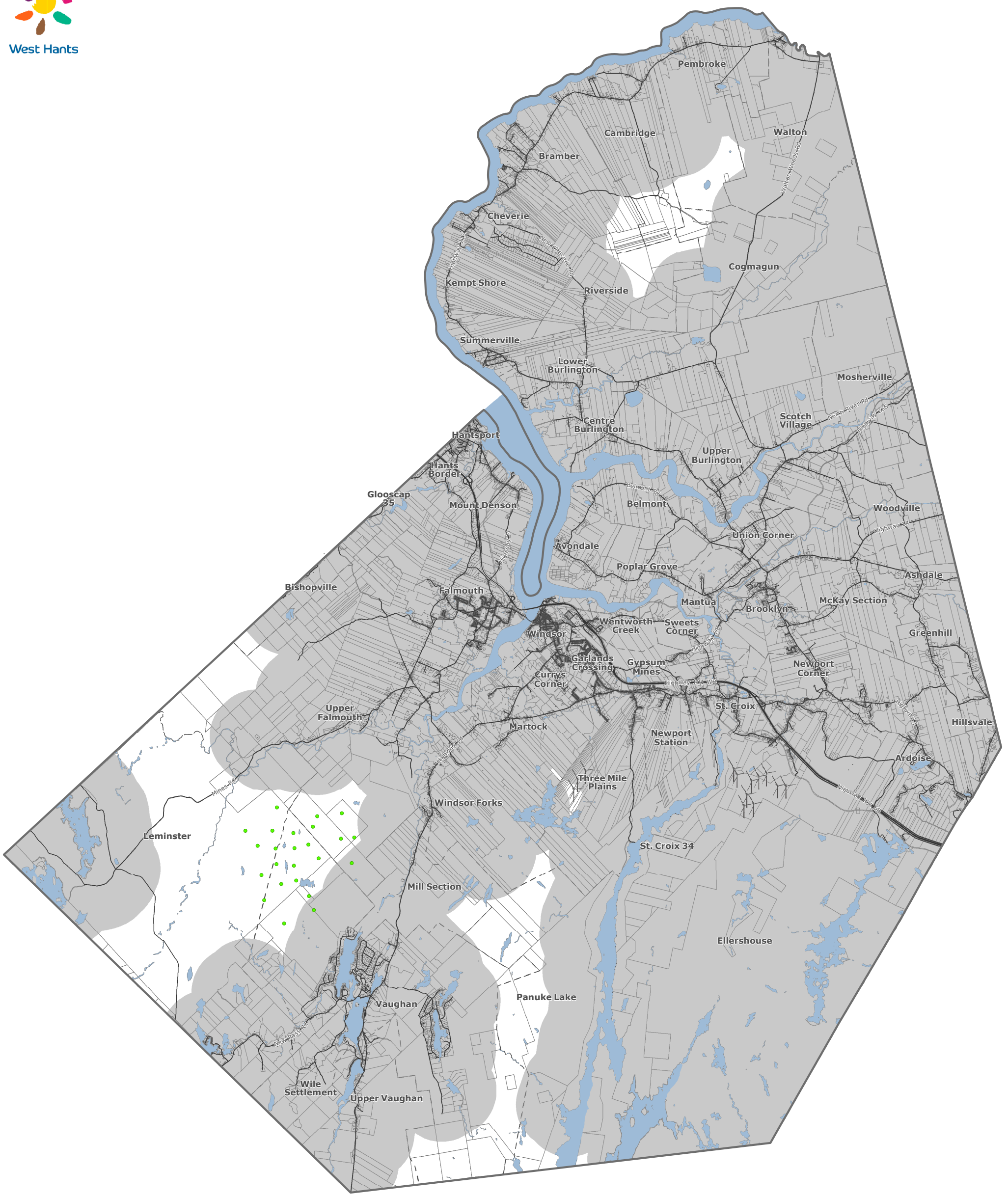
Metres

Scale:1:165,000

- Parcels
- Civics
- Estimated Benjamins Mill
- Wind Turbine Locations
- Wind Turbines 2023
- Municipal Boundary
- Communities
- Roads
- Water

West Hants

Figure 3



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Prepared by: West Hants Regional Planning and Development Department April, 2024

Buffers from Land Parcels with Civics 2 Kilometers

0 3,000 6,000

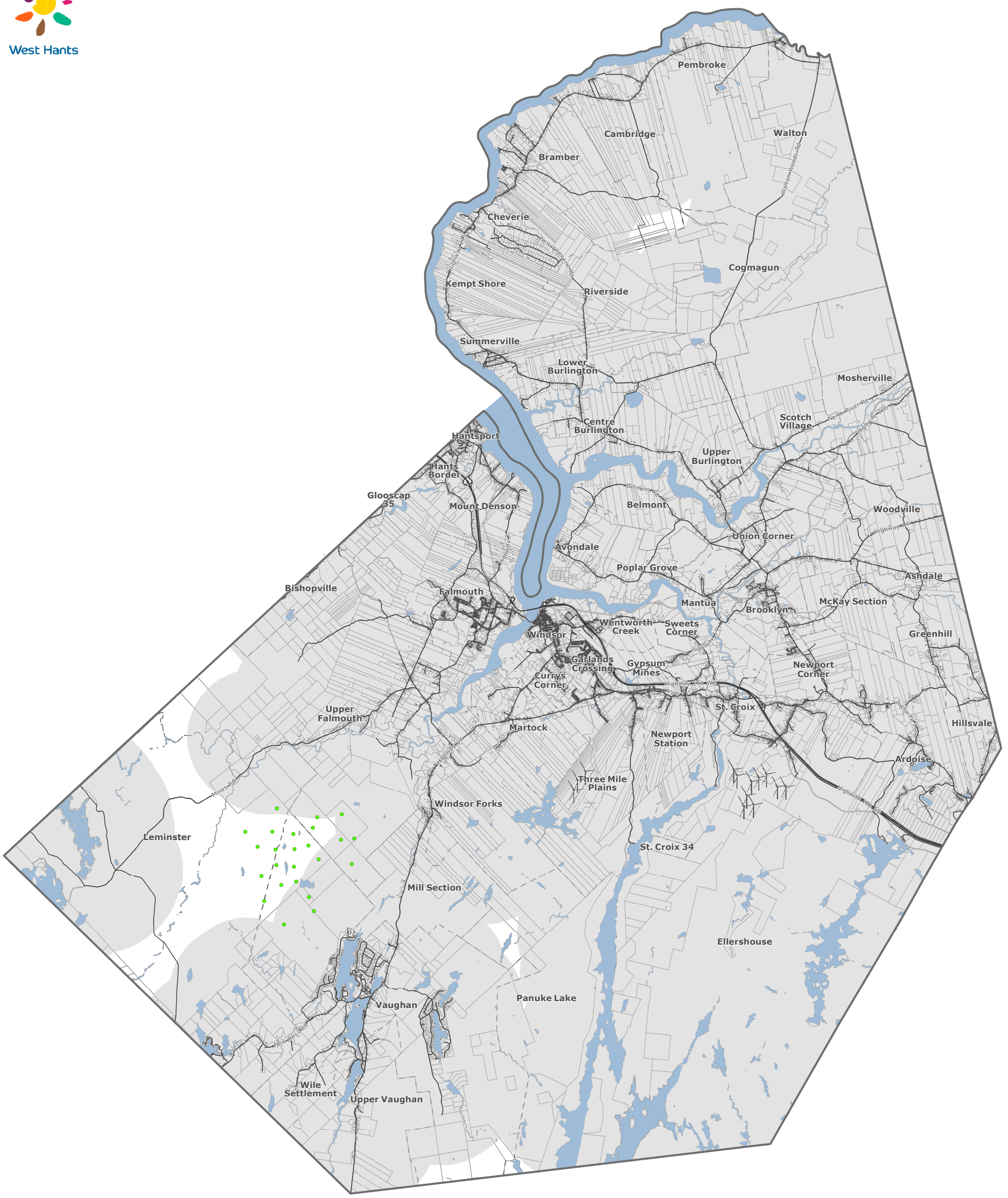
Metres

Scale:1:165,000

- Parcels
- Civics
- Estimated Benjamins Mill
- Wind Turbine Locations
- Wind Turbines 2023
- Municipal Boundary
- Communities
- Roads
- Water

West Hants

Figure 4



Km Radius from Land Parcels with Civics

3

N

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Prepared by: West Hants Regional Planning and Development Department April, 2024

Buffers from Land Parcels with Civics 3 Kilometers

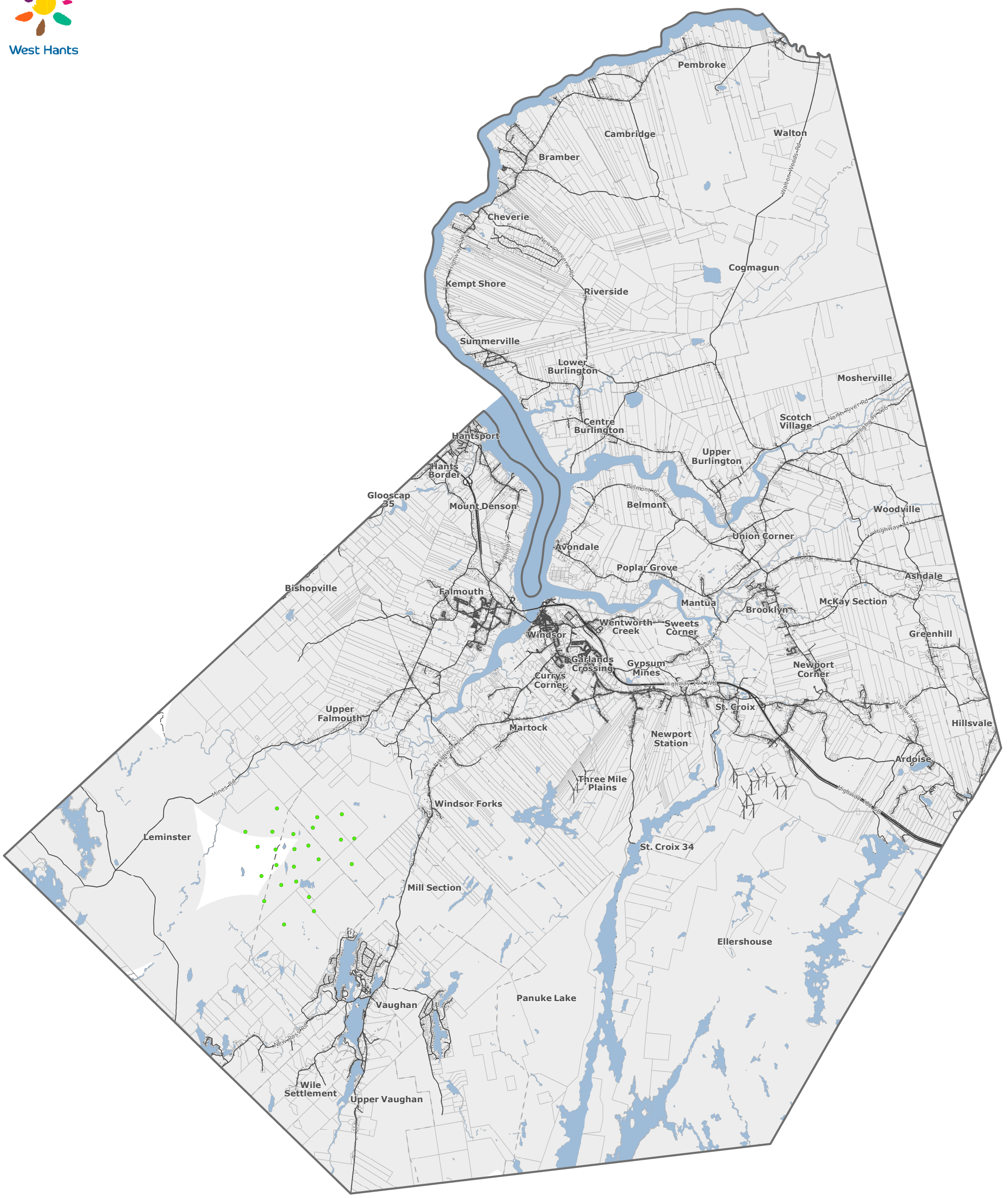
0 3,000 6,000

Metres

Scale:1:165,000

- Parcels
- Civics
- Estimated Benjamins Mill
- Wind Turbine Locations
- Wind Turbines 2023
- Municipal Boundary
- Communities
- Roads
- Water

Figure 5



Km Radius from Land Parcels with Civics

4

N

Base data derived from the Nova Scotia Property Records Database (NSPRD) and the Nova Scotia, Geomatics Centre (NSGC), Copyright Her Majesty The Queen in Right of the Province of Nova Scotia.

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Prepared by: West Hants Regional Planning and Development Department April, 2024

Buffers from Land Parcels with Civics 4 Kilometers

0 3,000 6,000

Metres

Scale:1:165,000

- Parcels
- Civics
- Estimated Benjamins Mill
- Wind Turbine Locations
- Wind Turbines 2023
- Municipal Boundary
- Communities
- Roads
- Water

Attachment A
Draft WHMPS and WHLUB Amendments

Note: purple text indicates a change from the present WHMPS or WHLUB and is provided only for the convenience of PAC/HAC and Council.

Text amendments to Section 4.24 of the West Hants Municipal Planning Strategy to create a wind turbine overlay which incorporates a minimum setback for large-scale wind turbines to dwelling units of 4 km. The amendments also remove the policy which allows exploration or test turbines and removes the policy requiring a development agreement.

West Hants Municipal Planning Strategy

1. **Amend Section 4.24 in the West Hants Municipal Planning Strategy to describe the current intent in relation to large-scale wind turbines, so that Section 4.24 reads as follows:**

4.24 Wind Turbines

~~Council wishes to encourage the use of technologies that reduce dependence on non-renewable resources and do not contribute to greenhouse gas emissions.~~ Wind energy systems are a clean, renewable source of electric power. Residential-scale wind turbines will be permitted in most zones, subject to lot size, setback and height requirements.

Utility-scale wind turbines have a rated production capacity greater than 100 kW. Much larger than those used for residential energy generation, utility-scale turbines may have towers ranging from 165 to 430 feet (50 to 131 meters) in height, for a total turbine height of up to 709 feet (216 meters). These large wind turbines may be used in wind farms, where a number of turbines feed electricity directly into the utility grid, or as stand-alone installations. ~~As Council wishes to facilitate the development of wind energy systems, the installation of exploration or test turbines will be treated as a temporary use and permitted as-of-right outside of the Growth Centres, Village and Hamlets subject to setbacks, minimum lot size standards, and requirements for removal within specified time limits. More~~ Due to controversy in the Municipality regarding siting of wind turbines, permanent installations of large-scale wind turbines, including the establishment of wind farms, will be considered only ~~by development agreement~~ in the area identified as the Wind Turbine Overlay. The Wind Turbine Overlay was created in 2024 and represents a setback of 4 km from any civic addressing point identified as a dwelling existing on May 1, 2024. Where these facilities have a production rating of two megawatts or more, they are also subject to the Nova Scotia Environmental Assessment Regulations as a Class I Undertaking. Most wind farms also require a federal Environmental Assessment under the Canadian Environmental Assessment Act (CEAA).

2. **Remove Policy 4.24.3 regarding the temporary establishment of large wind turbines for exploration or test purposes and Policy 4.24.4 regarding a development agreement requirement for permanent large-scale wind turbines or wind farms.**

~~***Policy 4.24.3*** It shall be the intention of Council to include standards in the Land Use By-law for the temporary establishment of large wind turbines for exploration or test purposes outside the Growth Centre, Village and Hamlet designations, including requirements for removal within specified time limits.~~

~~***Policy 4.24.4*** It shall be the policy of Council to consider the development of permanent or long-term installations of large wind turbines or wind farms outside the Growth Centre, Village and Hamlet designations by development agreement, having regard to the following:~~

~~(a) any required provincial and/or federal government environmental assessment processes have been completed;~~

~~(b) adequate separation distances are maintained from adjacent land uses to minimize impacts of noise and shadow and to ensure public safety;~~

~~(c) the development is not visually intrusive in the landscape, taking into account the location and distance from which it is visible, and the significance and sensitivity of the landscape, topography, vegetation and built form in the surrounding area;~~

~~(d) safe roadway access can be provided;~~

~~(e) any other matter which may be addressed in a development agreement; and~~

~~(f) Policy 16.3.1.~~

3. **Create a new Policy 4.24.3, which establishes the Wind Turbine Overlay, so that it reads as follows:**

Policy 4.24.3 establish a Wind Turbine Overlay which will apply to land located a minimum of 4 km from any civic addressing point identified as a dwelling existing on May 1, 2024.

4. Create a new Policy 4.24.4, which establishes the permitted uses in the Wind Turbine Overlay, so that it reads as follows:

Policy 4.24.4 permit large-scale or utility-scale wind turbines in the Wind Turbine Overlay.

West Hants Land Use By-law

Text amendments to remove Section 5.54 in relation to exploration or test turbines and to remove Section 6.0 (aa) in relation to the development agreement requirement for wind turbines. The amendments also add Section 35.0 which outlines the provisions of the Wind Turbine Overlay.

1. **Remove Section 5.54 regarding the temporary establishment of large wind turbines for exploration or test purposes.**

~~5.54 The erection of a single large wind turbine for exploration or test purposes shall be permitted subject to the following:~~
~~(a) the turbine shall not remain in place for more than two years;~~
~~(b) turbines shall be permitted only in zones outside the Growth Centre, Village and Hamlet designations provided the lot is at least 10 acres (4.05 ha) in area; and~~
~~(c) the requirements of Section 5.52 (d), (e), (f) and (g).~~

2. **Remove (aa) from Section 6.0, *Development Agreements,* which requires large-scale wind turbines to be considered by development agreement.**

~~(aa) permanent or long-term installations of large wind turbines or wind farms outside the Growth Centre, Village and Hamlet designations in accordance with Policy4.22.4 of the Municipal Planning Strategy.~~

3. **Add Section 35.0, Wind Turbine Overlay, so it reads as follows:**

35.0 Wind Turbine Overlay

Permitted Uses

35.1 The following uses shall be permitted in the Wind Turbine Overlay:

- large-scale or utility scale wind turbines

Wind Turbine Overlay General Requirements

35.2 In the Wind Turbine Overlay, no development permit shall be issued except in conformity with the following:

(a) large-scale wind turbines shall be sited:

(i) a minimum of 4 km from any civic addressing point identified as a dwelling existing on May 1, 2024; and

(ii) a minimum of at least 1.1 times the height of the turbine from an abutting property line not included in the project site.

(b) Development permit applications for large-scale wind turbines or utility-scale wind turbines shall, in addition to the standard required information, be accompanied by the items noted below:
   (i) Environmental Assessment approval from the Province;
   (ii) Site plan(s) showing all proposed and existing wind turbines, buildings, roads, boundaries, and natural features;
   (iii) An emergency response and fire safety plan approved by the local Fire Chief and Municipal Emergency Management Coordinator; and
   (iv) Any other information required by the Development Officer to determine whether the development conforms to this By-law.

Attachment B

Public Information Meeting Notes

April 2 – 16, 2024

WHMPS and WHLUB Amendments: Large-scale wind turbine setbacks; File 24-10

Meeting date and time	A public information meeting was held on April 2, 2024 beginning at 6:27 p.m. in Council Chambers at 76 Morison Drive in Windsor.
Attending	In attendance: Chair • Councillor Ivey Three (3) members of staff: • Director of Planning and Development, Sara Poirier • Planner, Alex Dunphy • Planning Administrative Assistant Vanessa Lake 38 members of the public attended the meeting.
Applicants Council **Property** N/A	Director Poirier outlined the direction from Council to consider amendments to the West Hants planning documents to increase the setback requirements for large-scale wind turbines from dwelling units to 4 km.
Comments	13 members of the public spoke at the Public Information Meeting, 1 letter was received at the Municipal office and 31 written comments were received via email. The questions and comments from the public are summarized below. Email responses are attached. Five emails were received after the noon deadline on April 16. These email submissions have been included for consideration but are indicated with a star (*). Staff responses are included in purple. At the Public Information Meeting the following comments were made: • Graham Marshall spoke on behalf of Membertou First Nation and Bear Lake wind farm to give a brief explanation of their project and to note that 1km is a

	standard distance used for setbacks between wind turbines and dwellings. • Dwayne Walker asked about catastrophic blade failure and where the blades would go if a blade was to come apart from the nacel. • Mark Kehoe had concerns with the size of the turbines now being proposed and suggested the setback be from property lines instead of dwellings, emphasized the consideration for wildlife / sensitive habitats, as well as the inclusion of woods camps in the setback distance requirement. • Andrew Hardman asked if Council was deciding on a 4km or nothing. Director Poirier and Councillor Ivey noted that the motion from Council was to consider a 4 km setback, however the final decision of Council could include a different setback distance. • Karen Wallace asked about possible uranium poisoning and local jobs specifically in relation to the Bear Lake wind farm project. Graham Marshall responded that more information would be provided at the Public Information Meeting for the Bear Lake wind farm. • Ashley asked why Council was considering increasing the setback to 4km. Director Poirier noted that the Council discussions prior to the direction to staff to begin the review for these proposed amendments related to the perceived cumulative impacts of wind turbines. • Seamus Mariott agreed that the setback distance should be measured from a property lines instead of a dwelling and asked who would be responsible for the anticipated diminished returns on property values in relation to the proximity to wind turbines. • Shirley Walker asked about the timing of these proposed amendments and if the amendments would affect the proposed Bear Lake wind farm. Director Poirier noted that any large-scale wind turbine/farm application would follow the existing planning documents at the time of application. Seamus Marriott asked for clarification on this point. Director Poirier added that as the Bear Lake wind farm has submitted a completed application for consideration by Council, they would be

	considered under the existing planning documents, and not these proposed amendments. • Steven and Jason Hart outlined several health, safety (i.e., fire suppression and Fire Chief training), and environmental concerns regarding wind turbines as well as the amount of the Municipality currently occupied or approved for wind farms. They noted that the newer turbines are taller than an apartment building and suggested a 2 km setback from abutting property lines. Steven asked about the planning document review and amendments that were being discussed in 2020 regarding a change in designation of some areas of Vaughan to remove the private road developments from the Resource designation. Director Poirier responded that other priorities such as consolidation and the pandemic meant the planning document review is still ongoing. Consultants have been hired to assist with this process and the new Regional documents are anticipated in early 2025. • Lindsay noted that the setbacks should be from property lines as her family enjoys spending time in their yard, not just their home, and that future generations should have the ability to enjoy their land too. • Meg Morris spoke on behalf of the Benjamins Mill wind farm to clarify that the development agreement was approved for 28 turbines which will not take up the entire land area that was included in the development agreement. • Chris Rafuse is a veteran. He noted he cannot sleep due to the noise from the South Canoe wind farm when the wind comes from that direction. • Mark Kehoe added that noise should be a larger consideration. He noted that no one should have to live with a constant drone and that the noise should be 0dB within a certain distance. He mentioned Vaughan is in a valley and noise carries further. • Dr. Chris Olsen, a consultant for the Bear Lake wind farm project, provided responses to some of the health and safety concerns that were brought up (i.e., sound,

	shadow flicker, blade failure, cumulative effects, and the presence of uranium). • Seamus Marriott asked about the financial impact to landowners within a certain distance of wind turbines after they are constructed. • Steven Hart clarified that he submitted an application which led Council to begin discussing wind turbine regulations in more detail. Steven and Jason Hart discussed blade failure and the distance the blades could travel. Jason Hart felt Vaughan would become uninhabitable with more wind farms.
Adjournment	There being no further business, the meeting adjourned at 7:50 p.m.

Public Email Responses Submitted for the PIM

March 28, 2024

From: Chief Terry Paul

To: WHRM Council, Sara Poirier, Mark Phillips, Mark Fredericks

Attachments: OEHM Wind Turbine Siting Summary; OEHM Wind Turbine Siting Report; OEHM Siting Guidance for Wind Turbines Presentation

Dear Mayor, Councillors and Municipal Staff,

I hope this email finds you well. As representatives of West Hants, you hold key positions in determining and serving the community's best interests. We have been actively engaged in the conversation taking place in the community through council regarding wind developments. We are writing to you today to bring your attention to the work we are doing to support informed decision making when planning for renewable energy projects that will play a critical role in greening the Nova Scotia economy and addressing issues of climate change.

Science-Based Memo to West Hants on Wind Farm Setbacks

Attached to this correspondence, you will find a detailed memo outlining sound and setback siting guideline for wind energy projects prepared by Ollson Environmental Health Management. Dr. Christopher Ollson is an industry leader, and we believe that his insight and expertise are invaluable in addressing the concerns raised effectively and ensuring positive outcomes for the community.

An excerpt of the summary, based on scientific literature is summarized below:

> "OEHM recommends that West Hants Regional Municipality adopt into their By-law their previously established practice of using a 1 km setback to dwellings and 550 m to woods camps for existing projects. Based on the available scientific literature, this is more than sufficient to ensure the protection of the public health and safety of their

residents. In fact, a lesser setback between 550 m to 1 km would be equally protective of public health and safety. There is no scientific basis to increase these setbacks. It would afford no additional protection of public health and safety and would unduly restrict areas for development."

In light of this, we would like to extend an invitation to you for a meeting to discuss the contents of the attached memo in further detail and walk through the steps we are taking as an organisation to ensure the Bear Lake Wind Project is being developed to the highest standards.

Meeting Invitation

We will be in Windsor on Tuesday April 2 and have an open office at Super 8 by Wyndham in Windsor, 63 Cole Dr, Windsor, NS B0N 2T0 between 10am-1.30pm and 4pm-5.30pm. We understand that your schedules may be busy but would appreciate the opportunity to meet with you, so please let us know if these times are convenient for you or if an alternative arrangement is necessary. Please contact Mark Stewart at [redacted] or [redacted] if you want to book in a meeting time.

Your participation and collaboration are essential to our collective efforts in addressing the needs and concerns of the community. We look forward to your response and the opportunity to work together with you on this important project.

Thank you for your time, commitment, and collaboration.

Sincerely,

Chief Terry Paul

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Terry Paul, *O.C*

Chief & CEO, Membertou

50 Autwen Ma'sl Awti | Membertou | Nova Scotia | Canada | B1S 2P5
Tel: [redacted] | **Fax:** [redacted] **Cell:** [redacted]
Email: [redacted] | **www.**membertou.ca | **www.**membertoucorporate.com

Setback Siting Guidelines for Wind Energy Projects

Prepared by: Ollson Environmental Health Management
Prepared for: West Hans Regional Municipality, Director of Planning and Development

Canada continues to see exponential growth in the installation of wind turbines across the country. Over the years onshore wind turbines have grown from 1.5 megawatt (MW) machines (~400 feet tall) to the current models typically ranging from >2.5 MW to 7 MW (500 feet to over 600 feet). With over 15,000 MW of generating capacity, there are over 6,000 wind turbines across Canada and more than 300 in Nova Scotia. It is anticipated that the need for wind energy will continue to expand, especially in light of Nova Scotia's goal of 80% of electrical generation by renewables by 2030.

OEHM recommends that West Hants Regional Municipality adopt into their By-law their previously established practice of using a 1 km setback to dwellings and 550 m to woods camps for existing projects. Based on the available scientific literature, this is more than sufficient to ensure the protection of the public health and safety of their residents. In fact, a lesser setback between 550 m to 1 km would be equally protective of public health and safety. There is no scientific basis to increase these setbacks. It would afford no additional protection of public health and safety and would unduly restrict areas for development.

With the growth of the industry has come the need to develop proper siting guidelines to ensure the protection of wildlife, the environment, and public health. There are no overarching federal guidelines that govern wind turbine installation and their interaction with local residents. The Nova Scotia Department of Environment and Climate Change (NSDECC) has established a series of guidelines for wind turbine sound and shadow flicker that are reviewed under the provincial Environmental Assessment processes. However, setting appropriate setback back distances to homes, cottages, and dwellings are left to the local municipalities.

West Hants Regional Municipality (West Hants) Council has directed the Planning Staff to review potential amendments to the West Hants Municipal Planning Strategy and Land Use By-law (WHLUB) to consider increasing the required setback for large-scale wind turbines from dwellings to 4 km.

Setting Science-Based Wind Energy Siting Requirements

There is no question that setting appropriate wind turbine siting guidelines for sound and distance setback to homes is a complicated undertaking. As with any energy production project one needs to balance community concerns with the need for the renewable energy and economic benefits, while still ensuring the protection of public health and welfare of the local population.

Appropriate setback distances to dwellings go hand in hand with sound and shadow flicker standards to ensure protection of public health and welfare. In addition, setbacks need to account for public safety issues with respect to potential ice throw, blade failure, and tower collapse. Public safety setback distances are often set both to non-participating property lines and dwellings themselves.

Over the past twenty years there has been extensive research evaluating public health, safety and welfare concerns of those living in proximity to wind turbines. This independent research by university professors, consultants and government agencies has taken place in many different countries on a variety of turbine models, many of which have been in communities for years. It is on the basis of this research that municipalities should set appropriate setbacks to dwelling. Caution should be exercised to not establish excessive setbacks that afford no additional benefit or protection of public health and safety.

Common Sound, Shadow Flicker and Setback Standards for Wind Energy Projects

The audible sound limit established by the NSDECC of 40 dBA Leq at dwellings (ambient sound + wind turbine sound), protects against direct and indirect potential health impacts, while ensuring people's quality of life and enjoyment of their property. This sound standard is amongst the most stringent anywhere in the world. The setback distance required to meet this stringent sound standard at most dwellings would be approximately 500 m. This is confirmed by individual sound modeling reports produced for each new proposed project. It is the cumulative sound from existing and proposed turbines. The NSDECC has also set a shadow flicker guideline of no more than 30 minutes a year and 30 minutes during any given event. With the height of modern turbines this equates to a minimum setback also of ~500 m.

There is no overarching Nova Scotia setback siting criteria, guidelines or regulations for wind energy projects. Instead, local counties/municipalities establish what they believe to be reasonable siting criteria for wind turbines in relation to dwellings. Setbacks in Nova Scotia typically are fixed distances that range from 550 m to 2 km, the most common of which is 1,000 m (1 km) to occupied dwellings (homes and seasonal cottages; but not cabins/camps) or a multiplier of turbine height to the home.

To put this in perspective, in Ontario the minimum setback distance from a wind turbine to a home is set by the province at 550 m, while in Alberta minimum distances to dwellings is also setback by the counties and typically range from 800 m to 1 km. There are >70,000 turbines across the United States and the most common setback distances are typically 500 m or in some cases a multiplier of wind turbine height of ~3x turbine height (from a 200 m tall turbine this would be 600 m).

The WHLUB does not currently specify a setback distance from wind turbines to dwellings. However, as detailed in the Planning Staff report (December 14, 2023) "*all approved development agreements for wind farms within WHRM require a minimum setback of 1,000 m (3,280.84 ft) from the base of the tower to any dwelling, hotel, motel, or apartment hotel existing as of the date of the agreement, and a minimum setback of 550 m (1,8046 ft.) from the base of the tower to any woods camps existing as of the date of the agreement.*" This WHRM precedent is consistent with other municipalities across Nova Scotia and in many cases greater than other jurisdictions with operating wind turbines in North America.

Potential Health Effects and Wind Energy Projects

Wind turbine setbacks from homes should, at least in part, be based on the science of potential health implications for those living in proximity. The most significant public health research on how living near a wind energy project could impact health was published after 2015. The weight of public health scientific evidence finds:

- There is no association between wind turbine sound levels of up to 46 dBA at the exterior of non-participating homes and impact on sleep.
- There is no association between distance from wind turbine to homes and does not impact sleep or other potential health impacts.
- The level of low frequency noise or infrasound from wind turbines at non-participating homes does not cause sleep disturbance or other health effects. The levels are typically within background levels at homes and are well below levels that could induce health impacts.
- The results from the Health Canada study did not show any statistically significant increase in the self-reported prevalence of chronic pain, asthma, arthritis, high blood pressure,

bronchitis, emphysema, chronic obstructive pulmonary disease (COPD), diabetes, heart disease, migraines/headaches, dizziness, or tinnitus in relation to WTN exposure up to 46 dB. In other words, individuals with these conditions were equally distributed among people living at all sound levels and distances from <500 m to 11 km in the study area.

- There will always be a percentage of people that self-report annoyance with having to live near wind projects, regardless of whatever sound or setback distances are permitted. This is a well-understood scientifically documented phenomenon. Levels of self-reported annoyance are largely driven by one's feelings towards how the turbines change the visual nature of the landscape and their perception of the perceived fairness in the permitting process for a project. The level of annoyance one feels towards the wind projects does not impact one's health. Therefore, it would be inappropriate to base wind turbine sound and setback standards on people's annoyance levels.
- Public safety setbacks of 110% (or 1.1 times) tip height of a wind turbine to property lines and roads ensure protection against ice throw, blade failure, and tower collapse.

Socio-Economic Determinants of Health and Wind Energy Projects

Wind energy projects bring clear socio-economic health benefits to host communities. These are in the form of taxes, landowner payments, jobs, potential impact on healthcare costs and an offset for the need for fossil fuel derived energy. These all have indirect health benefits at the individual and community level. At the same time wind energy projects allow for continued use and enjoyment of rural and forested areas.

Consideration of Cumulative Effect of Multiple Turbines in the Municipality

Another issue in determining appropriate setbacks is the cumulative effect and visual impact of projects on community members. Often the question becomes how many turbines in a community are enough. Currently, WHRM hosts 13 wind turbines, with another 24 wind turbines under construction by 2025, and potentially up to an additional 27 turbines in the county.

WRHM Council is wrestling with the question of the cumulative effect of wind turbines and how many are enough in one community. There are two distinct issues with respect to this topic. The first is the cumulative effect of the number of wind turbines on public health from sound and shadow flicker. The second is the visual aspect of the turbines on the horizon.

First, health impacts are assessed by the adherence to the sound and shadow flicker standards, regardless of the number of turbines in an area. Each of the sound and shadow flicker standards require an assessment of the cumulative effect of the individual project, as well as any adjacent project within 3 km. That is because the largest zone of influence of sound from one turbine to the next is within 2 km and the same is true for shadow flicker. That means that cumulative effects from all proposed and existing wind turbines are always accounted for.

In terms of the visual aspect of turbines on the horizon, beauty is truly in the eye of the beholder. There are numerous studies that describe that approximately 10% of the population living in proximity to a wind turbine will be annoyed by their presence. However, given that wind turbines do not impact property values, impact health or result in other impacts on quality of life OEHM does not believe that counties should use health or visual cue as the basis to increase setback distances to turbines. This would effectively be a roundabout way of zoning out wind turbines based on visual appearance. There are counties in Canada and the United States that host hundreds of wind turbines without impact on their communities.

OEHM Recommended Sound and Setback Siting Guidelines for Consideration by WHRM

Based on totality of these findings OEHM believes that the following siting guidelines are protective of public health, while providing a reasonable balance between community concerns and achievable project siting constraints:

- The audible sound limit of 40 dBA Leq established by the NSDECC at dwellings is protective against direct and indirect potential health impacts, while ensuring quality of life and enjoyment of property. This typically requires an approximate setback distance to homes of at least 500 m.
- NSDECC Shadow flicker guideline of no more than 30 hours a year and 30 minutes a day ensures protection of health and typically requires a setback distance of at least 500 m.
- Infrasound and low frequency noise, although emitted from wind turbines, have been demonstrated to be at level that is too low to be of health concern. Therefore, no additional setback standard is required.
- WHRM could consider instituting a public safety setbacks of 110% (or 1.1 times) tip height of a wind turbine to non-participating property lines and roads ensure protection against ice throw, blade failure, and tower collapse. Further distances are not recommended and not required to protect public safety.

OEHM recommends that West Hants Regional Municipality adopt into their By-law their previously established practice of using a 1 km setback to dwellings and 550 m to woods camps for existing projects. Based on the available scientific literature, this is more than sufficient to ensure the protection of the public health and safety of their residents. In fact, a lesser setback between 550 m to 1 km would be equally protective of public health and safety. There is no scientific basis to increase these setbacks. It would afford no additional protection of public health and safety and would unduly restrict areas for development.

These recommended siting guidelines are consistent with requirements of other Nova Scotia municipalities, many counties in Alberta, and far more stringent than the minimum setback distance of 550 m, which is common in Ontario and most jurisdictions in the United States.

OLLSON ENVIRONMENTAL HEALTH MANAGEMENT

Christopher Ollson, Ph.D.

Setback Siting Guidelines for Wind Energy Projects

Prepared for:

Director of Planning and Development
West Hants Regional Municipality
76 Morison Dr., P.O. Box 3000
Windsor, NS B0N 2T0

March 28, 2024

OLLSON
Environmental Health Management

Setback Siting Guidelines for Wind Energy Projects

Ollson Environmental Health Management

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Another issue in determining appropriate setbacks is the cumulative effect and visual impact of projects on community members. Often the question becomes how many turbines in a community are enough. Currently, WHRM hosts 13 wind turbines, with another 24 wind turbines under construction by 2025, and potentially up to an additional 27 turbines in the county.

WRHM Council is wrestling with the question of the cumulative effect of wind turbines and how many are enough in one community. There are two distinct issues with respect to this topic. The first is the cumulative effect of the number of wind turbines on public health from sound and shadow flicker. The second is the visual aspect of the turbines on the horizon.

First, health impacts are assessed by the adherence to the sound and shadow flicker standards, regardless of the number of turbines in an area. Each of the sound and shadow flicker standards require an assessment of the cumulative effect of the individual project, as well as any adjacent project within 3 km. That is because the largest zone of influence of sound from one turbine to the next is within 2 km and the same is true for shadow flicker. That means that cumulative effects from all proposed and existing wind turbines are always accounted for.

In terms of the visual aspect of turbines on the horizon, beauty is truly in the eye of the beholder. There are numerous studies that describe that approximately 10% of the population living in proximity to a wind turbine will be annoyed by their presence. However, given that wind turbines

do not impact property values, impact health or result in other impacts on quality of life OEHM does not believe that counties should use health or visual cue as the basis to increase setback distances to turbines. This would effectively be a roundabout way of zoning out wind turbines based on visual appearance. There are counties in Canada and the United States that host hundreds of wind turbines without impact on their communities.

OEHM Recommended Sound and Setback Siting Guidelines for Consideration by WHRM

Based on totality of these findings OEHM believes that the following siting guidelines are protective of public health, while providing a reasonable balance between community concerns and achievable project siting constraints:

- The audible sound limit of 40 dBA Leq established by the NSDECC at dwellings is protective against direct and indirect potential health impacts, while ensuring quality of life and enjoyment of property. This typically requires an approximate setback distance to homes of at least 500 m.
- NSDECC Shadow flicker guideline of no more than 30 hours a year and 30 minutes a day ensures protection of health and typically requires a setback distance of at least 500 m.
- Infrasound and low frequency noise, although emitted from wind turbines, have been demonstrated to be at level that is too low to be of health concern. Therefore, no additional setback standard is required.
- WHRM could consider instituting a public safety setbacks of 110% (or 1.1 times) tip height of a wind turbine to non-participating property lines and roads ensure protection against ice throw, blade failure, and tower collapse. Further distances are not recommended and not required to protect public safety.

OEHM recommends that West Hants Regional Municipality adopt into their By-law their previously established practice of using a 1 km setback to dwellings and 550 m to woods camps for existing projects. Based on the available scientific literature, this is more than sufficient to ensure the protection of the public health and safety of their residents. In fact, a lesser setback between 550 m to 1 km would be equally protective of public health and safety. There is no scientific basis to increase these setbacks. It would afford no additional protection of public health and safety and would unduly restrict areas for development.

These recommended siting guidelines are consistent with requirements of other Nova Scotia municipalities, many counties in Alberta, and far more stringent than the minimum setback distance of 550 m, which is common in Ontario and most jurisdictions in the United States.

Table of Contents

List of Figures

List of Table

1 Introduction

Canada continues to see exponential growth in the installation of wind turbines across the country. Over the years onshore wind turbines have grown from 1.5 megawatt (MW) machines (~400 feet tall) to the current models typically ranging from >2 MW to 7 MW (500 feet to over 600 feet). With over 15,000 MW of generating capacity, there are over 6,000 wind turbines across Canada and more than 300 in Nova Scotia. It is anticipated that the need for wind energy will continue to expand, especially in light of Nova Scotia's goal of 80% of electrical generation by renewables by 2030.

With the growth of the industry has come the need to develop proper siting guidelines to ensure the protection of wildlife, the environment, and public health. There are no overarching federal guidelines that govern wind turbine installation and their interaction with local residents. The Nova Scotia Department of Environment and Climate Change (NSDECC) has established a series of guidelines for wind turbine sound and shadow flicker that are reviewed under the Provincial Environmental Assessment processes. However, appropriate setback back distances to homes, cottages, and dwellings are left to the local municipalities. This has resulted in a diverse range of siting criteria being implemented within the province and across the country.

In recent years, communities have raised concerns about having wind turbines placed in close proximity to their homes. These issues include concerns around distance of the towers to their homes and property lines, the change to the landscape that comes with construction of a wind project, the sound they will experience at their homes, shadow flicker and safety issues involving ice throw and structural failure of the turbines. It is these issues that need to be addressed when determining appropriate siting criteria for protection of public health, while still ensuring that regulations are not so overly restrictive that projects cannot be built.

Community concerns have led to an explosion of misinformation on the Internet with respect to how living in proximity to wind turbines may impact health. This is not unique to wind turbines and is similar to other modernization efforts and changes to the environment that are typically accompanied by unsupported health claims (e.g., EMF from transmission lines, cellular towers, and cellular phones).

West Hants Regional Municipality (West Hants) Council has directed the Planning Staff to review potential amendments to the West Hants Municipal Planning Strategy and Land Use By-law (WHLUB) to consider increasing the required setback for large-scale wind turbines from dwellings to 4 km.

Over the past twenty years there has been extensive research evaluating public health and welfare concerns of those living in proximity to wind turbines. This independent research by university professors, consultants and government agencies has taken place in many different countries on a variety of turbine models, which have been in communities for years.

The purpose of this report is to provide science-based factual information to support siting guidelines that are protective of public health, understands community concerns and recognizes the economic benefits and the desire for wind energy development. The focus of this review is on non-participating homes and property. Although the science on appropriate sound levels to protect against direct and indirect health impacts is well supported, it is acknowledged that issues surrounding level of community annoyance is far more subjective. This is also addressed within the paper.

2 Considerations for Developing Science-Based Setback Regulations

There is no question that setting appropriate wind turbine siting guidelines for sound and distance setback to homes is a complicated undertaking. As with any energy production project one needs to balance community concerns with the need for the renewable energy and economic benefits, while still ensuring the protection of public health and welfare of the local population.

Appropriate setback distances to dwellings go hand in hand with sound and shadow flicker standards to ensure protection of public health and welfare (Figure 1). In addition, setbacks need to account for public safety issues with respect to potential ice throw, blade failure, and tower collapse. Public safety setback distances are often set both to non-participating property lines and dwellings themselves.

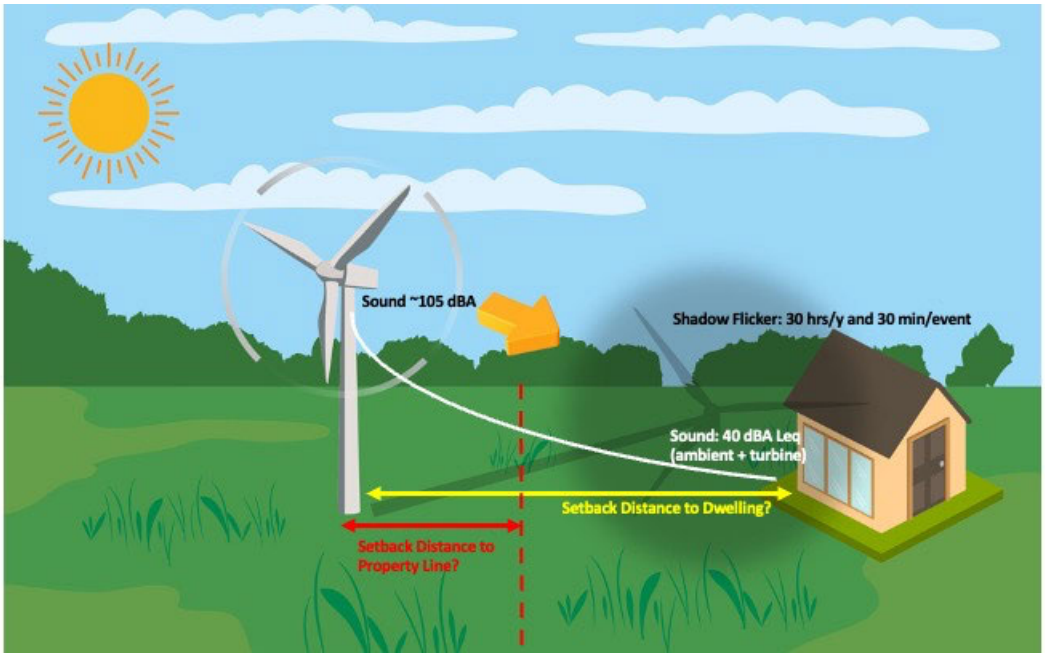

Figure 1. Setback considerations

Over the past twenty years there has been extensive research evaluating public health, safety and welfare concerns of those living in proximity to wind turbines. This independent research by university professors, consultants and government agencies has taken place in many different countries on a variety of turbine models, many of which have been in communities for years. It is on the basis of this research that municipalities should set appropriate setbacks to dwelling. Caution should be exercised to not establish excessive setbacks that afford no additional benefit or protection of public health and safety.

The following sections will first describe how the NSDECC guidelines for sound and shadow flicker are appropriate for protection of public health. This is important to understand so that they can be used to establish minimum setback distances to homes. Next discussion on setback requirements for ensuring protection of public safety from physical issue will be explored. Finally, putting these two issues together OEHM will describe recommended setbacks for West Hants to dwellings.

3 Sound and Shadow Flicker Guidelines in Nova Scotia

The first step in setting health-based guidelines for any infrastructure project is to understand its emissions and how they could interact with people in the surrounding area. For wind turbines the emissions of concern are sound and shadow flicker. The studies that justify appropriate standards are later in this document. However, OEHM can attest that the NSDECC standards for sound and shadow flicker are indeed protective of public health.

3.1.1 Nova Scotia Sound Standard (NSDECC, 2021)

The NSDECC's sound guideline requires:

> *In establishing separation distances, a proponent must ensure that the wind farm design and turbine siting does not cause sound levels to exceed 40 dBA (A-weighted decibels) at the exterior of receptors.*

The standard requires that all existing dwelling and those with building permits be identified within a 2 km area of a wind turbine. In addition, all existing or permitted wind projects within 3 km of the proposed project must be identified. Then acousticians (noise professionals), knowing the rated sound power level coming from the proposed turbines, use internationally accepted models to predicted sound level that will be experienced at nearby dwellings. These models are conservative and have been demonstrated to accurately predict the wind turbine sound through post-construction monitoring of sound in the field.

These assessments take into account cumulative effects of multiple turbines and multiple projects, as they calculate the cumulative sound coming from each turbine in the area. It also conservatively assumes that the wind is blowing from all directions and carries the sound from each turbine, simultaneously towards the home.

In addition, the NSDECC sound standard requires that the wind turbine sound be added to the existing ambient sound in the area. The cumulative level of sound cannot exceed 40 dBA. The standard approach is to assume a 35 dBA ambient sound level (from Health Canada) add the modeled wind turbine sound level at the homes. Sound is reported on a logarithmic scale, hence to meet the NSDECC cumulative sound standard the highest wind turbine d sounca be 38.4 dBA.

Sound Standard 40 dBA = Ambient Sound 35 dBA + Wind Turbine Sound at home 38.4 dBA

The NSDECC sound standard is amongst the most stringent around the world and is similar to that required in Alberta. Although the Ontario sound standard is also 40 dBA at homes, it is the wind turbine sound alone and does not take into account ambient background sound levels. In addition, the most common sound standard in the United States is 45 dBA of wind turbine sound alone and can range up to 50 dBA. There are very few US jurisdictions that have a 40 dBA sound standard and there are over 70,000 operating turbines across the country.

There have been hundreds of sound model reports generated for the wind projects across North America. Review of these reports shows that a minimum setback distance from wind turbines, modeled with multiple turbines in a project, to achieve a 40 dBA sound level is typically between 500 m to 750 m (Whitfield Aslund, 2013).

In recent years there have been a number of changes in wind turbine technology. Wind turbine nameplate capacity in megawatts (MW) has been increasing. This has resulted in taller hub heights, longer blades (rotor diameter) and overall height of the wind turbines. In addition, there has been improvement in blade technology, where blades typically now have serrated edges to reduce sound levels emitted from the turbines. The resulting sound power level (SPL) from these newer turbines varies considerably across turbine type and manufacturer.

Regardless of how tall the wind turbines are, or their SPL, it is still incumbent on the wind energy project developers to ensure that the regulated sound level at homes is met. The SPL of the wind turbine model to be used will directly affect how far it must be setback to meet permitted wind turbine sound levels at homes. Therefore, sound levels and setback distances to homes must be evaluated in tandem to ensure compliance with permit requirements. Setback distances from homes should not be set at a distance that would be far in excess than those required to meet the permitted sound level.

Implications of Sound Standard for WHRM Setback to Dwellings:

There is no need for WHRM Council to adopt a sound standard, given that the NSDECC existing standard is among the most conservative in the world. Adhering to this cumulative sound standard would require a setback of between 500 m to 750 m from turbines to dwellings. OEHM recommends that the WHRM Council not adopt a significantly greater setback than this and rather rely on the results of the cumulative sound modeling to ensure the protection of public health.

Once a project becomes operational it is possible to measure the sound levels at exterior of homes to ensure compliance with permit conditions. This is commonly referred to as post-construction sound monitoring. Field verification testing has demonstrated that proper modeling of sound in the pre-construction permitting process ensures compliance once the wind turbines are operational. If post-construction sound monitoring does reveal compliance issues, the operator is required to bring the offending turbine back within permitted levels. This can be achieved through the noise reduction modes (NRO) in turbines, but is not desirable for the operators as it can affect power output. Therefore, it is imperative that the pre-construction sound modeling is conducted correctly by trained professional acousticians.

3.1.2 Nova Scotia Shadow Flicker Standard (NSDECC, 2021)

Shadow flicker occurs when interruption of sunlight by the wind turbine blades results in a change in light intensity within a home or building. The flickering phenomenon does not occur unless one is inside a building or structure with windows. As demonstrated in Appendix A, shadow flicker does not cause health impacts. Instead, governments around the world have set what they believe to be reasonable limits on the amount of shadow flicker that non-participating dwellings should experience.

The NSDECC's shadow flicker guideline requires:

> *Proponents must demonstrate through modelling that no receptor will receive 30 minutes or more per day, and/or 30 hours or more per year of shadow flicker.*
>
> - *discuss the methods to be used to monitor shadow flicker throughout the life of the development.*
> - *discuss the methods to be used to mitigate shadow flicker should modelling be inaccurate or shadow flicker be in excess of 30 minutes per day, and/or 30 hours or more per year.*

The internationally developed shadow flicker models are very accurate in predicting shadow flicker at dwellings. Similar to the sound model, it is a cumulative effects model where the location of each of the turbines in a project and those within 2 km of a neighbouring project are inputted along with the location of the dwellings. Then based on a simple physics model using the location of the sun throughout the year it generates the dates and times that shadow flicker could occur at dwellings from all of the surrounding turbines.

Implications of Shadow Flicker Standard for WHRM Setback to Dwellings:

There is no need for WHRM Council to adopt a shadow flicker standard, given that the NSDECC existing standard is very stringent and similar to those used around the world. In fact, the addition of the no more than 30 minutes of shadow flicker a day at a dwelling is more conservative than most North American jurisdictions, that typically on have the requirement of no more than 30 hours a year. Adhering to this cumulative shadow flicker standard would require a setback of between 500 m to 750 m from turbines to dwellings. OEHM recommends that the WHRM Council not adopt a significantly greater setback than this and rather rely on the results of the cumulative shadow modeling to ensure a reasonable level to avoid nuisance with neighbouring landowners.

As the height of turbines has increased, so has the distance from which shadow flicker can be cast from the turbine to a dwelling. For those turbines greater than 200 m to the total tip height it is possible that you could have exceedances of the NSDECC's guideline up to approximately 750 from turbine. That said, there are curtailment measures that can be put in place to ensure that the turbines can be stopped during any shadow flicker events that exceed the NSDECC standard.

4 Setback Guidelines in Other Jurisdictions

The NSDECC does not prescribe any setback to dwelling and differ to the local municipality. However, they do state some general considerations on setbacks.

> *Locate wind turbines far enough away from domestic dwellings so that the turbines do not unreasonably affect the amenity of such properties through sound, shadow flicker, visual domination, or reflected light.*
>
> *The advisable distance between residences and a proposed wind development to avoid any disturbance of neighbours depends on a variety of factors including local topography, climate, character and level of background noise, and overall size of the development.*

Municipalities throughout Nova Scotia have set a variety of setback distances from wind turbines to dwellings. Table 1 provides examples of setbacks from across a number of North American jurisdictions with operating wind projects. In many jurisdictions setbacks are a fixed distance to homes, whereas in others a multiplier on the total turbine height is used to establish the setback distances.

In many cases the rationale for establishing the setbacks has not been provided in a manner easily accessible by the public. However, Dr. Ollson of OEHM has been involved in the development of many of these standards and can attest that the setbacks are typically based on the distance needing to meet sound and shadow flicker requirements and in some cases with an additional buffer for community acceptance.

Table 1. Typical North American Jurisdiction Wind Turbine Setbacks from Homes.

Municipality	Minimum Setback for Wind Turbines from Residential Dwellings
Nova Scotia	
West Hants Regional Municipality	Precedent of 1000 m. (3,280 ft.) from dwelling for existing projects
Municipality of East Hants	4 times the height of the wind turbine
Municipality of the County of Kings	Only permitted in the "Large Scale Wind Turbine Overlay"; the boundaries of the overlay are a minimum of 3 km from dwellings existing on November 15, 2018.
Colchester County	2 km for wind turbines greater than 100 m. (328 ft.). If a wind turbine exceeds 200 m. (656 ft.) an increased setback of 7.5 m. (26.5 ft.) is required for every 1 m. (3.3 ft.) of additional height if the increased minimum setback is necessary to satisfy the maximum ambient degradation noise standard of the By-law.
Municipality of Yarmouth	1000 m. (3,280 ft.) or 6.5 times the height of the turbine, whichever is greater
Region of Queens Municipality	1.5 times the total height of the turbine from all property lines and watercourses
Municipality of the County of Annapolis	Only permitted within a "Wind Resource Areas"; requires a minimum of 1,000 m (3,280 ft.) .
Halifax Regional Municipality	550 m. (1,805 ft.)
Municipality of Cumberland	1000 m. (3,280 ft.) or 3.5 times the height of the turbine, whichever is greater
Municipality of the District of Digby	1000 m. (3,280 ft.)
Municipality of Pictou County	1000 m. (3,280 ft.)
Municipality of the County of Antigonish	1000 m. (3,280 ft.)
Top Canadian Jurisdictions with Operating Wind Projects	
Ontario	550 m from a residence
Quebec	Set by the municipalité régionale de comté (MRC) and typically governed by sound standard setback, most common 750 m
Alberta	Set by the counties. Typical setbacks to dwelling range from 800 m to 1000 m.
United States Examples	
North Dakota (State)	*One and one-tenth times the height of the turbine from the property line of a nonparticipating landowner and three times the height of the turbine from an inhabited rural residence of a nonparticipating landowner, unless a variance is granted.*
Wisconsin (State)	*The lessor of 1,250 feet or 3.1 times the maximum blade tip height.*
New York (State)	Non-participating, non-residential Structures 1.5 times, non-participating residences 2 times
Illinois (State)	1.1 times tip height to non-participating property lines, 2.1 times tip height to non-participating receptors.
Michigan (State)	2.1 times from occupied community buildings and residences on nonparticipating properties 1.1 times from non-participating property lines
Nebraska (County)	Varies county by county but most common between 300 m to 500 m
Kansas (County)	Varies county by county but most common between 300 m to 500 m

The typical setback distance in Nova Scotia to dwellings (homes and cottages) is 1,000 m. This is similar to what many counties have established in Alberta, which has seen one of the highest growth rates of wind project in Canada over the past decade. Many other Canadian jurisdictions, including Ontario and Quebec with the greatest number of turbines have much lower setbacks of 550 m to 750 m from homes. These provinces tend to have a higher population density living near turbines than either Nova Scotia or Alberta. In addition, many areas of the United States have far lessor setback distances between non-participating homes and wind turbines.

Implications of Other Jurisdiction Setback Standards for WHRM Setback to Dwellings:

OEHM recommends that West Hants Regional Municipality adopt into their By-law their previously established practice of using a 1 km setback to dwellings and 550 m to woods camps for existing projects. This is more than sufficient to ensure the protection of the public health and safety of their residents. In fact, a lesser setback between 550 m to 1 km would be equally protective of public health and safety. There is no scientific basis to increase these setbacks. It would afford no additional protection of public health and safety and would unduly restrict areas for development. It would also be consistent, or greater than, other jurisdictions' setback standards in Nova Scotia and across North America.

In all cases these jurisdictions have successfully hosted wind projects for one to two decades. It is true that there are jurisdictions that have greater setbacks. However, in most, if not all instances these setbacks (>1 km) were designed to exclude wind projects from being built in their communities. Setback distances greater than 1 km afford no greater health protection for resident's health.

5 Review of Health Research with Living in Proximity to Wind Turbines

An extensive review of the findings of the bulk of peer-reviewed scientific literature on living in proximity to wind turbines is found in Appendix A. Readers are encouraged to consult the appendix for any questions they have on health impacts and siting.

Wind turbine setbacks from homes should, at least in part, be based on the science of potential health implications for those living in proximity. The most significant public health research on how living near a wind energy project could impact health was published after 2015. The weight of public health scientific evidence finds:

- There is no association between wind turbine sound levels of up to 46 dBA at the exterior of non-participating homes and impact on sleep.
- There is no association between distance from wind turbine to homes and does not impact sleep or other potential health impacts.
- The level of low frequency noise or infrasound from wind turbines at non-participating homes does not cause sleep disturbance or other health effects. The levels are typically within background levels at homes and are well below levels that could induce health impacts.
- The results from the Health Canada study did not show any statistically significant increase in the self-reported prevalence of chronic pain, asthma, arthritis, high blood pressure, bronchitis, emphysema, chronic obstructive pulmonary disease (COPD), diabetes, heart disease, migraines/headaches, dizziness, or tinnitus in relation to WTN exposure up to 46 dB. In other words, individuals with these conditions were equally distributed among people living at all sound levels and distances from <500 m to 11 km in the study area.

- There will always be a percentage of people that self-report annoyance with having to live near wind projects, regardless of whatever sound or setback distances are permitted. This is a well-understood scientifically documented phenomenon. Levels of self-reported annoyance are largely driven by one's feelings towards how the turbines change the visual nature of the landscape and their perception of the perceived fairness in the permitting process for a project. The level of annoyance one feels towards the wind projects does not impact one's health. Therefore, it would be inappropriate to base wind turbine sound and setback standards on people's annoyance levels.

Implications of Health Studies for WHRM Setback to Dwellings:

The West Hants Regional Municipality previously established practice of using a 1 km setback to dwellings and 550 m to woods camps for existing projects ensures the protection of the public health and safety of their residents. There is no health justification basis to increase these setbacks.

- Public safety setbacks of 110% (or 1.1 times) tip height of a wind turbine to property lines and roads ensure protection against ice throw, blade failure, and tower collapse.

6 Consideration Cumulative Effects and Visual Aspect of Wind Turbines

Another issue in determining appropriate setbacks is the visual impact of projects on community members. Often the question becomes how many turbines in a community are enough. Currently, WHRM hosts 13 wind turbines (Martock 3; Ellerhouse 10) with another 24 wind turbines due to be erected under the Benjamins Mills project by 2025, or a total of 47 turbines. OEHM understands that there are two current development permit applications before WHRM for the Bear Lake project (15 wind turbines) and the Ellerhouse 3 project (up to12 wind turbines), for up to an additional 27 turbines in the county.

OEHM understands that the WRHM Council is wrestling with the question of the cumulative effect of wind turbines and how many are enough in one community. There are two distinct issues with respect to this topic. The first is the cumulative effect of the number of wind turbines on public health from sound and shadow flicker. The second is the visual aspect of the turbines on the horion.

OEHM has been involved in projects across the continent with more than 100 wind turbines in a single project. In addition, Dr. Ollson has worked in counties that have more than 500 turbines across only two to three counties.

First, as described above the health impacts is assessed by the adherence to the sound and shadow flicker standards, regardless of the number of turbines in an area. Each of the sound and shadow flicker standards require an assessment of the cumulative effect of the individual project, as well as any adjacent project within 3 km. That is because the largest zone of influence of sound from one turbine to the next is within 2 km and the same is true for shadow flicker. That means that cumulative effects from all proposed and existing wind turbines are always accounted for.

Implications of Cumulative Effects for WHRM Setback to Dwellings:

The sound and shadow flicker studies inherently include a cumulative effects assessment. There are numerous counties across North America that have far greater number of turbines than proposed for West Hants that have been operating harmoniously with the communities for over a decade.

In terms of the visual aspect of turbines on the horizon, beauty is truly in the eye of the beholder. There are numerous studies that describe that approximately 10% of the population living in proximity to a wind turbine will be annoyed by their presence. However, given that wind turbines

do not impact property values, impact health or result in other impacts on quality of life OEHM does not believe that counties should use health or visual cue as the basis to increase setback distances to turbines. This would effectively be a roundabout way of zoning out wind turbines based on visual appearance.

7 Conclusion on Setting a Proper Siting Guidelines for Wind Energy Projects

There is no question that setting appropriate wind turbine siting guidelines for sound and distance setback to homes is a complicated undertaking. As with any energy production project one needs to balance community concerns with the need for the renewable energy and economic benefits, while still ensuring the protection of public health and welfare of the local population.

Wind energy projects bring clear socio-economic health benefits to host communities. These are in the form of taxes, landowner payments, jobs, potential impact on healthcare costs and an offset for the need for fossil fuel derived energy. These all have indirect health benefits at the individual and community level. At the same time wind energy projects allow for continued use and enjoyment of rural and wooded areas.

Based on totality of these findings OEHM believes that the following siting guidelines could be implemented in West Hants and are protective of public health, while providing a reasonable balance between community concerns and achievable project siting constraints:

- The audible sound limit of 40 dBA Leq established by the NSDECC at dwellings is protective against direct and indirect potential health impacts, while ensuring quality of life and enjoyment of property. This typically requires an approximate setback distance to homes of at least 500 m.
- NSDECC Shadow flicker guideline of no more than 30 hours a year and 30 minutes a day ensures protection of health and typically requires a setback distance of at least 500 m.
- Infrasound and low frequency noise, although emitted from wind turbines, have been demonstrated to be at level that is too low to be of health concern. Therefore, no additional setback standard is required.
- WHRM could consider instituting a public safety setback of 110% (or 1.1 times) tip height of a wind turbine to non-participating property lines and roads ensure protection against ice throw, blade failure, and tower collapse. Further distances are not recommended and not required to protect public safety.

OEHM recommends that West Hants Regional Municipality adopt into their By-law their previously established practice of using a 1 km setback to dwellings and 550 m to woods camps for existing projects. This is more than sufficient to ensure the protection of the public health and safety of their residents. In fact, a lesser setback between 550 m to 1 km would be equally protective of public health and safety. There is no scientific basis to increase these setbacks. It would afford no additional protection of public health and safety and would unduly restrict areas for development.

These recommended siting guidelines are consistent with requirements of other Nova Scotia municipalities, many counties in Alberta, and far more stringent than the minimum setback distance of 550 m, which is common in Ontario and most jurisdictions in the United States.

OLLSON ENVIRONMENTAL HEALTH MANAGEMENT

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8 References

Bakker RH, Pedersen E, van den Berg GP, Stewart RE, Lok W, Bouma J. Impact of wind turbine sound on annoyance, self-reported sleep disturbance and psychological distress. *Sci Total Environ* (2012) **425**:42–51.

Barry, R., Sulsky, S., Kreiger. N. 2018. Using residential proximity to wind turbines as an alternative exposure measure to investigate the association between wind turbines and human health. The Journal of the Acoustical Society of America. 143, 3278

Berger R.G., Ashtiani P., **Ollson C.A.**, Whitfield Aslund M., McCallum L.C., Leventhall G., Knopper L.D. 2015. *Health-based audible noise guidelines account for infrasound and low frequency noise produced by Wind Turbines.* Front Public Health. Vol 3, Art. 31

Feder K, Michaud DS, Keith SE, Voicescu SA, Marro L, Than J, Guay M, Denning A, Bower TJ, Lavigne E, Whelan C, van den Berg F. 2015. An assessment of quality of life using the WHOQOL-BREF among participants living in the vicinity of wind turbines. Environ Res. 2015 Oct;142:227-38. doi: 10.1016/j.envres.2015.06.043. Epub 2015 Jul 11

Fidell, S and Mestre, V. 2020. A Guide to U.S. Aircraft Noise and Regulatory Policy. Springer. ISBN 978-3-030-39908-5

Fredianelli et al. 2019. A procedure for deriving wind turbine noise limits by taking into account annoyance. Science of the Total Environment 648 (2019) 728–736

Freiberg et al. 2019 Health effects of wind turbines on humans in residential settings: Results of a scoping review. Environmental Research 169 (2019) 446–463

Grimwood CJ, Skinner GJ, Raw GJ, BRE, Watford, WD25 9XX. *The UK national noise attitude survey 1999/2000*. Noise Forum Conference, London, England (2002).

Haac, R.T., Kaliski, K., Landis, M., Hoen, B., Rand, J., Firestone, J., Elliott, D., Hübner, G., Pohl, J. 2019 Wind turbine audibility and noise annoyance in a national U.S. survey: Individual perception and influencing factors. Journal of the Acoustical Society of America 146.

Health Canada. Wind Turbine Noise and Health. The Government of Canada. 2014. Available online: http://www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php

Hoen, B., Firestone, J., Rand, J., Elliot, D., Hübner, G., Pohl, J., Wiser, R., Lantz, E., Haac, R., Kaliski, K. 2019. Attitudes of U.S. Wind Turbine Neighbors: Analysis of a Nationwide Survey. Energy Policy 134 (2019) 110981

Hübner G, Pohl J, Hoen B, Firestone J, Rand J, Elliott D, Haac R. 2019. Monitoring annoyance and stress effects of wind turbines on nearby residents: A comparison of U.S. and European Samples Environ Int. 2019 Nov;132:105090. doi: 10.1016/j.envint.2019.105090. Epub 2019 Aug 19.

International Standards Organization (ISO). 2003. Technical Specification. ISO/TS 15666:2003(en) Acoustics – Assessment of Noise annoyance by means of social and social acoustics survey.

Institute of Medicine of the National Academies. 2006. Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem

Jalali et al. 2016. Before–after field study of effects of wind turbine noise on polysomnographic sleep parameters. Noise Health; 18:194-205.

Jakobsen J. Danish guidelines on environmental low frequency noise, infrasound and vibration. *J Low Freq Noise V A* (2001) **20**:141-8.

Janssen SA, Vos H, Pedersen E. A comparison between exposure-response relationships for wind turbine annoyance and annoyance due to other noise sources. *J Acoust Soc Am* (2011) **130**:3746-53.

Kamigawara K, Yue J, Saito T, Hirano T. Publication of "Handbook to deal with low frequency noise (2004)". *J Low Freq Noise V A* (2006) **25**:153-6.

Keith SE, Feder K, Voicescu SA, Soukhovtsev V, Denning A, Tsang J, Broner N, Richarz W, van den Berg F. 2016. Wind turbine sound power measurements. J. Acoust. Soc. Am. 139 (3), 1431-1435

Klaeboe & Sundfor (2016) Windmill Noise Annoyance, Visual Aesthetics, and Attitudes towards Renewable Energy Sources Int. J. Environ. Res. Public Health 2016, 13, 746

Knopper, L.D., **Ollson, C.A.,** McCallum, L.C., Aslund, M.L., Berger, R.G, Souweine, K., and McDaniel, M. 2014. *Wind turbines and Human Health*. Front. Public Health, Vol. 2, Art. 63

Laszlo HE, McRobie ES, Stansfeld SA, Hansell AL. Annoyance and other reaction measures to changes in noise exposure - A review. *Sci Total Environ* (2012) **435**:551-562.

Liebich et al. 2020. A systematic review and meta-analysis of wind turbine noise effects on sleep using validated objective and subjective sleep assessments. Journal of Sleep Research.

McCunney, R.J., Mundt, K.A., Colby, D., Dobie, R., Kaliski, K., Blais, M. 2014. Wind Turbines and Health A Critical Review of the Scientific Literature. JOEM Volume 56, Number 11

Michaud DS, Feder K, Keith SE, Voicescu SA, Marro L, Than J, Guay M, Denning A, Murray BJ, Weiss SK, Villeneuve PJ, van den Berg F, Bower T. 2016. Effects of Wind Turbine Noise on Self-Reported and Objective Measures of Sleep. Sleep. 2016 Jan 1;39(1):97-109

Michaud DS, Feder K, Keith SE, Voicescu SA, Marro L, Than J, Guay M, Denning A, McGuire D, Bower T, Lavigne E, Murray BJ, Weiss SK, van den Berg F. 2016a. Exposure to wind turbine noise: Perceptual responses and reported health effects. J Acoust Soc Am. 2016 Mar;139(3):1443-54.

Michaud DS, Keith SE, Feder K, Voicescu SA, Marro L, Than J, Guay M, Bower T, Denning A, Lavigne E, Whelan C, Janssen SA, Leroux T, van den Berg F. 2016b. Personal and situational variables associated with wind turbine noise annoyance. J Acoust Soc Am. 2016 Mar;139(3):1455-66.

Michaud DS, Feder K, Keith SE, Voicescu SA, Marro L, Than J, Guay M, Denning A, Bower T, Villeneuve PJ, Russell E, Koren G, van den Berg F. 2016c. Self-reported and measured stress related responses associated with exposure to wind turbine noise. J Acoust Soc Am. 2016 Mar;139(3):1467-79.

Michaud DS, Keith SE, McMurchy D. 2005. Noise annoyance in Canada. *Noise Health* **7**:39-47.

Michaud, DS., Guay, M., Marro, L., Than, J. 2018 Response to: “Using residential proximity to wind turbines as an alternative exposure measure to investigate the association between wind turbines

and human health," by Barry, Sulsky, Kreiger (2018) The Journal of the Acoustical Society of America. 144, 330

Ministry for the Environment, Climate and Energy of the Federal State of Bade Wuerttemberg Germany. 2016. Low-frequency noise including infrasound from wind turbines and other sources

Nova Scotia. Policy Division. Environmental Assessment Branch. 2021. Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia. May 2007, Revised October, 2021.

Pedersen E, Persson Waye K. Perception and annoyance due to wind turbine noise – a dose–response relationship. *J Acoust Soc Am* (2004) **116**:3460-70.

Pedersen E. Health aspects associated with wind turbine noise-Results from three field studies. *Noise Control Eng J* (2011) **59**:47-53.

Pedersen E, Persson Waye K. Perception and annoyance due to wind turbine noise – a dose–response relationship. *J Acoust Soc Am* (2004) **116**:3460-70.

Pedersen E, Persson Waye K. Wind turbine noise, annoyance and self-reported health and well-being in different living environments. *Occup Environ Med* (2007) **64**:480-6.

Pohl et al. 2018. Understanding stress effects of wind turbine noise – The integrated approach Energy Policy 112 (2018) 119–128

Smith, MG., Ogren, M., Thorsson, P., Hussain-Alkhateeb, L., Pedersen, E., Forssen, J., Ageborg Morsing, J., Persson Waye, K. 2020. A laboratory study on the effects of wind turbine noise on sleep: results of the polysomnographic WiTNES study. SLEEPJ, 2020, 1–14

Turnbull C, Turner J, Walsh D. 2012. Measurement and level of infrasound from wind farms and other sources. *Acoust Aust* **40**:45-50.

U.S. EPA. 2019. Public Health Benefits per kWh of Energy Efficiency and Renewable Energy in the United States: A Technical Report

Verheijen, E., Jabben, J., Schreurs, E., Smith, K.B., (2011). Impact of wind turbine noise in The Netherlands. *Noise Health* 13(55), 459-63.

WHO 1948. Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June, 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on 7 April 1948

World Health Organization (WHO). 1999. Berglund B, Lindvall T. (Eds.) *Community Noise*. Center for Sensory Research, Stockholm University and Karolinska Institute

World Health Organization (WHO) Regional Office for Europe. 2009. Night noise guidelines for Europe. Copenhagen (Denmark): World Health Organization Regional Office for Europe; p. i-xviii; 1-162.

World Health Organization (WHO) Regional Office for Europe. 2018. Environmental Noise Guidelines for the European Region

World Health Organization (WHO). 2019. Health Impact Assessment. https://www.who.int/hia/en/

Appendix A

Review of Health Implications for Living Around Wind Turbines as the Relate to Setbacks to Dwellings

9 Health Research Supporting the Proper Siting of Wind Turbines

Wind-based energy production has been identified as a clean and renewable resource that does not produce any known emissions or harmful wastes. As a result, wind power has become one of the fastest growing sources of new electric power generation, with several countries achieving high levels of wind power capacity.

Over 100 studies have been published worldwide to examine the relationship between wind turbines and possible human health effects. Based on the findings and scientific merit of these studies, lead health and medical authorities have stated that when sited properly (i.e., based on distance and/or noise guidelines and setbacks), wind turbines are not causally related to adverse effects.

Appropriate science-based setbacks and sound limits are required to ensure the protection of public health and safety. One needs to ensure these protections for issues on:

- Sound (audible noise)
- Low frequency noise and infrasound
- Setback Distances – public safety

The focus of this review is on the non-participating residences.

9.1 Sound (Noise): Audible, Low Frequency and Infrasound

Perhaps one of greatest areas of research on proper siting of wind turbine to avoid health issues is in relation to wind turbine sound and setback distances to homes. The past decade has seen numerous independent research efforts undertaken in the U.S., Canada, Europe and Australia.

In 2014, Health Canada released the findings of their Wind Turbine Noise (WTN) and Health Study. This is most comprehensive study of its kind to date and its results will be referenced a number of times in this report. The following provides a high-level overview of the study design. This study was initiated in 2012 and was a partnership between Health Canada and Statistics Canada to understand the potential impacts of wind turbine noise on health and wellbeing of communities in Southern Ontario and Prince Edward Island (PEI). A total of 1238 households participated in the study, with an almost 80% response rate of all households within 6 miles (10 km) of projects investigated, making it the largest and most comprehensive study ever undertaken around the world.

Households were located between 820 ft (250 m) and 6 mi (10 km) from operational wind turbines. The A-weighted (dBA) sound levels (audible sound/noise) were grouped into 5 dBA increments with the loudest level in the study at the exterior of a home being 46 dBA Leq (highest nighttime level). These levels are lower than the typical Western state standards of 50 dBA at the exterior of homes.

In 2014, Health Canada released a Summary of their findings on their website (Health Canada, 2014).

http://www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php

Health Canada's public brochure contains the following statement:

> *"The Wind Turbine Noise and Health Study is a landmark study and the most comprehensive of its kind. Both the methodology used and the results are significant contributions to the global knowledge base and examples of innovative, leading edge research."*

I note that Health Canada has provided the following limitations to their study results (Health Canada, 2014):

> *As with other studies of this nature, a number of limitations and considerations apply to the study findings including:*
>
> - *results may not be generalized to areas beyond the sample as the wind turbine locations in this study were not randomly selected from all possible sites operating in Canada;*
> - *results do not permit any conclusions about causality; and,*
> - *results should be considered in the context of all published peer-reviewed literature on the subject.*

It is with these limitations in mind, that I have provided my interpretation of the significance of the results in relation to setting of appropriate sound and setback standards.

Since 2015, Health Canada has published numerous peer-reviewed scientific publications with their results. This research will be discussed as appropriate throughout this report and is often referred to the "Michaud" work as Dr. David Michaud was typically the first author on these papers.

9.1.1 Audible Sound

With any sound source sleep is the critical health endpoint that needs to be protected at residences. However, there are a number of other concerns that have been raised with living in proximity to wind turbines. The past decade of rapid increase in wind power development in North America has been coupled with some who believe that wind turbines should be set miles back from residences, or else it will result in public health impacts. However, the weight of scientific evidence does not hold this to be true. The following section provides an overview of the most up to date, peer-reviewed published, evidence to understand how the proper operation of a wind turbine project should not interfere with sleep.

9.1.1.1 Sleep

The critical effect from a health perspective in setting any nighttime sound source standard is to ensure that it is protective of sleep. Quality of sleep and sleep perception can be challenging to establish causation through self-reported surveys alone.

In 2006, the Institute of Medicine of the National Academies released the book "*Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem*" (IOM, 2006). At that time they reported that*: "It is estimated that 50 to 70 million Americans suffer from a chronic disorder of sleep and wakefulness, hindering daily functioning and adversely affecting health."* In 2006 the population of the United States was 298 million, resulting in an approximately 23% of Americans with sleep disorders. This needs to be considered within any review of the sleep literature with respect to wind turbines in the American context.

The following provides an overview of a number of wind turbine specific sleep studies in relation to nighttime noise levels at exterior of homes.

Michaud et al., 2016. Effects of Wind Turbine Noise on Self-Reported and Objective Measures of Sleep. Sleep, Vol. 39, No. 1 (Health Canada)

The journal Sleep is a highly respected scientific publication in this area of research. This is reflected in its five-year Impact Factor score of 5.8. The paper presents the peer-reviewed published findings of the Health Canada study (2014) of wind turbine noise on sleep. The sample size was the entire 1,238 participants from the overall study for self-reported sleep quality over the 30 days using the Pittsburgh Sleep Quality Index (PSQI) and additional questions assessing the prevalence of diagnosed sleep disorders and the magnitude of sleep disturbance over the previous year. For the first time, objective measures for sleep latency, sleep efficiency, total sleep time, rate of awakening bouts, and wake duration after sleep were recorded using the wrist worn Actiwatch2® for 654 participants, over a total of 3,772 sleep nights. It is the largest and most comprehensive of its kind ever undertaken for wind turbine noise.

The following excerpt from the paper discusses the study objective:

> *"The current study was designed to objectively measure sleep in relation to WTN exposure using actigraphy, which has emerged as a widely accepted tool for tracking sleep and wake behavior. The objective measures of sleep, when considered together with self-report, provide a more comprehensive evaluation of the potential effect that WTN may have on sleep."*

The importance of this study is that for the first time self-reported sleep concerns, Pittsburgh Sleep Quality Index (PSQI – a self-report questionnaire on sleep activity) results and objective measures of sleep using actigraphy were investigated for wind turbine noise.

> *"Table 2 presents the summary statistics for PSQI as both a continuous scale and a binary scale (the proportion of respondents with poor sleep; i.e., PSQI above 5) by WTN exposure categories. Analysis of variance was used to compare the average PSQI score across WTN exposure groups (after adjusting for provinces). There was no statistical difference observed in the mean PSQI scores between groups (P = 0.7497) as well as no significant difference between provinces (P = 0.7871) (data not shown). Similarly, when modeling the proportion of respondents with poor sleep (PSQI > 5) in the logistic regression model, no statistical differences between WTN exposure groups (P = 0.4740) or provinces (P = 0.6997) were observed (see supplemental material)."*

Table 2 is an excerpt from Michaud et al. (2016; their Table 1), provides an overview of the self-reported sleep magnitude and contribution of disturbance. It was reported that there was no statistical difference in self-reported sleep disturbance for participants living with exterior to home sound levels from <25 dBA to 40-46 dBA. They reported:

> "*The prevalence of reported sleep disturbance was unrelated to wind turbine noise levels.*"

Table 2. Self-reported magnitude and contributing sources of sleep disturbance.

Table 1—Self-reported magnitude and contributing sources of sleep disturbance.

	Wind Turbine Noise, dB(A)						
Variable	< 25	25–30	30–35	35–40	40–46	Overall	CMH P value[a]
n	83	95	304	519	234	1,235	
Self-reported sleep disturbance n (%)							
Not at all	29 (34.9)	44 (46.3)	112 (36.8)	208 (40.1)	85 (36.3)	478 (38.7)	
At least slightly[b]	54 (65.1)	51 (53.7)	192 (63.2)	311 (59.9)	149 (63.7)	757 (61.3)	0.7535
Highly[c]	13 (15.7)	11 (11.6)	41 (13.5)	75 (14.5)	24 (10.3)	164 (13.3)	0.4300
Source of sleep disturbance (among participants at least slightly sleep disturbed) n (%)							
n[d]	53	51	186	298	138	726	
Wind turbine	0 (0.0)	2 (3.9)	4 (2.2)	45 (15.1)	31 (22.5)	82 (11.3)	< 0.0001
Children	9 (17.0)	12 (23.5)	21 (11.3)	36 (12.1)	20 (14.5)	98 (13.5)	0.2965
Pets	7 (13.2)	12 (23.5)	9 (4.8)	45 (15.1)	22 (15.9)	95 (13.1)	0.3582
Neighbors	6 (11.3)	5 (9.8)	9 (4.8)	13 (4.4)	5 (3.6)	38 (5.2)	0.0169
Other	41 (77.4)	35 (68.6)	162 (87.1)	232 (77.9)	87 (63.0)	557 (76.7)	0.0128
Stress/anxiety	6 (11.3)	2 (3.9)	21 (11.3)	33 (11.1)	11 (8.0)	73 (10.1)	0.8938
Physical pain	11 (20.8)	9 (17.6)	50 (26.9)	48 (16.1)	18 (13.0)	136 (18.7)	0.0289
Snoring	5 (9.4)	6 (11.8)	17 (9.1)	20 (6.7)	12 (8.7)	60 (8.3)	0.4126

Participants were asked to report their magnitude of sleep disturbance over the last year while at home by selecting one of the following five categories: not at all, slightly, moderately, very, or extremely. Participants that indicated at least a slight magnitude of sleep disturbance were asked to identify all sources perceived to be contributing to sleep disturbance. [a]The Cochran Mantel-Haenszel chi-square test was used to adjust for provinces. [b]At least slightly sleep disturbed includes participants indicating the slightly, moderately, very or extremely categories. [c]Highly sleep disturbed includes participants who reported the very or extremely categories. The prevalence of reported sleep disturbance was unrelated to wind turbine noise levels. [d]Of the 757 participants who reported at least a slight amount of sleep disturbance, 31 did not know what contributed to their sleep disturbance. Of the remaining 726, at least one source was identified. Columns may not add to sample size totals as some participants did not answer questions and/or identified more than one source as the cause of their sleep disturbance.

From the conclusions of the paper:

> *"The potential association between WTN levels and sleep quality was assessed over the previous 30 days using the PSQI, the previous year using percentage highly sleep disturbed, together with an assessment of diagnosed sleep disorders. These self-reported measures were considered in addition to several objective measures including total sleep time, sleep onset latency, awakenings, and sleep efficiency. In all cases, in the final analysis there was no consistent pattern observed between any of the self-reported or actigraphy-measured endpoints and WTN levels up to 46 dB(A) [820 ft]. Given the lack of an association between WTN levels and sleep, it should be considered that the study design may not have been sensitive enough to reveal effects on sleep. However, in the current study it was demonstrated that the factors that influence sleep quality (e.g. age, body mass index, caffeine, health conditions) were related to one or more self-reported and objective measures of sleep. This demonstrated sensitivity, together with the observation that there was consistency between multiple measures of self-reported sleep disturbance and among some of the self-reported and actigraphy measures, lends strength to the robustness of the conclusion that WTN levels up to 46 dB(A) [820 ft] had no statistically significant effect on any measure of sleep quality.*

The findings of Michaud et al., (2016) supports the position that residents living with exterior nighttime sound levels of <46 dBA at the exterior of homes should not experience sleep disturbance from the wind turbine sound.

The Health Canada findings are consistent with credible previously published peer-reviewed literature in the field.

Bakker et al. 2012. Impact of wind turbine sound on annoyance, self-reported sleep disturbance and psychological distress. Science of The Total Environment, Volume 425, 15 May 2012, Pages 42-51

Bakker et al., (2012) completed the most compelling research, prior to the Health Canada Study (2014), into wind sound awakenings. This research reported the number or percentage of awakenings with those living in proximity to wind turbines in a rural setting. As can be seen in Table 3 (Table 7 from the Bakker paper), more people in rural environments are awakened by people/animal sound and traffic/mechanical sounds, than by the proximate wind turbines. In this study, people living in close proximity to wind turbines reported being awoken more by people/animal noise (11.7%) and rural traffic/mechanical noise (12.5%), than by turbine noise (6.0%). Sound levels in this study were as high as 54 dBA from wind turbines at the exterior of neighboring homes.

Table 3. Sound sources of sleep disturbance in rural and urban area types, only respondents who did not benefit economically from wind turbines (Bakker et al, 201)

Table 7
Sound sources of sleep disturbance in rural and urban area types, only respondents who did not benefit economically from wind turbines.

Sound source of sleep disturbance	Rural		Urban		Total	
	n	%	n	%	n	%
Not disturbed	196	69.8	288	64.9	484	66.8
Disturbed by people/ animals	33	11.7	64	14.4	97	13.4
Disturbed by traffic/ mechanical sounds	35	12.5	75	16.9	110	15.2
Disturbed by wind turbines	17	6.0	17	3.8	34	4.7
Total	281	100	444	100	725	100

From the Health Canada sleep study (Michaud et al., 2016):

> *"Study results concur with those of Bakker et al. (2002), with outdoor WTN levels up to 54 dB(A), wherein it was concluded that there was no association between the levels of WTN and sleep disturbance when noise annoyance was taken into account".*

Jalali et al. 2016. Before–after field study of effects of wind turbine noise on polysomnographic sleep parameters. Noise Health; 18:194-205.

The first study to be published on before-after operation effect of wind turbine noise on objectively measured sleep was conducted in 16 participants living within 1.25 mi (2 km) to a five-wind turbine project in Ontario, Canada. It should be noted that outdoor sound measurements ranged between 40 – 45 dBA before operation and 38-42 dBA after the turbines became operational. The average indoor sound level in the bedrooms was reported as 31 dBA while the wind turbines were operational. For the first time authors used portable polysomnography (PSG), which is a comprehensive system that objectively monitors people's sleep in their homes.

Although there are concerns about the small sample size and that exterior sound levels were higher pre-operation of wind turbines, the authors concluded:

> *"The result of this study based on advanced sleep recording methodology together with extensive noise measurements in an ecologically valid setting cautiously suggests that there are no major changes in the sleep of participants who host new industrial WTs in their community."*

These findings are consistent with the previous reported studies.

Smith et al. 2020. A laboratory study on the effects of wind turbine noise on sleep: results of the polysomnographic WiTNES study. SLEEPJ, 2020, 1–14

This Swedish study was the first of its kind to be conducted in a sleep laboratory setting. A total of 50 participants were recruited for the study. Twenty-four "Exposed" participants were selected from a group who lived within 1 km of a wind turbine and self-reported annoyance or sleep disturbance at their homes. There were 26 participants in the "Reference" group that did not live close to wind turbines.

Each of the group's physiologic and self-reported sleep effects was analyzed using polysomnography, electrocardiography, salivary cortisol and questionnaire endpoints. Their sleep was monitored over three consecutive nights (23:00 to 7:00): habituation night, quiet control night, and wind turbine noise night that simulated a 32 dBA Leq wind turbine sound in homes. Although this study does have some merit the results should be viewed with caution. It involved only a single night exposure to wind turbine noise in a laboratory setting, there may have been self selection bias with those living in proximity to wind turbines and the results could at best be used to establish in home future studies.

The researchers reported:

> *Physiologic effects of WTN were not found for the majority of sleep measures, which implies that nocturnal WTN may not be of major public health relevance. On the other hand, the self-reported data give indications of poorer sleep quality and restoration, which may contribute to a risk for long-term health effects in ways not captured by PSG.*

However, the researchers also reported:

> *The Exposed study group gave a more negative rating of sleep quality, tiredness, and sleeping worse than usual compared to the Reference group in both the Control and WTN-night. They also reported higher noise-induced sleep disturbance overall, in both the Control and WTN-night compared to the Reference group.*

When reviewed in context to the sleep studies that were actually completed inside homes of those living in proximity to wind turbines (Michaud et al.,2016 and Jalali et al., 2016) the Smith et al. (2020) study is consistent in that physiological are unlikely of major public health relevance. The self-reported sleep results in such a small number of participants is not consistent with the field studies involving many more participants.

Liebich et al. 2020. A systematic review and meta-analysis of wind turbine noise effects on sleep using validated objective and subjective sleep assessments. Journal of Sleep Research

Recently, researchers in Australia undertook a systematic review and meta-analysis of the published literature of how wind turbine noise may impact both objective and subjective sleep outcomes.

They retained nine studies for review, with five of them containing sufficient data that could be used in the meta-analysis of sleep outcomes. The systematic review includes the three publications already reviewed above in the OEHM report. They found:

> *The meta-analysis of five studies found no evidence to support that objectively measured sleep latency, sleep efficiency, time spent asleep and awake during the night are significantly different in the presence versus absence of WTN exposure.*

They could not conduct a meta-analysis on the self-reported sleep outcomes because the measurement outcomes were not consistent enough between studies. They concluded:

> *This systematic review and meta-analysis suggests that WTN does not significantly impact key indicators of objective sleep. Cautious interpretation remains warranted given variable measurement methodologies, WTN interventions, limited sample sizes, and cross-sectional study designs, where cause and- effect relationships are uncertain. Well-controlled experimental studies using ecologically valid WTN, objective and psychometrically validated sleep assessments are needed to provide conclusive evidence regarding WTN impacts on sleep.*

The authors also opined that:

> *Field studies are clearly the most ecologically valid and most representative of real-world WTN conditions in comparison to in-laboratory studies.*

To date, this is the most comprehensive review of wind turbine sound exposure and sleep. It is acknowledged that the authors did suggest that further in home studies are needed to provide "conclusive evidence". This additional research is currently underway in Australia.

Michaud et al., 2021. Sleep actigraphy time-synchronized with wind turbine output. SLEEPJ, 2021, 1–12. (Health Canada)

In March of 2021, the Health Canada team published their findings on a re-evaluation of their original collection of sleep data for those living around wind turbines. They further refined the data evaluation of the sleep actigraphy data to 10-minute intervals and time synchronized it to wind turbine supervisory control and data acquisition. Overall, they concluded:

> *Maximum calculated nightly average wind turbine SPL reached 44.7 dBA (mean = 32.9, SD = 6.4) outdoors and 31.4 dBA (mean = 12.5, SD = 8.3) indoors. Wind turbine SPL in 10 min intervals, and nightly averages, was not statistically associated with actigraphy outcomes. However, the variability in wind turbine SPL due to changes in wind turbine operation across the sleep period time, as measured by the difference between the 10 min SPL and the nightly average SPL (ΔSPL), was statistically related to awakenings ($p = 0.028$) and motility ($p = 0.015$) rates. These diminutive differences translate to less than 1 min of additional awake and motility time for a 5 dBA increase over a 450 min sleep period time. Overall results showed that wind turbine SPL below 45 dBA was not associated with any consequential changes in actigraphy-measured sleep. Observations based on ΔSPL provided some indication that a more sensitive assessment of sleep may be one that considers variations in wind turbine SPL throughout the sleep period time.*

The findings of the recent Health Canada research on sleep and wind turbine noise are consistent with their previous findings and the meta-analysis of sleep outcomes provided by Liebich et al. (2020).

Liebich et al. 2022. The effect of wind turbine noise on polysomnographically measured and self-report sleep latency in wind turbine noise naïve participants. SLEEPJ. Vol 45. No. 1. pg 1-11.

The objective of the study was to assess the impact of wind turbine noise (WTN) on polysomographically measured and diary-determined self-reported sleep latency compared to a controlled background in a laboratory sleep chamber. There were 23 urban participants that were naïve (never heard before) to wind turbine sound. They were exposed to 33 dBA of interior bedroom previously recorded wind turbine sound. This mimics the expected sound level of a home that would have windows open and an exterior wind turbine sound level of 40 dBA or greater. They concluded:

> *"WTN effects on objective and subjective sleep latency were assessed via a two-night sleep study in a controlled sleep laboratory setting using polysomnography and sleep diary measures in a sample of health sleeps not typically exposed to WTN. No differences were found in objective or subjective sleep latency when WTN at 33 dB(A) was presented during the sleep onset period compared to control background noise at 23 dB(A). Furthermore, no differences were found in latency to N2 sleep, nor in the proportion of individuals who took >20 or >30 min to fall asleep in the presence versus absence of WTN."*

Liebich et al. 2022a. An experimental investigation on the impact of wind turbine noise on polysomnography-measured and sleep diary-determined sleep outcomes. SLEEPJ. Vol 45. No. 8. pg. 1-16.

In this study the authors expanded the group of participants to 68 that included residents living close to turbines that previously reported sleep disruption, residents who report traffic sleep disruption and two control grounds. The groups participated in a four-night laboratory sleep study in which control background noise was 19 dBA and interior bedroom previously recorded WTN of 25 dBA. This level of sound was to reproduce the expected sound levels inside an Australian home with windows open and a 40 dBA sound level at the exterior of the home.

> *Overall, these results do not support that acute WTN exposures approximating median WTN exposure levels around 3 km from a windfarm, measurably impact sleep assessed using conventional sleep scoring metrics, including in individuals with self-reported sleep difficulties attributed to WTN living at a similar distance. However, further studies remain warranted to test for effects of higher WTN exposure levels on traditional sleep macrostructure outcomes, subtle microstructural sleep parameters, and impacts on nextday mood, anxiety, and performance.*

No individual study can answer all of questions about wind turbine noise and sleep. These studies were well executed, used sound scientific methodological approaches, and provided full details of their potential limitations. Overall, both Australian sleep studies and the recent Health Canada study are aligned with the previous international findings on wind turbine noise and sleep. This suggests that the continued use the NSDECC sound level of 40 dBA is appropriate for ensuring the protection of sleep.

Conclusion on Wind Turbine Noise and Sleep

The recent published findings reveal that there is no association between exterior wind turbine sound levels of up to 46 dBA and impact on sleep. The link between reported sound levels, annoyance and sleep disturbance does not appear to hold. In other words, regards of the reported wind turbine sound levels or annoyance levels, sleep outcomes are not different for people living with up to 46 dBA at their home with those with 30 dBA at their homes.

9.1.2 Low Frequency Noise and Infrasound

Infrasound is a term used to describe sounds that are produced at frequencies too low to be heard by the human ear at frequencies of 0 to 20 Hz, at common everyday levels. It is typically measured and reported on the G-weighted scale (dBG). Low frequency noise (LFN), at frequencies between 20 to 200 Hz, can be audible. It is typically measured and reported on the C-weighted scale (dBC) to account for higher-level measurements and peak sound pressure levels.

Universally wind turbine sound standard are set using audible dBA levels, as they are Nova Scotia, and approved based on modeling. Over the past couple of years there have been a limited number of researchers that have speculated that wind turbine infrasound and LFN could be the potential cause of potential health impacts or sleep disturbance. The mere presence of measured LFN and infrasound does not indicate a potential threat to health or an inability for people to sleep. The fact that one can measure infrasound and LFN from wind turbines at either the exterior or interior of a home does mean that it is at a level that poses a potential health threat. In addition, just because there may be a distinct acoustical signature that allows sound engineers to distinguish between low levels of infrasound or LFN from turbines does not mean that it results in health impacts.

Although wind turbines are a source of LFN and infrasound during operation, these sound pressure levels are not unique to wind turbines. Common natural sources of LFN and infrasound include ocean waves, thunder, and even the wind itself. Anthropogenic sources include road traffic, refrigerators, air conditioners, machinery, and airplanes.

Given the growing attention being paid to this issue several recent studies have been published.

Berger et al., 2015. *Health-based Audible Noise Guidelines Account for Infrasound and Low Frequency Noise Produced by Wind Turbines*" in the journal Frontiers in Public Health Vol 3, Art. 31

The purpose of this paper was to investigate whether typical audible noise-based guidelines for wind turbines account for the protection of human health given the levels of infrasound and LFN typically produced by wind turbines. New field measurements of indoor infrasound and outdoor LFN at locations between 1,312 ft (400 m) and 2,952 (900 m) from the nearest turbine, which were previously underrepresented in the scientific literature, were reported and put into context with existing published works. The analysis showed that indoor infrasound levels were below auditory threshold levels while LFN levels at generally accepted setback distances were similar to background LFN levels.

The paper discusses two guidelines for exposure to infrasound (dBG), although neither is specific to wind turbine noise. The Queensland Department of Environment and Resource Management's Draft *ECOACCESS Guideline- Assessment of Low Frequency Noise* proposed an interior

infrasound limit of 85 dBG (Roberts, 2004). This value was derived based on a 10 dB protection level from the average 95 dBG hearing threshold (Watanabe, 1990) and previous Danish recommendations for infrasound limits (Jakobsen, 2001). The Japanese Handbook on Low Frequency Noise provides an infrasound reference value of 92 dBG at 10 Hz and 1/3 octave bands up to 80 Hz (Kamigawara, 2006). These values were derived from investigations that monitored complaints of mental and physical discomfort from healthy adults exposed to low frequency sounds in a room (Kamigawara, 2006).

These guidelines for infrasound would not be reached in homes situated near the Crazy Mountain Wind Power Project. Quite simply, the homes are located too far back from the turbines based on audible sound criteria to have the accompanying infrasound levels exceed these guidelines. In fact, these levels of infrasound are not reached even in close proximity to the wind turbines themselves.

Collective, these data in conjunction with previous reports indicate that levels of infrasound and LFN are not sufficient to induce adverse health effects; therefore health-based audible noise guidelines are suitable for the protection of human health.

From the abstract of Berger et al., 2015:

> *Over-all, the available data from this and other studies suggest that health-based audible noise wind turbine siting guidelines provide an effective means to evaluate, monitor, and protect potential receptors from audible noise as well as Infrasound and Low Frequency Noise.*

Simply put, nighttime sound level on the A-weighted scale, and the setback to homes, act as a surrogates to ensure that levels of LFN and infrasound will not impact health or sleep.

In 2012, Turnbull *et al*. published a peer-reviewed paper titled *Measurement and Level of Infrasound from Wind Farms and Other Sources* to put this issue into context with other LFN and infrasound sources (Turnbull et al., 2012). The study was conducted in Australia around wind turbines and other common sources of infrasound and included the Clements Gap Wind Farm and the Cape Bridgewater Wind Farm. The Clements Gap Wind Farm is comprised of 27 Suzlon S88 2.1 MW wind turbines and the Cape Bridgewater Wind Farm is comprised of 29 Repower MM82 2.0 MW wind turbines. They determined that infrasound from wind turbines reached ambient (background) levels within 656 ft (200 m) to 1,180 ft (360 m) (Table 4). The levels were found to be lower than those measured around beaches, gas fired plants and major roadways. Indeed, humans are regularly exposed to infrasound from several natural and engineered sources at levels that exceed those produced by wind turbines. These findings are consistent with other scientific papers in the field.

Table 4. Infrasound Measurements Near Wind Turbines and other Sources (Turnbull, 2012)

Noise Source	Measured Level (dB(G))
Clements Gap Wind Farm at 85m	72
Clements Gap Wind Farm at 185m	67
Clements Gap Wind Farm at 360m	61
Cape Bridgewater Wind Farm at 100m	66
Cape Bridgewater Wind Farm at 200m	63
Cape Bridgewater Wind Farm ambient	62
Beach at 25m from high water line	75
250m from coastal cliff face	69
8km inland from coast	57
Gas fired power station at 350m	74
Adelaide CBD at least 70m from any major road	76

With respect to low frequency noise (LFN) and infrasound it is important to understand that Health Canada's Wind Turbine Noise study (Health Canada, 2014; Keith et al., 2016; Michaud et al., 2016) also includes consideration of these sound levels and their impact on heath.

Keith et al., 2016 (part of the Health Canada Research):

> *"The simple relationship between A- and C- weighted levels suggests that there is unlikely to be any statistically significant difference between analysis based on either C- or A-weighted data."*

Michaud et al., 2016:

> *"In the current study, low-frequency noise was estimated by calculating C-weighted sound pressure levels. No additional benefit was observed in assessing low frequency noise because C- and A-weighted levels were so highly correlated. Depending on how dB(C) was calculated and what range of data was assessed, the correlation between dB(C) and dB(A) ranged from r = 0.84 to r = 0.97."*

Because LFN (dBC) and A-weighted (dBA) levels were so highly correlated, Health Canada's conclusions on the absence of direct or indirect health effects for audible wind turbine noise <46 dBA are true also for the noise in the LFN (dBC) range around the wind turbines they studied. In otherwords, one does not have to conduct additional studies on LFN to determine potential noise health related impacts or sleep disturbance from wind turbines. Therefore, exposure to these frequencies are inherently included in the findings that no sleep disturbance was found in people living with up to 46 dBA audible sound (Michaud et al., 2016).

McCunney et al. (2014), published a study entitled "Wind Turbines and Health: A Critical Review of the Scientific Literature" in the Journal of Environmental and Occupational Medicine. This review came to similar findings of those published by others (e.g., Knopper and Ollson, 2011; MassDEP, 2012; Knopper et al., 2014; Merlin et al., 2014). This review conducted a significant review of infrasound and LFN levels from turbines and potential impact on health.

> *"Sounds with frequencies lower than 20 Hz (ie, infrasound) may be audible at very high levels. At even higher levels, subjects may experience symptoms from very low-frequency sounds—ear pressure (at levels as low as 127 dB SPL), ear pain (at levels higher than 145 dB), chest and abdominal movement, a choking sensation, coughing, and nausea (at levels higher than 150 dB).80,81 The National Aeronautics and Space Administration considered that infrasound exposures lower than 140 dB SPL would be safe for astronauts; American Conference of Governmental Industrial Hygienists recommends a threshold limit value of 145 dB SPL for third-octave band levels between 1 and 80 Hz.81 As noted earlier, infrasound from wind turbines has been measured at residential distances and noted to be many orders of magnitude below these levels."*

and

> *"Components of wind turbine sound, including infrasound and low frequency sound, have not been shown to present unique health risks to people living near wind turbines."*

In 2016 the Ministry for the Environment, Climate and Energy of the Federal State of Bade Wuerttemberg in Germany reported on their study "*Low-frequency noise including infrasound from wind turbines and other sources*" (MECE, 2016). The objective of the research was to collect field measurement of infrasound and low-frequency noise around six different turbines by different manufacturers ranging in size from 1.8 to 3.2 MW. Measurements were taken at 492 ft (150 m), 984 ft (300 m) and 2,296 ft (700 m) from wind turbines. Measurements of other common sources of infrasound and low frequency noise were also collected for comparative purposes.

Figure 2 provides detail on the range of infrasound and low frequency noise measured at 984 ft (300 m) from a wind turbine. It can be seen that the levels of infrasound from wind turbines were similar to that of just the wind in an open field, while there was an increase in low frequency sound. The levels were considerably lower than either being in the interior of a car, near the roadside traffic or in a home with oil heating. All infrasound levels (< 20 Hz) were below the perception threshold and international standards.

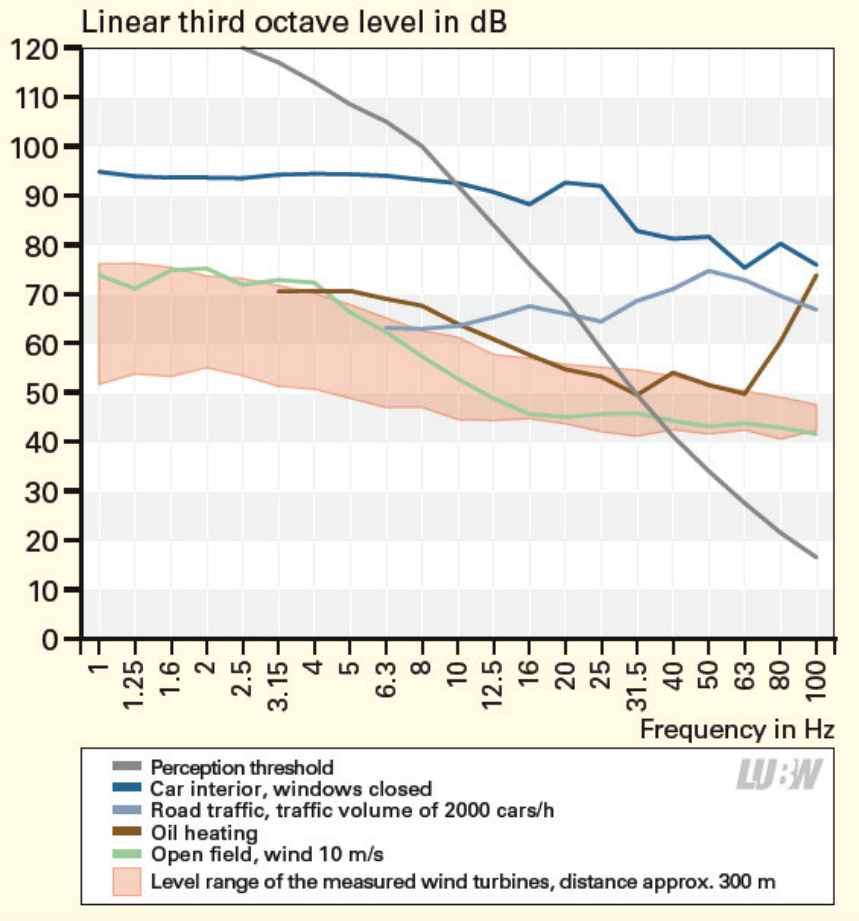

Figure 2. Measurements of infrasound and low frequency noise 300 m from wind turbines compared to other sources.

Overall, they concluded:

> *"Infrasound and low-frequency noise are an everyday part of our technical and natural environment. Compared with other technical and natural sources, the level of infrasound caused by wind turbines is low. Already at a distance of 150 m, it is well below the human limits of perception. Accordingly, it is even lower at the usual distances from residential areas. Effects on health caused by infrasound below the perception thresholds have not been scientifically proven. Together with the health authorities, we in Baden-Württemberg have come to the conclusion that adverse effects relating to infrasound from wind turbines cannot be expected on the basis of the evidence at hand.*
>
> *The measurement results of wind turbines also show no acoustic abnormalities for the frequency range of audible sound. Wind turbines can thus be assessed like other installations according to the specifications of the TA Lärm (noise prevention regulations).*
>
> *It can be concluded that, given the respective compliance with legal and professional technical requirements for planning and approval, harmful effects of noise from wind turbines cannot be deduced."*

Marshall et al. 2023. The Health Effects of 72 Hours of Simulated Wind Turbine Infrasound: A Double- Blind Randomized Crossover Study in Noise-Sensitive, Healthy Adults. Environmental Health Perspectives. 131(3) March 2023

As part of the large Australian National Health and Medical Research Council of Australia (NHMRC) Targeted Call for Research into Wind Farms and Human Health a group of researchers undertook a study to better understand the potential impacts of wind turbine infrasound on human physiology and sleep. Starting at noon, participants were subjected to either wind turbine infrasound, sham infrasound (same speakers not generating infrasound) and traffic noise for a 72-hour period, including 3 nights. The subjects did not leave the test setting that consisted of a bedroom with ensuite mimicking a studio apartment. Each of the 37 noise-sensitive but otherwise health adults (age 18 – 72; 51% female) were exposed to all three noise conditions for the 72-hour period, resulting in a double-blind triple arm study design.

Physiological and psychological measures and systems were tested for their sensitivity to infra-sound: wake after sleep onset (WASO; primary outcome) and other measures of sleep physiology, wake electroencephalography, Wind Turbine Syndrome (WTS) symptoms, cardiovascular physiology, and neurobehavioral performance.

The researchers found:

> *Our findings did not support the idea that infrasound cause WTS. High level, but inaudible, infrasound did not appear to perturb any physiological or psychological measure tested in these study participants.*

This is yet another study that strengthens the findings that although infrasound is emitted from wind turbines it is not at a level that causes health impacts, wind turbine syndrome symptoms, sleep effects or impairment of neurobehavioral performance.

Conclusion on Low Frequency Noise and Infrasound

The hypothesis that low frequency noise or infrasound from wind turbines is a causative agent in health effects or sleep disturbance is not supported by the scientific and medical literature. Although infrasound and low frequency noise are emitted from wind turbines and their contribution above background sources can be measured close to wind turbines, the levels are typically within background levels at homes and are well below levels that could induce health impacts. Measurements at other wind farms are similar, if not lower, than natural and anthropogenic sources of infrasound that we are exposed to, and are below international guidelines on infrasound.

9.2 Other Potential Health Concerns

Although with any sound source sleep is the critical health endpoint, there are a number of other concerns that have been raised with living in proximity to wind turbines.

9.2.1 Peer Reviewed Studies on Self-Reported and Objective Measures of Health

This section is focused on the literature investigating both self-reported and physical measures of health for those living around wind turbines. Given the extensive nature of the literature it is not possible to summarize it all in this document. Rather, preference has been given to key references and those most recent, or extensive.

There are numerous peer-reviewed studies that have explicitly examined the relationship between levels of wind turbine noise and various self-reported indicators of human health and well-being (e.g., Health Canada 2014 and associated publications; Bakker et al. 2012; Janssen et al. 2011; Pedersen 2011; Pedersen and Persson Waye 2004; 2007). These studies have included a wide range of wind turbine models, manufacturers, heights and noise levels. They were conducted over several years, in some cases over 10 years, after wind turbines became operational. The study of wind turbine health concerns began in Europe in the early 2000s and most recently examined in Canada.

In general, peer reviewed studies do not support a correlation between wind turbine noise exposure and any other response other than some annoyance. For example, various studies based on the results of two surveys performed in Sweden and one in the Netherlands (1755 respondents overall), found that no measured variable (e.g., self-reported evaluations of high blood pressure, cardiovascular disease, tinnitus, headache, sleep interruption, diabetes, tiredness, and reports of feeling tense, stressed, or irritable) other than annoyance was directly related to wind turbine noise for all three datasets (Pedersen, 2011) at noise levels below 45 dBA.

The most comprehensive study on health and living in proximity was that undertaken by Health Canada between May and September 2013. Again this study had a 78.9% response rate of those living within 10 km of numerous wind projects in Ontario and PEI. In 2016, Health Canada released a series of peer-reviewed publications on their findings in a special edition of the Journal of Acoustical Society of America in late March of 2016. Given that it was the most comprehensive study undertaken a great deal of weight on this research and its findings is placed on it, given that it is the most recent and comprehensive a cross-sectional epidemiological study undertaken on the topic. Their reported high response rate included 1238 randomly selected participants (606 males, 632 females) between the ages of 18-79 years old. In addition, the study included both self-reported and physical/objective measures of health in participants. The following sections contain conclusions of the three papers examining the potential for health issues to manifest living as close as 820 feet from a turbine and sound levels of up to 46 dBA.

Michaud et al. 2016a. Exposure to wind turbine noise: Perceptual responses and reported health effects.

This paper provides the results of Health Canada's investigation into perceptual responses (annoyance and quality of life) and those of self-reported health effects by participants. Only the self-reported health effects results are discussed here. Health Canada developed a final questionnaire (Michaud, 2013) that consistent of socio-demographics, modules on community noise and annoyance, self-reported health effects, lifestyle behaviors, and prevalent chronic illness.

Table 5 is a reproduction of Table V. of the study provides the list of self-reported health effects in the population studied broken down by varying wind turbine noise levels (dBA). Essentially this table reports the prevalence of each self-reported health effect, across varying sound levels, and then uses statistical analysis to provide a CHM *p-value* to determine if the self-reported health effects are significant. Simply put, if the CHM *p-value* is less than < 0.05 then there is a difference amongst the reported effects across sound levels and vice versa if it is greater than > 0.05 then there is no difference in how people are reporting effects across the sound groupings.

Health Canada reported that:

> *"The results from the current study did not show any statistically significant increase in the self-reported prevalence of chronic pain, asthma, arthritis, high blood pressure, bronchitis, emphysema, chronic obstructive pulmonary disease (COPD), diabetes, heart disease, migraines/headaches, dizziness, or tinnitus in relation to WTN exposure up to 46 dB. In other words, individuals with these conditions were equally distributed among WTN exposure categories."*

This resulted in the overall conclusion of the paper that:

"Beyond annoyance, results do not support an association between exposure to WTN up to 46 dBA and the evaluated health-related endpoints."

The Health Canada results are consistent with the previous decade of research in the field.

Table 5. Sample profile of health conditions (Michaud et al., 2016a).

TABLE V. Sample profile of health conditions.

	Wind turbine noise (dB)						
Variable *n* (%)	<25	[25–30)	[30–35)	[35–40)	[40–46]	Overall	CMH[a] *p*-value
n	84[b]	95[b]	304[b]	521[b]	234[b]	1238[b]	
Health worse vs last year [c]	17 (20.2)	12 (12.6)	46 (15.1)	90 (17.3)	51 (21.8)	216 (17.5)	0.1724
Migraines	18 (21.4)	24 (25.3)	56 (18.4)	134 (25.8)	57 (24.4)	289 (23.4)	0.2308
Dizziness	19 (22.6)	16 (16.8)	65 (21.4)	114 (21.9)	59 (25.2)	273 (22.1)	0.2575
Tinnitus	21 (25.0)	18 (18.9)	71 (23.4)	129 (24.8)	54 (23.2)	293 (23.7)	0.7352
Chronic pain	20 (23.8)	23 (24.2)	75 (24.8)	118 (22.6)	57 (24.5)	293 (23.7)	0.8999
Asthma	8 (9.5)	12 (12.6)	22 (7.2)	43 (8.3)	16 (6.8)	101 (8.2)	0.2436
Arthritis	23 (27.4)	38 (40.0)	98 (32.2)	175 (33.7)	68 (29.1)	402 (32.5)	0.6397
High blood pressure (BP)	24 (28.6)	36 (37.9)	81 (26.8)	166 (32.0)	65 (27.8)	372 (30.2)	0.7385
Medication for high BP	26 (31.3)	34 (35.8)	84 (27.6)	163 (31.3)	63 (27.0)	370 (29.9)	0.4250
Family history of high BP	44 (52.4)	49 (53.8)	132 (45.5)	254 (50.6)	121 (53.8)	600 (50.3)	0.6015
Chronic bronchitis/emphysema/COPD	3 (3.6)	10 (10.8)	17 (5.6)	27 (5.2)	14 (6.0)	71 (5.7)	0.7676
Diabetes	7 (8.3)	8 (8.4)	33 (10.9)	46 (8.8)	19 (8.2)	113 (9.1)	0.6890
Heart disease	8 (9.5)	7 (7.4)	31 (10.2)	32 (6.1)	17 (7.3)	95 (7.7)	0.2110
Highly sleep disturbed[d]	13 (15.7)	11 (11.6)	41 (13.5)	75 (14.5)	24 (10.3)	164 (13.3)	0.4300
Diagnosed sleep disorder	13 (15.5)	10 (10.5)	27 (8.9)	44 (8.4)	25 (10.7)	119 (9.6)	0.3102
Sleep medication	16 (19.0)	18 (18.9)	39 (12.8)	46 (8.8)	29 (12.4)	148 (12.0)	0.0083
Restless leg syndrome	7 (8.3)	16 (16.8)	37 (12.2)	81 (15.5)	33 (14.1)	174 (14.1)	
Restless leg syndrome (ON)	4 (6.7)	15 (17.4)	27 (11.0)	78 (17.3)	28 (16.5)	152 (15.0)	0.0629[e]
Restless leg syndrome (PEI)	3 (12.5)	1 (11.1)	10 (16.9)	3 (4.2)	5 (7.8)	22 (9.7)	0.1628[e]
Medication anxiety or depression	11 (13.1)	14 (14.7)	35 (11.5)	59 (11.3)	23 (9.8)	142 (11.5)	0.2470
QoL past month[f]							
Poor	9 (10.8)	3 (3.2)	21 (6.9)	29 (5.6)	20 (8.6)	82 (6.6)	0.9814
Good	74 (89.2)	92 (96.8)	283 (93.1)	492 (94.4)	213 (91.4)	1154 (93.4)	
Satisfaction with health[f]							
Dissatisfied	13 (15.5)	13 (13.7)	49 (16.1)	66 (12.7)	36 (15.4)	177 (14.3)	0.7262
Satisfied	71 (84.5)	82 (86.3)	255 (83.9)	455 (87.3)	198 (84.6)	1061 (85.7)	

[a]The Cochran Mantel-Haenszel chi-square test is used to adjust for provinces unless otherwise indicated, *p*-values <0.05 are considered to be statistically significant.
[b]Columns may not add to total due to missing data.
[c]Worse consists of the two ratings: "*Somewhat worse now*" and "*Much worse now.*"
[d]High sleep disturbance consists of the two ratings: "*very*" and "*extremely*" sleep disturbed.
[e]Chi-square test of independence.
[f]Quality of Life (QoL) and Satisfaction with Health were assessed with the two stand-alone questions on the WHOQOL-BREF. Reporting "*poor*" overall QoL reflects a response of "*poor*" or "*very poor*," and "*good*" reflects a response of "*neither poor nor good*," "*good*," or "*very good.*" Reporting "*dissatisfied*" overall Satisfaction with Health reflects a response of "*very dissatisfied*" or "*dissatisfied*," and "*satisfied*" reflects a response of "*neither satisfied nor dissatisfied*," "*satisfied*," or "*very satisfied.*" A detailed presentation of the results related to QoL is presented by Feder *et al.* (2015).

9.3 Recent Systematic Review on Wind Turbines and Health

Van Kamp, I & van den Berg, F. 2018. Health Effects Related to Wind Turbine Sound, Including Low-Frequency Sound and Infrasound Acoust Aust (2018) 46:31–57

Both authors work for public health agencies in the Netherlands and are highly regarded experts in wind turbine health research field. They conducted a systematic review of the published literature between 2009 to 2017 on health effects related to wind turbine sound, with particular emphasis on LFN and infrasound.

They concluded that there was no evidence of a specific health effect of the LFN or infrasound components of wind turbine sound. With respect to Dr. Alves-Pereira's work in relation to infrasound from turbines they found:

> *Vibroacoustic disease and the wind turbine syndrome are controversial and scientifically not supported. At the present levels of wind turbine sound, the alleged occurrence of vibroacoustic disease (VAD) or the disease (VVVD) causing the wind turbine syndrome (WTS) is unproven and unlikely.*

Freiberg et al. 2019 Health effects of wind turbines on humans in residential settings: Results of a scoping review. Environmental Research 169 (2019) 446–463

The authors conducted a comprehensive systematic review of the potential health effects in humans living in proximity to wind turbines. The researchers retrieved 84 articles that varied significantly in methods and health outcomes assessed that met their study inclusion criteria. Overall, they found:

> *Multiple cross-sectional studies reported that wind turbine noise is associated with noise annoyance, which is moderated by several variables such as noise sensitivity, attitude towards wind turbines, or economic benefit.*
>
> *Wind turbine noise is not associated with stress effects and biophysiological variables of sleep.*
>
> *Findings from cross-sectional studies of higher methodological quality – that were supported by findings from lower-quality observational studies – illustrated an existing association between wind turbine noise and annoyance and no association between noise from wind turbines and stress effects and biophysiological variables of sleep.*
>
> *In higher quality studies, wind turbine noise was not associated with restricted quality of life, sleep disturbance, and anxiety and/or depression, which contrasts – at least partly – with findings from lower-quality studies."*

Van Kamp, I & van den Berg, F. 2021. Health Effects Related to Wind Turbine Sound: An Update. Int. J. Environ. Res. Public Health 2021, 18, 9133

The authors conducted an updated systematic review of the published literature between 2017 to 2020 on health effects related to wind turbine sound. Their conclusions were consistent with their previous literature review (van Kamp & van den Berg, 2018). They reaffirmed:

> *There is no indication that the low-frequency component has other effects on residents other than normal sound nor that infrasound well below the hearing threshold can have any effect.*

Ellenbogen, J. 2022 Wind turbine noise and sleep. Editorial. SLEEP. 2022 1-3

Dr. Ellenbogen, MD is a highly regarded neurologist and sleep specialist whose focus is on noise-induced sleep disruption. He has been researching the potential for wind turbine noise to impact sleep since he was the lead author on the *Wind Turbine Health Impact Study: Report of Independent Expert Panel* report, prepared for the Massachusetts Department of Health (Ellenbogen et al., 2012). In this editorial he opines that:

> *Between Health Canada and this paper by Liebich et al., it appears that the reasonable placement of wind turbines does not pose a risk to human sleep. …If companies wish to remain in the reasonable window of protection against noise-induced sleep loss, they would do well to limit themselves to using the data demonstrated by Health Canada—allowing noises to not exceed 46 dBA measured outside the residence [8]. The actual, population-based threshold may be higher, but existing data support this number.*

The weight of scientific evidence continues to demonstrate that the siting guidelines of the NSDECC 40 dBA sound level and a 1 km setback, are amongst the most conservative in the world and will ensure the protection of the community's health.

Conclusions on Other Potential Health Impacts

The weight of scientific evidence supports that permitting sound levels at the exterior of non-participating homes of up to 40 dBA Leq and a setback of 1 km to dwellings would not impact sleep or other objective or self-reported measures of health.

10 Quality of Life and Wind Turbines

Determining if annoyance or any other perceived health effects for those living around wind projects has also been examined by determining if there has been a diminishment in their overall quality of life (QOL). This relates directly to whether or not annoyance leads to a deterioration of QOL.

There have been a few published papers in this field that have reached inconsistent findings (Shepherd, et al., 2011; Nissenbaum, et al., 2012; Mroczek et al., 2012). They are typically of very small sample size and lead to more questions than answers. The results of these peer-reviewed papers are best summarized in the review papers of Knopper et al. (2014) and McCunney et al. (2014).

However, the most comprehensive work that has been published in this field was through the Health Canada research.

Feder et al. 2015 An assessment of quality of life using the WHOQOL-BREF among participants living in the vicinity of wind turbines Journal of Environmental Research. (Health Canada)

They administered the World Health Organization Quality of Life – BREF (WHOQOL-BREF) questionnaire to 1238 participants that lived between 820 feet to 7 miles from wind turbines. This questionnaire evaluates self-reported physical health, psychological, social relationships and environment in relation to QOL. Regardless of sound level at people's homes wind turbine noise did not influence QOL. They start their Discussion with:

> *"The present study findings do not support an association between exposure to WTN up to 46 dBA [820 ft] and any of the WHOQOL-BREF domains (Physical Health, Psychological, Social Relationships and Environment) or the two stand-alone questions pertaining to rated QOL and Satisfaction with Health. Participants who were exposed to higher WTN levels did not rate their QOL or Satisfaction with Health significantly worse than those who were exposed to lower WTN levels, nor did they report having significantly worse outcomes in terms of factors that comprise the 4 domains."*

In addition, the Feder et al. (2015) paper includes a detailed discussion on how their findings compare with the previous conflicting report. Given the size and comprehensive nature of this study it should be given more weight than previous reports.

Overall, the work by Health Canada suggests that quality of life should not be diminished for residents around wind energy projects with sound levels as high as 46 dBA Leq and living within 1 km of multiple wind turbines.

11 Shadow Flicker

Shadow flicker occurs when interruption of sunlight by the wind turbine blades results in a change in light intensity within a home or building. The flickering phenomenon does not occur unless one is inside a building or structure with windows. When one experiences shadowing from a turbine when standing outdoors it is simply a rotating shadow cast on the ground. Shadow flicker is unavoidable for wind turbines; however, it typically only occurs for a limited number of hours a year at a home. This is due to the fact that certain factors must be present:

a. the sun must be in a precise location in the sky such that sunlight will cast a shadow from the wind turbine;

b. the wind turbine must be in operation during this period (i.e., the wind must be of sufficient speed for the wind turbine to be operational);

c. shadow will not be cast on overcast of cloud cover days; and,

d. the shadow will typically not be cast any further than 10x the total height of the turbine to any appreciable extent. For most modern turbines this would mean shadow flicker would not extend much past 2 km.

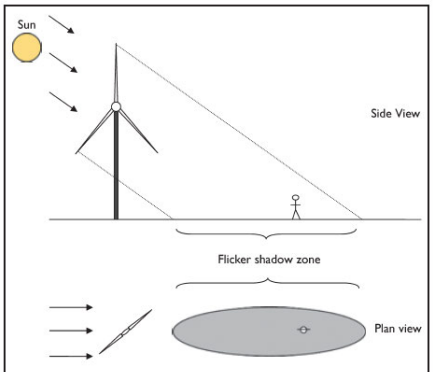

Figure 1.
Generalized geometry for turbine flicker, showing an observer in the shadow area. Note the main analysis assumes the observer and turbine blades are directly facing each other.
Epilepsia © ILAE

Conducting shadow flicker modeling has become common practice for proposed wind farm projects across Canada. There are several commercially available software packages, including WindPro that was used to model the shadow flicker for the Updated Project.

All models initially calculate a "Worst Case or Maximum Astronomical shadow" number of hours that a residence may experience shadow flicker (Assessment Case A – Updated Project). These numbers can then be adjusted to provide a "Adjusted, Realistic, Actual or Expected" number of hours of shadow flicker (Assessment Case B – Updated Project). It is important to distinguish between these scenarios, as some jurisdictions have adopted standards based on either astronomical or realistic shadow flicker hour predictions.

> ***Worst Case / Astronomical (Assessment Case A):*** *The models consider that the sun is always shining during daytime hours, the wind turbines are always rotating, and the wind direction from each turbine is such that the wind turbine is always perpendicular to the residences so that shadows could be cast at the residences. This is a predicted extreme theoretical number hours that will not occur at any residence.*
>
> ***Adjusted / Actual / Realistic / Expected (Assessment Case B):*** *The model is run in the astronomical mode and then the results are adjusted for percentage of monthly cloud cover (solar statistics) and operating hours of the wind project. Under these conditions shadow flicker will not be generated and it more accurately predicts the number of hours of shadow flicker at a residence.*

There are other obstructions that can limit both the Worst Case and the Realistic modeled numbers of shadow flicker. These include trees, shrubs, and other ancillary non-occupied structures (e.g.,

barns) that could interrupt the predicted shadow flicker at a home. Neither of the two Assessment Case scenarios takes into account these types of obstructions at residential receptors. Another layer of conservatism is that models are set-up and run in the "greenhouse mode". This means each residence is oriented to have omni-directional windows and thus it will produce more conservative results since it assumes that there is always a window in direct line of site of each wind turbine and the sun.

The model outputs can show the exact days, the time of day, the duration and turbine of origin of shadow flicker. These values are then summed to provide the annual number of hours of shadow flicker predicted. For the Realistic scenario (Assessment Case B) the percentage of cloud cover and operational downtime is used to adjust these values. Both Assessment Cases A and B provide a conservative estimate of shadow flicker that could be expected at a home.

11.1.1 Shadow Flicker Health, Annoyance and Nuisance

Four peer-reviewed scientific research papers were retrieved that considered the potential for shadow potential to impact health and to increase annoyance or nuisance in people living near wind turbines.

The main health concern raised relating to shadow flicker is the potential risk of seizures in those people with photosensitive epilepsy. Photosensitive epilepsy affects approximately 5% of people with epilepsy where their seizures can be triggered by flashing light. The Epilepsy Society first investigated this issue in the United Kingdom in the late 2000s. They polled their members and determined that no one had experienced an epileptic seizure living or being in proximity to a wind farm from shadow flicker (Epilepsy Society, 2012).

Following on this informal polling two of the United Kingdom's academic experts in epilepsy published scientific research articles in the area. I previously provided to the Commission that Harding et al. (2008) and Smedley et al. (2010) have published the seminal studies dealing with this concern. Both authors investigated the relationship between photo-induced seizures (i.e., photosensitive epilepsy) and wind turbine shadow flicker. Both studies suggested that flicker from turbines that interrupt or reflect sunlight at frequencies greater than 3 Hz pose a potential risk of inducing photosensitive seizures in 1.7 people per 100,000 of the photosensitive population. For turbines with three blades, this translates to a maximum speed of rotation of 60 revolutions per minute (rpm). The Nordex 155 turbine in the Updated Project has a nominal rotational speed of 11 rpm, well below a speed that could trigger epileptic seizure.

Two of the most comprehensive and widely cited published scientific review articles on this topic are Knopper & Ollson (2011) and McCunney et al. (2014). Both papers concluded that shadow flicker is not associated with health effects for those living in proximity to wind turbines. Knopper & Ollson (2011) concluded:

> *"Although shadow flicker from wind turbines is unlikely [to] lead to a risk of photo-induced epilepsy there has been little if any study conducted on how it could heighten the annoyance factor of those living in proximity to turbines. It may however be included in the notion of visual cues. In Ontario it has been common practice to attempt to ensure no more than 30 hours of shadow flicker per annum at any one residence."*

Since 2014, there have been two studies conducted that examined the potential for shadow flicker to lead to increased annoyance for those living near wind turbines.

Voicescu et al., 2016. Estimating annoyance to calculated wind turbine shadow flicker is improved when variables associated with wind turbine noise exposure are considered. J. Acoust. Soc. Am. 139 (3),

In 2016, Health Canada published a paper using the questionnaires of over 1200 people living as close as 800 feet from a turbine they attempted to determine if they could predict the percentage of people that were highly annoyed by varying levels of hours of shadow flicker (SF) a year or number of minutes on a given day. However, although annoyance did tend to increase with increasing minutes a day, they could not find a statistical relationship:

> *"For reasons mentioned above, when used alone, modeled SF_m results represent an inadequate model for estimating the prevalence of HA_{WTSF} as its predictive strength is only about 10%. This research domain is still in its infancy and there are enough sources of uncertainty in the model and the current annoyance question to expect that refinements in future research would yield improved estimates of SF annoyance."*

Haac et al. 2022. In the shadow of wind energy: Predicting community exposure and annoyance to wind turbine shadow flicker in the United States. Energy Research & Social Science 102471. Pg. 1-16.

This work was completed by the Lawrence Berkley National Laboratory (LBNL) in the United States as part of a large US Department of Energy (DOE) Wind Neighbors National Survey. The purpose of the study was to determine if the duration of shadow flicker could be correlated to shadow flicker (SF) annoyance in the population. Overall, the authors reported:

> *This study modeled SF exposure at nearly 35,000 residences across 61 wind projects in the United States, 747 of which were also survey respondents. Using these results, we analyzed the factors that led to perceived SF and self-reported SF annoyance. We found that perceived SF is primarily an objective response to SF exposure, distance to the closest turbine, and whether the respondent moved in after the wind project was built. Conversely, SF annoyance was not significantly correlated with SF exposure. Rather, SF annoyance is primarily a subjective response to wind turbine aesthetics, annoyance to other anthropogenic sounds, level of education, and age of the respondent.*

Similar to the Health Canada findings (Voicescu, 2016), the LBNL study could not correlate the number of theoretical (astronomical) or actual (adjusted case) hours a year or minutes at a time in duration of shadow flicker with annoyance in the population. In other words, limiting the number of hours of shadow flicker on an annual basis at a non-participating home is unlikely to decrease the annoyance the residents feel towards any shadow flicker at all or the turbines themselves.

Therefore, there is nothing in the scientific literature that suggests that shadow flicker should be limited, either for hours per year or total minutes at a time, to protect health or avoid annoyance.

11.1.2 Shadow Flicker Standards

However, I do believe that reasonable limits on shadow flicker are prudent to keep nuisance levels to a minimum at non-participating residences. There are few, if any jurisdictions in Canada,

including Alberta, that regulate a shadow flicker standard. This has led to shadow flicker consultants across Canada to suggest a variety of different guidelines that could be applied to Canadian wind project.

A number of North American jurisdictions have adopted various ordinances and rules limiting shadow flicker on non-participating land. A no more than 30 hours of actual shadow flicker modeled on a residence (Adjusted / Assessment Case B) has almost become the universally adopted standard. Erroneously this level of shadow flicker at homes has often been referred to as the "Industry Standard". It is not the wind turbine proponents that derived this standard; rather it is one that has been adopted in provincial/state or local statute.

The origins of this standard are traced to Germany in 2002. The German Territorial Committee for Emissions control released the document "Hinweise zur Ermittlung und Beurteilung der optischen Immissionen von Windenergieanlagen, Länderausschuss für Immissionsschutz [Notes on the identification and evaluation of optical emissions from wind turbines], (in German)." The standard was based on limiting the shadow flicker nuisance of local residents. They subsequently codified this formal shadow flicker guideline as part of the *Federal Emission Control Act* (Haugen, 2011). Similar standards to this have been adopted internationally with modifications for shadow flicker. The German standard is: no more that 30 hours of modeled shadow flicker (theoretical / worst case) a year, no more than 30 minutes of shadow flicker at a time, and no more than 8 hours of actual (Adjusted / Assessment Case B) shadow flicker a year on a home.

Each jurisdiction that has adopted a shadow flicker restriction at non-participating residences has had to weigh what would be a reasonable level of shadow flicker that they believe would be acceptable and avoid excessive complaints. It is clear from the Koppen et al. (2017) review of international standards for shadow flicker that they can vary considerably from jurisdiction to jurisdiction. I would caution the NSDECC that the table of shadow flicker jurisdictional standards in Koppen (2017) contains several errors, including for the North American references.

Koppen (2017) states:

> *However, there are differences in the exact implementation, like the consideration of only the worst case, only the real case or both the worst and the real case shadow impact. Other common differences are the exact definition of shadow flicker sensitive receptors and the zone of influence which has to be considered. This can lead to considerable differences in energy production losses by a shadow flicker control module.*

Across North America many jurisdictions have successfully adopted shadow flicker restrictions based on the "Adjusted/Actual/Realistic/Expected" scenario (Assessment Case B). The following are some examples of state-wide legislation.

<u>North Dakota</u>

The North Dakota Public Service Commission requires effects from the impact upon light-sensitive land uses to be managed and maintained at an acceptable minimum (N.D. Admin. Code §69-06-08-01(5)(c)(3)). The North Dakota Public Service Commission has recognized the 30-hour per year standard and evaluates actual shadow flicker impacts pursuant to this standard. Justification, similar to what is contained in this report, for continued use of this standard has been provided to the ND PSC during several recent wind project applications and hearings.

Connecticut

Similarly, the Regulations of Connecticut State Agencies Section 16-50j-95, part (c) requires:

> *Shadow flicker shall not occur more than 30 total annual hours cumulative at any off-site occupied structure location from each of the proposed wind turbine locations and any alternative wind turbine locations at the proposed site and any alternative sites.*

NSDECC Shadow Flicker Standard

Eliminating shadow flicker at non-participating homes does not afford any additional protection for health. The NSDECC has a shadow flicker standard of no more than 30 hours a year and 30 minute a day. This is a reasonable limit to avoid annoyance or nuisance complaints. To put this in perspective it represents less than 0.5% of the daylight hours a year.

This standard has a long history of success in many North American jurisdictions that have seen over a decade of wind farm operation. Shadow flicker at operating wind projects is rarely a source of complaint. In the very unlikely event of shadow flicker complaints there are a number of mitigation strategies that can be resolved between the companies and landowners.

12 Physical Health and Safety Considerations for Determining Appropriate Setback Distances

Public health and safety with respect to wind projects are governed by setback and safety distances set by local, state and federal authorities. In addition, equipment manufacturers have developed similar recommendations based on their experience with projects around the world.

The following describes the suitability of use of a turbine height multiplier for protection from ice throw and blade failure. Overall, these setback distances are not meant to be protective of the fact that these issues can occur, rather the infrequent events under which they happen and the odds that an individual would be harmed.

Ice Throw

In 2007, Garrad Hassan Canada Inc. was commissioned by the Canadian Wind Energy Association (CanWEA) to undertake a probabilistic risk evaluation of the likelihood of ice fragment throw from wind turbines would strike a member of the public. They used a hypothetical wind turbines, similar to those commonly in operation. They examined meteorological conditions in Ontario, Canada, which are similar to winter environment in Nova Scotia. Three scenarios were examined – Scenario A House, Scenario B Road and Scenario C Individual. Their findings are provided in Table 6.

Table 6. Ice Throw Strike Probabilities (Garrad Hassan, 2007)

Scenario A House	Scenario B Road	Scenario C Individual
• 1000 ft^2 house • 1000 ft from turbine • 1 ice strike per 62,500 years	• north-south road is situated directly west of a turbine at 650 ft • 100 vehicles at 40 mph • 1 vehicle strike per 100,000 years	• ever-present individual between 65 ft to 1000 ft from turbine • 1 strike in 500 years

More recent studies on the potential for vehicles or individuals to be struck by ice throw from larger wind turbines support the Garrad Hassan findings. What is seen is that ice throw pieces that would be capable of harming people or vehicles typically fall within a distance of the turbine height.

The results indicate an extremely low probability that an individual or vehicle would ever be struck. They are far less than risks that people face in everyday life (e.g., driving a car, being struck by lightning, or being in an airplane crash).

Blade Failure

There have been a number of probabilistic studies that have been conducted examining the potential for blade failure to harm people or strike vehicles. In a recent U.S. study by Rogers and Costello (2022) of the School of Aerospace Engineering, Georgia Institute of Technology, Atlanta, GA, titled *Methodology to assess wind turbine blade throw risk to vehicles on nearby roads*, they found:

> *For example, using the one fatality per impact assumption, the fatality risk for the 5.5 MW turbine at a 1.1x tip height setback is 1 fatality per 12 million years for 1 vehicle/mile traffic density, and 1 fatality per 1.1 million years for 10 vehicles/mile. Similarly, the results for the 1.5 MW and 3.4 MW turbines at a 1.1x tip height setback are well below 1 fatality per*

100,000 years for 1 vehicle/mile and 10 vehicles/mile traffic densities. This indicates that, from an engineering safety perspective, the 1.1x tip height setback produces a satisfactory level of risk mitigation for rural roadways.

Results for these example turbines show that the typical setback of 1.1x tip height is generally sufficient at reducing risk to extremely low levels (between 1 impact in 1 million years and 1 impact in 10 million years) for roads in rural areas which tend to be lightly traveled.

In 2013, MMI Engineering Ltd undertook a study titled "*Study and development of a methodology for the estimation of the risk and harm to persons from wind turbines*" for the United Kingdom government. Through their probabilistic assessment they determined that risk of fatality from wind turbine blade fragment throw is low in comparison to other societal risks. It was roughly equivalent to the risk of fatality from taking two aircraft flights a year or being struck by lightning.

Tower Collapse

Tower collapse is a very rare event, although it is acknowledged that it can occur. When wind turbine tower fail, they tend to collapse within a distance equal or less to their total height. The proposed changes require wind turbines be placed 1.1 times Turbine Height from edge of the Right-of-Way from roads and property lines. This safety distance ensures that in the unlikely event of a tower collapse that the wind turbine will impact only the participating parcel of land and not interfere, or affect, roads or neighboring properties.



Setback Siting Guidelines for Wind Energy Projects

Christopher Ollson, PhD
Ollson Environmental Health Management

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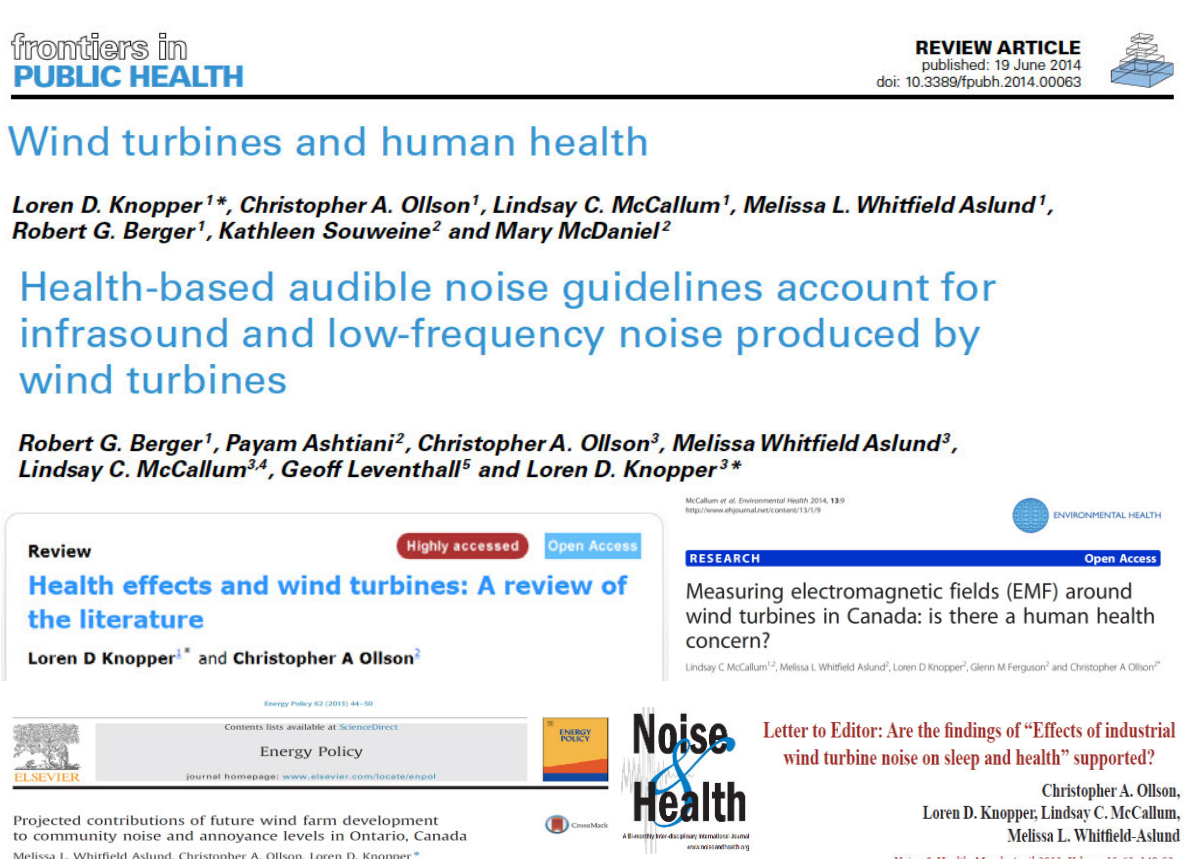
Environmental Health Management

Dr. Ollson Qualifications

- Doctorate in Environmental Health Science
- Over 25 years in international environmental risk assessment and health consulting
- Owner of Ollson Environmental Health Sciences for the past 10 years
- Adjunct Professor University of Toronto
- 15 years of researching potential health impacts for those living in proximity to renewable energy and transmission lines
- Testified before numerous county commissions, state hearings, and court cases as a qualified expert in the field
- Involved in over 25 GW of renewable energy projects across 26 States.
- Consultant of record for State of Vermont during wind siting rule making and appeared before Senate Committees in Kansas, North Dakota and Indiana



frontiers in PUBLIC HEALTH

REVIEW ARTICLE
published: 19 June 2014
doi: 10.3389/fpubh.2014.00063

Wind turbines and human health

Loren D. Knopper[1]*, Christopher A. Ollson[1], Lindsay C. McCallum[1], Melissa L. Whitfield Aslund[1], Robert G. Berger[1], Kathleen Souweine[2] and Mary McDaniel[2]

Health-based audible noise guidelines account for infrasound and low-frequency noise produced by wind turbines

Robert G. Berger[1], Payam Ashtiani[2], Christopher A. Ollson[3], Melissa Whitfield Aslund[3], Lindsay C. McCallum[3,4], Geoff Leventhall[5] and Loren D. Knopper[3]*

Review

Highly accessed

Open Access

Health effects and wind turbines: A review of the literature

Loren D Knopper[1]* and Christopher A Ollson[2]

McCallum et al. Environmental Health 2014, 13:9
http://www.ehjournal.net/content/13/1/9

ENVIRONMENTAL HEALTH

RESEARCH

Open Access

Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern?

Lindsay C McCallum[1,2], Melissa L Whitfield Aslund[2], Loren D Knopper[2], Glenn M Ferguson[2] and Christopher A Ollson[2]*

Energy Policy 62 (2013) 44–50

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

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ENERGY POLICY

Projected contributions of future wind farm development to community noise and annoyance levels in Ontario, Canada

Melissa L. Whitfield Aslund, Christopher A. Ollson, Loren D. Knopper *

CrossMark

Noise & Health

A Bi-monthly Inter-disciplinary International Journal

www.noiseandhealth.org

Letter to Editor: Are the findings of "Effects of industrial wind turbine noise on sleep and health" supported?

Christopher A. Ollson,
Loren D. Knopper, Lindsay C. McCallum,
Melissa L. Whitfield-Aslund

Noise & Health, March-April 2013, Volume 15:63, 148-52

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Setback Recommendation

- OEHM recommends that West Hants Regional Municipality adopt into their By-law their previously established practice of using a 1 km setback to dwellings and 550 m to woods camps for existing projects.
  - Based on the available scientific literature, this is more than sufficient to ensure the protection of the public health and safety of their residents.
  - In fact, a lesser setback between 550 m to 1 km would be equally protective of public health and safety.
  - There is no scientific basis to increase these setbacks. It would afford no additional protection of public health and safety and would unduly restrict areas for development.

Siting Considerations for Wind Turbines

- Includes concerns around:
  - Setbacks
  - Shadow Flicker
  - Audible Noise (sound you hear)
  - Low Frequency Noise
  - Infrasound (sound you don't hear)
  - Ice Throw
  - Blade Fragment Throw
  - Tower Collapse
  - Fire
  - Stray Voltage
  - BPA / PFAS
  - Electromagnetic Fields (EMF)
  - Livestock and Hunting

Acoustics

Engineering

HEALTH & SAFETY

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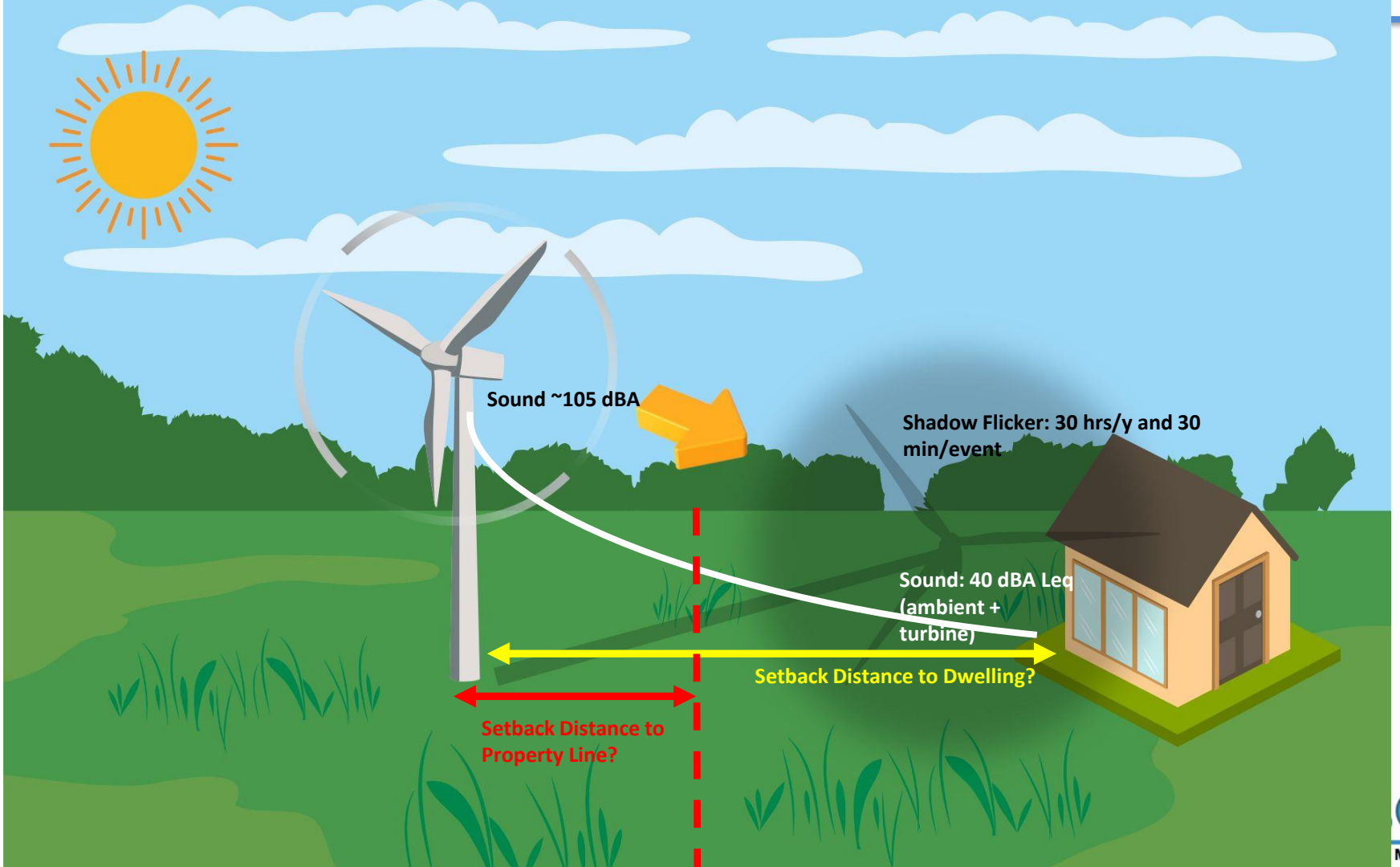
Sound ~105 dBA
Shadow Flicker: 30 hrs/y and 30 min/event
Sound: 40 dBA Leq (ambient + turbine)
Setback Distance to Dwelling?
Setback Distance to Property Line?

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Other Jurisdiction Turbine Setbacks

Municipality	Minimum Setback for Wind Turbines from Residential Dwellings
Nova Scotia	
West Hants Regional Municipality	Precedent of 1000 m. (3,280 ft.) from dwelling for existing projects
Municipality of East Hants	4 times the height of the wind turbine
Municipality of the County of Kings	Only permitted in the "Large Scale Wind Turbine Overlay"; the boundaries of the overlay are a minimum of 3 km from dwellings existing on November 15, 2018.
Colchester County	2 km for wind turbines greater than 100 m. (328 ft.). If a wind turbine exceeds 200 m. (656 ft.) an increased setback of 7.5 m. (26.5 ft.) is required for every 1 m. (3.3 ft.) of additional height if the increased minimum setback is necessary to satisfy the maximum ambient degradation noise standard of the By-law.
Municipality of Yarmouth	1000 m. (3,280 ft.) or 6.5 times the height of the turbine, whichever is greater
Region of Queens Municipality	1.5 times the total height of the turbine from all property lines and watercourses
Municipality of the County of Annapolis	Only permitted within a "Wind Resource Areas"; requires a minimum of 1,000 m (3,280 ft.) .
Halifax Regional Municipality	550 m. (1,805 ft.)
Municipality of Cumberland	1000 m. (3,280 ft.) or 3.5 times the height of the turbine, whichever is greater
Municipality of the District of Digby	1000 m. (3,280 ft.)
Municipality of Pictou County	1000 m. (3,280 ft.)
Municipality of the County of Antigonish	1000 m. (3,280 ft.)

Municipality	Minimum Setback for Wind Turbines from Residential Dwellings
Top Canadian Jurisdictions with Operating Wind Projects	
Ontario	550 m from a residence
Quebec	Set by the municipalité régionale de comté (MRC) and typically governed by sound standard setback, most common 750 m
Alberta	Set by the counties. Typical setbacks to dwelling range from 800 m to 1000 m.

Municipality	Minimum Setback for Wind Turbines from Residential Dwellings
United States Examples	
North Dakota (State)	One and one-tenth times the height of the turbine from the property line of a nonparticipating landowner and three times the height of the turbine from an inhabited rural residence of a nonparticipating landowner, unless a variance is granted.
Wisconsin (State)	The lessor of 1,250 feet or 3.1 times the maximum blade tip height.
New York (State)	Non-participating, non-residential Structures 1.5 times, non-participating residences 2 times
Illinois (State)	1.1 times tip height to non-participating property lines, 2.1 times tip height to non-participating receptors.
Michigan (State)	2.1 times from occupied community buildings and residences on nonparticipating properties 1.1 times from non-participating property lines
Nebraska (County)	Varies county by county but most common between 300 m to 500 m
Kansas (County)	Varies county by county but most common between 300 m to 500 m

Typical setback to a dwelling is 500 m to 1km

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State of Wind Turbine Research and Health Effects

- 20 years of research in the field
- Over 150 peer-reviewed research papers published in the field
- Findings support:
  - Sound levels 45 dBA
  - Shadow flicker <30 hours a year
  - Setbacks 1.1x tip height to roads, property lines, transmission lines, etc..
  - Setbacks 2-3x tip height to non-participating homes (based primarily on achieving sound limits) and no great than 1 km is required.

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Turbine Sound

The NSDECC's sound guideline requires:

- In establishing separation distances, a proponent must ensure that the wind farm design and turbine siting does not cause sound levels to exceed 40 dBA (A-weighted decibels) at the exterior of receptors.
- Cumulative sound from ambient background levels, all wind turbines in the proposed project + sound from any wind turbines from nearby projects.
- One of the most stringent (lowest) sound standards for wind projects in the world.

Sound Standard 40 dBA = Ambient Sound 35 dBA + Wind Turbine Sound at home 38.4 dBA

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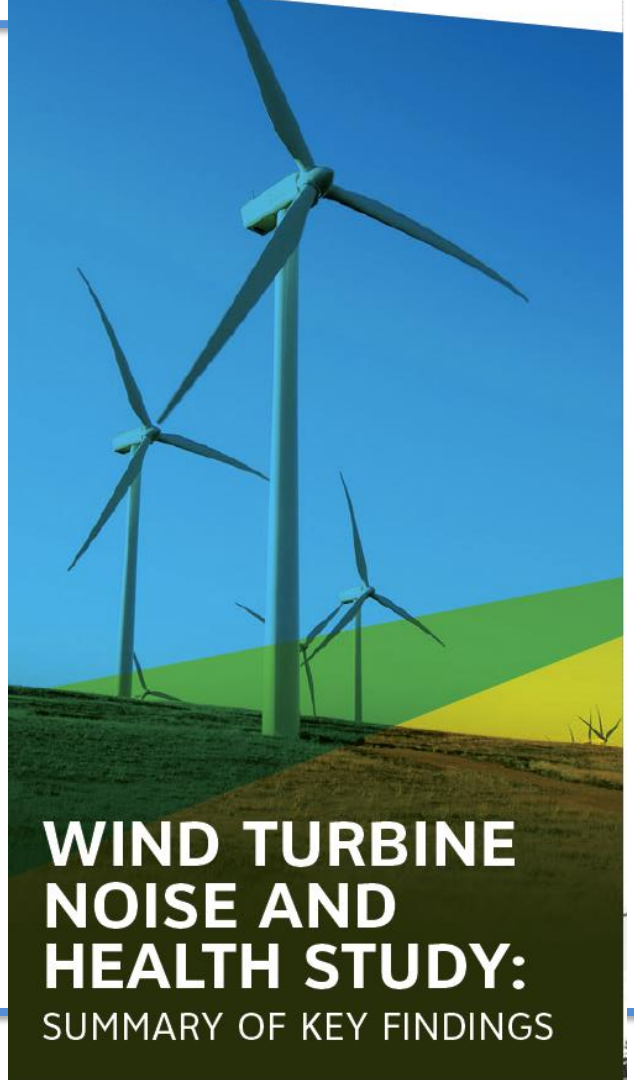

Health Canada Santé Canada

2014

Largest study ever undertaken around the world.

The following were <u>not</u> found to be associated with wind turbine noise:

a. self-reported sleep (e.g., general disturbance, use of sleep medication, diagnosed sleep disorders);

b. self-reported illnesses (e.g., dizziness, tinnitus, prevalence of frequent migraines and headaches) and chronic health conditions (e.g., heart disease, high blood pressure and diabetes); and

c. self-reported perceived stress and quality of life.

The overall conclusion to emerge from the study findings is that the study found <u>no evidence</u> of an association between exposure to WTN and the prevalence of self-reported or measured health effects beyond annoyance.

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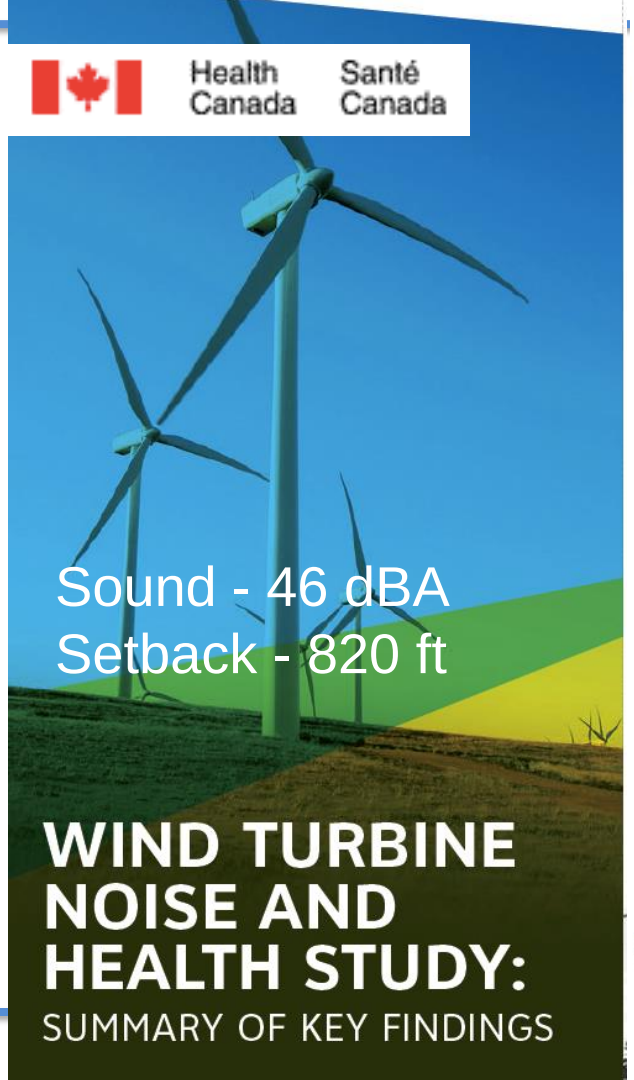

pii: sp-00087-15 http://dx.doi.org/10.5665/sleep.5326

SLEEP DURATION/SLEEP QUALITY

Effects of Wind Turbine Noise on Self-Reported and Objective Measures of Sleep

David S. Michaud, PhD[1]; Katya Feder, PhD[1]; Stephen E. Keith, PhD[1]; Sonia A. Voicescu, MSc[1]; Leonora Marro, MSc[2]; John Than, MSc[2]; Mireille Guay, MSc[2]; Allison Denning, MES[3]; Brian J. Murray MD, FRCP(C)D, ABSM[4]; Shelly K. Weiss, MD, FRCPC[5]; Paul J. Villeneuve PhD[6]; Frits van den Berg, PhD[7]; Tara Bower, MSc[8]

Exposure to wind turbine noise: Perceptual responses and reported health effects

David S. Michaud,[a)] Katya Feder, Stephen E. Keith, and Sonia A. Voicescu
Health Canada, Environmental and Radiation Health Sciences Directorate, Consumer and Clinical Radiation Protection Bureau, 775 Brookfield Road, Ottawa, Ontario K1A 1C1, Canada

Personal and situational variables associated with wind turbine noise annoyance

David S. Michaud,[a)] Stephen E. Keith, Katya Feder, and Sonia A. Voicescu
Health Canada, Environmental and Radiation Health Sciences Directorate, Consumer and Clinical Radiation Protection Bureau, 775 Brookfield Road, Ottawa, Ontario K1A 1C1, Canada

Self-reported and measured stress related responses associated with exposure to wind turbine noise

David S. Michaud,[a)] Katya Feder, Stephen E. Keith, and Sonia A. Voicescu
Health Canada, Environmental and Radiation Health Sciences Directorate, Consumer and Clinical Radiation Protection Bureau, 775 Brookfield Road, Ottawa, Ontario K1A 1C1, Canada

Environmental Research 142 (2015) 227–238
Contents lists available at ScienceDirect
Environmental Research
journal homepage: www.elsevier.com/locate/envres

An assessment of quality of life using the WHOQOL-BREF among participants living in the vicinity of wind turbines ☆

Katya Feder [a], David S. Michaud [a,*], Stephen E. Keith [a], Sonia A. Voicescu [a], Leonora Marro [b], John Than [b], Mireille Guay [b], Allison Denning [c], Tara J. Bower [d], Eric Lavigne [e],

Estimating annoyance to calculated wind turbine shadow flicker is improved when variables associated with wind turbine noise exposure are considered

Sonia A. Voicescu, David S. Michaud,[a)] and Katya Feder
Health Canada, Environmental and Radiation Health Sciences Directorate, Consumer & Clinical Radiation Protection Bureau, 775 Brookfield Road, Ottawa, Ontario K1A 1C1, Canada

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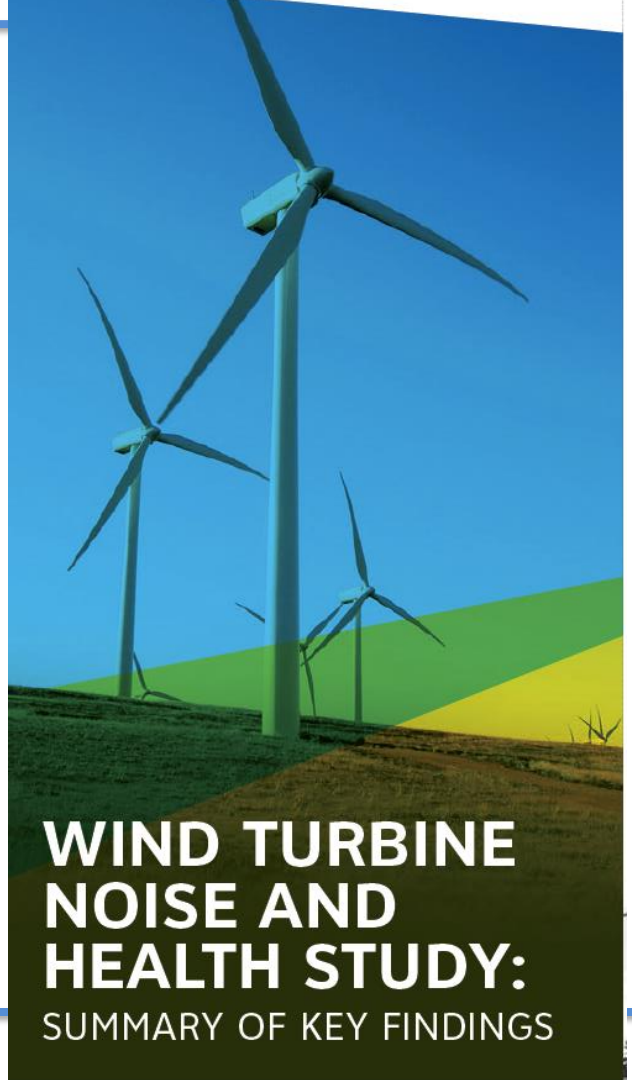

Health Canada Santé Canada

- The overall conclusion to emerge from the study findings is that the study found no evidence of an association between exposure to WTN and the prevalence of self-reported or measured health effects beyond annoyance.

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LOW FREQUENCY NOISE AND INFRASOUND

What about Low Frequency Noise / Infrasound?

- Are Low Frequency Noise and Infrasound emitted from wind turbines?
  - YES
- Are they emitted at levels that pose a potential health concern?
  - NO
- Are audible sound limits (dBA) for wind turbines sufficient to protect for emitted Low Frequency Noise and Infrasound from wind turbines?
  - YES

LUBW

Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg

Low-frequency noise incl. infrasound from wind turbines and other sources

Report on results of the measurement project 2013-2015

Baden-Württemberg

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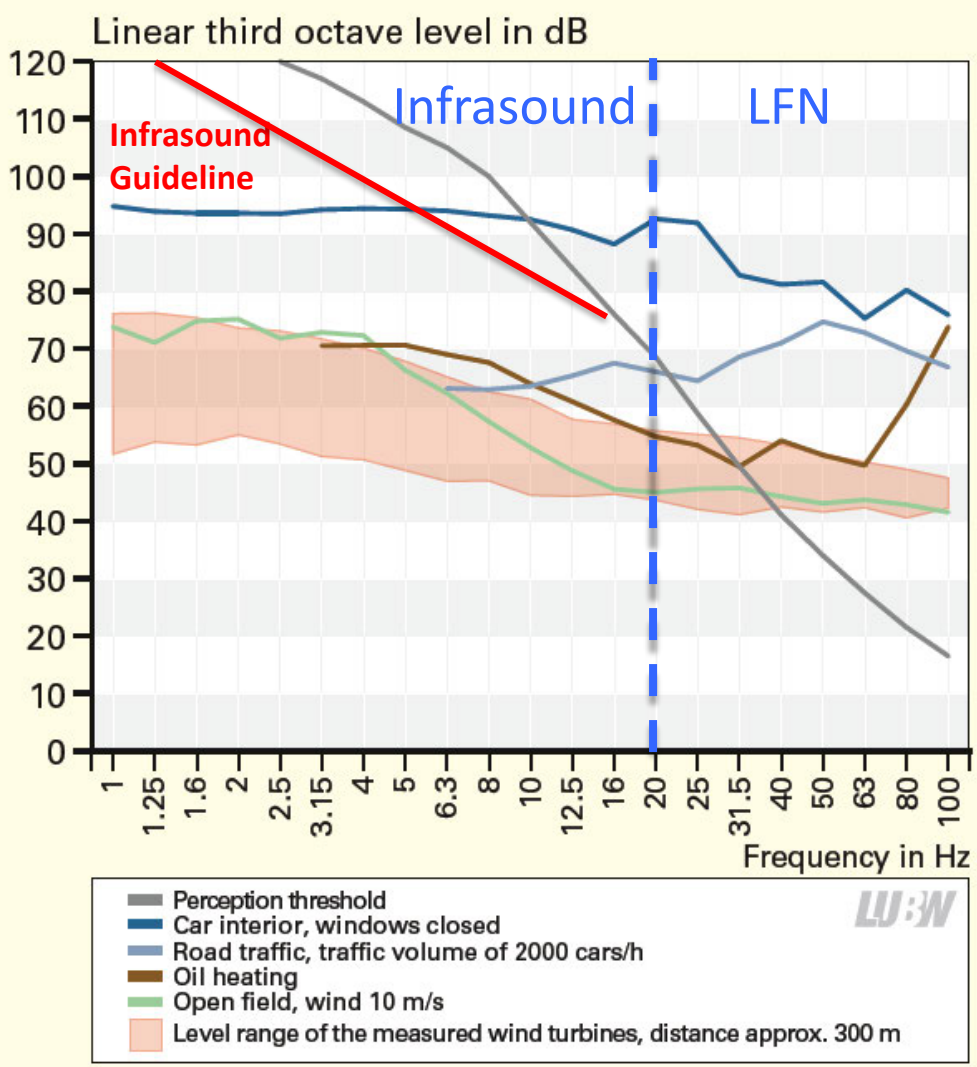

Infrasound and Low Frequency Noise

Wind Turbines and Other Sources

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Low Frequency Noise / Infrasound

frontiers in
PUBLIC HEALTH

ORIGINAL RESEARCH ARTICLE
published: 24 February 2015
doi: 10.3389/fpubh.2015.00031

Health-based audible noise guidelines account for infrasound and low-frequency noise produced by wind turbines

Robert G. Berger[1], Payam Ashtiani[2], Christopher A. Ollson[3], Melissa Whitfield Aslund[3], Lindsay C. McCallum[3,4], Geoff Leventhall[5] and Loren D. Knopper[3]*

[1] Intrinsik Health Sciences Inc., Mississauga, ON, Canada
[2] Aercoustics Engineering Limited, Mississauga, ON, Canada
[3] Intrinsik Environmental Sciences Inc., Mississauga, ON, Canada
[4] Department of Physical and Environmental Sciences, University of Toronto, Toronto, ON, Canada
[5] H.G. Leventhall – Consultancy, Surrey, UK

Over-all, the available data from this and other studies suggest that health-based audible noise wind turbine siting guidelines provide an effective means to evaluate, monitor, and protect potential receptors from audible noise as well as Infrasound and Low Frequency Noise.

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Shadow Flicker

- Shadow flicker does not induce seizures.
- Wind turbines quite simply don't rotate fast enough.
- Shadow flicker is not a health concern

<u>The NSDECC's shadow flicker guideline requires:</u>

- Shadow Flicker <30 hr/y and <30 min/day at dwellings.
- Cumulative shadow flicker from all wind turbines in the proposed project + shadow from any wind turbines from nearby projects.
- One of the most stringent (lowest) shadow flicker standards for wind projects around the world.

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PHYSICAL SAFETY CONSIDERATIONS

GE Renewable Energy

- Original -

Technical Documentation
Wind Turbine Generator Systems
All Onshore Turbine Types

General Description

Setback Considerations for Wind Turbine Siting

imagination at work

Setback considerations include adjoining population density, usage frequency of adjoining roads, land availability, and proximity to other publicly accessed areas and buildings.

Table 1 provides setback guidance for wind turbines given these considerations.

GE recommends using the generally accepted guidelines listed in Table 1, in addition to any requirements from local codes or specific direction of the local authorities, when siting wind turbines.

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GE Setback Recommendations

Setback Distance from center of turbine tower	Objects of concern within the setback distance

All turbine sites (blade failure/ice throw):
1.1 x tip height[1], with a minimum setback distance of 170 meters
	- Public use areas
	- Residences
	- Office buildings
	- Public buildings
	- Parking lots
	- Public roads
	  - Moderately or heavily traveled roads if icing is likely
	  - Heavily traveled multi-lane freeways and motorways if icing is not likely
	- Passenger railroads

All turbine sites (tower collapse): 1.1 x tip height[1]	- Public use areas - Residences - Office buildings - Public buildings - Parking lots - Heavily traveled multi-lane freeways and motorways - Sensitive above ground services[2]
All turbine sites (rotor sweep/falling objects): 1.1 x blade length[3]	- Property not owned by wind farm participants[4] - Buildings - Non-building structures - Public and private roads - Railroads - Sensitive above ground services

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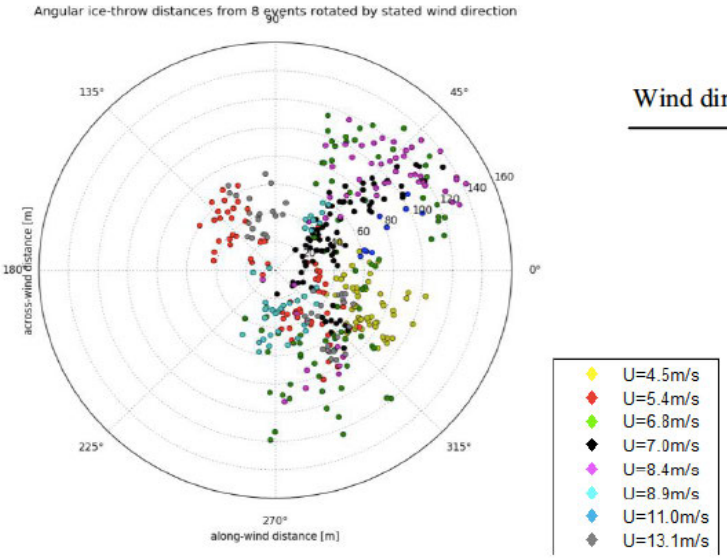
Risk Assessment of Ice Throw

PAPER · OPEN ACCESS

Understanding and acknowledging the ice throw hazard – consequences for regulatory frameworks, risk perception and risk communication

To cite this article: R. E. Bredesen *et al* 2017 *J. Phys.: Conf. Ser.* **926** 012001



Wind direction

Figure 6. 417 ice pieces from the IceThrower database for the considered V90 turbine with a tipheight of 140 m. The location of all ice pieces are rotated by the given wind direction for each given case. Events are listed A-H by colored markers for increasing wind velocities.

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Blade Fragment Throw

Source of Fatality	*Annual Risk*	*Assumptions*
Wind turbine - Direct impact by blade/fragment	10^{-9}	At 2x hub height from wind turbine
Wind turbine - Indirect impact by blade/fragment	10^{-8}	At 2x hub height from wind turbine
Cancer	2.58×10^{-3}	Averaged over population. England & Wales 1999
Lightning	5.35×10^{-8}	England & Wales 1995-1999
Mining Industry	1.09×10^{-4}	GB 1996-2001
Construction Industry	5.88×10^{-5}	GB 1996-2001
Agriculture	5.81×10^{-5}	GB 1996-2001
Service Industry	3.00×10^{-6}	GB 1996-2001
Fairground Rides	4.79×10^{-9}	Assumes 4x rides per annum. UK 1996-2000
Road Accidents (all forms)	5.95×10^{-5}	UK 1999
Rail Travel Accidents (per passenger journeys)	2.32×10^{-8}	Fatality per passenger journeys GB 1996-1997
Rail Travel Accidents (annual risk - commuter)	1.05×10^{-5}	Annual risk of fatality: 2 daily journeys, 45 weeks per year
Aircraft Accident (per passenger journeys)	8.00×10^{-9}	Fatality per passenger journeys UK 1991-2000
Aircraft Accident (annual risk – holidaymaker)	1.60×10^{-8}	Annual risk of fatality: 2 flights per annum

HSE Health and Safety Executive

Study and development of a methodology for the estimation of the risk and harm to persons from wind turbines

Prepared by **MMI Engineering Ltd**
for the Health and Safety Executive 2013

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Environmental Health Management

Cumulative Effects

Sound and shadow flicker

- standards and modeling require cumulative effect assessment of existing and proposed project turbines towards all dwellings.

Visual Aspect

- In terms of the visual aspect of turbines on the horizon, beauty is truly in the eye of the beholder.
- There are numerous studies that describe that approximately 10% of the population living in proximity to a wind turbine will be annoyed by their presence. However, given that wind turbines do not impact property values, impact health or result in other impacts on quality of life OEHM does not believe that counties should use health or visual cue as the basis to increase setback distances to turbines.
- This would effectively be a roundabout way of zoning out wind turbines based on visual appearance.
- There are counties in Canada and the United States that host hundreds of wind turbines without impact on their communities.

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Environmental Health Management

Setback Recommendation

- OEHM recommends that West Hants Regional Municipality adopt into their By-law their previously established practice of using a 1 km setback to dwellings and 550 m to woods camps for existing projects.
  - Based on the available scientific literature, this is more than sufficient to ensure the protection of the public health and safety of their residents.
  - In fact, a lesser setback between 550 m to 1 km would be equally protective of public health and safety.
  - There is no scientific basis to increase these setbacks. It would afford no additional protection of public health and safety and would unduly restrict areas for development.

Christopher Ollson, PhD

Ollson Environmental Health Management

[redacted]

OLLSON
Environmental Health Management

Scotia INVESTMENTS
A Family of Companies

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office 902 835 7100 *fax* 902 835 8151
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April 1, 2024

Mark Fredericks
Senior Planner
West Hants Regional Municipality
PO Box 3000
76 Morison Drive
Windsor, NS B0N 2T0

Dear Mr. Fredericks,

Re: West Hants Regional Municipality (the "Municipality")
Wind Farm Setback Review

Further to the meeting on April 2, 2024, where we discussed proposed amendments to extend the existing 1 km setback for potential wind farm developments to 4 km, please see attached a letter of comment on behalf of Scotia Investments Limited ("SIL"). SIL is a family of 9 companies with over 1600 employees. The ongoing mission of all our companies is to create long-term value, environmental resilience, and social well-being. Renewable energy, particularly wind energy, is a critical component of the future for all our companies and for Nova Scotia as a whole.

SIL agrees that wind turbines should not be located so close to domestic dwellings that they unreasonably affect the amenity of such properties through sound, shadow flicker, visual domination, or reflected light. In SIL's view, the existing 1 km setback strikes the appropriate balance to avoid any disturbance to neighbours of potential wind farm developments.

Our largest business in the West Hants Municipality, CKF Inc., is one of the largest power and energy consumers in Nova Scotia – electricity and fossil fuels. There is increasing demand from the customer base for suppliers to lower carbon profiles. As such, electrification of the facility and sourcing green power are key items being worked on to keep CKF competitive and a supplier of choice in the future. A potential avenue for additional green power for CKF may be to develop wind generation on land SIL holds in West Hants. The extension of setbacks from 1 km to 4 km will hamper this growth and the "greening" of CKF's energy profile.

Since the development of the existing 1 km setback, the Province of Nova Scotia has released the Nova Scotia Clean Energy Plan, which further commits Nova Scotia to phase out coal generation and obtain 80% of electricity from renewable sources by 2030. The Plan also seeks to reduce greenhouse gases from electricity by more than 90% (from 10.7 MT in 2005). These commitments are driven in part by the Federal requirements for coal closure and new Clean Electricity Regulations. One of the three main elements to the Clean Energy Plan is to increase onshore wind generation, specifically from 20% to over 50% of Nova Scotia's electricity. The Province's Plan contemplates the addition of 1370 MW of new onshore wind driven by 2030, and

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notes that this has been confirmed in all scenarios from Nova Scotia Power's Integrated Resource Plan. [1]

More recently, the provincial legislature introduced Bill 404 to create a new Independent Energy System Operator ("**IESO**") to help the Province achieve its 2030 clean energy goals. The motivation behind Bill 404 is reflected in the objects of the IESO, one being "to engage in activities to facilitate the diversification of sources of electricity supply by promoting the use of cleaner energy sources and technologies, including alternative energy sources and renewable energy sources."[2] The Clean Energy Task Force Report indicates that the motivation behind Bill 404 is in part to ensure that new renewable energy be connected to the grid in time for 2030.[3]

The Department of Natural Resources and Renewables believes that more than 80% renewable power can be achieved by building out Nova Scotia's own local renewables.[4] The successful implementation of local renewables, in particular from onshore wind, to achieve Nova Scotia's Clean Power Plan by 2030 depends on the cooperation and commitment of all stakeholders, including our municipalities.

Additional setback restrictions are counterproductive to the Clean Energy Plan goals and, if approved, would create an unnecessary additional burden for proponents to overcome in meeting the aggressive and challenging targets. Now is not the time to be placing further limits on renewable generation. To the contrary, Nova Scotia has an increasing and urgent need for more clean energy. Existing policy and legislative developments in the Province are clear that this can only be achieved with the help of onshore wind. If the Municipality were to extend the setback distance on wind turbines as proposed, this would significantly hinder our progress by limiting opportunities to develop new clean energy in the Municipality to support our local operations. We submit that additional restrictions at this time would not be appropriate and ask that the Municipality reject the proposed amendments.

Please let me know if you have further questions or would like to discuss.

Thank you,

Randy MacMillan
President and CEO
Scotia Investments Limited

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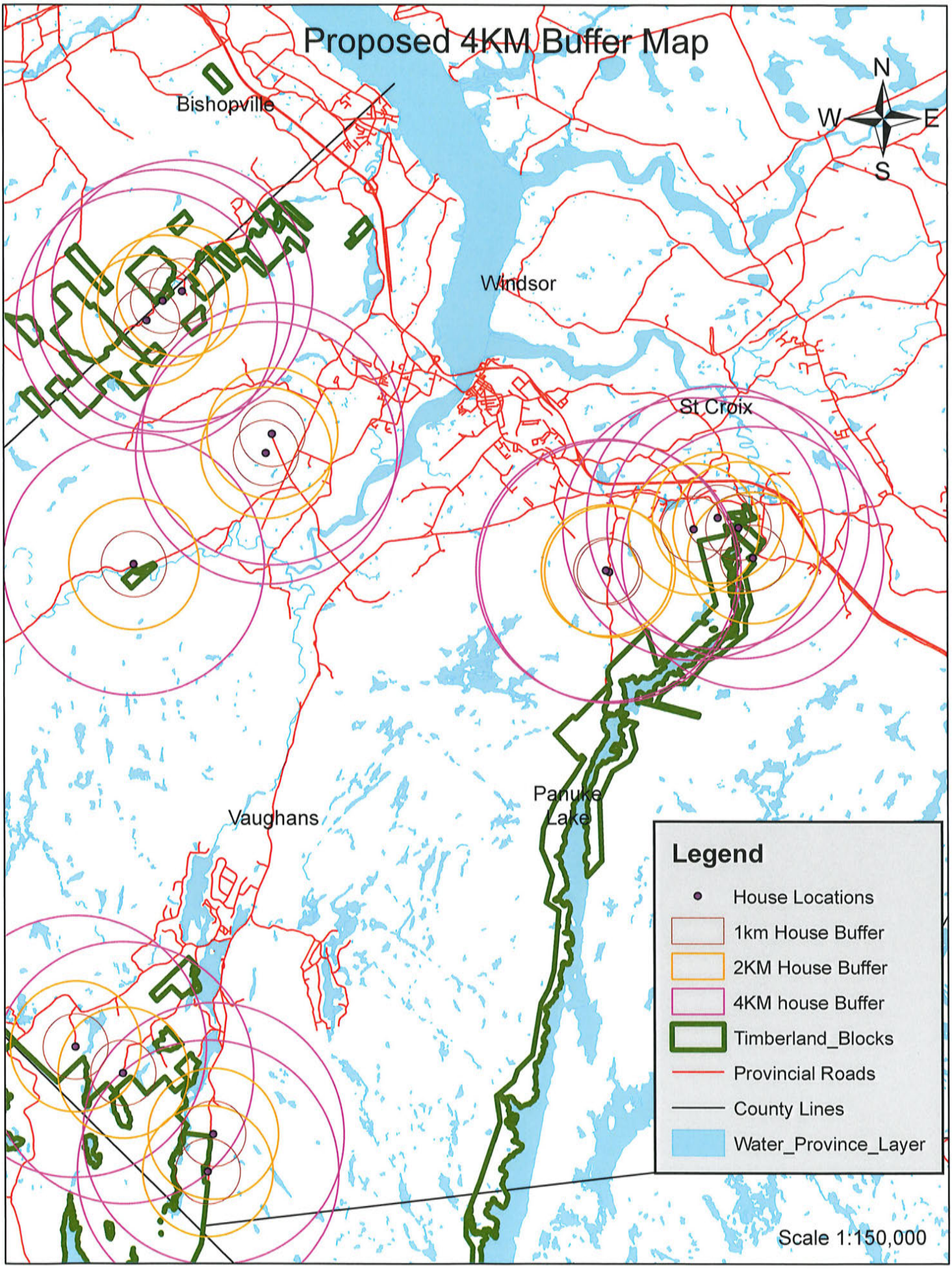
[1] Slide 11, October 2023 presentation by the NS Department of Natural Resources; nova-scotia-clean-power-plan-presentation-en.pdf (novascotia.ca)
[2] Bill 404, Section 7(9)(n); Nova Scotia Legislature - Bill 404 - Energy Reform (2024) Act (nslegislature.ca)
[3] Task Force Report, page 19, paragraph 3; FInal-Report-February-23.pdf (cetaskforce.ca)
[4] October 2023 presentation


Proposed 4KM Buffer Map
N
W
E
S
Bishopville
Windsor
St Croix
Vaughans
Panuke Lake
Legend
House Locations
1km House Buffer
2KM House Buffer
4KM house Buffer
Timberland_Blocks
Provincial Roads
County Lines
Water_Province_Layer
Scale 1:150,000

April 13, 2024
From: Jason Hart
To: Sara Poirier, Mark Fredericks

Hello Planner Poirier, Please accept my comments on set back change .

I strongly believe in a element of time between projects in near vicinity to determine the visual effect on landscape before another one is approved, but I also believe set backs need to be adjusted. Im not sure on appropriate setbacks . I know 1KM is too small for modern turbines that are over 200m tall . When they were 100-125M that might have worked . I believe I would be comfortable with a setback based on tower height . 1KM for 100M and down 2KM for up to 200M turbines 3KM for turbines above 200M .

The most important part though is not talked about . That is where the set back is measured from .
Measured from dwellings works fine in sub divisions where property size closely matches the home size . sometimes as little as 10 feet in difference .
In rural areas many residents have large acreages and even separate woodlots . The set back should be measured from property line of the Wind farm leased or owned property.
For several reasons .

Land owners cannot have the destiny of their property pre determined by a neighbour who chooses to have a wind farm. West Hants current system eliminates ability of adjacent property owners to seek compensation for the loss of use on their property as the wind turbine set back is measured from residence . If wind farm developers don't have enough land to contain their wind farm + set backs within their property lines they should have to seek permission form their neighbours.There very well might get that permission, but it absolutely must be asked for . Remembering the Wind Farm is the new comer to the community not the other way round .

Secondly Rural residents don't dwell in their home. They chose to live in Rural West hants because the only time there in the house is bed time and inclement weather. If its not acceptable to have sound and shadow flicker and ice throw around the home its not acceptable to expect the residents to put up with those things while on the back edge of their property , snow shoeing , hunting, fishing, foraging for mushrooms , or just having a nap under a tree. Remember it is their tree on their land why should a adjacent landowner be allowed to change that lifestyle ?

Also these setbacks should be measured form areas of importance like municipal parks , provincial parks , federal parks, protected wilderness areas and a like

Something of note . If a human can't dwell in a 1 km radius of a wind turbine safely and unbothered by shadow flicker and sound and ice throw . How is it that we can assume the wildlife can ?

Thank you for considering these points

Jason Hart West Hants Resident life long

April 14, 2024
From: Janice Caldwell
To: Sara Poirier

DEAR SARA,

I'M WRITING TO YOU WITH CONCERN TO THE SETBACK LIMITS FOR WINDMILLS IN OUR AREA OF UPPER VAUGHAN. IN MY OPINION THEY SHOULD BE 4 KILOMETERS FROM PROPERTY LINES . I HAVE LIVED HERE ALL MY LIFE AS WELL AS MANY OTHERS IN THE AREA. WE SHOULD BE ABLE TO USE EVERY INCH OF OUR PROPERTY FOR OUR OWN PERSONAL USE AND ENJOYMENT AS WE POSSIBLY CAN. WE WORK TO PAY TAXES SO WHY SHOULD SOME FOREIGN COMPANY BE ABLE TO MOVE IN ON US AND TAKE CONTROL OF US AND OUR PROPERTY WHICH THEY ARE GOING TO DO BUSINESS AND MAKE PROFITS WITH NEXT TO NO COMPENSATION TO US. THIS IS VERY UNFAIR AND CAN EVEN INVADE OUR PERSONAL HEALTH AND LIFE. THIS DECISION MUST BE TAKEN VERY SERIOUSLY AND YOU AND COUNCIL ARE TO MAKE THE BEST DECISION FOR US AND OUR FAMILIES. WE TRUST YOU WILL DO SO IN OUR FAVOR.

THANK YOU

JANICE CALDWELL
UPPER VAUGHAN

April 14, 2024
From: Terry Caldwell
To: Sara Poirier

April 14
As a resident of vaughan since 1977 im concerned about large corporations taking over, and changing our way of life that we have come to expect and enjoy . Our peacefull evenings ruined ..Everwind has stated that at 1 km setbacks the sound would be around 40 decibels, heres a fact Nova Scotia labour laws state.. anything 85 decibels and over requires you to wear ear protection .I think such huge turbines should be setback 4 km from property lines . this way residents can continue to enjoy all their property that they pay taxes on .
Thank You
Terry Caldwell, Upper Vaughan

April 15, 2024
From: Aaron Long
To: Sara Poirier, Mark Fredericks
Attachments: Letter RE: West Hants' proposed 4km wind turbine setback distance

Sara,

It was a pleasure meeting Mark on site today. Contact me if you wish to have a visit.

In the meantime, attached please find AREA's letter of comment in regards to the email subject line.

Please encourage Council to directly speak with residents of Ellershouse on their experience. I am available to speak with Council and or staff as desired.

Keep in touch,

Aaron Long, P.Eng., MSc, MBA General Manager
274 Main St Antigonish NS B2G 2C4
E aaron.long@municipalenergy.ca
P [redacted]
areans.ca

April 15, 2024

Sara Poirier, Director of Planning and Development
West Hants Regional Municipality
76 Morison Drive, PO Box 3000
Windsor, Nova Scotia, B0N 2T0

Delivered via email: spoirier@westhants.ca

RE: West Hants' proposed 4km wind turbine setback distance

Dear Ms. Poirier,

Thank you for the opportunity to provide comments on the West Hants Regional Municipality's (West Hants) proposed 4km setback distance from wind turbines to dwellings. The Alternative Resource Energy Authority (AREA), is a 100% municipally-owned company comprised of three Nova Scotia municipalities –Mahone Bay, Antigonish, and Berwick. AREA owns and operates the Ellershouse I and II Wind Farms, a $51 million, 10 turbine, 23.5 MegaWatt (MW) wind project located in West Hants. Fully completed in 2018, the Ellershouse Wind Farm pays the amounts specified in the Nova Scotia Wind Farm Tax Act annually to West Hants (over $1million paid to-date) and $10,000 annually to the Ellershouse Wind Farm Society ($80,000 to-date). AREA's donations to the Ellershouse Wind Farm Society have provided new playground equipment, sponsored summer camps, sponsored skating sessions and provided donations towards the Brooklyn District Elementary School, West Hants Middle School and Avon View High School to support their breakfast and lunch programs. When the community needed a kitchen upgrade, AREA joined West Hants and donated the necessary funding to ensure implementation of the required components.

AREA's renewable energy from the Ellershouse Wind Farm enabled our towns to uniquely achieve compliance with Nova Scotia's 2020 40% Renewable Electricity Standard.

In addition to operating the existing Ellershouse Wind Farm, AREA is also a development partner to Ellershouse 3 Wind LP, an affiliate of the Annapolis Valley First Nation and Potential Renewables Inc., on the proposed Ellershouse 3 Wind Project. We need this project to ensure that our associated municipal electric utilities achieve the designation as Canada's first net zero carbon communities and we have Federal funding available that relies on that narrative. AREA has significant experience as a responsible developer, owner and operator of wind energy projects in West Hants. AREA is concerned about proposed setback distances which would significantly limit or even eliminate future development of wind energy in the municipality. Ellershouse has seen firsthand the benefits of wind energy projects in the local community. While AREA recognizes the importance of responsible project planning, it is our position and our experience that wind projects are being responsibly developed and operated using the existing municipal and provincial siting requirements.

Additional restrictions on wind energy development in West Hants would limit future tax revenue from these projects to the municipality, potential funding to community initiatives (such as provided by the Ellershouse Wind Farm Society), rural economic development and employment opportunities, lease payments while impacting future greenhouse gas reductions.

AREA successfully integrated the wind farm into the community by establishing a Community Liaison Committee at the earliest outset. We conducted citizen tours of neighbouring wind energy facilities, and went to every length to address community concerns related to what was then a new and significant development. West Hants has a great history of citizen action, coming together to resolve differences and achieve great things, as exemplified by your consolidation. The same can be achieved with regards to the development of renewable energy facilities by maintaining your existing comprehensive development agreement review process, establishing community liaison committees, and using other well-tuned processes without industry-threatening setbacks. The strong relationship among AREA, including its owner towns of Antigonish, Berwick, and Mahone Bay, with the Regional Municipality of West Hants and the community of Ellershouse, is evidence of a successful process. I have been working on this project since its inception, and to my knowledge, the Ellershouse Wind Farm has never received a complaint from the community since operations started January 2016.

AREA supports West Hants Regional Municipality in maintaining current setback distance practices from wind turbines to dwellings in recognition of the significant benefits wind energy projects bring to the local community. Should you have any questions, or should you wish to set up a call, I would be pleased to discuss this matter further.

Regards,

Aaron Long, P. Eng., General Manager
Email: aaron.long@municipalenergy.ca
Phone: [redacted]

April 15, 2024
From: Andrea Lynn
To: Sara Poirier

If there are to be any more windmills in Hants West, they should be for the energy use of the people in the windmill construction area, not for the business purposes of a private company.

Setbacks then would be decided by residents living near to the said wind farm and might vary depending on topography, site lines, lot sizes etc.

Setback should be from the lot line of greatest distance from the primary dwelling, not the dwelling itself. 2 km should be the minimum setback but 4 km preferred.

The type of geology in Upper Vaughans proposed for the Everwind Mill Farm is simply not conducive to health or safety.

Sincerely
Andrea Lynn
Upper Vaughan

April 15, 2024
From: David Blanchard
To: Sara Poirier
Attachments: Letter RE: Ellershouse Windfarm Sponsorship Society

To: Sara Poirier, Director of Planning and Development
West Hants Regional Municipality
76 Morison Drive, PO Box 3000
Windsor, Nova Scotia B0N 2T0

From: Ellershouse Windfarm Sponsorship Society and Community Liaison Committee

Dear Sara,

In the attachment, you will find a letter in opposition of the proposed 4 km setback from wind turbines to dwellings.

Please consider our information as to why this distance is not necessary when making your decision.

Thanking you in advance,

David Blanchard,
President of Ellershouse Windfarm Sponsorship Society And Community Liaison Committee

Ellershouse Windfarm Sponsorship Society

[redacted]

To: West Hants Regional Municipality
Attention: Sara Poirier, Director of Planning and Development

We, the Ellershouse Windfarm Sponsorship Society and Community Liaison Committee, are writing to oppose the proposal of the 4 km setback from wind turbines to dwellings that is being looked at by Council.

We have had Ellershouse Wind Farm in our community since 2016. Since then, we have not experienced negative results from this Farm. Once the turbines were in place, the wildlife – deer, bear, coyote, fishers, etc. have all been seen in and around the turbines and our area. Bird and bat population continue to be present in the area. To our knowledge, there have been no health issues. At the time our Farm was being built, a parent who had a son who experienced seizures contacted the specialist and he said that the student would have more issues with noise at a school dance than noise from turbines. There was more traffic while the turbines were being built. However, this would be the same with any building project of this size. During strong winds, the turbines may make more noise; but, the rain beating on the metal roof makes a lot of noise too. Also, 4 wheelers traveling within the area are much noisier than turbines. We hear the roar of tires from 18 wheelers and vehicles on Hwy.# 101 much more frequently than we hear the turbines. Homes within our area continue to sell. As for the turbines ruining the skyline, it is a love/hate situation. Many people like them, find it relaxing to watch the blades rotating and some have said that they use them as a landmark as to their distance from Halifax. Others complain.

The turbines being 1 km away from dwellings does not appear to disturb our lives.

Thanking you in advance for considering our opposition to the proposal of the 4 km setback from wind turbines to dwellings.

David S Blanchard

David S Blanchard
President of Ellershouse Windfarm Sponsorship Society and Community Liaison Committee

April 15, 2024
From: Chris Ollson
To: Sara Poirier, Mark Fredericks
Attachments: Letter RE: Large-scale Wind Turbine Setback Review - WHMPS/WHLUB Amendments – Additional Information from OEHM

Ms. Poirier,

Please find attached a memo that provides additional information to you and planning staff on the proposed by-law amendment for wind turbines.

Please don't hesitate to contact me if you have any questions.

Sincerely,

Chris

--

Christopher Ollson, Ph.D.

Senior Environmental Health Scientist

Ollson Environmental Health Management

OLLSON
Environmental Health Management

April 15, 2024

Sarah Poirier
Planner
West Hants Regional Municipality
P.O. Box 3000
Windsor, NS B0N 2T0

Re: Large-scale Wind Turbine Setback Review - WHMPS/WHLUB Amendments – Additional Information from OEHM

Ms. Poirier,

Ollson Environmental Health Management (OEHM) is pleased to provide this supplemental information to my report dated March 28th, 2024 with regards to the large-scale wind turbine setback review.

In our meeting on April 2nd, you requested additional information on the Health Canada Wind Turbine Noise study. The summary of the study and their findings can be found at https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/everyday-things-emit-radiation/wind-turbine-noise/wind-turbine-noise-health-study-summary-results.html
In addition, I have attached the list of the peer-reviewed published papers released by Health Canada to this letter. All are open access and can be downloaded for free. It is the published papers that provide the detailed findings of their work.

As discussed, one can find “articles” that are either available on the internet or “published” in non-indexed journals that purport to claim health effects of living in proximity to wind turbines and suggest excessive setbacks or lower than required sound limits to protect health. However, the weight of peer-reviewed scientific evidence on living in proximity to wind turbines overwhelmingly demonstrates that sound levels of <40 dBA at homes and a setback of <1 km to non-participating homes is more than sufficient to protect public health and safety.

In our meeting, I mentioned that over the past decade there are other Provincial/State jurisdictions have undertaken extensive review of the peer-reviewed science to formulate opinions on appropriate setbacks for wind projects. For example, the Alberta Utilities Commission has held numerous hearings for wind projects over the past decade and has heard considerable evidence from experts on both sides of the argument. The same is true for the Public Services Commission of New York state.

After a decade of public hearings, the New York Office of Renewable Energy Siting (ORES) published siting requirements for large wind turbines on March 3, 2021 *Chapter XVIII, Title 19 of NYCRR Part 900 Office of Renewable Energy Siting Subpart 900-1*. https://ores.ny.gov/system/files/documents/2021/03/chapter-xviii-title-19-of-nycrr-part-900-subparts-900-1-through-900-15.pdf
The pertinent requirements are:

- A maximum noise limit of forty-five (45) dBA Leq (8-hour), at the outside of any existing non-participating residence, and fifty-five (55) dBA Leq (8-hour) at the outside of any existing participating residence

- Setback distances for a 200 m turbine to tip height of 220 m to non-partipating property lines of 220 m and 400 m from non-participating homes.

Table 1: Setback Requirements for Wind Turbine Towers

Structure type	Wind Turbine Towers setback*
Substation	1.5 times
Any Above-ground Bulk Electric System**	1.5 times
Gas Wells (unless waived by landowner and gas well operator)	1.1 times
Public Roads	1.1 times
Property Lines	1.1 times
Non-participating, non-residential Structures	1.5 times
Non-participating Residences	2 times
*1.0 times Wind Turbine Towers setback is equal to the Total Height of the Wind Facility (at the maximum blade tip height). **Operated at 100 kV or higher, and as defined by North American Electric Reliability Corporation Bulk Electric System Definition Reference Document Version 3, August 2018 (see section 900-15.1(e)(1)(i) of this Part)	

I have testified in numerous Alberta Utilities Commission (AUC) hearings since 2013 with respect to permitting wind projects. These hearings have involved review of AUC Noise Rule 012 that mandates a 40 dBA cumulative sound level at residents (aligned with the NSECC sound requirements), shadow flicker of no more than 30 hours a year and setback distances of 1 km set by local counties to ensure the protection of public health and safety. The following is an example of an AUC finding for the Halkirk 2 Wind Power Project AUC Decision 27691-D01-2022 (July 27, 2023), and is consistent with findings in other decisions that can be found on the AUC website:

> *202. The Commission accepts Dr. Ollson's evidence and finds that the project is not likely to exacerbate the pre-existing health conditions identified by the interveners. Further, in the original decision, the Commission was not persuaded that the project was likely to cause adverse health effects for nearby residents. In this proceeding, the Commission accepts Capital Power's submission that in light of compliance with Rule 012 and the application of reasonable setbacks and mitigations, the noise and shadow flicker effects of the amended project are acceptable and within ranges that are consistent with the protection of human health.*

Closure

OEHM appreciates that setting municipal setback distances to wind turbines can be a challenging undertaking. I would encourage staff to take into account the findings of scientists around the world and review of available information by other Provincial/State jurisdictions. Dr. Ollson believes that this additional information continues to support my previous finding that:

> *OEHM recommends that West Hants Regional Municipality adopt into their By-law their previously established practice of using a 1 km setback to dwellings and 550 m to woods camps for existing projects. This is more than sufficient to ensure the protection of the public health and safety of their residents. In fact, a lesser setback between 550 m to 1 km would be equally protective of public health and safety. There is no scientific basis to increase these setbacks. It would afford no additional protection of public health and safety and would unduly restrict areas for development.*

If you require any further details or clarification please do not hesitate to contact me.

Sincerely,
OLLSON ENVIRONMENTAL HEALTH MANAGEMENT

Christopher Ollson, PhD
Ollson Environmental Health Management

Health Canada Peer Reviewed Published Papers from the Wind Turbine Noise Study

2013	**Michaud, D. S**., Keith, S. E., Feder, K., et al. (2013). "Self-reported and objectively measured health indicators among a sample of Canadians living within the vicinity of industrial wind turbines: Social survey and sound level modeling methodology," *Noise News Int*. 21(4):122-131	DOI: 10.3397/1.37023117
2015	Feder, K., **Michaud, D.S**., Keith, S.E., Voicescu, S.A., Marro, L., et al. An assessment of quality of life using the WHOQOL-BREF among participants living in the vicinity of wind turbines. *Environ. Res.* 142:227-238	DOI:10.1016/j.envres.2015.06.043
2016	**Keith, S., et al.** Wind turbine sound power measurements. JASA	doi.org/10.1121/1.4942405
2016	**Keith, S. et al.** Wind turbine sound pressure level calculations at dwellings **JASA**	doi.org/10.1121/1.4942404
2016	**Michaud, D.S**., Feder, K., Keith, S.E., Voicescu, S.A., Marro, L., et al. Effects of wind turbine noise on self-reported and objective measures of sleep. *Sleep* 39(1):97-109	DOI:10.5665/sleep.5326
2016	**Michaud, D.S**., Feder, K., Keith, S.E., Voicescu, S.A., Marro, L., et al. Exposure to wind turbine noise: Perceptual responses and reported health effects. *J. Acoust. Soc. Am.*, 139(3): 1443-1454	DOI:10.1121/1.4942391
2016	**Michaud, D.S**., Keith, S.E., Feder, K., Voicescu, S.A., Marro, L., et al. Personal and situational variables associated with wind turbine noise annoyance. *J. Acoust. Soc. Am.*, 139(3):1455-1466	DOI:10.1121/1.4942390
2016	**Michaud, D.S**., Feder, K., Keith, S.E., Voicescu, S.A., Marro, L., et al. Self-reported and measured stress related responses associated with exposure to wind turbine noise. *J. Acoust. Soc. Am.*, 139(3):1467-1479	DOI:10.1121/1.4942402
2016	Voicescu, S.A., **Michaud, D.S**., Feder, K., Marro, L., et al. Estimating annoyance to calculated wind turbine shadow flicker is improved when variables associated with wind turbine noise exposure are considered. *J. Acoust. Soc. Am.*, 139(3):1480-1492	DOI: 10.1121/1.4942403
2018	**Michaud, D.S**, Guay, M., Marro, L., Than, J. Response to: "using residential proximity to wind turbines as an alternative exposure measure to	**DOI:** 10.1121/1.5047437

	investigate the association between wind turbines and human health," by Barry, Sulsky, Kreiger (2018) J. Acoust. Soc. Am. 143 (6), 3278-3282. *J. Acoust. Soc. Am.* 144(1):330-331.	
2018	**Michaud, D.S**, Marro, L., McNamee, J. Derivation and application of a composite annoyance reaction construct based on multiple wind turbine features. *Can J. Public Health*109(2):242-251.	DOI: 10.17269/s41997-018-0040-y
2018	**Michaud, D.S**, Marro, L., McNamee, J. The association between self-reported and objective measures of health and aggregate annoyance scores toward wind turbine installations. *Can J. Public Health* 109(2):252-260.	DOI: 10.17269/s41997-018-0041-x
2018	**Michaud, D.S,** Feder, K., Voicescu, S., Marro, L., et al. Clarifications on the design and interpretation of conclusions from Health Canada's study on wind turbine noise and health.*Acoustics Australia* 46:99-110	DOI:10.1121/1.5047437
2018	**Keith, S. et al.** Wind turbine low frequency and infrasound propagation and sound pressure level calculations at dwellings **JASA**	doi.org/10.1121/1.5051331
2019	Keith, SE, **Michaud, D.S**., Feder, KP., Soukhovtsev, V., et al. Wind turbine audibility calculations inside dwellings. *J. Acoust. Soc. Am.* 145(4):2435-2444.	**DOI:** 10.1121/1.5098776
2021	**Michaud, DS**, et al Sleep actigraphy time-synchronized with wind turbine output *SLEEP*, zsab070	**https://doi.org/10.1093/sleep/zsab070**

April 15, 2024
From: Dennis Hartt
To: Sara Poirier

Good Day,

I am emailing my concerns about the current regulations and By-laws for Windmill distances from residential areas. As a resident and a business operator in Vaughan I am upset with the new proposed Bear Lake development. These Windmills will be viewed by most properties in the Vaughan area changing the beauty of this land forever. I fell that they should be made to move these further away from the developed properties. The only reasons that this is not happening is the By-Laws in place, and the cost to the developer to do so.

Thank You for your time and consideration.

Sincerely
Dennis Hartt
Vaughan

April 15, 2024
From: Graham Sanford
To: Sara Poirier

Hi Sarah.

My opinion, for the record, is 2km from property lines, not dwellings.

Best regards,
Graham Sanford
Hants Border

April 15, 2024
From: Julia Cushing
To: Sara Poirier, Mark Fredericks
Attachments: Letter RE: West Hants' proposed by-law amendment 4km wind turbine setback distance to dwellings

Good afternoon Sara and Mark,

Please find attached Potentia Renewables Inc.'s comments on the proposed amendments to wind turbines setback distances in West Hants.

Please let us know if you have any questions or if you'd like to discuss.

Regards,
Julia

Julia Cushing
Director, Development & Origination
Potentia Renewables Inc.

Potentia

200 Wellington St. W, Suite 1102
Toronto, ON M5V 3C7
potentiarenewables.com

April 16, 2024

Sara Poirier, Director of Planning and Development
West Hants Regional Municipality
76 Morison Drive, PO Box 3000
Windsor, Nova Scotia, B0N 2T0

Via Email: Spoirier@westhants.ca

RE: West Hants' proposed by-law amendment 4km wind turbine setback distance to dwellings

Dear Ms. Poirier,

Thank you for the opportunity to provide comments on West Hants' proposed by-law amendment to a 4 km setback distance for wind turbines to dwellings.

Potentia Renewables Inc. ("Potentia"), is a 100% Canadian owned renewable energy developer and operator that owns or manages more than 1,300 MW of wind and solar projects in operation in North America. With an investor committed to our long-term success, combined with the industry-leading experience of our team, Potentia is a prominent renewable energy provider in Canada that is ideally positioned for continued substantial growth.

Potentia currently owns and operates 44 MWs of wind in Nova Scotia and has submitted a development permit to West Hants for the Ellershouse 3 Wind Project. The Ellershouse 3 facility is being developed by an affiliate of Potentia and our partners, the Annapolis Valley First Nation, who are the majority owners of the project. The power from the project will be sold to the Alternative Resource Energy Authority ("AREA"). In addition to Potentia's operating assets and the Ellershouse 3 project, Potentia is also developing one additional project in West Hants, the Ellershouse 4 Wind Project in close proximity to Ellershouse 3, which Potentia is seeking to bid into the Province's Green Choice Program.

Over the last twenty years many academics, consultants and government agencies have studied the impacts of wind turbines on human health and there is no evidence to suggest that properly sited wind projects negatively impact public health and safety. According to the report and presentation from Ollson Environmental Health Management ("OEHM") (April 2024) commissioned by Bear Lake Wind, setback distances greater than 1km are not necessary for protecting human health and safety. In fact, research findings indicate the following to be protective of human health and safety:

- sound levels below 45 dBA
- shadow flicker under 30 hours a year
- setbacks of 1.1x tip height to roads, non-participating property lines and transmission lines
- setbacks of 2-3x tip height to non-participating dwellings

In addition, the Nova Scotia Department of Environment and Climate Change has an established a cumulative sound limit of 40 dBA at dwellings. This includes ambient sound and wind turbine noise. This is one of the most stringent sound standards in the world and will adequately protect human health in the province. Potentia has numerous wind projects operating across Canada that meet these stringent limits.

The current West Hants Land Use By-Law ("WHLUB") does not specify a setback distance from large wind turbines to dwellings. However, as detailed in the Planning Staff report *"all approved development agreements for wind farms within WHRM require a minimum setback of 1,000 m (3,280.84 ft) from the base of the tower to any dwelling, hotel, motel, or apartment hotel existing as of the date of the agreement, and a minimum setback of 550 m (1,8046 ft.) from the base of the tower to any woods camps existing as of the date of the agreement."* While Potentia maintains that a setback of 550 m is sufficient and encourages West Hants to adopt that as its setback, we also understand the precedent in previous development agreements is for a 1,000 meter setback from dwellings. Potentia can support the recommendation from OEHM (April 2024) commissioned by Bear Lake Wind for a setback of 1,000 metres; however, we are firmly opposed to anything further than a 1 km setback to dwellings. A setback of 4 kilometers would be the most stringent setback in North America with no scientific evidence to support that it will better protect human health and safety.

Further, a 4 kilometer setback in West Hants, and anything over 1 km, will effectively ensure there is no further wind development in the municipality and will ultimately deprive the community of the many economic and social benefits associated with wind facilities including:

- **Job Creation**: The development, construction, and operation of wind facilities generate well-paying local jobs. This includes positions directly related to the wind sector, such as engineers, technicians, and maintenance workers, as well as indirect jobs in supporting industries like construction, transportation, and the local service industry.
- **Local Revenue**: Wind projects provide local governments with additional revenue through property taxes and community benefits or other agreements. This revenue can be used to support public services that benefit the whole community.
- **Lease Payments**: Landowners hosting wind turbines or those within the project area also receive lease payments, which can provide a steady income stream. While not directly relevant to West Hants, these payments can be particularly beneficial for farmers and ranchers, offering a financial cushion that does not depend on crop yields or market prices.
- **Economic Diversification**: By adding wind energy to the local economy, communities can diversify their income sources, which makes them less vulnerable to economic fluctuations.
- **Energy Independence**: Wind energy contributes to national and local energy independence by reducing dependence on imported fuels. This can enhance energy security and stability in energy prices. Wind is also the lowest cost generation available.
- **Infrastructure Improvements**: The development of wind facilities can lead to upgrades in local infrastructure, including roads and bridges, which are needed during the construction phase but remain for community use afterward.

At the Public Information Meeting on April 2nd, many community members raised concerns about the impact of wind facilities on local wildlife and biodiversity. In fact, wind facilities require relatively little land to generate a significant amount of energy, preserving land for agriculture and wildlife. Moreover, the impact on the land is largely reversible, making it possible to restore sites to their original state if necessary. It should also be noted that wind energy projects, such as those proposed in West Hants, must go through a stringent provincial environmental assessment process. Any project submitting an application for a development agreement in West Hants, must also submit an environmental

assessment approval letter from the province, meaning environmental impacts (such as those raised regarding local wildlife and biodiversity) have already been evaluated and addressed through the existing provincial processes prior to seeking municipal planning approval.

Many municipalities have grappled with siting renewable energy within its boundaries, often in reaction to pressure from a few members of the local community who are unsure about the impact these facilities will have on individuals and the community as a whole. Potentia understands that community members have concerns, and we will work with Council, municipal staff, and community members in an open and transparent manner to answer all questions related to the siting and operation of its wind projects. We know our host communities are the heart of our company; we would not be able to do what we do without our municipal partners. We are committed to being good neighbours and to being part of the community over the long term.

Do not hesitate to reach out if you have any questions regarding our submission.

Sincerely,

Julia Cushing

Julia Cushing
Director, Development and Origination
Potentia Renewables Inc.

April 15, 2024
From: Lawrence Hart
To: Sara Poirier

Hello S Poirier, about the set backs I feel 4km is the least they can be, reports from the last turbine fire in NS parts of the propellers were flung thousands of feet , at the Hammonds Plains fire last summer fire fighters found burning embers were air borne up to https://urldefense.proofpoint.com/v2/url?u=http-3A__5km.In&d=DwIFAg&c=euGZstcaTDllvimEN8b7jXrwqOf-v5A_CdpgnVfiiMM&r=Uti-M7TLr3Z7cqp3O0uCkgRzVRGTxnP3GPb8E79zwls&m=naoJ5ota54WwaeFvBUOPmd9-p_V84ZbNAi1fiSHEzl5ULY8lKkVFi3DIccw8_QfA&s=-ByG4yQgrvxoIcOknvITBq_thWFUqtyF2_m9HnBCxtI&e= a dry time a forest up on that ridge could wipe out the village of upper Vaughan . Fire fighters can not get close to these machines when on fire because of the hot debris coming of the propellers

Thank you
L Hart

April 15, 2024
From: Mark Kehoe
To: Sara Poirier

Hello Sara, just a quick email to add to the public feedback. I own a home, a cottage and a woods camp in Upper Vaughen. I feel very strongly the municipality should be adjusting greater setback bylaws with Large Scale Wind Farms. As you are aware, Upper Vaughan is becoming surrounded by wind farms. If Bear Lake is approved, I believe 44% of Upper Vaughans, Upper Falmouth and Mill Section will be designated Wind Farm. This doesn't include South Canoe Wind farm that borders us on the Lunenburg county line. It's too much and doesn't fit our rural community, cottage country image.

When I reviewed the MGA, its direction was to create municipal planning for large windmills 165 to 400 feet in height. The windmills Bear Lake and Everwind plan to construct are 207m....677 feet. These are much taller and should be required to have a greater set back then 1km. I feel a 2km set back would be reasonable and appropriate.

I should mention, Everwind is offering a proximity payment for dwellings within 1.5kms. In essence, they are acknowledging there's issues greater than 1km.

I also feel "camps" on private property should also be considered dwellings. They are when it comes to provincial regulations like hunting. I own a camp that borders this proposal and if this is approved it will diminish our enjoyment of using our cabin.

Also, I strongly feel setbacks should be considered from property lines, not the dwelling itself. Property owners may want to develop or build homes on their own property and they shouldn't have to do it in the shadow of a 677 foot windmill. It would also decrease their property values for development.

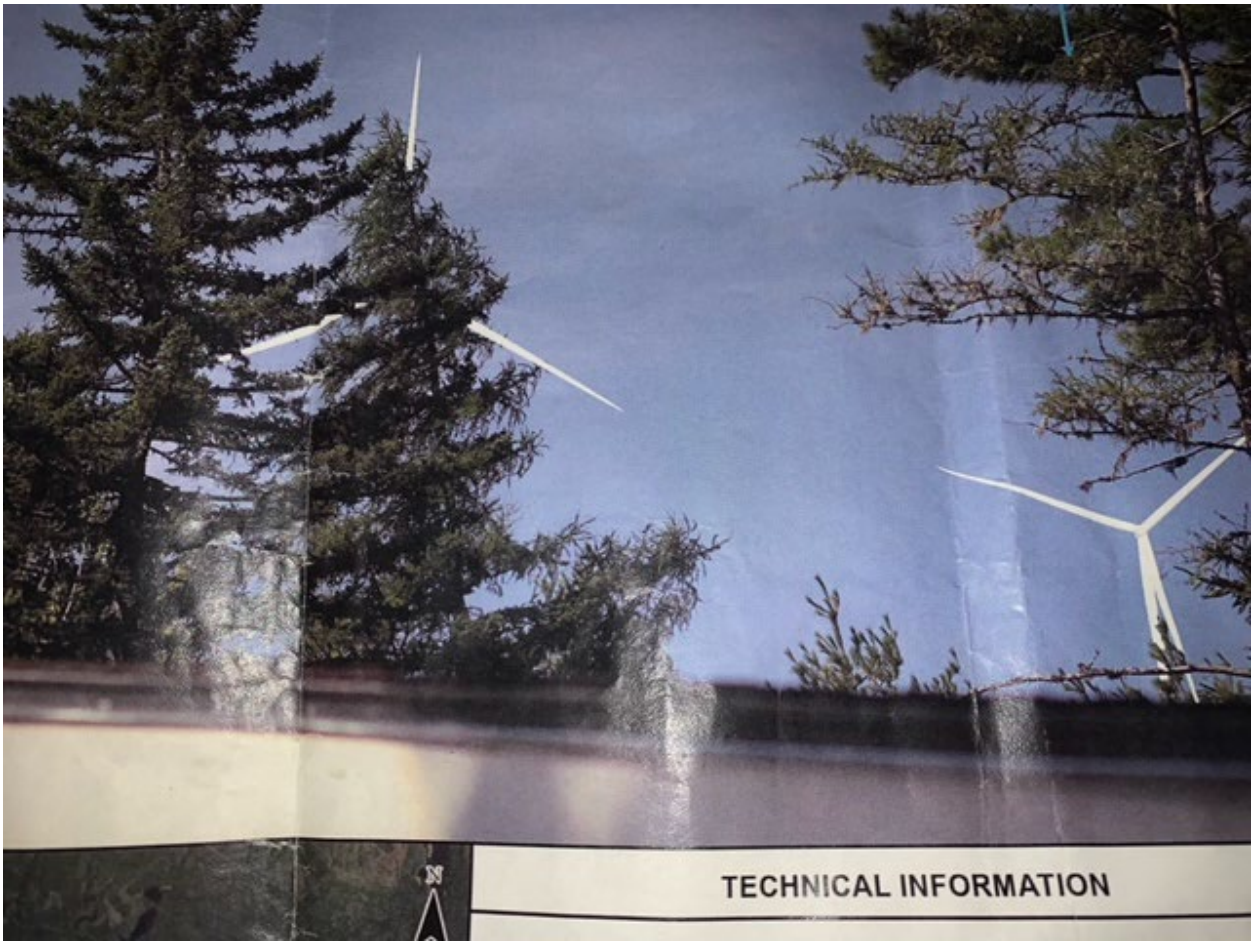
Thanks
Mark Kehoe
Upper Vaughan
--
Mark Kehoe
Account Manager
JC Bakker & Sons Ltd

April 15, 2024
From: Monique Wood
To: Sara Poirier

Windfarms should be set back 4 km from properties
--
Monique Wood

April 15, 2024
From: Nancy Durnford
To: Sara Poirier

I am sending this email to submit my opinion that all setbacks for wind farms should be 4 kilometres from any dwelling. The proposed wind farm at Bear Lake will put turbines within 1.45 kilometres from my home as can be seen from the attached photo. No one should have these huge turbines looking down on top of you while trying to enjoy your deck. Thank you for taking my concerns in this matter. Nancy Durnford



April 15, 2024
From: Seamus Marriott
To: Sara Poirier

Dear Ms. Poirier,
I would like to address the question of windmill setback looking at both the height of the windmills in the Bear Lake project and the proposed setback by the proponents.

There is no question that the windmills to be constructed for the Bear Lake Project will be the largest ever used in West Hants. The Municipal Planning Strategy addresses the question of setback for windmills 165' to 400', but there is no reference to windmills of 206m/677', which will be constructed with the Everwind project.Given the sheer size of these giant structures there is a definite need to develop greater setback requirements.

At present, many jurisdictions—particularly those with a long history of using wind turbines—are adopting greater setbacks for health and safety given the increasing size of wind turbines. In

Bavaria, Germany, for example, setbacks from residences are 10 times the height of the turbine which is equivalent to more than 2,000 metres or 2 kilometres. A bill by the House of Lords in England, outlining setback requirements for varying windmill heights states: If the height of a windmill turbine is greater than 150m, the minimum setback distance required is 3000m. In Scotland the setback is 2km while in Poland the setback requirement is 10times the tip height of the turbine. In its new zoning bylaw, the Ontario municipality of Dutton-Dunwich implemented a setback of 2,000 metres.

Pacific Northwest National Laboratory is one of the United States Department of Energy national laboratories, managed by the US Department of Energy's Office of Science. PNNL states that turbines higher than 200Mrequire setback distances of more than 2000M. In some cases, even larger distances are recommended for sites with migratory birds.

In addition to set back distance the municipality also needs to consider the point of setback. An established setback from a neighbouring dwelling will protect residents within the dwelling from the unwanted impacts of wind turbines (e.g. noise) while an established setback from the property line will protect neighbouring properties in their entirety – thus for example, allowing neighbouring properties full liberty in building new structures anywhere on their site without having to worry about impacts of the wind turbines on any such new structures.

To fully protect the health, welfare and property rights of the residents of Upper Vaughan and others within West Hants, should future projects be proposed, WHRM must demand changes to the Everwind proposal. A minimum set back of 2km from these giant turbines is required and this setback must be from property lines and not from people's homes.

Regards,
Seamus Marriott
Upper Vaughan

April 15, 2024
From: Stephen and Vanessa Rafuse
To: Sara Poirier

Hi Sara,
As homeowners that will visually see 8 of these turbines from our front deck, we do NOT welcome the purposed Bear Lake Wind Power project!!!! Our home, being the 4th generation farmer, the place we have grown up in and raised our family in feels lately like it is of no importance to these major projects that wish to take away our backyard, sort of speak. Our community has given enough towards a greener tomorrow, and very little to nothing to show for its sacrifice. Our home is [redacted] as visible on the attached map, upper right portion and

we own shares in a family piece of land labeled lot, that is adjacent to the property line that of the project. If it is a go ahead, that land will be deemed worthless and useless to us and future generations. The 1km setback is ridiculous from a dwelling. As most in this area having land proceeding towards the purposed project property line. This setback should be declared from the back property line and then even considered at a larger distance than that of 1 km. The words have been said that you can not create more land once ours is all gone. We need to save and protect what we do have around us for the future to come. Allowing strangers to come in to our neighborhood to set up construction of a project that we the community, province nor country is going to benefit from, is puzzling why our Municipality would even consider. If the small portion of tax return over the 35 years is what weavers the decision, well we would understand that our Municipality has a blind eye to that of the residents of the affected areas. And the kicker, upon dismantle, we the tax payers are going to have to pay towards removing something we never wanted in the first place. The one thing that Everwind does not know because they know no history of this area is the way that the water feeds from our high elevation to the water resources between Upper Vaughan clear into the Dykes and on in to Windsor. The blasting alone can leave many of people without a water supply from the many of natural spring that feed our wells. The disruption from the blasting I don't even want to think of its impact on the older/weaker foundations of the older homes in the area. Ours being one that is considered to be over 140 years old. We don't have a fund set aside for these kinds of repairs and no clear definite answer was giving from Everwind as to who will carry the responsibility of such damages. They seem to have painted a pretty picture and make us believe that we need to ...again... sacrifice our community/land to help with making the world a greener place. Well take it else where as I'm sure there are less invasive places that this project would be more suited. We are over populated with turbines in our area and don't care for more!!! The council has listened to the plea/cries of the people of the community and everyone has beyond valid reasons why this project is NOT for OUR COMMUNITY!!

Thank you for reading our concerns,
Stephen and Vanessa Rafuse of Upper Vaughan

April 15, 2024
From: Tyler Maskell
To: Sara Poirier

Good afternoon, my name is Tyler Maskell, I am a resident of Vaughan and I am one of the homes that are extremely close to one of the windmills, I think that the setback should be at least to a property line not a dwelling. They are way to close for my liking and I already have south canoe on one side of me with a bright flashing red light I can see from my house, and now they want to put one right behind me, witch I will be Abel to see/hear all day and all night long. They said they will be putting the sensors in the lights to only blink red when a plane flys by but

they didn't take in to consideration that we are a flight path I hear plans going all day and all night so regardless I will have a BRIGHT red light flashing in my windows at night and probably won't be able to sleep with the constant noise where I am a light sleeper and wake of from the smallest noise. to conclude I think it is only fair that these windmills get set back or set to a properly line not a dwelling.

Thank you for your time.
Tyler Maskell

April 16, 2024
From: Chris Rafuse
To: Sara Poirier

My name is Chris Rafuse I live in upper Vaughn I can hear sound of the windmills from south Canoe if these ones go in at 1 km at the bear lake wind project then I will have no peace and sound when the wind is blowing towards south canoe so I will be surrounded by if they do get put in place could they be around 4 km from us please that would be greatly appreciated.
Thank you for your time

April 16, 2024
From: Elizabeth Skelhorn
To: Sara Poirier

Good day,
Setback regulations are valuable for preserving the health and wellbeing of people and natural surroundings. As well, setbacks can promote commercial and industrial prosperity although it may seem counterintuitive. We have an agricultural history that places us also at the entrance to the Annapolis Valley (part of the Annapolis Valley). After all we have the oldest Agricultural Fair in North America!
Well thought out setbacks may prove to be essential to the effects of climate change changes, safety concerns and our future health and economics. Let's be smart about progress.
Wind farm set backs should be based on bordering property lines not existing structures. This allows for owners of property to build / expand for family housing and better use of residential properties(within reason).
I would prefer at least a2 km setback as a minimum and in some cases 4 km setback may be needed.
Thanks for the opportunity to give some feedback to the discussion.
Respectfully
Elizabeth Skelhorn

April 16, 2024
From: Ellen Hart
To: Sara Poirier
Attachments: Letter RE: Comments on set-back change

Hello,

Please find attached letter regarding set-back bylaws for wind farms

--
Ellen Hart

April 16, 2024
Re: Comments on set-back change

Hello:

Reaching out today to share my thoughts on the proposed set-back for the windfarms

Given the monstrous size of these turbines I believe a 1 km set-back will not suffice. There is not enough information to support a 1 km set-back in our rural communities. I am in agreement with residents suggesting the set-back be based on tower height. I am not sure what these larger set-back would look like. Some residents have suggested 1KM for 100-meter turbines, 2KM for 200-meter turbines and 3KM for turbines above 200 meters. I believe more discussion is warranted before proceeding with only a 1KM set-back.

Also, there needs to be a discussion as to where a set-back distance begins. Residents have voiced concerns over property use in the future, if the set-back is based on the location of their dwelling and not property lines. A set-back based only on location of residence is unacceptable. In Vaughans property size can be much larger than in more urban areas, with owners utilizing many areas of their property, not just the dwelling they reside in.

Please take into consideration that residents living in rural areas use their property for more than just dwelling. Many hunt, fish, forage and exercise across the expanse of their property. As such, how residents use their property should not be determined by a windfarm moving onto neighboring property. Set-back should be measured from the property line of the wind farm, leased or owned.

The set-back also needs to be considered for areas such as municipal parks, provincial parks, federal parks, areas for protected wildlife. I believe the potential harm to wildlife is not being addressed as it should be in these discussions.

Please consider these points

Sincerely,

Ellen Hart
[redacted]

April 16, 2024
From: Jessica Pitman
To: Sara Poirier
Attachments: Letter RE: File #24-10 WHMPS Amendments: Wind Farm Setback Review

Good morning Sara,

Please find attached our comments for the staff review of file #24-10 WHMPS Amendments: Wind farm setback review.

Please don't hesitate to reach out if you have any questions about our submission.

Best,

Jessica Pitman (she/her) | Project Developer

Natural Forces

1701 Hollis Street | Suite 1200 | Halifax, NS | B3J 3M8
t: +1 902 422-9663 | m: [redacted]
www.naturalforces.ca

1701 HOLLIS ST. SUITE 1200 HALIFAX, NS B3J 3M8 | (902) 422-9663 | NATURALFORCES.CA

To: Sara Poirier, Director of Planning, West Hants Regional Municipality
From: Meg Morris, Project Manager, Natural Forces
Re: File #24-10 WHMPS Amendments: Wind Farm Setback Review

April 16, 2024

Dear Director Poirier,

Please accept this letter and the attached memo as Natural Forces' submission in response to *File #24-10 WHMPS Amendments: Wind Farm Setback Review* wherein the West Hants Regional Municipal (WHRM) Council is considering amending the Municipal Planning Strategy to require utility-scale wind turbines to be setback up to 4 km from residences.

Natural Forces is an independent power producer based in Halifax with over 20 years of experience in wind project development in Atlantic Canada and additional experience across Canada, Ireland, and France. Natural Forces develops, constructs, owns, and operates renewable energy projects across these jurisdictions, largely with community partners. Within West Hants Regional Municipality, Natural Forces is developing the Benjamins Mill Wind Project, for the first phase of which we are partnered with the 13 Mi'kmaw bands in Nova Scotia. We have worked closely with staff and Council for this project and have an active development agreement in place to inform project design and execution. Therefore, Natural Forces offers an informed industry perspective on the permitting process and responsible wind project development in this area.

Given our breadth of experience in wind project development, Natural Forces believes the 1 km setback for utility-scale wind turbines from residences that has been precedented in WHRM through past development agreements is more than sufficient in mitigating or eliminating potential impacts alongside the provincial Environmental Assessment process. The attached memo provides additional detail and evidence in support of this position.

A setback requirement larger than 1 km would significantly impede upon, or prevent, future wind development in WHRM. Wind energy development will play a crucial role in the clean energy transition in Nova Scotia. This development must be done responsibly to address the real potential impacts to nearby residents. However, policy requirements that are too strict and not based in tangible potential impacts run the risk of leaving WHRM out of this important industry aimed at fighting the climate crisis

If WHRM Council or staff have any questions, please do not hesitate to contact us.

1701 HOLLIS ST. SUITE 1200 HALIFAX, NS B3J 3M8 | (902) 422-9663 | NATURALFORCES.CA

Natural Forces appreciates this opportunity to participate in this review process to work towards continuing to responsibly develop wind energy projects in WHRM. We thank you for your time to review our comments and welcome future discussions on this topic.

Sincerely,

Meg Morris
Project Manager
Natural Forces

By: Natural Forces
For: Sara Poirier, Director of Planning
Date: April 16, 2024
Re: File #24-10 WHMPS Amendments: Wind Farm Setback Review

This memo is in response to *File #24-10 WHMPS Amendments: Wind Farm Setback Review* in which the West Hants Regional Municipal (WHRM) Council is considering amending the Municipal Planning Strategy (MPS) to require utility-scale wind turbines be setback up to 4 km from residences. Currently, wind turbines are regulated under the MPS by development agreement, which allows the residential setback requirement to be set on a case-by-case basis. This memo has been written to address concerns raised by the public with respect to residence setbacks and to provide evidence for why the 1 km setback for utility-scale wind turbines from residences that has been precedented in WHRM through past development agreements is sufficient in mitigating or eliminating potential impacts.

This memo represents the viewpoint of Natural Forces, an independent power producer that develops, constructs, owns, and operates wind projects across Canada. Natural Forces is based in Halifax and is the development partner for the Benjamins Mill Wind Project in WHRM. As such, Natural Forces offers a local industry perspective to consider during the review process.

The WHRM Council is an active supporter of the fight against climate change, which is codified in the MPS through statements in Section 4.24 Wind Turbines such as it "wishes to encourage the use of technologies that reduce dependence on non-renewable resources and do not contribute to greenhouse gas emissions" and that it "wishes to facilitate the development of wind energy systems". These progressive policies alongside regulation of these projects through development agreement have led to several successful and responsibly developed wind energy projects in WHRM.

The local regulation of wind energy projects must be considered in the larger context of wind development in Nova Scotia at this time. Most immediately, the provincial Green Choice Program has been announced wherein the Province is procuring renewable energy for the Nova Scotia Power grid in order to reach their target of 80% renewable energy on the grid by 2030. The electricity generated by these new projects will largely offset the retirement of coal plants in Nova Scotia, which is critical to the fight against climate change. Nova Scotia generally and WHRM specifically, have experienced the real impacts of climate change over the past couple years with more extreme weather events. The only way to mitigate these impacts in the future is to take action today to significantly reduce our emissions.

Wind energy technology is not new; rather, it is very well understood. The regulation of wind projects is important to ensure that development is carried out responsibly. Effective regulations are rooted in accurate information that addresses the need for renewable energy to combat the climate crisis, reflects the need for responsibly developed projects within communities, and mitigates real potential impacts. The three main potential impacts related

to wind turbine proximity to homes are related to sound levels, visual changes, and health impacts. These impacts are all addressed through the provincial Environmental Assessment (EA) process and are additionally addressed in the sections below and supported by the data sources in the final section.

Sound Levels

The main public concerns related to wind turbine sound levels are associated with wind project operation. Sound is generated by wind turbine operation in two ways: the blades cutting through the air and any mechanical components, such as a gearbox, operating.

As part of the provincial EA process in Nova Scotia, sound level modelling is required to show that maximum sound levels will always be less than 40 dB(A) at all nearby residences during project operation. The modelling must use industry proven and standard software and must also consider existing ambient sound levels in the project area. In rural areas of Nova Scotia, the ambient sound levels are, on average, estimated at 35 dB(A). This leaves a maximum addition of 5 dB(A) from a new wind energy project. The 40 dB(A) limit at residences is based on World Health Organization guidelines which identify this as the target level below which no health effects associated with sleep disturbance are expected to occur, even amongst the most vulnerable people.

The 40 dB(A) limit at residences is common in other jurisdictions outside Nova Scotia. As such, there are studies that confirm sound levels at nearby residences are consistently lower than 40 dB(A) when turbines are responsibly sited approximately 1 km from residences. It is also important to note that regardless of the setback distance, all projects must comply with the 40 dB(A) sound requirement in order to obtain provincial EA approval.

Visual Changes

The main public concerns related to wind turbine visual impacts are associated with wind project operation via shadow flicker and changes to the existing visual landscape.

As part of the provincial EA process in Nova Scotia, a full visual assessment is carried out. In particular, shadow flicker modelling is required to demonstrate that shadow flicker occurs less than 30 hr/yr with a maximum of 30 min/day at all nearby residences during project operation. The modelling must use industry proven and standard software. These shadow flicker limits at residences are based on internationally adopted guidelines. As such, the 30 hr/yr with a maximum of 30 min/day limits at residences is common in other jurisdictions outside Nova Scotia. Consequently, there are studies that confirm shadow flicker impacts on nearby residences is consistently lower than these limits when turbines are responsibly sited approximated 1 km from residences.

A more fulsome visual assessment is also carried out as part of the EA to assess changes to the existing visual landscape. While this impact cannot be avoided, the tangible impacts to humans are related to subjective opinion on appearance. In the end, these studies often show there is much less impact than anticipated by the community due to factors such as topography and tree cover.

Human Health and Safety

The main public concerns related to wind turbine health impacts on humans are associated with wind project operation. Largely, these concerns tend to be related to sound and visual impacts, which are addressed above. Other concerns brought up by the community on this topic are ice accumulation, fire safety, stormwater management, vehicle traffic, and blade failure. These are all addressed through the EA process and explained briefly below:

Blade Icing

Through the EA process, proponents must demonstrate that the project design will address the potential impacts of blade icing. Blade icing occurs under certain climatic conditions when ice accumulates on the wind turbine blades, which leads to the risk of ice falling from the blades when they are moving or stationary, often called 'ice throw'. Studies have shown that the highest risk of ice throw is within 1x turbine height of the turbine location, and that risk is well mitigated at distances beyond 1.4x turbine height. Most modern wind turbines have a total height to blade tip of approximately 200 m, meaning that the risk of ice through only extends to approximately 280 m from the turbine location.

Fire Safety

Through the EA process, proponents must demonstrate that the project design will address the potential impacts from fire. This typically includes details of how local emergency services will be engaged to ensure that, if a fire or other emergency were to occur, they would be able to respond quickly and appropriately. This engagement, through direct communication, site visits, and documentation, continues throughout the project life to ensure that the local emergency services keep their knowledge of site response fresh. Additionally, modern turbines typically have 24/7 remote monitoring during project operation. This means that any potential issues are identified immediately and can be communicated directly to emergency services to respond if need be.

Additional measures are implemented in the EA required Environmental Management and Protection Plan, which details mitigation measures for fire risk during construction activities.

Stormwater Management

Through the EA process, proponents must demonstrate that the project design will address the potential impacts from extreme storms, erosion, and floods. Most typically, this is addressed through a Surface Water Management Plan and a Stormwater Management Plan created by as part of the overall civil design work for the project. This planning considers the existing site conditions, how the project will change these conditions, and measures to control drainage and any associated erosion/sedimentation. Ultimately, this work informs the way the project is constructed to manage surface water with appropriate drainage channels and measures.

Blade Failure

The potential risks associated with blade failure are that a blade of a portion of a blade could fall from the turbine when moving or stationary. Studies have shown that the risk of material

throw from a blade failure is mitigated beyond 1.1x turbine height. Most modern wind turbines have a total height to blade tip of approximately 200 m, meaning that the risks associated with blade failure are limited to the area within 220 m of the turbine location.

As demonstrated above, all of these concerns are either not impacts related to setback from residences or are addressed well within a 1 km setback.

Property Values

The main public concerns related to wind turbines as they relate to property values are associated with wind project operation. The common concern is that close proximity to wind turbines will lower market property values.

This phenomenon has been studied many times and has consistently shown that property values are not meaningfully impacted by nearby wind projects. The studies referenced below collectively support the conclusion that setbacks beyond those required to mitigate tangible sound level and shadow flicker impacts at residences are not important to maintaining nearby property values.

Conclusion

Natural Forces believes that it is important for municipalities to have policy that encourages responsibly developed wind energy projects. These policies need to be rooted in addressing real potential impacts from this type of development. As demonstrated in the above sections, the existing precedented and industry standard 1 km setback from residences alongside the provincial EA requirements addresses the potential impacts to these nearby residents. The WHRM development agreement process further situates staff and Council to address the concerns related to each individual project.

WHRM is in a great position to participate in and benefit from the clean energy transition currently happening in Nova Scotia. Participating in this transition through supporting the development of wind energy projects brings along various benefits, which include:

- Property taxes paid to the municipal government as per the Wind Turbine Facilities Municipal Taxation Act;
- Job creation in the local area during project development and construction;
- Economic spinoff for local businesses during development, construction, and operation; and
- Reduction of greenhouse gas emissions in the province.

Natural Forces appreciates this opportunity to participate in the process for proposed amendments to the required setback from residences for utility-scale wind turbines in WHRM and looks forward to further discussions and participation.

References

Sound Levels Sources:

- Turku University of Applied Sciences (2021), *Health effects of wind turbine noise and road traffic noise on people living near wind turbines* https://www.sciencedirect.com/science/article/pii/S1364032121013022
- National Institute for Public Health and the Environment and Mundonovo Sound Research (2021), *Health Effects Related to Wind Turbine Sound: An Update* https://www.rivm.nl/bibliotheek/rapporten/2020-0150.pdf
- Berger R.G., Ashtiani P., Ollson C.A., Whitfield Aslund M., McCallum L.C., Leventhall G., Knopper L.D. (2015). *Health-based audible noise guidelines account for infrasound and low frequency noise produced by Wind Turbines.* Front Public Health. Vol 3, Art. 31. https://doi.org/10.3389/fpubh.2015.00031
    - Frontiers | Health-Based Audible Noise Guidelines Account for Infrasound and Low-Frequency Noise Produced by Wind Turbines (frontiersin.org)
- Various (2014), *Wind Turbines and Health: A Critical Review of Scientific Literature* https://journals.lww.com/joem/Fulltext/2014/11000/Wind_Turbines_and_Health___A_Critical_Review_of_the.9.aspx
- Health Canada (2014), *Wind Turbine Noise and Health Study* https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/everyday-things-emit-radiation/wind-turbine-noise/wind-turbine-noise-health-study-summary-results.html
    - Pamphlet: https://publications.gc.ca/collections/collection_2014/sc-hc/H129-46-2014-eng.pdf
- World Health Organization (WHO). Regional Office for Europe. (2009). *Night noise guidelines for Europe.* https://iris.who.int/handle/10665/326486
- Canadian Wind Energy Association (CanWea). (2007). Canadian Wind Energy Association Position on Setbacks for Large-Scale Wind Turbines in Rural Areas (MOE Class 3) in Ontario. https://www.gov.mb.ca/sd/environment_and_biodiversity/energy/pubs/cwea_position.pdf

Visual Changes Sources:

- Haac, R. Darlow, R., Kaliski, K., Rand, J. & Hoen, B. (2022). *In the shadow of wind energy: Predicting community exposure and annoyance to wind turbine shadow flicker in the United States.* Energy Research & Social Science. Vol 87. https://doi.org/10.1016/j.erss.2021.102471
- Koppen, E., Gunuru, M., & Chester, A. (2017). *International Legislation and Regulations for Wind Turbine Shadow Flicker Impact.* 7th International Conference on Wind Turbine Noise. Rotterdam. https://www.slideshare.net/ErikKoppen/wtn-2017-international-legislation-and-regulations-for-wind-turbine-shadow-flicker-impact
- World Bank Group. (2015). Environmental, Health and Safety Guidelines for Wind Energy. Pg 12. https://documents1.worldbank.org/curated/en/498831479463882556/pdf/110346-WP-FINAL-Aug-2015-Wind-Energy-EHS-Guideline-PUBLIC.pdf

Human Health & Safety Sources:

- Rogers, J, & Costello, M. (2022). *Methodology to assess wind turbine blade throw risk to vehicles on nearby roads.* Wind Engineering. 46(4):1187-1202. doi:10.1177/0309524X211072869
    - https://journals.sagepub.com/doi/10.1177/0309524X211072869
- Government of Nova Scotia. (2021). *Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia.* Policy Division. Environmental Assessment Branch. https://novascotia.ca/nse/ea/docs/EA.Guide-Proponents-WindPowerProjects.pdf

    - Guidelines to address the considerations made by the Environmental Assessment Branch when reviewing applications for wind projects.
- Krenn, A., Jordaens, P., Wadham-Gagnon, M., Davils, N., Clausen, N.-E., Lehtomäki, V., . . . Cattin, R. (2016). *Available Technologies for Wind Energy in Cold Climates.* Verein: IEA Wind Task 19. https://www.researchgate.net/publication/305881044_IEA_Wind_Task_19_-_Available_Technologies_report_of_Wind_Energy_in_Cold_Climates

Property Value Sources:

- University of Connecticut (2016), *Wind Turbines, Amenities and Disamenities: A Study of Home Value Impacts in Densely Populated Massachusetts* https://emp.lbl.gov/publications/wind-turbines-amenities-and
- University of Guelph (2014), *The Effects of Wind Turbines on Property Values in Ontario: Does Public Perception Match Empirical Evidence?* https://www.researchgate.net/publication/264725640_The_Effects_of_Wind_Turbines_on_Property_Values_in_Ontario_Does_Public_Perception_Match_Empirical_Evidence_Reply
- Canning Consultants Inc and John Simmons Realty Services Ltd. (2010), *Wind Energy Study – Effect on Real Estate Values in the Municipality of Chatham-Kent, Ontario* http://canada.wpd.de/fileadmin/pdfs/PropertyValuesConsultingReportFeb42010-Ontario.pdf
- Canadian Wind Energy Association (CanWea). (n.d.). Wind Facts: Property Values. https://www.northlandpower.com/en/resourcesGeneral/ProjectDocuments/Grand%20Bend/canwea-factsheet-property-v6.pdf
- Government of Nova Scotia. (n.d). *Wind Turbine Effects.* https://energy.novascotia.ca/sites/default/files/Wind%20Turbine%20Effects.pdf
    - https://energy.novascotia.ca/renewables/wind-energy

April 16, 2024
From: John Kennedy
To: Sara Poirier

Hello Ms. Poirier,
I am writing regarding the setback for wind farms. Living in Vaughans I am unfortunately familiar with them. I absolutely believe the set back should be at least 4 km. They are very distracting and disturbing. Imagine sitting in your back yard and trying to relax when all you see are giant turbines endlessly turning as you look for the calm and quiet of the blue sky. And this is something you have to live with from your home each and every day. Then, of course, you have the flashing red nights ruining the beauty of the night sky. I don't care what the experts say the "studies" show, or at least the Everwind experts, wind turbines are very upsetting visually.
Now the noise is something else again. One can certainly hear the deep thrum at 3 km. The sound is like a jet at height passing so that sometimes you find yourself looking to the sky when you hear it, only to see there is no jet, it is the trubine. But not only do you hear turbines, you feel their sound. The best analogy I can give is that it is similar to when a car passes by you and the boombox on the car stereo is up loud such that you not only hear the deep bass sound, you feel it as well as the car passes.

I know we need new forms of green energy but it is critical to take into account their impact on those who live near them.

Sincerely,
John Kennedy

April 16, 2024
From: Krista Hart
To: Sara Poirier

Good Morning Sara,

I am writing this morning concerning the setback bylaws for windfarms, while I don't usually respond to different matters that I read about or view on council meetings, I felt this one is very important. I feel that the current setback should be at least 2KM from property lines and not just a person's home. In Vaughn's and Upper Falmouth peoples properties are usually quite extensive and I don't feel that the proposed windmill farms should impact a persons enjoyment or benefit of there property.

Thank you,

Krista Hart
Life long West Hants Resident

April 16, 2024
From: Lacey King
To: Sara Poirier

Good morning Sarah,

As a resident of Lower Vaughan and the mother of a young family that hopes to grow old in this lovely community, I wanted to reach out regarding the wind farm amendments.

We have previously lived next to “one” operating wind turbine in Cape Breton. This turbine was just over 2 km from our home and again, it was only one. The turbine resulted in near constant swooshing sounds, especially noticeable at night. It got to the point that the children would notice at night when it was not working, because they became so accustomed to the pattern of shooshing sounds as their background noise. I do not wish to relive that experience. We moved to cottage country to experience peace and the sound of nature. Not constant man-made background noise.

The real estate agent also voiced buyer concern with the noise of the windmill and the fact it impeded the natural scenic views. The windmill resulted in lower resale value of our home.

I am a big believer in transitioning to green energy. But, I am also strongly opposed to having these windmills close to any homes. It is unfair to ruin a peaceful community with noise pollution and have people lose money on the sale of their home. These wind farms need to be at least 4km away from any residence. There is no reason we can’t have the best of both, being environmental conscious but also respecting the residents already living in the community.

Thank you for your time. I truly pray you make the necessary changes to keep everyone happy.

Kind regards,

Lacey Wheaton

April 16, 2024
From: Laura Hart
To: Sara Poirier

Good morning Sarah,

This is what I think is fair and should be considered for the windmill setbacks.

2.5kms from property lines.

People move to rural areas for quiet and peaceful experience where they can raise their families and often times have larger sized property to have their loved ones build houses on the property to keep them all close. An industrial complex such as these large industrial electrical generating devices should not impede on the safety, value and destiny of what an adjacent land owner should be able to do with their own property.

Tha k you,

Laura Hart

April 16, 2024
From: Steven Hart
To: Sara Poirier
Attachments: Video Clip – Nuclear Radiation Detector reading (image of video attached below)

Dear Sara,

I hope this email finds you well. I am writing to provide my feedback on the proposed adjustments of wind farm setbacks.

This is a complex issue that requires careful consideration and articulation to effectively convey my point. Which is based upon facts from reputable sources and personal experiences.

Sara, as you know, this has been an extremely important topic for me as I am undeniably passionate about my municipality, my community and the members who make West Hants whole. We strive for inspiriement and we strive for participation in passionate matters. It has become clearly evident with the participation from residents in the most recent meetings at council chambers that we have achieved the ultimate level of inspiration and participation.

Oftentimes society will label residents of rural communities as uneducated, slack jawed, unprofessional, and vocal minorities.That label could not be farther from the truth. I am proud to say the communities mostly affected by wind farms are packed with well respected business owners, medical professionals, teachers, engineers and some of the best baked goods and community support you've ever experienced. When I started this journey of informing the community of what is going on in our area I was completely blown away with the amount of support that I had behind me. Which inspired me to push through all the other negative impacts this has had on my life. It is amazing how our community has come together, put

differences aside and supported one another through what will, without a doubt, change their lives indefinitely with the stroke of a pen.

We, as a community, have been repeatedly told that we are not to worry about the environmental aspect of such developments like wind farms as the provincial government has our backs. I can tell you with certainty this is giving the residents false hope. I know you have been hearing me beating the drum of what is happening with the South Canoe Wind Farm with the oil running all over the ground, blades detaching from the turbines, drums of oil left open to the atmosphere through some of the most torrential rain falls I have ever experienced. I had reached out to all the proper channels provided by the government that we are supposed to, and eventually once I hit a brick wall with our MLA I went a step ahead and reported the environmental disaster to the Department Of Environment. They did a report on the wind farm (I had to FOIPOP) and once I received the report it stated they only reviewed 3 turbines, not the other 31 turbines which were reported on in the first place and that everything was "fine". It is very hard to have faith in a system which is built intentionally to frustrate someone out of trying to make a difference, and make the owners of these industrial complexes abide by the very rules they put in place themselves...

Then we move over to the newly approved Benjamin Mills Wind Farm development, which to be honest, I was in full support of.... At first...

I took it upon myself to do my own research and travel through the development at its construction phase, and after the "big blast" that could be felt clear to Mount Denson I bought a radiation detector and traveled through the roads. As you know, this particular wind farm development is located in Atlantic Canada's largest uranium deposit, estimated at over 190,000,000 kgs of uranium. Even in the EARD provided by Dillon Consulting they referenced the level of radiation that one is safe to be around for a certain amount of time.. That's scary, was Council aware of this?

While i was driving through the roads I received a very high reading of 1.5usv/h on one of the roads from the windmill sites **IN A WATER COURSE.**

Someone has clearly built the road out of uranium or some sort of radioactive material provided onsite and put it in a water course that is running directly to the residents of Falls Lake and surrounding areas. I have no idea how far radioactive material can flow, but I can only assume it is farther than 1km from a wind turbine. (I have attached a video for your reference.)

I understand that WHRM can only address land uses, and setbacks as the rest is solely the responsibility of the Province. However, these sorts of things have to be considered when allowing a development to commence. Many, many studies have been performed by very reputable organizations and doctors indicating the adverse health effects of industrial wind turbines being in close proximity to residential houses and the devaluation it causes to property. Many residents within Vaughan have been there for over 200 years. 7 generations of

families with the intent to hand those properties down to their loved ones to keep the generational knowledge within the community they hold near and dear to their hearts. I am proud to be one of those 7 generational families. Despite what the self appointed medical professional stated over the last two weeks on Everwinds behalf. I sincerely hope that planning staff, council and members of the public heard what he inadvertently admitted to in regards to the Bear Lake Project. He openly admitted that South Canoe, Benjamin Mills, Martock Ridge and Ellershouse 1,2 and 3 wind farms were not considered when evaluating the cumulative effects of these wind farms combined with Bear Lake, after he stated he was satisfied with the cumulative effect study performed. He also admitted the only cumulative effects measured were for birds and bats, not adverse health effects. Then testified there would be no adverse health effects. So, who are we to believe? The hired, self appointed medical professional by a wind farm company who has yet to build a wind farm? I think we should be taking the road less travelled and read between the lines of the professionals who do not stand to make a significant financial gain from approving projects.

Moreover, many of these wind farms are being built a-top mountainous terrain with villages at the foot of these hills, and more often than not require countless wetland removals and destruction. Wetlands are the kidney to our ecosystems, they prevent flooding and help filter out our drinking water. I can only reference the proposed Bear Lake Project as it has stated it will require destruction of 77 wetlands out of 94 which were identified. Just think of the potential flooding risks that are associated with wetland and forest destruction, especially if these turbines are only 1km from a dwelling.

I have spoken to residents from Ellershouse that can speak directly about what happened to them after last year's flood which is partially due to the wind farm developments in their area, its sad, scary and disheartening.

Over the last year I have consulted and conversed with many medical professionals, engineers, residents and elected officials who have stated wind turbines need to have a greater setback and that they should be based off of non-participating property lines and not from dwellings. These opinions were from well respected individuals with experience to back their opinions. Many fire chiefs recommend the distance to be 2-3kms from property lines to allow for fire breaks, habitability and safety aspects. These were also supported by recommendations from engineers and medical professionals. (I would be happy to share this information should you want to set up a meeting.)

With all this being said, as a passionate resident with deep ancestral ties to the land of Vaughan and West Hants I am asking you to please support amending our set-back bylaw to a minimum of 2.5km from a non-participating property line and support the residents who support you!

A multi-billion dollar business enterprise should not be allowed to pre-determine the destiny of a community member's property usage.

Yours truly,

Steven Hart

Lower Vaughan

April 16, 2024*
From: Elaine Rafuse
To: Sara Poirier

Hello Sara. My name is Elaine Rafuse and I am a concerned citizen of Upper Vaughan. I am writing to ask that the adjustment to the setback required for wind farms be 4 KM from a property line. A multi billion dollar company should not be allowed to dictate how we can use our property. One KM from dwellings is insane to say the least. Please consider the lives and

well being of those people who elect the council of West Hants. Keep West Hants a good place to live.

Regards,
Elaine Rafuse

April 16, 2024*
From: Mark Stewart
To: Sara Poirier
Attachments: Maps - Bear Lake Wind Speeds Including Structure Setback of 2km; Bear Lake Wind Speeds Including Structure Setback of 4km; Bear Lake Wind Speeds Including Structure Setback of 2km with Crown Land; Bear Lake Wind Speeds Including Structure Setback of 4km with Crown Land

Good evening Ms. Poirier,

Regarding the proposed by-law amendment for wind turbines, particularly the increased setback of 4kms to homes, please find attached maps which clearly demonstrate the impact to potential development opportunities which contravenes the WHMPS. The WHMPS states "that Council wishes to encourage the use of technologies that reduce dependence on non-renewable resources and do not contribute to greenhouse gas emissions. (Policy 4.24)."

In addition to the proposed increase in setbacks from home addresses there are other constraints which limit the developable areas such as wind speed, access to transmission, roads, protected areas and existing development or access. The attached two documents demonstration the impact for 2 and 4 km setbacks:

- Bear_Lake_wind_speeds_incStructureSetback2km_Protected Areas
- Bear_Lake_wind_speeds_incStructureSetback4km_Protected Areas

Furthermore, if a project was bid into the Provincial Green Choice Program this year crown lands would not be allowed to be included. The attached two documents demonstrate the impact of 2 and 4km setbacks as well as the exclusion of crown lands:

- Bear_Lake_wind_speeds_incStructureSetback2km_crownland
- Bear_Lake_wind_speeds_incStructureSetback4km_crownland

Please consider the impact to development opportunities to combat climate change in West Hants if any setbacks greater than the existing municipal of setback distance standard of 1 km to homes and 550 m to cabins.

Thanks,

Mark

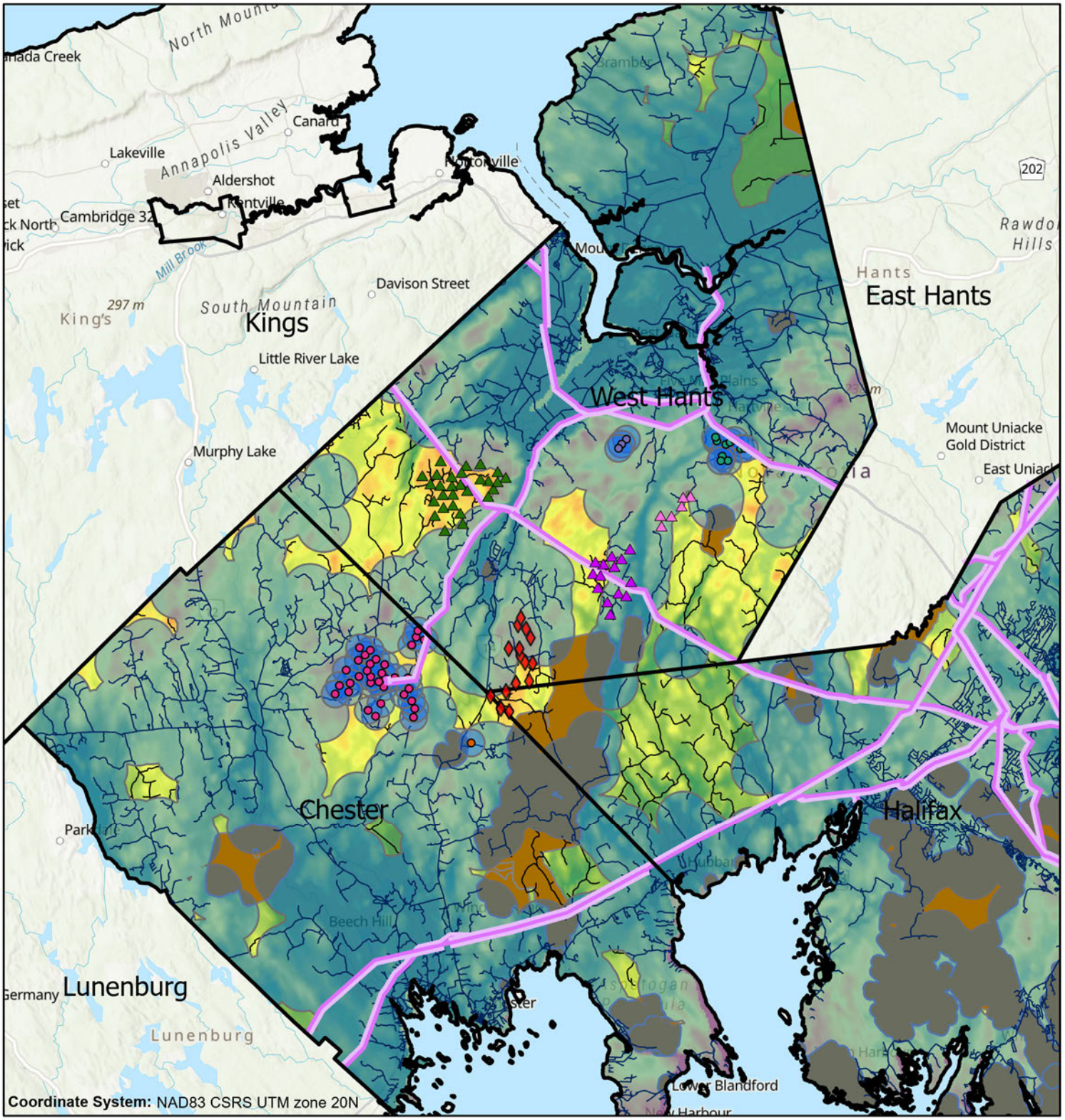
Mark Stewart he / him /his

Engagement Manager

[redacted]

M [redacted]

Nova Scotia, Canada



Legend

- Bear Lake Turbines
- Existing Wind Projects
  - Ellershouse
  - Kaizer Meadow
  - Martock Ridge
  - South Canoe
- Existing Turbine Setback
- Proposed Wind Projects
  - Benjamin_Mills
  - Panuka_Lake
  - Ellershouse III
- Regional_Municipality
- structures_setback2km
- NS Protected Areas
- transmission
- roads
- Wind Speed (low – high)

N

1:400,000

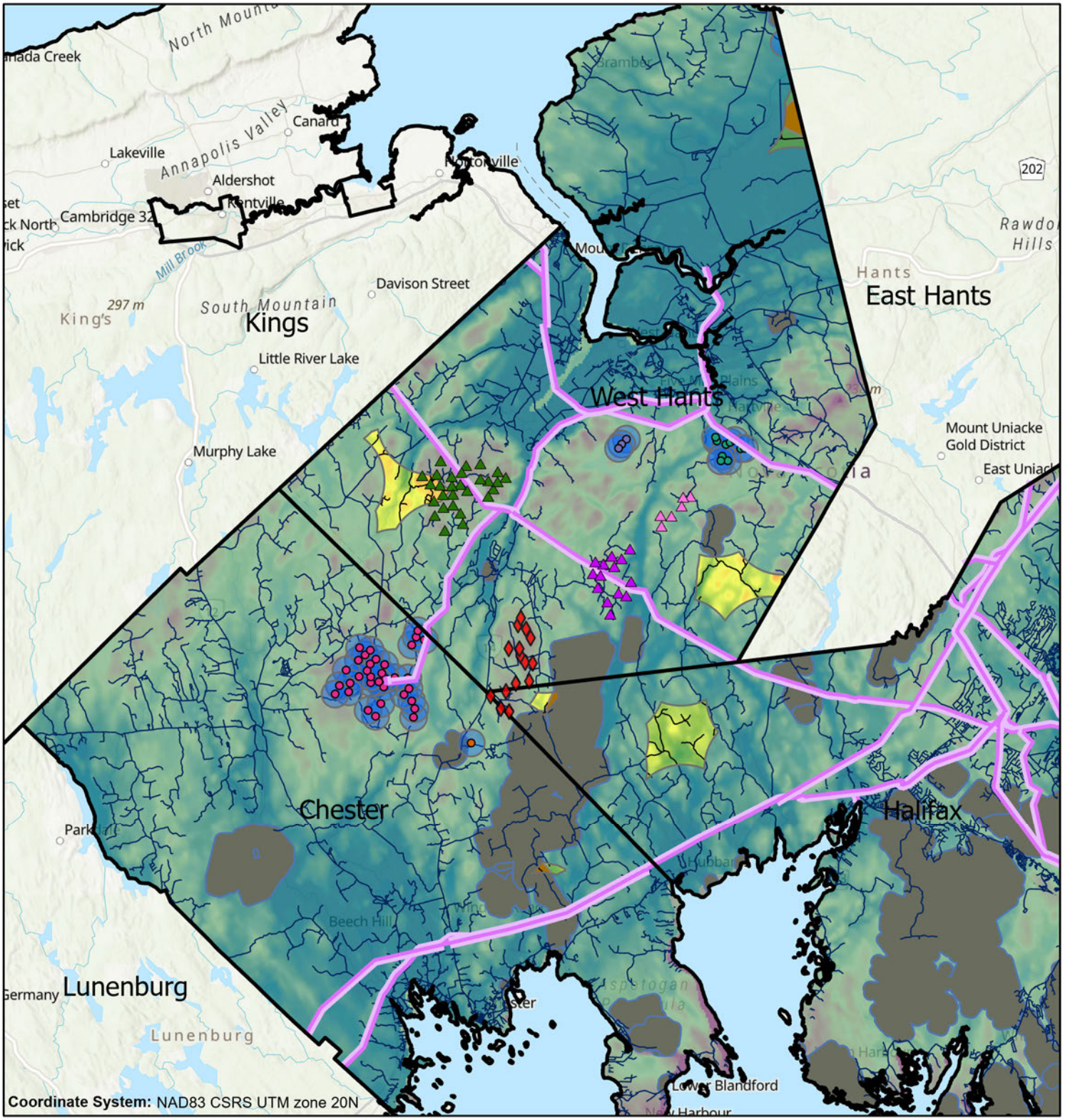
0 10 20 km

0 5 10 mi.

Proposed Bear Lake Wind Power Project

RENEWABLE ENERGY SYSTEMS

5605 Avenue de Gaspé
Suite 508
Montreal, Quebec, H2T 2A4
Phone: (514) 525-2113



Legend

- Bear Lake Turbines
- Existing Wind Projects
  - Ellershouse
  - Kaizer Meadow
  - Martock Ridge
  - South Canoe
- Existing Turbine Setback
- Proposed Wind Projects
  - Benjamin_Mills
  - Panuka_Lake
  - Ellershouse III
- Regional_Municipality
- structures_setback4km
- NS Protected Areas
- transmission
- roads
- Wind Speed (low – high)

N

1:400,000

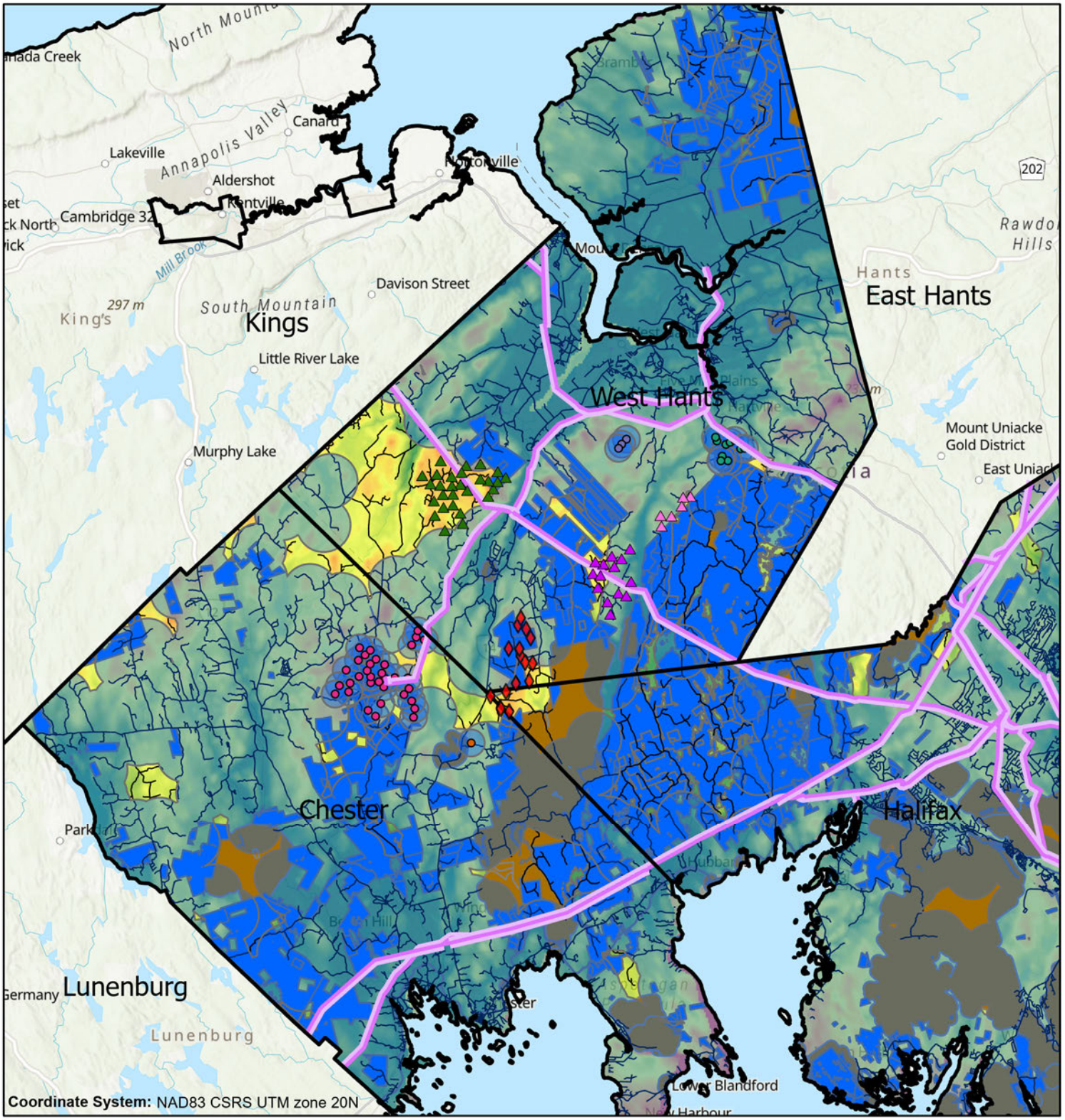
0 10 20 km

0 5 10 mi.

Proposed Bear Lake Wind Power Project

RENEWABLE ENERGY SYSTEMS

5605 Avenue de Gaspé
Suite 508
Montreal, Quebec, H2T 2A4
Phone: (514) 525-2113



Legend

- Bear Lake Turbines

Existing Wind Projects
- Ellershouse
- Kaizer Meadow
- Martock Ridge
- South Canoe

Existing Turbine Setback

Proposed Wind Projects
- Benjamin_Mills
- Panuka_Lake
- Ellershouse III

Regional_Municipality

structures_setback2km

NS Protected Areas

crown_land

transmission

roads

Wind Speed

low high

N

1:400,000

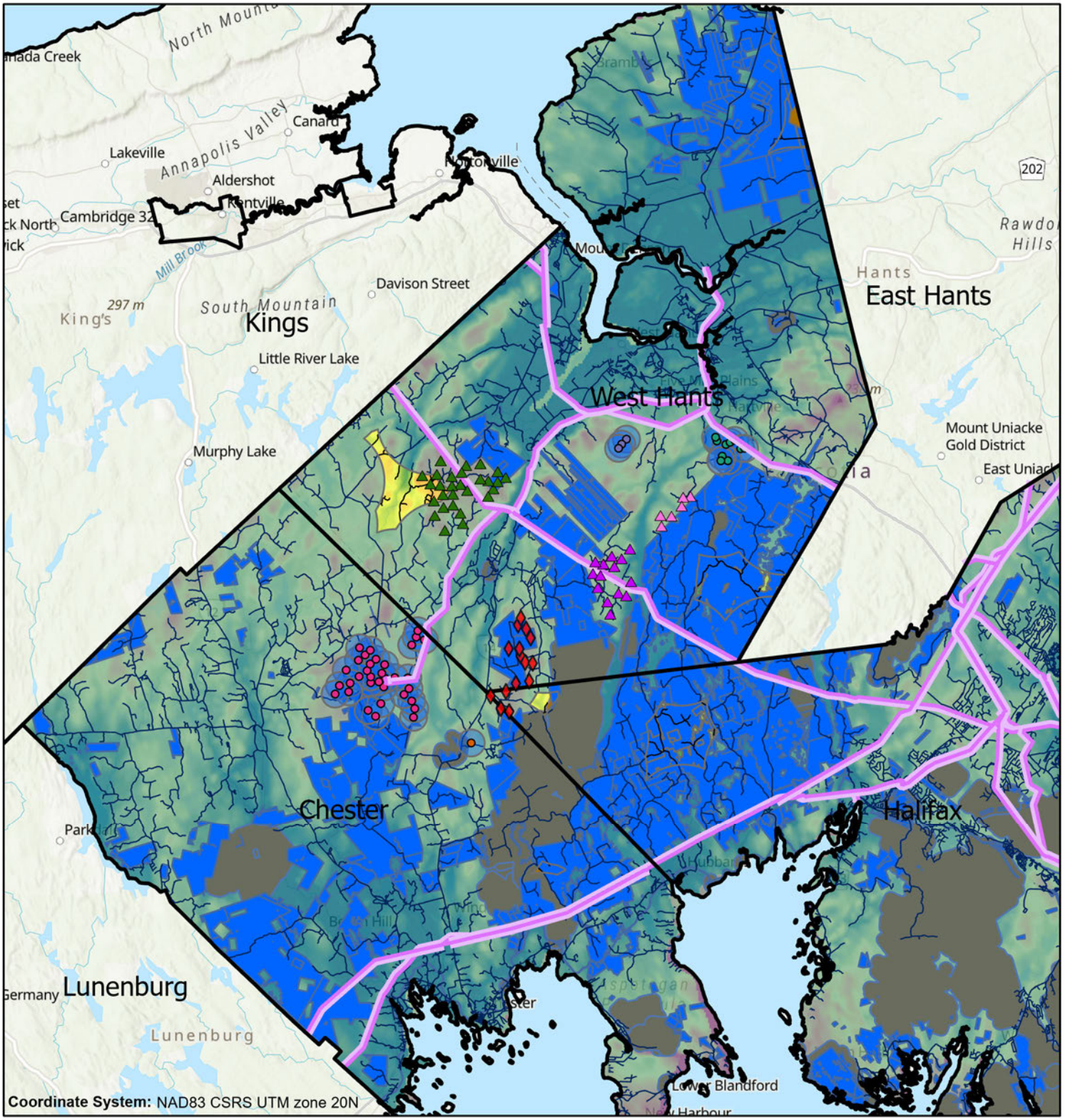
0 10 20 km

0 5 10 mi.

Proposed Bear Lake Wind Power Project

RENEWABLE ENERGY SYSTEMS

5605 Avenue de Gaspé
Suite 508
Montreal, Quebec, H2T 2A4
Phone: (514) 525-2113



Legend

- Bear Lake Turbines
- Existing Wind Projects
  - Ellershouse
  - Kaizer Meadow
  - Martock Ridge
  - South Canoe
- Existing Turbine Setback
- Proposed Wind Projects
  - Benjamin_Mills
  - Panuka_Lake
  - Ellershouse III
- Regional_Municipality
- structures_setback4km
- NS Protected Areas
- crown_land
- transmission
- roads
- Wind Speed (low – high)

N

1:400,000

0 10 20 km

0 5 10 mi.

Proposed Bear Lake Wind Power Project

RENEWABLE ENERGY SYSTEMS

5605 Avenue de Gaspé
Suite 508
Montreal, Quebec, H2T 2A4
Phone: (514) 525-2113

April 16, 2024*
From: Andrew Hardman
To: WHRM Council, Sara Poirier, Mark Fredericks, Alex Dunphy, Deanna Snair, Mark Phillips, Shelleena Thornton

Hello Ms. Poirier

I'm going to be pretty dry about my suggested setback for the Bear Lake wind turbines.

Policy 4.24 of the MPS addresses appropriate setbacks for wind turbines up to 400 ft tall. The current "standard" is 1000 from dwellings.

The Bear Lake wind turbines are 677 ft tall. Using simple math 677ft/400ft x 1000m = 1692 meters. This would make them appear to be of relative size to a 400 ft turbine at 1000m. That is, a similar visual intrusiveness to a 400 ft tall turbine.

In addition, the noise produced by a turbine of this size would not have a linear correlation to a smaller turbine.

Also, it is unfair to property owners whose property extends toward a turbine that they would not have the same setback if there were not an already a dwelling at the property boundary closest to the wind turbine.

I therefore suggest that that the minimum set-back be set at 1692 metres from the closest property boundary of a non-participating property owner.

Sincerely,

Andrew Hardman, P.Eng.
Upper Vaughan

April 25, 2024*
From: Ian Johnstone
To: Sara Poirier

Sara Poirier, Director of Planning and Development
West Hants Regional Municipality
76 Morison Drive, PO Box 3000
Windsor, Nova Scotia, B0N 2T0

Via Email: Spoirier@westhants.ca
RE: Proposed 4km wind turbine setback distance

Dear Ms. Poirier,
We are writing to express our support for maintaining a 1km and 550m setback distance from wind turbines to residences and camps, respectively, as is the current practice in the West Hants Regional Municipality. Wagner Forest NS is the participating landowner in the Ellershouse 3 Wind Project, proposed by Ellershouse 3 Wind Limited Partnership, an affiliate of Potentia Renewables Inc. We are also landowners in close proximity to the existing, 10-turbine, Ellershouse Wind Farm, operated by AREA.
As landowners in close proximity to an existing wind project, we are accustomed to seeing wind turbines on the landscape and we haven't found the turbines to be disruptive. The existing setback distances are sufficient for minimizing effects on adjacent residences while balancing the need for renewable energy development in Nova Scotia. Not only will wind energy development support the Province's emission reduction targets, but these projects support the municipality through tax revenue and local landowners, such as ourselves, through lease payments. Any additional setbacks imposed on wind energy development, beyond the current practice, will limit future development of these projects in the municipality and therefore prevent the municipality and landowners from realizing project benefits.
Should you have any questions about our experience with the existing Ellershouse Wind Farm or our experience as a participating landowner in the proposed Ellershouse 3 Wind Project, please do not hesitate to contact the undersigned. We look forward to the West Hants Regional Municipality maintaining the current setback distance from wind turbines to residences and camps in order to allow for future wind energy development.
Regards,
Ian Johnstone
General Manager
Wagner Forest NS

May 1, 2024*
From: Julia Cushing
To: Sara Poirier, Mark Fredericks
Attachments: AVFN – Band Office Letter

Good morning Sara and Mark,
I hope this email finds you well. I am forwarding to you a letter from the Annapolis Valley First Nation regarding setback distances from wind turbines to dwellings in the West Hants Regional Municipality.
Best regards, Julia

ANNAPOLIS VALLEY FIRST NATION
29 Toney Blvd, Cambridge Station
Nova Scotia, B0P 1G0
Telephone: (902) 538-7149

April 16, 2024

Sara Poirier, Director of Planning and Development
West Hants Regional Municipality
76 Morison Drive, PO Box 3000
Windsor, Nova Scotia, B0N 2T0
Via Email: Spoirier@westhants.ca

RE: West Hants' proposed 4km wind turbine setback distance

Dear Ms. Poirier,

As a majority owner of the Ellershouse 3 Wind Project, proposed by the Annapolis Valley First Nation (AVFN) and PR Canada Holdings, an affiliate of Potentia Renewables Inc. (together referred to as "PRI"), we are closely watching the developments in West Hants related to policies surrounding wind energy development. Although we understand these new policies will not be applied to the Ellershouse 3 Wind Project as an application for a development agreement has been submitted to the West Hants Regional Municipality, we are concerned with any new policies that would limit future renewable energy development.

The AVFN have a total population of approximately 300 people; 119 live within the community and 173 live outside of the community. We have worked closely with PRI on the development of the Ellershouse 3 Wind Project and through this development, not only are we receiving annual financial benefits, but we are also gaining land access to our St. Croix Reserve. These benefits will positively impact our community for generations to come.

Any new policies that restrict wind energy development beyond the existing municipal and provincial requirements are not only excessive, but also infringe on the AVFN's ability to secure new development agreements which would bring additional benefits to our community and to our members. The AVFN recognizes the importance of responsible project development and it is our position that existing municipal and provincial siting frameworks allow for project development in a manner that protects communities and the environment.

We encourage West Hants Regional Municipality to consider the impact of this proposed policy on communities who benefit greatly from wind energy development. Should you have any questions or should you wish to set up a call, we would be pleased to discuss this matter further.

Regards,

Chief Gerald B. Toney
Annapolis Valley First Nation