Report to Council

Department:	Office of the CAO
Division:	Legal and Legislative Services
Date:	December 19, 2022
Prepared by:	Robert W. Auger Director, Legal and Legislative Services/Clerk
Report Number:	Legal and Legislative Services-2022-41
Subject:	Greenhouse Light Abatement By-Law
Number of Pages:	6 plus attachments

Recommendation(s)

The following two (2) recommendations are provided for Council's consideration:

1. **That** Legal and Legislative Services-2022-41 entitled "Greenhouse Light Abatement By-Law" prepared by Robert W. Auger, Director, Legal and Legislative Services/Clerk, and dated December 19, 2022, be received; and
2. **That** By-Law No. 2211 being a by-law to require the abatement of interior greenhouse light emissions be read a first and a second time and provisionally adopted on December 19, 2022.

Purpose

The purpose of this report is to recommend provisional adoption of By-Law No. 2211 regulating public nuisances related to interior greenhouse light emissions, and to provide Council with a summary of the comments and best practices received from the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and industry stakeholders.

Background and Discussion

Council received an update regarding the development of the proposed Greenhouse Light Abatement By-Law at its March 21, 2022, Regular Meeting of Council (See Administration Report dated March 21, 2022 and attached as Appendix A to this report). Upon consideration of Legal and Legislative Services Report 2022-10, Council directed Administration to prepare and return with a by-law regulating public nuisances related to interior greenhouse light emissions following best practice recommendations received from the greenhouse industry.

Proposed Greenhouse Light Regulations

For the purposes of the regulations, a **greenhouse** is defined as a structure exceeding five hundred (500) square metres in gross floor area that is made of plastic or glass and used for growing plants in regulated temperatures, humidity, and ventilation.

The proposed regulations are as follows:

1. An owner or occupant of a greenhouse that utilizes lights shall ensure barriers are installed in good practice so that the **barriers cover the entirety of the sidewalls and endwalls** of the greenhouse from sunset to sunrise.
2. An owner or occupant of a greenhouse that utilizes lights shall ensure barriers are installed in good practice so that the **barriers cover a minimum of ninety percent (90%) of the ceiling** of the greenhouse from sunset to sunrise.

Barriers are to be permanently installed and maintained to prevent or block direct light emitting from the interior of the greenhouse from escaping to the exterior of the greenhouse onto adjoining land(s) or into the night sky. The barriers may be permanently affixed to a wall or ceiling, or permanently affixed to a system which permits the barrier to extend or retract by mechanical or manual means.

It is important to note that a farmer affected by a municipal by-law that may have the effect of restricting a normal farm practice in connection with an agricultural operation may apply to the Normal Farm Practices Protection Board for a determination as to whether a practice is a normal farm practice for the purposes of the non-application of a municipal by-law.

Stakeholder Consultation

The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) has been provided the opportunity to provide technical input on the Town's proposed regulations. **OMAFRA's feedback and comments were favorable to the proposed Town of Essex regulations (see OMAFRA correspondence attached to this Report as Appendix B).**

OMAFRA is currently working with Agriculture and Agri-Food Canada, the University of Guelph, and other academic institutions, as well as the Ontario Greenhouse Vegetable Growers to address research gaps and provide further evidence-based guidance for future greenhouse light management.

OMAFRA recently released an information sheet that outlines the latest science-based research in greenhouse light management, entitled *Managing Nighttime Greenhouse Light Emissions* (included in Appendix B attached to this report).

The research recognizes that light emitted from the sides and ceiling of greenhouses using supplemental lighting at night may impact neighbouring land uses. These light emissions can be minimized by using ceiling, side, and end wall light abatement curtains.

The research also recognizes that when ceiling light abatement curtains are 100% closed, heat and humidity cannot escape the greenhouse. Therefore, OMAFRA encourages consideration be given to allow some opening for ventilation purposes. This approach of 10% gapping of light abatement curtains is used in other jurisdictions and has been incorporated into the Town's proposed regulations such that the proposed regulations are in line with the latest recommended best practices.

OMAFRA in its favourable review of the Town's proposed regulations also recommended that consideration be given to phasing-in regulations to recognize the potential challenges in adopting new technologies on the farms. However, Administration is not recommending a phased-in approach due to the minimal number of greenhouses that are currently operating in the Town of Essex, and due to the fact that none of the greenhouses currently in existence utilize lights as part of their operations.

Administration also acknowledges that the science and technology related to greenhouse light abatement will continue to evolve. Research outcomes including those of OMAFRA will help inform the development of best management practices for use by the sector and municipalities. The OMAFRA Research is expected to be completed in 2023 and such research may form the basis of revised regulations in the future so that the Town stays in line with current recommended best practices.

Additionally, Administration further sent (in addition to the consultation reported at the March 21, 2022 Council Meeting) the proposed regulations to the following organizations for consultation, however, no responses were received to date:

- Caldwell First Nation
- Essex Region Conservation Authority (ERCA)
- Essex County Field Naturalists Club
- Point Pelee National Park
- Holiday Beach Migration Observatory (HBMO)
- Wildlife Preservation Canada

Site Plan Control Agreements

Proposed industrial greenhouses are subject to site plan control approval.

During the pre-consultation phase, applicants will be advised of the regulations relating to greenhouse light abatement to ensure they are followed and continue to be followed in the design, construction, and operation of the greenhouse.

Applicants for site plan control approval may also be required to undertake studies related to such matters as water supply needs and impacts to Town infrastructure and ground water.

Enforcement

Due to the lack of greenhouses currently utilizing lights in the Town of Essex, it is proposed that enforcement could commence immediately on a complaint basis, without a prior period of education.

Once the proposed by-law is passed, Administration will apply to the Ministry of the Attorney General for set fines. The maximum set fine that can be applied for is $1,000 which includes a victim fine surcharge. The option also exists to lay an information under Part III of the Provincial Offences Act in order to seek a fine that is higher than the set fine. Included in the proposed by-law is a provision indicating each calendar day a violation continues is deemed to be a separate offence under the by-law.

In addition to seeking fines, the Town may apply to the Superior Court for an order to prohibit the continuing contravention of the by-law. Continuous breaches of a court order may result in a finding of contempt of court.

Financial Impact

The passing of the proposed by-law may have a significant impact upon the resources of the Building and By-Law Enforcement Division due to the limited number of opportunities for cost recovery through user fees. Any significant impact realized in the future would require a further review from a budgetary perspective.

At this time identifying the potential enforcement costs would be purely speculative as these costs depend on the nature of the enforcement activity necessary, whether the Town would retain external legal counsel, and the number of orders in which the Town would be required to act. At present, the impact on enforcement resources is expected to be minimal due to the nominal number of greenhouses currently operating in the Town of Essex.

The prosecution of Part III charges through the Provincial Offences Act that must be brought before a Justice of the Peace for resolution could also result in an increase on the resources of Legal and Legislative Services, as resulting fines are set and collected by the province.

Again, as stated above any future budgetary implications will be brought forward during budget deliberations.

Consultations

Town of Essex Legal and Legislative Services

Town of Essex Planning Division

Town of Essex Building and By-Law Enforcement Division

Municipality of Leamington

Ontario Ministry of Agriculture, Food and Rural Affairs

Ontario Greenhouse Vegetable Growers

Link to Strategic Priorities

☐ Manage, invest and plan for sustainable municipal infrastructure which meets current and future needs of the municipality and its citizens.

☐ Create a safe, friendly and inclusive community which encourages healthy, active living for people of all ages and abilities.

☐ Provide a fiscal stewardship and value for tax dollars to ensure long-term financial health to the municipality.

☒ Manage responsible and viable growth while preserving and enhancing the unique rural and small town character of the community.

☒ Improve the experiences of individuals, as both citizens and customers, in their interactions with the Town of Essex.

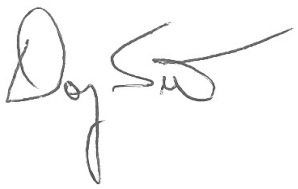
☒ Improve the Town's capacity to meet the ongoing and future service needs of its citizens while ensuring the corporation is resilient in the face of unanticipated changes or disruptions.

Report Approval Details

Document Title:	Greenhouse Light Abatement By-Law - Legal and Legislative Services-2022-41.docx
Attachments:	- Appendix A - March 21 Report Light Abatement By-Law Update.pdf - Appendix B - OMAFRA Comments-2022-10-31.pdf - By-Law No. 2211 - Greenhouse Light Abatement.pdf
Final Approval Date:	Dec 13, 2022

This report and all of its attachments were approved and signed as outlined below:

Robert Auger, Director, Legal and Legislative Services/Clerk - Dec 13, 2022 - 11:30 AM



Doug Sweet, Chief Administrative Officer - Dec 13, 2022 - 11:31 AM

No Signature found

Lori Chadwick, Director, Development Services - Dec 13, 2022 - 2:14 PM

Report to Council

Department:	Office of the CAO
Division:	Legal and Legislative Services
Date:	March 21, 2022
Prepared by:	Robert Auger, Town Solicitor/Clerk Matthew Ducharme, Legislative Intern
Report Number:	Legal and Legislative Services-2022-10
Subject:	Update re: Light Abatement Bylaw
Number of Pages:	8 pages

Recommendation(s)

The following two (2) recommendations are provided for Council's consideration:

1. **That** Legal and Legislative Services-2022-010 entitled "Update re: Light Abatement Bylaw" prepared by Robert Auger, Town Solicitor/Clerk and Matthew Ducharme, Legislative Intern, and dated March 21, 2022, be received for Information; and
2. **That** Council direct Administration to prepare and return with a by-law to regulate public nuisances related to interior greenhouse light emissions in the Town of Essex, following the best practice recommendations that are expected to be received in 2022 from the greenhouse industry.

Purpose

This report is to respond to the following resolution Council passed on November 16, 2020:

> **(R20-11-434) That** Administration review and a Report be brought back to Council on the implementation of a by-law prohibiting and regulating lights and odours, similar to that recently passed by the Town of Kingsville. **Carried**

Background and Discussion

Industry trends point towards more greenhouse development in the future as the climate becomes increasingly variable and hostile for field crop cultivation. The Town of Essex has to date not experienced the influx of greenhouse development seen in neighbouring municipalities. However, as agricultural lands become scarcer, greenhouse developers will be looking to Essex to establish their operations.

The consequences of internal greenhouse lighting and odour arising from processing and production activities is very evident in Southwestern Ontario. This has resulted in an increase of public nuisance concerns by area residents in recent years. The Town of Kingsville and the Municipality of Leamington have both passed by-laws restricting public nuisances related to greenhouse operations, and other local municipalities are investigating possible regulations to prepare for future greenhouse development.

The Municipal Act does give municipalities the authority to prohibit and regulate public nuisances, including those related to odour and indoor lighting impacts derived from Greenhouse operations.

However it is important to note that Ontario's Farming and Food Production Protection Act indicates that a farmer is not liable in nuisance to any person for a disturbance resulting from an agricultural operation carried on as a normal farm practice, and no municipal by-law applies to restrict such practices.

As a result a farmer or operator affected by a municipal by-law that restricts its agricultural operations may apply to the Normal Farm Practices Protection Board (NFPPB) for a determination as to whether a practice is a normal farm practice for purposes of non-application of a municipal by-law. Similarly, a person directly affected by a disturbance from an agricultural operation may apply to the NFPPB for a determination as to whether the disturbance results from a normal farm practice. This determination is often made on a case by case basis but also in conjunction with what may be established best practices for that particular industry.

Odour Nuisances

Federal Cannabis Regulations already require any building or part of a building where cannabis or anything that will be used as an ingredient is produced, packaged, labelled, stored, or tested must be equipped with a system that filters air to prevent the escape of odours to the outdoors. Municipalities are not responsible for enforcing these regulations.

While notice is provided to the municipality in connection with a Part I Cannabis Facility (commercial facilities), please note that no municipality receives notice of any application to Health Canada in connection with a Part II Cannabis Facility (facilities that produce medical cannabis for those individuals who have a certificate to produce the same). A municipality is made aware of these facilities only as a result of information from the public or other sources.

In addition to the Federal Cannabis Regulations, the Town of Essex also already regulates odours emitted from Agricultural Operations through regulations under Zoning By-Law No. 1037 including the following:

Agricultural District 1.1 (A1.1) has the following regulations:

> "A mushroom farm shall not be permitted within 350m (1150f) of a Residential District. A facility used for the growing, storage, packaging, or distribution of marijuana or hemp shall be licensed by the licensing authority having jurisdiction and shall be a minimum of 300m (985f) from a dwelling and a Green District and 500m (1640f) from a Residential District."

Manufacturing District 2.1 (M2.1) has the following regulations:

> "A facility used for the growing, storage, packaging, or distribution or marijuana and or hemp or for the production of products derived from them shall be licensed by the licensing authority having jurisdiction and be a minimum of 300m (985f) from a dwelling and Green District and 500m (1640f) from a Residential District."

These regulations prescribed by the Zoning By-Law No. 1037 together with the Federal Cannabis Regulations are intended to mitigate the effects of possible or realized odour nuisances on neighbouring properties. As such, Administration is recommending that odour

regulations not be included in a municipal by-law relating to greenhouse public nuisances and that the focus be upon the nuisance impacts from light activities.

Light Nuisance Abatement By-laws and Industry Consultations

By-laws

Currently, there are no provincial regulations that address greenhouse lighting. At the current time the Municipality of Leamington, Town of Kingsville, Municipality of Lakeshore, and Municipality of Chatham-Kent have reacted to greenhouse lighting by taking the following regulatory approaches:

- Leamington has adopted a by-law requiring 100% light abatement in Greenhouse sidewalls and endwalls from one hour before sunset to one hour after sunrise. 100% ceiling abatement for the same time period is required except between 2:00 a.m. and 6:00 a.m. when 90% light abatement is required.
- Kingsville has adopted a by-law that simply prohibits greenhouse lighting shining on neighbouring properties or into the night sky at any time.
- Lakeshore and Chatham-Kent have each adopted an interim control by-law to prohibit new greenhouse development to provide time for each municipality to conduct a municipal review of the effects of greenhouses.

Administration is aware that the Normal Farm Practices Protection Board has received many applications by the greenhouse industry for a determination as to whether the regulations of the Municipality of Leamington's Greenhouse Light Abatement By-law are restricting a normal farm practice. The hearing is scheduled for summer of 2022. If the Normal Farm Practices Protection Board rules that the by-law is restricting a normal farm practice, the by-law will not apply to the extent specified in the decision. Administration is recommending that it monitor the rulings forthcoming in this matter as it will provide more guidance to Administration on its future by-law.

Industry Consultations

The Ontario Greenhouse Vegetable Growers (OGVG) association (an organization that represents over 220 of Ontario's greenhouse farmers/operators) is moving forward with efforts to provide reasonable and effective light mitigation solutions. The farm practices of the industry's advanced year- round production of greenhouse produce, which enhances food security and sustainability in Ontario, requires additional light and heat. As a result the OGVG recognizes the community nuisance concerns associated with greenhouse lighting.

Administration has further been advised by the Municipality of Leamington that greenhouse specialists from the Ministry of Agriculture, Food and Rural Affairs (OMAFRA) are working in collaboration with the Ontario Greenhouse Vegetable Growers (OGVG) and Agriculture and Agri-Food Canada (AAFC) to provide scientific evidence upon which municipalities can base its regulations. Administration is aware that OMAFRA is also working with University of Guelph researchers to look at both future light abatement and energy modelling measures to consider within the greenhouse structures as energy curtains and lights contribute to the overall energy balance in commercial greenhouses. Both projects began in September 2020 with final results expected in the fall of 2023. We are advised that interim results will be available through various forums while the projects are underway. Following the completion of the projects, OMAFRA plans to incorporate the results and information into Ministry Factsheets or recommended Best Management Practices for Ontario greenhouse growers.

Finally Administration has directed consulted with the Ontario Greenhouse Vegetable Growers (OGVG) on a proposed by-law with regulations for greenhouse light abatement. During these consultations OGVG indicated that it was not opposed to regulating light emissions from greenhouses but noted that they are finishing the process of developing new/revised best practice recommendations for such greenhouse light abatement , recommendations that would be supported by their organization and its members. Administration was advised that such recommendations would be provided within the second quarter of 2022.

Planning Regulations

Proposed industrial greenhouse operations are currently subject to site plan control approval by Council. During pre-consultation, applicants for site plan control approval are advised of the regulations contained in the Property Standards By-Law, including Section 5.5:

> "Lighting fixtures and their supports shall be installed and maintained in a safe and structurally sound condition, and in good working order and in good repair and designed and/or positioned so as to not project light onto abutting properties or otherwise cause a nuisance."

If a future by-law regulating light emissions is adopted in the future, applicants would be advised of such a by-law during pre-consultation to ensure regulations are followed in the design, construction, and use of the greenhouse. Applicants for site plan control approval would also be required to undertake studies related to such matters as water supply needs and impacts to Town infrastructure and ground water.

Additionally, as part of the development of a new Town of Essex Official Plan currently underway, Planning Services will also review greenhouse and speciality crop land use policies and guidelines.

Conclusion

Given the expected increase in greenhouse development within the Town, it is the recommendation that Administration utilize the proposed light abatement best practices forthcoming from OGVG (expected to be provided to the Town within the second quarter of 2022) These updated/revised best practices will serve as a reasonable basis upon which the Town can prepare a by-law under the nuisance provisions of the Municipal Act to regulate light emissions from greenhouse operations in the Town. It is recognized, however, that such a by-law may require subsequent amendment when the final results/recommendations from the OMAFRA and AAFC abatement projects are released in the fall of 2023.

Financial Impact

All costs associated with the development of a nuisance by-law related to greenhouse light emissions will be absorbed by the operating cost centre for Legal and Legislative Services. Any budgetary implications will be brought forward in future budget deliberations.

The implementation of such a by-law has the potential to have an impact upon the resources of the Building and By-Law Enforcement Division. At this time identifying the potential enforcement costs would be purely speculative as these costs depend on the nature of the enforcement activity necessary, whether the Town would retain external legal counsel, and the number of orders in which the Town would be required to act. At present the impact on enforcement resources is expected to be minimal due to the minimal number of greenhouses currently operating in the Town of Essex.

Consultations

Lori Chadwick, Director, Development Services

Rita Jabbour, Manager, Planning Services

Jeff Watson, Policy Planner

Kevin Carter, Chief Building Official/Manager, By-Law Enforcement

Mike Diemer, By-Law and Property Standards Officer

Kate Giurissevich, Director, Corporate Services/Treasurer

Municipality of Leamington

Ontario Greenhouse Vegetable Growers

Link to Strategic Priorities

☐ Manage, invest and plan for sustainable municipal infrastructure which meets current and future needs of the municipality and its citizens.

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Report Approval Details

Document Title:	Potential Nuisance Effects of Greenhouse Development.docx
Attachments:	
Final Approval Date:	Mar 15, 2022

This report and all of its attachments were approved and signed as outlined below:

Doug Sweet, Chief Administrative Officer - Mar 15, 2022 - 5:41 PM

Dear Mr. Auger:

Thank you for the opportunity to provide technical input on the proposed by-law for greenhouse light management for the Town of Essex.

I would like to recognize and thank you for your proactive and thoughtful approach to this important issue.

The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) is focused on promoting and protecting agricultural uses and normal farm practices in agricultural areas, while also protecting public health, safety, and the environment. The ministry understands the importance of the greenhouse sector in supporting food security for Ontario and the role of year-round production as a way to increase food security, create jobs, and build a more sustainable industry.

OMAFRA is working with industry and others to address research gaps and provide evidence-based guidance for greenhouse light management that reflects Ontario's growing conditions. There is a range of work completed and ongoing with multiple partners, including Agriculture and Agri-Food Canada, the University of Guelph and other academic institutions, as well as the Ontario Greenhouse Vegetable Growers. Some of these projects study the use of light management products and practices with a focus on optimizing performance and minimizing impacts to plant health and crop yields. To-date, the research has focused on light escape and in-progress research focuses on the impact of various control measures on crop production. Research on impacts to plant health is expected to be completed in 2023.

OMAFRA recently released an information sheet that outlines the latest science-based research in greenhouse light management, titled the *Managing Nighttime Greenhouse Light Emissions,* which is attached to this letter. OMAFRA technical staff have also reviewed the proposed by-law in the context of early research findings, initial scans of leading jurisdictions, available science, and current best practices.

A preliminary scan of legislation in other jurisdictions with intensive greenhouse production (i.e., Netherlands, Ohio, and British Columbia) revealed approaches that permit some light to escape at specified times, while also implementing requirements for greenhouse light management, such as the use of light abatement curtains on sidewalls and ceilings.

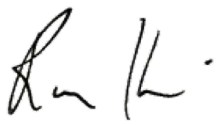
With respect to the emerging research on managing greenhouse light, it has been confirmed that ceiling curtains cause increased heat and humidity levels in the greenhouse. The effects of managing light must be controlled to prevent harm to crop production. Passive venting through the ceiling is a common means to manage heat and humidity levels, which also contributes to the release of some light into the environment when vents and curtains are opened. Release of heat through the ceiling is also a means to prevent the accumulation of snow, which is also important to avoid the collapse of greenhouse structures. When ceiling light abatement curtains are 100% closed, heat and humidity cannot escape the greenhouse. Therefore, consideration should be given to allow some opening for ventilation purposes. An approach used in other jurisdictions (e.g., Netherlands and Leamington allow 10% gapping of light abatement curtains at certain times). It is positive that the proposed bylaw also allows for gapping of ceiling light abatement curtains. If you have not already done so, you may wish to reach out to Leamington to learn from their experiences with this issue.

These and other considerations are included in greater detail in the attached information sheet. It is acknowledged that the science and technology in this area will continue to evolve. Research outcomes will help inform development and continuous improvement of best management practices (BMPs) and guidance for use by the sector and municipalities.

At this time, OMAFRA recommends being as consistent as possible with leading jurisdictions and practices, while factoring in the need to accommodate any unique Ontario greenhouse structures or conditions such as climate. It is also recommended that The Town of Essex considers phasing in, planned requirements to recognize the economic implications of light management measures on greenhouse operations, the potential supply chain challenges (e.g., access to materials, labour), as well as the new evidence being generated with respect to managing greenhouse light in Ontario. A phased-in approach was adopted recently in Leamington for their bylaw addressing light emissions in recognition of potential challenges in adopting new technologies on the farms.

OMAFRA would be pleased to discuss this further with Town of Essex officials.

Sincerely,



Randy Jackiw
Assistant Deputy Minister

Ontario

Ontario Ministry of Agriculture, Food and Rural Affairs

Managing Nighttime Greenhouse Light Emissions

An increase in the use of supplemental lighting in greenhouses has been accompanied with an increase in the amount of light emitted from greenhouses at night during fall and winter months. Without proper management strategies, light emitted from greenhouses during nighttime hours can potentially be disruptive to neighbouring residents. As a result, the objective of this document is to outline the latest research in greenhouse light management for producers and to provide information on managing nuisance complaints should they arise.

Highlights of Greenhouse Light Management Research:

- While many studies have investigated the effects that different lighting strategies have on plant production, there has been little examination of light emissions from greenhouses.
- The amount of light emitted from greenhouses using supplemental light is dependent on many factors including light abatement curtain use, crop stage, and light intensity (Snow et al.; 2022a, 2021a, 2021b).
- Sky brightness levels near greenhouses using supplementary lighting can be affected by light levels emitted from other sources in the region (e.g., infrastructure, industry, residences and businesses). Cloud conditions, air quality and moon phase also impact sky brightness (Snow et al.; 2022a, 2021a, 2021b).
- Research to determine optimal light management strategies for greenhouse production is ongoing, with the goal of developing strategies that create growing environments to support plant health, yield, energy efficiency and compatibility with neighbouring land uses.

Greenhouse light emissions

The amount of light emitted from greenhouses using supplemental lighting at night depends on light intensity, closure of light abatement curtains and amount of vegetation.

Light intensity of the fixtures installed in the greenhouse

In general, crops that produce fruits like high wire vegetables or large flowers such as cannabis require more light than potted ornamental plants or lettuce (Faust, 2021). The use of higher intensity supplemental lighting in greenhouses is associated with higher light emissions when light abatement curtains are not being used (Snow et al.; 2022a, 2021a).

Closure of light abatement curtains over the crop and on side and end walls

There are many models of light abatement curtains on the market that are made of different materials to suit the needs of greenhouse producers for managing the greenhouse environment for the crop (see Table 1 in the Appendix). These curtains reduce the amount of light emitted from greenhouses by reflecting the light back into the greenhouses. Current ceiling light abatement curtains allow less than 1% light transmission and wall light abatement curtains allow less than 2% light transmission when fully closed. This allows for greater use efficiency of the supplemental lighting since most of the light is contained inside the greenhouse to be used by the crop.

Light emitted from the sides and ceiling of greenhouses using supplemental lighting at night may impact neighbouring land uses. These light emissions can be minimized by using ceiling, side and end wall light abatement curtains. As ceiling light abatement curtains are opened to different gapping degrees (10%, 20% gapping, etc.), there is an increase in the amount of light emitted that is somewhat proportional with the gapping (Snow et al., 2021b).

Furthermore, light emitted from the top of greenhouses using supplemental lighting at night may be observed further from the source by artificially illuminating the night sky. These emissions can be reduced by using light abatement curtains over the crop. There may not be much change in sky brightness when fully closed light abatement curtains are opened to a 10% gap, but as light abatement curtains are

fully opened there may be a significant increase in sky brightness near the greenhouse (Snow et al., 2022a).

Amount of vegetation in the greenhouse

More light is emitted from walkways and areas with less plant volume than areas in full production. This is most likely due to more light being reflected by surfaces than plants (Snow et al., 2022a).

Energy efficiency considerations

Curtains designed for light abatement (keeping supplemental light in the greenhouse) or blackout (keeping sunlight out of the greenhouse; typically used in cannabis or ornamental production) offer potential energy savings especially when used in combination with energy curtains as a double layer over the crop (Hanifin, 2022). The use of light management curtains can impact the climate in the greenhouse, which in turn can negatively impact plant growth and yield. Therefore, it is important to research production practices and technologies that can address potential humidity and temperature concerns.

Strategies to maintain a consistent environment in greenhouses with deployed light abatement curtains are being researched (Nauta et al.; 2022). Using new technology, such as air-mix fans, may help growers maintain a consistent environment under light management conditions. Air-mix fans blend air from above light abatement curtains with air from below the curtains when curtains are fully closed. The cooler air above the curtains is pulled below the curtains and mixed with the warmer air to cool it down before being blown into the greenhouse. These fans are typically installed below the curtains with a duct leading through the curtain to the space above the curtains (see Table 2 in the Appendix). This technology may assist in maintaining a constant climate in a greenhouse where light abatement curtains are closed.

Dehumidification technologies may also provide additional climate control in the greenhouse and energy savings in the fall and winter months (Han et al.; 2021) or when outside ventilation is limited by curtain deployment. However, this needs to be tested in greenhouses with light abatement curtains.

Why is Supplemental Lighting Necessary

Shorter days in the autumn and winter seasons and low light levels during cloudy days in the spring and summer seasons make the use of supplemental lighting necessary for the production of high-quality greenhouse vegetables, fruits, ornamentals, and other crops year-round in Ontario. Greenhouse producers may use supplemental lighting throughout the year for a variety of reasons based on the crops they produce, such as:

1. Supplemental light may be used to increase the amount and/or duration of light a plant receives during a day to ensure optimal growth. This can be achieved through **day length extension** by using lights before sunrise or after sunset. Lights may also be used during the day to provide increased light intensity on cloudy days or during sunrise and sunset.
2. In ornamental and cannabis plants, supplemental light may be used to **control flowering**. Night interruption may be used to control flowering time in ornamental crops by providing a brief period of light during the dark/night period. Certain species of cannabis need a fixed light period to promote the transition from vegetative growth to flowering.

There are two common types of supplemental lighting used in greenhouse production. **High pressure sodium (HPS)** lights have traditionally been more popular, but the transition to more energy efficient **light-emitting diodes (LED)** is ongoing. LED fixtures also allow growers to use different spectrums of light to optimize how the plant develops, and the lower amount of heat generated by LEDs allows them to be placed closer to the crop, and where appropriate, within the crop canopy.

Supplemental lighting is most commonly delivered from above the crop with fixtures hung from greenhouse trusses. **Overhead** supplemental lighting is typically used to extend the day length in the fall and winter months, but it can be used year-round to increase the amount of light a crop receives. **Intracanopy** lights, which are placed within the canopy of vine vegetable crops like tomatoes, peppers, and cucumbers can also be used year-round to improve light delivery to shaded areas of the canopy where the plant develops fruit.

References

Faust, J.E. **DLI Requirements for Various Greenhouse Crops**. Ball RedBook. Volume 2: Crop Culture and Production. 19th Edition. June 2021.

Han, J., J. West and A. Huber. 2021. **Demonstration of Energy-Saving Dehumidification in Ontario Greenhouses**. Canadian Greenhouse Conference. Poster presentation: October 6-7, 2021.

Hanifin, R. 2022. **Saving energy with curtains: A simulation exercise.** Greenhouse Canada Magazine. January 11, 2022.

Nauta, A., W.D. Lubitz, S.H. Tasnim, J. Han. **Methodology and Validation of a New Interior Climate Prediction Model for Commercial and Small-scale Greenhouses.** Proceedings of 2022 Responsible Engineering and Living Symposium. Windsor, Ontario Canada. June 23-24, 2022.

Snow, B., W.D. Lubitz. 2022a. **Progress Report: Greenhouse Light Emissions Survey**. Light Management Research Advisory Committee. Presentation: June 1, 2022.

Snow, B., W.D. Lubitz, S.H. Tasnim**,** T. Graham, D. Llewellyn, F. Al-Daoud, C. Dayboll. 2022b. **Comparison of the spectral and intensity responses of light sensors used to measure greenhouse light emissions.** Presentation at 2022 Responsible Engineering and Living Symposium. Windsor, Ontario Canada. June 23-24, 2022.

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Appendix: Technology to aid in light management

Operators are encouraged to do their own research. The list below is not comprehensive in nature. No ministry or public sector agency has approved or endorsed any particular service provider or structural solution. Presence on or absence from this list does not indicate quality or reliability of the service provided.

Light Abatement Curtains:

Table 1: Examples of available light abatement curtain models and their manufacturer specifications. This is not a comprehensive list.

Model	Ceiling or wall curtain	Material	Weight (g/m^2)	Fire retardant	Light transmission (%)	Energy savings (%)
A	Ceiling	Polyester	67	Yes	1	50
B	Wall	Polyolefin	252	Yes	0.01	70
C	Ceiling	69% Polyolefin, 31% Polyester	109	Yes	0.5	51
D	Ceiling	61% Polyolefin, 39% Polyester	127	Yes	0.5	58
E	Wall	Polyester	255	Yes	2	45

Table 2: Examples of available air mix fans and their manufacturer specifications. This is not a comprehensive list.

Model	**Ventilation Capacity (m^3/hr)**	**Installation**	**Air flow direction**
A	Up to 5200	Side of truss, hole in screen cloth is needed	Horizontal
B		On truss, no hole in the screen cloth needed	
C	Up to 5500	Side of truss, hole in screen cloth may not be needed as it is thin	Horizontal and vertical

The Corporation of the Town of Essex
By-Law Number 2211

Being a by-law to require the abatement of interior greenhouse light emissions

WHEREAS Section 128(1) of the *Municipal Act, 2001, S.O. 2001, c.25,* as amended, provides that a local municipality may prohibit and regulate with respect to public nuisances, including matters that, in the opinion of council, are or could become or cause public nuisances;

AND WHEREAS Section 129 of the *Municipal Act, 2001, S.O. 2001, c.25,* as amended, provides that a municipality may prohibit and regulate with respect to outdoor illumination, including indoor lighting that can be seen outdoors;

AND WHEREAS it is the opinion of the Council of The Corporation of the Town of Essex that without proper abatement of interior greenhouse light, the effects of such unabated light could become or cause a public nuisance;

NOW THEREFORE be it resolved that the Council of The Corporation of the Town of Essex hereby enacts as follows:

1.0 SHORT TITLE

1.1 This By-Law may be referred to as the "Greenhouse Light Abatement By-Law".

2.0 DEFINITIONS

2.1 **"Barrier"** means a barrier permanently installed and maintained so as to prevent or block direct light emitting from the interior of a Greenhouse from escaping to the exterior of the Greenhouse onto adjoining land(s) or into the night sky, which may be permanently affixed to a wall, ceiling, or permanently affixed to a system which permits the barrier to extend or retract by mechanical or manual means.

2.2 **"Council"** means the Council of The Corporation of the Town of Essex.

2.3 **"Greenhouse"** means a structure exceeding five hundred (500) square metres in gross floor area that is made of plastic or glass and used for growing plants, including, but not limited to, fruits, vegetables, flowers or cannabis in regulated temperatures, humidity, and ventilation.

2.4 **"Lights"** means any manufactured lighting that emits photometric light used for the purposes of inducing plant growth, including, but not limited to, incandescent, halogen, fluorescent, metal halide, induction, light emitting diode, laser, or high pressure sodium lights.

2.5 **"Officer"** means any Person authorized, assigned, or appointed by the Town to administer or enforce the provisions of this By-Law.

2.6 **"Owner"** means the registered owner, lessee, or occupant of a Greenhouse.

2.7 **"Person"** means any individual, corporation, partnership, or association.

2.8 **"Town"** or **"Town of Essex"** means The Corporation of the Town of Essex or the geographical area of the Town of Essex, as the context may suggest.

3.0 APPLICATION AND SCOPE

3.1 This By-Law applies to all persons, lands, and properties in the Town of Essex.

3.2 The provisions of this By-Law may be enforced by an Officer.

3.3 References in this By-Law to any legislation or by-law means as may be amended or replaced from time to time and include any regulations thereunder.

4.0 LIGHT ABATEMENT REQUIREMENTS

4.1 An Owner of a Greenhouse that utilizes Lights shall ensure that Barriers are installed at or near the sidewalls and endwalls of the Greenhouse and maintained in good practice, so the Barriers cover the entirety of the sidewalls and endwalls of the Greenhouse from sunset to sunrise, which times shall be determined by the sunrise/sunset calculator of the National Research Council of Canada.

4.2 An Owner of a Greenhouse that utilizes Lights shall ensure that Barriers are installed at or near the ceiling of the Greenhouse and maintained in good practice, so that the Barriers cover a minimum of ninety percent (90%) of the ceiling of the Greenhouse from sunset to sunrise, which times shall be determined by the sunrise/sunset calculator of the National Research Council of Canada.

5.0 EXEMPTIONS

5.1 Section 4 of this By-Law shall not apply to a Greenhouse that utilizes Lights if the Lights are completely shut off and remain off from sunset to sunrise, which times shall be determined by the sunrise/sunset calculator of the National Research Council of Canada.

6.0 SEVERABILITY

6.1 If a court of competent jurisdiction should declare any section or part of a section of this By-Law to be invalid, such section shall not be construed as having persuaded or influenced Council to pass the remainder of the By-Law and it is hereby declared that the remainder of the By-Law shall remain in force.

7.0 PENALTY

7.1 Every Person who contravenes any provision of this By-Law is guilty of an offence and upon conviction is subject to a fine pursuant to the *Provincial Offences Act, R.S.O. 1990, c. P.33,* as amended from time to time.

7.2 Each calendar day on which a Person contravenes any provision of this By-Law shall be deemed to constitute a separate offence under this By-Law.

8.0 ENFORCEMENT

8.1 Pursuant to Section 447.1 of the Municipal Act, 2001 and in addition to any other penalty or remedy available to the Town, the Council may, on behalf of the Town with the consent of the local detachment commander of the Ontario Provincial Police or the chief of police of the municipal police force as the case may be, and with notice to the Attorney General of Ontario, apply to the Superior Court of Justice for an order requiring all or part of a Greenhouse be closed for a period not exceeding two (2) years if it be proved on a balance of probabilities that:

a) activities or circumstances on or in the Greenhouse constitute a public nuisance or cause or contribute to activities or circumstances constituting a public nuisance in the vicinity of the Greenhouse;

b) the public nuisance has a detrimental impact on the use and enjoyment of property in the vicinity of the Greenhouse;

c) the Owner of the Greenhouse or part of the Greenhouse knew or ought to have known that the activities or circumstances constituting the public

nuisance were taking place or existed and did not take adequate steps to eliminate the public nuisance; or

d) a conviction for a contravention of this By-Law by a court of competent jurisdiction of a public nuisance in respect to the Greenhouse has been entered, and the conviction is not currently under appeal.

9.0 POWERS OF ENTRY

9.1 Pursuant to Section 436 of the Municipal Act, 2001 and in addition to any other powers of entry granted to the Town, the Town, by its employees or agents, may enter into the Greenhouse at any reasonable time for the purpose of carrying out an inspection to determine whether or not the following are being complied with:

a) this By-Law or any other by-law passed by the Town;

b) any direction or order of the Town made under the Municipal Act, 2001 or this By-Law; or

c) an order to discontinue or remedy a contravention of this By-Law for which a conviction has been entered by a court of competent jurisdiction.

10.0 POWERS OF INSPECTION

10.1 The Town may do any of the following for the purposes of an inspection:

a) require the production for inspection of documents or things relevant to the enforcement of this By-Law;

b) inspect and remove documents or things relevant to the enforcement of this By-Law for the purpose of making copies or extracts;

c) require information from any person concerning a matter relevant to the enforcement of this By-Law; and

d) alone or in conjunction with a person possessing special or expert knowledge, make examinations or take tests, sample or photographs necessary for the purposes of the inspection.

11.0 ENACTMENT

11.1 This By-Law shall come into full force and effect upon the final passing thereof.

Read a first and a second time and provisionally adopted on December 19, 2022.

_____

Mayor

_____

Clerk

Read a third time and finally passed on January 16, 2023.

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Mayor

_____

Clerk