



**City of Kingston
Report to Council
Report Number 24-035**

To: Mayor and Members of Council
From: Craig Desjardins, Director, Office of Strategy, Innovation & Partnerships
Resource Staff: None
Date of Meeting: April 16, 2024
Subject: Opportunities to Support Vertical Farming in Kingston

Council Strategic Plan Alignment:

Theme: 4. Foster a Caring and Inclusive Community

Goal: 4.2 Help address food insecurity and sustainability.

Executive Summary:

The purpose of this report is to address, in part, City Council's Strategic Priority 4.2.1- Examine policies to support urban and vertical farming: Research and report back with options to support vertical farming in partnership with post-secondary institutions and partners (2024-2025). This report will provide a summary of what vertical farming is, current vertical farming activity in Kingston and provide Council with a recommendation to support vertical farming that aligns with the community's vision of food sustainability, economic development, and resilience. Staff recognize that policy development to support vertical farming is still outstanding and will be addressed in the coming months.

By way of background, vertical farming is a method of growing crops in vertically stacked layers/shelving or inclined surfaces, often in controlled environments like shipping containers. This approach aims to maximize space efficiency, reduce environmental impact, and optimize growing conditions through technologies such as artificial lighting, climate control, and nutrient optimization using hydroponics or aeroponics systems.

The evaluation of vertical farming options often considers elements of financial feasibility including initial setup costs such as electrical servicing and water and wastewater connections,

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operational expenses (energy costs and space availability), potential market demand opportunities, economic development potential including direct and indirect employment, and contribution to addressing food insecurity in the community. It could also give consideration to the role and policy implications that vertical farming can play in the broader food ecosystem such as food security, food education, food entrepreneurship, building a sustainable food system and support for local agriculture.

Staff has been working with several vertical farming proponents to advance the vertical farming Council priority and see good alignment of outcomes both in terms of food security, academic research and economic development with more opportunities for collaboration possible with others interested in vertical farming in the future.

Recommendation:

That Council direct staff to continue to explore opportunities to support private sector vertical farming operations in the city through coordination, collaboration and networking efforts appropriate to each organization's stage of development; and

That Council authorize the Mayor and Clerk to enter into any agreements required to reallocate surplus food from Neavie Beans Organic assuming that there are no budgetary impacts outside of the 2024 approved budget; and

That Council support a pilot project with the Queen's University Vertical Farm Team by providing access to City space, in a to be determined City facility, and with a one-time financial contribution of up to \$15,000 to be included in the 2025 operating budget.

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Authorizing Signatures:

ORIGINAL SIGNED BY DIRECTOR

**Craig Desjardins, Director, Office
of Strategy, Innovation &
Partnerships**

ORIGINAL SIGNED BY CHIEF

ADMINISTRATIVE OFFICER

**Lanie Hurdle, Chief
Administrative Officer**

Consultation with the following Members of the Corporate Management Team:

Paige Agnew, Commissioner, Growth & Development & Services

Jennifer Campbell, Commissioner, Community Services Not required

Neil Carbone, Commissioner, Corporate Services

David Fell, President & CEO, Utilities Kingston Not required

Peter Huigenbos, Commissioner, Major Projects & Strategic Initiatives Not required

Brad Joyce, Commissioner, Infrastructure, Transportation
& Emergency Services Not required

Desirée Kennedy, Chief Financial Officer & City Treasurer

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Options/Discussion:

As part of the work to research vertical farming and potential projects to implement in the community, staff have identified two opportunities to support progress of vertical farming in Kingston. These are presented below:

Opportunity 1: Support private sector vertical farming operations in the City through coordination, collaboration and networking efforts appropriate to each organization's stage of development.

Vertical Farming in Kingston**Growcer**

Growcer provides industry-leading vertical farming solutions supported by cutting-edge research, enabling individuals to cultivate hyper-local produce using customizable, turn-key modular vertical farms. They not only assist customers in starting their growth journey but also ensure their continuous success.

Their philosophy revolves around empowerment and collaboration. They equip growers with the necessary tools and technologies while offering expert advice, support, services, financing, and training to facilitate the process. Growers rely on them for more than just a farm; they rely on them for comprehensive support throughout their farming endeavors.

Their technology is meticulously designed and manufactured in Canada, undergoing rigorous testing to ensure durability and resilience against the most challenging conditions. They take pride in their dedication to quality and innovation, guaranteeing that modular vertical farms not only meet but exceed expectations, benefiting customers, businesses, and communities.

The Osiris® farm is a testament to commitment, supporting businesses, communities, and individuals worldwide in cultivating sustainable and delicious food year-round effortlessly. Utilizing reliable, outage-proof deep water culture technology, the Osiris® farm yields over 10,000 lbs of food annually.

To cater to the diverse project needs, they have developed three variations of the Growcer Osiris® farm. These farms are available as standalone units or as part of a Farmplex®, integrated with a Hub Unit alongside other farms.

Over the years, Growcer has developed a close working relationship with Modern Niagara, collaborating on various development aspects of our farms and services. As the next stage in collaboration, Modern Niagara, through its Air Wise division, will commence manufacturing Growcer farms in Kingston. Through this manufacturing partnership, Growcer and Modern Niagara wish to establish a showcase Farmplex project (4 Farms connected together) in the City of Kingston at the new Modern Niagara facility, at 945 Princess Street.

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The goal of this showcase project, besides offering testing and research opportunities to Growcer and Modern Niagara, will be to have the maximum positive impact on the community of Kingston based on what City Council deems most meaningful for the city. The Farmplex will produce over 40,000 lbs of fresh greens year-round. Some of its applications could include:

- Food donation to local food pantries, shelters, and other social & health organizations.
- Research and Education collaborations with Queen's University and St. Lawrence College through research partnerships or micro-credential development.
- Empowering a local entrepreneur to develop a Kingston-grown brand of leafy greens distributed throughout the city by leasing them the farm at an affordable rate.

Collective Joy Farms

Tammara Maher of Collective Joy Farm has been located in downtown Kingston for about a year with an indoor vertical farm and retail store at 477 MacDonnell Street at Princess Street. She is an active community member, business owner and goes to many farmers markets in the region on a regular basis.

Neavie Beans Organic

Neavie Beans Organic is the newest brand under Smitty's Farm Fresh Produce Company Inc., located in Kingston, Ontario. The main objective of Neavie Beans Organic is to produce the best quality leafy greens and culinary herbs organically for the local community all year round who currently must rely on imported products especially during the winter months.

Neavie Beans Organic uses vertical grow technology to maximize its production in a smaller confined space with a 1 to 24 ratio. This means that for every 1,000 square feet of vertical growing, it would require an equivalent of 24,000 square feet of land to produce the same amount of products. They currently grow up to nine feet vertically using only sixteen square inches of floor space, producing up to 48 heads of lettuce, while a conventional field grow operation would only produce 2 head of lettuce in the same square feet area.

Neavie Beans Organic is the first vertical grow operation with a certified organic designation in Ontario, made possible by their innovative and signature growing system, that allowed them to meet the specifications required by the Canadian Organic Regime (COR). They are currently certified by Pro-Cert, one of Canada's largest and respected organic certification body.

City staff have initiated discussions with Neavie Beans to have surplus food redirected to not-for-profit organizations. This report is recommending that Council authorize Mayor and Clerk to sign any agreements required to facilitate the allocation of surplus food as long as there are no financial impacts that outside of the approved 2024 budget.

Opportunity 2: Support a pilot project with the Queen's University Vertical Farm Team by providing access to City space, in a to be determined City facility, and with a one-time financial contribution of up to \$15,000 to be included in the 2025 operating budget.

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Background

Founded in September 2019, the Queen's Vertical Farming Team (QVFT) is Canada's first student-led undergraduate vertical farming design team. They are designing and building a functional, software-automated aeroponic vertical farm on Queen's University campus.

The majority of existing research in this field is conducted by private companies and is thus inaccessible to the public; through its open-source approach, QVFT aims to democratize vertical farming knowledge and research.

QVFT employs an aeroponic cultivation method, in which plants grow without soil and are fed by a nutrient-enriched mist. Crops rest in thin, slotted plastic root cups, through which their roots hang into a basin below. Aeroponics lend well to automation and can allow for near-complete control over the plant growth environment. The system is broadly divided into five zones: mixing tank, nutrient zone, supply line, growth zone, and return line.

The prototyping and manufacturing will be all student based using necessary tools and machines on campus to complete the design.

QVFT x City of Kingston Collaboration

The project being proposed by QVFT is to implement a small-scale vertical farm, capable of growing simple produce in the Kingston community. The students have requested a location somewhere close to Queen's, possibly Portsmouth Olympic Harbor or Portsmouth Town Hall.

This vertical farm would be designed by QVFT and constructed/implemented with the assistance of the City of Kingston. The hope is for this farm to be self-sustainable, with weekly maintenance/check-ins being completed by the City of Kingston. The farm produce would be provided to local not-for-profit meal providers free of charge. The cost of equipment is up to \$10,000.

This farm will follow a simple hydroponic vertical farming model, with technology implemented to monitor water levels, temperature, and lighting. Using LED lights and a water hook-up, this vertical farm model will have the ability to grow a wide variety of produce. Operating costs are up to \$5,000 for the operation of the unit.

QVFT hopes to have a preliminary prototype design completed by Fall 2024, meaning implementation would occur during the semester of Winter 2025.

The prototype would be equipped with a system of pipes, water lines, temperature monitors, and lighting systems will have to be created. The intent of this model is to be as self-sufficient as possible. There are three main designs of vertical farms to choose from.

The proposed design- tower farm can be seen in Image 1.0 below. Some advantages of this design are that production is maximized based on space availability, it is cost effective, and virtually any produce can be grown from this system. Nutrient-rich water from the tank is

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pumped to the top of the tower and it will trickle down the roots of the plants. Water is recycled once it reaches the bottom of the tower. A disadvantage of this system is that it would require slightly more frequent cleaning and maintenance.

Vertical Farming Overview

The concept of vertical farming has roots dating back to the early 20th century. However, the term gained prominence in the 21st century as a response to increasing urbanization, population growth, and concerns about existing agriculture's environmental impact.

While the idea of growing crops vertically was mentioned as early as 1915 by Gilbert Bailey, the modern concept of vertical farming is often attributed to Dickson Despommier, a professor at US college, Columbia University. In 1999, he and his students popularized the idea of transforming urban spaces, into multi-storey farms.

As concerns about food security, community resiliency, resource efficiency, and greenhouse gas emissions from food imports have grown over recent decades, vertical farming has gained attention. At the same time, advances in technology, such as LED lighting and hydroponics, have made vertical farming more feasible.

Vertical farming continues to evolve, with ongoing research and innovations. It remains a promising approach to address the challenges of traditional agriculture and meet the demands of a growing global population, especially in urbanized areas.

The suitability of vertical farming depends on various factors such as climate, available space, and economic feasibility. Kingston has a temperate climate with cold winters, which could impact the energy requirements for maintaining optimal growing conditions in a vertical farm.

Types of Farming

There are many types of farming, each adapted to specific environmental, economic, and cultural conditions, including:

- **Subsistence Farming:** Farmers grow crops and raise animals primarily to meet the needs of their own families. The focus is on self-sufficiency rather than selling produce in the market.
- **Commercial Farming:** Agriculture conducted primarily for the purpose of selling crops and livestock for profit. Commercial farmers aim to maximize yields and revenue.
- **Intensive Farming:** Involves high levels of input, including labour, machinery, and fertilizers, to maximize the yield of crops per acre of land. Often associated with commercial agriculture.
- **Extensive Farming:** Involves large areas of land and lower inputs per acre. Common in regions where land is abundant, and farmers can allow fields to lie fallow to maintain soil fertility.
- **Organic Farming:** Emphasizes sustainable practices, avoiding synthetic pesticides and fertilizers. Organic farmers focus on maintaining soil health and biodiversity.

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- **Precision Farming (Precision Agriculture):** Utilizes technology such as GPS, sensors, and data analytics to optimize farming practices, improving efficiency and reducing resource inputs.
- **Mixed Farming:** Combines different types of farming activities on a single farm, such as crop cultivation alongside livestock raising. This approach helps diversify income sources.
- **Vertical Farming:** Involves cultivating crops in vertically stacked layers/shelving or vertically inclined surfaces, often in controlled indoor environments. It maximizes space efficiency and allows for year-round production.
- **Aquaponics:** Integrates aquaculture (raising fish) and hydroponics (growing plants in water) in a symbiotic environment. Fish waste provides nutrients for plants, and plants help filter the water for the fish.
- **Hydroponics:** Involves growing plants without soil, using nutrient-rich water solutions. This method allows for precise control over nutrient levels and is commonly used in controlled indoor environments.
- **Agrivoltaics:** Involves the simultaneous use of areas of land for both solar panels and agriculture. It can refer to different methods of combining crops with solar panels, from conventional solar panels placed on top of crops, to greenhouses made of semi-transparent PV panels.
- **Agroforestry:** Integrates trees and shrubs into agricultural systems. This approach enhances biodiversity, improves soil fertility, and provides additional products such as timber or fruits.
- **Horticulture:** Focuses on the cultivation of fruits, vegetables, and ornamental plants. Horticultural practices often include intensive cultivation methods and specialized techniques.
- **Silvopasture:** Integrates trees and livestock grazing. This practice combines the benefits of forestry, agriculture, and animal husbandry to enhance sustainability.

These farming types can overlap, and farmers choose a combination of practices based on factors such as climate, soil conditions, market demand, and personal preferences.

Vertical Farming Types

A vertical farming operation can take many forms, depending on the goals of the project and the resources available. The following are examples vertical farming models:

- **A small-scale, indoor hydroponic farm:** A pilot operation could be a small-scale, indoor hydroponic farm located in an abandoned industrial building, warehouse, greenhouse or any room of suitable size with water and electricity access. This type of pilot would typically use a hydroponic system, such as nutrient film technique (NFT) or deep-water culture, to grow leafy greens, herbs, and microgreens. This type of pilot would have a low to moderate investment and would be suitable for testing and evaluating growing methods and the feasibility of different crops.

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- A modular, containerized farm: A pilot operation could be a modular, containerized farm, located in an urban area. The containers are equipped with all the necessary equipment and technology to grow crops using hydroponic or aeroponic systems. This type of format allows flexibility to move the containers to different locations and can have a low to moderate investment, depending on the technology used.
- A research-oriented farm: An operation could be a research-oriented farm located in a research institute, university, or non-profit organization. This type of vertical farm focuses on testing and evaluating new technologies, growing methods and crop varieties. It may have a higher investment, requiring advanced equipment and technology.
- An open-air, urban farm: An operation could be an open-air, urban farm located in an unused public space or a community garden. This type of vertical farm would typically use aeroponic or hydroponic systems to grow crops, and it would be a low-cost option to test and evaluate different growing methods. Due to climate constraints, this model would produce roughly half the annual produce as the three preceding examples.

Municipal Success Stories

Jersey City, USA

In New Jersey, the City of Jersey City partnered with Aero Farms to install ten vertical farm operations across the city at a cost of \$1,000,000 USD. The vertical farms will be installed in public housing developments, the City Hall annex, two senior centers and a community center owned by the City. The City is considering installing the remaining units in a public school, a medical clinic, and a university. The goal is to place the farms in locations with low food access and high propensity for poverty. The overarching program, Healthy Greens JC, will provide the produce grown for free to eligible residents (eligibility requirements not available) in the hope that the fresh and free produce will increase the health and well-being of the program's participants. The municipality will work with local non-profits to expand the program's reach. To educate the public about the program, the City will host quarterly 'health fairs' and health workshops to increase participation in the program.

Newark, USA

In New Jersey, the City of Newark partnered with the vertical farming company AeroFarms to build a large-scale vertical farm in an abandoned steel factory. The partnership demonstrates how municipalities can support vertical farming by providing funding or facilities and by helping to connect the farms to local markets.

The farm, one of the largest indoor vertical farms in the world, is a fully-controlled environment that produces leafy greens and herbs using aeroponic systems and supplies its produce to local supermarkets and food service providers. The partnership between the local government and AeroFarms was established in 2013. It has successfully brought jobs, promoted local food systems and increased access to fresh, sustainable produce for the City of Newark.

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The facility uses proprietary LED lighting technology and a closed-loop irrigation and nutrient delivery system, which allows it to conserve water and energy while producing food year-round. The farm also employs several sustainable practices, such as recycling water, capturing and reusing carbon dioxide, and composting plant waste. The facility was built in an unused industrial space, which helped to revitalize the area.

Youngstown, USA

In Youngstown, Ohio, the Youngstown City Schools purchased a Fork Farms Flex Farms indoor vertical hydroponic system with their William Swanston Charitable Fund grant. The \$4,000 USD units take up less than 10 square feet of space, are portable, and are planned to provide fresh greens for the lunch menu in three Youngstown elementary schools. Fork Farms is a Wisconsin-based company.

Analysis

Vertical farming offers several advantages over traditional farming, but also faces challenges that need to be addressed for widespread adoption and long-term sustainability. Technological advancements, economies of scale, and ongoing research will play key roles in overcoming these challenges.

The advantages and disadvantages of vertical farming are provided below:

Advantages of Vertical Farming:

- **Space Efficiency:** Vertical farming maximizes space utilization by stacking layers of crops vertically, allowing for higher yields in smaller areas compared to traditional farming.
- **Year-Round Crop Production:** Controlled indoor environments enable year-round cultivation, reducing dependency on seasonal changes and weather conditions.
- **Resource Efficiency:** Vertical farms often use less water compared to traditional agriculture, and the closed systems minimize the need for pesticides and herbicides.
- **Climate Control:** Precise control over temperature, humidity, and lighting creates optimal conditions for plant growth, enhancing overall crop quality and yield.
- **Localized Production:** Vertical farms can be established in urban areas, reducing transportation costs and carbon footprint associated with long-distance food distribution.
- **Reduced Land Footprint:** Vertical farming reduces the need for expansive land, making it feasible in densely populated regions where traditional farming might not be viable.
- **Crop Diversity:** The controlled environment allows for the cultivation of a variety of crops, including those that might not thrive in specific climates.
- **Faster Growth Cycles:** With controlled conditions, crops can grow faster, leading to more frequent harvests and increased overall productivity.

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Disadvantages of Vertical Farming:

- **High Initial Costs:** Setting up a vertical farm with advanced technologies can be expensive, making it a barrier for entry, especially for small-scale farmers.
- **Energy Consumption:** The artificial lighting, heating, and climate control systems contribute to higher energy consumption, potentially offsetting some of the environmental benefits.
- **Technical Complexity:** Managing and maintaining the technology required for vertical farming demands specialized knowledge, which can pose challenges for traditional farmers transitioning to this model.
- **Dependency on Technology:** Malfunctions or disruptions in technology can have significant impacts on crop production, making vertical farms vulnerable to technical failures.
- **Limited Crop Types:** While advancements are being made, certain large or root-based crops are still challenging to grow efficiently in vertical systems.
- **Waste Generation:** The production of certain materials like LED lights and the disposal of non-recyclable components can contribute to environmental waste.
- **Economic Viability:** The success of vertical farming depends on factors such as market demand, pricing, and consumer willingness to pay a premium for locally grown produce.
- **Regulatory Challenges:** There may be regulatory hurdles related to land use, building codes, and safety standards that vary by location and can impact the feasibility of vertical farming.

Considerations of Municipal Policy Implications in Vertical Farming:

Any consideration of policy supports for vertical farming should be done within the context of policies in broader farming sector. Examples of policies used in other jurisdictions include:

Zoning and Land Use Regulations:

- Consider development of clear zoning regulations to accommodate vertical farming within urban areas.
- Establish vertical farm installation guidelines for building heights, structural requirements, and permissible locations to ensure safety and compliance.

Incentives for Urban Agriculture:

- Consider introduction of financial incentives, or grants to encourage the establishment and growth of vertical farming operations within the city limits.
- Offer reduced property taxes or utility subsidies for businesses adopting sustainable practices.

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Water and Energy Policies:

- Implement water conservation policies to regulate the use of water in vertical farms and encourage the adoption of water-efficient technologies.
- Promote the use of renewable energy sources and consider incentives for sustainable energy practices in vertical farming operations.

Waste Management:

- Develop policies for responsible waste management in vertical farms, including guidelines for recycling and proper disposal of agricultural and technological waste.
- Encourage composting and the reuse of organic waste for local agricultural purposes.

Educational Programs:

- Create educational programs to inform residents about the benefits of vertical farming and sustainable agriculture.
- Collaborate with post-secondary education institutions (like Queen's University and St. Lawrence College) to promote research and education in the field of urban agriculture.

Food Safety and Quality Standards:

- Enforce regulations to ensure the safety and quality of produce from vertical farms, including monitoring of pesticide use, nutrient management, and adherence to health standards.
- Collaborate with relevant agencies to establish certification programs for local vertical farms.

Community Engagement:

- Facilitate community engagement initiatives to gather input on vertical farming policies.
- Encourage public engagement in decision-making processes related to urban agriculture to build support and address concerns.

Support for Research and Development:

- Provide support for research and development in vertical farming technologies and sustainable agricultural practices.
- Foster partnerships with research institutes and private enterprises to drive innovation in urban agriculture.

Job Training and Employment Opportunities:

- Develop programs (similar to the Kingston Community Training Farm) to train and educate residents for employment in vertical farming.

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- Facilitate partnerships between vertical farms and local secondary schools to create internship and apprenticeship opportunities.

Emergency Preparedness and Resilience:

- Include vertical farming in local emergency preparedness plans, recognizing its potential role in ensuring a stable food supply during crises.
- Develop contingency plans for disasters and emergencies to safeguard both the infrastructure and food production capabilities of vertical farms.

By addressing these policy considerations, the municipality can create an enabling environment for the growth of vertical farming, fostering sustainability, economic development, and community resilience. As per the Council strategic plan, City staff will explore this policy framework in 2024-2025.

Public Engagement

While staff have not conducted public engagement on vertical farming, staff has recently completed a survey on local food. With the goal of better understanding the perceptions and food-buying habits of Kingstonians, the survey was conducted to collect feedback to inform a food strategy. This engagement directly supports the strategic priority of supporting local food, food production, agriculture, food security and sovereignty.

The survey was conducted on Get Involved Kingston from June 28 until August 18. The community was provided with the opportunity to engage online, by phone, by email or in-person at pop-up events, including Canada Day in Shannon Park and Pride at City Park. Social media and the Get Involved Kingston Newsletter were used to communicate this opportunity to the public, and the survey was also shared via email with City councillors and community partners such as Loving Spoonful and the Memorial Centre Market.

The survey engaged 880 participants who completed the survey, with 870, or 98% of respondents being consumers as compared to only 9% reporting they were farmers, home business or a community gardener. Below is a summary of key messages from the survey:

- Nearly all respondents understood what “local food” meant when asked in a multiple-choice question, with the majority of respondents answered that local food mean that it was either grown in my region (80%), grown in Ontario (54%) or grown within 100 km (53%). Less than 1% said that they did not know what local food meant.
- In the past year, most respondents have bought local food weekly, with 90% of people buying local food in the past year, and 53% purchasing it weekly. Purchases of local food were most often made at local grocery stores (74%), farmers’ markets (72%) or at a farm or farm gate (47%). Culturally-specific food stores (4%) and online (6%) were the least frequent food purchase locations.
- The majority of respondents go out of their way to buy local food (90%) and find it easy to get locally produced foods (80%).

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- Most respondents are also willing to pay more for local food (70%); however, half of respondents don't believe the cost is comparable to food that isn't grown or produced locally (50%).
- A variety of barriers face respondents when they buy local food. These include the amount of time it takes to find local food or read labels (55% feel it is too long) and knowing if food is local or not in the store (45%) or in restaurants (72%).
- If local food was more convenient to access, a large majority of respondents would purchase and consume it more often (83%). Wider availability in big box stores (80%), wider availability of products in winter (70%) and lower prices (73%) would also influence respondents to buy local foods more often.
- Visiting farms (18%) or participating in growing local food (19%) would have the least influence on purchasing behaviours.
- Clear labeling (42%) was moderately important to respondents and having more information available about local food being the least area of influence (16%).

Survey results highlight the desire of many Kingston residents for easy and year-round access to locally grown food. These results align with many of the project outcomes of vertical farming.

Indigenization, Inclusion, Diversity, Equity & Accessibility (IIDEA) Considerations:

It has been proposed that the fresh produce grown by the Queen's Vertical Farm Team will be donated to local organizations supporting food insecurity. Discussions with Green Leaf Farms on the donation of some percentage of produce grown is ongoing.

Financial Considerations:

Funds to support the pilot project with QVFT of up to \$15,000 will be included in the 2025 operating budget.

Contacts:

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Julie Salter-Keane, Manager, Climate Leadership

Desiree Kennedy, Chief Financial Officer and City Treasurer

Exhibits Attached:

None