Kwantlen Polytechnic University

Department of Sustainable Agriculture

KPU Farm at the Garden
City Lands Report (2021)

City of Richmond Department of Parks, Recreation, and Cultural Services Committee

Introduction

Kwantlen Polytechnic University has now completed four growing seasons at the KPU Farm on the Garden City Lands. The first three hectares (Phase 1) were certified organic by the BC Association for Regenerative Agriculture in April of 2021, upon completion of the three-year organic transition period.

Highlights of 2021 include a substantial berry planting, further expansion of our irrigation system, and addition of track to our sliding high tunnels. KPU dedicated resources to establishment of a new learning garden, planning for expansion onto the remaining five hectares (Phase 2) of the license area, and plans to construct a barn to replace temporary infrastructure at the site.

In 2021 we harvested 18 tons of certified organic produce from the site, with a retail value of more than $80,000. This was sold at a Tuesday afternoon farmers market across from City Hall, through a variety of wholesale channels, or donated to the Richmond Food Bank. Our capacity to scale up is limited only by labour.

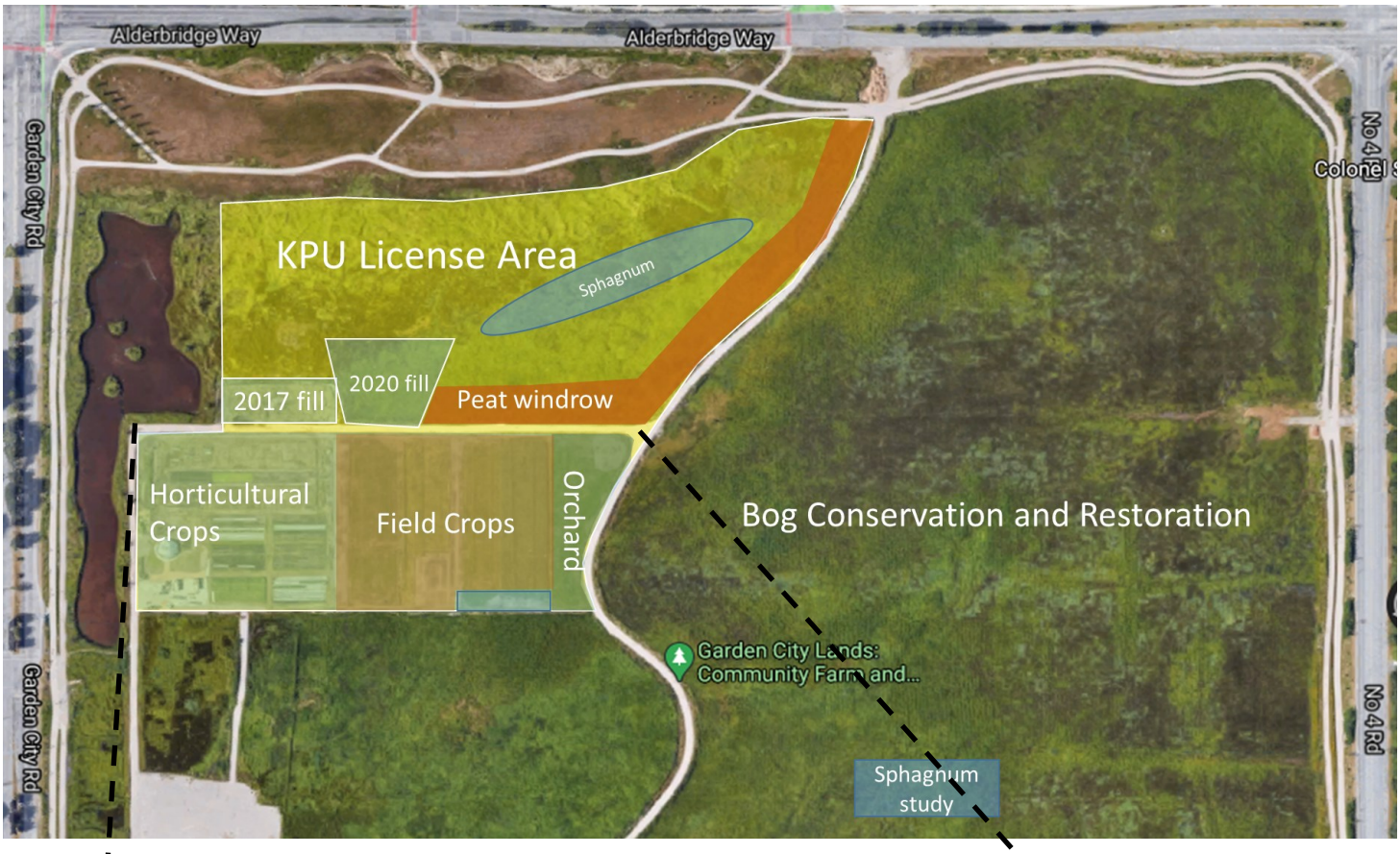
The farm continued to adapt to challenges posed by the pandemic, coupled with a series of notable extreme weather events. It proved to be resilient to the heat dome in June and atmospheric rivers in November. Despite pandemic-imposed safety restrictions that required most KPU classes to remain online in 2021, students were able to participate in all aspects of farm planning, management, and sales throughout the year. In-person classes at the KPU Farm on the Garden City Lands continued year-round, and no incidents of COVID transmission occurred in the outdoor learning environment. Several students were also able to complete applied research projects at the site.

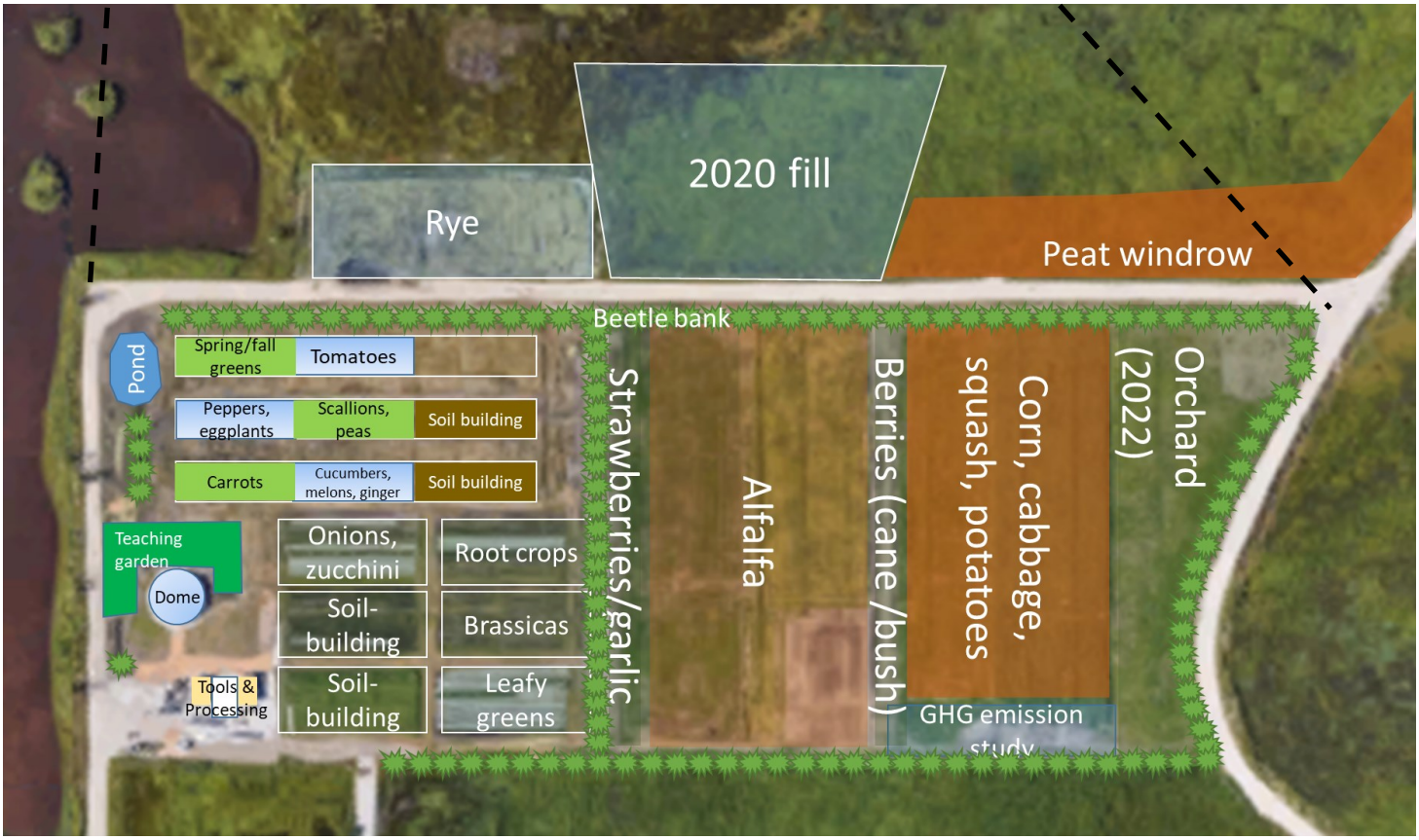
Although the ongoing pandemic reduced opportunities for public engagement, it also opened the door for virtual interactions that might not have occurred otherwise. These included virtual tours of the site by Premier John Horgan and several MLAs in March, and by province-wide participants in a virtual edition of the biennial BC Seed Gathering in November.

We are grateful for the support from the City of Richmond that continues to enable the KPU Farm at the Garden City Lands to teach and demonstrate community-engaged sustainable agriculture.

KPU students and faculty masked and distanced in a high tunnel, April 2021.

Farm Maps—2021





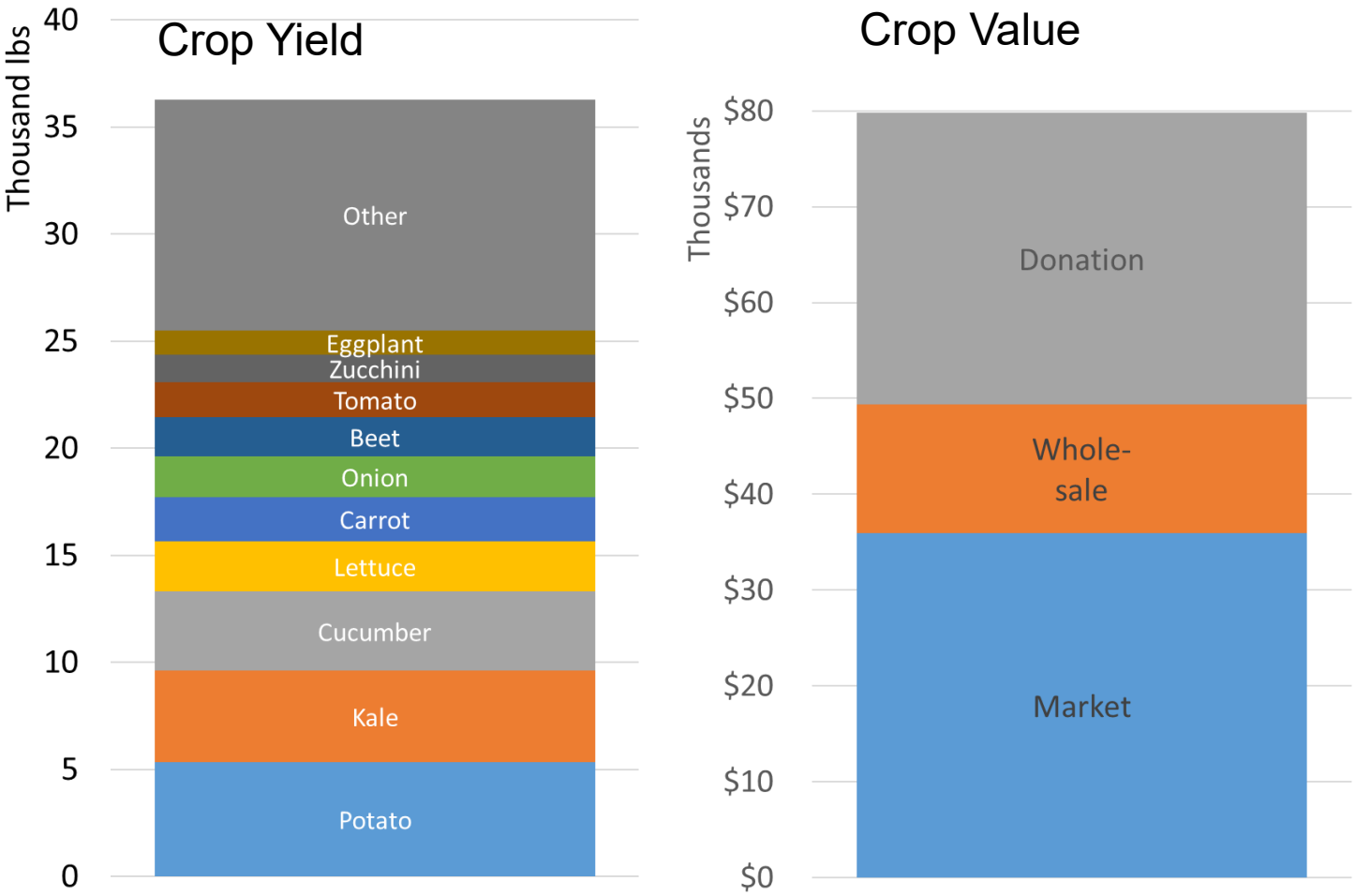
Crop Production

The KPU Farm at the Garden City Lands produced 36 thousand pounds (18 imperial tons or 16 metric tonnes) of certified organic vegetables in 2021, with a retail value of 80 thousand dollars. More than 40 different crops were grown. The 10 most productive are shown by the coloured slices in the Crop Yield bar graph below.

The harvested produce was either sold or donated, as shown the crop value bar graph below. The Richmond Food Bank accepted more than 30 thousand dollars worth of produce donations. Sales totaled 50 thousand dollars, with 36 thousand dollars in direct sales at the Kwantlen St. Farmers Market, and the remainder from sales to wholesale distributors that prioritize local organic produce, including Discovery Organics and the Jarr package-free delivery service.

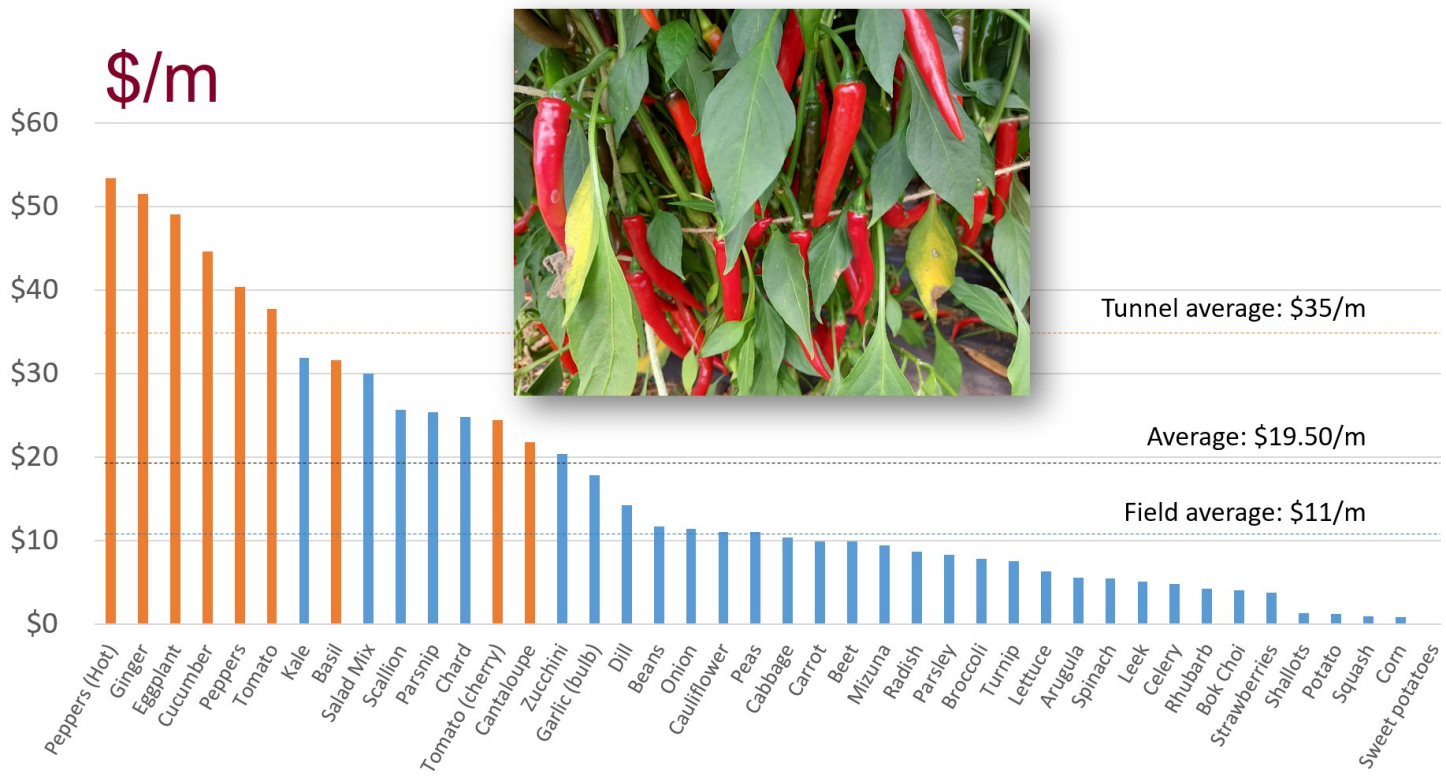
Salad mix, carrot, and lettuce were the top-selling crops at the Farmers Market, while kale, tomato, and cucumber led wholesale sales. Cucumber, lettuce, and tomato were the most donated crops.

Productivity per unit area was measured in dollar value per bed meter. High tunnel beds produced an average of 35 dollars per meter, while outdoor beds produced an average of 11 dollars per meter. Hot peppers, ginger, and eggplant were the most productive high tunnel crops. Kale, salad mix, and scallions (also grown in high tunnels in early spring and late fall) were the most productive outdoor crops.



Crop yield by weight (left) and dollar value (right). Yield bar is divided to show 10 most productive crops on a weight basis. Value bar is divided to show how yield was distributed between direct-market sales, wholesale sales, and donations.

Small farm production types at the Garden City Lands include high tunnels (left, 20 m beds); market gardens (center, 30 m beds); and field crops (right, 100 m beds) zones. Larger-scale systems tend to be less labour intensive and are positioned further from the entrance hub in the southwest corner of the farm.



Farm income per bed meter by crop variety for 2021. Orange and blue bars denote high tunnel and outdoor field beds, respectively. Orange and blue dashed lines show the average income per bed meter for high tunnel and outdoor field beds, respectively. The average income overall was $19.50 per bed meter, shown by the black dashed line.

Pandemic and extreme weather responses

The farm was remarkably resilient in spite of extreme weather events and an ongoing pandemic in 2021.

Pandemic

The hands-on classes offered at the Garden City Lands were among very few that KPU allowed to run in-person throughout 2021. Students and faculty appreciated the rare opportunity to engage with one another and with the farm during a second year when most schooling was conducted online. No COVID-19 transmission events occurred.

Heat dome (June)

Unusually high temperatures occurred between June 26th and 29th, with highs at the Garden City lands exceeding 30°C for four consecutive days. Before the heat dome, high tunnels were moved from cool-season crops (e.g. lettuce, chard, kale) to warm-season crops (e.g. tomato, cucumber, pepper) with better ability to tolerate high temperatures. Transplants were removed from the solar-heated dome and established outdoors. The farm continued to produce abundantly despite the unusual weather event, and likely helped counter the urban heat island effect experienced in Central Richmond.

Atmospheric rivers (November)

More than 120 mm of rain fell at the Garden City Lands between November 14th and 16th, flooding all of the site except the KPU Farm, where raised and drained soil allowed farming to continue.

KPU student Alex Bisset harvests tomatoes in a high tunnel on July 6th, following an extended period of record-breaking high temperatures. Although high temperatures inhibit tomato fruit set, the structure's passive ventilation system, controlled by a solar-powered computer, enabled sufficient cooling for plants to recover quickly. The high tunnel yielded 1.2 tons of cherry and slicing tomatoes between June 30 and Sept. 7, 2021, with a fresh market value of $7,400. Tomato varieties grown in the tunnel included local heritage accessions 'Alpha,' 'Golden,' and 'Mikado,' conserved by Richmond's Steves family.

The sun rises over the Garden City Lands on November 17th, 2021. The raised area of the KPU Farm was the only section of the Garden City Lands to escape severe flooding during two atmospheric rivers that brought record-breaking precipitation between November 14th and 16th. Soils drained well, and farm operations continued throughout the unusually wet period, despite flooding on the remainder of the site. *Ruth Fung photo*.

Infrastructure

Irrigation

The irrigation system was expanded and improved in 2021. A frost-free irrigation line was run to the dome greenhouse to allow year-round irrigation in the structure. New lines were buried between the dome and the processing area and between the dome and the high tunnels.

Supply lines were extended to each of the market garden plots, and along the eastern edge of the currently farmed are, in preparation for orchard planting. Each line can be controlled independently and the solar greenhouse now has year-round access to irrigation.

Blowing out the irrigation connection between the dome and high tunnels, November 30, 2021,

Solar Growing Dome

The solar dome greenhouse was built in October, 2018. Its primary purpose is early production of spring vegetable transplants while avoiding the greenhouse gas emissions normally associated with greenhouse heating systems.

Improvements to the dome in 2021 include:

- Weather station hub. Temperature, relative humidity, rainfall, and windspeed can be monitored at various sites around the farm, which feed their data wirelessly to a display monitor in the dome.
- Germination chamber. A salvaged commercial refrigerator has been re-purposed to create a germination chamber in the dome. A warm, humid environment is maintained in the chamber by a thermostat-controlled slow cooker full of water.
- Soil blocking system. The soil blocking system consists of soil blockers and a re-purposed bathtub filled with potting soil mix. Soil blockers are used to compact the potting soil into trays of cubic soil blocks for seeding. The roots of the growing seedlings help hold the blocks together, and the entire block can be transplanted directly. The system reduces plastic tray waste and speeds transplanting. A student experiment in 2021 showed that the peat component of the potting soil mix could be cut in half without reducing seedling growth by substituting aged mushroom manure compost. While adopting this tactic, we continue to search for locally-available replacements for peat in our potting soil mixes.

A KPU student makes soil blocks in front of the germination chamber, Feb. 23, 2021. Blocks of germinated seedlings are below.

Infrastructure

Moveable High Tunnels

Three 9 x 21 m (30 x 70 ft.) moveable high tunnels are used at the farm. These are passively-heated plastic-covered hoop structures that harness the energy of the sun to extend the growing season for soil-based crop production. They are securely attached to steel tracks, each anchored by six one-ton concrete blocks. A tunnel can be detached, rolled to a different position, and reattached to its tracks. Moving the tunnels facilitates crop rotation, prevents salt accumulation by exposing previously covered areas to rainfall, and reduces soil-borne disease incidence.

The tunnel tracks were extended near the end of 2021, allowing each tunnel to sit in one of three positions.

The tunnel side walls and end vents automatically open and close to allow passive ventilation and stabilize internal temperatures. Automation is driven by electric motors and controlled by a computer attached to environmental sensors. The system is powered by photovoltaic panels, allowing the tunnels to operate without any connection to the electrical grid.

Salad greens in a high tunnel, ready to harvest from dry soil on November 17, 2021, the day after an atmospheric river flooded most of the Garden City Lands.

Swales constructed between the tunnels guide rainwater shed by the tunnels into a seasonal catchment pond. Photo taken January 15, 2021.

Over-wintered spinach, ready to harvest from a high tunnel, January 15, 2021.

Cucumbers in a high tunnel, August 5, 2021.

KPU Farm at the Garden City Lands in early, mid, and late 2021. Note changing positions of sliding high tunnels on left. Additional track laid in late 2021 will allow each tunnel to move to a third position in its rotation in the future. *Ruth Fung photos.*

Learning Garden

In January 2022, KPU provided funding to support the establishment of a Learning Garden at the KPU Farm for our local community. Through partnerships with local community organizations, the garden will provide an experiential learning space to foster appreciation of the critical role that agroecology plays in building healthy, sustainable communities.

The Learning Garden consists of 14 raised beds on the north side of the dome, and includes beds accessible to those who use wheelchairs.

Objectives

1. Establish an engaging learning environment to increase community literacy about sustainable food production, agroecology, ecosystem diversity, and climate resilience.
2. Foster long-term relationships with grade schools in Richmond to facilitate transformational learning experiences focused on food systems and sustainability.
3. Work with community partners to provide programing for all ages and abilities that fosters appreciation of the importance of protecting land for sustainable regional food production, and the critical role that resilient ecosystems play in sustainable communities.

These objectives will be met through activities that include:

- school field trips;
- a community volunteer program;
- adult workshops; and
- community tours.

Community Volunteer Program

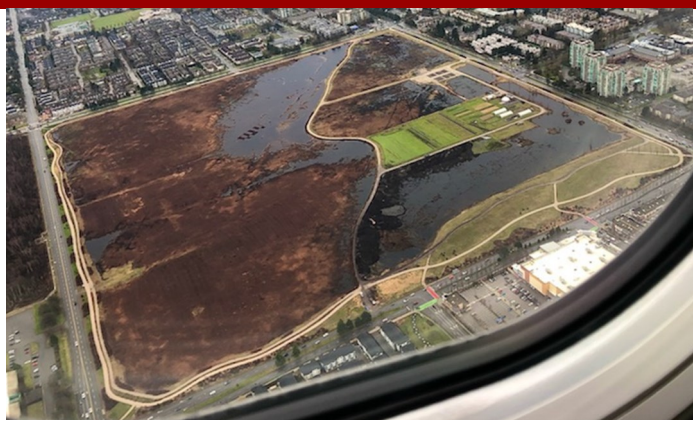
We are currently accepting applications for the community volunteer program. Volunteers will grow food at the learning garden, assist with programing on site, and learn more about sustainable agriculture. Learn more, and apply to volunteer, at https://www.kpu.ca/agriculture/kpu-farm-learning-garden

Biodiversity

Promoting Biodiversity

The farm is managed to creating varied habitats for a wide range of species. Tactics used to promote biodiversity include:

- **Cover cropping.** We avoid bare soil by planting cover crops in any areas not used for cash crop production. Cover crops are selected for their soil-building properties, and often include grass -legume mixtures. Legumes convert atmospheric nitrogen into plant-available forms, and grasses scavenge nutrients and build soil organic matter. Market garden plots are cover-cropped each winter and every third summer.
- **Bird houses.** Owl boxes and swallow houses have been installed along the farm edges, providing nesting sites for important predators. The City of Richmond has erected signs to keep visitors away from the bird houses, with QR codes linking to online information about City conservation programs. We plan to follow this model by erecting QR code signs linking to information about our other efforts to promote biodiversity on the farm.
- **Beetle banks.** Raised linear mounds planted to native perennial grasses and forbs run around the farm perimeter and cut across the farm. These 'beetle banks' are intended to provide habitat for ground-nesting predatory beetles that assist with biological pest control. They also provide habitat for ground-nesting native bees, and forage for honeybees and other pollinators.



Cover crops keep the KPU Farm green through winter.

Visitors with smart phones can access online information about City conservation programs using the QR code on signs like this.

Information about conservation efforts on the KPU farm is being added to the KPU website, and will be accessible through QR code signs.

Biodiversity

- **Heritage crops and participatory breeding.** Our planting choices incorporate a wide diversity of crops and varieties to foster genetic diversity in the field. We incorporate open-pollinated varieties, heritage varieties, and locally-adapted varieties into our crop rotations. Dr. Alex Lyon joined our department in 2020, bringing her wealth of experience in participatory plant breeding. She leads trainings in crop evaluation for seed selection and propagation.
- **Perennial plantings.** Land dedicated to annual crop production is broken up by zones of perennial plantings. Perennial zones provide important habitat and help build and conserve soil carbon by reducing soil disturbance and promoting deep and extensive root systems. Perennial crops grown at the farm include alfalfa, cane fruits, and fruit trees. In 2021, the City of Richmond helped secure Tree Canada grant funds to plant a fruit tree orchard next to the dike.
- **Invasive removal.** Perennial zones can be overrun by invasive perennial weeds such as blackberry, bindweed, Canada thistle, and reed canary grass. We attempt to prevent, remove, and suppress invasive perennials throughout the farm without using herbicides.

Dr. Lyon evaluates radicchio varieties with KPU Sustainable Agriculture students on the Garden City Lands, October 2021.

A study conducted from 2019 to 2020 compared different mulches for management of invasive perennials. Freshly-laid mulches on the left (2019) include a hemp blanket, clear or black plastic film, and wood chips. A year later (right) all but the plastic mulches had disintegrated and invasive perennials in the mulched plots included reed canary grass and blackberry. These invasive perennials did not survive in a mowed strip along the roadside, which supported a much more diverse assortment of grasses and forbs. Based on this study, regular selective mowing is being used as a management tactic to combat blackberry and reed canary grass.

Community Engagement

Farmers Market

Our program continues to sellour produce at a weekly Tuesday market (12-4 pm, April-November) in the Brighouse Park lacrosse court, across from City Hall. The site allows control over how many people are admitted at once.

The market has been an important connection with community members seeking fresh locally-grown produce during the pandemic. Demand has been growing, and people are willing to line up to visit the stand one-by-one in order to maintain physical distancing. We have developed a strong following of appreciative customers, facilitating many learning oppotunities for both our students and community members.

Spring market stand, April 20, 2021.

Informal Conversations with Neighbours

As the community is increasingly using the trials on the Garden City Lands, there have been many conversations with neighbours about what is happening on the farm. There is a great deal of public interest in farm activities, leading to opportunities for impromptu tours and discussions.

Farm neighbor Ruth Fung regularly shares her bird's-eye-view photos of the farm, taken from her home on the 12th floor of a building on the west side of Garden City Road.

Student Research Projects

Several students conducted experimental field studies in collaboration with community stakeholders at the Garden City Lands in 2021. These included a test of spent mushroom compost as a replacement for peat in our transplant production system, and a comparison of different planting dates for organic canola production. Industry partners included Highline Mushrooms, Nature's Path, and Stonehenge Organics.

Details of the student research projects are at https://www.kpu.ca/agriculture/student-research/

Student C.J. Nyereyegona tends his canola research plots at the Garden City Lands, June 17, 2021.

BC Seeds Gathering

The biennial BC Seeds Gathering was held virtually in November 2021, instead of at KPU's Richmond campus, to minimize risk of disease spread. A video introduction to KPU's Seed Lab and the KPU Farm at the Garden City Lands was shared with seed growers province-wide (see www.kpu.ca/seeds). The event attracts seed growers, researchers, students, advocates and community seed organizers, facilitating connections and conversations to build a strong local seed sector.

Virtual Tour with Premier and MLAs

Premier John Horgan, Minister of Agriculture Lana Popham, and several other MLAs participated in a one-hour virtual interactive tour of the KPU Farm at the Garden City Lands in March, 2021. MLA Henry Yao (Richmond South Centre) followed up with an in-person visit to the farm. Minister Popham invited Dr. Bomford to serve on a Minister's Advisory Committee for Regenerative Agriculture and Agri-Tech.

Dr. Bomford led a virtual farm tour for provincial legislators in March, 2021. The interactive tour was streamed live through an iPad, allowing the legislators to see transplants growing in the solar dome greenhouse, visit the sliding high tunnels, and discuss beekeeping with apiculture instructor Dr. Lait.

Twilight Tours

The series of 'Twilight Farm Tours' resumed in fall of 2021. Evening farm tours will continue to be offered on the second Tuesday of each month during the growing season. The three tours offered in fall 2021 attracted small groups of interested Richmond residents, allowing for plenty of discussion.

Garden City Conservation Society

The Garden City Conservation Society held a hybrid (in-person and live-streamed) annual general meeting at the farm on October 2, 2021. The Society was an early advocate for retention of the Garden City Lands in the Agricultural Land Reserve, and is taking an active interest in wetland restoration on the east side of the property.

The Society's AGM was followed by group visit to the area north of the existing farm, slated for farm expansion. This area includes a thriving population of *Sphagnum* moss, a keystone species that plays an important role in peat formation. The Society has since received an Environmental Enhancement Grant from the City of Richmond for a citizen science project to transplant *Sphagnum* to the wetland restoration zone on the other side of the dike, to establish a *Sphagnum* propagation system that will allow continued transplanting in future years, and to conduct *Sphagnum* surveys to monitor progress in re-establishing the moss for bog restoration.

The Garden City Conservation Society is working with KPU to transplant *Sphagnum* moss (inset) from the area slated for farm expansion to the area east of the dike, dedicated to bog conservation and restoration.

Feed BC Initiative

The BC Ministry of Agriculture launched the Feed BC Initiative in February 2021 to increase institutional procurement of food grown in BC. Through this initiative the provincial government is partnering with KPU, and other post-secondary institutions, to promote and track local food procurement for campus food services. KPU's new food services vendor, Compass/Chartwells, has committed to purchasing at least 30% of the food it serves in campus cafeterias from local vendors, with a particular emphasis on utilizing food grown by Sustainable Agriculture students at the KPU Farm on the Garden City Lands. KPU has also invested in a food waste dehydration system at its Richmond campus to facilitate a closed-loop nutrient cycle, with food scraps returned to the farm for composting and soil amendment.

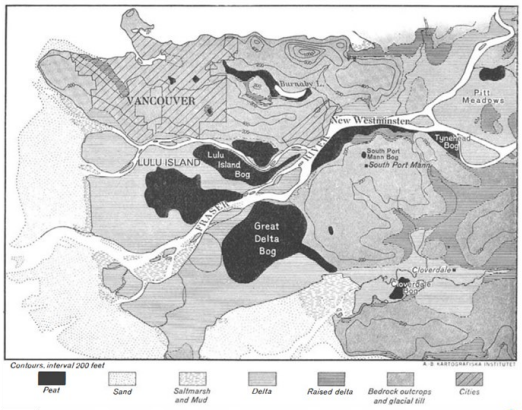
Farm expansion and carbon sequestration

The Garden City Lands sit at the northwest edge of an ancient peat bog. Peatlands are important natural carbon sinks: They cover just 3% of the earth's land, but store more carbon than all other vegetation types combined. Richmond's peatlands contain the highest concentration of soil carbon in the Fraser Valley.

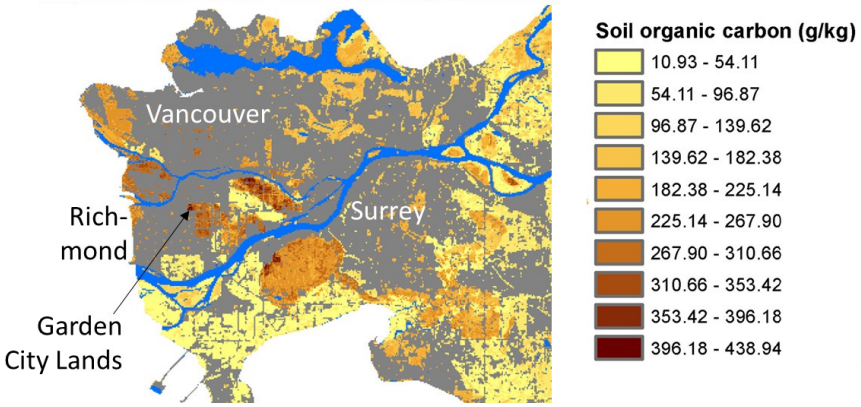
Peatlands preserve sequestered carbon when they are wet. Draining peat allows oxygen to enter, favouring microbes that break down the peat and release long-sequestered carbon into the atmosphere as carbon dioxide, contributing to climate change. More than a ton of carbon dioxide is released for every dry ton of peat that decomposes.

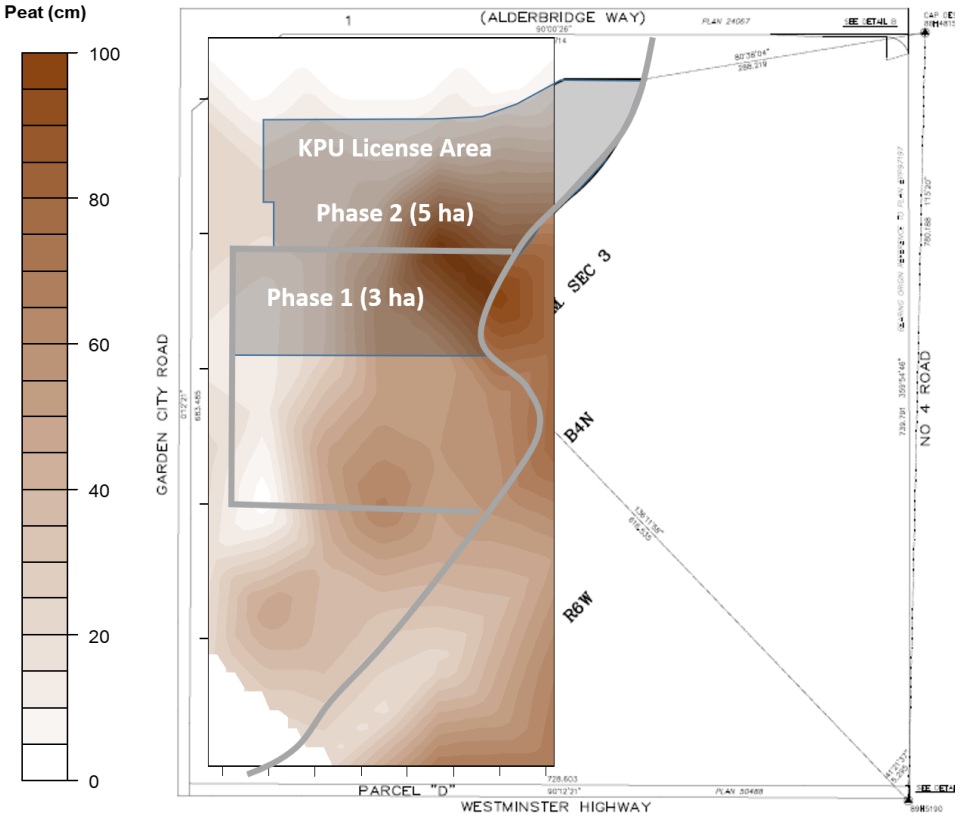
KPU conducted systematic sampling of the west side of the Garden City Lands in 2016 to measure peat depth. Peat was mostly shallow on the farmland (west) side of the dike, reaching a maximum depth of 1 m near the northeast corner of the area now being farmed.

In 2017, clean sandy-clay loam sourced from Sea Island (YVR) was layered over 3 ha of native peat soil in the southern portion of KPU's license area. The strategy was necessary to address contamination concerns, but had



The ancient peatlands of Metro Vancouver, shown in black on this 1935 map (top), correspond with areas of high soil carbon content today (bottom, Paul et al. 2020). The Garden City Lands sit at the north-west edge of what was once the Greater Lulu Island Peat Bog.

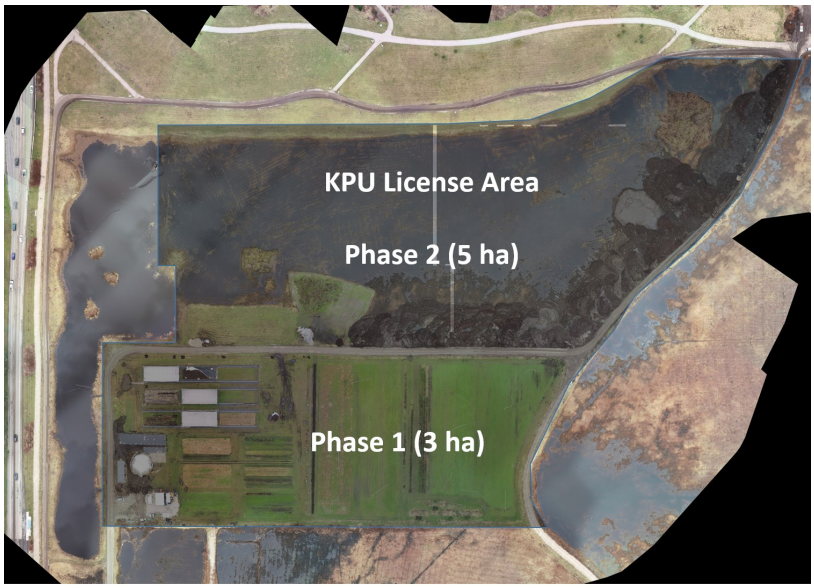




Shades of brown correspond to peat depth (0-1 m) in the western half of the Garden City Lands, based on systematic sampling conducted in 2016. Grey overlay shows Phases 1 and 2 of the KPU License Area.

Farm expansion and carbon sequestration

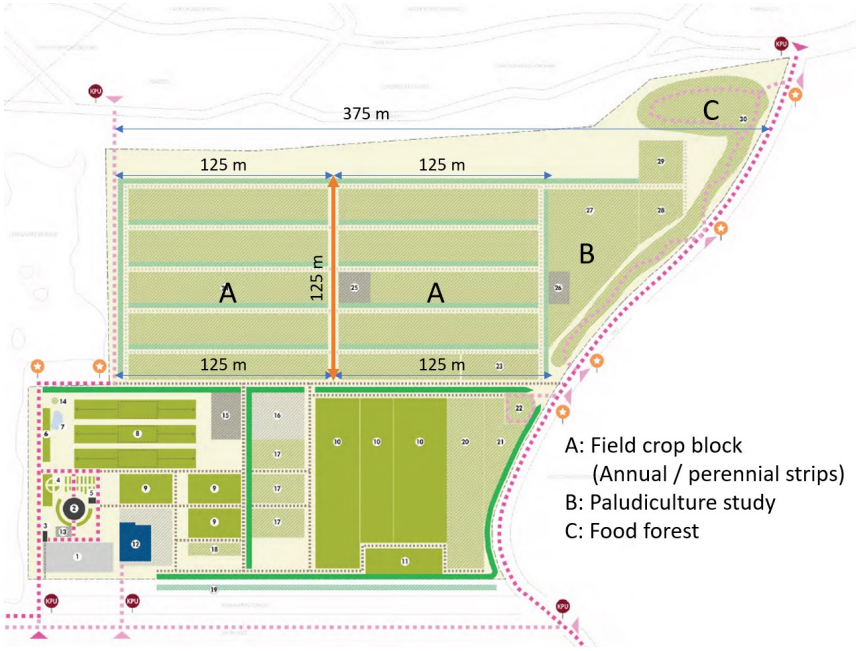
the added benefit of conserving carbon long sequestered in the underlying peat. No subsidence has been observed over the area where peat was deepest, suggesting that it has remained wet and is not disintegrating. Drain tile laid at the bottom edge of the mineral soil was positioned so that it would not penetrate, or drain, the underlying peat.



A five hectare expansion of the farm is planned for the northern section of the license area. Clean peat excavated from a greenhouse construction project on No. 5 Road will be spread over the existing peat to address contamination concerns. This will be topped with mineral soil and topsoil excavated from the Polygon development being constructed at the junction of Cambie and Garden City Roads. Drains will again be positioned above the peat. If successful, this strategy will enable preservation of the sequestered carbon in both the native peat and the imported peat, avoiding substantial greenhouse gas emissions.

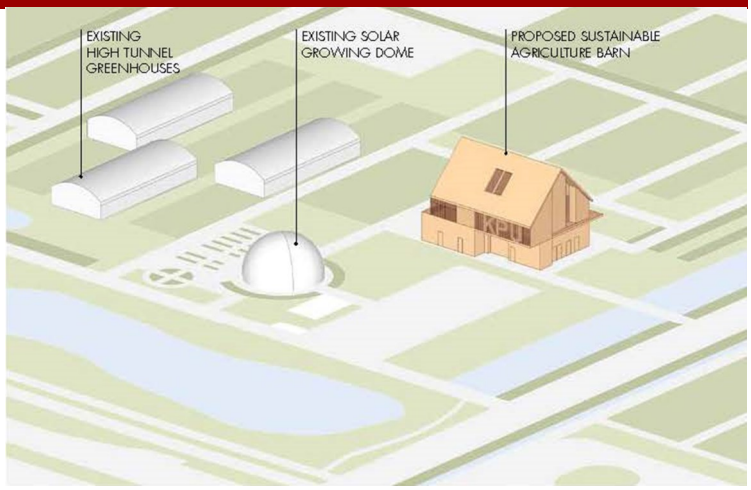
Peat formation is largely due to growth of *Sphagnum* mosses, which thrive in acidic, saturated, low-nutrient environments. *Sphagnum* has been found growing in the area slated for farm expansion. Before imported soil is spread for Phase 2, the *Sphagnum* will be collected and transplanted in the bog restoration area east of the dike, to promote future peat formation and carbon sequestration on the Garden City Lands. A *Sphagnum* propagation system will also be established on the farm to allow transplanting to continue in future years.

KPU has hired a planning firm to facilitate Phase 2 farm plan development. The current plan is to emphasize public engagement with a food forest at the site entrance across from May Drive, and along the west edge of the dike. A triangle west of the food forest will be used to experiment with paludiculture, which couples peat conservation with agricultural production. The remaining land will be divided into two 125 m x 125 m blocks of annual field crops, segmented with linear perennial zones to create habitat for beneficial organisms, deter snow goose landings, and sequester carbon.



Next steps

Barn construction



A new barn is planned to consolidate temporary infrastructure near the main farm entrance, in the southwest corner of the KPU Farm. The barn will demonstrate green building technology, with a view to energy conservation and use of renewable building materials. The barn will include indoor and outdoor produce processing lines, expanded cold storage capacity for produce, flexible workshop space for servicing equipment, and safe storage space for farm tools and small equipment. A farm office and kitchen in the barn will replace the Atco trailer brought to the site in 2021. Publicly-accessible washrooms will replace the portable toilet currently at the site, which is only available to KPU personnel. The west face of the structure will be designed for easy market setup, creating a welcoming public interface for the KPU Farm.

Temporary infrastructure within the yellow oval includes an Atco office trailer, two shipping containers for tool storage, a produce washing station under a canvas tent, storage for irrigation supplies and produce crates, and a portable toilet. The proposed barn will consolidate and replace this necessary farm infrastructure, while allowing capacity for farm expansion and improving security at the site. *Ruth Fung photo*, February 1 2022.

Learning Garden

The learning garden will offer new opportunities to engage with a broad cross-section of the public and community partners. Accessible garden beds have been built, and are being planted to illustrate learning objectives. A community volunteer program is being established and we are exploring the possibility of summer day camps at the site, in partnership with the KPU Education Program and Lifespan Cognition Lab. The gardens will provide a venue to summer workshops for community members, including the community gardeners who are now establishing plots just south of our license area.