



GenomePrairie

2021-22

ANNUAL REPORT



THE STORY OF GENOMICS

genomeprairie.ca



Welcome to the Genome Prairie **2021-22** **ANNUAL REPORT**

The story of genomics. For more than 20 years, Genome Prairie has been at the centre of the story about genomics research and innovation in Saskatchewan and Manitoba. From agriculture to medicine, the environment to energy, forestry to fisheries, Genome Prairie has been a leader in supporting genome-based projects that have helped to change the world.

Within every project, there is a story to be told. Much of what Genome Prairie has accomplished has changed how we grow our crops, provided better health options to Canadians, supported strategies to combat a changing climate, and discovered new and innovative scientific approaches.

Genome Prairie's story is the story of genomics. Every year new chapters are written. This annual report tells some of our stories from the past year.



GenomePrairie

2021-22

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Genome Prairie Admin Team

Programs and Administration Team

Meet the Genome Prairie administration team. Members of our programs team include Dr. Jerlene Halliday (Saskatoon office), Racquel Baert (Winnipeg), and Ifeoma Okwor (Winnipeg). Oyewole Oyebanji, accountant extraordinaire, Tony Bassett, Communications and Stakeholder Relations, Tyler Grodecki who analyzes all the data, and Faye Pagdonsolan who makes all the wheels turn, round out our administration team.



Dr. Jerlene Halliday, PhD
Manager, Sector Innovation



Racquel Baert, MSc
Project Manager



Ifeoma Okwor, DVM, PhD
Manager, Programs



Oyewole Oyebanji, MSc, CA, CIPC
Accountant



Tony Bassett, MA
Manager, Communications and Stakeholder Relations.



Faye Pagdonsolan
Manager, Administration



Tyle Grodecki
Data Analyst(intern)

Genome Prairie Exec Team

Executive Leadership Team

Meet the Genome Prairie executive team, who each bring exceptional experience in helping guide our organization to the next level of success. CEO Mike Cey, CFO Patrick Pitka, and Lester Young, Director of Scientific Affairs, round out the team.



Mike Cey, PAg, EMBA
President and CEO



Patrick Pitka, FCPA, FCA, Pro.dir
Chief Financial Officer



Dr. Lester Young, PhD
Director of Scientific Affairs



The Genome Prairie Pathway

Our Mission

Driving genomics research, development and knowledge translation to better protect, feed, heal and empower the people of Manitoba, Saskatchewan and beyond.

Our Vision

Building a healthier and more productive environment for everyone through genomics.

Project Development

Genome Prairie serves as an engine for economic development. With offices in Saskatoon and Winnipeg, Genome Prairie identifies and refines new project opportunities, facilitates national and international collaboration, and aligns partners and resources to ensure the success of selected research projects.

Research Management

Our projects are at the forefront of research and development in genomics and related biosciences. Genome Prairie's team strives to bring together significant expertise and resources from different academic institutions and industries across Canada. The scale and complexity of these initiatives requires strong project management to optimize successful completion of goals and objectives.

Community Engagement

Success in any scientific field often depends on factors beyond the lab bench. Relationship building and information sharing are critical activities that can lead to unexpected connections and innovation.

Our Impact

Through collaboration, Genome Prairie's operational activities and investments in projects create economic and social contributions in Manitoba and Saskatchewan.

Genome Canada's business model is based on partnerships with each Canadian region. Genome Canada mandates that every program launched has co-funding partners and every project or initiative has support.

Some of the ways Genome Prairie has an impact include:

- Addressing regional and national issues
- Advancing local talent
- Building public and private sector partnerships
- Contributing to training and employment opportunities
- Developing new technologies
- Establishing expertise, capabilities and capacity
- Facilitating industry solutions
- Leveraging funding

Our Board of Directors

Genome Prairie's leadership and strategic direction are provided in partnership with our Board of Directors. Representing an array of industry and research professionals, our Board volunteers their time and expertise to ensure the continued success of our organization.

Mr. Bill Johnson (Chair)
Ms. Patty Rosher (Vice-Chair)
Mr. Mike Lesiuk
Mr. David Migadel
Ms. Kendra Mueller
Dr. Jenisa Naidoo
Dr. Curtis Rempel
Dr. Annemieke Forenhorst
Dr. Shawn Gibson
Dr. Peter W.B. Phillips (incoming Chair)

“...we continue to execute our strategic plan, prioritizing prudent planning, focusing on primary research, and sharing our successes and learnings with the world.”



Message from the Chair

As the world slowly returns to “normal” after two-and-a-half years of the pandemic, Genome Prairie is emerging on the other side of the disruption stronger than ever.

The world is discovering what we have always known -- that genomics is not an esoteric area of science but instrumental to every aspect of our lives. As our researchers and partners continue to look for innovation in climate change and in health, food security, and agriculture, their projects continue to highlight the role genomics plays in finding solutions to the world’s challenges.

Our senior management team continues to be led by the steady hands of CEO Mike Cey and Chief Financial Officer Pat Pitka. Regrettably, we said goodbye to Chief Scientific Officer Dr. Lisette Mascarenhas this year. Still, she leaves behind a strong research team now led by Dr. Lester Young.

As an organization, we continue to execute our strategic plan, prioritizing prudent planning, focusing on primary research, and sharing our successes and learnings with the world. It’s a simple and focused strategy that has led to growing success.

In terms of the Board of Directors, I would like to say goodbye to Board members Mike Lesiuk and David Migadel. Both men have made significant contributions to the leadership of Genome Prairie and leave our organization stronger than they found it.

Our volunteer Board remains engaged and focused on providing leadership and guidance to the management team. The new Governance and Nominating Committee has served as a welcome addition to our committee structure, and our Board members continue to be excellent ambassadors for the organization throughout their professional lives.

Genome Prairie has worked hard over the last three years to position our organization for success. We have welcomed many new staff members and researchers to the GP family over the previous year. We’re excited to lead the prairies and the country into a new age of genomics.

Bill Johnson
Chair
Genome Prairie Board of Directors



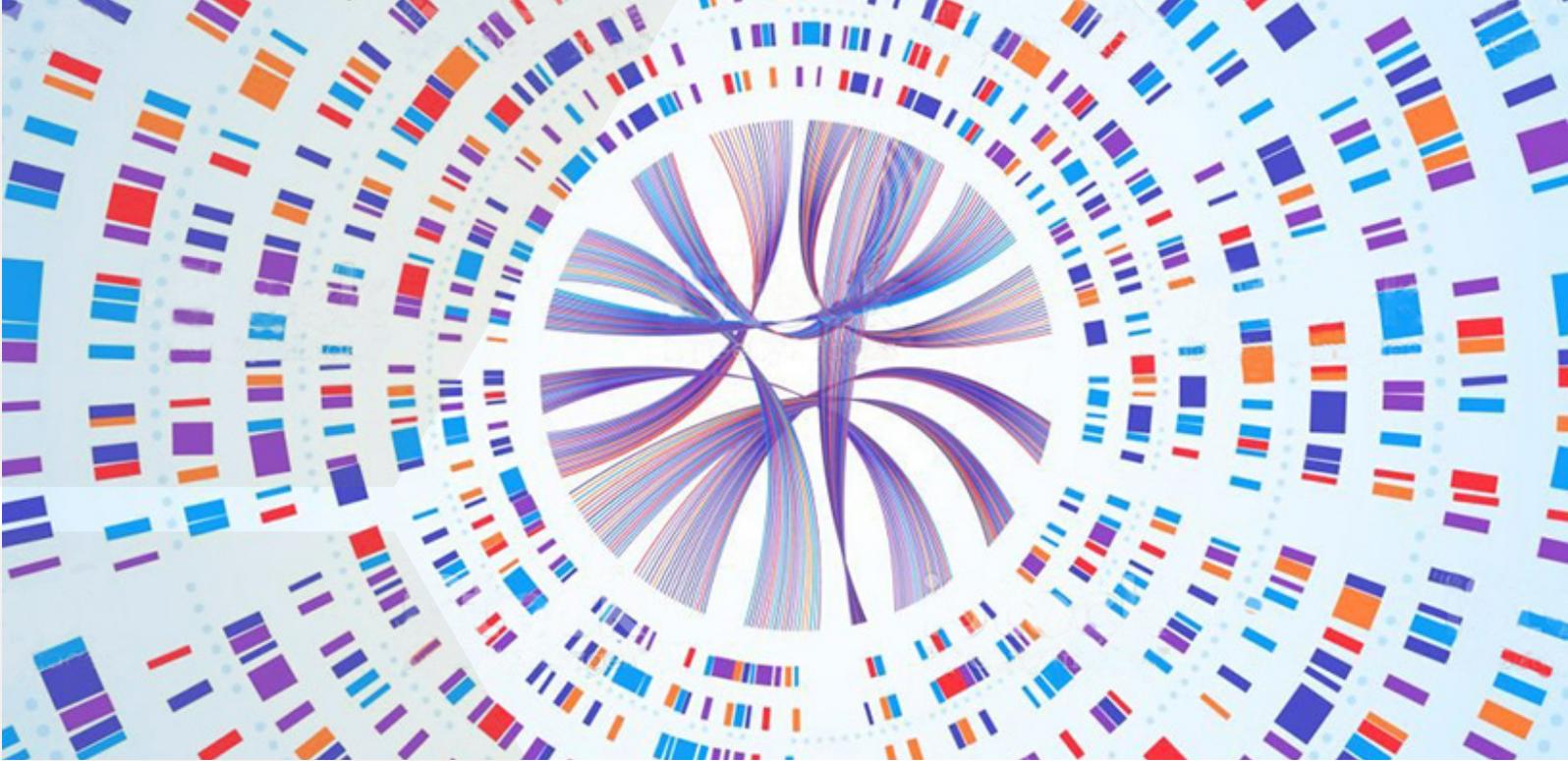
Message from the CEO

Along with Genome Prairie staff and colleagues serving on our Board of Directors, it is my pleasure to bring warm greetings as we review our work over the past year and look forward to an exciting year ahead.

The year previous saw Genome Prairie emerge from the covid pandemic led by a renewed staff and Board with a laser focus on our core priorities: The development and management of world-class genomics-based research projects; the careful stewardship of finite human and capital resources; and the communications and outreach efforts necessary to explain and grow support for the deployment of genomics-based solutions in an increasingly complex world.

The year past also saw the Bison Integrated Genomics (BIG) project launch, led by Dr. Gregg Adams at the University of Saskatchewan in partnership with Todd Shury of Parks Canada. We are thrilled to see this project's potential to help maintain and sustain a healthy and diverse wood bison herd in North America for many decades to come.

We are further inspired by the launch of the new \$30 million Climate Smart in Agriculture and Food Systems (CSAFS) funding opportunity recently announced by Genome Canada. The focus of this opportunity will be developing and deploying mitigation and adaptation solutions within the realm of climate-smart agriculture and food systems. The established agri-food genomics research capacity in Manitoba and Saskatchewan will ensure that the solutions our region brings will benefit the Canadian people and our environment.



“I am especially pleased to report several new projects are under development in the areas of human & animal health, agriculture, the environment, and natural resources.”

In collaboration with Genome Canada, the other five regional Genome Centres, the federal ministry of Innovation Science and Economic Development (ISED), and numerous other stakeholders, work is well underway to develop a pan-Canadian Genomics strategy to guide our efforts through the next several years. A well-thought-out strategy that takes advantage of all the best Canada has to offer in working together brings with it the promise of continued success.

I am especially pleased to report that several new projects are under development in human and animal health, agriculture, the environment, and natural resources. These projects include some of the most brilliant and capable researchers on the planet. It is our humble pleasure to collaborate with them to bring about continued prosperity and success to the people of Manitoba, Saskatchewan, across Canada, and, indeed, throughout the world.

In addition to launching several new projects in the coming year, Genome Prairie will release an updated Economic Impact Assessment to help demonstrate and confirm the value brought forward to Canada through the research, use, and advancement of genomics-based tools and technologies.

Finally, with great gratitude, I express my appreciation for the staff, colleagues, researchers, funders, and other key stakeholders I have the privilege to work with daily. For that, I offer a most humble thank you! Your enthusiasm, resilience, and competence exemplify a culture of excellence that embodies the Prairies’ spirit.

I will conclude with some of the great words of Sir Winston Churchill, who seemed to have prescient knowledge of how genomics would shape our world when he said the following;

Every day you may make progress. Every step may be fruitful. Yet there will stretch out before you an ever-lengthening, ever-ascending, ever-improving path. You know you will never get to the end of the journey. But this, so far from discouraging, only adds to the joy and glory of the climb.

Mike Cey
President & CEO
Genome Prairie



“Our projects demonstrate that genomics research is far-reaching and positively impacts our lives and land.”

and protecting our environment (GENICE II and FLOWTER). Our projects demonstrate that genomics research is far-reaching and positively impacts our lives and land. They also show the ingenuity and dedication of the research community in our provinces and beyond.

I look forward to seeing the results of these projects as they are released. I am highly confident they will be outstanding!

I also look forward to the new projects in the development pipeline. The CSAFS funding opportunity will support 8-10 projects that use genomics tools to mitigate greenhouse gas emissions from agricultural and food production systems without compromising productivity. I believe Genome Prairie will have a significant role in this funding opportunity. Unquestionably, research from CSAFS will positively impact climate change and help Canada meet its net-zero carbon targets. It will also ensure our agricultural production systems are resilient and adaptable.

Additionally, multiple projects are in the Genomics Applications Partnership Program (GAPP) pipeline.

I eagerly anticipate meeting many of our partners and stakeholders over the next year while focusing on the Genome Prairie DSA portfolio towards fulfilling its full potential.

Dr. Lester Young
Director of Scientific Affairs
Genome Prairie

Message from the Genome Prairie DSA

Greetings from the desk of the Genome Prairie Director of Scientific Affairs!

I am excited to join the dynamic and energetic team as we continue our robust funding of genomics research in Saskatchewan and Manitoba. I am particularly pleased to support applicants in the recently launched Climate Smart Agriculture and Food Systems (CSAFS) funding opportunity.

The position of Director of Scientific Affairs is new to Genome Prairie but not new to the Enterprise. As the DSA, I hold many of the same responsibilities as the outgoing CSO, Dr. Lisette Mascarenhas, who has taken a position at the University of Victoria. Dr. Mascarenhas brought a wealth of executive experience and scientific expertise to Genome Prairie and ushered in the GENICE II, CPMN, and CanCOGeN projects. I have big shoes to fill. I hope my 15 years of experience in plant genomics and passion for genomics research will greatly assist researchers currently making CSAFS applications.

Genome Prairie plays a stand-out role in the genomics research space in Saskatchewan and Manitoba. Our current projects are building regional strengths in agriculture (4DWHEAT, ASSETS, and EVOLVES), supporting public health (CanCOGEN, COV3R and CPMN),



Wood and plains bison are part of the bison herd at the University of Saskatchewan's Livestock and Forage Centre of Excellence (LFCE). Photo: Christina Weese. Courtesy Western College of Veterinary Medicine.

the story of genomics

How genomics are saving the wood bison where they roam

The story of the Genome Prairie Big project is how the bison, who once dominated the North American landscape, was nearly hunted to total extinction. More than 100 years of conservation efforts to save the species, the wood bison face another major threat – the spread of disease and a lack of genetic diversity. Now, Canadian researchers, through the Genome Prairie Bison Integrated Genomics project, are working to save the remaining herds in Canada through innovative genome-based solutions.

For those living in the 21st century, it's difficult to fathom how there once was a time when the bison dominated the North American landscape. The bison reach was once expansive, with herds found as far north as the western Arctic and as far south as Mexico. Its population was once even more impressive. In the early 1800s, the plains bison subspecies, mainly in the continental United States, had a population estimated to be between 30 and 60 million. Meanwhile, the other bison subspecies, the wood bison, had around 170,000 roaming the wilds of what is now northwestern Canada and Alaska.

However, European settlement and the fur trade created conditions almost annihilating the bison population. By 1900, the plains bison population was estimated at less than 1,000, while the wood bison population had only a few hundred left alive. Urgent conservation efforts, which included the creation of Wood Buffalo National Park (which spans the borders of Alberta and the Northwest Territories), helped increase the population. By the early 1920s, conservationists estimated the wood bison population had dwindled to around 2,000 in the wild.

Some early conservation efforts, however, created more problems than solutions for the dwindling bison population. There is perhaps a no better example than the Canadian government's transfer of plains bison from Buffalo National Park (once located in central Alberta) to the Wood Buffalo National Park. The transfer resulted in the transmission of diseases from the plains to wood bison and hybridization between the subspecies.

"Mixing the wood and plains bison populations was strongly denounced by conservationists at the time," said Todd Shury, acting manager of wildlife health and management with Parks Canada and adjunct professor in the Department of Veterinary Pathology at the University of Saskatchewan. "In addition to mixing subspecies, it for sure introduced tuberculosis and may have also introduced brucellosis into the population."

"This has really been a wicked ecological problem," said Shury. "It's led



**Bison cows and calves at the University of Saskatchewan's Livestock and Forage Centre of Excellence (LFCE).
Photo: Christina Weese.**

to a legacy of these two diseases that have seriously threatened the Canadian bison population to the present day.”

This ongoing threat of disease and the overall lack of genetic diversity among wood bison represents the backbone of the Bison Integrated Genomics project (or ‘BIG project’). The project is led by Shury (as receptor lead) and Dr. Gregg Adams (academic lead), a professor from the Western College of Veterinary Medicine at the University of Saskatchewan.

“The greatest threat to wood bison recovery is the presence of bovine tuberculosis and brucellosis,” said Shury, who indicated that conservationists have fewer tools to combat these infectious diseases. “They’re very limited and often inadequate.”

For many years, the most conventional method for tackling tuberculosis and brucellosis has been culling herds. Culling was often met with resistance from some environmentalists and indigenous communities.

“In the mid-1990s, an environmental task force recommended culling bison in Wood Buffalo National Park, and that generated more than 11,000 letters to the Minister of the Environment at the time, most very negatively opposed to a culling approach,” said Shury.

In 2016, some northern indigenous groups in Canada approached the federal government with a request to conduct an imminent threat assessment of herds located near Wood Buffalo National Park. The government determined an imminent threat to the recovery of the population and that an immediate intervention would be required.

“While there was no imminent threat to the survival of the herds, they were threatened by disease and their existing small population.”

Instead of draconian culling strategies, the BIG project aims to develop various genome-based strategies to tackle the long-standing “wicked” problem through advanced genomic technologies. A critical project

strategy will be the development of tuberculosis and brucellosis vaccines.

“This will be a combined oral vaccine delivered in a single dose to wild populations,” said Shury. “The vaccine will be long-lasting, and we hope that over time it will reduce the prevalence of disease and protect herds that are disease-free.”

The development of vaccines would mark a huge step in combating disease. Knowing which animals are infected is equally critical. The BIG project will use a proteomic approach (a form of protein screening) combined with genomic data to allow conservationists to identify individually diseased bison.

“We don’t have good tests for tuberculosis right now, but this approach will allow us to potentially go into affected herds to know which animals are infected and then have them removed,” said Shury.

The disease problem and the lack of genetic diversity among existing populations are co-exacerbating. With existing herds being small and the vast wilderness on which they roam, there is little opportunity for interaction among herds, and prevents movement from infected areas. The project, under the direction of Dr. Adams, will use collected genetic materials in the form of embryos and semen, including from bison currently living at the Toronto Zoo, for transfer to and from wild herds. “The idea is to deploy a long-term bison genome biobank to enhance genetic diversity without

spreading disease. It would be a huge improvement to the health of the Canadian population.”

Finally, the BIG project team will develop an “SNP chip” (SNP stands for single nucleotide polymorphism, which helps to identify specific traits). The SNP chip will enable researchers to differentiate between plains and wood bison subspecies and identify bison that may have evidence of cattle genetic introgression (cattle genetic signatures that have become incorporated into the bison genome through cross-breeding). Gaining a greater understanding of the genetic diversity among Canadian bison populations will help better determine introgression and estimate genetic diversity to help future conservation efforts.

Beyond the ultimate research and genome-based goals to eradicate disease and increase genetic diversity, Shury is fully conscious of the symbolic and cultural importance of the bison, especially to indigenous people and communities. Moving into the fall of 2022, the BIG project team will expand its conversations with indigenous communities about the project towards forming a greater collaborative relationship.

“We want to talk to community leaders and elders about issues like the development of the genome biobank,” said Shury. “We want to ensure that concerns like ownership of genetic data are addressed. We want indigenous communities to know exactly where genomics samples are located and how they will be used in the future.

“If the project reaches its goals, it’s going to improve food security for indigenous communities who won’t have to worry about getting tuberculosis or brucellosis from hunted bison,” said Shury. “It’ll improve cultural connections with indigenous communities located near the herds.

Ultimately for Shury, the BIG project represents the potential for genome-based research and its application in solving some of the most wicked problems in the world.

“I really see this as a once-in-a-generation legacy project for conservation not just in Canada but in North America using some of these state-of-the-art genomic tools.”

the story of genomics

How Prairie researchers played a key role in the COVID-19 battle

The story of the CanCOGeN project is how researchers quickly turned Saskatchewan and Manitoba public health laboratories into world-class centres for infectious disease genomics.

It’s been more than two years since Genome Prairie and Genome Canada unveiled a collaborative effort to leverage the power of genomics to fight a global pandemic. For almost 100 years, the world had mostly avoided the outbreak of a large-scale infectious disease. In Canada, systems designed to quickly analyze and respond to a highly contagious pathogen were still to be fully developed.

What a difference those two years made.

With the world only now moving past the worst effects of the 2+-year-long epic journey of the COVID-19 pandemic, the capacity to respond to highly contagious pathogens is markedly higher in Canada’s prairie region. At its April 2020 launch, CanCOGeN’s primary focus was on genome sequencing of the SARS-CoV-2 virus to better understand the virus and offer Canadians information to make decisions on preparing and responding to an ever-changing and dynamic pandemic landscape.

When the SARS-CoV-2 virus was declared a pandemic in February 2020, international borders began to close, dramatically changing how people lived their day-to-day lives. Scientists worldwide scrambled to understand the virus, how it spread, and how it made tens of thousands (and soon millions) of people sick. In Canada, many provincial governments declared public health emergencies which caused many offices, shops, and public gathering places to shut their doors indefinitely.

In Saskatchewan and Manitoba, public health officials sought information about how SARS-CoV-2 spread among cities and towns. Was the virus widespread? Was it contained? Who was getting sick? How was it being transmitted? There were many tough questions and policy decisions to be made with little time to spare and very little information. The system that was in place wasn’t highly optimized for efficiency.

“When COVID-19 emerged as a serious public health issue, we didn’t have a lot of capacity for sequence-based typing and surveillance of pathogens at our laboratory. We were mainly participating in the surveillance of enteric bacteria responsible for outbreaks of food-borne illnesses,” said Dr. Ryan McDonald, who is a CanCOGeN project lead at the Roy Romanow Provincial Laboratory (RRPL) in Regina, Saskatchewan.

Since its beginning, CanCOGeN has raised the ability of laboratories in the prairies to respond to outbreaks of infectious diseases. It’s also



Dr. Stefani Kary with the EpiMotion instrument at the Roy Romanow Provincial Laboratory in Regina, Saskatchewan. Photo courtesy Saskatchewan Health Authority (SHA).

heightened the quality of information that serves as the lifeblood for public health officials in making critical decisions affecting residents.

“One thing CanCOGeN has changed is the turnaround time in getting results. Before, we didn’t have as much capacity for our laboratory scientists to generate and analyze sequencing data,” said McDonald.

Sequencing and bioinformatics analysis – the process by which critical information is revealed based on a pathogen’s genomic material – required significant resources beyond lab scientists. Crucial infrastructure such as equipment for automated sample processing, sequencing instruments, and powerful computers to analyze data was needed quickly.

“A fast turnaround was vital for public health action both in the provinces and around the world,” said McDonald. “We were racing to understand how the virus was evolving and trying to stay in front of it as best we could,” said McDonald.

“Very early in the pandemic, we leaned heavily on the National Microbiology Laboratory (NML) in Winnipeg to perform our sequencing and bioinformatics analysis. At that time, we would send them our clinical specimens without any contextual information about the case itself. We’d get results back and communicate those to stakeholders and medical health offices.”

Part of the initial challenge for the Romanow Lab was the need for sequencing equipment to study the SARS-CoV-2 virus and the computing power to analyze the genomic data produced. The CanCOGeN project changed the situation almost overnight. With funding support, the RRPL suddenly found themselves in the enviable position of having the means to get the gear.

“In very short order, the project allowed us to put together what was once a wish-on-a-hope-on-a-star list for laboratory equipment and infrastructure,” said Dr. Amanda Lang, who works as a clinical microbiologist at Romanow Lab.

“Mainly because of CanCOGeN’s funding support, we could procure laboratory equipment that we previously could only dream of having. Even the bioinformatics side, we put things in place we didn’t have like the computing power and infrastructure needed for large-scale data like that produced by genome sequencing,” said McDonald.

But in preparing to ramp up the laboratory infrastructure, researchers suddenly discovered a huge problem. At the time of the outbreak, the world was desperately short of computer graphics cards, an essential component for building the supercomputers needed for genome sequencing analysis.

“Global supply chains presented a huge challenge for establishing our SARS-CoV-2 surveillance program. Almost all the world’s graphic cards were being snapped up by those involved in mining cryptocurrencies,” said Dr. Keith MacKenzie, an Associate Clinical Scientist at the RRPL.

“It was next to impossible to find this crucial computer part. I remember browsing the internet



Dr. Kara Loos works the iSeq sequencing system at the Roy Romanow Provincial Laboratory. Photo courtesy Saskatchewan Health Authority (SHA).

at midnight one evening and through luck, found a computer with the right graphics card. I clicked the order button immediately.

“It probably would have been gone within hours if I hadn’t acted on the moment.”

“Keith and I were actually texting each other in the middle of the night about this computer, and we each decided to purchase one in the hopes that one would actually ship,” said Lang.

Keith’s order went through. RRPL’s ability to establish its essential surveillance of SARS-CoV-2 variants, at least on its bioinformatics side, could proceed.

Now with the physical infrastructure in place and lab scientists geared to put their knowledge to work, RRPL quickly produced significant data that became invaluable to health officials in the province and eventually played a crucial role in building a national sequencing repository.

“With Variants of Concern emerging, the pressure was on to get genome sequencing up and running so we could better understand the dynamics of the pandemic in Saskatchewan. We started our in-house sequencing program in February 2021, just as the Alpha variant started to take off. Our early experience with Alpha prepared us for the introduction of other variants like Beta and then

Delta in the fall of that year. We were acutely involved with genomic sequencing through all the major Variants of Concern.”

“CanCOGeN dramatically changed how we responded to COVID-19 and what we can do for infectious disease surveillance in Saskatchewan,” said MacKenzie. “Before CanCOGeN, we had fairly minimal amounts of sequencing and bioinformatics in-house capacity. We sequenced about 20 specimens per week and mainly targeted specific outbreaks of infection or cases of concern.”

“At the height of Omicron in December 2021, we had ramped that up to almost 1,200 sequences a week.”

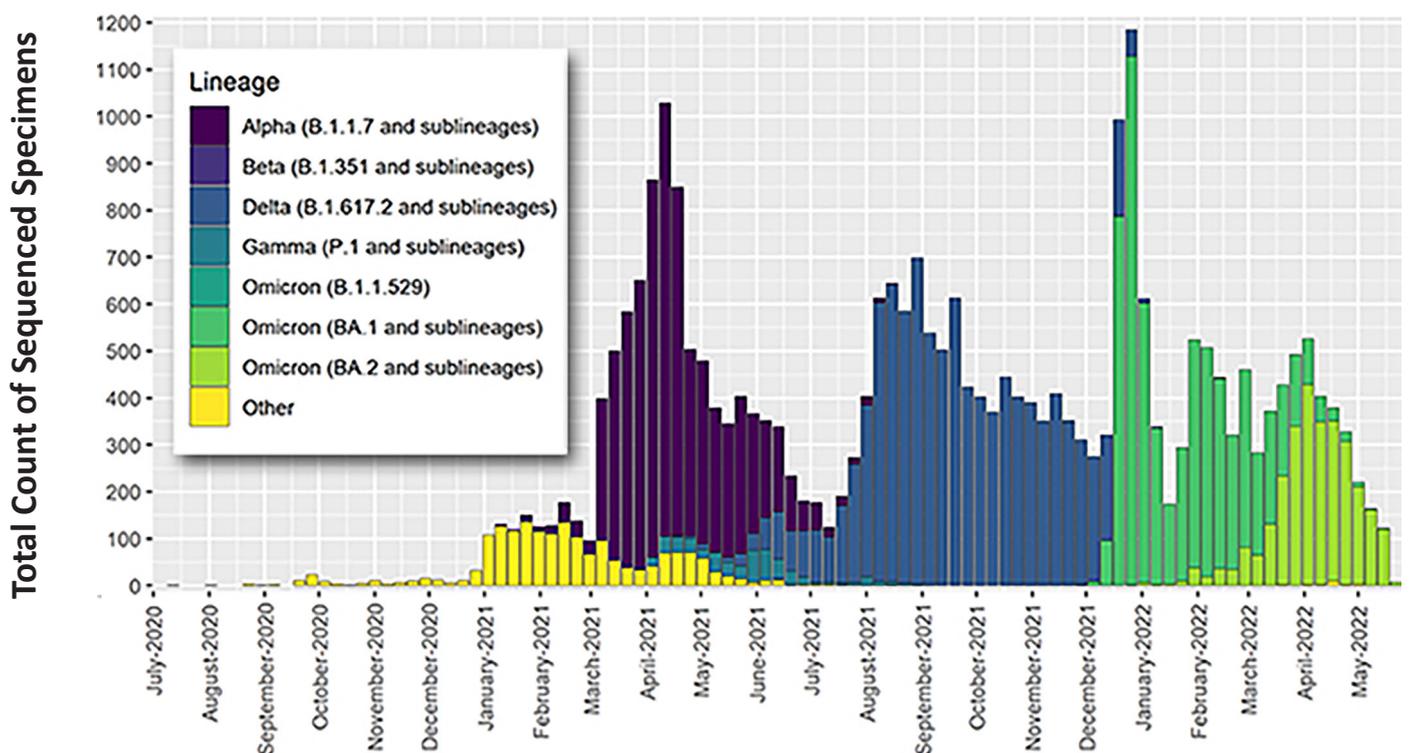
A vital part of the project is how the information is being shared among other CanCOGeN-supported laboratories in Canada. Sequencing data was uploaded to a central national database for further analysis. The national database is also shared with publicly accessible repositories such as GISAID, the world’s primary SARS-COV-2 genome sequencing database.

“Plugging into the national and international databases was very time-consuming,” said McDonald. “We had to get a Memorandum of Understanding in place to share contextual data about clinical cases.

“Getting from near zero to a weekly functioning bench where we’re producing data and contributing timely reports about the landscape of SARS-CoV-2 in Saskatchewan was huge,” said McDonald.

Getting “plugged in” to national and international resources added to building capacity in the prairies. It also took some pressure off the National Microbiology Laboratory, which had shouldered sequencing and bioinformatics tasks.

SARS-CoV-2 Whole Genome Sequences from Saskatchewan



Total number of specimens sequenced at the Roy Romanow lab during each week of the COVID-pandemic. The lab sequenced 29,556 genomes from clinical specimens collected in Saskatchewan alone (date is up to May, 2022). Chart provided by Roy Romanow Provincial Laboratory.

“Before CanCOGeN, our understanding of COVID-19 and how SARS-CoV-2 was changing during the pandemic heavily depended on bigger provinces that had more support outside of CanCOGeN to do the high-throughput surveillance and fine resolution analyses needed to predict what was coming next with the virus,” said MacKenzie.

“Flash forward to now, both Saskatchewan and Manitoba’s provincial public health labs can better represent what’s happening in the Canadian prairies and contribute as a region to the national picture of infectious disease surveillance. Without CanCOGeN, we wouldn’t have been able to accomplish what we have during this pandemic,” said MacKenzie.

“Our Medical Health Officers, epidemiologists, and lab leadership were all very engaged in tracking variants,” said Lang. “Every time we heard a new variant was coming and it had early indications of being more infectious or severe, we would get ready to respond. Our work in the lab focused on producing timely surveillance data for our Medical Health Officers and public health officials that told the ‘prairies’ picture. We could say hey, we’ve found this variant in this area through whole genome sequencing, and we think it’s moving in a certain direction.

With COVID-19 now largely considered less of a public health risk compared to the first 24 months of the pandemic, the future of sequencing and surveillance work at both provincial public health labs will focus on preparing for future threats.

“The most immediate goal we’re already working on in Saskatchewan is influenza sequencing,” Lang said.

“Sequencing influenza and putting it into public repositories, just as we

have with SARS-CoV-2, will help the WHO [World Health Organization] influenza network to develop the annual flu vaccine. We currently rely on the National Microbiology Laboratory to perform this crucial work.”

“We’re also sequencing important pathogen outbreaks like Salmonella and E. coli. Performing the sequencing at our provincial labs, and coordinating with experts at the National Microbiology Laboratory, means that we can quickly determine who is affected by an outbreak. We’ll be able to quickly track down potential food reservoirs that may be behind what’s making people sick.”

As for the next contagious pathogen? McDonald said the prairies are better-prepared thanks to the groundwork performed through CanCOGeN.

“I think from the prairies’ perspective, we’re in a much better place now than we were two years ago. If we need to port our experience to another organism in short order, we are poised to do that very quickly. We have staff trained, we’ve got the know-how, and we have resources now that we didn’t before.”

“The people, the expertise, and the equipment are in place. If that can be sustained, we’ll be positioned for success for whatever the future holds.”



Dr. Kara Loos, research associate and lab manager, and Dr. Andrew Cameron, associate professor of biology, working on the COV3R project at the University of Regina in July, 2020. Photo courtesy University of Regina Photography.

the story of genomics

Are co-infections the next great pandemic battlefield?

Nearly three years since SARS-COVID-19 (conventionally referred to as 'COVID') was declared a global pandemic, much of the world is returning to a sense of normality. While the rate of death from the coronavirus may have decreased, researchers like Dr. Andrew Cameron are helping Canada and the world prepare for another near-term COVID threat: coinfections.

The COVID pandemic has and continues to affect every corner of the globe and forever change how we view and understand the devastating effect of pathogens.

Since its emergence in 2019, COVID has impacted health care systems worldwide. Up to the spring of 2022, at least 6.4 million people have died, and at least 580 million infections have occurred worldwide. These numbers have dominated the conversation about COVID's effect on society, so much so that how COVID affects people with other respiratory conditions has received little attention.

Understanding how COVID affects people coinfecting by a viral or bacterial respiratory

pathogen is the main element behind the Genome Prairie and Saskatchewan Health Research Foundation-funded COV3R project. The COV3R project began in the summer of 2020 at the Institute for Microbial Systems and Society (IMSS) in Regina, Saskatchewan, in partnership with the Roy Romanow Provincial Laboratory in Saskatchewan, the Cadham Provincial Laboratory in Manitoba, the British Columbia Centre for Disease Control, and the National Microbiology Laboratory in Winnipeg.

The COV3R project is developing 'genome capture' to improve infectious agents' detection and genotyping. Viruses and bacteria are incredibly small, so they represent 'needles in a haystack' in the human respiratory tract. The new technique of genome capture excels at focusing sequencing efforts on pathogens. The capture technique allowed the labs to detect the coronavirus in patients and other respiratory viruses. Moreover, IMSS has demonstrated how genome capture is very powerful for detecting both emerging infectious diseases and unanticipated pathogen variants. The team is expanding the technique to identify diverse viruses, bacteria, and antibiotic resistance genes to better understand the effects and severity of COVID coinfections.

"We want to sequence other pathogens that may be co-infecting along with COVID, particularly respiratory viruses circulating simultaneously," said COV3R project lead Dr. Andrew Cameron. "This is important



Members of the CoV3R team (l-r) Dr. Keith MacKenzie, Dr. Kara Loos, Dr. Andrew Cameron and master's of science student Daneu Suchen. Photo taken in 2020, courtesy University of Regina Photography.

from a clinical perspective because it might be a person infected with COVID and, say, Influenza A. This person will have a much worse disease progression and might need targeted and aggressive treatment because their body is fighting off destructive infections.”

Examining the impact of coinfections is gathering pace and interest beyond the Institute. A recently published report from the U.S. Centers for Disease Control (CDC) has raised the alarm that higher rates of antimicrobial resistance among the general population may occur due to bacterial coinfections with COVID. Recently researchers at the University of Saskatchewan’s Vaccine and Infectious Disease Organization (VIDO) began looking at how patients with coronavirus and tuberculosis are impacted.

Trying to pinpoint coinfections and develop strategies to mitigate their effects on patients poses a massive problem for health authorities. The huge volume of potential viral and bacterial threats means a project like COV3R is faced with a complicated question: where does a project researcher even start to look at the danger?

“There are so many microorganisms in any person’s respiratory tract,” said Cameron, who is also an associate professor at the University of Regina, and IMSS co-founder. “There are hundreds of species of bacteria in your upper respiratory tract at any moment, and there will also be viruses there. We want to survey these microorganisms because there’s also an element of luck. Some microorganisms pose more risk of infection, and some combinations of microorganisms may be a serious health threat.

“Ideally, we would swab a respiratory tract, extract all the genetic material, and sequence it. But right now, sequencing everything is intensive. It’s just not useful from a public health perspective. Putting it

all together is really, really hard to do and too big a barrier for time and cost for public health labs.”

There are faster, more focused strategies labs can take. For example, public health relies heavily on the polymerase chain reaction or PCR testing to detect genetic material from specific organisms.

“A shortcoming of PCR is that it is only able to test for a limited number of select pathogens that we’re already aware of,” said Cameron. “Another shortcoming is that when those pathogens mutate, PCR tests can fail.

“So, while PCR is fast, effective, and very sensitive, it has a minimal view of what’s potentially in a person’s respiratory tract.”

An effective solution, says Cameron, is using a “middle ground” strategy in sequencing organisms that could pose significant threats to human health. This approach, hybridization probe capture, forms the foundation of the COV3R project.

“Hybridization probe capture, or ‘genome capture’, is a targeted metagenomic approach. We genotype the known pathogens, we expand our understanding of their diversity, we discover pathogens we didn’t know about before, and we do it more efficiently and cost-effectively.”

Cameron indicated that the COV3R project had

already made significant progress in gaining greater insights into the pandemic, mainly tracking how COVID spread through the Saskatchewan and Manitoba population.

However, the COV3R project has run into challenges in understanding the effects of coinfections involving the COVID virus. Ironically, the pandemic had a marked positive effect on the number of coinfections seen among the general public.

“Our behavior changed unlike anything we’ve seen in modern history,” said Cameron. “We avoided community transmission of flu in Canada in 2020 and 2021, and viral coinfections were almost non-existent.

“We stopped the flu because of behavior changes. We worked at home. We did better sanitation. We did social distancing. We stopped the transmission of almost all respiratory viruses we usually monitor, which we know are major causes of infectious disease.

The lack of coinfections at the start of the pandemic also had a downside. Many governments, including those in Canada, have recently loosened or eliminated health restrictions to reduce COVID transmission. The growing ‘we’re over COVID’ sentiment concerns Cameron about COVID’s continued spread in the coming autumn and winter months.

“COVID hasn’t disappeared. It’s still out there. It’s still infecting people. It’s still making people sick. The other respiratory viruses haven’t disappeared either. Co-occurrence of these infectious diseases could make the coming months very challenging.”

“I think October is going to be interesting. I know myself and many people who work in the health sector are worried about what could happen this winter.”

Another big challenge in the coming months and years ahead will be higher antimicrobial-resistant bacterial infections. Antibiotic resistance is becoming more widespread, reducing options for treating severe diseases. Unfortunately, little is known about how bacterial infections interact with viruses, yet antibiotics are prescribed as a safeguard when patients are suffering from a severe respiratory infection.

“We’re working on hybridization probe capture to detect antimicrobial resistance genes. For example, diagnostics to tell which antibiotics may be effective for some pathogens like tuberculosis can take months to complete. But suppose you can identify the gene variants that allow the



Dr. Andrew Cameron, COV3R Project Lead.

bacterium to be resistant. In that case, it will help in prescribing the best antibiotics.

“This is another example of how genomics has a big advantage over other genetic approaches.”

Even with the premise that the world could be facing future serious COVID challenges, Cameron remains upbeat about how public health systems will use genomic technologies to recognize and respond to future global pandemics.

“The key to better preparing for the next pandemic will be monitoring and anticipating which pathogens can jump from animals into humans. It includes zoonotic pathogens like influenza, coronavirus, and many other types of pathogens, both bacterial and viral.”

Cameron emphasized that genomic sequencing offers researchers and scientists the greatest opportunity for understanding pathogens, both in the present with COVID and the inevitability of future global pandemics.

“In terms of detecting other pandemics and other outbreaks, genomics is certainly the most powerful tool we have to track how pathogens evolve.”



With the ongoing melt of what was once frozen passageways, large-sized ships and tankards are an increasingly visible presence in Canada's High Arctic region. Photo courtesy Suresh B.K., Nicole Wilson, University of Manitoba.

the story of genomics

How genomics is working to protect Canada's most northerly environment

The story of GENICE II is based on the historic exploration of a rugged and unforgiving territory by explorers centuries ago and the modern-day effects of climate change on a vast but vulnerable Canadian region. It was 119 years ago when Norwegian explorer Roald Amundsen left port and set sail towards Canada's High Arctic region. Amundsen had one goal: finding a passage that would wind his ship through treacherous waters, taking his crew from the Atlantic to the Pacific Ocean. It was a journey that had been tried countless times by some of the most famous explorers in human history. In 1498, John Cabot set sail with five ships carrying a 200-person crew. He was never seen again.

Other European explorers like Jacques Cartier and Henry Hudson made attempts and, like Cabot, failed miserably. But in 1903, Amundsen entered Baffin Bay just west of Greenland. Three years later, his ship finally found its way to Nome, Alaska, becoming the first in recorded history to traverse the Northwest Passage fully.

Since Amundsen's milestone passage, much has changed about the Arctic landscape and the waters surrounding it. A warming planet has caused a slow but sustained sea ice melt through the various channels that guide ships through Canada's far north. Once home to

300-foot-tall icebergs, which frequently stopped and trapped cargo ships for months on end, in the summer of 2007, climatologists declared the Northwest Passage ice-free.

To gain a sense of the impacts felt by climate change, there may be no better place on earth than Canada's Arctic region. A vast expanse of primarily uninhabited territory, Canada's most northern regions cover more than 2.6 million square kilometers, about 40% of the world's second-largest nation by land.

Much of the Arctic landmass is tundra, where the ground is permanently frozen at about 3 feet depth. The landscape is dotted with geographical features like forests, fields, and lakes in the southern Arctic region. To the very far north, steep valleys containing glaciers and icefields dominate the landscape. Its coastlines, more than 162,000 kilometers in length, are rugged, inaccessible, and, until recently, surrounded by

oceans frozen much of the year.

Within the Arctic, anthropogenic global warming has resulted in a continual decrease in sea-ice extent, thickness, and changes in ice type. In Hudson Bay, ice normally starts building up across Hudson Bay in November, but the area has remained almost entirely ice-free in the face of temperatures 6°C above average. In the north-western Hudson Bay – where GENICE II research is focused - ice extent is at a record low, said Dr. Gary Stern from the Centre of Earth Observation Science at the University of Manitoba. “Shipping and oil exploration are, therefore, becoming increasingly more feasible, thereby increasing the potential of crude oil or fuel being spilled into the marine environment.

The disappearance of sea ice in Canada’s high arctic has made traversing from western Europe to eastern Asia far more efficient. It’s also resulted in a dramatic increase in shipping traffic. According to a 2021 study by the Protection of Arctic Marine Environment working group, traffic increased 44% between 2013 and 2019, with some tankers carrying up to 18,000 tonnes of oil.

“Canada is woefully unprepared for oil spills, especially in the Arctic,” said Stern. “It’s a whole different ballgame than what you’d deal with in the south where you’re closer to land where you can get out oil skimmers and other forms of remediation.”

Stern, along with Dr. Eric Collins from the University of Manitoba, lead GENICE II, a Genome Prairie and Genome Canada-funded project to detect and monitor oil or fuel spills. GENICE II will leverage genome-based DNA sequencing technologies to monitor microbes that act as natural hydrocarbon degraders that break down and disperse fuel contaminants.

The sequencing technologies are portable handheld devices called MinION Oxford Nanopores. The real-time devices will allow a new way of seeing marine microbial communities and how they change seasonally as a result of light, temperature, and nutrient availability – factors that constrain the efficacy of oil biodegradation. Our ultimate goal will be to use nanopore sequencing technology to enable the iterative, real-time, affordable, on-

“By having indigenous people and communities involved and trained to use the portable sequencers, we can broaden the scope where monitoring is done year-round. It also means we could monitor how microbes respond during the cold months.”

Dr. Gary Stern

site monitoring necessary to evaluate and monitor natural microbial attenuation and its value in an effective response should a spill occur.”

“When you add food which is oil, the bacteria that are hydrocarbon degraders just bloom,” said Stern. “So, spills are monitored by looking at the bacteria that are present. If the degraders ramp up, it means they are doing their job. Once they start ramping down, the hydrocarbon degraders, along with the remaining oil, will slowly disappear.”

The disappearance of ice also raises the possibilities for the expansion of oil exploration and drilling activities, where an estimated 8.4 billion barrels of oil lay beneath the ocean beds and land tundra. Although there is an oil drilling moratorium in Canada’s Arctic, Stern notes increasing oil prices increase the economic viability for producers and governments to eventually open the region for exploration.

The potential for Arctic spills and the possibility of future oil exploration is an issue of great concern to indigenous populations that live in communities that dot the region. In 2021, a study by the University of Manitoba found an oil spill event would be significantly impactful on communities and Indigenous populations. Published in the journal Risk Analysis, its lead author Mawuli Afenyo from the U of M, noted that “Our study showed that an oil spill in this region has serious social impacts -- affecting the family dynamics, hunting



The village of Chesterfield Inlet, on the western shore of Hudson Bay, Kivalliq Region, Nunavut. Photo by Nicole Wilson and Suresh BK. Courtesy The University of Manitoba.

traditions, and culture of vulnerable indigenous communities.”

“We talked to many far northern communities like Baker Lake, Rankin Inlet, Arviat and Chesterfield Inlet, they’ll tell you the amount of ship traffic in their region has increased dramatically,” said Stern. “The increase of ship traffic is the result of increasing regional mining activities and comes with a number of issues, the biggest one being the potential for oil spills.

Since its launch, GENICE II has worked cooperatively and collaboratively with many indigenous communities, including Inuit populations in the northwestern Kivalliq region. Maintaining a strong relationship between the GENICE II project team and indigenous communities is essential to the project’s ultimate success. As Chesterfield Inlet mayor Bernie Aggark said in June 2021 to UM Today News, the Kivalliq region “... is a rich and sensitive ecosystem that is a highly important area to our community and any spills would flow down the inlet and through our hunting and fishing areas, damaging the environment and our marine mammals that are already impacted by the shipping.”

GENICE II will also aim to provide training to local Arctic communities to monitor identified contaminated areas beyond the length of the project itself. The hope, says Stern, is to distribute the portable DNA sequencing devices to residents who would use them to further collect more data and better understand how microbes respond to spills.

“To do field work, we use ships and traveled up and down the

coastline of Hudson Bay,” said Stern. “But it’s very limiting because using ships is very expensive, and you can really only do field work during warmer months.

“By having indigenous people and communities involved and trained to use the portable sequencers, we can broaden the scope where monitoring could be done year-round. It also means we could monitor how microbes respond during the cold months,” said Stern.

Beyond experimenting with the sequencers and understanding how the High Arctic environment responds to human-made contamination, Stern says one of the most rewarding part of the GENICE II project has been his work with indigenous people.

“We’re always meeting and working with communities to gain their perspective. Working with and hearing the traditional knowledge they provide us; I find it extremely interesting and rewarding.

“I think people underestimate the talent of the indigenous populations in the Arctic and how much they want to be directly involved in the research. It’s been incredibly rewarding.”



the story of genomics

How the CPMN is delivering genome-based precision medicine to Canadians

The Canadian Prairie Metabolic Network (CPMN) is the story of how genome sequencing and precision health are helping give Canadians help (and a sense of relief) to one of medicine's most challenging conditions.

Launched in early 2021 by Genome Prairie and Genome Canada through the All for One Initiative, the CPMN is building greater capacity to provide precision healthcare for Canadians with rare diseases. The CPMN focuses on diagnosing those suspected of having Inborn Errors in Metabolism (IEM).

IEM is a particularly challenging disease to spot. Many with the condition live with its symptoms for years without a diagnosis. IEM affects mainly children, but many adults live with symptoms and in some instances, have lived most of their lives unaware they have the condition. The actual diagnosis of IEM can take considerable time, with some patients, before the CPMN, waiting three years (or longer) to complete their testing.

The CPMN project has used an "OMICS-first" approach to diagnosing IEM. This approach provides patients with access to rapid testing and options for new therapies and clinical support in treating the condition. The CPMN will also help the prairie region further develop its capacity for delivering precision health via genomics-based diagnostics and treatment.

With its laboratory facilities located at the Children's Hospital Research Institute of Manitoba, the CPMN project is led by Dr. Cheryl Rockman-Greenberg, one of Canada's most esteemed and respected physicians and educators. As Rockman-Greenberg said in an article recently published by Genome Prairie, "we hope to focus on patients who are early in their diagnostic journey, where we can hopefully help them avoid undergoing many other tests."

Even though the CPMN started patient intakes in the fall of 2021, patients are already benefiting. Some have provided testimonials about how the network has brought them peace of mind and hope for the future. As one patient recently wrote, the CPMN "... has brought me relief! ... I really hope the CPMN will help others to get the answers they are looking for. There is nothing easy waiting for test results of any kind."



the story of genomics

How 4DWheat helped solve the wheat genome puzzle

The world is projected to have significant food shortages in the years ahead. The story of the Genome Prairie-supported 4DWheat project is, does it hold one of the major keys to feeding humanity?

In plant genomics, fewer puzzles have been more difficult to solve than that of wheat.

Present-day food challenges (supply and cost) reflect a longer-term worry that the world's food supply may be running short to supply the growing world human population. The scientific community is doubling its efforts to find solutions, including genomic researchers on the prairies to improve wheat production. Now, genomics researchers say, the wheat genome code has been cracked, and the doors toward developing more robust crops are opening.

With the global population expected to surpass the 10 billion mark in the next 30 years, the consensus among many experts is at the current consumption pace, severe shortages will arrive by around 2050. To meet the demands of feeding 10 billion people, scientists have feverishly sought ways of producing 50% more wheat than it does now. It's no easy feat considering almost no more arable land is left on earth to grow crops. Genomics may offer the solution to the projected

wheat shortage. Developing strains with greater tolerance to disease, abiotic stresses, and climate change could lead to significantly higher yields for farmers, bridging the anticipated food gap.

From a genomics perspective, developing new wheat strains first requires fully understanding the complexity of wheat itself, a grain that has challenged plant breeders since its human domestication some 10,000 years ago. Plant breeders like Dr. Curtis Pozniak from the University of Saskatchewan have toiled over figuring out wheat's hidden secrets, methodically untangling its enormous genomic structure.

"Wheat has around 14 billion base pairs in its DNA, which means it has five times more DNA than the human genome," said 4DWheat project leader Dr. Curtis Pozniak from the University of Saskatchewan Crop Development Centre. "In the early days, deciphering the wheat genome puzzle was painstaking. Think of it this way. Imagine



Dr. Curtis Pozniak, leader of the 4DWheat project. The University of Saskatchewan.

doing a puzzle of a clear blue sky with nearly identical pieces. Where do they go? How do they fit together? Now imagine doing that with a puzzle that's got millions of pieces. That's wheat."

Pozniak co-leads Genome Prairie's 4DWheat project with Dr. Sylvie Cloutier, a genomics scientist at Agriculture and Agri-Food Canada. The project builds off the exhaustive research by numerous laboratories in sequencing the dizzyingly complex wheat genome. Launched in 2019, the 4DWheat project's self-described focus is on "harnessing diversity, advancing domestication, enabling discovery, and expediting delivery (explaining the "4D" part of the project's name).

"We want to take advantage of genomic technologies and apply them to understand the breadth of diversity in wheat. Wheat is an interesting species in that it's evolved over the last 10,000 odd years and is actually comprised of individual subgenomes derived from wild relatives that still exist today.

"These wild relatives are a reservoir of genes for disease resistance or productivity traits or stress tolerance that we can still tap into.

"4DWheat is designed to characterize the extent of that genetic variability while developing genetic tools that can effectively tap that diversity in plant breeding," added Pozniak. "This will ultimately

help us develop new varieties that are higher yielding, more disease resistant, and adaptive to a changing climate.

"In the past 10 or 15 years, there's been an unprecedented evolution in genomic technologies. Each time there's been an advancement in sequencing technology and bioinformatics, it allows us to understand more, building on one project after another. So we've been taking advantage of the latest genomic technologies along that pipeline of projects.

"Today, sequencing technology is getting so much better, so what used to be a 1,000,000-piece puzzle is now more like a 1000-piece puzzle."

Putting together the puzzle pieces is being driven by uncertainties about global food security over the next three decades and this year. Conflict in Europe, and drought conditions in parts of Asia, the U.S., and Canada are creating conditions for higher prices in the supermarket for basic groceries like bread and cereals.

Even with looming questions about the future of food supply, Pozniak remains upbeat about the short and long-term challenges that face food producers in Canada and beyond.

"There's no doubt the current geopolitical situation in Europe is impacting. About 30 to 40% of global production comes from there, and the drought that we had last year in Western Canada it's had a significant impact on supply.

"But, I tend to be a glass half full person. People are very resilient, and when we get into these tough situations, this is when the human spirit shines the most. That's why it's so important that we continue to invest in science and technology because it helps deliver solutions that will ultimately buffer geopolitical crises and environmental impacts."



the story of genomics

How EVOLVES is changing the future demand for lentils

For Dr. Kirstin Bett, a professor, and researcher at the Crop Development Centre at the University of Saskatchewan, explaining one of the biggest goals of her time spent researching how we grow lentils is best accomplished by comparing it to how we buy an automobile: “Think of it this way. When we decide to buy a car, we don’t go to a dealership and point at the first red car we see and buy it. We have specifics of what we want in the car. Shape, size,

“It’s the same for lentils.”

Bett’s nearly two-decade-long time researching the lentil genome is now paying dividends. The story of the EVOLVES project is how the future of food production may not be that different from buying a customized red car.

“Soon, you can choose the size, shape, and colour of a lentil crop. Maybe you might want something more specific? Maybe you want something with greater nutrition? Maybe you want something that can be specialized to make a better pasta?” said Bett recently at a coffee shop on the U of S campus.

“The sky really is the limit.”

About the size of confetti, the lentil seed comes in a variety of colours ranging from olive green to pumpkin orange, deep earth red to midnight black.

For the average Canadian consumer, lentils are readily found on the shelves of the international section of local supermarkets or at the neighborhood health food store.

It’s hard to fault Bett for her keen interest in this seemingly modest seed, which has emerged as a remarkable agricultural success story. 50 years ago, it would have been almost impossible to find a single lentil farmer in Canada. Fast forward to the present, and the nation grows more than 3 million tonnes of lentils annually, more than half of the world’s total supply. Nearly all (about 95%) of Canada’s lentil crops, which produced almost \$3 billion in export revenue in 2021, are grown in Saskatchewan. To put that into perspective, if every living Canadian got a share of Saskatchewan’s crop, they would have a 174-pound box of lentils dropped on their doorstep.

“Canadian farmers have gone from 0 to 100 in about 25 years,” said Bett. However, her reference to the industry’s success is tempered by the realism that the days of Canadian dominance as a volume supplier may be ending.



Dr. Kirstin Bett, leader of the EVOLVES project. The University of Saskatchewan.

“Kazakhstan has come online and is now producing the same varieties grown in Canada, and they have a huge exporting advantage in that they are way closer to India and north and south Asia, which are the biggest lentil consumers.” Competitors like Kazakhstan, India, Turkey, and Nepal have steadily increased their production (US output has also increased significantly in the past decade). In contrast, Canada’s production levels started to flatten out.

“Countries like Kazakhstan are poised to undercut Canada’s exporters, so we have to get out ahead of that by having better genetics. One way is to diversify what we’re producing to go after the premium markets.”

Great opportunity, emphasizes Bett, is at hand for markets with increasing levels of wealth. “There is a rising middle and upper class in places like India. These are consumers who demand high quality. They’re very picky. They know the product way better than an average Canadian,” said Bett.

“Think about something like fruit. It used to be you’d go to the supermarket and buy, say, some apples. You basically had one choice. Today if you go to the market, there are wide varieties of apples. You buy Honey Crisp apples; you pay more for them. If consumers are willing to pay a premium for apples, why not lentils?”

The EVOLVES laboratory work has mainly been happening at the Crop Development Centre located on the main campus of the University of Saskatchewan. A significant part of the project is improving the genetic variability, phenotyping, and gene sequencing of both

cultivated and wild lentils. EVOLVES also takes an ‘omics (combining genomics and phenomics) approach so traits highly valued by exporters can be “zeroed in on” to produce specific varieties. This could result in crops with a specific colour, size, taste, or nutritional value.

“We’re developing tools to give plant breeders the ability to efficiently change traits. So, if it’s got, say, a green seed coat and we want the French green speckled seed coat, we would have a genomic marker that would allow you to do that quickly.”

But are the increased demands being seen among Canadian consumers? While a mainstay staple in places like India, far southeast Asia, and the Middle East, lentils have struggled to establish themselves beyond the fringe of a typical Canadian diet.

“We’ve always been a meat and potatoes country,” shrugged Bett. “The settlers who came to this country in the 1800s and 1900s were mainly Europeans who didn’t bring a diet high in pulse foods or vegetables.”

As food prices continue to rise in stores and supply shortages loom for staple crops like wheat, lentils may play an increasingly important role in diets in Canada and beyond, said Bett.

“Lentils are probably the cheapest sources of protein and easiest to cook. It works well with so many other ingredients like rice and potatoes, or spices like curry.”

“We need to view it not just as a low-cost protein. You’re seeing lentils more and more in upscale restaurants, especially as menus cater more to vegetarian and vegan options. Even steakhouses are including them in their menus.”

With attitude changes, said Bett, maybe, lentils might be like a shiny new red car for consumers.

“Let’s make lentils more sophisticated. Let’s make lentils cool.”



Genome Prairie project update

ReVAMP: combating TB and Johne's disease

In 2014, the “Reverse Vaccinology Approach for the Prevention of Mycobacterial Disease in Cattle”, better known as the ReVAMP project, was launched. The project, which was co-led by Genome Prairie and Genome British Columbia, had two big goals – to find vaccines through a genomics-based “reverse vaccinology” to combat two major bovine infectious diseases - tuberculosis, and Johne’s disease.

Bovine TB, which is not dissimilar to human tuberculosis, is estimated to cost the Canadian cattle and dairy producers more than \$10M annually, while Johne’s disease, which is an intestinal condition that is often difficult to diagnose and causes more than \$80M annual losses.

Much of the project laboratory research was conducted at the Vaccine and Infectious Disease Organization (VIDO) on the campus of the University of Saskatchewan. ReVAMP project researchers used a reverse vaccinology approach, which was first developed in the 1990s, to help identify genes within viruses which would be the best target for a vaccine. The big advantage to reverse vaccinology is that it can dramatically speed up the process for the development of vaccines for specific diseases.

In the fall of 2021, a final project report was submitted to project funders,

and while the ReVAMP project did not fully develop each vaccine, it made significant steps that could in the future, tackle these debilitating diseases. Specifically, the project team was able to find potential antigens which could lay the groundwork for future vaccines. The model developed by ReVAMP researchers is, to date, the only one formally recognized by the United States Department of Agriculture (USDA).

Recently, Merck, the multinational pharmaceutical corporation, announced they would leverage the work done by the ReVAMP team to fully develop vaccine therapies for bovine TB and Johne’s diseases. Also, spin-off projects, including ones that explore combating tuberculosis infections among Bison populations, are also being considered.

The ReVAMP project’s success illustrates the importance of genomic investment in laying the foundation for finding cures for serious diseases, and is attracting interest from major global health research firms. ReVAMP’s story will benefit the health and well-being of cattle, and the future prosperity of profitability of the Canadian beef and dairy industries.



Genome Prairie project update

ASSETS: The battle against the rising tide of antibiotic resistance

For years scientists and medical experts have voiced heightened concerns about the rise of antibiotic resistance in humans. The use, or in many instances, the overuse of antibiotics has led to higher infections gaining resistance to treatment, which, according to recent studies, results on average in nearly 4,000 deaths worldwide.

The story of Genome Prairie's ASSETS project (Antimicrobial Stewardship Systems from Evidence-based Treatment Strategies) is how researchers are seeking to prevent a future of antibiotic resistance in animals. The project, launched in 2019, aims to leverage genomic tools to identify individual animals with bacterial diseases, specifically bovine respiratory diseases in calves. ASSETS hopes to develop precision diagnostic strategies that will allow producers to rapidly field test calves for bacterial pneumonia and antibiotic resistance.

While antibacterial resistance in humans

receives much attention, it has also significantly impacted other animals, particularly livestock. In 2017, the World Health Organization warned of rapidly increasing levels of bacteria resistant to antibiotic medicines, which the WHO said: "is as serious a security threat as a sudden and deadly disease outbreak." Livestock producers in Canada are particularly impacted by resistance, which threatens to disrupt an industry that contributes billions to the economy (the beef industry alone exports nearly \$3 billion annually).

"Antibiotic resistance surveillance and research to inform best practices for antimicrobial use and disease management have been priorities for the beef industry for more than twenty years," said Dr. Cheryl Waldner, ASSETS project lead and professor at the University of Saskatchewan. "There is increasing pressure to ensure that antibiotics are used prudently in all sectors, including agriculture, to preserve their effectiveness to protect both animal and human health."

A major challenge frequently faced by producers is identifying livestock with debilitating and highly infectious respiratory viruses. Because places like feedlots have animals gathered in close proximity, respiratory infections are difficult to identify individually. If an infection is spotted in a herd, current strategies

“The tools developed by ASSETS will better inform prudent antibiotic use for groups of sick animals.”

Dr. Chery Walder
ASSETS project leader

often include giving antibiotics to the entire herd, including calves who may not be infected. Mass medication can lead to greater antibiotic resistance (something that’s becoming a growing problem in fighting infections among humans).

“In the feedlot, antibiotics are needed to treat sick calves and, in some cases, to control disease spread because the untreated bovine respiratory disease can have severe health and welfare impacts,” said Waldner. “The tools developed by ASSETS will better inform prudent antibiotic use for groups of sick animals.

“By identifying bacteria and viruses present in cattle arriving at feedlots, we can improve vaccination recommendations and reduce the risk of respiratory disease and the need for treatment.”

With hundreds of pathogen DNA samples taken from calves over the past year, the ASSETS project team has continued to advance its research. Numerous antimicrobial-resistant genes closely associated with respiratory illnesses have been detected by the project research team. Waldner said she’s hopeful that the ASSETS project will soon provide producers with diagnostic tools.

“We’re working closely with Prairie Diagnostic Services to develop a diagnostic protocol for respiratory swabs that we will test with partnering veterinary clinics in commercial feedlots this fall. We’re also working with veterinarians to ensure the testing results will help them evaluate and customize their treatment protocols for specific groups of cattle.”



Genome Prairie project update

CTAG2: understanding the wheat genome

Launched in 2014, CTAG2 (short for Canadian Triticum Applied Genomics) not only made big advancements in understanding the incredible complexity of the wheat genome but also helped set the table for research happening today, including the 4DWheat project (there’s more information about that in this Annual Report).

CTAG2 was a project led by Genome Prairie, and its research was overseen by Dr. Curtis Pozniak from the University of Saskatchewan and Dr. Andrew Sharpe from the Global Institute for Food Security. CTAG2’s major focus was on understanding the genetic diversity of the wheat genome, which has 14 million DNA strands (the human DNA genome, by comparison, has a relatively modest 3 million strands). Understanding the wheat genome and its diversity would unlock the potential for developing strains of wheat more resistant to disease (like Fusarium head blight and leaf and stem rust), pests (such as the orange wheat blossom midge and wheat stem sawfly), and climate (drought and moisture).

Why was CTAG2’s research important? It helped set the stage for future wheat genomics research (like 4DWheat). Also, it lays the foundation for breeding new wheat strains, which could produce higher volumes of food (for a continuously growing planet) and more dependable crop production (which means more profitability for wheat farmers).

The final project report was submitted in June of 2021. The CTAG2 project, like so many other genome-based research projects supported by Genome Prairie, demonstrates the spinoff effect of genomic research. CTAG2, like many other Genome Prairie-supported projects, never really ‘end’, but functions as a stepping-stone towards a greater understanding of the world that surrounds us, resulting in finding answers and solutions that help make the world a better place.

the Genome Prairie Impact

the impact

Through collaboration, Genome Prairie's operational activities and investments in projects create economic and social contributions in Manitoba and Saskatchewan.

Some of the ways Genome Prairie has an impact include:

- Addressing regional and national issues
- Advancing local talent
- Building public and private sector partnerships
- Developing new technologies
- Contributing to training and employment opportunities
- Facilitating industry solutions
- Establishing expertise, capabilities and capacity
- Leveraging funding



5:1 leverage power

Since 2017, for every dollar invested in Genome Prairie activity by the provinces, another five dollars of near-term economic impact was generated.

46

funded
genome
projects

\$410M

total
project
investments

\$338M

increase
in Total GDP

3,365

FTEs created in
SK and MB
(2005-22)

Current Genome Prairie Projects

PROJECT TITLE	SECTOR	LEADERS	ORGANIZATION(S)	FUNDING
GENICE II: Reimaging Monitored Natural Attenuation as an Oil Spill Response Strategy in the Arctic	Environment	Stern, Gary Collins, Eric	University of Manitoba	\$6,020,874
Enhancing the Value of Lentil Variation for Ecosystem Survival (EVOLVES)	Agriculture	Bett, Kirstin, Vandenberg, Albert	University of Saskatchewan	\$7,432,398
Genomic ASSETS (Antimicrobial Stewardship Systems from Evidence-based Treatment Strategies) for Livestock	Agriculture	Waldner, Cheryl Otto, Simon	University of Saskatchewan, University of Alberta	\$5,678,154
4DWheat: Diversity, Discovery, Design and Delivery	Agriculture	Pozniak, Curtis Cloutier, Sylvie	University of Saskatchewan, Agriculture and Agri-Food Canada	\$11,166,747
GEN-FISH: Genomic Network for Fish Identification, Stress and Health	Fisheries	Heath, Daniel Docker, Margaret Cooke, Steven.	University of Windsor, University of Manitoba, Carleton University	\$9,072,963
GENICE II: Microbial Genomics for Oil Spill Preparedness in Canada's Arctic Marine Environment	Environment	Hubert, Casey Stern, Gary	University of Calgary, University of Manitoba	\$10,612,988
ExoToxChip: Toxicogenomic Tool for Chemical Prioritization and Environmental Management	Environment	Basu, Niladri Hecker, Markus Crump, Doug	McGill University, University of Saskatchewan, Environment and Climate Change Canada	\$9,786,922
DivSEEK International Network	Agriculture	Murphy, Lee Anne Navabi, Katayoon	University of Manitoba	\$742,073
An Integrated Approach for Enhancing Fusarium Head Blight Resistance in Durum	Agriculture	Pozniak, Curtis	University of Saskatchewan	\$1,475,000
Genome360 Phase II: Manitoba's Provincial Applied Genomics Enterprise Platform		Spriggs, Beth Wilcox, Ayn Banerji, Shantanu	Manitoba SharedHealth Inc, CancerCare	\$2,027,496
Canadian Prairie Metabolic Network	Health	Rockman-Greenberg, Cheryl Topp, Adam	University of Manitoba Shared Health	\$6,068,618

Genome Prairie Funders and Partners

Major Funding Agencies



GenomeCanada



Prairies Economic
Development Canada

Développement économique
Canada pour les Prairies

Canada

Manitoba

Agriculture



Major Project Partners



Agriculture and
Agri-Food Canada



Public Health
Agency of Canada

Agence de la santé
publique du Canada



UNIVERSITY OF
SASKATCHEWAN



University
of Manitoba



Shared health
Soins communs
Manitoba



WGRF

Advancing Agriculture through Research



GIFS

SASKATCHEWAN
pulse
Growers



Government
of
Saskatchewan
Ministry of Agriculture

SaskWheat
DEVELOPMENT COMMISSION



MANITOBA
CROP
ALLIANCE



CAPP

CANADIAN ASSOCIATION
OF PETROLEUM PRODUCERS

Consolidated Financial Statements of

GENOME PRAIRIE

And Independent Auditors' Report thereon

Year ended March 31, 2022



KPMG LLP
500-475 2nd Avenue South
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Canada
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INDEPENDENT AUDITORS' REPORT

To the Directors of Genome Prairie

Opinion

We have audited the consolidated financial statements of Genome Prairie (the Entity), which comprise:

- the consolidated statement of financial position as at March 31, 2022
- the consolidated statement of operations and changes in net assets for the year then ended
- the consolidated statement of cash flows for the year then ended
- and notes to the consolidated financial statements, including a summary of significant accounting policies

(Hereinafter referred to as the "financial statements").

In our opinion, the accompanying financial statements, present fairly, in all material respects, the consolidated financial position of the Entity as at March 31, 2022, and its consolidated results of operations and its consolidated cash flows for the year then ended in accordance with Canadian accounting standards for not-for-profit organizations.

Basis for Opinion

We conducted our audit in accordance with Canadian generally accepted auditing standards. Our responsibilities under those standards are further described in the "**Auditors' Responsibilities for the Audit of the Financial Statements**" section of our auditors' report.

We are independent of the Entity in accordance with the ethical requirements that are relevant to our audit of the financial statements in Canada and we have fulfilled our other ethical responsibilities in accordance with these requirements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

KPMG LLP, an Ontario limited liability partnership and member firm of the KPMG global organization of independent member firms affiliated with KPMG International Limited, a private English company limited by guarantee. KPMG Canada provides services to KPMG LLP.



Responsibilities of Management and Those Charged with Governance for the Financial Statements

Management is responsible for the preparation and fair presentation of the financial statements in accordance with Canadian accounting standards for not-for-profit organizations, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, management is responsible for assessing the Entity's ability to continue as a going concern, disclosing as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the Entity or to cease operations, or has no realistic alternative but to do so.

Those charged with governance are responsible for overseeing the Entity's financial reporting process.

Auditors' Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditors' report that includes our opinion.

Reasonable assurance is a high level of assurance but is not a guarantee that an audit conducted in accordance with Canadian generally accepted auditing standards will always detect a material misstatement when it exists.

Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of the financial statements.

As part of an audit in accordance with Canadian generally accepted auditing standards, we exercise professional judgment and maintain professional skepticism throughout the audit.

We also:

- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion.

The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.

- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Entity's internal control.
- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.



- Conclude on the appropriateness of management's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Entity's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditors' report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditors' report. However, future events or conditions may cause the Entity to cease to continue as a going concern.
- Evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.
- Communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.
- Obtain sufficient appropriate audit evidence regarding the financial information of the entities or business activities within the group Entity to express an opinion on the financial statements. We are responsible for the direction, supervision and performance of the group audit. We remain solely responsible for our audit opinion.

A handwritten signature in black ink that reads 'KPMG LLP'. The signature is written in a cursive, slightly slanted style. Below the signature is a long, horizontal, slightly curved line that serves as a separator or underline.

Chartered Professional Accountants
Saskatoon, Canada
June 27, 2022

GENOME PRAIRIE

Consolidated Statement of Financial Position

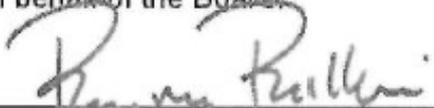
March 31, 2022, with comparative information for 2021

	2022	2021
Assets		
Current assets:		
Cash and cash equivalents	\$ 4,012,427	\$ 3,003,755
Accounts receivable	71,097	577,564
GST receivable	44,777	11,429
Project advances	2,457,340	1,713,358
Prepaid expenses	10,814	10,813
	\$ 6,596,455	5,316,919
Liabilities and Net Assets		
Current liabilities:		
Accounts payable and accrued liabilities	\$ 81,873	107,441
Project advances payable	153,784	515,572
Deferred contributions (note 4)	6,095,311	4,428,419
	6,330,968	5,051,432
Net assets	265,487	265,487
	\$ 6,596,455	\$ 5,316,919

Commitments (note 5)

See accompanying notes to consolidated financial statements.

On behalf of the Board:



Director



Director

GENOME PRAIRIE

Consolidated Statement of Operations and Changes in Net Assets

Year ended March 31, 2022, with comparative information for 2021

	2022	2021
Revenue:		
Project revenues (note 4)	\$ 4,136,638	\$ 3,817,456
Administrative support revenues (note 4)	1,125,990	961,681
Government COVID-19 grants	-	101,456
Interest income	26,446	49,127
	<u>5,289,074</u>	<u>4,929,720</u>
Expenses:		
Project expenditures	4,280,113	3,842,558
General and administrative	993,328	1,022,460
Project development	15,633	64,702
	<u>5,289,074</u>	<u>4,929,720</u>
Excess of revenue over expenses	-	-
Net assets, beginning of year	265,487	265,487
Net assets, end of year	<u>\$ 265,487</u>	<u>\$ 265,487</u>

See accompanying notes to consolidated financial statements.

GENOME PRAIRIE

Consolidated Statement of Cash Flows

Year ended March 31, 2022, with comparative information for 2021

	2022	2021
Cash flows from (used in):		
Operations:		
Excess of revenues over expenses	\$ -	\$ -
Change in non-cash operating working capital:		
Accounts receivable	506,467	(491,962)
GST receivable	(33,348)	6,427
Project advances	(743,982)	(1,063,010)
Prepaid expenses	(1)	19,509
Accounts payable and accrued liabilities	(25,568)	(93,686)
Project advances payable	(361,788)	(109,843)
Deferred contributions	1,666,892	2,178,884
Increase in cash and cash equivalents	1,008,672	446,319
Cash and cash equivalents, beginning of year	3,003,755	2,557,436
Cash and cash equivalents, end of year	\$ 4,012,427	\$ 3,003,755
Cash and cash equivalents consist of:		
Cash	\$ 2,393,851	1,907,699
Investment certificate	1,618,576	1,096,056
	\$ 4,012,427	\$ 3,003,755

See accompanying notes to consolidated financial statements.

GENOME PRAIRIE

Notes to Consolidated Financial Statements

Year ended March 31, 2022

1. Nature of business:

Genome Prairie (the "Corporation") was incorporated in 2000 under the *Canada Corporations Act* and transitioned in 2013 to the *Canada Not-for-profit Corporations Act* as a not-for-profit organization. The Corporation funds organizations and institutions that conduct genomic research and development for the economic benefit of the Prairie Region (Saskatchewan and Manitoba) and Canada. The majority of Genome Prairie's operational funding is received from Genome Canada.

2. Significant accounting policies:

(a) Basis of presentation:

The consolidated financial statements include the accounts of the Corporation and its subsidiary, Interra Biosciences Inc.

These financial statements have been prepared in accordance with Canadian accounting standards for not-for-profit organizations ("ASNPO").

(b) Use of estimates:

The preparation of financial statements in accordance with ASNPO requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements and the reported amount of revenue and expenses during the year. Significant items subject to such estimates and assumptions include deferred revenue. Actual results could differ from these estimates.

(c) Revenue recognition:

The Corporation follows the deferral method of accounting for contributions. Restricted contributions are recognized as revenue in the year in which the related expenses are incurred. Unrestricted contributions are recognized as revenue when received or receivable if the amount to be received can be reasonably estimated and collection is reasonably assured.

During the year ended March 31, 2022 and March 31, 2021 the Corporation received contributions related to the purchase of equipment. There is uncertainty related to the future ownership of this equipment. Therefore, the Corporation has expensed this as project costs and recognized the corresponding contribution as project revenue.

(d) Cash and cash equivalents:

Cash and cash equivalents include cash on hand and short-term deposits which are highly liquid with original maturities of less than three months or are readily convertible to known amounts of cash and are subject to insignificant risk of changes in value.

GENOME PRAIRIE

Notes to Consolidated Financial Statements (continued)

Year ended March 31, 2022

2. Significant accounting policies (continued):

(e) Financial instruments:

Financial instruments are comprised of financial assets (including cash and cash equivalents, accounts receivable, GST receivable, project advances, and prepaid expenses) and financial liabilities (including accounts payable and accrued liabilities and project advances payable). Financial instruments are initially recognized at fair value and subsequent measurement is at amortized cost with investment income recorded on an effective interest basis.

(f) Income taxes:

The Corporation qualifies as a tax-exempt organization under Section 149 of the Income Tax Act.

(g) Government assistance:

Government assistance related to current revenue and expenses is included in the determination of excess of revenue over expenses for the period.

3. Financial risk management:

The fair value of the Corporation's cash and cash equivalents, accounts receivable, and accounts payable and accrued liabilities approximate their carrying amounts due to the short-term to maturity of these financial instruments. The Corporation has exposure to the following risks from its use of financial instruments:

Interest rate risk

The Corporation is exposed to interest rate risk arising from fluctuations in interest rates on amounts invested in interest bearing accounts and investment certificates. Cash, when received, is deposited into an interest-bearing account which earns interest at a rate of 0.40%. The current investment certificate is a term deposit which earns interest at a rate of 2.50% and matures on March 17, 2023. The term deposit may be redeemed by the Corporation at any date prior to the maturity date without penalty.

Credit risk

The Corporation's financial assets including accounts receivable are not exposed to significant credit risk since the majority of receivables are from government organizations.

Other risks

The Corporation has no significant exposure to liquidity risk, currency risk or other price risk. There is a concentration of risk due to the limited number of individual counterparties to the Corporation's cash and cash equivalents and investment certificate.

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GENOME PRAIRIE

Notes to Consolidated Financial Statements (continued)

Year ended March 31, 2022

4. Deferred contributions:

The Corporation receives funding from Genome Canada, Provincial Ministries, Western Economic Diversification Canada and other sources to be held, administered and distributed in accordance with the related funding agreements between Genome Prairie and the other parties. Deferred contributions relate to expenses of future periods and represent the unspent externally restricted funding and related investment income, which are for the purposes of providing funding to eligible recipients and the payment of operating and capital expenditures in future periods. The changes in the deferred contribution balances for the period are as follows:

	2022	2021
Opening deferred contributions for expenses of future periods	\$ 4,428,419	\$ 2,249,535
Contributions during the year:		
Genome Canada	5,873,929	5,764,255
Province of Saskatchewan – Projects	528,293	210,000
Western Grain Research Foundation	28,015	-
Genome Alberta	14,000	5,000
Western Economic Diversification	171,009	269,542
Miscellaneous	32,194	34,958
Manitoba Agriculture, Food and Rural Initiatives	225,000	138,013
University of Saskatchewan – Project development	4,818	23,000
Total contributions received	6,877,258	6,444,768
Total contributions available	11,305,677	8,694,303
Less amounts recognized as project revenues	(4,136,638)	(3,817,456)
Less amounts recognized as administrative support revenues	(1,125,990)	(961,681)
Plus: Deferred funds receivable	67,895	513,253
Project development funds used	(15,633)	-
Closing deferred contributions for expenses of future periods	\$ 6,095,311	\$ 4,428,419

Deferred contributions are comprised of the following balances:

	2022	2021
Projects	\$ 5,627,924	\$ 3,920,278
Operating expenses	467,387	508,141
Closing deferred contributions for expenses of future periods	\$ 6,095,311	\$ 4,428,419

GENOME PRAIRIE

Notes to Consolidated Financial Statements (continued)

Year ended March 31, 2022

5. Commitments:

Funding commitments:

The Corporation signed a funding agreement with Genome Canada on March 24, 2020 which applies to all funding awarded and provided to the Corporation from April 1, 2020 until such time that a new or amended agreement is signed or the agreement is cancelled. Negotiations for an amended agreement are underway and are expected to be finalized in June 2022.

Base funding

The Corporation received a Notice of Award from Genome Canada on March 29, 2022, approving administrative support funding up to a maximum of \$880,000 for fiscal years 2022-23 and 2023-24. As a condition of funding under this Notice of Award, the Corporation is expected to secure co-funding from other sources in an amount at least equal to the contribution of Genome Canada or provide Genome Canada with a documented plan to meet this requirement within a reasonable time period. As specified in the funding agreement, Genome Canada may provide funding to the Corporation notwithstanding the fact that formal commitments from other parties have not yet been secured. In such cases, funds provided in advance "in good faith" shall not be reimbursable in the event such commitments from other parties are not secured, but Genome Canada may then terminate the present agreement or suspend or reduce funding.

Project funding

Genome Canada has approved funding remaining of \$7,549,854 (2021 - \$6,887,446) to be provided to the Corporation for ongoing and future research projects. In accordance with the funding agreements, the Corporation will secure additional financial contributions or in-kind commitments at amounts specified in the Notice of Awards issued by Genome Canada. As at March 31, 2022, the Corporation had \$11,675,986 (2021 – \$14,405,910) in co-funding related to these projects still to be applied.

Lease commitments:

The Corporation has entered into a sub-lease agreement for its Saskatoon office space expiring on December 31, 2025. The approximate annual rental is \$50,000. The Corporation has also entered into a sub-lease agreement with University of Manitoba for its new Winnipeg office space with approximate annual rental of \$16,000 upon expiration of the agreement at the former locations on March 31, 2022.

6. COVID-19:

On March 11, 2020 COVID-19 was declared a pandemic by the World Health Organization. This has resulted in significant economic uncertainty and financial markets have experienced significant volatility in response to the developing COVID-19 pandemic. While operations of the Corporation have not been significantly impacted by the pandemic, the situation is dynamic and the ultimate duration and magnitude of the potential impact on future results is currently undeterminable.



GenomePrairie

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