Low Carbon Feasibility Study

Redevelopment of PRC at Parkinson Rec Park

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PART 1: Redevelopment of PRC Performance Requirements

Part 1 summarizes the proposed performance requirements for the Redevelopment of PRC based on the Low Carbon Feasibility Study which follows in Part 2.

Kelowna recognizes the significant resource requirements and greenhouse gas impacts of buildings. The Province of BC's Green Communities legislation requires municipalities to have GHG reduction targets, and actions and policies for achieving those targets in their OCPs.

Kelowna's Community Climate Action Plan (CCAP) set targets for emissions reduction from every sector and the 2040 Official Community Plan reflects those targets in objectives and policy statements accordingly. The CCAP states immediate and accelerated action is required, and the performance requirements recommended for the redevelopment of PRC reflect this accordingly.

Climate Risk
The project must be designed and constructed to mitigate and adapt to the risk and impacts of climate change and address both acute and chronic stressors. The project team must conduct a climate risk assessment and should consult with the City of Kelowna to confirm the appropriate assessment methodology. In addition, refer to the Community Climate Action Plan and municipal, provincial, and federal governments for climate and resilience planning resources.

Performance targets:

- Emissions neutral in embodied and operational emissions per ZCB methodology.
- At least 25% better than NECB 2017
- Thermal Energy Demand Intensity (TEDI): 45 kWh/m2/yr
- Total Energy Use Intensity (TEUI): 220 kWh/m2/yr
- Greenhouse Gas Intensity (GHGI): 4.5
- Airtightness: 1.0 L/s/m2 @50pa
- A minimum embodied carbon reduction of 20% from baseline (baseline methodology to be confirmed by the project team)

*If Step Code applies at the time of building permit, it is anticipated that the performance requirements established here will meet or exceed Step Code targets. The next BC Building Code update is expected to be implemented December 2023 and is anticipated to reference NECB 2020 for minimum energy performance which generally aligns with the requirement to improve performance by 25% from NECB 2017. If misalignment between performance requirements and future code requirements occur, the design team must adopt the most stringent requirements and agree with the city on the most efficient methods and modelling baselines to demonstrate compliance.

Design strategies:

- The project must explore thermal heat recovery and sharing with neighbourhood sources.
- The project must explore on site renewable and/or alternative energy systems, with potential for inter-seasonal heat storage.
- The project must conduct a Life Cycle Assessment (LCA) to assess embodied carbon impacts and consider using materials with the lowest embodied carbon.
- Refrigerants must be centralized at the primary mechanical heat pump and chiller plant with no refrigerant distribution around the building.
- Design strategies should consider currently emerging technologies and systems acknowledging future-state operational and end-of-life replacement scenarios.

- Life cycle cost analysis (LCCA) must consider future operational cost of carbon, energy, and maintenance (refer to source), and plant replacement costs.
- The project must include a Building Management System that enables energy tracking for performance optimization and maintaining exemplary indoor environmental quality (IEQ) across all zones.

3rd Party verification

- Earn at least LEED Gold certification under the current BD+C for New Construction. The city expects LEED Platinum is a reasonable target for the RPRC, and the design and construction team will strive to attain the highest rating possible while keeping the interests of community benefit, operations and maintenance, and budget as the priority.
- Earn CAGBC Zero Carbon Building (ZCB) Standard Design certification per the current version of the rating system. The city intends to pursue ZCB Performance post construction. The project is registered under ZCB v2 which will be sunset on 29 September 2024. The project team will be required to move the registration into the latest version available at the time of design.
- If the project team wishes to propose alternative or additional certification programs to be pursued, they may do so for consideration provided alignment with the city's objective for climate neutral with stretch goal of climate positive can be demonstrated.

PART 2: Redevelopment of PRC Low Carbon Feasibility Study

EXECUTIVE SUMMARY

This report is based on work and analysis done between December 2020 and September 2021, updated and revised for the latest siting and indicative design established in May 2022.

KEY OBJECTIVES

This work aims to assess the climate-responsive design opportunities for the proposed redevelopment of PRC and recommend strategies to maximize benefits for the City of Kelowna. For the purposes of this report, the redevelopment of PRC in Parkinson Rec Park will be referred to as RPRC. The report includes a passive environmental site analysis, consideration of building envelope, energy and engineering opportunities, carbon emissions mitigation, and opportunities for innovation, informed by the current and expected future policy context.

Recommendations were informed by discussions with the key project stakeholders for high-level, comparative considerations of carbon emissions, capital and operational costs, and program use scenarios to inform the recommendations.

KEY FINDINGS

The policy context and future climate predictions for the Okanagan region demand that the RPRC set aggressive climate performance goals. The Federal Ministry of Environment and Climate Change Canada recently released the “Healthy Environment and a Healthy Economy” plan. The Plan will triple the price of carbon, and see it rise incrementally every year from $50/tonne in 2022 to $170/tonne in 2030, representing a financial risk to the City of Kelowna based on any current and future operational greenhouse gas emissions.

Based on current emissions pricing and policy, increased operating impacts from carbon pricing on any new building could range from 7% to 15%. Furthermore, future policy is moving towards the pricing of embodied carbon emissions and the valuation of natural systems that sequester carbon, manage air quality, and water, and maintain temperatures as carbon management assets.

Relevant policies, including the City of Kelowna’s own Community Climate Action Plan, the Province’s Clean BC Initiative, and the federal government’s Pan Canadian Framework on Clean Growth and Climate Change, calls for new infrastructure investment to perform as net zero carbon facilities (at a minimum) to contribute to our global climate commitment ratified in the 2015 Paris Agreement.

Any new City and Provincial infrastructure must set aggressive performance goals for energy and carbon, in addition to the related subject areas to conserve, restore and manage natural, social, and economic assets.

Site analysis confirms a range of opportunities available to optimize passive conditions for the project. An optimized facility connected to available community energy resources, could be an ultra-low energy, net-zero carbon project, with the potential to further reduce community carbon emissions for a climate-positive project.

Reducing GHGs will lower the operational cost risk over the life of the building> A minimum of 20% reduction in embodied carbon is possible with low-carbon materials such as mass timber for structure

and low carbon concrete. Emissions can be further mitigated by conserving landscape and restoring ecological function.

RECOMMENDATIONS

A climate leadership response must embrace more than efficiency for the RPRC. Building a networked system with the project's surrounding neighborhood and business community partners will unlock the potential for the project to be recognized as a world-class climate-positive [1]project. The site provides several fortuitous connection points that offer a range of low-carbon design strategies.

Planning for a project that shows true leadership in sustainability requires the following:

- Setting a vision for carbon-neutral development with a stretch goal of being climate-positive.
- Adopt a whole systems-thinking approach to assess potential strategies and seek shared benefits.
- Conserve, restore and enhance the biodiversity and riparian habitat of Mill Creek.
- Protect the Okanagan watershed and the community from flooding and pollutants.
- Implement energy systems in the building that do not emit carbon.
- Explore heat recovery from the two municipal trunk sewers that pass through the site.
- Explore opportunity to receive surplus heat from the nearby commercial district to decarbonise energy consumption.
- Explore sharing surplus heat with neighbouring buildings to reduce their emissions and carbon tax burden.
- Generate electricity on-site from solar PV, phased to align with technology.
- Use BC-sourced mass timber for the building structure to address embodied carbon emissions.
- Provide generous fresh air ventilation and daylight for healthy, comfortable, low-carbon operation.
- Optimize passive strategies for a flexible and resilient facility that can respond to future climate conditions, including extreme weather events and other climate impacts such as wildfire smoke.
- Optimize the site for active transportation to reduce emissions from transportation further and improve health.

These recommendations will set the RPRC on the path to a climate-positive development; It will be the first in the Okanagan region, possibly the first in BC and at this stage, quite likely the first in Canada. The City of Kelowna has the opportunity demonstrate leading carbon-resilient community development by becoming climate-positive campus showcasing the project as a centre of excellence in innovation.

[1] Climate positive: reducing more greenhouse gas than is generated by a building, product, or process.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Purpose and Scope

The City of Kelowna plans to build a new community centre to replace the Parkinson Recreation Centre, referred to in this report as the RPRC. The City contracted consultants to consider sustainable design opportunities and benefits of the early design concepts for the RPRC.

The objective of this work is to assess the sustainable design opportunities of the proposed project and recommend strategies that seek to maximize co-benefits for the City of Kelowna. This assessment is not exhaustive, recognizing that sustainability and sustainable design are broad and complex concepts and practice areas. To narrow the work, this assessment is focused on emissions reduction and climate resilience. The scope includes a passive environmental site analysis, consideration of building envelope, energy and engineering opportunities, carbon emission mitigation, and opportunities for innovation, informed by the current and expected future policy context. High-level considerations of capital cost, operational cost, program, and shared-use scenarios informed the recommendations.

Further, this work is limited to assessing areas with most the potential for benefit based on the early site planning and program concept schemes.

1.2 Approach and Grounding

The assessment and strategies proposed here are grounded in the comprehensive climate action planning already done by the City of Kelowna, Regional District of Okanagan Similkameen, the Province of BC and the Government of Canada, which aim to meet and exceed the global commitment to the reduce greenhouse gas emissions according to the 2015 Paris Agreement. As described herein and in the extensive referenced policies and their associated analysis, we begin from the premise that, to be responsive to this commitment, any newly built infrastructure must be carbon neutral[2] in operation at a minimum and strive to be climate-positive, accounting for embodied emissions. The analysis presented here demonstrates this goal is possible, building on current best practices and local precedents.

1.3 Methodology

A desktop review was conducted of relevant local, provincial, and federal policies, and of select best practice guidance and emerging policy from relevant organizations and institutions. The following policies and guidance documents were reviewed, and recommendations are aligned accordingly:

- The City of Kelowna Community Climate Action Plan (June 2018)
- The City of Kelowna Corporate Energy and GHG Emissions Plan (2018)
- RDOS Climate Projections for the Okanagan Region (February 2020)
- Clean BC (December 2018)
- British Columbia Climate Action for the 21st Century
- BC Energy Step Code
- Pan-Canadian Framework on Clean Growth and Climate Change (2016)

[2] Carbon neutrality means reducing building or project greenhouse gas emissions to zero by reducing emissions from all sources first, and then compensating for the remaining emissions by offsetting them with direct investment in programs that reduce emissions elsewhere.

- A Healthy Environment and Health Economy, Environment and Climate Change Canada (December 2020)
- City of Vancouver Climate Emergency Action Plan (October 2020)

Interviews with stakeholders from both the City of Kelowna, SD 23, local utilities, commercial landowners, and other relevant parties also informed this work:

- City of Kelowna (Corporate Energy Manager)
- City of Kelowna (Grants and Special Projects Manager)
- City of Kelowna (Sanitary sewers)
- City of Kelowna (Community Energy Manager)
- Stober Group/Landmark District (Surplus heat capture)
- SkyFire Energy (Solar PV assessment)
- Geotility (Geoexchange assessment)
- Powermatrix (Waste heat energy assessment)
- Fortis BC (Electric and Natural Gas)
- AME Group (Rec Centre Mechanical assessment)
- reLoad Sustainable (Technical support)

Recommendations and information documented here are based on the above, as well as on professional experience and expertise. This work was carried out between 11 May and 30 June 2021 and updated in June 2022 to reflect the latest siting and indicative design.

2.0 POLICY CONTEXT

Scientific evidence of global climate change is driving a range of new planning, development and building policies at all scales of jurisdiction and are resulting in new regulatory conditions on managing natural systems, built assets, and conservation. There is an urgent need to consider the short-, medium-, and long-term impacts of the built environment on the health of our planet and ourselves. The trajectory of climate change is accelerating resulting in the implementation of increasingly strict policy conditions. It is useful to consider current policy trends directly applicable to this project.

Policies and best practice documents from across jurisdictions were reviewed to inform the context provided here (refer to 1.2 Methodology). The following summarizes the policy context within which the RPRC must respond.

2.1 Climate Policy Commitments

The Paris Agreement commits Canada to reduce Greenhouse Gas emissions by 30% below 2005 levels by 2030 and 80% by 2050. The Province of British Columbia's Climate Action Plan is committed to similar reductions, using 2007 as the baseline. The City of Kelowna's Community Climate Action Plan follows suit in support, with recommended actions to aggressively tackle from transportation, buildings, and waste emissions. As custodians of municipal infrastructure, the City of Kelowna must address emissions reduction and long-term emissions management of all current and future infrastructure.

The emissions reductions and time frames set out in both the Federal and Provincial commitments are aggressive, and recent data points to a trend of *increasing* emissions. In August 2020, the Provincial government released the 2018 greenhouse gas inventory figures that show a seven percent increase

from 2007. We are now 14 percent further from our 2030 target than in 2007 (https://www2.gov.bc.ca/gov/content/environment/climate-change/data/provincial-inventory).

The City of Kelowna's Community Climate Action Plan sets a trajectory for reduction that must be implemented with more haste to meet the targets. Set in context, this means that new infrastructure built today must emit no carbon (or target net-zero emissions) to leave room in the carbon 'budget' to address emissions from existing infrastructure and accommodate growth.

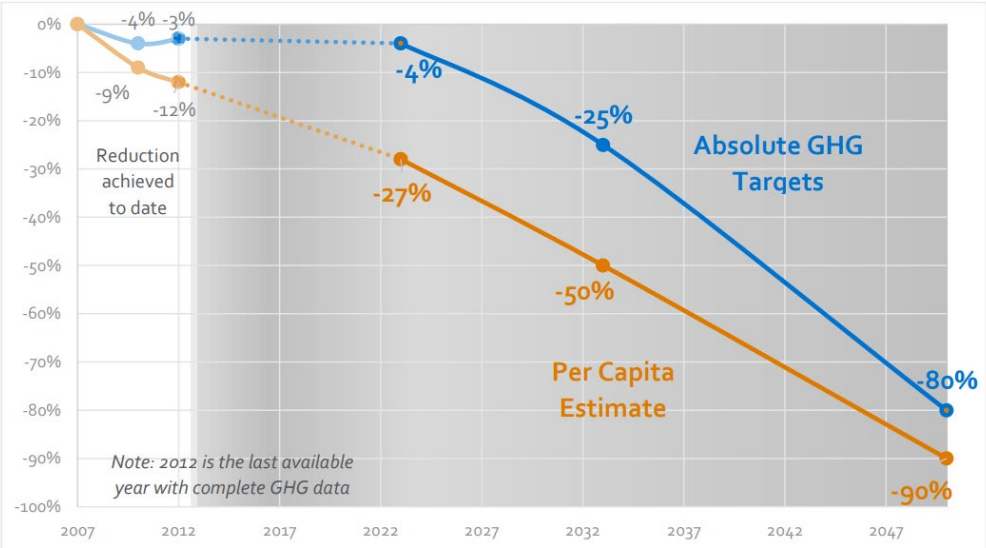

Figure 1: City of Kelowna GHG Reduction Targets.
Source data and image: City of Kelowna Community Climate Action Plan
https://www.kelowna.ca/sites/files/1/docs/community/community_climate_action_plan_june_2018_final.pdf

2.2 Current Policy and Future Trends

A range of policy or regulatory conditions are currently in place or will come into effect as the planning, design, and construction of the RPRC project proceeds. Moreover, we expect regulatory conditions and policy to evolve relatively rapidly, hastened in part by the declaration of 'Climate Emergencies' by cities around the world responding to implement actions accordingly. In general, climate action implementation is evolving holistically to recognize the importance of managing energy demand, and the impacts of emissions beyond those generated by the operation of buildings and infrastructure alone.

2.2.1 Energy Efficiency

While energy efficiency is at the core of climate mitigation planning and action, policy and codes in BC are evolving rapidly to address the ever-increasing demand for electricity, as the built environment, transportation networks, and industrial sector move to electrification in service of reducing greenhouse gas emissions. Low-emission grid-generated electricity in BC drives demand for it quickly, and we can assume limited supply will drive utility costs higher over time. A key part of creating sustainable infrastructure for the long term is addressing energy demand as well as emissions as we plan for the transition to electrification. This aim is reflected in current ultra-low energy policies, codes, and regulations such as the BC Energy Step Code, which takes an incremental approach to reduce building energy demand over time to ensure net-zero energy buildings by 2050. The growth of the Passive House program as part municipal energy policy, (the City of Vancouver, for example) is another indicator

of aggressive mechanisms to drive energy demand down. Both the BC Step Code and Passive House rely on predictive modelling and actual performance metrics measured during construction and at completion to ensure performance in service. These include setting thermal energy demand intensity targets (TEDI), and air tightness (ACH). Further, air tightness testing is required to demonstrate code compliance in both cases, demonstrating increasingly sophisticated implementation to ensure true results. We expect future codes and policies to advance this trend to rely more heavily on absolute metrics and measured performance data rather than predictive modelling, relative comparisons to business-as-usual performance, or prescriptive requirements.

2.2.2 Resilience Planning

As greenhouse gas emissions continue to climb, global climate conditions are changing. New climate conditions, as identified in the RDCO Climate Projections for the Okanagan Region Report (February 2020), include the following expected significant changes:

- Warmer temperatures year-round
- Summers will be considerably hotter
- Increased duration of the growing season
- Warmer winter temperatures
- Increased precipitation across all seasons except summer
- Summer is expected to remain the driest season and become drier

We can expect shifting seasons and more intense storm activity, flooding, wildfire and more. Planning and designing for future climate scenarios are part of current best practices and are beginning to emerge across leading organizations through policy. UBC, lower mainland health authorities and BC Housing require new buildings and infrastructure to account for and respond to future climate scenarios. Methodologies and tools are being informed based on the work of the Pacific Climate Impacts Consortium (PCIC) at the University of Victoria. We can expect to see strategic provincial-level organizations adopt similar requirements, signalling code changes will follow as cycle updates allow.

2.2.3 Operational and Embodied Carbon Emissions

Emissions measured from the building sector have historically accounted only for operational emissions. Embodied energy or carbon refers to emissions generated or energy used to produce a good or service (extraction, manufacturing, transportation, construction). Embodied emissions associated with materials used to construct buildings are now understood to represent a significant share of the greenhouse gas emissions from the built environment. Tools and methods of measuring embodied carbon now exist to assess the relative impacts of a project over time, usually referred to as Life Cycle Assessment (LCA).

While still emerging, policies and codes are currently embedding requirements to quantify and report total operational emissions, future regulations will set maximum thresholds and are expected to include embodied emissions building on the carbon pricing schemes already in place.

The City of Vancouver's recently adopted Climate Emergency Action Plan sets a limit on embodied emissions for all new construction. Growing best practice standards and green building rating systems are supporting good quality tools and quantification methods, including the Zero Carbon Building Certification Program and the LEED Green Building Rating System. Finally, the federal climate action commitments recently announced as part of the 'Healthy Environment and a Healthy Economy' initiative

(see Cost of Carbon below), recognize the importance of a low-carbon material supply chain, and commit to expanding capacity in Canada in response.

2.2.3 Natural Capital Sequestration

Capturing carbon pollution is recognized as a key mitigating measure. Maintaining functional ecosystems such that forests, wetlands, and soils can sequester emissions from the atmosphere is part of emissions reduction policy and strategies at all levels of jurisdiction. Canada's Pan-Canadian Framework on Clean Growth and Climate Action prioritizes conservation and restoration in support, and the City of Vancouver's recently adopted Climate Emergency Action Plan addresses the need to remove carbon from the atmosphere by restoring natural systems in urban and non-urban areas. Known as Natural Carbon Sequestration (NCS) projects, these can include a range of efforts such as urban forest projects, tree planting, shoreline restoration, riparian and river system restoration, and soil protection. Methods of measuring the carbon sequestration potential of ecological systems are still emerging, but some good tools and methods exist as part of green building rating systems (SITES, Envision), which are driving traction for broader adoption in policy and regulation. We expect to see this reflected in the best practices guidance for new development in the very short term, and to be embedded as policy in a range of governments in the medium term.

2.3 Cost of Carbon

Canada's Pan-Canadian Framework on Clean Growth and Climate Change is the national plan to reduce greenhouse gas emissions, grow the economy, and build resilience to a changing climate. On 11 December 2020, the federal government announced the 'A Healthy Environment and a Healthy Economy' initiative to augment the Pan-Canadian Framework. These initiatives are projected to exceed Canada's 2030 greenhouse gas reduction target. At the heart of the initiative is a significant increase in the cost of carbon emissions, from the current $30/tonne, increasing $15 every year after 2023, to a maximum of $170 in 2030. While in BC, emissions are currently priced at $40/tonne, this federal initiative will significantly increase the cost of carbon in the short term.

This recent announcement includes, among many other initiatives, investment funding and support for the building sector, including:

- $1.5 billion over three years for green and inclusive community buildings through retrofits, repairs, upgrades and new builds, which would support good jobs and local economic growth, contribute to climate objectives and serve disadvantaged populations.
- Working with provincial and territorial partners and with industry to advance technology and uptake of the next generation of low-emission, high-efficiency space and water heating equipment and windows, building on the Market Transformation Roadmap
- Working with the building materials sector and other stakeholders to develop a robust, low-emissions building materials supply chain to ensure Canadian, locally-sourced products are available, including low-carbon cement, energy-efficient windows and insulation.
- Conducting Canada's first-ever national infrastructure assessment, starting in 2021, to help identify needs and priorities in the built environment, and undertake long-term planning towards a net-zero emissions future. Reference: https://www.canada.ca/en/environment-climate-change/news/2020/12/a-healthy-environment-and-a-healthy-economy.html

3.0 PASSIVE ENVIRONMENTAL SITE ANALYSIS

The following summarizes key site conditions that can contribute to and inform the climate responsive design approach for the RPRC. The analysis is based on the site climate conditions and the site plans provided by HCMA Architecture. Strategies presented here are generated based on first principles of practice, and are generally low-cost, and high-impact, together contributing to the potential for a climate-positive development. For reference, the site plan is provided here in Figure 2.

Figure 2: Site Plan proposed redevelopment of RPRC in Parkinson Rec Park

Solar orientation:

The site is open to the sunpath for the whole year, which allows for excellent daylighting to reduce energy associated with artificial lighting. The southwest elevations of the building will be shaded to control excessive solar gains, from causing glare and/or overheating.

Preventing Overheating:

The heat gain from surrounding at-grade parking is a significant factor for regular buildings of this type – to accommodate the need for multiple visitors. The RPRC incorporates an at-grade parking lot to the northeast which will be partially shaded by the RPRC Building and trees around the creek – these help to significantly reduce the local heat island effect, resulting in considerably reduced demand for air conditioning.

Seasonal Natural Ventilation:

The site is ideally orientated to capture the prevailing breezes through the valley and to make use of natural ventilation in spring, fall and early summer. This orientation would further reduce operational energy and carbon emissions, enhancing occupant health and wellness for staff in the building.

Mill Creek:

The presence of Mill Creek to the south and east of the RPRC is a unique feature that provides inherent value in its natural capital as an environmental buffer and source of rich biodiversity. The creek and riparian zone provide an appealing amenity zone of interest that must be protected and enhanced as part of the project goals.

Fresh Air Reservoirs

The area between the creek and the south of the RPRC is proposed to be a natural zone, free of active sporting programs – and as such it is an ideal “fresh-air reservoir” from which to draw the ventilation air for the building. The naturally cooled and oxygenated air around the creek riparian zone will be drawn to the RPRC building to support the healthy building and low-carbon goals.

Flood considerations

The Mill Creek flood zone will be enhanced with a natural buffer that has the capacity to absorb more water. Additionally, ongoing City of Kelowna projects at interconnections to Mission Creek and Brandts Creek is helping to prevent increased flood risk downstream of the site and the Lake.

Evaporative cooling

Working with both the natural environment and the built environment in synergy, the natural, evaporative effect of the surface water will further aid in enhancing a cooler microclimate for the building, reducing air conditioning loads and providing more resiliency to climate change.

Groundwater

Preliminary investigations have shown that local groundwater associated with the Mill Creek watershed will provide excellent thermal capacity for geoexchange heating and cooling. The groundwater flow is

constant, with subsurface run-off from Glenmore and the Mill Creek basin, which means that a geo-exchange field will not become oversaturated with heat or coolth – allowing optimum energy efficiency in operation throughout the heating and cooling seasons.

Shallow Ground Heat Exchange

The new courtyard garden area to the west of the RPRC building is more shaded and ideal to allow the use of earth-coupled heat exchange technology to provide shallow ground heat exchange and complete passive cooling for ventilation systems serving the building.

Energy Exchange

The neighbourhood around the RPRC site provides important opportunities for energy exchange and to reduce the overall carbon footprint of the community. These include energy capture from sanitary sewers, and thermal energy sharing to apartments, hotels, and commercial neighbours.

4.0 PERFORMANCE TARGETS AND STRATEGIES

4.1 Targets

To align design strategies with a climate-positive outcome, it is essential to set performance targets to guide design decisions. Targets necessitate analysis and support verification. The following performance metrics align with current best practices to encourage passive design strategies and efficient active systems; as well they are consistent with metrics used in leading rating systems and the BC Energy Step Code. Proposed targets for RPRC are:

- **Thermal Energy Demand Intensity (TEDI)**

TEDI Target: 45 kWh/m^2/yr

TEDI is a measure of the building's total annual heating load per unit of floor area (kWh/m^{2}yr). This metric measures the effectiveness of passive design strategies. It represents the heat needed to compensate for heat losses through the building envelope and ventilation system, after accounting for solar heat gain and internal heat gain from occupants and equipment.

TEDI is a building performance metric used by many high-performance standards like Passive House, Zero Carbon Building Standard and the Step Code. A low TEDI results from strategies such as a highly insulated enclosure, triple-glazed windows, an airtight envelope, highly efficient ventilation system with heat recovery.

Based on the performance data of existing aquatic recreation centres and best practice energy performance, the TEDI target is proposed at 45 kWh/m2.

- **Total Energy Use Intensity (TEUI)**

TEUI Target: 220 kWh/m^2/yr

The TEUI is an energy efficiency metric that represents the total amount of energy used by all the building systems including lighting, equipment, ventilation, heating, cooling, and domestic hot water, expressed per unit of floor area.

Based on the performance data of existing aquatic recreation centres and best practice energy performance, the TEUI target is proposed at 220 kWh/m2.

- **Greenhouse Gas Intensity (GHGI)**

GHGI Target: 4.5 kgCO_2e/m^2/yr

The greenhouse gas intensity (GHGI) is expressed in annual kilograms of carbon dioxide equivalent per square metre (kgCO_2e/m^2). The GHGI is directly linked to both the TEDI and TEUI targets but is also dependent upon the carbon intensity of the fuel source. In British Columbia, the carbon emissions from the electrical grid are around one-tenth (10%) of the GHG emissions compared to combustion of natural gas. To achieve a climate-positive solution for the RPRC, it will be necessary to avoid the combustion of natural gas for heating throughout, with potentially more reliance upon electrical heat pumps instead. A zero-carbon building would have a GHGI of 0 kgCO2e/m2.

Based on the performance data of existing aquatic recreation centres and best practice energy performance, the GHGI target is proposed at 4.5 kgCO2e/m2.

- **Embodied Carbon**

Embodied Emissions Target: Minimum 20% reduction from baseline

The total life cycle carbon emissions include the emissions from operational energy and the emissions from the construction materials and energy used in processing, transportation, and assembly. The target for RPRC is to use materials that have a lower embodied carbon compared to conventional construction, or a baseline.

Based on current analysis of similar building types, a life cycle assessment of the indicative design and best practice, the embodied carbon emissions target is proposed as a 20% reduction from a baseline building (baseline methodology to be confirmed by the project team).

- **Refrigerants**

Building systems commonly use refrigerant gas as part of an enhanced energy efficiency strategy, but careful management is requirement reduce the risk of global warming potential (GWP).

A sound strategy for maximizing the energy benefit of refrigerants while managing the risk of global warming potential is to centralize refrigerant use within the primary mechanical systems plant with no refrigerant distribution around the building. This approach reduces the overall charge of refrigerant gases in the building and mitigates the risks of broken/punctured lines in public areas.

4.2 Strategies

A climate-positive outcome for the RPRC will require the evaluation of design strategies beyond the boundaries of the building. Design strategies evaluated with significant potential to manage emissions follow.

4.2.1 Building Energy Recovery

The interface of the mechanical systems between the natatorium systems and other building systems provides opportunities for energy recovery. This enables the mechanical system to be optimized and to operate at a more efficient baseload.

4.2.2 Neighbourhood Energy recovery

The neighbourhood surrounding the RPRC includes existing commercial spaces that have the potential for recovering waste energy via thermal energy exchange. This method of energy recovery is common in modern cities, a key element in driving down carbon emissions. A neighbourhood energy recovery system would utilise surplus waste heat rather than rejecting it via cooling towers. Heat could be used directly or stored through an interseasonal heat process to mitigate the combustion of natural gas.

4.2.3 Expanding Community Energy

A neighbourhood energy recovery system could be expanded in the future to serve other potential commercial partners – creating further opportunities for reducing carbon emissions. Neighboring properties to the RPRC could also make use of the waste heat reducing their own natural gas emissions

from boilers/furnaces for heating or hot water. Financing of such a carbon neutral heat network (CNHN) could be through a third-party utility – which would show as cost-neutral on the project balance sheet – and facilitate the maximum carbon savings as part of the climate positive vision.

4.2.4 Infrastructure Heat Sources

The City of Kelowna sanitary sewer infrastructure provides a near constant source of thermal energy that could be repurposed through indirect heat recovery. Two sanitary sewers run through the RPRC Site – one north of Highway 97 and the other along Burtch. The new sanitary connection required as part of the RPRC project, would facilitate the straightforward installation of the heat exchange equipment.

This would be a similar method to that the Olympic Village in Southeast False Creek utilizes as part of its low-carbon energy system. Furthermore, heat from traffic on the highway could also be captured, as is becoming more widely used in Europe and Japan (www.ICAX.co.uk).

4.2.5 Renewable Energy Systems

Commercially available renewable energy systems have been considered, including solar electric/photovoltaics (PV), solar thermal (solar hot water), wind turbines and biomass/waste to energy. The use of solar electric (PV) and solar thermal provides the most effective method for implementation.

4.2.6 Embodied Carbon

The materials used to construct the RPRC will impact embodied energy and carbon. Embodied emissions will likely become part of carbon pricing in the future, potentially within the timeframe of the RPRC. The recent Climate Emergency Action Plan implemented in the City of Vancouver sets maximum thresholds of embodied emissions for new buildings and current policy requires quantification and reporting of embodied emissions for all new rezonings. We expect policy at all levels to draw on this example in the short term.

A material study and whole building LCA were conducted using the indicative design, order of magnitude assumptions and extrapolated material estimates to understand the potential to address embodied emissions. Results demonstrate that a mass timber structure and low carbon concrete mixes combined with other low carbon materials will reduce embodied emissions by at least 20%. Kelowna is optimally situated for local access to high quality mass timber products and fabrication expertise. Using wood products for building structure avoids significant emissions associated with more intense materials like concrete or steel. Study recommendations include:

- Specify low carbon concrete. This study scope did not research available low carbon mixes and SCMs in the local market are becoming more readily available.
- Use mass timber instead of structural steel.
- A range of potential mass timber products and hybrid systems can be assessed for optimal performance.
- Conduct analysis to determine what alternatives are available as alternatives to XPS roof insulation.
- Use lower-impact materials like fibre cement board, aluminum composite panel, and roll-formed steel cladding rather than aluminum cladding.

4.3 Rating Systems

Green building rating systems are very useful tools to advance project performance goals. While rating systems offer many benefits, the main value is a framework for accountability. Formal, third-party verified rating systems, ensure performance, keep stakeholders accountable from project start to finish and offer exceptional value. Rating systems are most effective if used as tools and methods to advance a project's vision rather than to set or define the vision. All rating systems are rapidly evolving and responsible for driving many of the regulatory and code changes we expect. The project should expect to apply one or more, to benefit from guidance, rigor, methods, tools, accountability, and recognition. Three ratings systems are recommended:

4.3.1 Leadership in Energy and Environmental Design (LEED)

LEED v4.0/v4.1 is the leading, holistic building scale industry standard for green building design and construction and aligns directly with the City's broader commitment to sustainability. It is recommended that the project target LEED Gold as a minimum with a stretch goal of LEED Platinum.

4.3.2 Zero Carbon Building Standard (ZCB)

The Zero Carbon Building Standard (ZCB) Design and Performance Certification is aligned with an emissions-focused approach to support the City's climate action targets. LEED and ZCB are designed to be used in parallel and offer good process and documentation synergy. The project is registered under ZCB v3.

5.0 CONCLUSION + RECOMMENDATIONS

From the analysis presented throughout that the global climate context, and local policy demand that any new buildings and/or infrastructure must meaningfully respond by setting ambitious climate performance goals. To be responsive to the targets and timelines of our climate commitments, any newly built infrastructure must be carbon neutral in operation at a minimum and strive to be carbon-positive, accounting for embodied emissions. The City of Kelowna has supporting policy in the Provincial Clean BC initiative, and clear direction in the City of Kelowna's Community Climate Action Plan to implement such an approach.

The RPRC must reflect the rapidly changing context and trajectory of climate policy and responds to the conditions we expect in the short and medium term. The strategies explored demonstrate that the project can take advantage of resource sharing beyond the site boundary, representing a significant opportunity to reduce energy use and lower carbon emissions.

The site is strategically located to initiate a network of resource sharing that can make the RPRC a net-zero carbon and climate-positive project. A networked heating system could recover heat from adjacent developments, with the potential to expand beyond the RPRC. The project has the opportunity to minimize operational and embodied energy and carbon and could further contribute to managing carbon emissions through natural capital site sequestration.

In summary, the recommendations to deliver a climate-positive project are:

1. Define a vision that includes clear climate performance targets based on future climate conditions and the expected trajectory of policy and regulatory conditions.
2. Adopt a whole systems-thinking approach to assess potential strategies and seek co-benefits.
3. Use rating systems as tools to support the vision and performance targets, maintain accountability, and earn recognition. Assess appropriate rating systems as the concept develops to ensure selections are most advantageous, reflect the site and stakeholder context, and advance the vision accordingly. Achieve a minimum of LEED Gold with the stretch goal of LEED Platinum, and the Canada Green Building Council's Zero Carbon Building - Performance certification.
4. Optimize the site to facilitate low carbon transportation, reduced heat island effect, and improved ecological function and potential natural capital carbon sequestration.
5. Recover waste heat: pursue a networked, community energy approach by capturing the waste thermal energy from sources in the surrounding community – by absorbing waste heat from the neighbourhood (for example, the City of Kelowna wastewater treatment plant and Okanagan College district energy).
6. Recover city energy: pursue a networked, community energy approach by capturing thermal energy (heat) from the existing sanitary trunk sewers from Glenmore and Enterprise (for example, Olympic Village, Vancouver).
7. Investigate heat transfer capacity from highway traffic.
8. Address embodied carbon: pursue low emissions construction materials including prioritizing wood for structure.

9. Manage stormwater on-site through an absorbent landscape, to mitigate flooding and to restore, and enhance habitat and biodiversity in the Mill Creek corridor.
10. Minimize potable water consumption through the integration of dual plumbing systems to allow for reclaimed water to be utilised where appropriate.

The findings and recommendations in this report confirm the project can commit to a compelling vision: a carbon neutral development, with the potential to further reduce community emissions and make the project climate-positive. This vision requires collaboration between the City of Kelowna with other community partners.