Technical Description

The following section summarizes how The Green Dream Home meets the goals and objectives of the EQuilibrium initiative by describing how the project incorporates aspects of each of the five key principles for sustainable design: Health, Energy, Resources, Environment, and Affordability.

1 HEALTH

The indoor environment of The Green Dream Home will be one that is ultimately comfortable. The home has been designed to provide superior quality air, water, and lighting. This house will be much quieter inside than others in the neighbourhood, while featuring control for the occupants over their temperature, humidity, and lighting. Natural light and ventilation will be supplied to all rooms and natural materials will be used to finish the interior to ensure a healthy indoor environment.

1.1 Indoor Air Quality

Occupant health and comfort will be optimised within the home by preventing or limiting exposure to pollutant *emissions*, maintaining an acceptable level of *thermal comfort* for the occupants, *controlling moisture* sources, limiting exposure to *airborne particles*, ensuring adequate *ventilation*, and protecting against the infiltration of *soil gases*.

1.1a Emissions

The quantity of indoor air contaminants will be reduced by selecting low emitting materials, by effectively sealing those materials that do emit pollutants, and by providing sufficient ventilation to remove emissions from the air.

In choosing construction materials, preference will be given to materials in their natural state over those that are synthetic. Wood, stone, steel, and glass shall be used in their raw states and shall be mechanically fastened if possible. If painting, staining, sealing, or gluing is necessary, then water based substances with low levels of volatile organic compounds (VOCs) shall be specified. “Beetle killed pine” will be used extensively as an interior finish due to its nature as a non-emitting material and its abundance in the area. No carpet or vinyl will be installed in the project. Basement floors will be polished concrete.

The insulation and exterior finishes will be sealed from the interior spaces using a Code compliant vapour barrier.

1.1b Thermal Comfort

Indoor air conditions will be maintained according the ASHRAE Standard 55 by installing and calibrating a fully ducted heat pump system. Occupants will be given control over the temperature in each room through the use of adjustable vents and operable windows. All windows will be triple glazed, argon filled with low emissivity coating, featuring frames that are thermally broken and nonconductive spacers between glass panes. Windows are placed so that the majority are on the

South side of the home. The roof overhangs are designed to shade these windows in the summer while allowing more light and heat to enter in the winter. West facing windows will be shaded by the neighbouring house (yet to be built). East facing windows will be shaded in the summer by deciduous plantings. The thermal mass effect of the concrete building components will help to moderate the interior temperature.

1.1c Moisture Control

While moisture is not typically as great a problem in Kamloops as other parts of the country due to the arid climate, the building will nonetheless be designed and constructed to both prevent the infiltration of rainwater and allow for the expedient exfiltration of excessive moisture away from the home.

The insulated concrete forms used to construct the foundation and walls will help to protect the concrete mass wall from moisture. Dampproofing will be provided to BC Building Code standards below grade.

Roof water runoff will be collected into cisterns to be used for irrigation. The cisterns will have overflows directed into the municipal storm water collection system. The site will be graded away from the home so as to prevent ground water from flowing into the house.

The HVAC system will be balanced to provide a comfortable level of humidity within the home. In Kamloops, this most often requires humidification of the air. Exhaust vents in the bathrooms and the kitchen will isolate and remove excess water vapour at the source. Placement of the vapour barrier on the interior of the wall assembly will ensure that vapour diffusion does not occur, preventing moisture and mould accumulation within the structure.

1.1d Particle Control

An indoor air quality (IAQ) management plan will be implemented during construction. Absorptive materials that are installed or stored on-site will be protected from moisture and dust. Provisions will be made for inspections of building and HVAC systems for deficiencies that could adversely affect the IAQ. The HVAC system including ducts will be protected (sealed) during construction, and the installation of materials will be sequenced to avoid contamination of absorptive materials.

The home will be equipped with a HEPA type air filtration system. Prior to occupancy and after construction ends and all interior finished are installed, new filtration media will be installed and the building will be flushed-out to remove airborne contaminants.

No carpet will be used to ensure that the home is easy to clean. A commercial grade recessed entry mat will be installed at the front and back door of the project to limit the amount of particulate matter entering the home.

Smoking will not be permitted in the home during the construction and demonstration phase.

1.1e Ventilation

The HVAC system and building envelope will be designed to optimise air change effectiveness, and the building will be tested after construction to ensure that the system performs as intended.

A fully ducted mechanical ventilation system will be installed and operable windows will be included in each regularly occupied room. A heat recovery ventilator (HRV) will be installed as part of the HVAC system to enable the effective delivery and mixing of fresh supply air necessary for occupant comfort and health.

No combustion appliances will be used in the project, and therefore venting of combustion gases will not be an issue. Electric fireplaces will be installed in place of gas or wood burning models.

Carbon monoxide (CO) detectors and smoke detectors will be installed within the home as required by the BC Building Code. With the assistance of the CMHC, a carbon dioxide (CO_2) monitoring system will be installed in the home in order to monitor the indoor air quality.

1.1f Soil Gas Protection

Soil gases include methane, radon, and water vapour. Measures will be taken to ensure that the infiltration of these gases does not occur. Sub-slab polyethylene sheeting will be installed as required by the BC Building Code, and control joints and floor drain penetrations will be adequately sealed. A sump pump will not be used in the project.

1.2 Daylighting

The design intent for this project was to allow natural light into all regularly occupied interior spaces without significantly degrading the efficiency of the building envelope. This goal was accomplished by placing at least one window in each room. More public spaces feature more windows, while the bedrooms and bathrooms have less. This is because more waking hours will be spent in the public spaces, while the private spaces require task lighting. The interior stair has been placed in the middle of the home and then pulled back from the south wall to create a two storey volume that allows the south light to spill down into the lower level. Borrowed lights in two of the bedrooms allow for increased natural lighting without adding to the heating and cooling loads. North facing windows have been minimised to limit heat loss in the winter. The best views are to the South, so this was an easy decision. Skylights have been avoided due to their tendency to overheat the home during the summer and allow heat to escape during the winter. Glare will be controlled by interior shades and/ or exterior shutters. In the summer, the roof overhangs on the south side and deciduous plantings on the east side will limit the amount of direct sunlight entering the home.

1.3 Noise Control

Although the building is located in the heart of the Sun Rivers development, far from highway and train noise, many lots have yet to be built-out so the site will no doubt be subjected to a lot of

construction noise during the next few years. The increased insulation, increased wall mass, and carefully sealed assemblies featured in this home will greatly reduce the volume of any sound made on the exterior. Public and private spaces have been carefully separated within the home in an attempt to avoid disturbances. Mechanical equipment and the clothes washer and dryer will be located in separate rooms, sealed with acoustically insulated walls from the rest of the home. Kitchen appliances will be high efficiency and feature low noise levels. Outside the home, a concrete/ stone retaining wall has been designed to create a secluded outdoor patio.

1.4 Water Quality

Water will be delivered to the site through a municipal system, run by Corix Utilities that delivers potable and irrigation water separately. Potable water is treated in a nearby facility using a state of the art rapid sand filtration system. This technology provides high quality water while requiring reduced levels of chemicals and waste water during treatment. Irrigation water is simply filtered and pumped directly to the subdivision from the South Thompson River with no added chemicals, reducing the delivery energy and reducing the negative effects on the environment of water treatment. Irrigation water may only be connected to automatic sprinkler systems and not to hose bibs so that there is little chance someone could drink the irrigation water. Water quality will be tested in the home prior to occupancy.

The Sun Rivers development is serviced by a gravity sewer collection system that connects to the City of Kamloops sewage treatment plant. Studies are currently underway to develop a sewage treatment facility to be dedicated to the KIB lands that will treat the effluent to a higher standard than the City's existing facility, possibly using the same filtration technology as the water treatment facility.

2 ENERGY

The principal goal of EQuilibrium housing is to design and build a home that produces as much or more energy than it consumes on an annual basis. In order to accomplish this goal the Green Dream Team has designed the home with increased insulation, increased envelope tightness and efficient systems to reduce electrical demand and then supplied the home with sufficient photovoltaic panels, a solar hot water heating system, and a ground source geothermal heat pump to meet or exceed the reduced energy demand.

2.1 Total Net Annual Energy Consumption

It is the intention of the Green Dream Team that this project will achieve an EnerGuide for Houses (EGH*) Rating of 100. This will be accomplished by designing and constructing a building with a minimum (standard) EGH rating of at least 82 with standard HVAC equipment, and without renewable energy systems. The remaining energy will then be supplied by photovoltaic cells, a

solar hot water heating system, and desuperheating domestic hot water preheating via the heat pump.

Net annual energy consumption will be lowered using the following strategies: optimal solar orientation; smaller housing size; increased thermal insulation; high performance building envelope; low energy HVAC; passive solar heating; thermal mass; energy recovery; optimised appliance and equipment power requirements; integrated renewable energy technologies; grid interconnection; display of energy use for occupants; simple control strategies for occupants.

2.1a Optimal Solar Orientation

The Green Dream Home is located on a lot that has excellent solar access, in a city that gets over 2000 hours of sun per year. Optimal solar orientation for the project has been achieved by rotating the house relative to its lot so that the long side of the rectangular plan is facing due south. As Kamloops is located at 50º 43' north latitude, the roof has been inclined at an angle of 50 degrees to take maximum advantage of the sun's energy and to allow for effective shedding of snow. The sloping site allows for both the basement and the main level of the home to be exposed to the sun on the south side, while the basement is effectively buried on the north side.

2.1b Smaller housing size

The size of the home has been kept to the minimum size permitted by the development guidelines for the neighbourhood in order to reduce heating and cooling requirements. The building shape has been kept as simple as possible in order to reduce the surface area of the home, enclosing more volume with less material, thus reducing insulation requirements and material costs. The garage will not be heated, as is common in Kamloops, to further decrease energy demands.

2.1c Increased thermal insulation

With 3650 degree days below 18 º C, Kamloops has a relatively mild climate when compared to other cities across Canada. Insulation levels will not have to be as high as EQuilibrium homes located in harsher climates. Due to our hot summers, cooling loads will be significant and modelling shows that air conditioning will be required. The Green Dream Team is proposing to use insulated concrete forms (ICFs) to construct the foundations and walls above grade up to the attic level. ICFs are used extensively at the Sun Rivers development for the construction of foundations, but are not typically used for walls due to increased cost. ICFs offer advantages over traditional frame walls in terms of higher R-values, decreased air leakage, and high thermal mass. The R-value of an ICF wall, made up of 8" of concrete with 2-5/8" of expanded polystyrene insulation on each side, is in the range of R-20-25, but there are few thermal breaks in this system, where a frame wall has many. The R-value of the ICF walls will be increased by adding additional three inches (75mm) of expanded polystyrene (EPS) insulation to the exterior to achieve a total R-value of 35 for the wall assembly. The Green Dream Team will investigate the possibility of using insulating concrete in the project to further increase the R-value of the wall. Four inches of rigid insulation will be installed below the basement slab to give an R-value of 20. The attic space will be insulated to R-60 using

sixteen inches of blown-in cellulose insulation. Triple glazed windows with low-emissivity coatings and argon gas fill will be required to meet envelope performance targets.

2.1d High performance building envelope

By using insulated concrete forms for the construction of the walls, which result in a monolithic concrete wall surrounding the building, it is expected that this home will achieve a superior level of air tightness. By carefully detailing, constructing and sealing the home it is expected that the rated air change value for the home will not exceed 0.5 air changes per hour at 50 pascals pressure. Blower door tests will be conducted before installing interior finishes to ensure that the air tightness rating will be below 0.5ACH @ 50Pa.

2.1e Low energy HVAC

A high efficiency ground source heat pump will be used to deliver heating and cooling to the home with minimal energy usage. Careful sizing of the geothermal wells, as well as efficient design of the building envelope will allow a smaller than typical heat pump to be installed, further reducing electrical loads. Domestic hot water will be preheated using the ground source heat pump system. A domestic hot water storage tank with electric boost will ensure adequate water temperature under all conditions. Use of ground source heat pumps has been mandated throughout the Sun Rivers development due to their effectiveness and reliability. Wells are drilled and maintained by Corix Utilities for which the homeowners pay a monthly user fee based on heat pump size. High efficiency ECM motors will be used for all ventilation and forced air heating and cooling.

2.1f Passive solar heating

Passive solar heating of the home is accomplished by placing the majority of the windows on the south facing facade, while minimizing the windows on the east and west sides and eliminating completely all windows from the north side. Careful design of the overhanging roof on the south side will allow for the low winter sun to enter directly into the home, heating the air and the building structure. In the summer, when the sun is high, the overhangs will protect the south windows from direct sun. Planting deciduous trees and vines on the east side will protect the home from overheating in the summer but allow for sun to enter the home in the winter when the plants have lost their leaves. The west side of the building will be partially blocked from the sun by a neighbouring house. A solar chimney will be investigated for passive cooling of the home. The sun will also be used to heat the domestic hot water for the project using a solar hot water heating system located on the south facing roof of the project.

2.1g Thermal mass

The insulated concrete form walls to be used in the project provide excellent thermal mass. In addition, the central stair and hearth for the project will be constructed of concrete. Due to its location behind the large south-facing windows this stair is expected to heat up during winter days

and release this heat at night. It is important to note that the ground source heat pump also takes advantage of the thermal mass characteristics of the earth by storing heat in the ground during the summer and removing this heat during the winter. The balanced nature of heating and cooling requirements for this climate make ground source heating and cooling extremely effective. This is also a form of energy recovery because the heat removed from the home is not wasted, but is instead stored in the earth.

2.1h Energy recovery

A heat recovery ventilator (HRV) will be used to recover heat from exhaust air. Drain water heat recovery will also be employed in the project. Energy modelling has shown this to be a cost effective addition to the design.

2.1i Optimized appliance and equipment power requirements

Appliances specified for this project will be carefully chosen based on their energy usage. Wherever possible, the model with the lowest power requirement will be chosen.

2.1j Integrated renewable energy technologies

Grid tied photovoltaic (PV) panels will be the sole source of renewable electrical energy for the project. These panels will be integrated into the roof of the project. This integration allows the project to fit into the neighbourhood, while still allowing people to view the PV array and hopefully become inspired by it. High power, high efficiency PV modules are specified, rather than shingle type PV panels due to higher efficiency relative to cost. The PV panels will be installed on the south facing roof at the optimum angle of 50º. Placement of the panels around the edge of the sun deck should allow for easy cleaning of the modules or removal of snow when necessary.

A 5kW array of PV panels will provide an estimated 6190kWh annually to the home. The PV system will be designed to allow for increased capacity at a later date.

2.1k Grid interconnection

The photovoltaic panels will be connected to an inverter and then to the electrical grid. An agreement will be developed between the homeowner and Corix Utilities (the supplier of all utilities to the Sun Rivers development). The agreement will allow excess energy from the home to be delivered into the grid for use by others, and allowing the home to draw power from the grid when required. It is expected that the result will be net-zero for the year, resulting in no electrical utility charges for the homeowner. The agreement will allow the homeowner to sell excess power to the utility. This will be the first net metering agreement of this kind at Sun Rivers.

2.1l Display of energy use for occupants

It is hoped that by displaying the energy use in an easily understood manner, occupants will be further encouraged to reduce their power consumption. In addition to monitoring incoming electrical

usage like a standard home, this home will also need to monitor outgoing electrical production. This will either require a second electrical meter or one meter that can run backwards when more energy is being produced than consumed. Inverters considered for this project will offer visual readouts for power production. It is hoped that with the help of the CMHC systems will be installed (such as provided by Fat Spaniel) that will allow for online monitoring of home energy usage from anywhere in the world. Corix Utilities has also expressed an interest in monitoring the energy usage of the home for their own purposes. Thompson Rivers University (TRU) is also interested in installing a smart home system to allow for the effective display and monitoring of energy use for the occupants and simple control of the building systems. During the design charrette, more sophisticated measurement and data logging will be considered in support of sustainable energy research at TRU. Design, purchase and installation of this equipment may be covered by research grants with no additional cost to the project or homeowner.

2.1m Simple control strategies for occupants

Control of occupant comfort will range from passive solutions such as opening windows and shades for ventilation and lighting control to active solutions like programmable thermostats and adjustable ventilation and lighting. All regularly occupied rooms (living rooms and bedrooms) will feature opening windows that will allow for passive ventilation of the space. This will reduce cooling loads and is known to have a positive effect on the well being of the occupants.

2.2 Renewable Energy Strategy

British Columbians enjoy some of the lowest electricity rates in North America due to the abundance of hydroelectric dams and a government owned electric company (BC Hydro). While many people consider hydroelectricity to be a green technology there are some environmental costs associated with this technology, such as loss of natural habitat due to increased wetlands behind dams, as well as increased carbon dioxide emissions from these wetlands. It is also worth noting that BC is a net energy importer, due to insufficient generation to meet peak demands. The energy that is imported from Alberta or the United States is typically generated by burning fossil fuels. Natural Gas is most often used for heating the Kamloops area because heating with gas has traditionally been cheaper than heating with electricity, but the deregulation of the natural gas industry in BC, and increases in oil and gas prices worldwide have led to increased natural gas rates. As the British Columbia government moves to implement a carbon tax, the true environmental cost of energy will come further into focus. Faced with all of these uncertainties, a net-zero energy house makes sense and is expected to be highly desirable.

The renewable energy strategy for The Green Dream Home is a simple one: reduce electrical demand through the use of efficient systems and effective envelope design, then produce the remaining energy required using grid-tied photovoltaic panels and solar hot water heating.

While wind power would be feasible for this project due to high wind speeds on the site, it is not permitted by the development guidelines. Presumably the negative perception of wind turbines is

due to noise and aesthetic concerns. It is recommended that Sun Rivers look into large scale wind power generation that can be more isolated and provide significant bulk power to the entire development.

Due to extremely high sun exposure of the site, photovoltaic (PV) panels are an excellent choice for providing power to the Green Dream Home. While PV panels are considered by many to be too expensive relative to the amount of power that they deliver, the combination of this technology with an efficient building will result in complete independence from escalating energy prices. By encouraging increased use of this technology nationally, it is hoped that PV system prices will continue to fall.

PV systems are known to be reliable and robust, as there are no moving parts and the panels can last indefinitely. The panels typically come with a 20-25 year warranty, with only a small decrease in efficiency each year (less than 1%). There is little maintenance required by the homeowner other than periodically cleaning off any snow or dust. This is no more maintenance than a window assembly would require. The system to be used on the Green Dream Home is easily installed over the roofing of the home, providing extra protection for the roof from wind, rain, and ultraviolet light, resulting in less maintenance of the roofing. Connecting the PV panels to the electrical grid will eliminate the maintenance and environmental risk associated with battery systems, however it may be desirable for the homeowner to have battery backup in case of a power outage. Should the eventual owner wish to install a battery backup system, wiring will be provided to allow for this.

Pairing the PV system with a ground source heat pump is ideal because a heat pump typically uses only electricity to generate heat as opposed to a traditional furnace that burns fuel. The main criticism against heat pump systems is that they use electricity for heating, which is more expensive than using gas. By providing electricity with PV panels, this criticism is avoided. As previously mentioned, the ground source heat pump can also preheat domestic hot water in a very efficient manner. By combining this system with solar a hot water heater the energy needed for heating domestic hot water will be minimized.

2.3 Peak Electricity Demand

Peak electricity demands for the area are typically experienced during the day in summer when cooling loads are highest and during the night in winter when heating loads are highest. The Green Dream Home will be producing the most renewable energy from the PV array in summer months when cooling loads are highest, allowing electricity to be returned to the grid. In winter the heating loads for the house will be reduced by the ground source heat pump system and the thermal mass of the building, but there will still be a draw from the grid. This peak demand during winter could possibly be reduced by incorporating a heat storage system such as a large water tank from which the heat pump could draw energy during the winter. Since this would add significant cost and complexity to the project this is not currently being recommended. Other strategies for reduction of peak electricity demand will include using LED and fluorescent lighting controlled by occupancy

sensors to avoid lights being left on, using programmable thermostats to automatically turn down temperatures during winter nights, and effective air sealing and insulation of the home.

2.4 Embodied Energy Strategy

The embodied energy of the Green Dream Home will be minimized wherever possible by using locally manufactured products, specifying products with recycled content, choosing materials that require relatively low amounts of energy to manufacture, and by choosing materials made from rapidly renewable sources. As the builders involved in this project have completed numerous Built Green projects where the embodied energy of materials must be accounted for, this information is readily available.

The concrete for the project is manufactured at the Lafarge Canada's Kamloops plant located approximately five kilometres from the site. While concrete requires a large amount of energy to produce it is extremely durable and provides many comfort benefits to the project. Since the embodied energy of a building is relatively very small compared to the energy consumed by a building over its lifetime, durability and energy usage should be of greater concern than embodied energy. While concrete buildings are difficult and expensive to demolish and recycle it is hoped that the flexible design of the building will allow it to serve a valuable function for a very long time. If possible, recycled content such as fly ash will be included in the concrete. The concrete floor slab in the basement will be cut, polished and sealed with a low VOC sealant, creating a beautiful, durable, but inexpensive floor. As no additional materials will be needed for the basement floor, there will be no additional embodied energy.

Framing members within the home will be sourced from sustainably managed forests within 100km of the site. The use of "beetle killed" pine flooring on the second level will ensure that this overabundant resource does not go to waste. As these trees will rot if not harvested their embodied energy is very low. If budget and availability allows, the photovoltaic panels and inverter will be sourced from BC companies.

3 RESOURCES

While construction resources in British Columbia are abundant, they still need to be conserved wherever possible. To this end The Green Dream Home will be constructed of sustainably harvested materials that are locally sourced when possible. This durably constructed building will be kept to a modest size. Waste materials during construction will be recycled or reused elsewhere when possible. Natural materials will be used for their low embodied energy as well as their timeless beauty.

3.1 Sustainable Materials

In order for materials to be sustainable they must be *both* good for the environment as well as good for the occupants of the home. As outlined in the Health section of this proposal, the materials used

on the interior of the building will be chosen with occupant health in mind. As such they will have no (or low levels of) emissions. It is no coincidence that the natural materials that are healthiest for the building occupants are also healthiest for the environment. By using renewable materials that are sustainably harvested we can ensure the continued health of our planet. Also, by using locally sourced materials with low embodied energy we can reduce carbon emissions that also negatively affect the health of the environment and the planet's occupants.

3.2 Design for Durability

In order to ensure that the building has a long life it has been designed with a compact yet flexible plan and a timeless aesthetic. As beautiful buildings are less likely to be demolished or renovated, the challenge is to design a home that does not follow a particular fad, and that fits well into the neighbourhood while at the same time has a character of its own.

The building will be detailed to last much longer than typical homes. By insulating the foundations and walls on the exterior they will be protected from frost and water damage and their life will be greatly increased. The concrete walls will not rot if water does enter the wall, but prolonged exposure to moisture will rust the rebar, so care must be taken to damp proof the foundations. The PV panels on the south facing roof will protect the roofing below them from rain and UV light. The north facing roof will not experience as much UV radiation as the south facing roof.

The dry Kamloops climate is very friendly to most exterior finishes, especially stucco and concrete. Wood finishes tend to suffer from UV damage, so fiber cement siding (such as Hardy plank) is preferred from a durability standpoint. Predominantly light coloured materials will be used for exposed exterior finishes like roofing and siding to reduce the heat island effect. Fiberglass shingles with a 40/50 year rating will be used for roofing the home.

3.3 Material Efficiency

During the design development phase the plans will be adjusted to modular dimensions based on the size of the insulated concrete forms to be used. This will minimize cutting of the forms and thus minimize waste. The ICF system results in very little waste as separate formwork is not required. In designing the home, interior partition walls have been minimized to reduce materials and labour. The roof trusses will be manufactured in a local factory that uses a computer controlled cutting system to minimise waste wood. As many of the CHBA-CI members are involved in renovation projects, there may be specific opportunities to reuse building materials that will have to be identified as design and construction progresses.

3.4 Water Conservation

The Green Dream Home will feature low flow fixtures, dual flush toilets, and appliances with very low water consumption. If local authorities permit, plumbing will be installed in the home to allow for the use of a grey water recycling system. All homes in Sun Rivers feature separately metered potable and irrigation water, with the occupants paying for the water according to use. This is in

stark contrast to other Kamloops subdivisions where irrigation uses expensive treated water and water meters are not mandatory. Automatic sprinklers with rain sensors are also mandatory at Sun Rivers, allowing landscaping to be watered at night when it is more efficient to do so and preventing sprinklers from operating when not required. Cisterns will be installed to capture rainwater from the roof for manual watering, with overflows directed into the storm sewer system for the development. This storm sewer system leads to a large retention pond where the water is slowly dissipated. The landscaping, to be designed and installed by Thompson Rivers University horticulture students, will incorporate either drought resistant native plantings or edible landscaping where possible and lawn will be minimized.

3.5 Adaptability/ Flexibility

The Green Dream Home has been designed using CMHC FlexHousing concepts to meet the changing needs of whoever the eventual owner(s) may be. Each floor features at least one bedroom and bathroom and is directly accessible from the exterior without any stairs. The result is that with minor renovations the home could be converted into two suites, which is permitted in the zoning at Sun Rivers. The attic will be framed in such a way as to allow for its conversion into liveable space. A stair to the attic could easily be placed above the existing stair. The home could also be expanded to the east without encroaching on utility easements. The den on the second level could be converted to an additional bedroom if necessary, or used for a home office, as could one of the bedrooms downstairs. The home has also been designed to be “adaptable” so that with only minor renovations the home could accommodate a higher level of accessibility. From the wide driveway a 1500mm wide covered pathway leads to the front door. All exterior doors will be 910mm (36”) wide and all interior doors to rooms will be a minimum of 865mm (34”). All hallways will be 1200mm (4’-0”) wide and the stairs are sized according to the Code requirements of a public exit stair. The main bathrooms have been sized to allow room for a wheelchair to enter the room and backing will be provided for grab bars in appropriate locations. The kitchen is large enough to accommodate a 1500mm (5’-0”) wide turning radius. The second level balconies will be easily accessible through 910mm wide doors with low threshold heights. All railings will be 1250mm (49”) high. The resulting home will be more safe, comfortable and flexible than a home built to minimum Building Code standards.

4 ENVIRONMENT

The Green Dream Home will protect the environment through careful land use planning and landscaping, by controlling site sediment and erosion, by effectively managing water and waste, and by minimizing air pollutants.

4.1 Land Use Planning and Landscaping

While the Sun Rivers development is not located on a brownfield site, it is located on an underutilized section of native reserve land, which makes it socially sustainable. The funds

generated from the development will help the Kamloops Indian Band (KIB) become more self sufficient, and less reliant on government subsidies. The foremost concern of the Band is that the development itself be as sustainable as possible, therefore many measures have been put in place and more are still to come that will make Sun Rivers a green community.

The form of the Sun Rivers community is that of a clustered development, where the homes are grouped together into smaller neighbourhoods that follow the contours of the land. This results in pockets of density that allow for more public green space (often golf greens) surrounding the development. The green space allows for the use of zero emission vehicles (golf carts). Street widths and on-street parking have been kept to a minimum. The development is located a short drive or walk from downtown and public transit will be extended to the development soon. Construction is underway on the first phase of a multi-unit complex that will include retail shops and services for the residents of Sun Rivers.

Landscaping, to be designed and installed by TRU horticulture students, will incorporate either drought resistant native plantings or edible landscaping where possible and lawn will be minimized. Deciduous shade trees will be planted on the east side of the house to protect it from hot summer sun. Light coloured water permeable pavers (such as GrassCrete) will be used for the driveway to reduce the heat island effect.

4.2 Construction Site Sediment and Erosion Control

Erosion control is of particular concern at the Sun Rivers development. The soil at the site contains high levels of silt and often must be conditioned before houses can be built on it, therefore care must be taken to ensure that runoff does not undermine the homes. All rain water leaders in the development must be connected to the storm sewer system. Driveways should slope towards the street where runoff can be collected. During construction the builder is responsible for preparing a gravelled area for staging to minimize erosion and keep dirt off the public roadways.

4.3 Storm Water Management

Although Kamloops receives very little precipitation on a yearly basis, storms often bring large volumes of rain in a short time and therefore storm water management is important. Storm water will be managed both on the site and at a development level. Cisterns will capture all rainwater from the roof of the Green Dream Home and overflow will drain into the storm sewer system. The permeable pavers used in the driveway will allow some water to infiltrate the ground without washing away the soil. Rain from the storm sewer system is collected in a large retention pond for the site, allowing sediment to settle out before the water is discharged to the river. It has been recommended that this water be reused for watering the public landscaping and golf course.

4.4 Waste Water Management

The amount of waste water generated by the home will be reduced through a number of strategies such as rain water capture and grey water reuse. Please refer to the sections on Water Conservation and Water Quality for details.

4.5 Solid Waste Management

In order to minimize the amount of solid waste generated by the construction and use of the building a comprehensive waste management strategy will be developed for the Green Dream Home starting with design and continuing through occupancy. During construction separate bins will be provided on site for waste wood, gypsum and metal. The materials will be recycled or reused. The use of ICFs for the foundations and walls will eliminate the waste associated with traditional formwork.

Recycling bins will be provided in the garage and composting facilities will be included in the garden for the use of residents and visitors.

4.6 Air Pollution Emissions

Air pollution generated by the Green Dream Home will be greatly reduced by not installing any gas burning appliances and eliminating the need to connect to the natural gas supply line that is already at the site. Electric fireplaces will be installed instead of gas or wood burning models. Care will be taken when choosing a heat pump and refrigerator to ensure that they use no CFCs or HCFCs. Fire extinguishers containing halons will not be installed. When selecting insulation, preference will be given to products that are manufactured with no CFCs or HCFCs.

5 AFFORDABILITY

The Green Dream Home is foremost a training house where Thompson Rivers University students can get hands-on experience in designing and constructing a state of the art, ecologically responsible home that pushes the boundaries of conventional construction. However, at the end of the day the training house must be sold by the Canadian Homebuilders Association-Central Interior, be it to the YMCA as in the past or to another party, and therefore the home must represent good value.

5.1 Financing

This will be the 14th training house that has been built through the partnership of the Canadian Homebuilder's Association Central Interior (CHBA-CI) and Thompson Rivers University (TRU). Each year the CHBA-CI finances the project and under the guidance of experienced instructors the students of TRU provide the basic labour. Materials are often donated, as are professional and contract services. The result is a home of superior quality that appeals to a broad range of people. Although this home is not intended to be sold in the traditional sense, it must be sold by the CHBA-CI to a charity group (usually the YMCA) and then it is effectively sold one ticket at a time as a fund raiser. In order to generate top dollar for the charity, the construction costs of the home must be

kept to a minimum while ensuring that the perceived value of the home is high. It is believed by all involved that by making The Green Dream Home an EQuilibrium home that this will increase the perceived value of the home by an amount greater than the increased construction costs.

Please consult the table of monthly costs below for further financing information.

Housing Type	EQuilibrium Project	Conventional House (of the same size and form)	MLS (of the same size and similar location)
Land Cost	139,500.00	139,500.00	139,500.00
Construction Cost	459,900.00	343,330.00	399,500.00
Incentives and Other Financing	140,000.00	72,424.50	80,850.00
Total Mortgage over 20 years	459,400.00	410,405.50	458,150.00
Mortgage Payment per Month	2975.90	2765.49	3087.22
Predicted Monthly:			
Utility Bills	100.00	300.00	416.00
Total Cost Without Incentives	599,400.00	482,830.00	539,000.00
Total Cost with Incentives	459,400.00	343,330.00	399,500.00

5.2 Marketability

While this home will no doubt cost more than a conventional house of the same size, a home that uses net-zero energy and will effectively eliminate the uncertainty of steadily increasing utility bills is extremely marketable. The sustainability movement is at an all time high and this home is expected to generate a lot of publicity. Were this a home constructed by a private developer for sale to one client, there would be much less public awareness than with this home which anyone could win for the price of a ticket. As such the home will reach a wider audience and more broadly inform and educate on the benefits of a net-zero energy home. The home is also expected to be easily marketable to industry, increasing the likelihood of donations of materials, funds technology, and services.

The lottery is the major fundraiser for the Kamloops YMCA each year, with the home being open to the public each weekend for several months prior to the draw. If the home does not have significant curb appeal then ticket sales will suffer, but to date the fundraiser has always made money. Like previous training houses the Green Dream Home has been designed to fit into its neighbourhood, a subdivision called Ironwood, where all of the homes are mandated to have an English country style. This area of Sun Rivers is highly desirable to a broad demographic. As Sun Rivers is expected to

experience tremendous growth over the next few years, the location for this project is ideal. Anyone looking to buy or build a new home in Kamloops would certainly view this development.

It is our hope that the entire building industry in Kamloops and the Central Interior will be inspired by this project to work towards net-zero energy for all homes. With the assistance of the CMHC we look forward to marketing The Green Dream Home to the world.