VANCOUVER COASTAL HEALTH
ST MARY'S HOSPITAL EXPANSION AND RENOVATION CASE STUDY

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BACKGROUND

The Perkins+Will Vancouver, in association with Farrow Partnership Architects Inc., was retained by Vancouver Coastal Health (VCH) to provide an addition to accommodate their expanded emergency, diagnostic imaging, ambulatory care and special care services.

St. Mary's Hospital is unique among other British Columbia hospitals: not only are all of its inpatient rooms single-occupancy—a first for VCH and a proven method for minimizing the transmission of infections between patients—it is one of the few hospitals to have operable windows in all clinical and inpatient areas, which has received significant positive feedback from patients and staff. St. Mary's is also one of the first recent hospitals in the province to incorporate point-of-care stations at each inpatient bedroom, allowing supplies to be loaded on the corridor side of the room and be accessed from within, creating effective restocking processes and reducing interruptions to patients.

The project has a light-filled lobby that serves as the new face of the hospital, marks the new main entrance, and connects the new and existing portions of the hospital. Central to the design of the lobby was the creation of a new public room for the community, the recognition of the many donors who contributed to the project, and the inclusion of artwork—such as a mural that welcomes visitors to the hospital and spans the entire 70-foot-long lobby—created by members of the Sechelt Indian Band, who also donated the land for the hospital.

St. Mary's Hospital is pushing the environmental envelope as well: the entire site is targeting net carbon reduction through the use of a geo-exchange system, a high-performance envelope, a photovoltaic array and passive design strategies, such as the use of solar shading and operable windows that allow for natural ventilation.

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VANCOUVER COASTAL HEALTH - CARBON NEUTRALITY

Carbon neutrality involves measuring operational greenhouse gas emissions, reducing those where possible, offsetting the remainder and demonstrating leadership through public reporting. The commitment covers all public sector organizations (PSOs) including government offices, schools, post-secondary institutions, Crown corporations and hospitals.

VCH IS COMMITTED TO REDUCING ITS CARBON FOOTPRINT

"Vancouver Coastal Health is proud to contribute to BC's carbon neutral public sector. VCH is carbon neutral for the second year in a row. We achieved this by taking actions to reduce our green house gas emissions and by purchasing carbon offsets. Here's just a small sampling of some actions we took to reduce our carbon footprint." [1]

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2011 CARBON-REDUCING HIGHLIGHTS FROM VANCOUVER COASTAL:

"We completed 23 energy-retrofit projects in 13 buildings which reduced our energy consumption by 2.6 GWh and reduced our greenhouse gas by 964 tC02e.

We are pleased to commit to new green standards: it's now mandatory to incorporate an Integrated Design Process for all new construction and major renovation projects at VCH.

Implemented recycling renewal program at 4 acute care sites and 4 residential care sites – kudos to all who are making the recycling program work!

Promoted sustainable transportation and ran a commuting campaign through the Cut the Carbon Community and our Green+Leaders program which encouraged staff to walk, cycle or take public transit to work.

Over 2,300 Lower Mainland staff, including 975 Vancouver Coastal Health employees, signed up for this Cut the Carbon Community website and campaign, launched in 2011

All this work was done by GreenCare: an initiative to promote an environmentally conscious culture, orchestrated by the Energy & Environmental Sustainability team at our consolidated Lower Mainland Facilities Management department. GreenCare serves Fraser Health, VCH, PHSA, and PHC." [1]

[1] GreenCare Community, "Vancouver Coastal Health: carbon neutral for the 2nd year", https://bcgreencare.ca/vancouver-coastal-health-carbon-neutral-2nd-year

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LEED

The LEED Green Building Rating System is a voluntary, consensus based, market driven program based on existing, proven technology. The rating system is organized into five categories: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources and Indoor environmental Quality. An additional category, Innovation & Design Process, addresses sustainable design building not covered under the five categories. Improved building performance is recognized through 3rd party verification as – Certified, Silver, Gold or Platinum – based on the total number of points earned by a project.

SUSTAINABLE SITES

The project is located in Sechelt, a small coastal community on the Sunshine Coast of British Columbia which is approximately 50 kilometers northwest of Vancouver. The team made every effort to reduce the energy and resources associated with motorized travel. Staff and ambulatory patients are encouraged to travel by bicycle to the hopital by the provision of bike racks and shower facilities.

Staff and visitors also have access to 14 Alternative Fuel Vehicle charging stations located on site.

Carpooling at the hospital is managed and encouraged through a website set up by VCH in partnership with the Jack Bell Foundation. The Jack Bell Foundation is a "registered charitable BC Society funded by TransLink to operate Canada's only large-scale public vanpooling service and provide BC exclusive online ridematching"[(2)]. This web site is available to all employees of VCH and helps to connect employees all over the province who may be interested in carpooling.

Light pollution reduction strategies were used both inside and outside of the building,including lighting shut-off scheduling programs and exterior fixture shielding, to work towards achieving a dark night sky, both to help preserve the nocturnal ecosystem, and provide safe surroundings with night-time visual comfort.

The hospital has a helicopter pad on site for emergency medical transportation. Light pollution considerations presented a challenge to the desgin team who were required to include up lighting for safety and navigation A solution to control Light pollution even with a helipad is to control the helipad lighting separately from all other exterior lights, such that the helicopter lights are only turned on when required.

[(2)] Jack Bell Ride Share Society, About Us https://online.ride-share.com/en/my/mytext.php?section=aboutus

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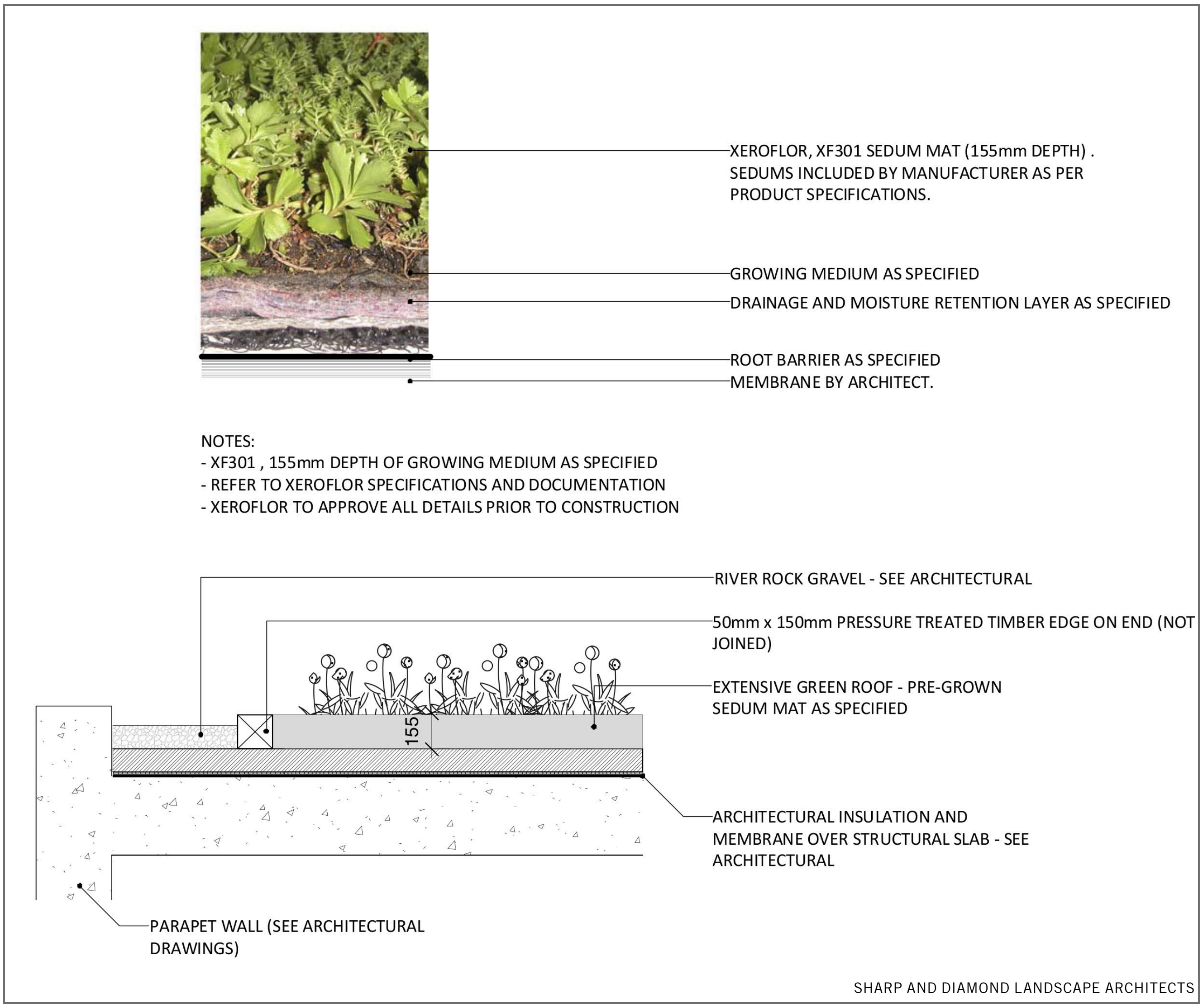
HEAT ISLAND

St Mary's Hospital installed high albedo roofing and a 275 square metre green roof to mitigate the impacts of the heat island effect. The heat island effect is the "condition when warmer temperatures are experienced in urban landscape compared to adjacent rural areas as a result of solar energy retention on constructed surfaces. Principal surfaces that contribute to the heat island effect include streets, sidewalks, parking lots and building."[3] Reducing heat island " minimizes the impact on microclimate and human and wildlife habitat."[3]

GREEN ROOF

The green roof installed on the project also provides many benefits to the surrounding microclimate. For example, "a reduction in storm water run off, increased energy efficiency , habitat for ground nesting birds, improved roof membrane longevity, an important connection to nature for hospital patients."[4] Studies have shown that "hospital patients with natural views require less medication and attention and may be discharged sooner."[4]

The green roof uses "sedum tiles wih integrated fleece mats retain moisture, while also going dormant through the hot summer months. As a result, no irrigation has been installed." [5]



(3) LEED Canada NC 1.0 Reference Guide, pg 111

(4) Centre for Architectural Ecology, Why Green Roofs , http://commons.bcit.ca/greenroof/faq/why-green-roofs-benefits/

(5) Water Efficiency Narrative, Bryce Gauthier Landscape Architect, Sharp and Diamond Landscape Architects

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WATER EFFICIENCY

Landscape

The VCH mandate was to " minimize site disturbance and potable water use. An equally important goal was using the landscape design to emphasize the range of native planting on the Sunshine Coast in particular species of cultural relevance to the first nations on whose land the project is situated - no irrigation has been installed on the site" [5] The team was able to avoid the use of irrigation by choosing native and adaptive plants that could thrive without irrigation.

Planting Plan :

1) Meadow Grass

All lawns within the LEED project site area were replaced with drought tolerant meadow grass and native bulb and seed mix. the specified seed mix contains a variety of tough fescue species that go dormant in the summer - a factor that reduces irrigation demand. [5]

2) Infiltration Planting

Working with the civil engineer curb cuts have been placed where practical to drain storm water into infiltration gardens. These gardens are planted with tough native species that can survive periodic inundation as well as drought. [5]

3) Pacific Northwest Wetland Plant Palette

A planting plan consisting of drought tolerant native and adapted species have been placed in the planting beds to provide color, seasonal interest. Above all, these plants can survive with only minimal water.[5]

The garden was not only designed "simply to minimizing the use of water using drought tolerant planting. Every plant was carefully selected to tell a story about the people and place (both past and present). As a modern botanical garden each plant will tell a story of history, culture, ecology and sustainability." [5]

Potable Water Use Reduction

St Mary's Hospital uses water efficient fixtures to reduce potable water use. These fixtures include:

- Dual flush water closets 4.8 LPF (half flush) 6 LPF (full flush)
- Low-flow faucets with sensors, 5.7 LPM, duration 12 seconds
- Low flow showers 5.7 LPM.
- Low flow kitchen sinks. 5.7 LPM.

Resulting water use redution is 30.65% compared to baseline fixtures in the Energy Policy Act (EPA) of 1992 [6]

[5] Water Efficiency Narrative, Bryce Gauthier Landscape Architect, Sharp and Diamond Landscape Architects

[6] Water Use Reduction, Paul Richards P.Eng, Integral Group

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ENERGY & ATMOSPHERE

Design Approach

Several energy conservation measures were applied to the project through integrated design team efforts. The proposed building simulation resulted in annual regulated energy cost savings of 36%. The results show that the proposed building design meets LEED Canada NC v1.0 prerequisite EAp2 and achieves 5 points in EAc1. Both the prerequisite and credit are part of the Energy and Atmosphere category. The following key characteristics of the proposed design result in energy savings when compared to the reference case [8]

Energy Conservation Measures[7]

The hospital' s proposed design has the following key energy conservation measures (ECM's):

1. Wall insulation U 0.704 and roof insulation U.360 levels higher than the ASHRAE mandatory requirements.
2. High efficiency glass and framing fenestration. Tvis 0.68 and SHGC 0.38
3. Space heating and cooling provided by high-mass hydronic radiant floor slab in concert with a VAV reheat system.
4. Heat recovery from exhaust air using high efficiency water to water heat pumps.
5. Reduced interior lighting power density.
6. Geoexchange system used as both a heat source and a heat sink.
7. Solar PV panels to provide renewable energy.

Main HVAC Design Features[7]

The main design features of the hopsitals include the following:

1. There is one common loop for heating or cooling from the heat pump (heat pump load loop).
2. There is one common source loop for heat rejection/injection (heat pump source loop).
3. All VAV reheat coils are heated by existing boiler plant.
4. All radiant slabs are heated/cooled by the heat pump load loop.
5. Heat recovery/rejection is done by water source heat pumps on exhaust air.
6. AHU's are heated by heat pump load loop and can be topped up by existing boiler.
7. Heat pump source loop is connected to a dry cooler and the geothermal loop.

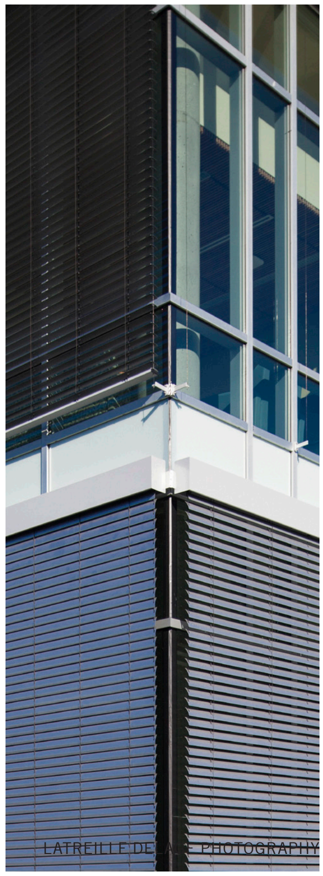
(7) Enersense Consulting Inc. Third Party Energy Model Review Final Report, Oct 2013

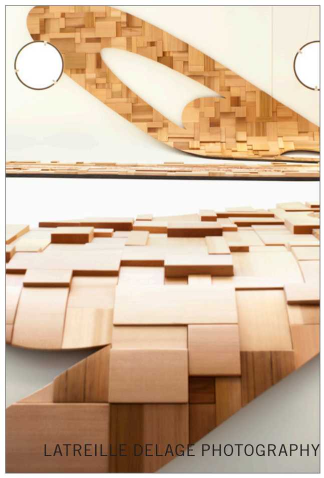
(8) St Mary's Hospital Expansion LEED EAc1 Narrative and Inputs, Integral Group

ENERGY & ATMOSPHERE

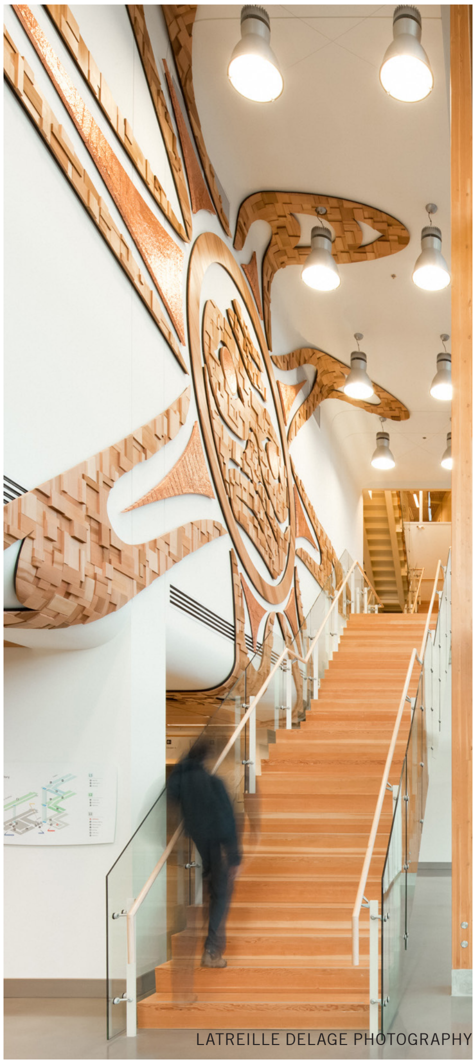
Model inputs for Baseline and Proposed Models

Model Parameter	Baseline Building - ASHRAE 90.1-1999	Proposed Building
Modelling Software	IESVE, including PRM Navigator	
Schedules	24 hours/day, 7 days/week for majority of Hospital. Typical working hours, 5 days/week for Office spaces and Diagnostic Imaging suites.	
Space Use Classification	By space function	
Model Climate Zone	Victoria – Climate zone B-18	
Gross Floor Area	5,486 m^2	
Envelope Performance		
Window/Wall Ratio	21%	21%
R3: Green Roof on Concrete Slab	U 0.360 W/m^2K (R15 IP)	U 0.095 W/m^2K (R60 IP)
R6: Insulated Roof on Concrete Slab	U 0.360 W/m^2K (R15 IP)	U 0.095 W/m^2K (R60 IP)
R7: Insulated Roof on Steel Structure	U 0.360 W/m^2K (R15 IP)	U 0.095 W/m^2K (R60 IP)
W1: C.I.P. Concrete Foundation Wall (Walls Below Grade)	C 6.473 W/m^2K (R0.9 IP)	U 0.334 W/m^2K (R17 IP)
W3: Masonry Wall w/ Metal Stud	U 0.704 W/m^2K (R8 IP)	U 0.142 W/m^2K (R40 IP)
W5: Panel Wall w/ Metal Stud	U 0.704 W/m^2K (R8 IP)	U 0.331 W/m^2K (R17.14 IP)
W8: Concrete Panel Wall w/ Metal Stud	U 0.704 W/m^2K (R8 IP)	U 0.142 W/m^2K (R40 IP)
W10: Mechanical Penthouse Panel w/ Metal Stud Wall	U 0.704 W/m^2K (R8 IP)	U 0.331 W/m^2K (R17.14 IP)
R2: Soffit at Level 0 & Level 1 (Exposed/Suspended Floor)	U 0.608 W/m^2K (R9 IP)	U 0.237 W/m^2K (R24 IP)
Slab-on-grade	F 1.264 W/mK (F 0.730 IP)	U 0.284 W/m^2K (R20 IP)
W13: Curtain Wall	U 3.237 W/m^2K (R1.754 IP) SHGC 0.49	U 1.41 W/m^2K (R4.027 IP) SHGC 0.37
S3: Skylight Glazing	U 6.644 W/m^2K (R0.855 IP) SHGC 0.68	U 1.41 W/m^2K (R4.027 IP) SHGC 0.37
Shading Deices	None	Fixed Solar Shading as well as Automatically Controlled External Shading Devices
Internal Loads		
Interior Lighting Power Density	Varies - See Lighting Calculator Spreadsheet	
Lighting Controls	No Control	No controls modelled
Lighting Schedule	Lighting schedules derived from ASHRAE 90.1 User Manual. Modified to suit 7 day / week operation of Hospital. Same schedules used in both Baseline and Proposed.	
Receptacle Equipment	Varies - Same for both Baseline and Proposed.	
Plug Load Schedule	Plug load schedules derived from ASHRAE 90.1 User Manual. Modified to suit 7 day / week operation of Hospital. Same schedules used in both Baseline and Proposed.	
Occupancy Load	Peak Occupancy 311 People (As per ASHRAE 90.1 Occupancy Load for Each Space Type)	
Occupancy Schedule	Occupancy schedules derived from ASHRAE 90.1 User Manual. Modified to suit 7 day / week operation of Hospital. Same schedules used in both Baseline and Proposed.	
Operating Conditions		
Indoor Design Temperatures	As per CSA Z317.2-10. Varies by space type. Typically 22-24 C for patient areas.	
Ventilation Rate	As per CSA Z317.2-10. Varies by space type. Same minimum ventilation rate applied to both Baseline and Proposed models.	
Infiltration rate	0.1 ACH (IESVE Default)	
Mechanical Systems		
System Type	ASHRAE 90.1-1999 System Type 2 as per Table 11.4.3 and supporting clauses. System types 9 and 11 used for spaces not conditioned by the main building mechanical system.	Variable Air Volume system with hydronic reheat. Radiant mass slabs for additional heating and cooling. Supplementary cooling provided to high load spaces via Water Source Heat Pumps.
Heating Plant	Gas Boiler & PSZ-HP as per 11.4.3	Heat Pumps with Gas Boiler backup. Heat sources from Exhaust Air Heat Recovery, WSHP heat rejection, and Geoexchange Field.
Cooling Plant	Central Chiller & DX Cooling as per 11.4.3	Heat Pumps. Heat rejected to Geoexchange field.
Service Hot Water	Same as proposed (as per 11.4.4)	Gas Boiler, 82% nominal efficiency. Hot water consumption according to LEED WEc3 calculation methodology.
Fans and Pumps	As per Energy Cost Budget Method.	As per schedules and cutsheets.
Energy Rates		
Gas (Fortis BC Rate LCS- 3)	Cost per GJ **$ 12.015** Daily Charge **[not included as this is an addition]**	
Natural Gas Carbon Tax	Cost per GJ **$ 1.4898**	
Electricity (BC Hydro Large General Service), Discount 1 & 2	Standing Charge Per Day **[N/A]** Demand Charge: First 35 kW **$0.0** 35 to 115 kW **[N/A]** 115 kW **$8.74** Energy Charge: First 14800 kWh/Month **[N/A]** > 14,800 kWh/ Month **$0.0455**	
Energy Levy + PST	0.40% + 7.0% = 7.4%	





[8] St Mary’s Hospital Expansion LEED EAc1 Narrative and Inputs, Integral Group



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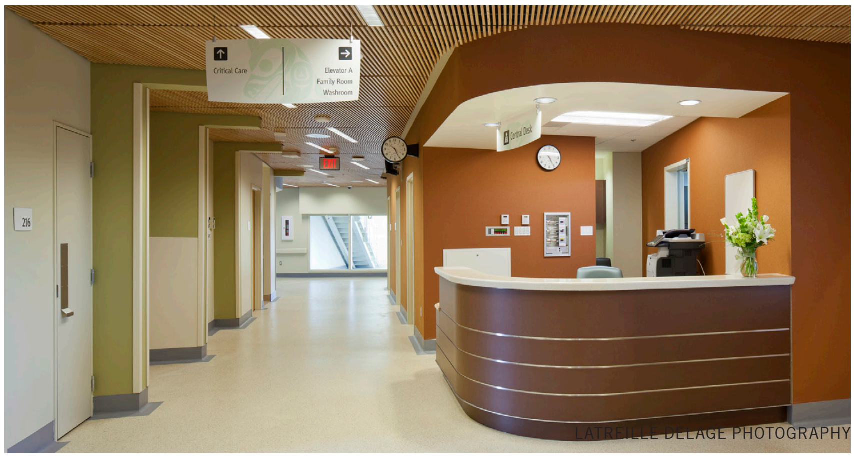

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MATERIALS AND RESOURCES

During the construction process, all efforts were made to sort and recycle construction waste. St Mary's Hospital diverted 86.9% of construction waste from landfill. Inside the building an easy and effective operational waste management program was created. This program includes dedicated areas for recycling collection and storage for cardboard, paper, plastics, glass, compost and metals for occupants. Where possible, recycled content was specified for building materials, such as, linoleum flooring, insulation and others. Sourcing local materials was prioritized to reduce emissions associated with transportation of materials.

INDOOR ENVIRONMENTAL QUALITY

Indoor air quality was protected during construction through a comprehensive IAQ plan.

Low-emitting materials, including all adhesives and sealants, paints, coatings, and flooring systems were selected to reduce emissions from volatile organic compounds (VOCs), improve air quality during construction and occupancy.

Also to support comfort, wellbeing and productivity the staff and patients were provided with a high level of controllability of their spaces allowing adjustment of ventilation, lighting and temperature. St Mary's is one of the few hospitals to have operable windows in all clinical and inpatient areas. The majority of perimeter spaces have operable windows and individual lighting control. Patients and staff also have direct connection to the outdoors; by providing a narrow floor plate inpatient rooms were able to be pushed to the perimeter of the building, and provided with operable windows, daylight and views to the exterior.

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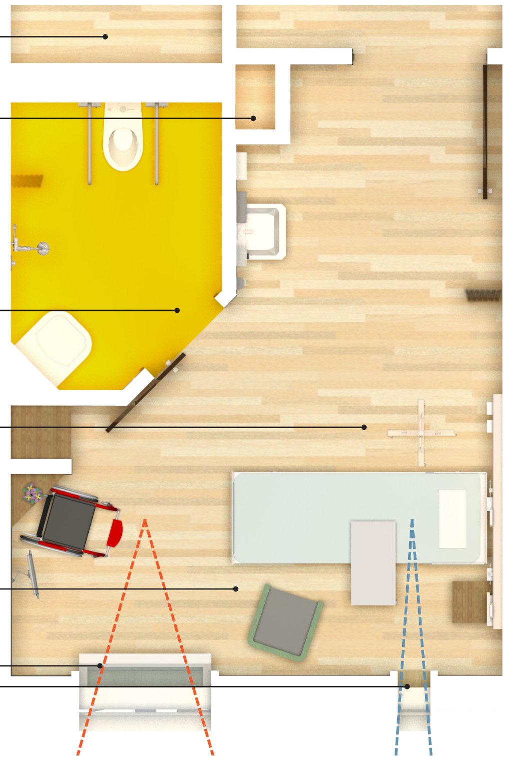
HOSPITAL DESIGN INNOVATION

The design includes 100% single occupancy and same-handed rooms, a decision that was based on an effort to minimize the spread of infections and bacteria that often occur in shared in-patient rooms. The First Nations believe a connection to nature is necessary for healing and overall health in all living things. Therefore all patient rooms were designed with large windows, views and ample natural light. On-site respite gardens promote healing and provide a connection to nature.

SAME-HANDED ROOM PLAN



WORKSTATION: This alcove gives nurses proximity to patients through smaller workstations with laptop, sink and file storage.

NURSE SERVER: With inside and hallway access, this storage area allows nurses to stock supplies from outside the patient's room, therefore minimizing patient disturbances.

WASHROOM: Washroom entrances were placed for the most direct access from the bed, reducing the potential for injuries.

CARE ZONE: The care zone allows doctors and nurses space and access to the patient that is separate from visitors.

FAMILY ZONE: This zone gives family and friends a comfortable area to visit with patients or rest between visits.

VIEWS: The size and placement of windows were designed specifically to be as energy efficient as possible while also maximizing the views.

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WORKING WITH FIRST NATIONS

The hospital's land was a gift from the Shishalh First Nations people, and the design process included extensive consultations with their Elders. The design was based on a traditional Native bent box and includes fenestration design to free the departing spirit and acoustics that accommodate drumming rituals.


PERKINS + WILL


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FULL SCALE MOCK UP

Throughout spring and summer 2009, the design team rented a nearby helicopter hanger and constructed a 1:1 mock-up of full departments in the hospital's new addition. Hospital staff were on hand to test out a variety of scenarios to help determine the appropriate sizes, locations and adjacencies of rooms in order to maximize efficiency.

PERKINS + WILL


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