

# HUMBER RIVER HOSPITAL

A MODEL FOR SUSTAINABLE  
HEALTHCARE DESIGN





**20** Operating Rooms

**656** beds (80% single patient rooms)

## LEAN, GREEN, AND DIGITAL

The most energy efficient, fully-digital acute care hospital in North America, Humber River Hospital's built environment is revolutionizing sustainable healthcare design.

Incorporating digital integration and interoperability to reduce operating costs and carbon footprint, the 1.8M square foot facility was design-built by PCL Constructors Canada Inc. (Toronto) in just 43.5 months, boasting an unprecedented annual EUI target of 348 ekWh/m<sup>2</sup>, which is 47% lower than the Energy Star Portfolio Manager Canada target for hospitals, with 100% fresh air. The build incorporates Information, Communications and Automation Technology (ICAT) infrastructure, first-in-Canada use of Automated Guided Vehicles (AGVs), one of the world's largest dynamic glass installations, and incorporation of sustainable offsite manufacturing techniques.

In collaboration with an expert team of partners, PCL, as part of the Plenary Health Partnerships team, design-built HRH's vision for a building that maximizes technology, lean design, and environmental planning, as characterized by the hospital's three guiding principles: lean, green, and digital.

- **Lean**—Maximize clinical design efficiency to enable high-quality, cost-effective care.
- **Green**—Minimize the environmental impact of the new facility wherever possible.
- **Digital**—Develop an affordable, fully integrated and interoperable digital hospital, using the best possible technology to support the delivery of compassionate, respectful, patient-centred care.

The collaborative project team's technical expertise, combined with user group, stakeholder, and community engagement input were of paramount importance to achieving HRH's environmental vision and overall project success.

## UNPRECEDENTED EFFICIENCY TARGETS

The team was challenged to meet unprecedented targets for energy efficiency, including 15 points for the LEED Canada-NC 2009 Credit EA – Credit 1: Optimize Energy Performance, a first for an acute care hospital in Canada. Not only were these targets 40.1% better than ASHRAE 90.1-2007 standards, the hospital specified 100% fresh-air circulation, well above CSA-Z317 standards.

Commissioned building systems demonstrate unprecedented targets for energy efficiency, with a resulting energy model predicting an annual EUI of 348 ekWh/m<sup>2</sup>, 47% lower than the Energy Star Portfolio Manager Canada target for hospitals.

The building meets the City of Toronto's Green Standard (TGS) Tier 1 requirements. The hospital's state-of-the-art heating, ventilation and air-conditioning (HVAC) system pumps 100% fresh air throughout the building. Adding to increased energy savings are automated climate and lighting controls, condensing boilers, high-efficiency chillers, variable-speed drives and pumps throughout, heat-recovery chillers to provide low-temperature heating, efficient duct design to reduce static pressures, exhaust-air heat recovery, a high-performance building envelope that includes increased insulation levels in the roof and walls, and an energy-efficient lighting design that includes LEDs and provides a building average lighting power density of 0.75W/ft<sup>2</sup>.

A result of steadfast determination, the team secured 17 points for LEED® Canada-NC 2009 Optimized Energy, and surpassed the project's intended LEED® Silver classification to achieve LEED® Canada NC v2009 Gold certification.

100%  
fresh Air



At almost 26,000 square feet, it is one of the largest installations of electrochromic windows in the world.

## INNOVATIVE TECHNOLOGY

Among the innovative design features that make this project stand out and show how technology and green building go hand-in-hand is the use of dynamic glass as a response to solar control. Like transition sunglasses for a building, this innovation allowed for downsizing of HVAC infrastructure, while maintaining patient privacy.

With the ability to change its shading throughout the day according to patients' preference or the sun, the feature uses less energy, and it supports infection prevention and control at a time when hospitals are moving away from curtains as an infection-control measure. At almost 26,000 square feet, it is one of the largest installations of electrochromic windows in the world.

To support occupant engagement, the hospital is armed with a fully converged ICAT infrastructure that integrates building automation and clinical care into a common network. This approach simplifies the ability of systems to share digital information; enabling patients, staff, and visitors with ease of access to information when and where they need it, allowing people to be mobile and connected: a true revolution for hospitals of the future.

Integrated Bedside Terminals (IBT) help connect patients with their care and their social network. Provided in patient rooms and selected outpatient areas, the IBT allows patient and care team access to electronic medical records at the bedside, and enables the patient to control room temperature and window shading, access to TV and internet, and communication with staff. The handset features a built-in scanner for reading barcodes and provides access to the Nurse Call system.

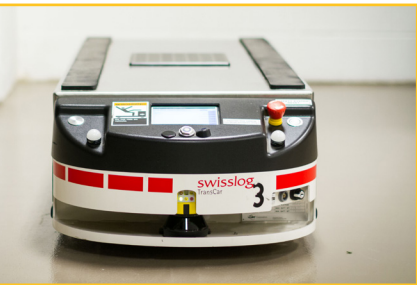
Innovations include smart bed technology; robotic technology for certain surgical procedures; automated laboratory processing; and bedside computer screens that allow patients to control their environments and communicate with physicians.

The hospital includes first-in-Canada use of AGVs. Programmed to move custom-built carts to carry food, linens, medication, and general supplies throughout the hospital, that are capable of calling elevators, opening doors, picking up loaded carts, and determining timing of each delivery based on their location, priority level of the call and time of day. Sneaker time for staff searching for equipment and supplies is reduced using Radio-frequency identification (RFID) technology on equipment, and delivering 75 per cent of supplies and medicine by automation.

## REDUCING EMBODIED ENERGY THROUGH OFFSITE MANUFACTURING

To further the hospital's lean and green philosophy, PCL's agile thinking led to a solution that reduced critical path of the 43.5-month schedule through utilization of virtual construction technology and offsite manufacturing techniques to prefabricate and install 360 patient washrooms and 14 telecommunications/data rooms.

Fabrication of the modules in PCL Agile's design for manufacture and assembly (DFMA)'s factory-controlled environment generated less waste, created fewer site disturbances, and affected the overall embodied energy of the project. Embodied energy is the sum of all energy needed to produce a product, as if that energy were incorporated or "embodied" into the product itself. Reducing embodied energy therefore reduces a building's carbon footprint, which is the sum of all greenhouse gases emitted during the full life cycle of a product.



**DFMA seeks to reduce materials used onsite, labour and overhead costs by employing factory processes to build elements that can efficiently manufactured offsite, shipped to the construction site with just-in-time delivery, and installed in an organized and systematic way.**

# MILESTONES

## GREEN BUILDING ENHANCES PATIENT WELL-BEING

HRH serves a catchment area of more than 850,000 people in the northwest Greater Toronto Area. With 656 beds, 3,300 staff, approximately 700 physicians, and 400 volunteers, the ability of the facility to promote the wellness of occupants through immersion in the natural environment is a major priority.

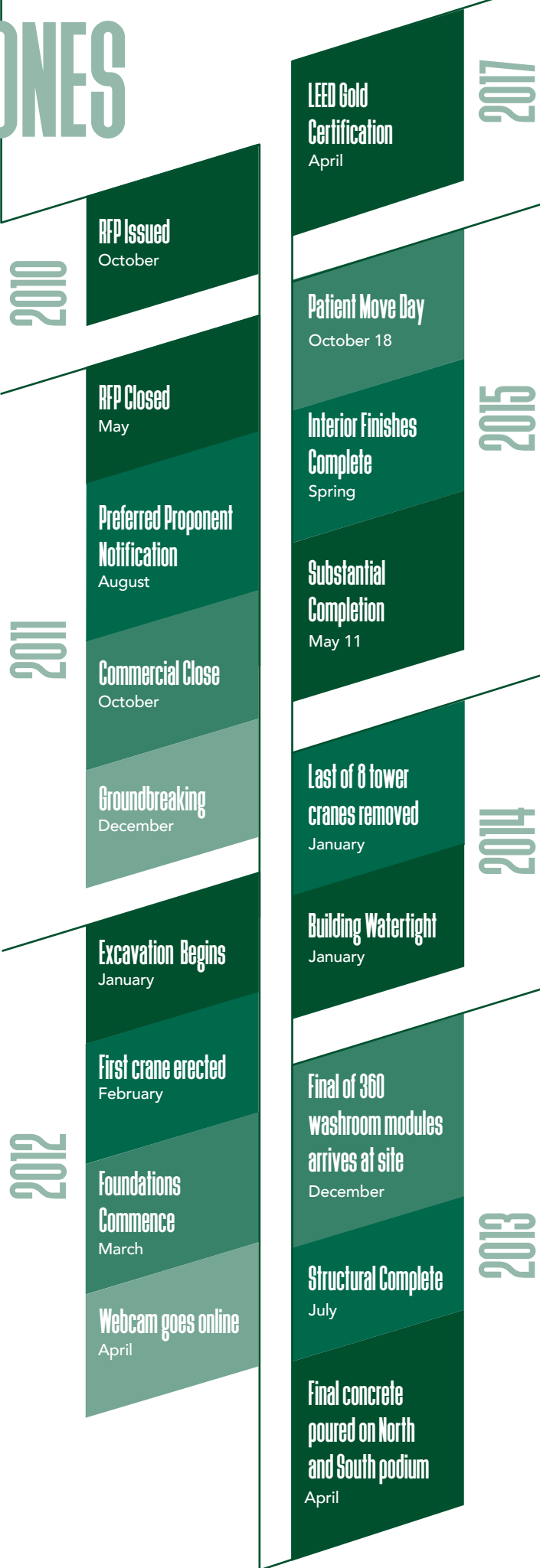
The Aspen Grove glass installations on the north and south façades are a striking design feature that recall a colourful woodland scene representative of the way the hospital harmonizes with the local community. More than 38% of the project's total site area includes vegetated open space, incorporating pedestrian-oriented hardscape and landscape features within the campus environment, including outdoor furnishing, benches, group seating arrangements, and shelters to encourage interaction between people. It also provides open spaces with native adaptive vegetation and walking paths that allow for transition between public and private spaces accessible by patients, staff, and the general community. Garden roofs within mental-health inpatient areas provide additional access to natural landscapes and promote optimal healing.

Plants were chosen strategically to ensure minimal water demands. All irrigation is provided by a rainwater harvesting system that collects rainwater from the roofs, expected to save approximately 450,000 litres of potable water each year. The use of low-emitting materials helps protect occupants from harmful volatile organic compounds and improves indoor air quality. Functional parameters, such as proper sight lines for staff to monitor patients, and places of respite for staff and patients alike,

both within and outside of the facility, promote a balanced healing process and a high-quality work environment.

Low-flow plumbing fixtures were incorporated into the building design, resulting in a 33% reduction in potable water use compared to the LEED baseline. In addition, while the site features a number of pedestrian-oriented landscaped areas, the plants selected for the environs were chosen to ensure minimal water demands. All irrigation is provided by a rainwater harvesting system that collects rainwater from the roofs and directs it to two on-site cisterns, to be redistributed to irrigation if required. This system is expected to save approximately 450,000 liters of potable water each year.

The hospital employs a recycling and waste program and conducts frequent site tours and on-site conferences, to date having welcomed more than 100 health-care organizations from around the world, as well as local community and school groups interested in learning about its innovative sustainable features.



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## WASTE DIVERSION AND MORE

To grow the built environment sustainably, attention was paid not only to creating an efficient building but also to drastically limiting waste during construction; this resulted in 96% of construction waste being diverted from landfill. In addition to being paperless, green practices during the build included the use of low-volatile organic compound materials for adhesives and sealants, paints and coating, and carpets.

The project team was committed to educating subtrades on how to make waste diversion a priority in their daily routines. They used the hospital's loading docks as an efficient layout area to separate waste streams, sorting concrete, metal, wood, drywall, insulation, and paper and cardboard products into separate bins. A bin full of one presorted material was then taken directly to the final recycling station rather than traveling to a transfer station for secondary sorting, which is far less cost-effective and results in lower diversion rates. Before bringing a waste-management partner on board, PCL committed to understanding where they would take the project's waste, as well as the capacity and location of their facilities.

As important as they are to sustainable building, however, waste diversion strategies—even those that result in 96% diversion of waste from landfill—are the responsibility of any contractor of choice working on today's construction scene.



# ENVIRONMENTAL HIGHLIGHTS

Greenguard certified furniture and materials reduce environmental impact.



**GREENGUARD**

PRODUCT CERTIFIED FOR  
LOW CHEMICAL EMISSIONS  
UL.COM/GG  
UL 2818

**GOLD**

Vegetated roof and reflective roofing materials reduce the heat island effect, with visible green roofs installed on 50% of the roof space throughout the campus.

**50%**

38% of the project's total site area is vegetated open space.

**38%**

20% of materials used to construct the facility contained recycled content, and 46% were sourced regionally.

**46%**

**20%**



## UNPRECEDENTED ENERGY EFFICIENCY TARGETS

It took an expert team to bring the hospital's lean and green vision to fruition. "Getting through a concept design through an eight-month bid period to try and achieve an acute care hospital have 100% outside air and be 40% below the MNECB (Model National Energy Code for Buildings) on consumption was a significant challenge. It's never been done in North America," said PCL Toronto construction risk manager Jason Andraza (quoted in Daily Commercial News, January 1, 2014).

This past April 2017, the Canada Green Building Council validated that the project surpassed its intended LEED® Silver classification, attaining LEED® Canada NC v2009 Gold certification.

“ Surpassing the project’s intended LEED® Silver classification to achieve LEED® Gold is a testament to the entire collaborative team’s relentless pursuit of achieving unprecedented energy efficiency targets to reduce Humber River Hospital’s carbon footprint and create a facility that balances energy efficiency and innovative technology, enabling the hospital to focus on its core business of providing exemplary patient care, ”

— PCL Toronto project director Bruce Macpherson.

## SHIFT TO A LOW-CARBON ECONOMY IS POSSIBLE FOR ALL BUILDING TYPES

One of the best things about this unprecedented environmental achievement is that it creates a new precedent, setting the stage for future, even-greener, building. Thomas Mueller, president and CEO of the Canada Green Building Council said, "As one of the most energy-efficient acute care hospitals in North America, Humber River Hospital is a strong example of how the shift to a low-carbon economy is possible for all building and project types. By committing to green building through LEED®, the patients, staff, and visitors of this hospital also benefit from a healthier indoor environment which will support patient care and recovery for years to come."





# A SELECTION OF HUMBER RIVER HOSPITAL'S AWARDS

**2016 Global Best Project Healthcare,**  
Engineering News-Record

**2015 Best of the Best Award,**  
Toronto Construction Association

**Gold Medal,**  
Modern Healthcare Design Awards

**Gold Award (Infrastructure),**  
Canadian Council for Public-Private Partnerships



**#22—Top 100:**  
Canada's Biggest Infrastructure Projects (2014),  
ReNew Canada magazine

**2013 Best Healthcare Project,**  
North America, World Finance magazine—P3 Awards

**2013 Best Project Sponsor,**  
North America, World Finance magazine P3 Awards

**Silver Award Innovation & Excellence—Project Finance, CCPPP**



To top it all off, construction of this 1.8 million square foot environmental showpiece was delivered on time and on budget, with an impressive industry-leading safety record, including over five million hours worked without a lost time injury.



# CONSTRUCTION HIGHLIGHTS

**43.5** month schedule  
Or about 5.5 NHL hockey seasons.



**\$1.75** billion  
Project Value (NPV)

**1.8** million ft<sup>2</sup>  
That is equivalent to 32.25 football fields.



More than **29,500** loads excavated and hauled offsite



**13,000** truckloads of concrete



More than **260 tons** of structural steel framing installed

**123,270** cubic metres of concrete poured  
Or about 49 Olympic pools worth





**96%**  
construction  
waste diverted  
from landfill



**35%**  
less water used



**100%**  
fresh air throughout  
the entire building



**20,000**  
equivalent savings in  
tons of CO2 due to  
green initiatives

An impressive safety  
record with over

**5,000,000**



man hours worked without  
a lost time injury





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Humber River Hospital was delivered under Infrastructure Ontario's Alternative Financing and Procurement (AFP) delivery model in partnership with:

- Owner: **Humber River Hospital**
- Lead Sponsor and Financial Arranger: **Plenary Group**
- Design-Builder:  
**PCL Constructors Canada Inc. (Toronto)**
- Architect:  
**HDR Architecture Associates Inc.**
- Facilities Management:  
**Johnson Controls**
- Sustainability Consultant:  
**MMM Group Limited**
- Mechanical/Electrical Consultant:  
**Smith + Andersen**
- Structural Consultant:  
**WSP Canada Inc./Halsall**
- Mechanical Contractor:  
**Modern Niagara Toronto Inc.**
- Electrical Contractor:  
**Plan Electric**
- Civil Engineer:  
**A.M. Candaras Associates Inc.**
- Landscape Architect:  
**Quinn Design Associates**

