Reaching for LEED<sup>™</sup> Gold – Case studies of greening existing buildings in Vancouver



## About us



Green Building & Sustainable Community Consulting Company

Values-based

8 people with backgrounds in project management, architecture, mechanical engineering, academic research, and education

Design workshop facilitation, LEED project management, building simulations, research, and policy

60 active LEED projects, over 12 million SF of residential, commercial, & institutional projects



# **Real and Perceived Challenges**

- Choose between Green and Perseveration?
- Creative Solutions
- Time
- Budget





### Case Study #1: The Friedman Building



The original building and the addition formerly housed the Faculty of Anatomy and research labs on UBC Campus.

RECELLECTIVE

Photo credit: Acton Ostry Architects

### Case Study #1: The Friedman Building



The new building is home for the School of Audiology and Speech Sciences and the Physical Therapy Division, School of Rehabilitation Sciences



Photo credit: Acton Ostry Architects



41 2

Y Y? 1 1 1 1 5 Y? Y Y Y Y X Y 3

1

1

7 1

#### **UBC Friedman Renovation**

LEED Canada Summary Scorecard

#### Last Updated: April, 2009

2 Total Project Score

5	22	Total	Project Sc	ore								Possible Point	s 70	
Certified 26 to 32 points Silver 33 to 38 points Gold 39 to 51 points Platinum 52 or more								pre points						
4	2	Sustai	nable Sites		Possible Points	14	7	1	1	5	Materi	ials & Resources Possible Point	is 14	
N?	N	1					Y	Y?	N?	N				
		Prereq 1		imentation Control			Y				Prereq 1	Storage & Collection of Recyclables		
-		Credit 1	Site Selection	it		1	1	_	_		Credit 1.1	Building Reuse, Maintain 75% of Existing Walls, Floor & Roof	1	
	1	Credit 2 Credit 3	Development E	ensity it of Contaminated Sites		1	1	_	-		Credit 1.2 Credit 1.3	Building Reuse, Maintain 95% of Existing Walls, Floor & Roof Building Dames, Maintain 56% of Interior New Structure Floorest	1	
-	1	Credit 4.1	-	nsportation, Public Transporta	tion Access	1	1	-	-	-	Credit 2.1	Building Reuse, Maintain 50% of Interior Non-Structural Elements Construction Waste Management, Divert 50% from Landfill	1	
-	-	Credit 4.1		insportation, Bicycle Storage &		1	1	-	-		Credit 2.1	Construction Waste Management, Diver 35% from Landfill	1	
1	-	Credit 4.3		nsportation, Alternative Fuel R	••	1	-	-	-		Credit 3.1	Resource Reuse, Specify 5%	1	
1		Credit 4.4		nsportation, Parking Capacity		1			_	1	Credit 3.2	Resource Reuse, Specify 10%	1	
1	<u> </u>	Credit 5.1	Reduced Site [	Disturbance, Protect or Restore	Open Space	1	1				Credit 4.1	Recycled Content, Specify 7.5% (post-consumer + 1/2 post industrial)	1	
		Credit 5.2	Reduced Site [	Disturbance, Development Foo	tprint	1	1				Credit 4.2	Recycled Content, Specify 15% (post-consumer + 1/2 post industrial)	1	
		Credit 6.1		anagement, Rate and Quantity		1	1				Credit 5.1	Local/Regional Materials, 10% Extracted & Manufactured Regionally	1	
_	1	Credit 6.2		anagement, Treatment		1		1			Credit 5.2	Local/Regional Materials, 20% Extracted & Manufactured Regionally	1	
		Credit 7.1	•	xterior Design to Reduce I		1				-	Credit 6	Rapidly Renewable Materials	1	
1		Credit 7.2		Exterior Design to Reduce I	leat Islands, Roof	1		_			Credit 7	Certified Wood	1	
		Credit 8	Light Pollution	Reduction		1			1		Credit 8	Durable Building	1	
<u> </u>	1	Water	Efficiency		Possible Points	5	13	$\rightarrow$	_	2	Indoor	r Environmental Quality Possible Point	s 15	
N?	_				1 0331010 1 01113	•	Ÿ	Y?	N?	N	macor			
		Credit 1.1	Water Efficient	Landscaping, Reduce by 50%	0	1	Y				Prereq 1	Minimum IAQ Performance		
		Credit 1.2	Water Efficient	Landscaping, No Potable Use	e or No Irrigation	1	Y				Prereq 2	Environmental Tobacco Smoke (ETS) Control		
	1	Credit 2	Innovative Was	stewater Technologies		1	1				Credit 1	Carbon Dioxide (CO <sub>2</sub> ) Monitoring	1	
		Credit 3.1	Water Use Rec	luction, 20% Reduction		1				1	Credit 2	Increase Ventilation Effectiveness	1	
		Credit 3.2	Water Use Rec	luction, 30% Reduction		1	1				Credit 3.1	Construction IAQ Management Plan, During Construction	1	
	1.15	_					1	_	_	_	Credit 3.2	Construction IAQ Management Plan, Before Occupancy	1	
	_	Energy	y & Atmosph	ere	Possible Points	17	1	_			Credit 4.1	Low-Emitting Materials, Adhesives & Sealants	1	
N?	N	Prereg 1	Eurodamental E	uilding Systems Commissi	oping		1	_	-	_	Credit 4.2 Credit 4.3	Low-Emitting Materials, Paints	1	
		Prereg 2		gy Performance	oning		1	-	-	_	Credit 4.5	Low-Emitting Materials, Carpet Low-Emitting Materials, Composite Wood	1	
		Prereg 3		in HVAC&R Equipment			1	-	-	_	Credit 5	Indoor Chemical & Pollutant Source Control	1	
	7	Credit 1		y Performance		10	1	-	-	_	Credit 6.1	Controllability of Systems, Perimeter	1	
-	1	Credit 2.1	Renewable En	ergy, 5%		1			-	1	Credit 6.2	Controllability of Systems, Non-Perimeter	1	
	1	Credit 2.2	Renewable En	ergy, 10%		1	1				Credit 7.1	Thermal Comfort, Comply with ASHRAE 55-2004	1	
	1	Credit 2.3	Renewable En			1	1				Credit 7.2	Thermal Comfort, Permanent Monitoring System	1	
	1	Credit 3	Best Practice (	Commissioning		1	1				Credit 8.1	Daylight & Views, Daylight 75% of Spaces	1	
_		Credit 4	Ozone Depletio			1	1				Credit 8.2	Daylight & Views, Views for 90% of Spaces	1	
-	1	Credit 5	Measurement a	& Verification		1				_				
		Credit 6	Green Power			1	5 Y	Y?	N?	N	Innova	ation & Design Process Possible Point	ts 5	
							Y	Tf	NE		Credit 1.1	Innovation in Design: Green Bldg Education	1	
							1				Credit 1.2	Innovation in Design: Green Biog Education	1	
							1			_	Credit 1.3	Innovation in Design: Exemplary Performance - 40% Reduction	1	
							1		-		Credit 1.4	Innovation in Design: Green Power 100% for 2 years	1	
							1				Credit 2	LEED <sup>™</sup> Accredited Professional	1	
									_					

LEED Analysis by: RECOLLECTIVE Consulting (www.recollective.ca)



- Energy Conservation Measures
  - More efficient air handling units
  - Double-paned thermally-broken aluminum windows
  - Insulation increased in part of the building and on the entire roof
  - Interior glazing and clerestories to allow for daylighting and reduced artificial lighting
  - Low-flow plumbing fixtures to reduce hot water demand
  - Heat recovery for Air Handling Unit #1

LEED Gold Upgrade Study for the UBC Friedman Renovation



Prepared June 2008 for the University of British Coluumbia by:



ACTON OSTRY ARCHITECTS INC



- The study reveals the hidden energy savings that are invisible in LEED
- Additional upgrades would only provide marginal improvements
- Few cost effective options that could help the project earn more than 4 points or 29% better than MNECB

FCTIVE



Image credit: Acton Ostry Architects

### Preliminary Life Cycle Analysis



TOTAL IMPACTS BY BUILDING COMPONENT	Primary Energy (NJ) TOTAL	GWP (tonnes) TOTAL	Resource Use (tonnes) TOTAL	Air Pollution Index TOTAL	H2O Pollution Index TOTAL
COLUMNS & BEAMS	719953	38	290	4338	32.00
INTERMEDIATE FLOORS	6843104	539	4945	73398	144.95
EXTERIOR WALLS	3930381	245	1822	47830	319.05
WINDOWS	0	0	0	0	0.00
INTERIOR WALLS	0	0	0	0	0.00
ROOF	0	0	0	0	0.00
WHOLE BUILDING	11493438	822	7056	125566	495.99

- Weighted resource use
- Solid waste diversion
- Global warming potential
- Primary energy
- Water use savings from manufacturing and construction
- Coal savings from manufacturing

70% less

1.5 million kg

822 tonnes of carbon dioxide equivalent

11.5 million MJ

0.5 million litres

559,746 kg

#### Case Study #2: The Salt Building



 $R \in C \bigcirc L L E C T | V E$ 

Photo credit: Commonwealth Historic Resource Management

# Case Study #2: The Salt Building

- Rehabilitation project adapted for contemporary use: bakery, café, brewpub and restaurant
- Part of redevelopment of Vancouver's Southeast False Creek (SEFC), Olympic Village site







Image credit: Acton Ostry Architects

# Case Study #2: The Salt Building

• Character-defining Elements:



Monitor roof, with a clerestory containing a row of 15-pane windows and cedar ventilation louvres



Large, open interior space, interrupted only by a row of columns down the centre



Photo credit: Commonwealth Historic Resource Management



- Exposed piles supporting the building
- Wetland beneath building



Photo credit: Acton Ostry Architects



N? N



Possible Points 70

1

#### 43 5 1 21 Total Project Score & Rating GOLD

V     N	Certif	ied 26 to 32 points Silver 33 to 38 points Gold 39 to 51 points Platinum	n 52 o	r mo	re poi	ints		· · · · ·	
Y   Image S   Constant   Site Selection   Y   Image S   Constant   Site Selection     1   0		ainable Sites Possible Points 14				6	Materia	als & Resources Possible Points	14
1   0   Creat: 1:   Site Selection   1   1   0   Creat: 1:   Building Reuse, Mantan 0%, of Exsing Walk, Floor & Rood     1   0   Creat: 1:   Development Density   1   0   1   0   Creat: 1:   Building Reuse, Mantan 0%, of Exsing Walk, Floor & Rood     1   0   Creat: 1:   Development Density   1   0   1   0   Creat: 1:   Building Reuse, Mantan 0%, of Exsing Walk, Floor & Rood     1   0   Creat: 2:   Atternative Transportation, Abentary Evaluation Abcenss   1   0 <td></td> <td></td> <td>-</td> <td>Y?</td> <td>N?</td> <td>N</td> <td></td> <td></td> <td></td>			-	Y?	N?	N			
1   0			Y						
1   0   Const.3   Redevelopment of Contaminated Sites   1   1   0   Const.1.3   Building Reuse, Mantain 60% of Instera <sup>®</sup> Non-Stuductal Elements     1   0   Const.1.4   Alternative Transportation, Reing Readers   1   1   0   Const.1.2   Construction Waste Management, Diver 75% from Landfill     1   0   Const.1.3   Resource Reuse, Specify 15%   Construction Waste Management, Diver 75% from Landfill     1   0   Const.1.4   Alternative Transportation, Atania Period Const. Specify 15%   Construction Waste Management, Diver 75% from Landfill     1   0   Const.1.3   Resource Reuse, Specify 15%   Construction Waste Management, Teating Construction Master Management, Teating Construction Waste Management, Teating Construction Waste Management, Teating Construction Master Management, Teating Construction Master Management, Teating Construction Master Management, Teating Construction Master Master Management, Teating Materials, 20% Extracted & Mandature Regionally     1   1   0   Construction Master Master Management, Teating Construction Master Masterials, 20% Extr	•	·	1						1
1   creat 4.1   Alternative Transportation. Public Transportation Access   1   1   creat 4.2   Alternative Transportation. News State Sta	1 Credit 2					1			1
1   Construction   Alternative Transportation, Bayake View Reducing Stoms   1   1   Construction Waste Management, Diver 75% from Landfill     1	1 Credit 3					1			1
1   Cost 3.4   Alternative Transportation. Aximative Evel Relating Stations   1   Cost 3.3   Resource Reuse, Specify 1%     1   Cost 3.4   Alternative Transportation. Axima Specify Cost 3.   Cost 3.4   Resource Reuse, Specify 1%     1   Cost 3.4   Reduced Site Disturbance, Protector Resize Open Space   1   Cost 3.4   Reported Content. Specify 7.5% (postconsumer + 12 post industrial)     1   Cost 3.4   Stormwater Management. Trastmet   1   Cost 3.4   Cost 3.4   Reported Statistics (Disturbance, Protein Resize Open Space)     1   Cost 3.4   Stormwater Management. Trastmet   1   Cost 3.4   Cost 3.4   Mandatuset Regionally     1   Cost 3.4   Light Pollution Reduce Heat Islands, Non-Rof   1   1   Cost 3.4   Indicate Regionally     2   Tot N   1   Cost 3.4   Indicate Regionally   1   1   Cost 3.4   Mandatuset Regionally     2   Tot N   Indicate Regionally   Indicate Regionally   1   1   Cost 3.4   Mandatuset Regionally     1   Cost 3.4   Light Pollution Reduction   1   Cost 3.4   Indicate Region Reside Regionally   Reside Region Reside Reside Reside Reside Reside Reside Resid	1 Credit 4	1 Alternative Transportation, Public Transportation Access 1	1				Credit 2.1	Construction Waste Management, Divert 50% from Landfill	1
1   Credit J.   Alternative Transportation, Paking Capacity   1   1   1   1   1   Credit J.   Requeed Site Disturbance, Preceiv on Bapse     1   1   Credit J.   Requeed Site Disturbance, Preceiv on Bapse   Credit J.   Required Content, Specify 75% (post-consumer + 12 post industrial)     1   Credit J.   Required Content, Specify 75% (post-consumer + 12 post industrial)   Credit J.     1   Credit J.   Required Content, Specify 75% (post-consumer + 12 post industrial)   Credit J.     1   Credit J.   Reduced Site Disturbance, Preceive Orden Law Specify 15% (post-consumer + 12 post industrial)     1   Credit J.   Mainscape & Extremor Design to Reduce Heat Islands, Non-Roof   1   Credit J.   Credit J.   Maintau MAP Performance     1   Credit J.   Mainscape & Extremor Design to Reduce Heat Islands, Non-Roof   1   Credit J.   Water Efficient Landscaping, Reduce Hot Islands, Non-Roof   1   Credit J.   Water Efficient Landscaping, Reduce Hot Islands, Non-Roof   1   Credit J.   Water Efficient Landscaping, Reduce Hot Islands, Non-Roof   1   Credit J.   Water Efficient Landscaping, Reduce Hot Islands, Non-Roof   1   Credit J.   Water Efficient Landscaping, Reduce Hot Islands, Non-Roof   1   Credit J.	1 Credit 4		1						1
1   Credit 3.   Reduced Site Disturbance. Predoment Footprint   1   1   Credit 4.1   Recycled Content. Specify 75% (post-consumer + 12 post-industrial)     1   Credit 5.1   Stormwater Management, Tatament   1   Credit 5.1   Local/Regional Materials, 10% Extracted & Manufactured Regionally     1   Credit 5.2   Stormwater Management, Trasment   1   Credit 5.1   Local/Regional Materials, 10% Extracted & Manufactured Regionally     1   Credit 5.2   Local/Regional Materials, 10% Extracted & Manufactured Regionally   Credit 5.2   Local/Regional Materials, 10% Extracted & Manufactured Regionally     1   Credit 5.2   Local/Regional Materials, 10% Extracted & Manufactured Regionally   Credit 5.2   Local/Regional Materials, 10% Extracted & Manufactured Regionally     1   Credit 7.2   Lordscape & Exterior Design to Reduce Heat Islands, Non-Root   1   Credit 7.2   Certified Wood     2   3   Water Efficient Landscaping, Reduce by 50%   1   1   Credit 7.2   Environmental Ouality   Prent 1   Winnum IAQ Performance     2   7   N   N   1   Credit 7.2   Certified Wood   Credit 7.2   Control 1.1   Y   Y   N   N   Y   N   N	1 Credit 4					1			1
1   Orent 32   Reduced Site Disturbance. Development Fordint   1   1   Orent 41   Recycled Content, Specify 15% (postconsumer + 12 post industrial)     1   Orent 41   Stormwater Management, Trasment   1   1   Orent 41   Local/Regional Materials, 20% Extracted & Manufactured Regionaly     1   Orent 71   Landscape & Exterior Design to Reduce Heat Islands, Non-Roof   1   1   Orent 72   Landscape & Exterior Design to Reduce Heat Islands, Non-Roof   1   1   Orent 72   Landscape & Exterior Design to Reduce Heat Islands, Roof   1   1   Orent 72   Landscape & Exterior Design to Reduce Heat Islands, Roof   1   1   Orent 72   Landscape & Exterior Design to Reduce Heat Islands, Roof   1   1   Orent 74   Desible Points     2   3   Water Efficient Landscaping, Reduce by 50%   1   1   Orent 11   Water Efficient Landscaping, No Potable Use ro No Ingation   1   1   Orent 11   Water Efficient Landscaping, No Potable Use ro No Ingation   1   1   Orent 13   Water Use Reduction, 30% Reduction   1   1   Orent 13   Construction IAQ Management Plan, Brice Roduce   1   1   Orent 14   Control Lightter Reduce   No     1   Crent 12   Wat	1 Credit 4					1			1
1   Oratt 11   Sortmwater Management, Rate and Quanty   1   1   Const 13   Local/Regional Materials, 10% Extracted & Manufactured Regionally     1   Crest 13   Local/Regional Materials, 10% Extracted & Manufactured Regionally     1   Crest 13   Local/Regional Materials, 10% Extracted & Manufactured Regionally     1   Crest 13   Local/Regional Materials, 10% Extracted & Manufactured Regionally     1   Crest 13   Local/Regional Materials, 10% Extracted & Manufactured Regionally     1   Crest 13   Local/Regional Materials, 10% Extracted & Manufactured Regionally     1   Crest 14   Crest 14   Crest 14   Crest 14     1   Crest 14   Materials, 10% Extracted & Manufactured Regionally   Crest 14     1   Crest 14   Index extracted & Manufactured Regionally   Crest 14     1   Crest 14   Index extracted & Manufactured Regionally   Crest 14     1   Crest 14   Index extracted & Manufactured Regionally   Crest 14     1   Crest 14   Index extracted & Manufactured Regionally   Crest 14     1   Crest 14   Index extracted & Manufactured Regionally   Crest 14     1   Crest 14   Indextracted Regional Materia	1 Credit 5.	1 Reduced Site Disturbance, Protect or Restore Open Space 1	1				Credit 4.1	Recycled Content, Specify 7.5% (post-consumer + 1/2 post industrial)	1
1   Credt 2:   Stormwater Management, Treatment   1   1   Credt 3:   Local/Regional Materials, 20% Extracted & Manufactured Regionally     1   Credt 7:   Landscape & Exterior Design to Reduce Heat Islands, Non-Root   1   1   Credt 7:   Certifitied Wood     1   Credt 7:   Landscape & Exterior Design to Reduce Heat Islands, Non-Root   1   1   Credt 7:   Certifitied Wood     1   Credt 7:   Landscape & Exterior Design to Reduce Heat Islands, Non-Root   1   1   Credt 7:   Certifitied Wood     2   7   N   Credt 7:   Landscape & Exterior Design to Reduce be for Non-Root   1   1   Credt 7:   Certifitied Wood     2   7   N   N   Credt 7:   Marter Efficient Landscape No Probable Use on No Ingation   1   1   Credt 7:   Control     1   Credt 7:   Newer 1:   Water Efficient Landscape No Probable Use on No Ingation   1   1   Credt 7:   Control     1   Credt 7:   Newer 1:   Water Headscape Construction   1   Credt 7:   Control     1   Credt 7:   Newer 1:   Water Headscape Root No Root Cert 7:   Control   Cre	1 Credit 5.	2 Reduced Site Disturbance, Development Footprint 1	1				Credit 4.2	Recycled Content, Specify 15% (post-consumer + 1/2 post industrial)	1
1   Credit 7: Credit 7: Landscape & Exterior Design to Reduce Heat Islands, Nor-Roof 1   1   Credit 7: Credit 7: Credit 7: Light Pollution Reduction   Credit 7: Credit 7: Cr	1 Credit 6.	1 Stormwater Management, Rate and Quantity 1	1				Credit 5.1	Local/Regional Materials, 10% Extracted & Manufactured Regionally	1
1   Credit 3:   Light Pollution Reduction   1   1   Credit 3:   Urable Building     2   3:   Water Efficient Landscaping, Reduce by 50%   1   1   Credit 3:   Vironmental Quality   Possible Points     7   N7   N   1   Credit 3:   Water Efficient Landscaping, No Potable Use No Irrigation   1   Y   N   N   Y   N   N   Y   N   N   Y   N   N   N   N   N   N   N   N   N   N   N   N   N   N   N	1 Credit 6	2 Stormwater Management, Treatment 1	1				Credit 5.2	Local/Regional Materials, 20% Extracted & Manufactured Regionally	1
1   1	1 Credit 7.	1 Landscape & Exterior Design to Reduce Heat Islands, Non-Roof 1				1	Credit 6	Rapidly Renewable Materials	1
2   3   Water Efficiency   Possible Points   5     2   7   N <sup>2</sup> 1   Credit 1   Water Efficient Landscaping, Reduce by 50%   1     1   Credit 1   Water Efficient Landscaping, Reduce by 50%   1   1   Preeq 2   Environmental Tobacco Smoke (ETS) Control     1   Credit 2   Innovative Wastewater Technologies   1   1   Credit 2   Construction IAQ Management Plan, During Construction     1   Credit 3   Water Use Reduction, 20% Reduction   1   1   Credit 3   Construction IAQ Management Plan, During Construction     1   Credit 3   Water Use Reduction, 30% Reduction   1   1   Credit 3   Construction IAQ Management Plan, During Construction     1   Credit 3   Construction IAQ Management Plan, During Construction   1   Credit 3   Construction IAQ Management Plan, During Construction     1   Credit 4   Low-Emitting Materials, Composite Wood   1   Credit 4   Low-Emitting Materials, Composite Wood     Y   Preeq 2   Minimum Energy Performance   1   Credit 4   Low-Emitting Materials, Composite Wood     Y   Preeq 1   Minimum Energy Performance   1   Credit	1 Credit 7.	2 Landscape & Exterior Design to Reduce Heat Islands, Roof 1				1	Credit 7	Certified Wood	1
Y   Y	1 Credit 8	Light Pollution Reduction 1	1				Credit 8	Durable Building	1
Y   Y	a Vate	ar Etticiancy Dossible Doints b	44			4	Indoor	- Environmental Quality	14
1   Credit 1.1   Water Efficient Landscaping, Reduce by 50%   1   Y   Preeq 1   Minimum IAQ Performance     1   Credit 1.2   Water Efficient Landscaping, No Potable Use or No Irrigation   1   Y   Preeq 1   Environmental Tobacco Smoke (ETS) Control     1   Credit 1.2   Innovative Water Water Vasewater Technologies   1   1   Credit 1.2   Carbon Dioxide (CG) Monitoring     1   Credit 3.1   Water Use Reduction, 20% Reduction   1   1   Credit 3.1   Coredit 2.1   Core					N7		indoor		13
1   Credit 1.2   Water Efficient Landscaping, No Potable Use or No Irrigation   1   Prereq 2   Environmental Tobacos Smoke (ETS) Control     1   Credit 2.1   Innovative Wastewater Technologies   1   1   Credit 3.1   Corrects 3.1   Corrects 3.1   Construction IAQ Management Plan, During Construction     1   Credit 3.1   Construction IAQ Management Plan, Before Occupancy   Low-Emitting Materials, Adhesives & Sealants     1   Credit 3.1   Fundamental Building Systems Commissioning   1   Credit 4.1   Low-Emitting Materials, Capet     Y   N?   N   Prereq 2   Minimum Energy Performance   1   Credit 4.1   Low-Emitting Materials, Capet     Y   NPrereq 3   Credit 2.1   Renewable Energy, 5%   1   Credit 4.1   Low-Emitting Materials, Capet     Y   Prereq 3   Credit 3.1   Renewable Energy, 5%   1   Credit 7.1   Credit 7.1   Credit 7.1     Y   No   Credit 3.1   Renewable Energy, 10%   1   Credit 7.1   Credit		1 Water Efficient Landscaping Reduce by 50%		1			Prereg 1	Minimum IAO Performance	
1   Credit 2   Innovative Wastewater Technologies   1     1   Credit 31   Water Use Reduction, 20% Reduction   1   1   Credit 31   Construction IAQ Management Plan, During Construction     1   Credit 32   Water Use Reduction, 30% Reduction   1   1   Credit 31   Construction IAQ Management Plan, During Construction     12   5   Energy & Atmosphere   Possible Points   17   1   Credit 32   Construction IAQ Management Plan, During Construction     12   5   Energy & Atmosphere   Possible Points   17   1   Credit 41   Low-Emitting Materials, Adhesives & Sealants     12   7   N   N   Prereq 1   Fundamental Building Systems Commissioning   1   Credit 43   Low-Emitting Materials, Carpet     1   Credit 41   Optimize Energy Performance   10   Credit 44   Low-Emitting Materials, Composite Wood     1   Credit 21   Renewable Energy, 10%   1   Credit 54   Controllability of Systems, Non-Perimeter     1   Credit 23   Renewable Energy, 20%   1   1   Credit 54   Controllability of Systems     1   Credit 35   Measurement & Verificati									
1   Credit 3.1   Water Use Reduction, 20% Reduction   1   1   Credit 2   Increase Ventilation Effectiveness     1   Credit 3.2   Water Use Reduction, 30% Reduction   1   1   Credit 2.1   Construction IAQ Management Plan, Deing Construction     12   5   Energy & Atmosphere   Possible Points   17   Credit 3.1   Construction IAQ Management Plan, Deing Construction     12   5   Energy & Atmosphere   Possible Points   17   Credit 3.1   Construction IAQ Management Plan, During Construction     12   5   Energy & Atmosphere   Possible Points   17   Credit 3.1   Construction IAQ Management Plan, During Construction     14   0   Credit 3.1   Credit 3.1   Construction IAQ Management Plan, During Construction     14   0   Credit 3.1   Credit 3.1   Low-Emitting Materials, Composite Wood     15   Energy Credit 3.1   Minimum Energy Performance   1   Credit 4.1   Low-Emitting Materials, Composite Wood     16   Credit 1.1   Credit 3.1   Renewable Energy, 5%   1   1   Credit 6.2   Controllability of Systems, Non-Perimeter     16   Credit 3.2   Renewable Energy, 20%									1
1   Credil 32   Water Use Reduction, 30% Reduction   1   1   Credil 31   Construction IAQ Management Plan, During Construction     12   5   Energy & Atmosphere   Possible Points   1   Credil 32   Construction IAQ Management Plan, During Construction     12   Y   N   Prefeq 1   Fundamental Building Systems Commissioning   1   Credil 41   Low-Emitting Materials, Adhesive & Sealants     Y   N   Prefeq 2   Minimum Energy Performance   1   Credil 42   Low-Emitting Materials, Composite Wood     Y   Prefeq 3   Credil 40   Optimize Energy Performance   10   Credil 41   Low-Emitting Materials, Composite Wood     1   Credil 21   Renewable Energy, 5%   1   Credil 51   Indoor Chemical & Pollutant Spiteme     1   Credil 22   Renewable Energy, 10%   1   Credil 62   Controllability of Systems, Non-Perimeter     1   Credil 3   Best Practice Commissioning   1   Credil 72   Thermal Comfort, Cemply with ASHRE 55-2004     1   Credil 4   Ozone Depletion   1   Credil 81   Daylight & Views, Daylight 75% of Spaces     1   Credil 6   Green Power   Gree		0	-						÷
1   Credit 3:   Construction IAQ Management Plan, Before Occupancy     1   5   Energy & Atmosphere   Possible Points 17     1   5   Energy & Atmosphere   Possible Points 17     1   7   N   N   Credit 4:   Low-Emitting Materials, Adhesives & Sealants     Y   N   Prereq 1   Fundamental Building Systems Commissioning   1   Credit 4:   Low-Emitting Materials, Carpet     Y   N   Prereq 2   Minimum Energy Performance   10   Credit 4:   Low-Emitting Materials, Carpet     Y   N   Optimize Energy Performance   10   Credit 3:   Indoor Chemical & Pollutant Source Control     8   2   Credit 1:   Renewable Energy, 5%   1   1   Credit 5:   Controllability of Systems, Non-Perimeter     1   Credit 2:   Renewable Energy, 10%   1   1   Credit 7:   Thermal Comfort, Comply with ASHRAE 55-2004     1   Credit 3:   Best Practice Commissioning   1   1   Credit 1:   Daylight 8 Views, Daylight 75% of Spaces     1   Credit 6:   Gredit 1:   Credit 8:   Daylight 8 Views, Views for 90% of Spaces   1			-						4
1   Credit 4:1   Low-Emitting Materials, Adhesives & Sealants     Y   N?   N     Y   N   Prereq 1   Fundamental Building Systems Commissioning   1   Credit 4:1   Low-Emitting Materials, Adhesives & Sealants     Y   N   Credit 2:1   Optimize Energy Performance   1   1   Credit 4:1   Low-Emitting Materials, Composite Wood     1   Credit 2:1   Optimize Energy Performance   10   1   Credit 5:1   Controllability of Systems, Non-Perimeter     1   Credit 2:2   Renewable Energy, 20%   1   1   Credit 4:1   Controllability of Systems, Non-Perimeter     1   Credit 2:3   Renewable Energy, 20%   1   1   Credit 7:2   Thermal Comfort, Comply with ASHR4E 55-2004     1   Credit 3:1   Daylight		- Water ose readdron, os a readdron	_						- 4
Y   N?   N     Y   Prereq 1   Fundamental Building Systems Commissioning     Y   Prereq 2   Minimum Energy Performance     Y   Prereq 3   CFC Reduction in HVAC&R Equipment     8   2   Credit 1   Optimize Energy, 5%     1   Credit 21   Renewable Energy, 5%   1     1   Credit 22   Renewable Energy, 5%   1     1   Credit 23   Renewable Energy, 20%   1     1   Credit 23   Renewable Energy, 20%   1     1   Credit 3   Daylight & Views, Daylight 75% of Spaces     1   Credit 6   Green Power     1   Credit 6   Green Power	12 5 Ener	rav & Atmosphere Possible Points 17	_						÷
Y   Preteq 1   Fundamental Building Systems Commissioning     Y   Preteq 2   Minimum Energy Performance     Y   Preteq 2   Minimum Energy Performance     Y   Preteq 3   CFC Reduction in HVAC&R Equipment     Y   Optimize Energy Performance   1   Credit 4.1   Low-Emitting Materials, Carpet     Y   Optimize Energy Performance   1   Credit 5.1   Indoor Chemical & Pollutant Source Control     1   Credit 2.1   Renewable Energy, 5%   1   1   Credit 6.2   Controllability of Systems, Perimeter     1   Credit 2.3   Renewable Energy, 10%   1   1   Credit 7.1   Thermal Comfort, Permanent Monitoring System     1   Credit 3   Best Practice Commissioning   1   1   Credit 8.1   Daylight & Views, Daylight 75% of Spaces     1   Credit 6   Green Power   1   Credit 8.1   Innovation & Design: Water Use Reduction 40%     1   Credit 1.1   Innovation in Design: Green Building Education   1   Credit 1.1   Innovation in Design: Green Building Education     1   Credit 1.1   Credit 1.1   Innovation in Design: Green Building Education   1   Credit 1.1			-						÷
Y   Prereq 2   Minimum Energy Performance   1   Credit 4.   Low-Emitting Materials, Composite Wood     Y   Prereq 2   CFC Reduction in HVAC&R Equipment   1   Credit 4.   Low-Emitting Materials, Composite Wood     8   2   Credit 1.1   Optimize Energy Performance   1   Credit 5.   Indoor Chemical & Pollutant Source Control     8   2   Credit 2.1   Renewable Energy, 5%   1   1   Credit 6.2   Controllability of Systems, Non-Perimeter     1   Credit 2.1   Renewable Energy, 10%   1   1   Credit 7.1   Thermal Comfort, Comply with ASHRAE 55-2004     1   Credit 3   Best Practice Commissioning   1   1   Credit 7.1   Thermal Comfort, Permanent Monitoring System     1   Credit 4.1   Ozone Depletion   1   Credit 8.1   Daylight & Views, Daylight 8.   Views, Dayl		1 Fundamental Building Systems Commissioning	-			4			4
Y   Prereq 3   CFC Reduction in HVAC&R Equipment     8   2   Credit 1   Optimize Energy Performance   1   Credit 5.1   Controllability of Systems, Perimeter     1   Credit 2.2   Renewable Energy, 5%   1   1   Credit 5.1   Controllability of Systems, Non-Perimeter     1   Credit 2.2   Renewable Energy, 20%   1   1   Credit 7.2   Thermal Comfort, Comply with ASHRE 55-2004     1   Credit 3   Best Practice Commissioning   1   1   Credit 3.1   Daylight & Views, Daylight 75% of Spaces     1   Credit 4   Ozone Depletion   1   1   Credit 8.1   Daylight & Views, Views for 90% of Spaces     1   Credit 6   Green Power   1   Credit 1.1   Innovation in Design:Water Use Reduction 40%     1   Credit 1.2   Innovation in Design: 100% Underground Parking   Innovation in Design: 100% Underground Parking			4			-			4
8   2   Credit 1   Optimize Energy Performance   10   1   Credit 6.1   Controllability of Systems, Perimeter     1   Credit 2.1   Renewable Energy, 5%   1   1   Credit 6.2   Controllability of Systems, Non-Perimeter     1   Credit 2.3   Renewable Energy, 20%   1   1   Credit 7.1   Thermal Comfort, Permanent Monitoring System     1   Credit 3   Best Practice Commissioning   1   Credit 8.1   Daylight & Views, Daylight 75% of Spaces     1   Credit 6   Green Power   1   Credit 8.1   Daylight & Views, Views for 90% of Spaces     1   Credit 6   Green Power   1   Credit 1.1   Innovation in Design:Water Use Reduction 40%     1   Credit 1.2   Innovation in Design: Green Building Education   1   Credit 1.1   Innovation in Design: Green Building Education     1   Credit 1.2   Innovation in Design: Green Building Education   1   Credit 1.2   Innovation in Design: Green Building Education									- 4
1   Credit 2:1   Renewable Energy, 5%   1   I   Credit 6:2   Controllability of Systems, Non-Perimeter     1   Credit 2:2   Renewable Energy, 10%   1   1   Credit 7:1   Thermal Comfort, Comply with ASHRAE 55-2004     1   Credit 3:3   Renewable Energy, 20%   1   1   Credit 7:2   Thermal Comfort, Comply with ASHRAE 55-2004     1   Credit 3:3   Best Practice Commissioning   1   1   Credit 7:2   Thermal Comfort, Permanent Monitoring System     1   Credit 4:0   Ozone Depletion   1   Credit 6:2   Daylight & Views, Daylight 75% of Spaces     1   Credit 6:0   Green Power   1   Credit 6:2   Daylight & Views, Views for 90% of Spaces     1   Credit 6:0   Green Power   Credit 1:1   Innovation & Design:Water Use Reduction 40%     1   Credit 1:1   Innovation in Design: Green Building Education   Tredit 1:1   Innovation in Design: Green Building Education			· ·			1			÷
1   Credit 22   Renewable Energy, 10%   1   1   Credit 7.1   Thermal Comfort, Comply with ASHRAE 55-2004     1   Credit 7.3   Renewable Energy, 20%   1   1   Credit 7.2   Thermal Comfort, Permanent Monitoring System     1   Credit 7.3   Best Practice Commissioning   1   1   Credit 7.2   Thermal Comfort, Permanent Monitoring System     1   Credit 7.3   Best Practice Commissioning   1   1   Credit 8.1   Daylight 8. Views, Daylight 75% of Spaces     1   Credit 7.5   Measurement & Verification   1   Credit 8.2   Daylight 8. Views, Views for 90% of Spaces     1   Credit 6   Green Power   1   Credit 7.1   Innovation & Design: Process   Possible Points     Y   Y?   N   1   Credit 1.1   Innovation in Design: Green Building Education     1   Credit 1.2   Innovation in Design: 100% Underground Parking   Credit 1.3   Innovation in Design: 100% Underground Parking			_						÷
1   Credit 23   Renewable Energy, 20%   1   1   Credit 7.2   Thermal Comfort, Permanent Monitoring System     1   Credit 3   Best Practice Commissioning   1   1   Credit 3.1   Daylight & Views, Daylight 75% of Spaces     1   Credit 4.1   Coredit 5   Measurement & Verification   1   1   Credit 8.2   Daylight & Views, Views for 90% of Spaces     1   Credit 6   Green Power   1   1   Credit 1.1   Innovation in Design:Water Use Reduction 40%     1   Credit 1.2   Innovation in Design: 100% Underground Parking			4			-			÷
1   Credit 3   Best Practice Commissioning   1   1   Credit 6.1   Daylight & Views, Daylight 75% of Spaces     1   Credit 6.1   Credit 6.1   Ozone Depletion   1   1   Credit 6.1   Daylight & Views, Daylight 75% of Spaces     1   Credit 6.1   Ozone Depletion   1   1   Credit 6.1   Daylight & Views, Views for 90% of Spaces     1   Credit 6.1   Green Power   1   1   Innovation & Design: Water Use Reduction 40%     1   V   Y   N   Credit 1.1   Innovation in Design: Green Building Education     1   Credit 1.3   Innovation in Design: Green Building Education   Credit 1.3   Innovation in Design: Green Building Education		6).	_						4
1   Credit 4   Ozone Depletion   1   1   Credit 5.2   Daylight & Views, Views for 90% of Spaces     1   Credit 5   Measurement & Verification   1   1   Credit 6.2   Daylight & Views, Views for 90% of Spaces     1   Credit 6   Green Power   1   1   Innovation & Design Process   Possible Points     Y   Y   N   1   Credit 1.1   Innovation in Design:Water Use Reduction 40%     Credit 1.1   Credit 1.2   Innovation in Design: Green Building Education   Innovation in Design: 100% Underground Parking			· ·			4			- 4
1   Credit 5   Measurement & Verification   1   1   Innovation & Design Process   Possible Points     1   Credit 6   Green Power   1   1   Innovation & Design: Water Use Reduction 40%   Credit 1.1   Innovation in Design: Green Building Education     1   Credit 1.2   Innovation in Design: 100% Underground Parking		-	4			÷.			- 4
1   Credit 6   Green Power   1   Importation & Design Process   Possible Points     Y   Y   Y?   N?   N   Importation in Design:Water Use Reduction 40%     1   Credit 1.2   Innovation in Design: Green Building Education   Importation in Design: 100% Underground Parking							oreun 0.2	Dayingint or views, views for auto of opages	
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									1
			-	1					1

1 Credit 2 LEED™ Accredited Professional

LEED Analysis by: RECOLLECTIVE Consulting (www.recollective.ca)



#### Strategies

- In-slab radiant flooring system was introduced
- Single-paned clerestory windows retained, repaired or replicated
- Louvers are retained and functional as much as possible; some are sealed
- More openings cut into the existing shell to allow for natural light and view access as well as to serve as a public venue

- LEED Implications
  - Energy model shows the project is achieving 8 out of 10 energy points
  - Natural ventilation through selected louvers in the clerestory also contribute to energy performance
  - View access credit can be achieved; but daylight model indicates not enough daylight to achieve the credit



- Strategies
  - Reduce exterior illumination to minimize light pollution even though it is a historic landmark
  - Retain and reuse existing materials including wood siding, floor, roof, trusses

- LEED Implications
  - Illuminated signs are downlighted and shielding is designed to meet the Light Pollution Reduction credit requirement
  - Retain enough structural and shell elements to achieve Building Reuse credit



- Envelope upgrade
  - Thermal performance
  - Heritage values
  - Moisture issue





Images and technical information courtesy of Morrison Hershfield





RECLLECTIVE

Images and technical information courtesy of Morrison Hershfield

### **Energy Performance: Actual and Modeled**

- Why does the energy score vary so wildly for these two projects?
  - HVAC: Radiant heating and cooling system vs. forced air system
  - Energy source: District Energy System vs. Steam Plant
- The proposed design is compared to a reference model, not the pre-renovation condition

FC



Courtesy of Lawrence Berkeley National Laboratory

- Integrated Design Process
  - Set reasonable expectations
  - Communicate priorities
  - Establish working relationships
  - Challenging to follow through given the time pressure or budgetary limitation







- Site Context
  - Chosen site (urban, campus, contaminated site, etc.)
  - Decisions made before project starts (energy source, district energy system, project boundary, etc.)
  - Could have a positive or negative impact on LEED scorecard
  - Pre-existing conditions (structural loads, opening locations, building envelope, etc.) could limit the selection of design strategies







Image credit: Acton Ostry Architects

- Assumptions
  - Engage the right stakeholders at the beginning
  - Provide opportunities to clarify LEED credit requirements and interpretations.
  - Every project is different. A preliminary LEED feasibility study is helpful in understanding the challenges and establishing team expectations.





Photo credit: Commonwealth Historic Resource Management

- LEED Rating System: designed with new commercial office building in mind
- Major limitations when applied to existing buildings:
  - Energy Performance: actual improvement is not accounted for
  - Building Reuse: challenging and timeconsuming to document at times; high percentage threshold to earn a point
  - Innovation in Design Credits: the only places to acknowledge cultural and social values and Life Cycle benefits





- Benefits:
  - Encourage Integrated Design Process
  - Relatively comprehensive
  - Follow-through from design to construction
  - Recognition and sense of accomplishment





- Decision making process: choose the "right" thing or the "LEED" thing?
  - Meet the <u>intent</u> of the credits

ECTIVE

 Aim to provide the best value to the clients, and most environmental benefits to the users and the community





Image credits: Acton Ostry Architects Commonwealth Historic Resource Management

#### Thanks!

Contact: Ting Pan ting@recollective.ca

