BUILDING FUTURES

SUSTAINABLE DESIGN + GREEN TECHNOLOGIES

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Global Innovation Initiative Grant: “Novel Approaches of Employing Green Infrastructure (GI) to Enhance Urban Sustainability”
U.S. Department of State + Institute of International Education (IIE)
Joint International Stakeholder Workshop | Universitas Indonesia | Jakarta, Indonesia | 21 October 2015

SUSTAINABLE

A system that maintains its own viability by using techniques that allow for continual reuse. [1]

Sustainable development meets the needs and aspirations of the present without compromising the ability of future generations to meet their own needs. [2]

Sources:
1. sustainable. Dictionary.com. *Dictionary.com Unabridged.* Random House, Inc. http://dictionary.reference.com/browse/sustainable (accessed: October 19, 2015).
2. *Report of the World Commission on Environment and Development "Our Common Future"* (Brundtland Commission). United Nations General Assembly Document A/42/427 (English), published August 4, 1987, 24, 51.

TECHNOLOGY

The branch of knowledge that deals with the creation and use of technical means and their interrelation with life, society, and the environment.

The sum of the ways in which social groups provide themselves with the material objects of their civilization.

ORIGIN: 1610s, “discourse or treatise on an art or the arts,” from Greek *tekhnologia* “systematic treatment of an art, craft, or technique,” originally referring to grammar, from *tekhno-* + *-logy*. Greek *tekhno-* refers to “art, skill, craft in work; method, system, an art, a system or method of making or doing.”

Sources: technology. Dictionary.com. *Dictionary.com Unabridged.* Random House, Inc. + *Online Etymology Dictionary*. Douglas Harper, Historian. http://dictionary.reference.com/browse/technology (accessed: October 19, 2015).

SUSTAINABLE DESIGN + GREEN TECHNOLOGIES

Systematic treatment of art, craft, or technique, to address:

- Environmental Sustainability
- Social + Cultural Sustainability
- Economic Sustainability

This is a broad area, including planning, land use, energy and resource management, architectural design, engineering, construction, public policy, social frameworks, philosophy and religion, public and individual health, political/legal structures, financing strategies, emergent technical tools and/or novel design strategies, etc.

The different measures and indicators often provide contradictory feedback, requiring a balancing of diverse interests and/or prioritization of strategies.

REBUILDING WATERWAYS + RESTORING WATER

BISHAN - ANG MO KIO PARK, SINGAPORE

Image: Atelier Dreiseitl

Image: Atelier Dreiseitl

Image: Atelier Dreiseitl

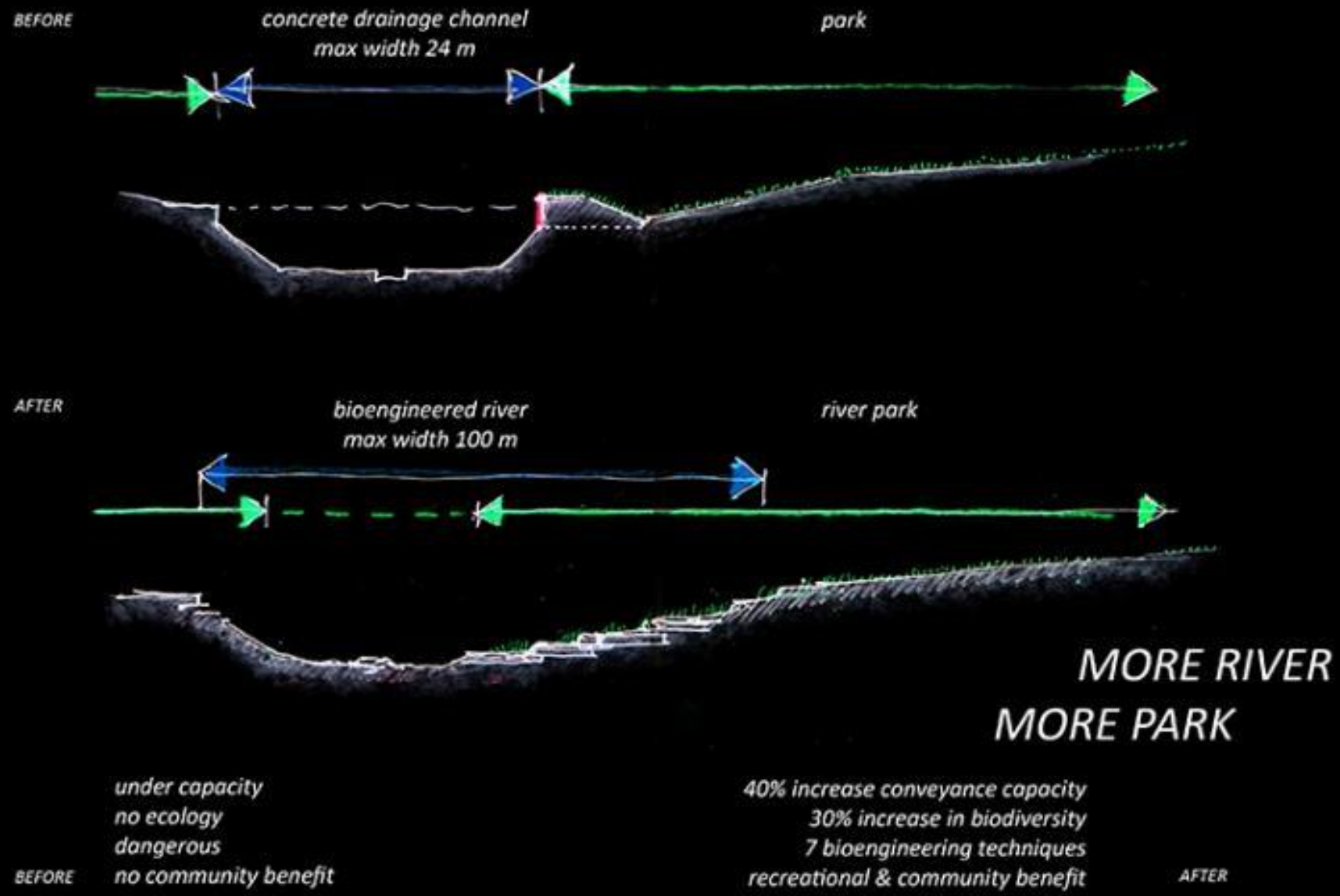


Image: Atelier Dreiseitl

Image: Bradley Walters

Images: Bradley Walters + Atelier Dreiseitl

Cleansing Biotope

Pond Gardens | Bishan Park

Spanning 27 hectares, Pond Gardens, as its name implies, is home to a number of ponds. Visitors will enjoy the tranquility of this park with the river that now runs through it. Pay a visit to Lotus Garden and see if you can catch the lovely sight of lotuses in full bloom. Another interesting feature in Pond Gardens is the cleansing biotope, in which water from the river and ponds is treated by plants before flowing back to the ponds and river again. For the younger ones, the park also offers two themed playgrounds to keep them entertained.

Bishan Park
Information Map

Features

Lotus Garden

Stroll along the bridges and admire the pond with its beautiful picturesque view of lotuses. The pond is also home to a healthy population of dragonflies and a wide array of birds.

Playground

Discover the exhilarating experience of how it would feel like to climb a tree and swing from one trunk to the next as you watch the world from above. Run, hide, climb, dangle, swing and slide as you wish. Those seeking an adventure could well find it here as you explore the climbing facilities in this playground.

Cleansing Biotope

The cleansing biotope is an artificially constructed wetland that offers effective water treatment and helps maintain the water quality naturally without the use of chemicals. A special selection of wetland plants has been chosen for their ability to cleanse the water by filtrating pollutants and absorbing nutrients.

Playground

Innovative and imaginative play is great fun for children. At this playground, children can manoeuvre sluice gates to control water flow and also learn to appreciate and value water while interacting with it.

Bus-stop
P Parking
Toilet
PCN Park Connector Network

Features
- Palm Court
- Lotus Garden
- Playground
- Cleansing Biotope
- Playground

Amenities
- Adventure Lawn
- Pond
- Fitness Corner
- Activity Lawn I
- Taichi Corner
- Activity Lawn II

Safety Features
- Safety Node
- River Depth Marker

Biodiversity At The Park

Sessile Joyweed *(Alternanthera sessilis 'Red')*

Dark reddish-purple leaves provide colour contrast in a mostly green landscape. Tea prepared from the leaves of this plant is thought to improve blood circulation and reduce cholesterol and high blood sugar levels. The leaves may also be consumed as a vegetable.

Townsville Stylo *(Stylosanthes humilis)*

In Bishan Park, this wildflower functions as groundcover to help reduce soil erosion. It is sometimes also planted as a cover crop in agricultural fields to prevent the growth of weeds.

Swamp Tea Tree *(Melaleuca cajuputi)*

A hardy tree that grows rapidly and is able to withstand waterlogged soils, it is often planted along the river banks. The leaves give a typical 'tea-tree' smell when crushed. The tree is also the source of a medicinal oil called cajuput oil, which has antiseptic properties.

Scaly Breasted Munia *(Lonchura punctulata)*

Scaly Breasted Munias are one of the most common munias in Singapore. They can be found in large flocks of more than 50 birds in Bishan Park throughout the length of the waterway. Munias feed on grass seeds and love foraging among the tall grasses. Often, the black headed and white headed munias can be spotted in the midst of their flocks.

Common Bluetail *(Ischnura senegalensis)*

The Common Bluetail is easily found throughout Singapore and it is the first damselfly to colonise Bishan Park's riverbanks. This tiny damselfly can be found perched on the knee-high vegetation adjacent to the water.

White-breasted Waterhen *(Amaurornis phoenicurus)*

These birds are often heard before they are seen and are also named "Ruak Ruak" because of their loud calls. There is a family of Waterhens at the Lotus Garden where they can be seen walking on lotus leaves.

NATIONAL PARKS | LET'S MAKE SINGAPORE OUR GARDEN

Visitor Information

Location
Along Bishan Road and Ang Mo Kio Ave 1

Getting here
Services 132, 133, 136, 165, 166, 169 and 262 from Ang Mo Kio Bus Interchange
Service 410 from Bishan MRT Station.

Like us on www.facebook.com/nparksbuzz

www.nparks.gov.sg

Image: National Parks Board

Image: Bradley Walters

Image: Atelier Dreiseitl

Image: Atelier Dreiseitl

River Plains | Bishan-Ang Mo Kio Park

Spanning 36 hectares, River Plains offers a variety of experiences for visitors. You can choose to head down to the river and stroll along the water's edge during dry weather or make use of the wide range of amenities in the park. There are playgrounds, foot reflexology paths, food and beverage outlets, and a dog run area. Unique to River Plains is Recycle Hill, with an equally distinctive sculpture, "An Enclosure for a Swing", perched on it. Visitors can get a vantage point of the park from the top of the hill.

Features

1 Playground

Kids will have an enjoyable time exploring this playground and climbing the round rubber mounds that seem to emerge from the sand.

9 Dog Run

Even man's best friend needs to stretch its legs once in a while. In Bishan-Ang Mo Kio Park, there is a dog run area where pet dogs can get their dose of exercise. With wide open areas sheltered by shady trees, pet dogs have the luxury of space to run freely and safely within the boundaries of the dog run area.

10 Recycle Hill

Made up of concrete slabs salvaged from the old canal, Recycle Hill provides a good vantage point for one to view the entire park. Sitting atop the hill is the award-winning sculpture, An Enclosure for a Swing, created to represent the fusion of nature and design.

11 Riverside Gallery

Located by the naturalised river, the Riverside Gallery is an ideal place to hold events and gatherings.

Naturalised River

The Kallang River that used to flow inside the concrete canal has been transformed into a naturalised, meandering river that flows through the park. The enhancement of this waterway is part of PUB's Active, Beautiful, Clean Waters (ABC Waters) Programme. Take a stroll along the river and enjoy its beauty and serenity.

Biodiversity At The Park

Common Scarlet *(Crocothemis servilia)*

These beautiful dragonflies can be seen at the river. They prey on smaller insects such as flies or mosquitoes. Males are bright red in colour, while females are yellow brown.

Purple Heron *(Ardea purpurea)*

Preferring to hunt alone in the early morning or at night, these shy but elegant birds can be spotted at the river looking for food. Though they have slender beaks and necks, purple herons are strong enough to kill large snakes!

Safety Features

Features
1 Playground
2 Foot Reflexology
9 Dog Run
10 Recycle Hill
11 Riverside Gallery

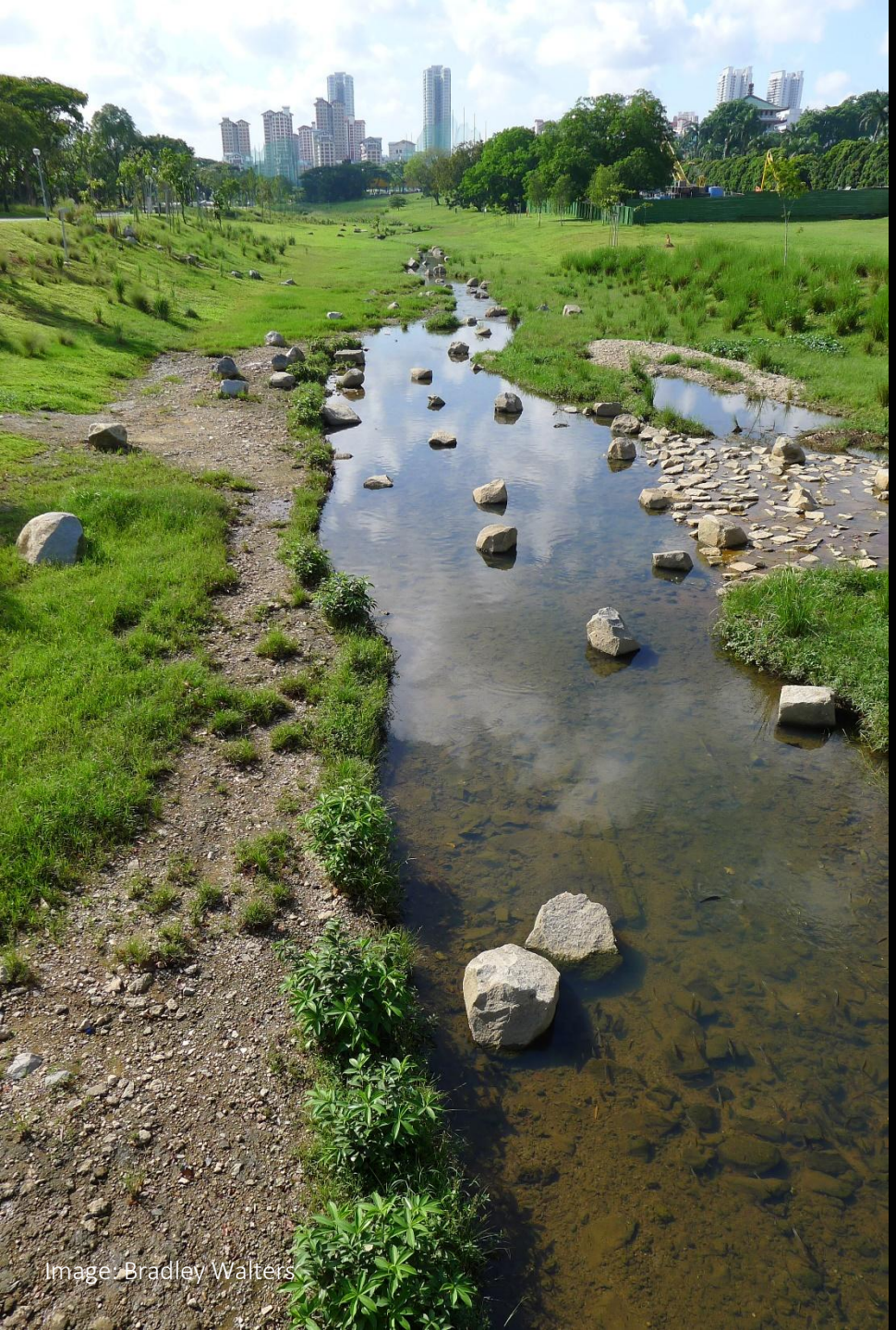
Amenities
3 F&B outlets
5 Grand Lawn I
6 Grand Lawn II
7 NParks Office
8 Fitness Corner & Playground
4 Community Garden

Bus-stop
Food & Beverage
Carpark
Toilet
PCN Park Connector Network

Image: National Parks Board

Image: Atelier Dreiseitl

Image: Atelier Dreiseitl



PROJECT DATA

Client: Public Utilities Board & National Parks Board

Design Team: Atelier Dreiseitl

Engineers: CH2M Hill, Geitz & Partner

Design: 2007-2010

Construction: 2009-2012

Central catchment area: 140 km^2

Site Area: 62 ha / 155 acres

2.7 km long straight concrete drainage channel restored into sinuous 3.2 km long Kallang River

24 m drainage channel widened to 100 m; 40% increase in conveyance capacity

Project Budget: 39,000,000 €

ROOFS THAT GROW

BECTON DICKINSON CAMPUS CENTER

FRANKLIN LAKES, NEW JERSEY U.S.A.

BENEFITS OF VEGETATED ROOFS

Aesthetic improvement
New amenity spaces
Prolonging the life of waterproofing membranes
Improved air quality

Stormwater Management

- With green roofs, water is stored by the substrate and then taken up by the plants from where it is returned to the atmosphere through transpiration and evaporation.
- In summer, depending on the plants and depth of growing medium, green roofs retain 70-90% of the precipitation that falls on them; in winter they retain between 25-40%. A grass roof with a 4-20 cm (1.6 - 7.9 inches) layer of growing medium can hold 10-15 cm (3.9 - 5.9 inches) of water.
- Green roofs reduce the amount of stormwater runoff and also delay the time at which runoff occurs, resulting in decreased stress on sewer systems at peak flow periods.

Source: Green Roofs for Healthy Cities - North America Inc., http://www.greenroofs.org/index.php/about/greenroofbenefits

BENEFITS OF VEGETATED ROOFS

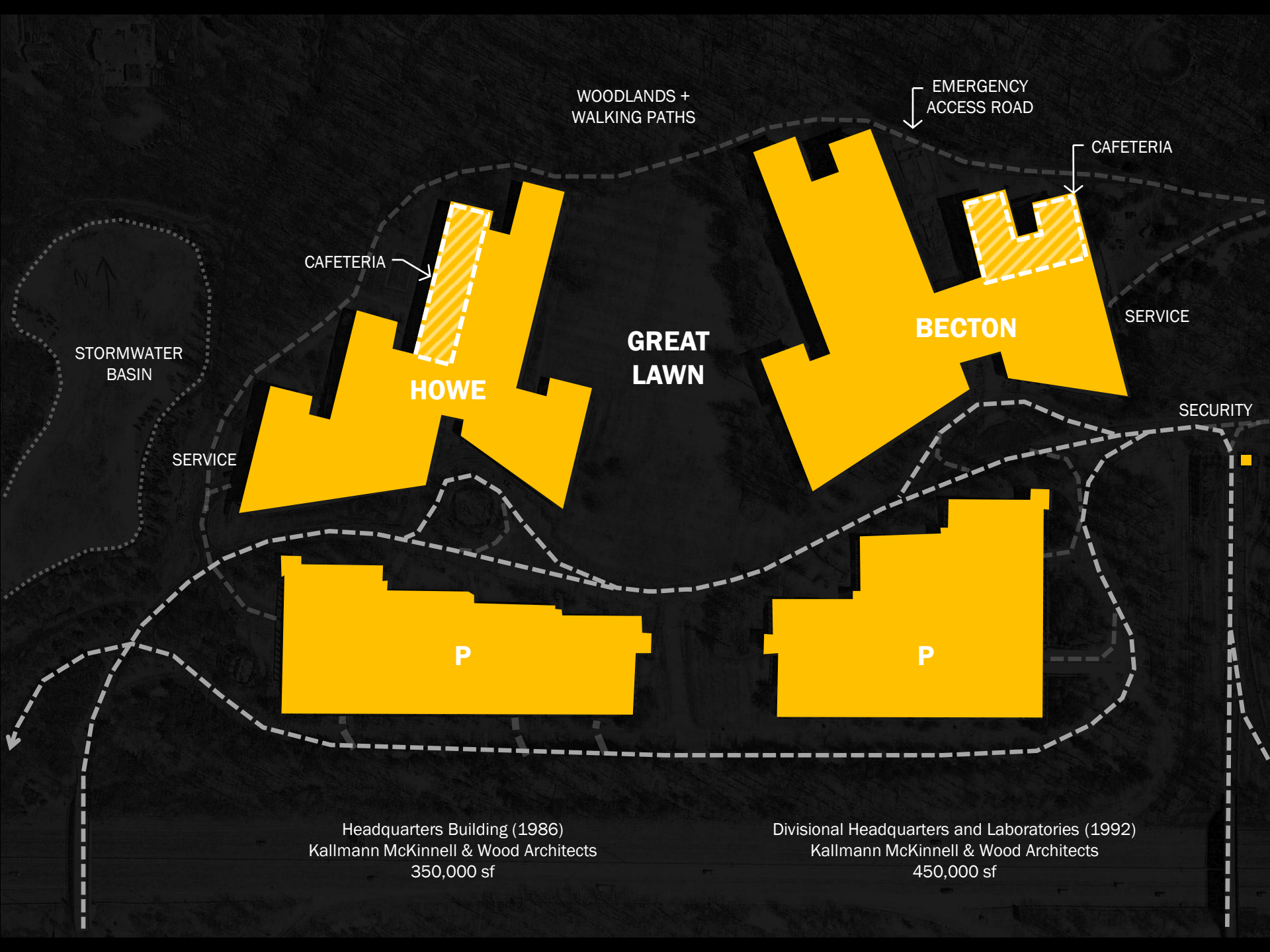
Energy Efficiency

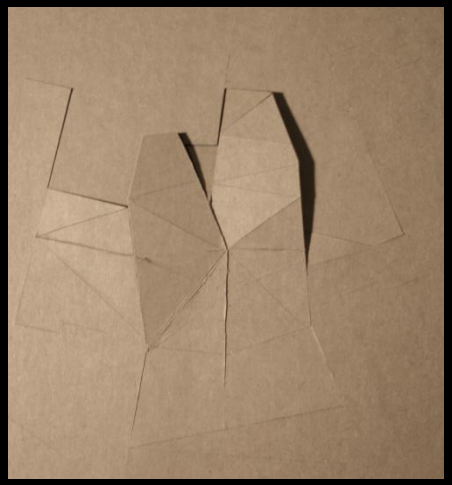
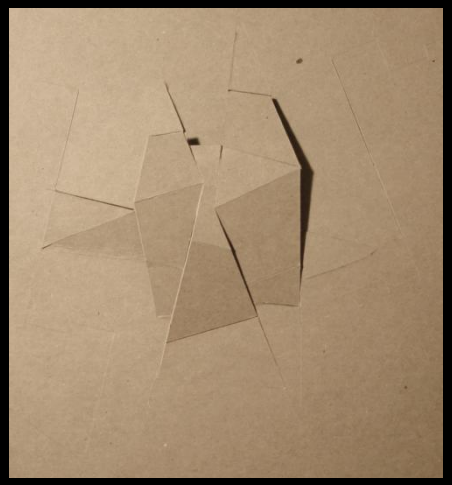
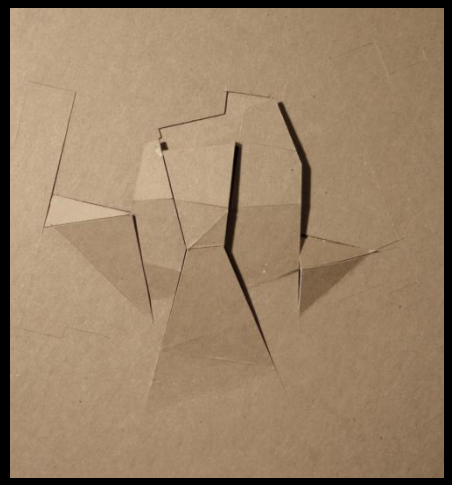
- Increased roof insulation in vegetated roofs can reduce the amount of energy needed to maintain comfort in the building. Roofs are the areas of greatest heat loss in the winter and greatest heat gain in the summer.
- Research published by the National Research Council of Canada found that an extensive vegetated roof reduced the daily energy demand for air conditioning in the summer by over 75% (Liu 2003).

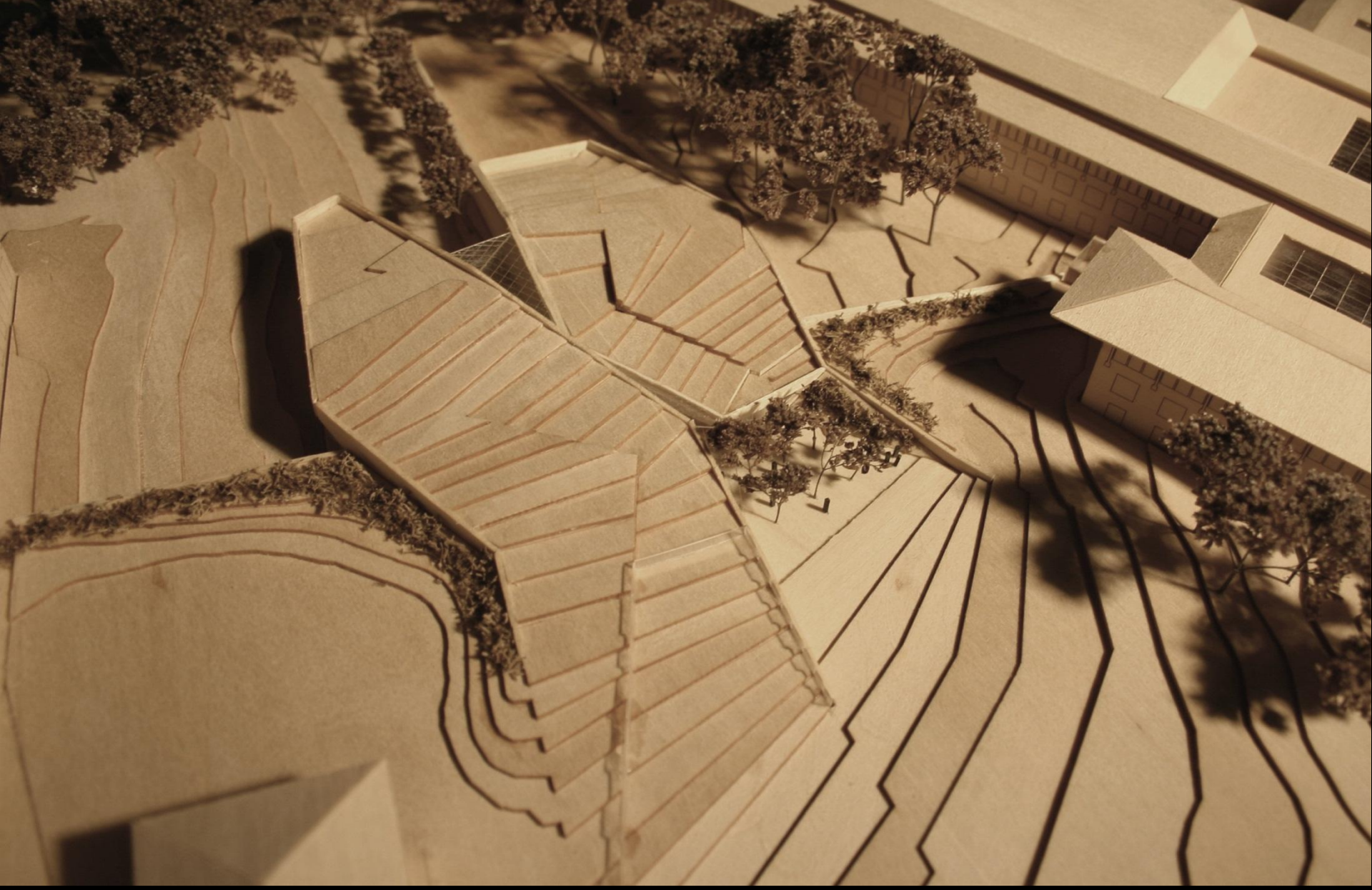
Noise Reduction

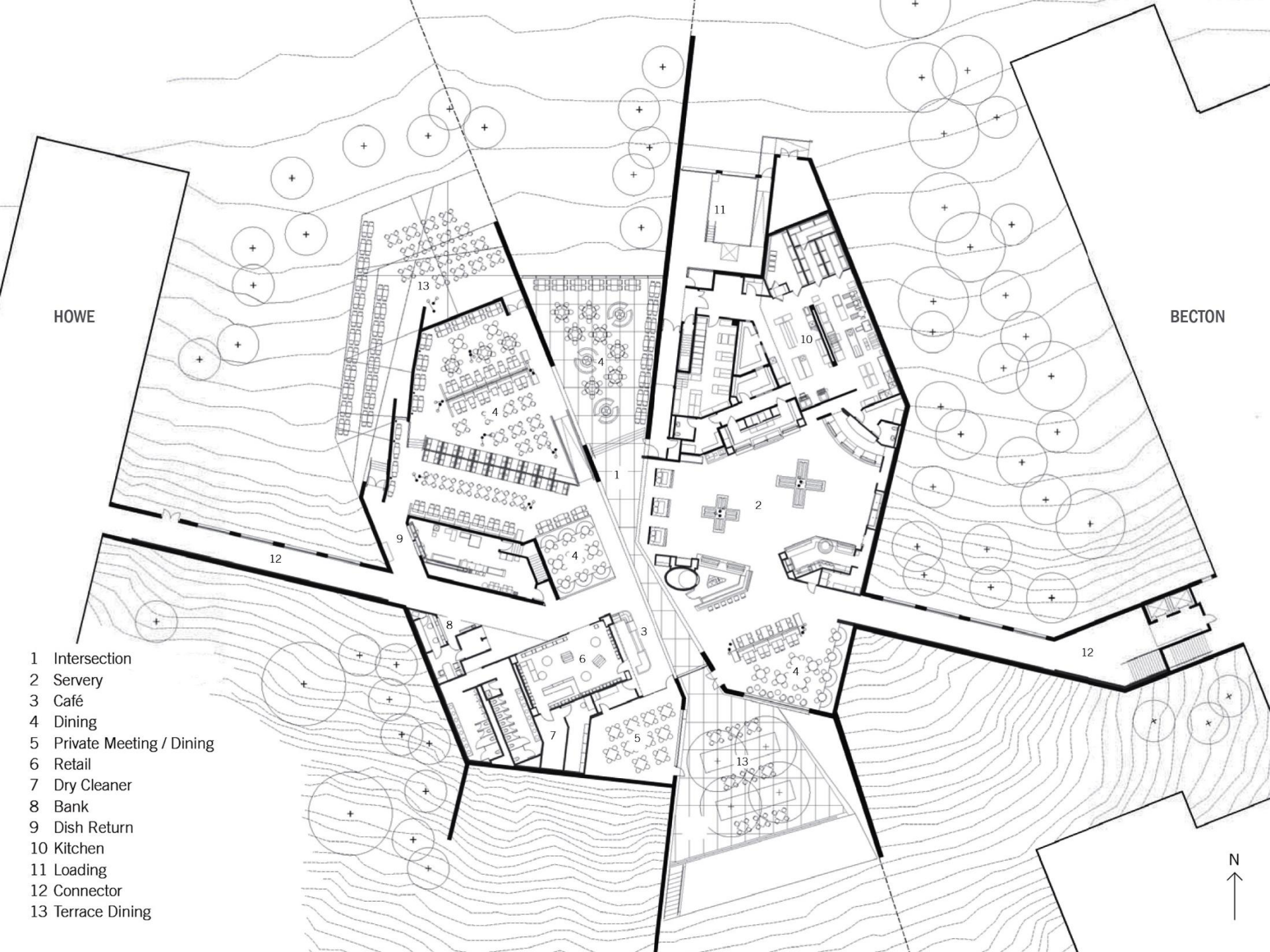
- Vegetated roofs can provide excellent noise attenuation, especially for low frequency sounds.
- An extensive vegetated roof (less than 6” growing media) can reduce sound from outside by 40 decibels, while an intensive vegetated roof (6” or more of growing media) can reduce sound by 46-50 decibels (Peck et al. 1999).

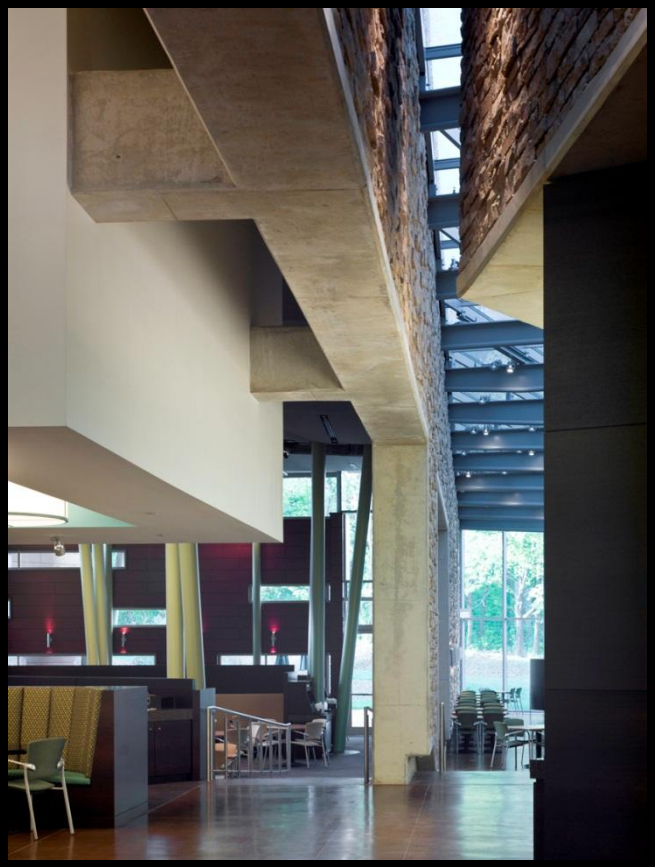
Source: Green Roofs for Healthy Cities - North America Inc., http://www.greenroofs.org/index.php/about/greenroofbenefits


WOODLANDS +
WALKING PATHS
EMERGENCY
ACCESS ROAD
CAFETERIA
CAFETERIA
STORMWATER
BASIN
HOWE
GREAT
LAWN
BECTON
SERVICE
SECURITY
SERVICE
P
P
Headquarters Building (1986)
Kallmann McKinnell & Wood Architects
350,000 sf
Divisional Headquarters and Laboratories (1992)
Kallmann McKinnell & Wood Architects
450,000 sf

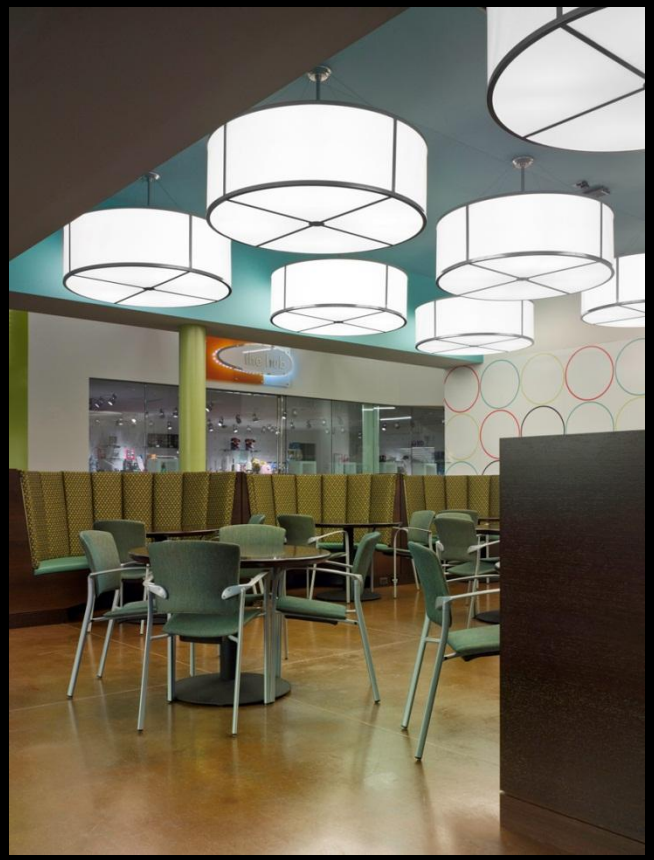




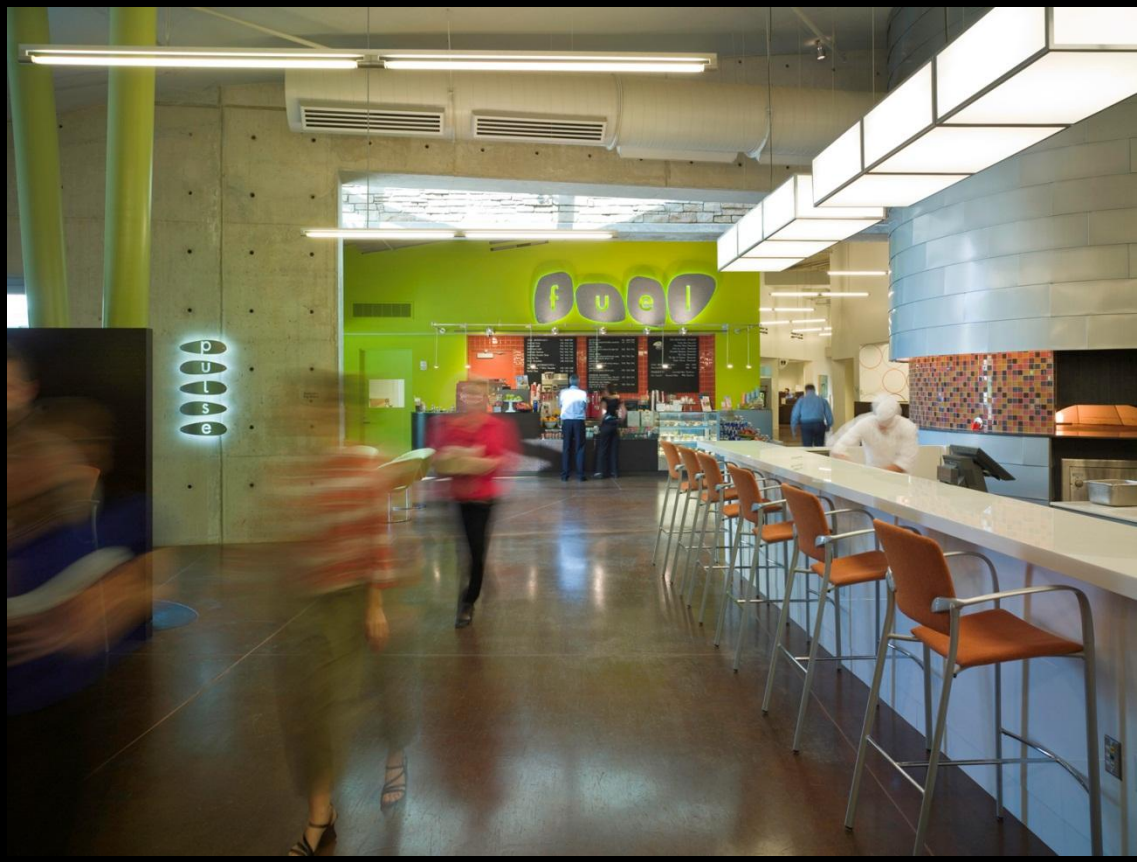

HOWE
BECTON
1 Intersection
2 Servery
3 Café
4 Dining
5 Private Meeting / Dining
6 Retail
7 Dry Cleaner
8 Bank
9 Dish Return
10 Kitchen
11 Loading
12 Connector
13 Terrace Dining
N




food




the hub


fuel
pulse

ABOUT THE VEGETATED ROOF AT THE BD CAMPUS CENTER

Structure of Vegetated Roof:

- Fine growing media (6 inches; 15.24 cm) over granular mineral drainage media (6 inches; 15.24 cm).
- Root-permeable separation fabric separates the growth media from the granular media and keeps the growing media fines from mixing with the granular media.

Water Management:

- Roof drains and pitches are shaped to pond water inside the lower layer.
- Water accumulates to 1 to 3 inches (2.5 to 8 cm) in depth.
- During the growing season, a constant water level is maintained by automated valves.
- Retained rain or irrigation water in this lower granular layer performs just as a perched water table does in nature.
- The upper granular layer (above the water storage layer) facilitates drainage.
- Irrigation is provided by a highly efficient base flood system that introduces water at the root level, an approach that minimizes water loss due to evaporation and promotes deep root development.


Secondary Membrane
Separation Fabric
Board Insulation (4 inches; 10.16 cm)
Fabric-faced Drainage Panel
(3/8 inches; 0.95 cm)
Waterproofing Membrane

PROJECT DATA

Client: Becton Dickinson

Design Team: Hillier Architecture + Roofmeadow (vegetated roof)

Design: 2004-2006

Construction: 2006-2008

Building Area: 3577 m^2 / 38,500 ft^2

ADDITIONAL TECHNOLOGIES

WATER, WASTE + ENERGY

NEWater

The 3rd National Tap

Use Each Drop of Water More Than Once

A Singapore success story and the pillar of Singapore's water sustainability, NEWater is high-grade reclaimed water. It is produced from treated used water that is further purified using advanced membrane technologies and ultra-violet disinfection, making it ultra-clean and safe to drink.

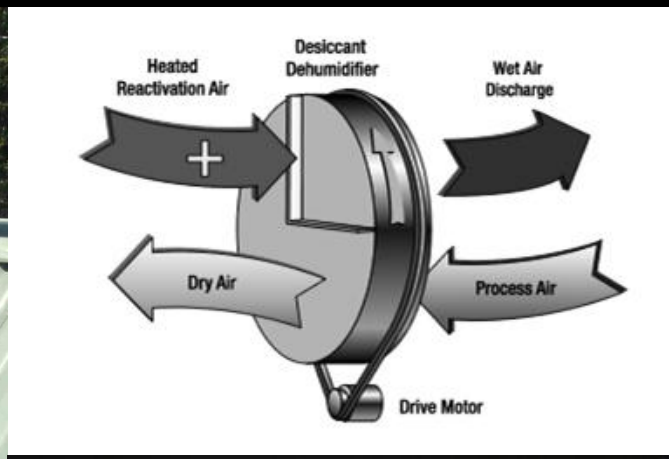
Developed by PUB after three decades, NEWater has passed more than 130,000 scientific tests and surpasses World Health Organisation requirements, a testimony of its high quality and reliability.

NEWater is proof that using today's water treatment technologies, water of any quality can be treated into drinking water. It has put Singapore on the world map for innovative water management, including winning for PUB the Stockholm Industry Water Award in 2007.

The first NEWater plants were opened in Bedok and Kranji in 2003. The latest and largest NEWater plant at Changi with a capacity of 50mgd was opened in May 2010. Currently, NEWater meets up to 30% of the nation's current water needs. By 2060, we plan to triple the current NEWater capacity so that NEWater can meet up to 55% of our future water demand.

http://www.pub.gov.sg/water/newater/Pages/default.aspx

SOLAR DEHUMIDIFICATION: REGENERATIVE SOLID DESICCANT SYSTEMS



Apricus evacuated tube collector, diagram of desiccant wheel, white silica gel (desiccant)

EMERGENT TECHNOLOGIES

RETHINKING WATER, WASTE + ENERGY

SANITARY SYSTEMS + ENERGY GENERATION: REINVENT THE TOILET

PRESS ROOM

PRESS RELEASES AND STATEMENTS

← BACK

Print

Gates Foundation Awards Grants to Develop Urine Powered Fuel Cells, Waterless Toilets and Solar Steam Sterilizers

SEATTLE (December 19, 2013) — The Bill & Melinda Gates Foundation today announced Phase II winners as part of its Grand Challenges Explorations (GCE) initiative focused on water, sanitation and hygiene, including one grant to do further research on microbial fuel cells which could power cellphones with urine.

Bill & Melinda Gates Foundation
206-709-3400
media@gatesfoundation.org
follow @gatesfoundation

"Today, 2.5 billion people practice open defecation or lack adequate toilet facilities so we are always looking for new ways to ensure that less human waste winds up in the environment, untreated," said Brian Arbogast, director of the Water, Sanitation & Hygiene team at the Bill & Melinda Gates Foundation. "Innovations don't need to be complicated or expensive in order to be impactful which is why we are so excited about the range of approaches these projects represent."

http://www.gatesfoundation.org/Media-Center/Press-Releases/2013/12/Gates-Foundation-Awards-Grants-to-Waterless-Toilets
Microbial Fuel Cells: http://www.gizmag.com/urine-microbial-fuel-cell-electricity/36444/

SANITARY SYSTEMS: REINVENT WASTEWATER TREATMENT

From Poop to Potable

This Ingenious Machine Turns Feces Into Drinking Water

By Bill Gates | January 5, 2015

I watched the piles of feces go up the conveyer belt and drop into a large bin. They made their way through the machine, getting boiled and treated. A few minutes later I took a long taste of the end result: a glass of delicious drinking water.

http://www.gatesnotes.com/Development/Omniprocessor-From-Poop-to-Potable

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PERCEPTIONS

"For the majority, the environment is perceived to be healthy for reasons unrelated to sanitation. Most cite the absence of disease or sickness. Many believe their environment Is healthy because it provides fresh air, good air, good climate, or accessibility. In crowded, concentrated settlements, a healthy environment is viewed as one that allows for privacy and is characterized by good relations with one's neighbors.

"It is significant that all of the reasons cited above are indicators verifiable by observation within the respondent's immediate surroundings. A healthy environment is not associated with abstract theories on disease vectors or with contamination through contact with nonvisible pathogens in water or waste." [1]

"Most believe water quality is good if the water looks clean." [2]

Source:
1. Elmendorf, Mary and Patricia Buckles. "Appropriate Technology for Water Supply and Sanitation: Sociocultural Aspects of Water Supply and Excreta Disposal." Washington DC: World Bank, 1980, 37.
2. Ibid, 38.