Urban Design that functions like a forest

Generating value using Governed & Engineered Ecology

Canadian Urban Forestry Conference
Wm. Patrick Lucey, Sr. Aquatic Ecologist
Aqua-Tex Scientific Consulting Ltd.
September, 2014

Life without oxygen,
but no life without water

The history (future) of the world is written not in ink but in water

青 山 常 在 , 綠 水 長 流 (Chinese Proverb)


Can we fix this?
Do we have a choice?

Our Current Perspective Dates to 500 BC

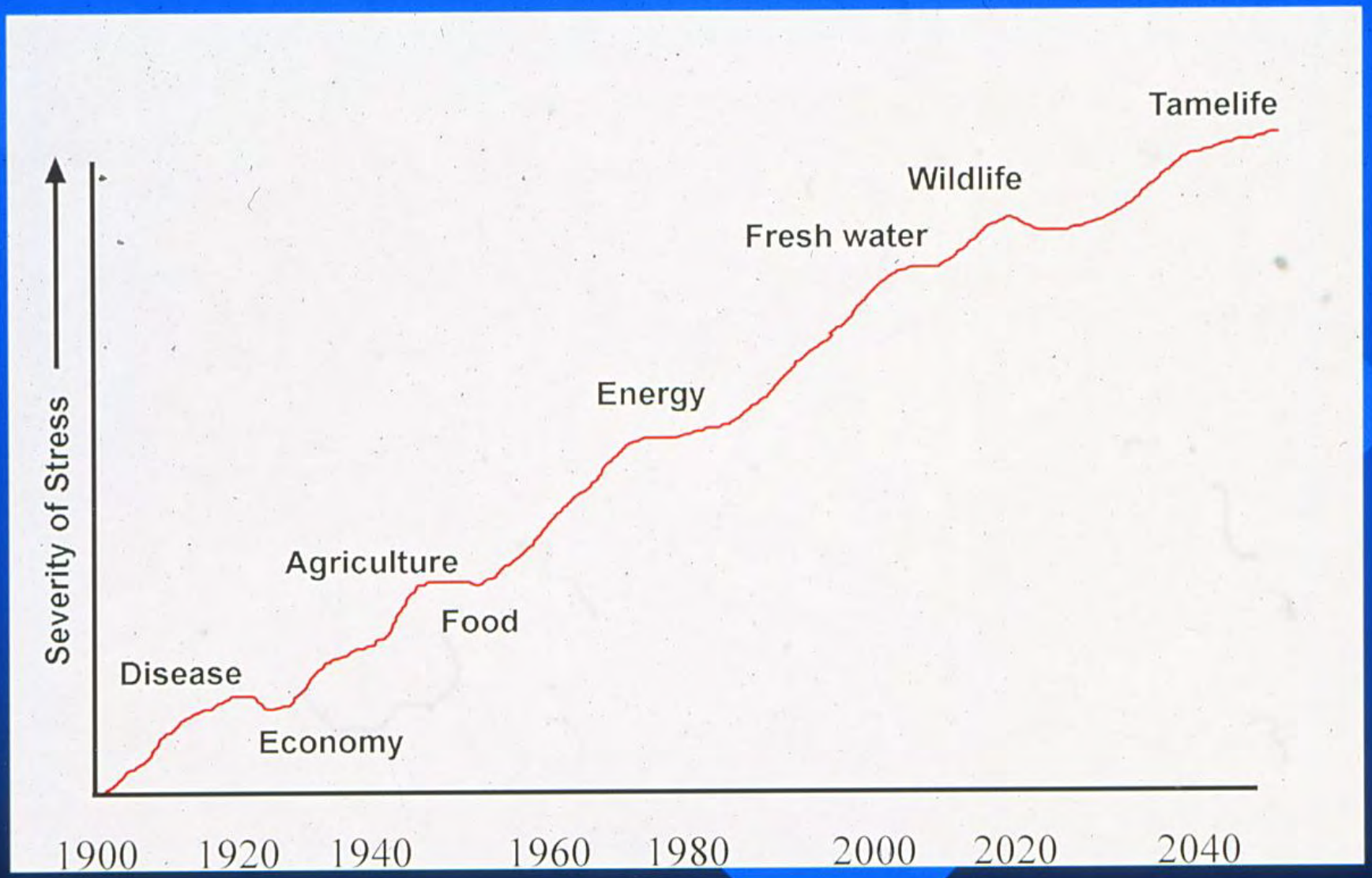
The Roman Goddess of the sewers, *Cloacina,* carried wastes to the river - so began our modern perspective on waste management – *"solution to pollution is dilution"*.

"Problems can not be solved at the same level of awareness that created them." Einstein

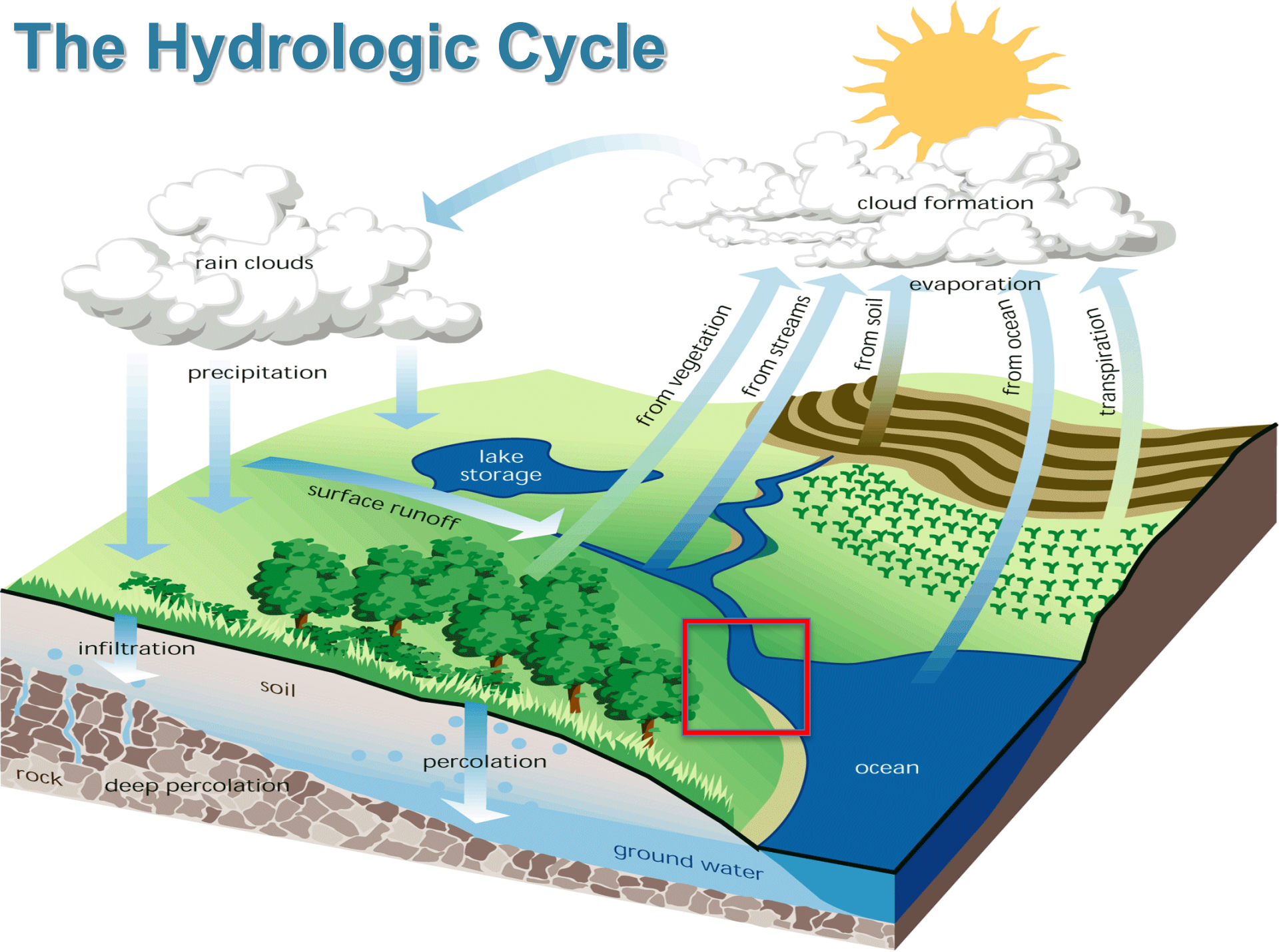
Ed Clerico, P.E., Natural Systems Utilities, 2 Clerico Lane Hillsborough, NJ 08844

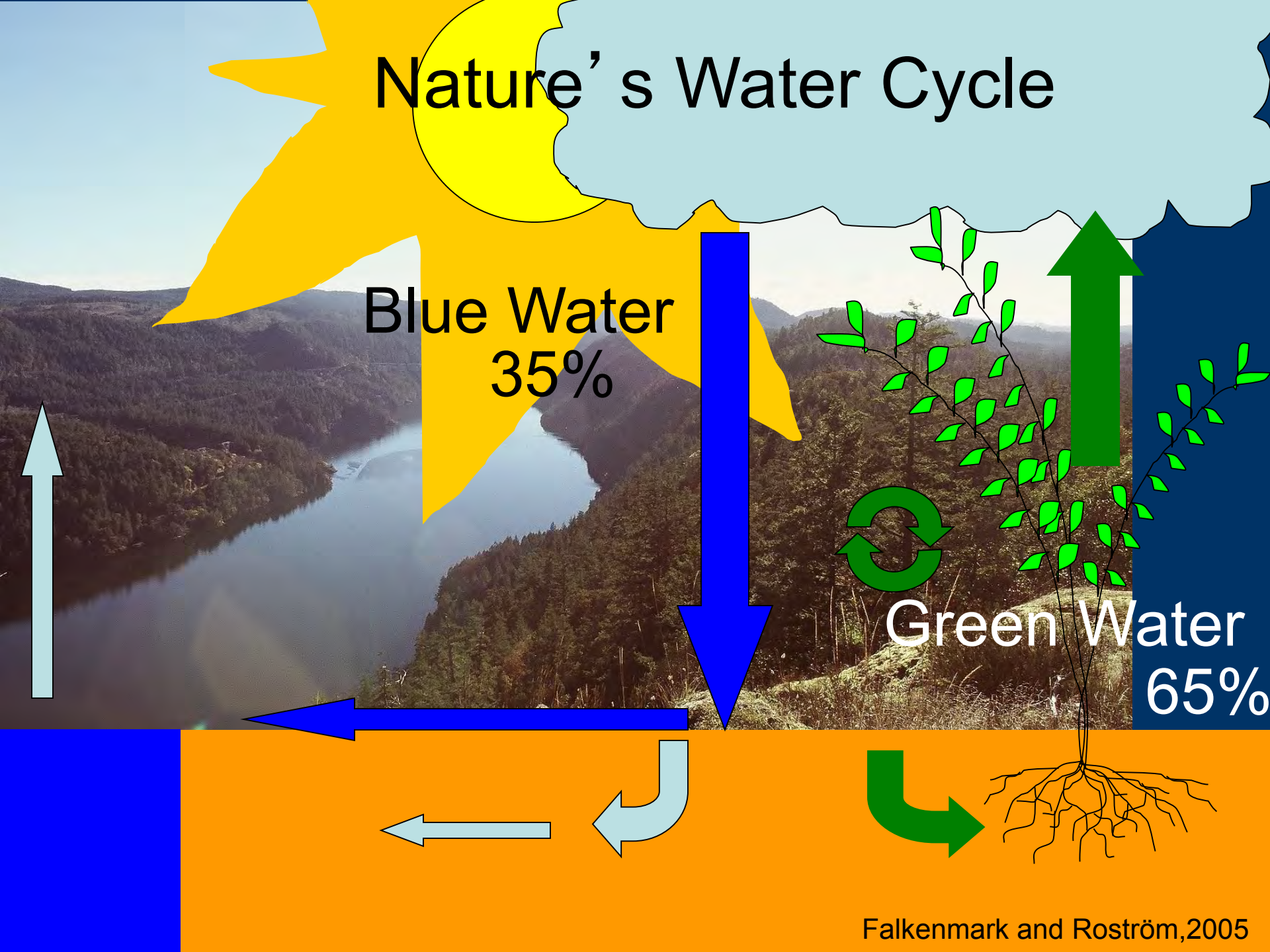

1900 = 1 bn
1910
HOFFET'S BEST
VANCOUVER FROM THE LEE BLOCK
COR BROADWAY AND MAIN


2014 = 7 bn
2045 = 9 bn
1,000 new Vancouver's!!!
2010


Severity of Stress
Disease
Economy
Agriculture
Food
Energy
Fresh water
Wildlife
Tamelife
1900
1920
1940
1960
1980
2000
2020
2040

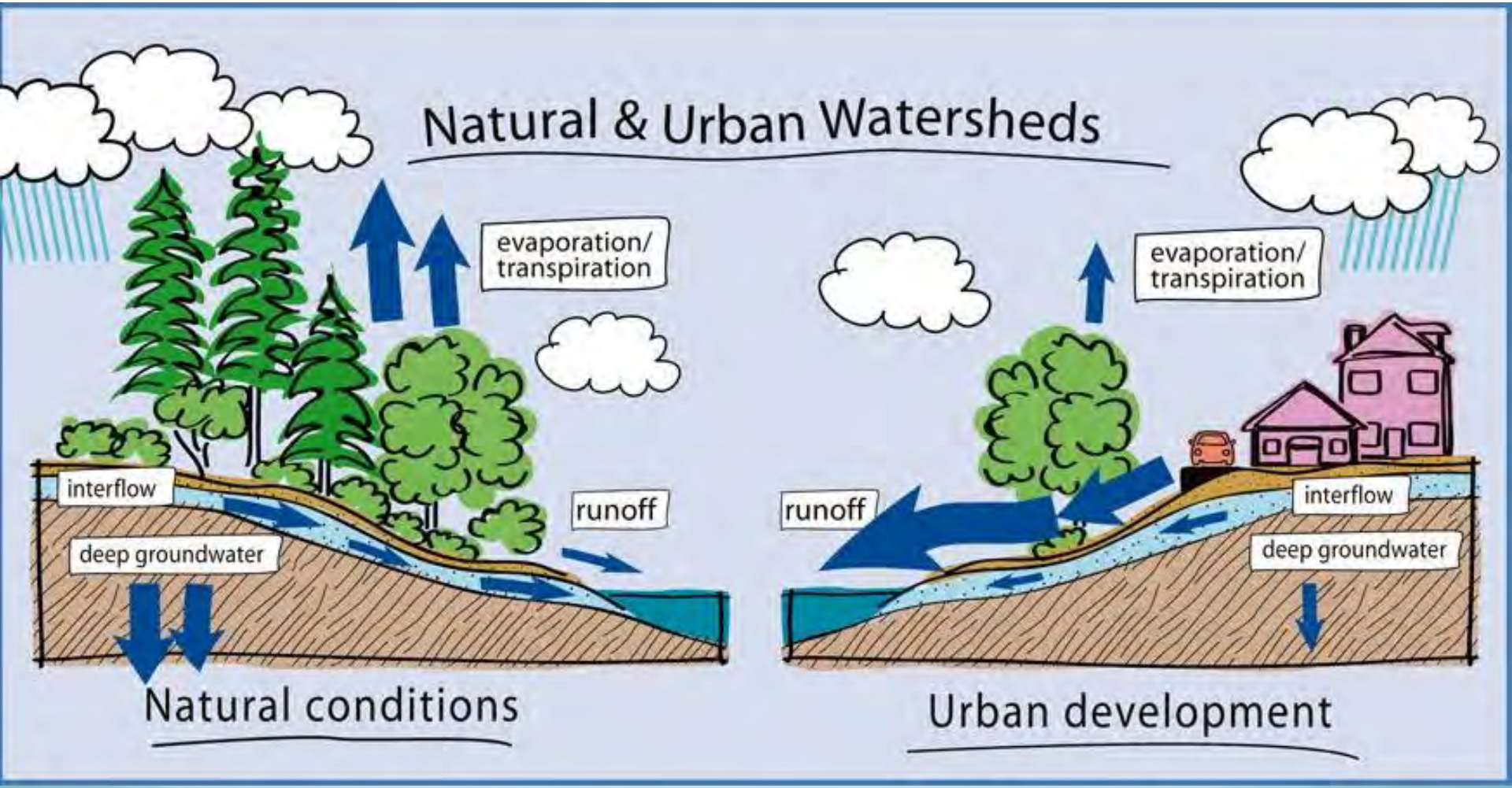
The Hydrologic Cycle

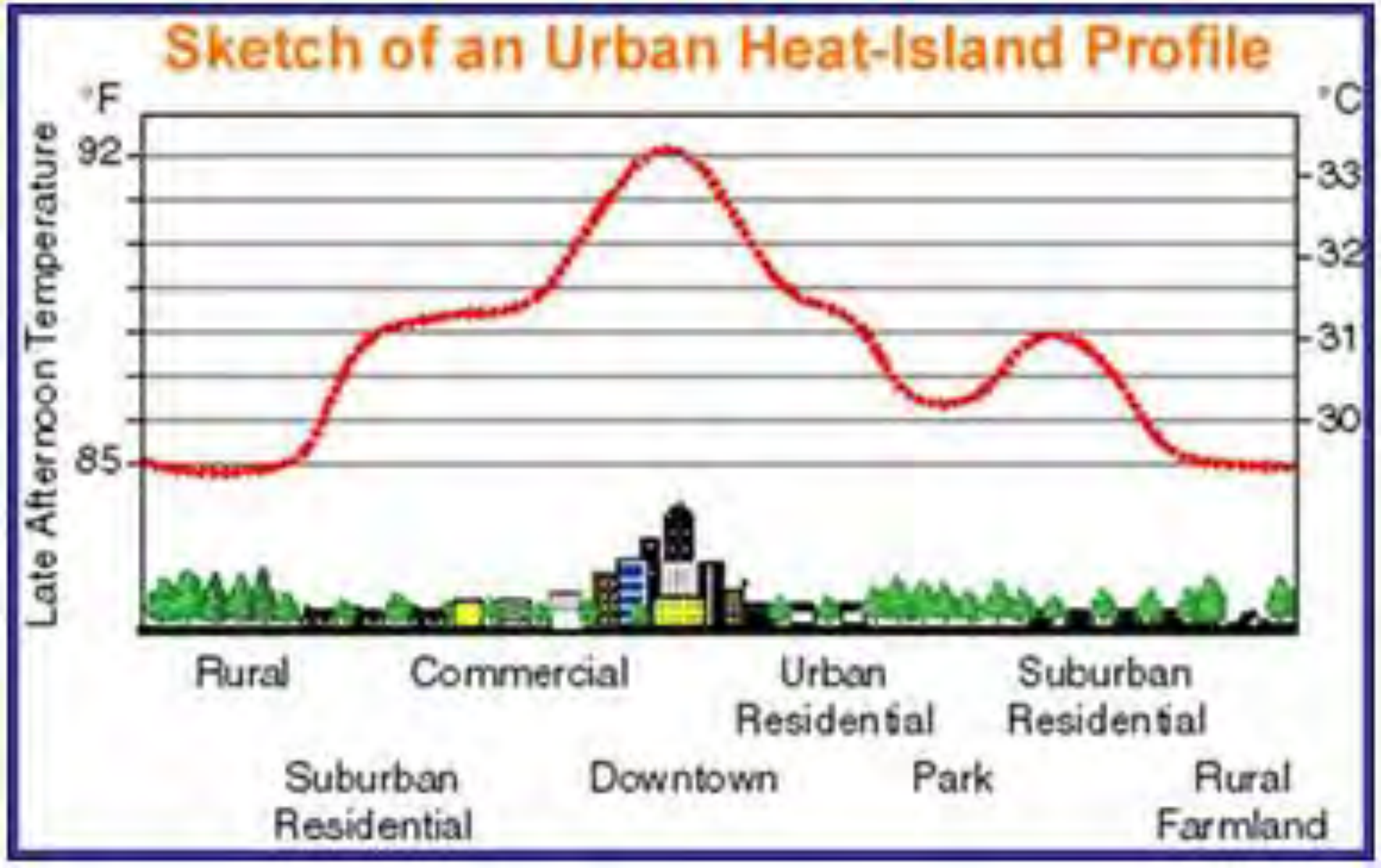




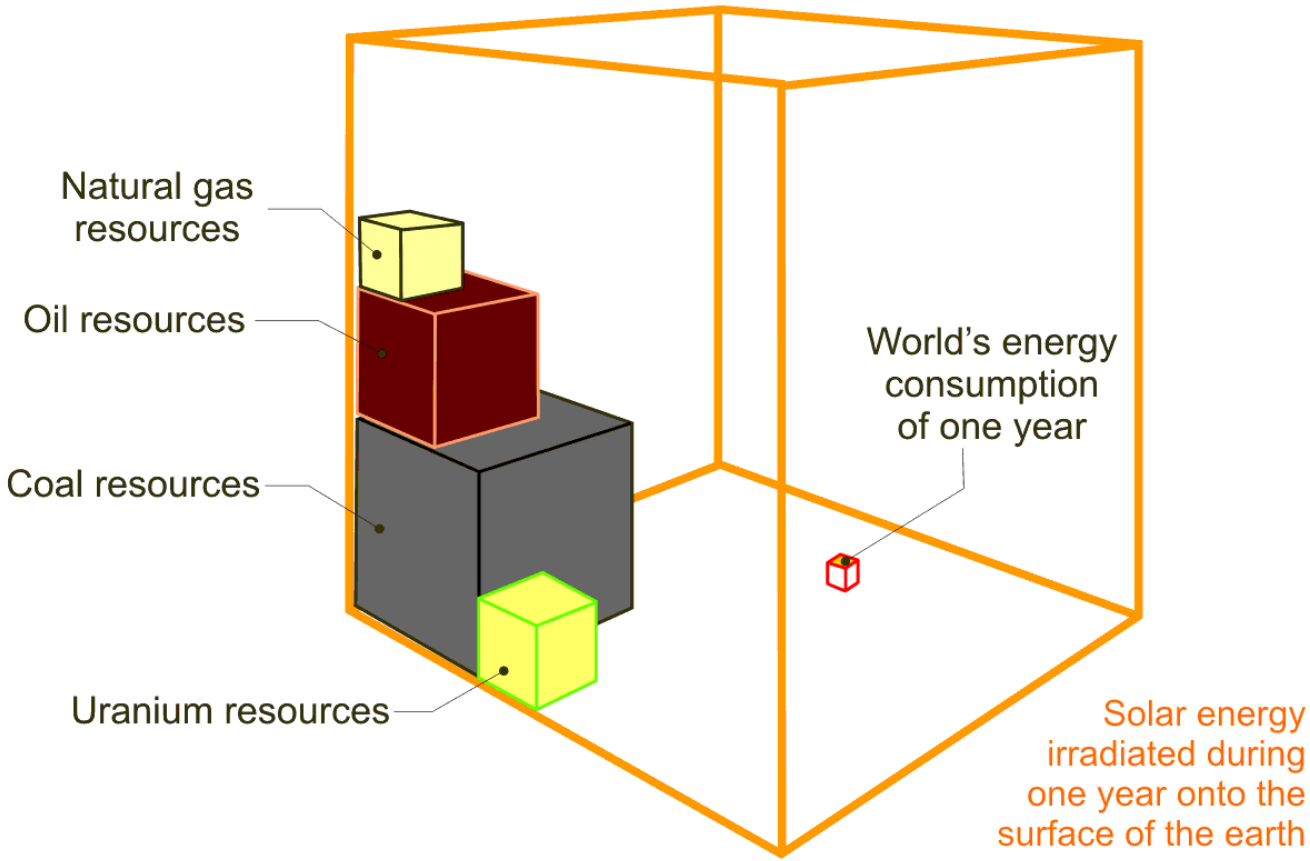
Falkenmark and Rosström,2005

Altered Hydrological Cycle



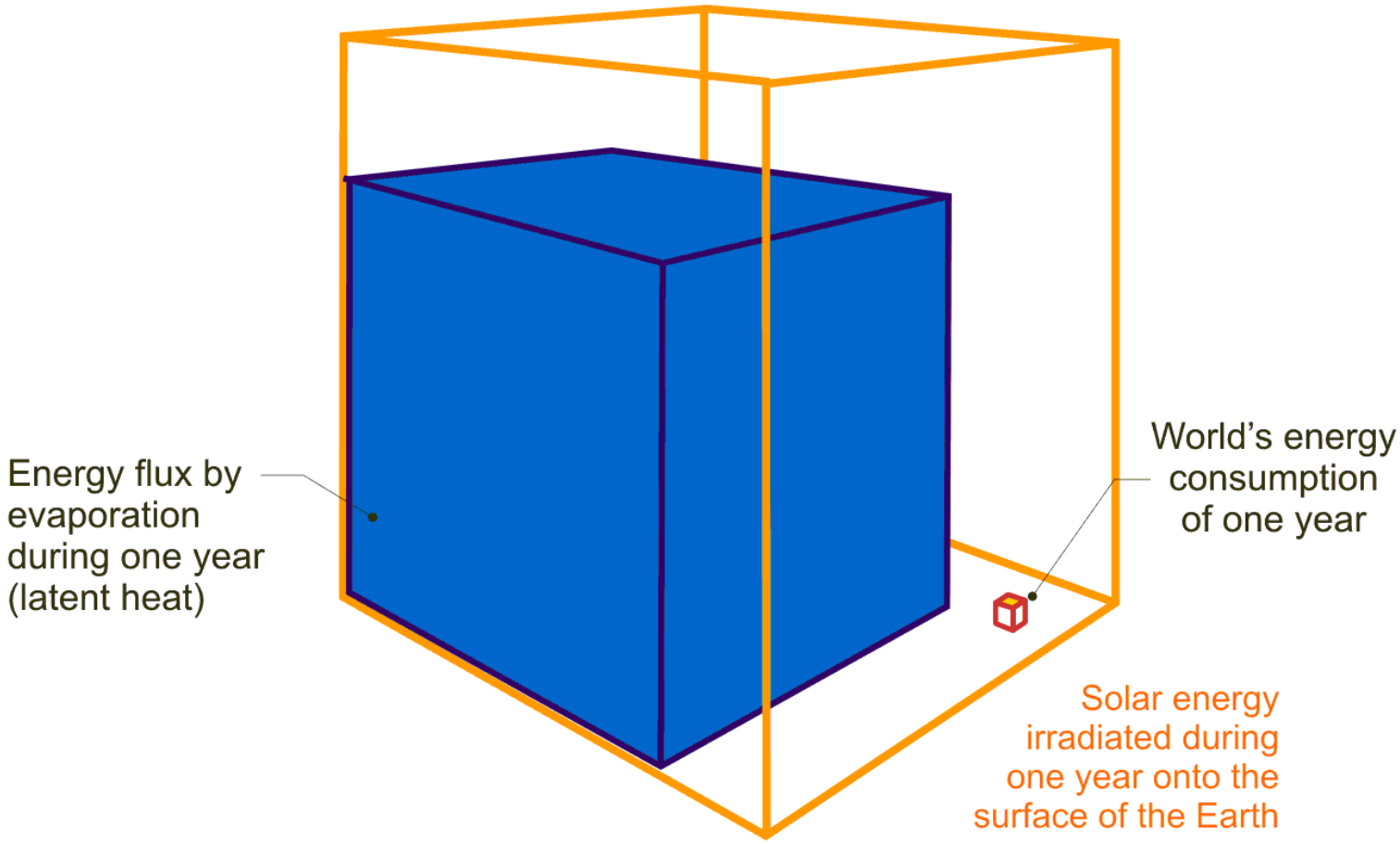

Sketch of an Urban Heat-Island Profile
°F
92
85
°C
33
32
31
30
Late Afternoon Temperature
Rural
Suburban Residential
Commercial
Downtown
Urban Residential
Park
Suburban Residential
Rural Farmland

World‘s Energy Consumption



after Greenpeace / S. Krauter 2006

Global Radiation in Relation of Evaporation (Latent Heat Flux)

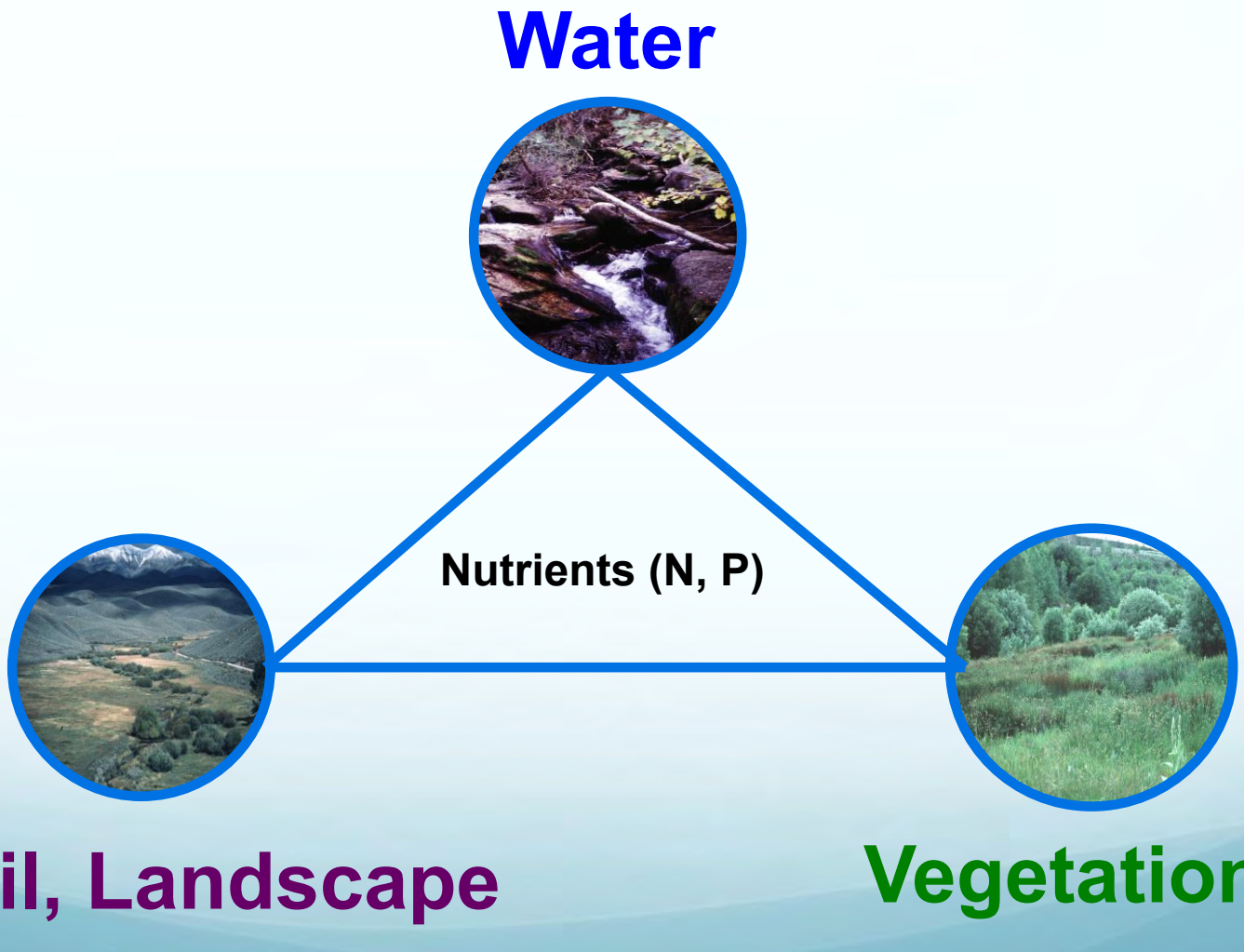


after Greenpeace / S. Krauter 2006

Keep water on the land longer

Capture, Store, Beneficial Use

Natural Riparian Resources



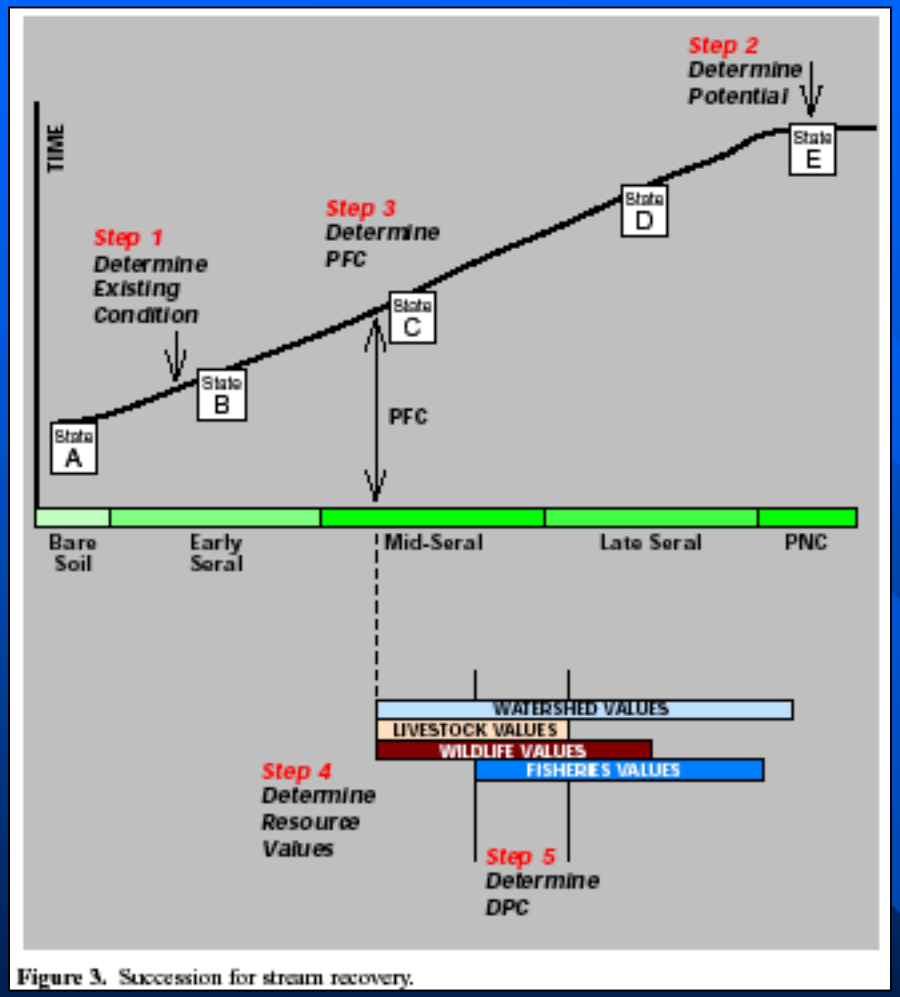


Figure 3. Succession for stream recovery.

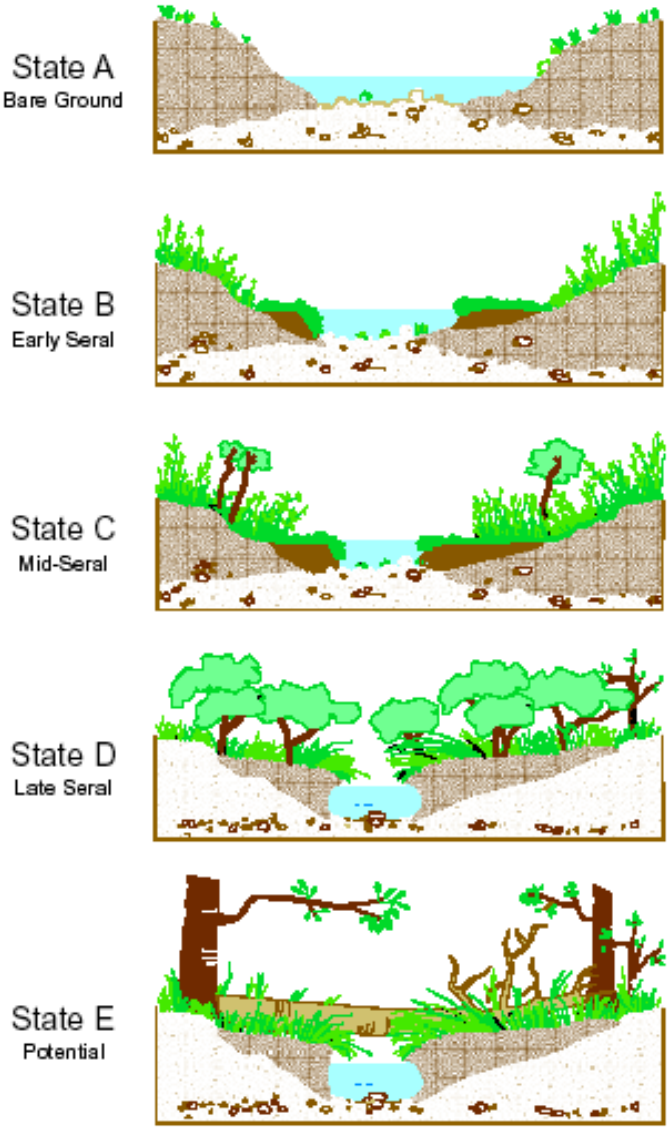


Figure 4. Stream cross sections.

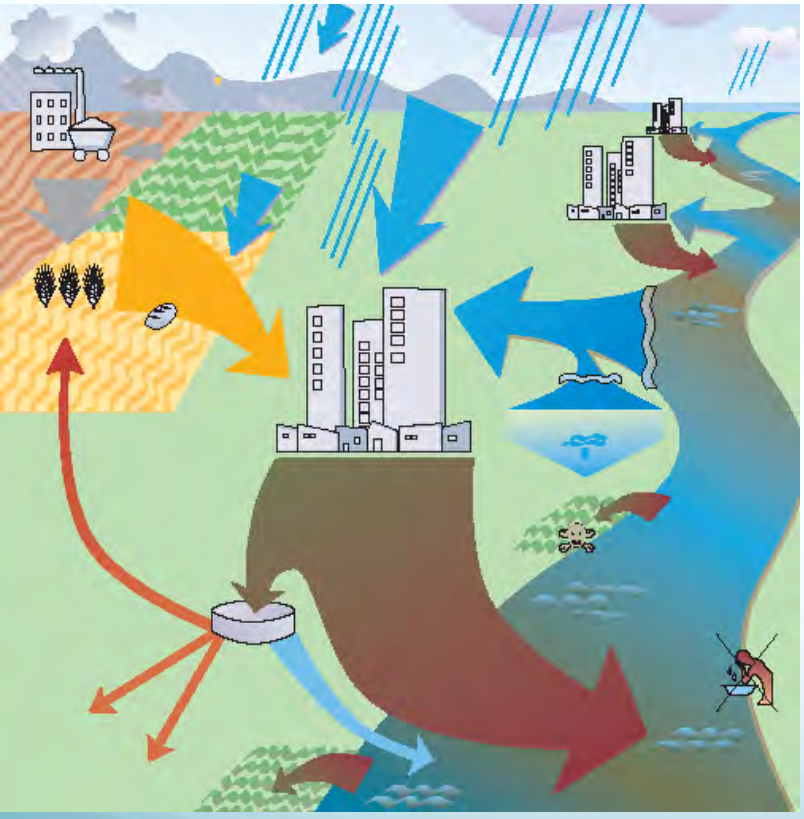
From: TR 1737-15, Riparian Area Management; USDI BLM, USDA FS, USDA NRCS, 1998

21st Century Challenge

Water + Energy + Natural Capital =
Adaptation to a Changing Climate +
Nutritional Self-Sufficiency

We need a cultural shift

Current: use resources once & dispose of it (tax payer costs)



Open linear system

Integrated Resource Recovery (tax payer revenues)

Closed loop system

Dr. Nicholas Ashbolt, EPA
http://www.ecosanservices.org

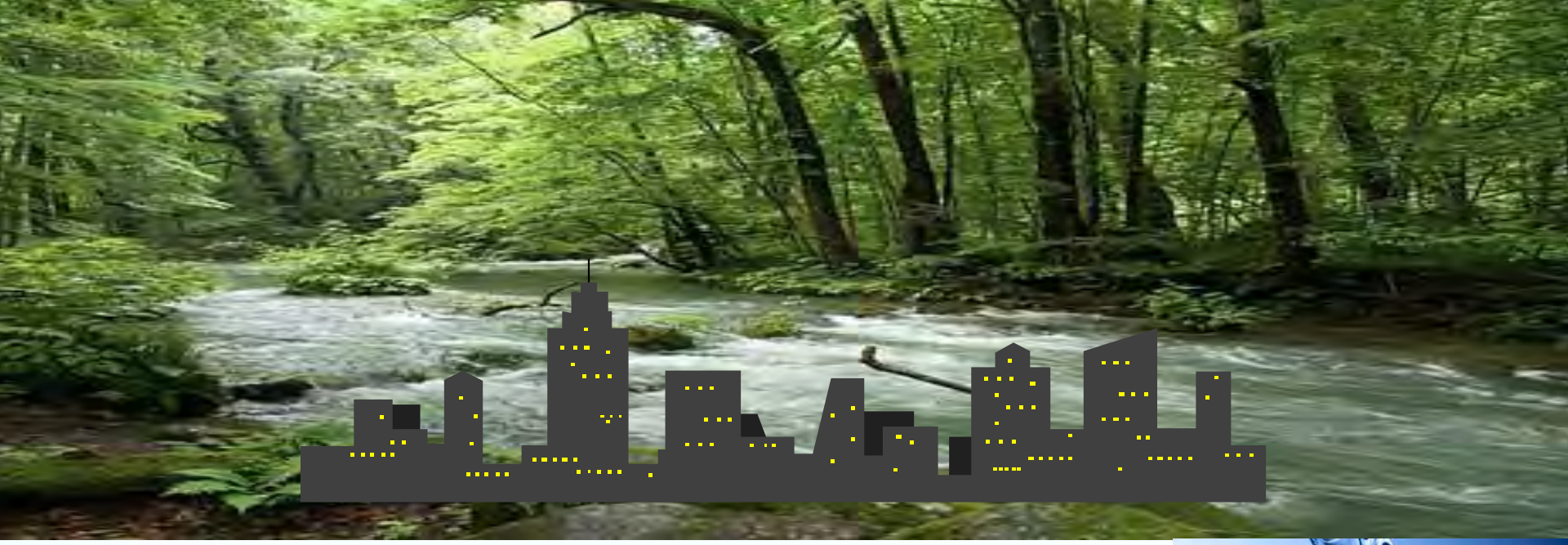

Q –can ecosystem services (Natural Capital) be valued in a free market economy?
[Bruce Sampson, VP of BC Hydro; World Business Council on Sustainable Development]

Valuing Nature's Infrastructure

Conventional
(Engineering)

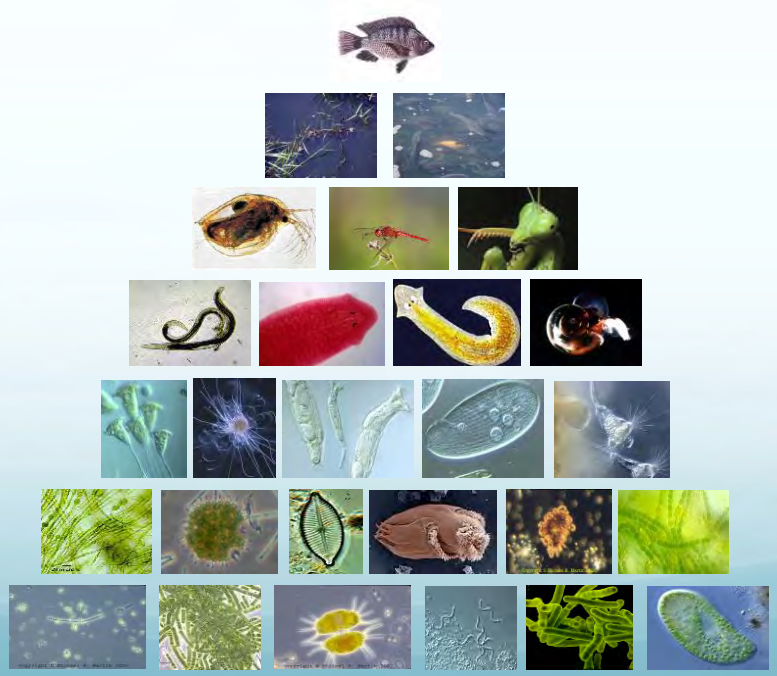
"Green"
(Environmental
Engineering)

Ecological Approach
(Governed & Engineered
Ecology™)
Resource Recovery



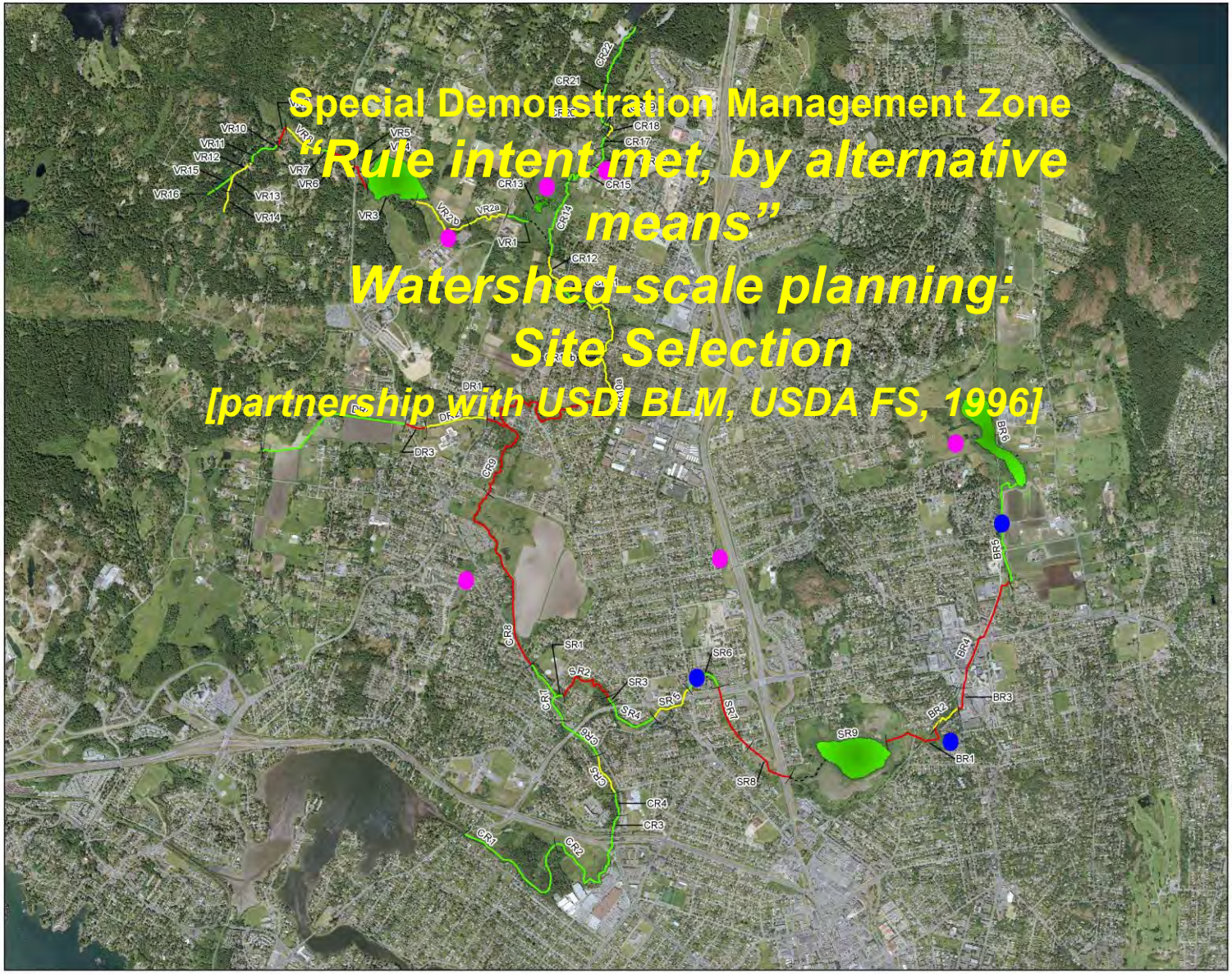
Integrated Resource Management

Balance development on ecological stability



When we focus on the foundation we expand the capability of the values

Accelerating Cooperative Riparian Restoration and Management: Proper Functioning Condition and Watershed Health The Colquitz River Watershed

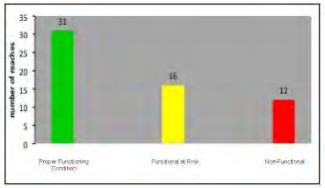


Assessed Lentic Condition

- Proper Functioning Condition
- Functional at Risk

Assessed Lotic Condition

- Proper Functioning Condition
- Functional at Risk
- Nonfunctional
- Not Rated
- Reach Break



Proper Functioning Condition (PFC) is both a state of health and an assessment tool for riparian-wetland areas developed jointly by the U.S. Bureau of Land Management, the U.S. Forest Service and the Natural Resources Conservation Service. The PFC assessment provides a consistent approach for assessing the physical functioning of riparian-wetland areas through consideration of hydrology, vegetation, and soil/landform attributes. It synthesizes information that is foundational to determining the overall health of a riparian-wetland area.

The Colquitz River is a third order stream found within the boundaries of the District of Saanich in Victoria British Colombia. Flowing for a length of approximately 9.5 km from its headwaters in Elk/Beaver Lake south to its outlet at Portage Inlet, it passes through areas of forest, agriculture, and increasingly urban regions. The Colquitz River watershed drains an area of approximately 46 km2, collecting water from the Bhenkiesop, Swan Lake, Viaduct, and Durrell sub-watersheds.

The purpose of this map is to identify the overall health and functionality of lentic (still water bodies) and lotic (actively moving water) systems within the Colquitz River watershed. The result is a framework that aids in identifying areas in need of restoration and protection on a reach by reach basis.

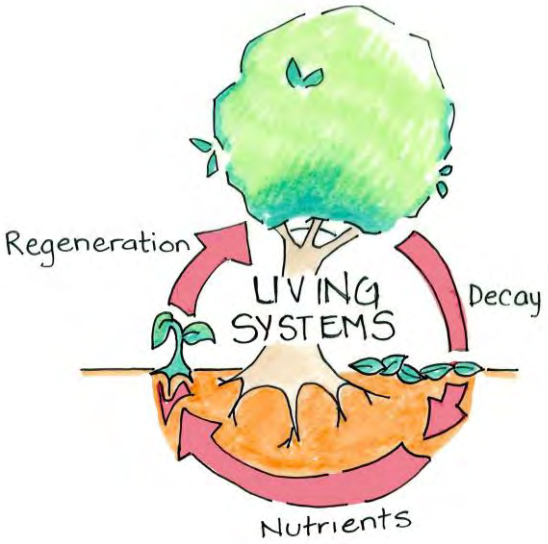
Funding Provided by:

Map Produced by: Stuart Barker

Aqua-Tex Scientific Consulting Ltd. (1993)

0 750 1,500 3,000
Meters

Scaling Up

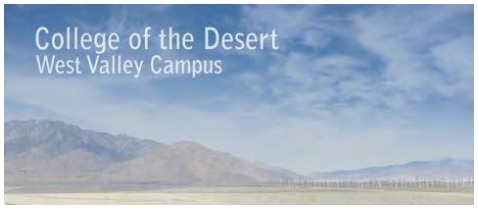


Education

City

Neighbourhood

Site



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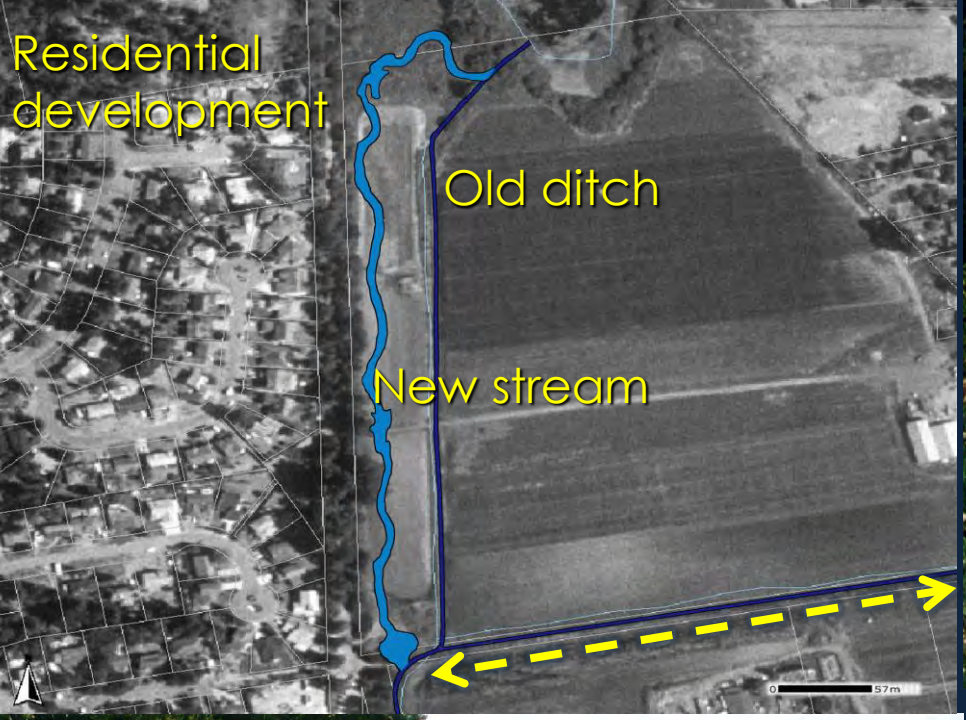


August 2000

August 2001

May 2010

Blenkinsop Valley: Green Valuation

Galey Farm Financial Summary
(PV= present value; red text =negative)

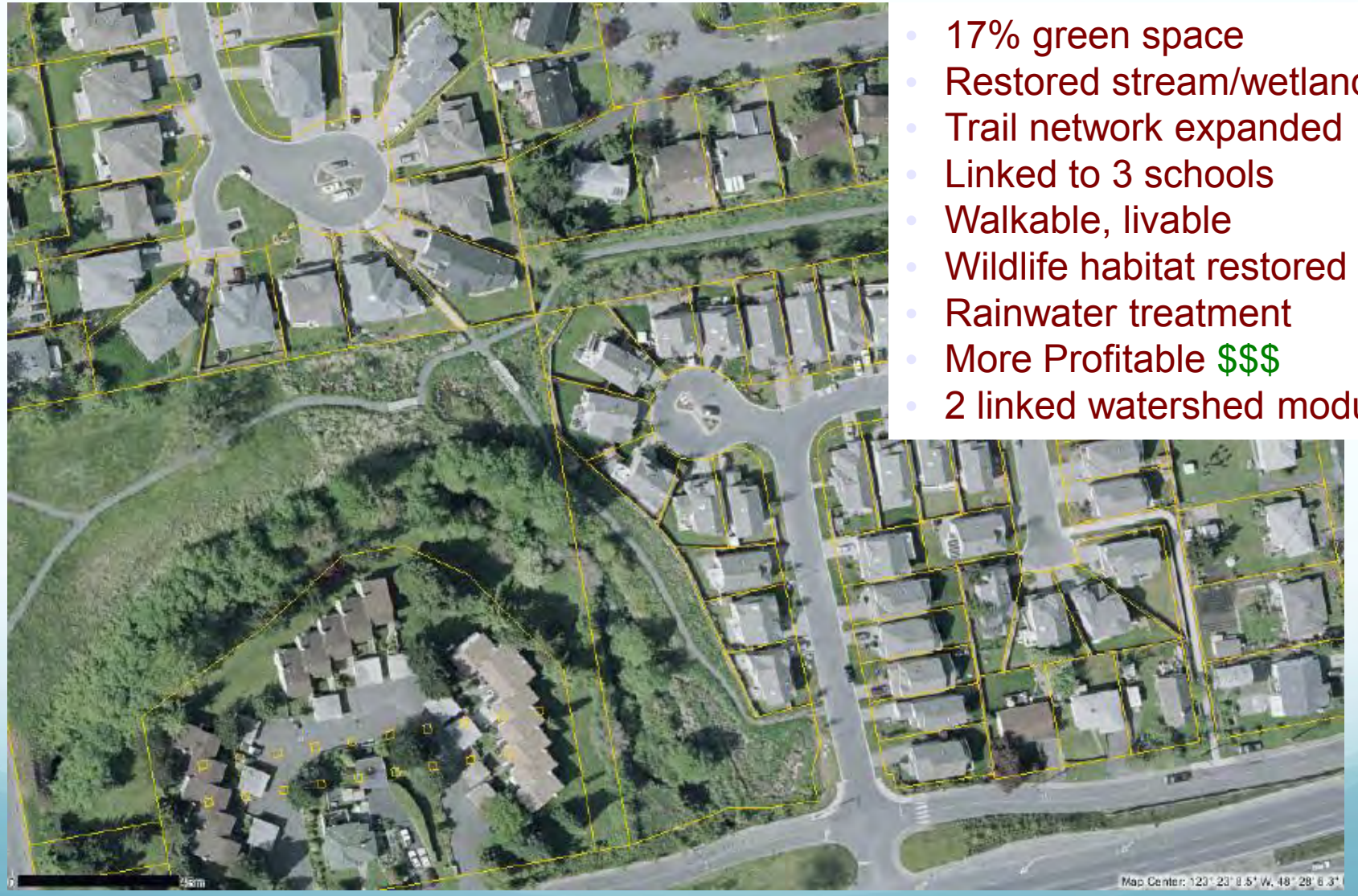
Blenkinsop (Traditional)	Municipality	Farmer
Installation of Ditch		($5,200.00)
PV of Ditch O&M		($6,631.69)
PV of Vandalism		($1,409,394.46)
Total Present Value	**$0.00**	**($1,421,226.14)**

Blenkinsop (Sustainable)	Municipality	Farmer
Cost of Restoration		($375,000.00)
Cost of Connector Trail	($500,000.00)	
PV of the Cost of Financing		($26,607.17)
PV of Pesticide Savings (adjusted for the cost of integrated pest management)		$497,657.18
Increased Value of the Land		$75,000.00
PV of Potable Water Savings		$8,548.33
PV of Flood Cost Avoidance to the Municipality	$765,484.59	
PV of Ecological Benefit	$12,006.19	
PV of Value of Carbon Stored and Sequestered	$496.13	
PV of Trail Connector Benefit	$3,302,784.65	
Total Present Value	**$3,580,771.55**	**$179,598.34**

	Municipality	Farmer
Net BENEFIT	**$3,580,771.55**	**$1,600,824.48**


Engineered Ecology™ - Urban In-fill Subdivision
1999
2006
2010

Willowbrook: the benefits



- 17% green space
- Restored stream/wetland
- Trail network expanded
- Linked to 3 schools
- Walkable, livable
- Wildlife habitat restored
- Rainwater treatment
- More Profitable $$$
- 2 linked watershed modules

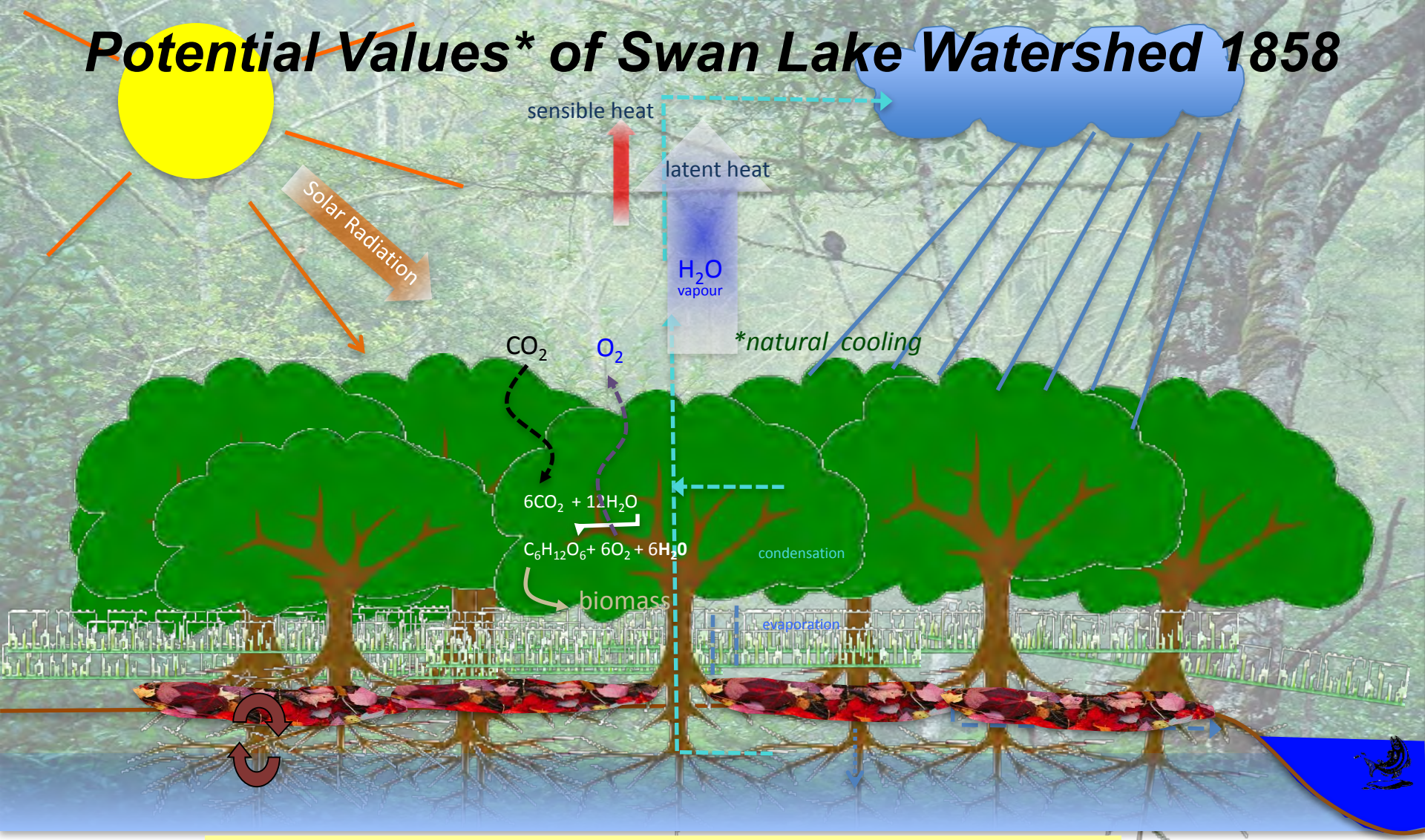
Nature's Revenue Streams (NRS): Willowbrook Subdivision

Willowbrook/Glanford (Traditional)	**Municipality**	**Developer**
Cost of the Traditional Stormwater System		($260,000.00)
PV of Ditch Maintenance	($7,651.95)	
PV of Costs for Future Capital Replacement of Stormwater Infrastructure	($9,908.03)	
Total Present Value	($17,559.97)	($260,000.00)

Willowbrook/Glanford (Sustainable)	**Municipality**	**Developer**
Cost of Restoration		($120,000.00)
Increased Lot Yield		$825,000.00
PV of Wetland Maintenance	($4,057.28)	
PV of Educational Value	$34,344.83	
PV of Ecological Benefit	$12,470.09	
PV of Value of Carbon Stored	$515.30	
Total Present Value	$43,272.94	$705,000.00

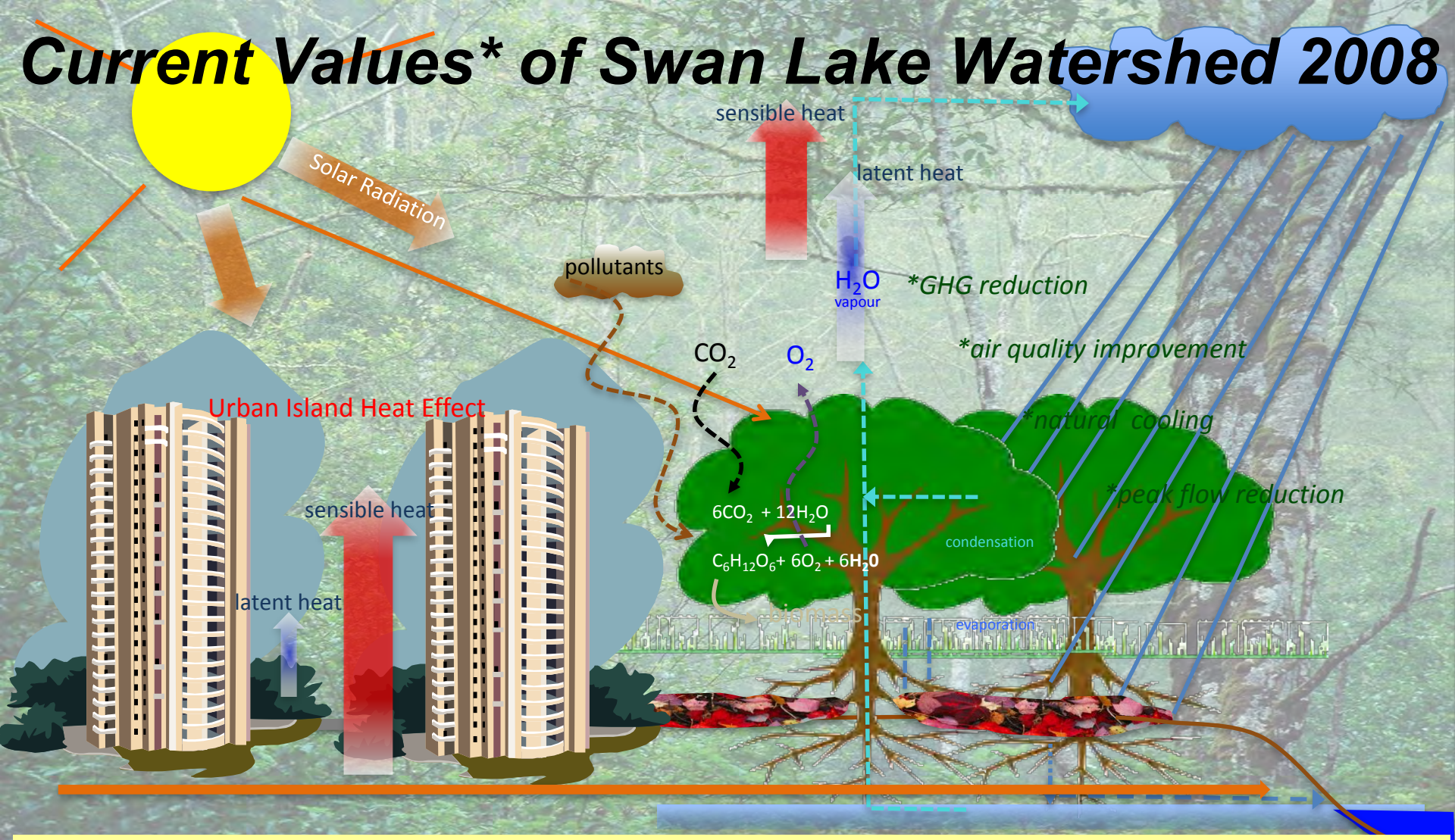
Net BENEFIT	**$60,832.91**	**$965,000.00**

Potential Values* of Swan Lake Watershed 1858



Benefit	1858
Carbon Stored (tonnes)	105,964
Carbon Sequestered (tonnes per year)	825
Evapotranspiration/Cooling Effect: Number of Air Conditioners - Equiv.	458,653
Pollution Abatement	--
Fisheries	- In progress -
Value	**--**

Current Values* of Swan Lake Watershed 2008

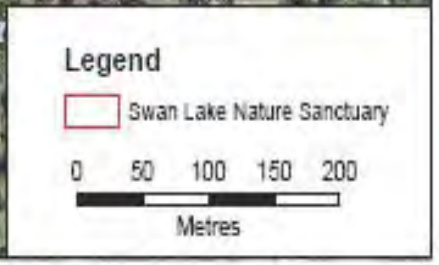


Benefit	2008	Difference (1858-2008)	Value of Lost Services
Carbon Stored (tonnes)	29,565	76,399	$1,610,496
Carbon Sequestered (tonnes per year)	230	595	$12,538
Evapotranspiration/Cooling Effect: Number of Air Conditioners - Equiv.	322,948	135,705	$21,663,918
Pollution Abatement	$589,522	$589,522	--
Fisheries	$-	$$$$	$$$$$
Value	**$52,824,145**		**$23,286,952**

Swan Lake Nature Sanctuary - Overview (48 ha)

Swan Lake Nature Sanctuary	Dollars
Carbon Stored (Tonnes)	1,784 tonnes
Carbon Sequestered (Tonnes)	$3,699
Transpiration (Cooling Effect)	$3,603,578
Pest Control Benefit	$793,634
Air Pollution Abatement Benefit	$313,423
Flood Benefit	$72,740
Stormwater Benefit	$384,694
Wildlife/Trail Benefit	$187,039
Operating and Maintenance Expenses	$(425,000)
Volunteer Time Expense	$(125,000)
Total Annual Net Value	**$4,808,806**

CAMF must include Natural Capital (ecosystem services) Institute "Municipal Ecologist"



Dockside Green: Before (Brownfield)

Dockside Green: After (Concept)
LEED™ Platinum Redevelopment

Regenerative, Adaptive Design


April, 2009


05/31/2009 15:15
May, 2009


June, 2009


August, 2010

Neighbourhood Energy Utility

Rainwater capture

Regenerate marine & terrestrial ecosystem function

Regeneration of Ecosystem Services & Natural Capital


Parcel 10


03/29/2012 13:42


04/18/2010 13:23

City of Cranbrook

SDMZ (1994)

Watershed = expanded infrastructure

Landscape ecology is the curriculum

ES protection – N&P, H_2O resource recovery

City of Colwood – Champion City

Markets for energy & water

Special Demonstration Management Zone – adopt an IRM infrastructure model


Cobble Hill
Wain Rd
Shawnigan Lake
Watershed
Saanich Inlet
McGee Creek
Sub-catchment
Shawnigan Lake
Sooke Lake
Watershed
Leech River
Watershed
1
17A
Island Hwy
Sooke Lake
Malahat
BRITISH
COLUMBIA
GeoBC
Image © 2013 IMTCAN

nd
e shown.

0 0.25 0.5 1 1.5 2
Kilometers

Legend

Watershed Boundary	Reach Break	Farm Ditch

Stream Assessment Condition

- Proper Functioning Condition
- Functional-At Risk
- Nonfunctional

Pond/Wetland Assessment Condition

- Proper Functioning Condition
- Functional-At Risk
- Nonfunctional

Stream temperature can affect development of Chinook salmon. The salmon fry are from the same family, emerged on the same day but were exposed to different temperature treatments (degree days remained the same).

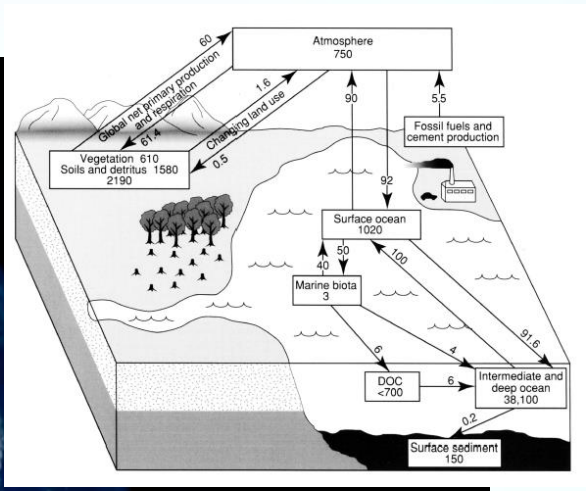
Habitat Banking

Regenerated riparian function

Viable investment model (ROI)

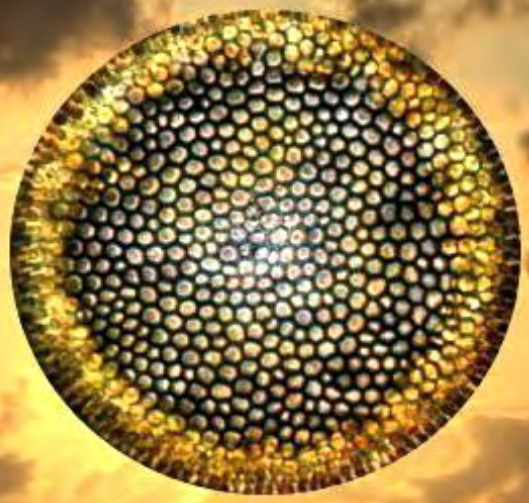
Regulator sanctioned

Lease ecosystem services?



Houston – You have a problem

Depiction of the global carbon cycle
completely ignoring the active role of inland waters and urban forests



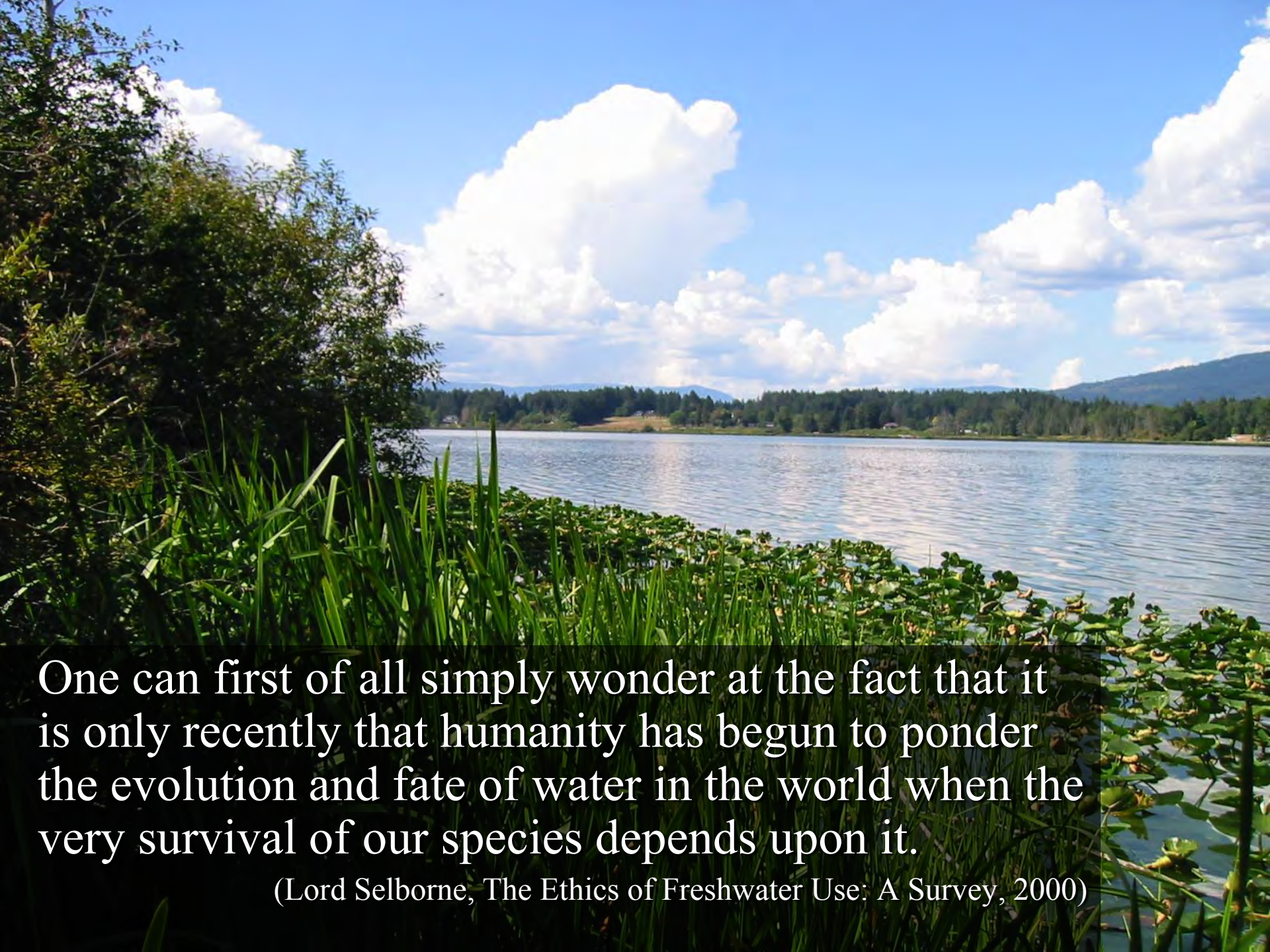
Phytoplankton
Centric diatom
Azpeitia africana

Dimethyl Sulfide Production

O_2

We need a 21st Century Moon-shot

A Regenerative Economy in a *"New Age of Governed & Engineered Ecology"*


One can first of all simply wonder at the fact that it is only recently that humanity has begun to ponder the evolution and fate of water in the world when the very survival of our species depends upon it.
(Lord Selborne, The Ethics of Freshwater Use: A Survey, 2000)

Cities of the Future

Towards integrated sustainable water and landscape management

Edited by Vladimir Novotny and Paul Brown

The Problem is Global

The **Solution** is Local
Champion Communities
Special Demonstration
Management Zones

Consent Decree by EPA – $4-8 bn for traditional WWTP
13 community centers
200,000 popn.