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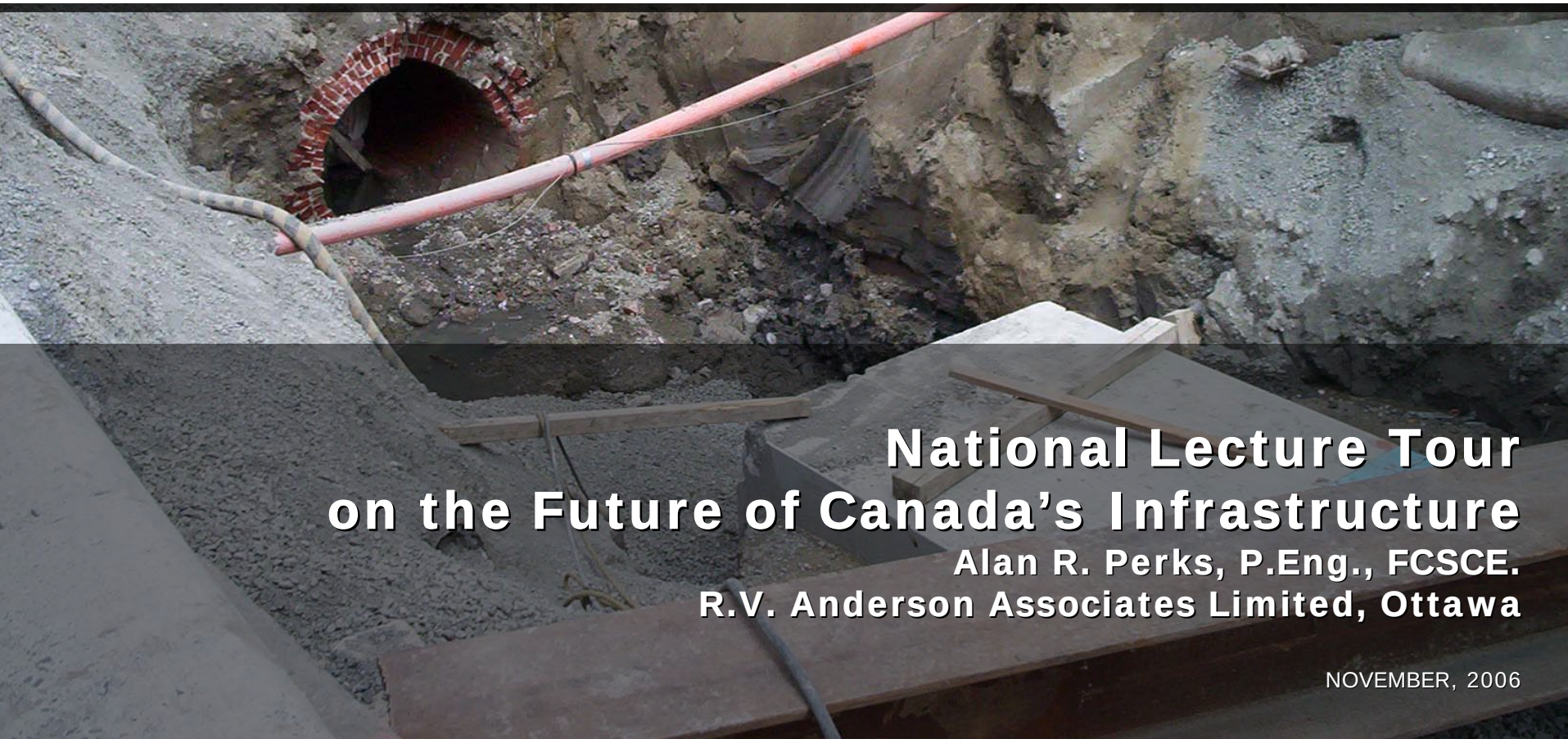
environment · infrastructure

Infrastructure Capacity Building

CURRENT CHALLENGES

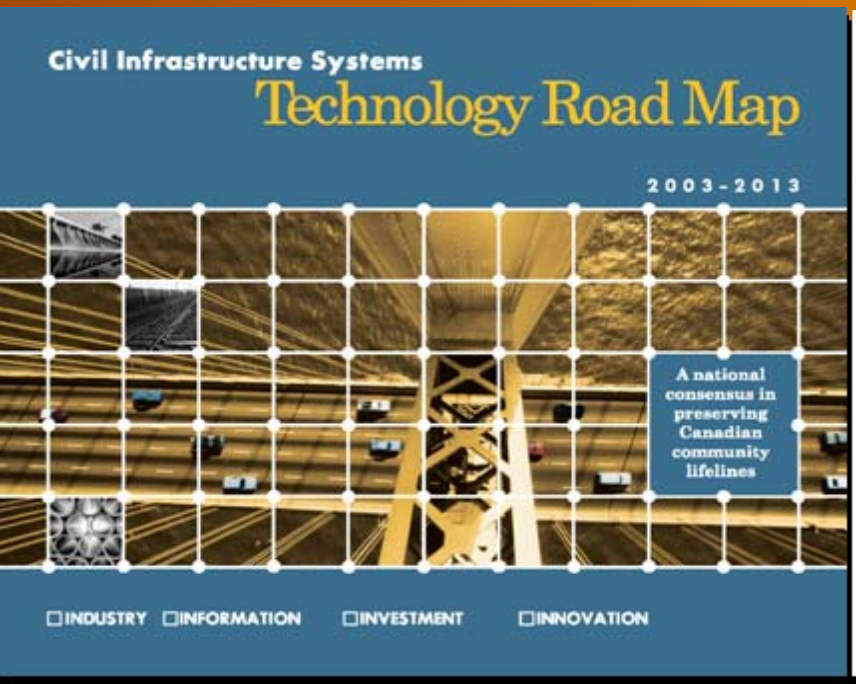


National Lecture Tour on the Future of Canada's Infrastructure

Alan R. Perks, P.Eng., FCSCE.
R.V. Anderson Associates Limited, Ottawa

NOVEMBER, 2006

CANADIAN COUNCIL OF PROFESSIONAL ENGINEERS
CONSEIL CANADIEN DES INGÉNIEURS



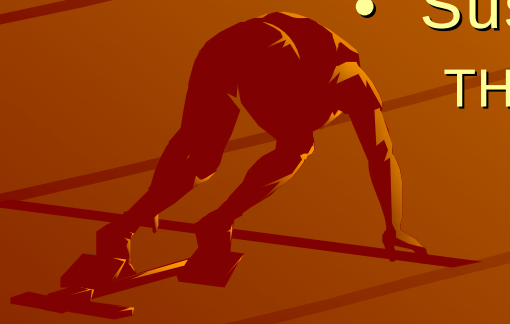
National Guide to Sustainable Municipal Infrastructure - InfraGuide

- Partnership FCM-CNRC (2000)
- Funded by Infrastructure Canada, NRC and in-kind contributions
- A national network of infrastructure experts AND a growing collection of best practices to support decisions and actions for sustainable municipal infrastructure.
- Activities in 6 key areas
  - Municipal roads and sidewalks
  - Potable water
  - Storm and wastewater
  - Decision making and investment planning
  - Environmental protocols
  - Urban transit

See www.infraguide.gc.ca

Capacity building is the key

- The Infrastructure Deficit in Canada
- Global Infrastructure Needs
- Sustainable Development
  - THE TRIPLE BOTTOM LINE
    - ✓Social
    - ✓Economic
    - ✓Ecological








The Infrastructure Deficit

Caused by Deferred Maintenance & Deterioration

INSUFFICIENT ANNUAL INVESTMENT TO KEEP UP WITH DETERIORATION




- **In 1992 …estimated at $20 billion**
- **In 2002 …estimated at $57 billion**
- **By 2027 … more than <u>$110 billion</u>**

Can we maintain performance standards?

Can we maintain performance standards ?

THE INNARDS

THE DIGESTER

Infrastructure (asset) management is a simple model

CORPORATE ASSETS

DATA → DECISION → ACTION

Information about Capital assets (condition, capacity, etc)

Evaluation of O&M, repair, upgrading & replacement needs

O&M $$$

Capital $$$

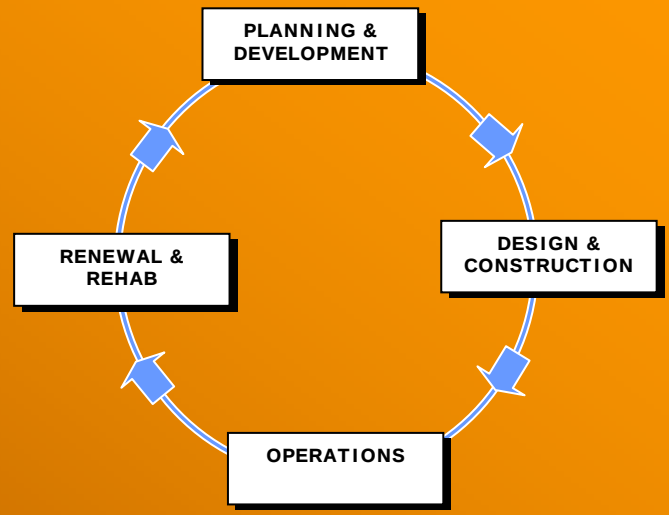
Reserves $$$

CORPORATE RESPONSIBILITY

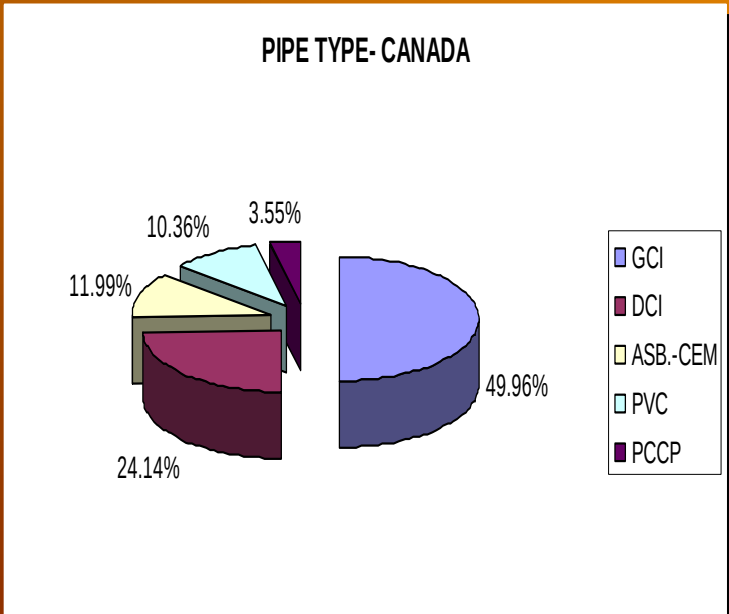
DELIVER SERVICES TO THE PUBLIC
E.G. WATER SUPPLY

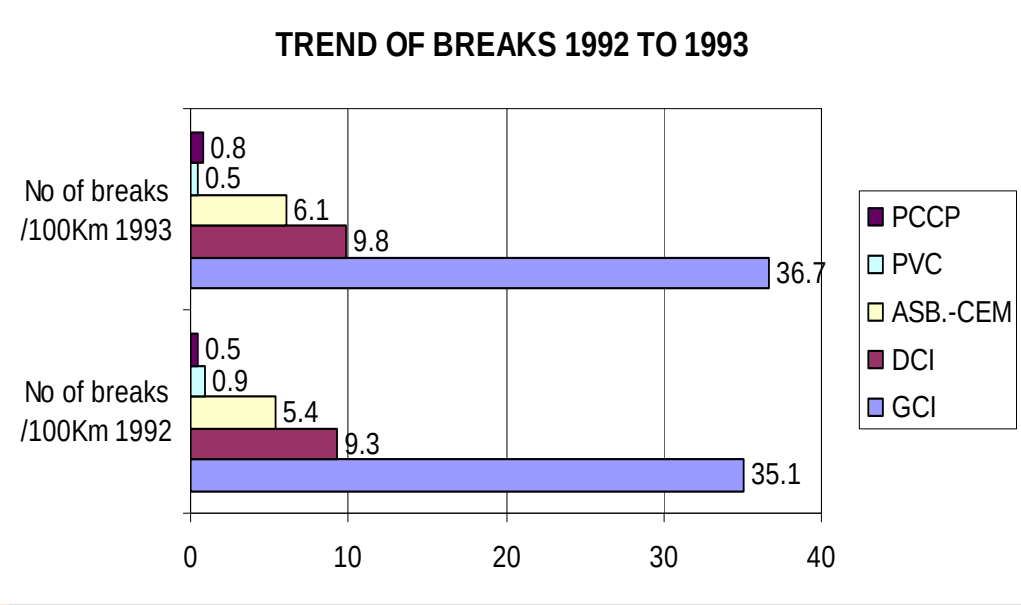
Building Capacity

- **Inventory**
  locating deep, inaccessible sewer (electro-magnetic technology, etc)
- **Valuation**
  accepted methods and valuation tools
- **Condition**
  non-destructive, non-invasive inspection tools for above grade and below grade infrastructure
- **Life-cycle profiles**
  tools to determine factors that influence service life of assets (e.g. maintenance, rehab)
- **Financing Models & Rate Design**
  Inccluding P3's, PUC's, etc. to leverage commercial financing for infrastructure.



Here's an example: water supply systems

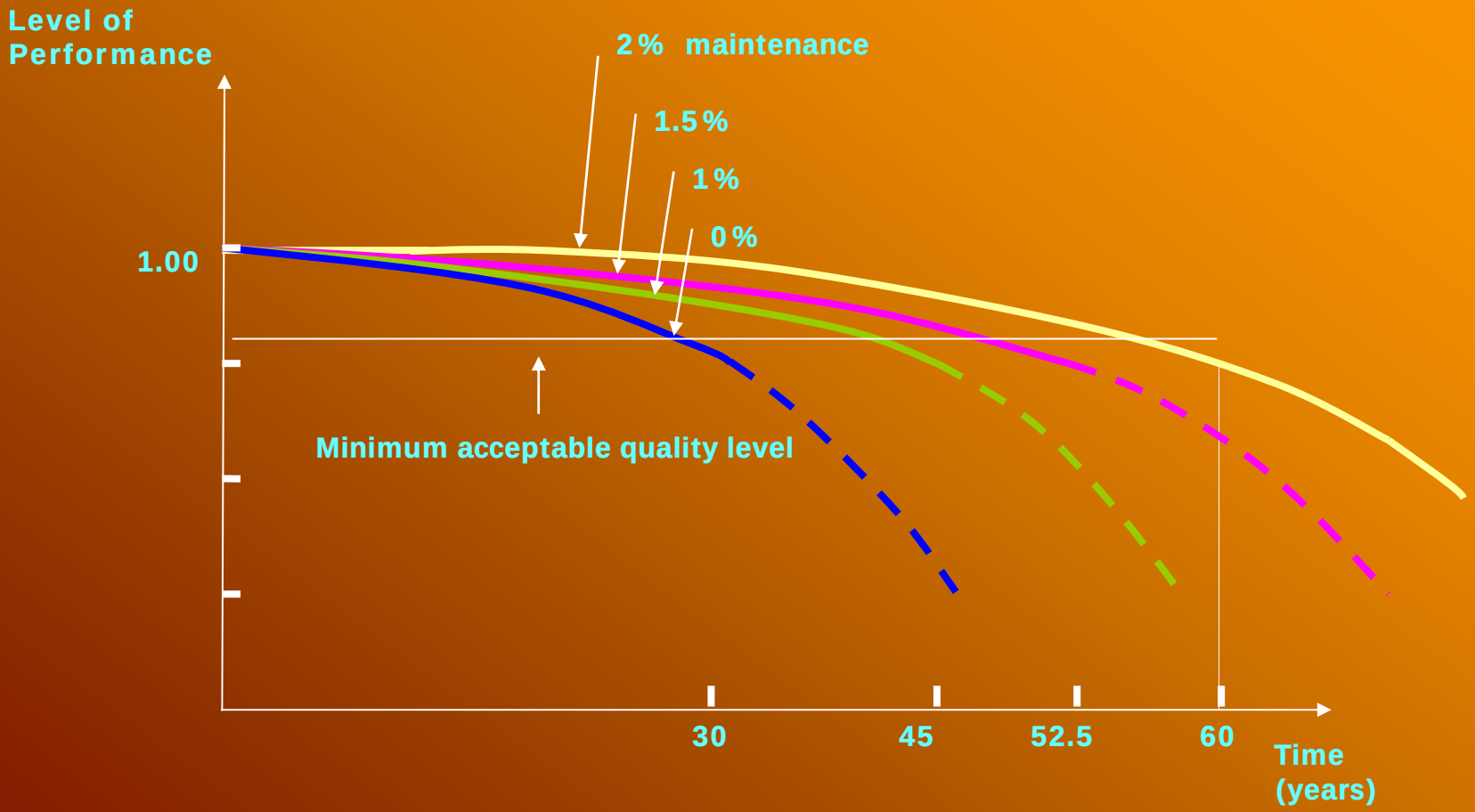




PIPE TYPE	GCI (GREY CAST IRON)	DCI (DUCTILE CAST IRON)	ASB.-CEM (ASBESTOS-CEMENT)	PVC (POLYVINYL CHLORIDE)	PCCP (PRESTRESSED CONCRETE CYLINDER PIPE)
% OF TOTAL LENGTH	50.0%	24.1%	12.0%	10.4%	3.6%

Number of breaks/100km of water pipes in Canadian municipalities 1992, 1993 (Canadian National Research Council, 1996)

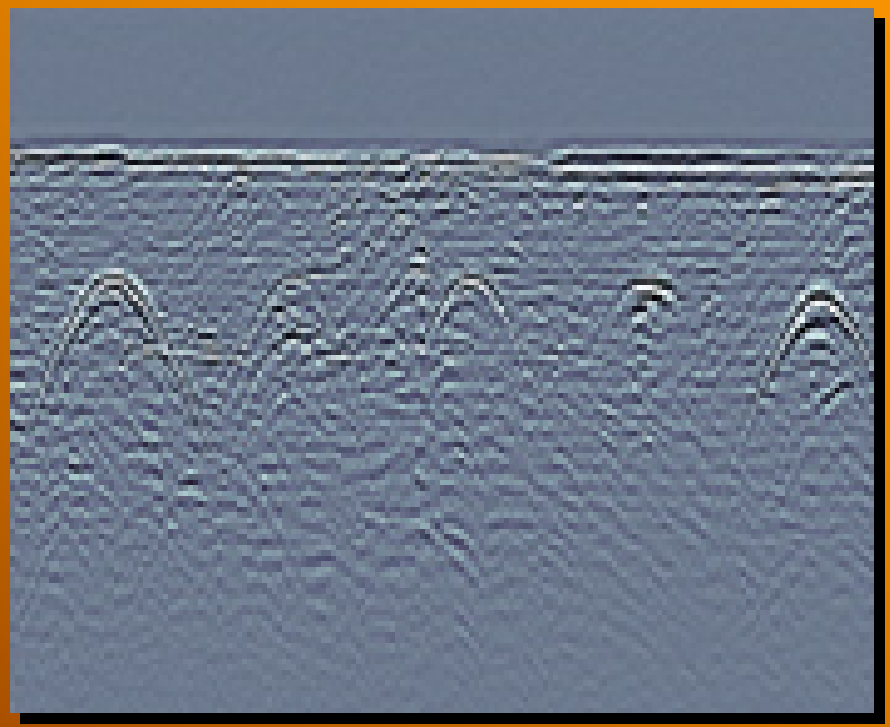
Infrastructure deteriorates over time and requires maintenance



Deterioration – Time Relationship for Different Levels of Maintenance (Mirza, 2005)

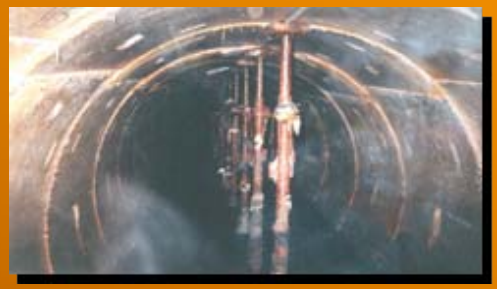
There are many new methods for detection of buried services

- Old methods: visual inspection of the site with interpretation of details such as pavement cuts, change in ground level or even tracing of underground pipe outlets
- Ground Penetrating Radar -high level of accuracy
- Other applications of GPR

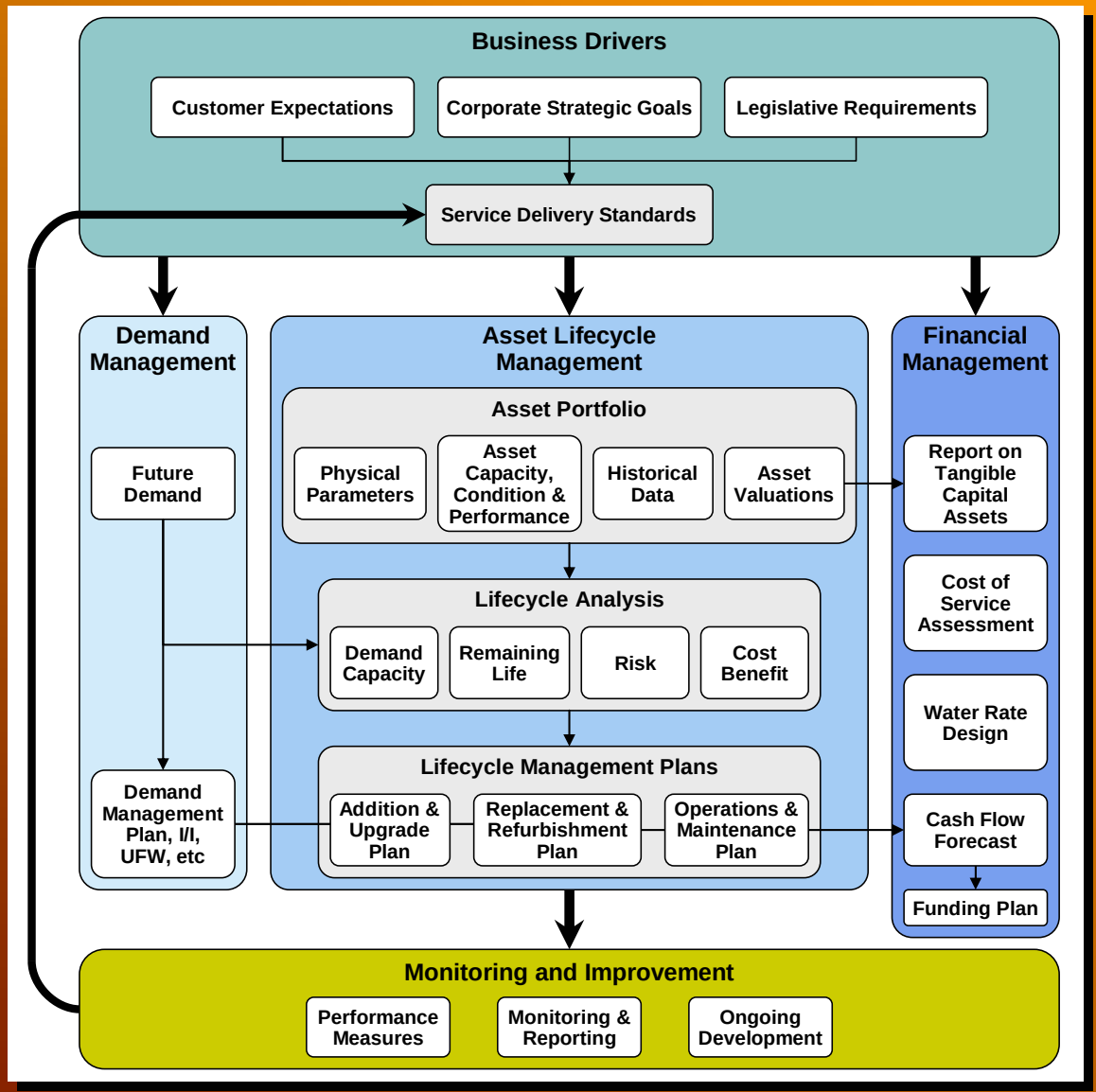


Typical view of an underground scan: Color scale traces (www.sensoft.ca)

Repair & Rehab



AM best practices framework



Basic AM Worksheets

System Inventory Worksheet 1

Date Worksheet Completed/Updated:

Asset	Expected Useful Life	Condition	Service History	Adjusted Useful Life	Age	Remaining Useful Life

Prioritization Worksheet 2

Date Worksheet Completed/Updated:

Asset	Remaining Useful Life	Importance	Redundancy	Priority (1 is high)

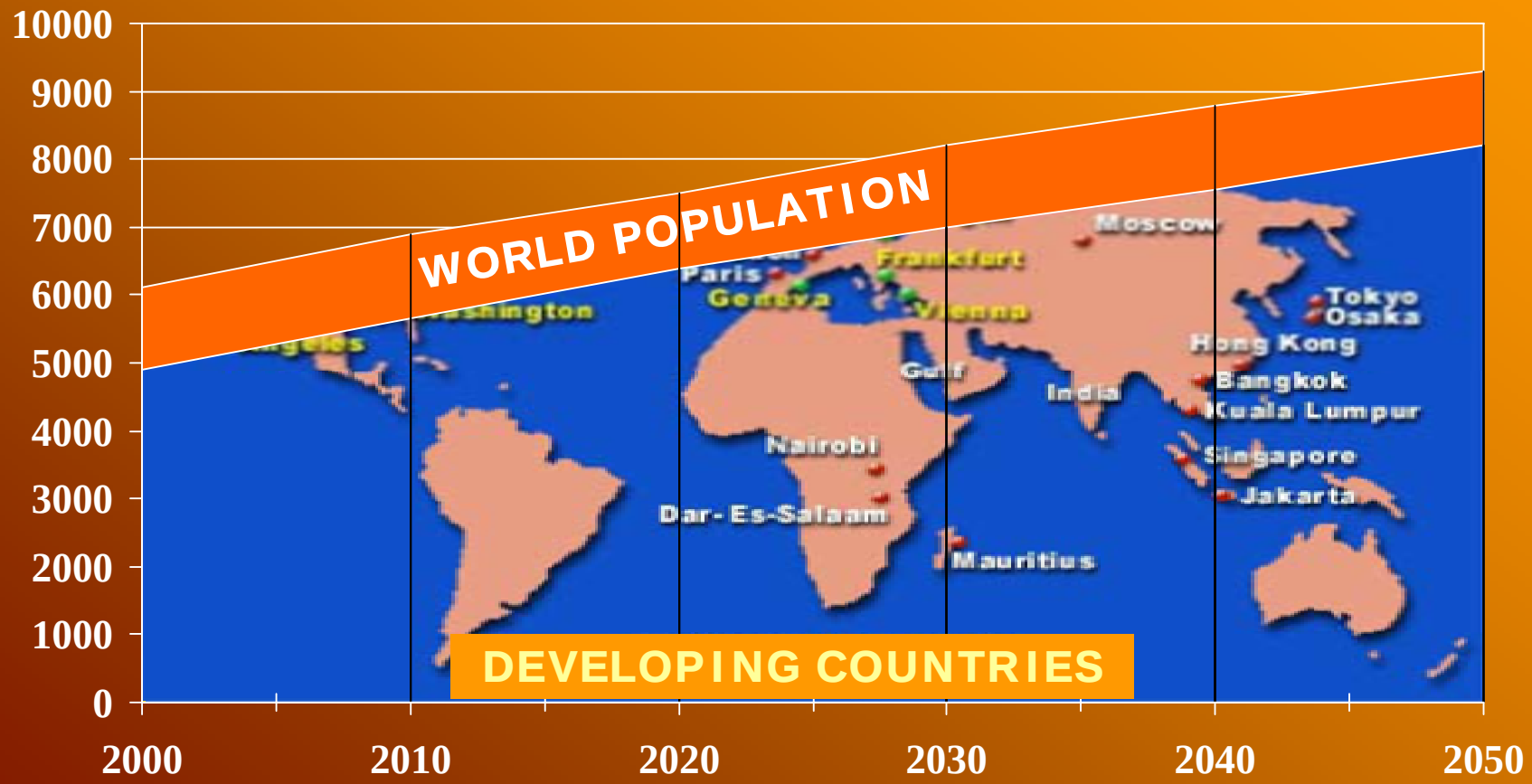
Required Reserve Worksheet[1] 3

Date Worksheet Completed/Updated:

Asset (list from highest to lowest priority)	Activity	Years until action needed	Cost ($)	Reserve required current year

World population trends drive resource depletion

POPULATION IN DEVELOPING COUNTRIES TO BE 88% OF TOTAL POPULATION BY 2050 – IN MILLIONS



Source: UN Population Division; WORLD POPULATION PROSPECTS
Population Reference Bureau: WORLD POPULATION DATA SHEET

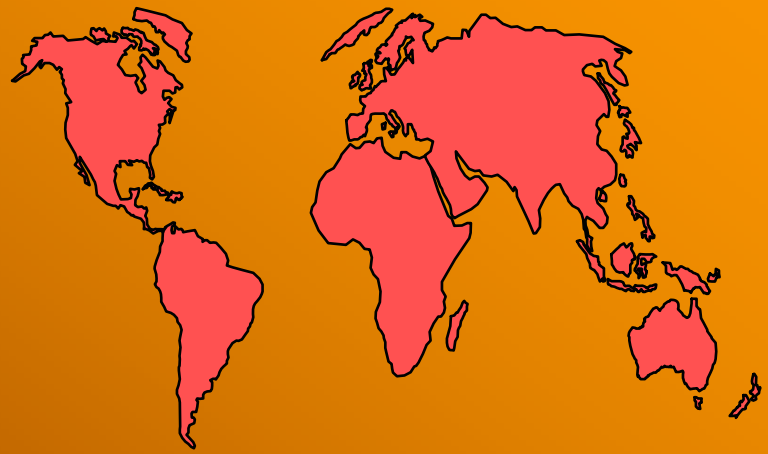
HUGE NEEDS ARE OUT THERE

- over 1 billion people without safe water, 2 w/o sanitation, 4 w/o sewage treatment
- existing systems are run-down
- needs in developing and transition economies: up to $50bn/year or 1% of GDP

NO MONEY

- fiscal constraints
- official aid stagnant (< $3bn/yr, WB $1bn)
- public utilities unable to self-finance or to carry debt
- private investment: a relative trickle so far

AN OLD STORY

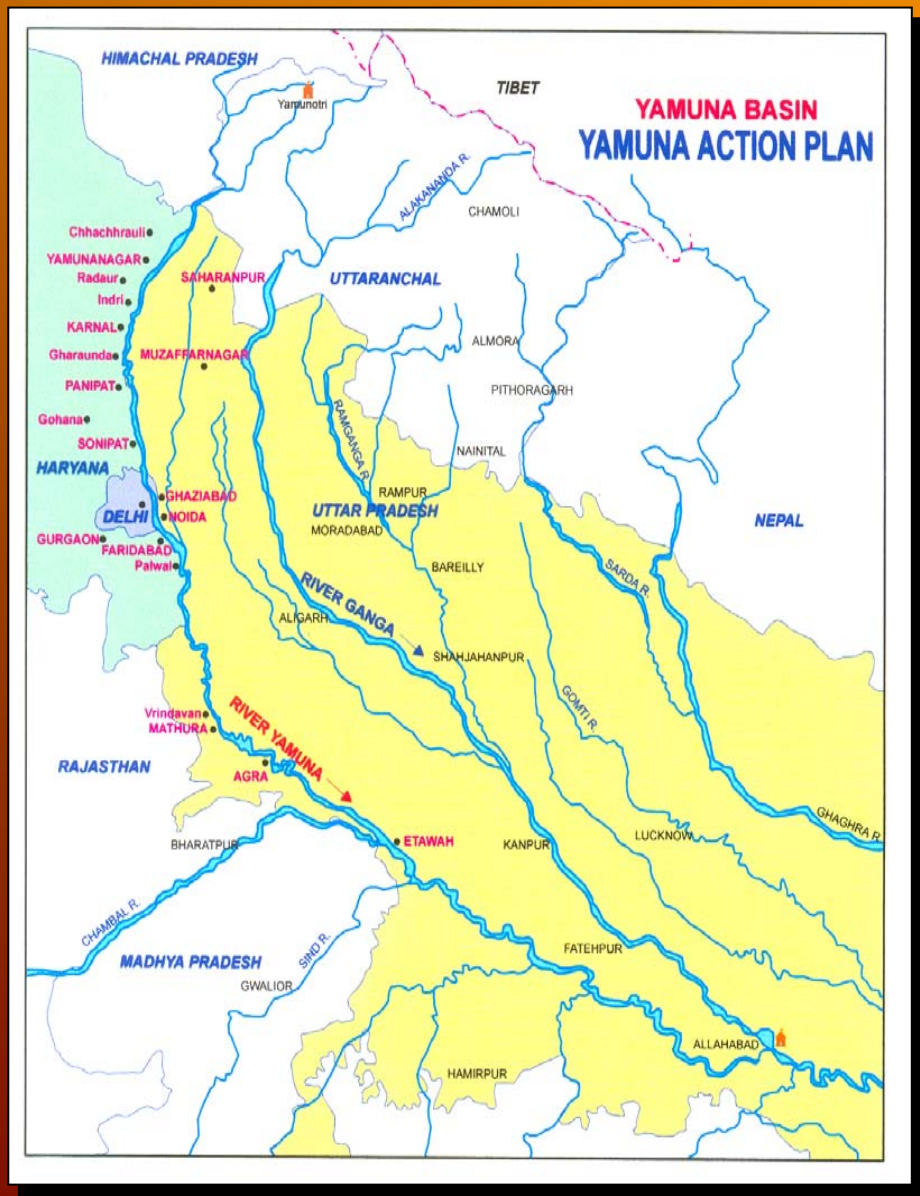


WHAT CAN WE DO?

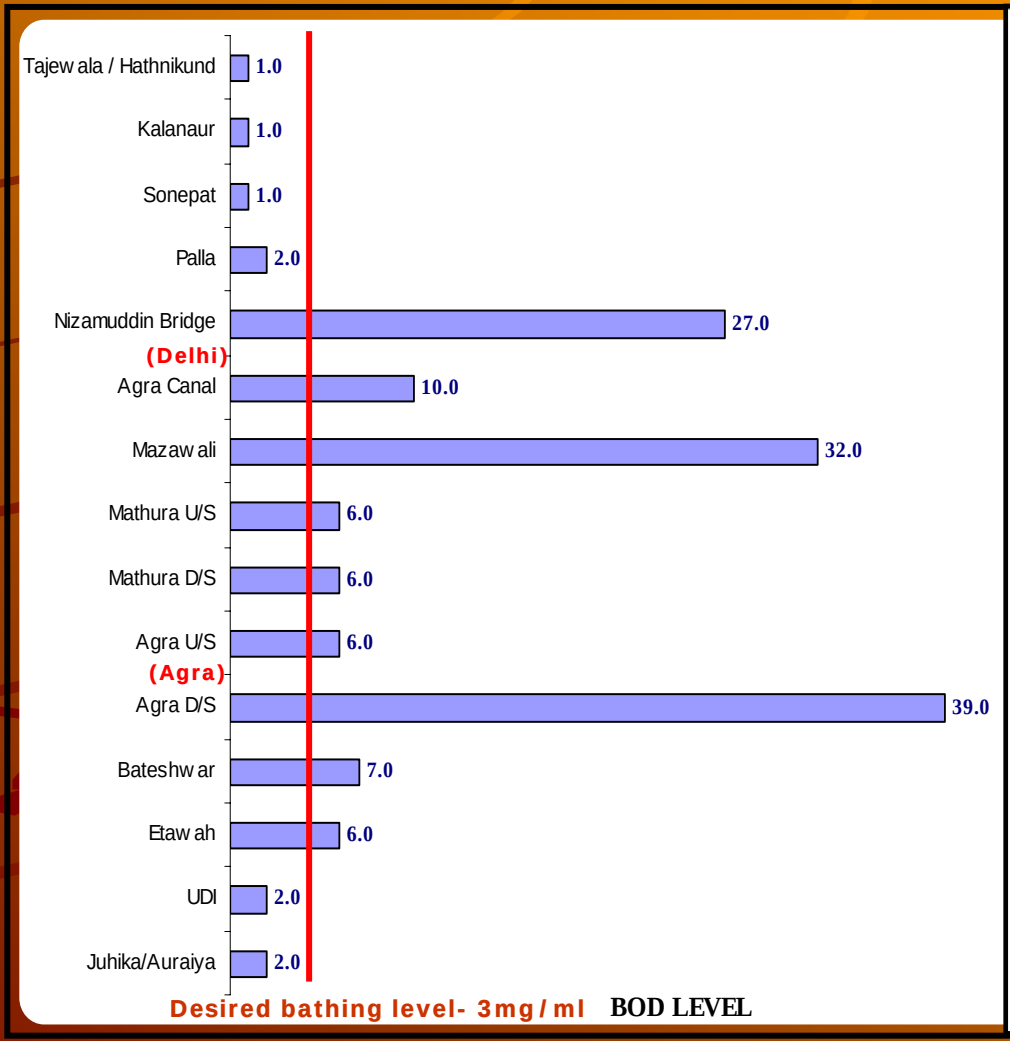
Gaps in the water sector

- Urban water and sanitation – is the *CRITICAL* problem
- It is S-U-G .... *Serious , Urgent and Growing.*
- 90% of the problem (and cost) is buried underground!
- O&M capacity often weak!
- Revenues do not match costs!
- Result is
  - ✓ Inadequate service coverage
  - ✓ Poor quality of service
  - ✓ Financially weak public utilities
  - ✓ Inappropriate pricing policies
  - ✓ Unresponsiveness to user needs
  - ✓ Inefficient operations

YAMUNA RIVER POLLUTION CRISIS



YAMUNA RIVER POLLUTION CRISIS

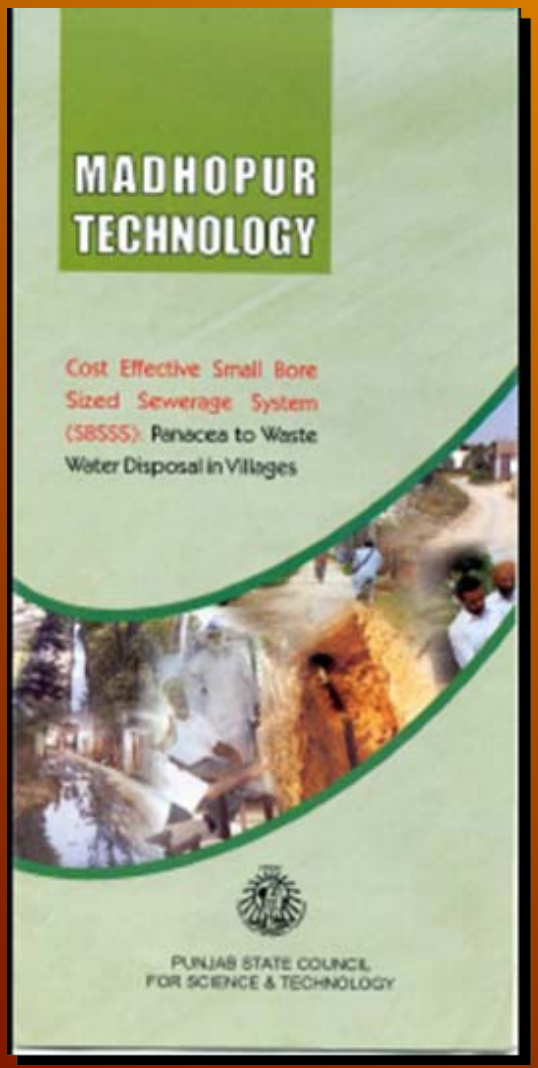


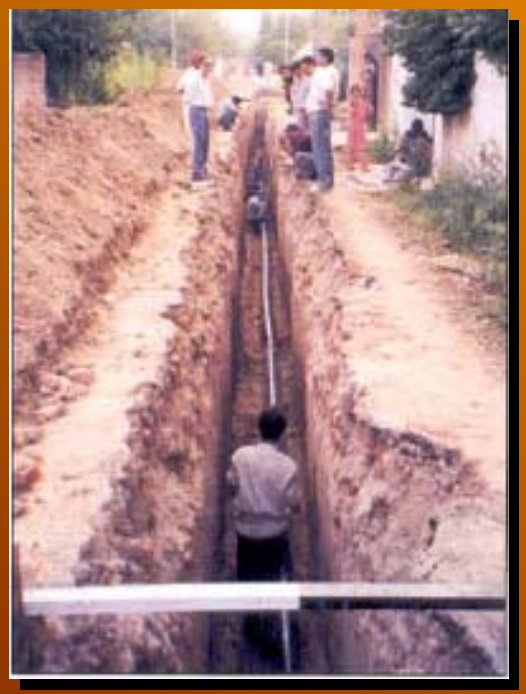
Innovations & best practices are emerging

A wider choice of options is needed

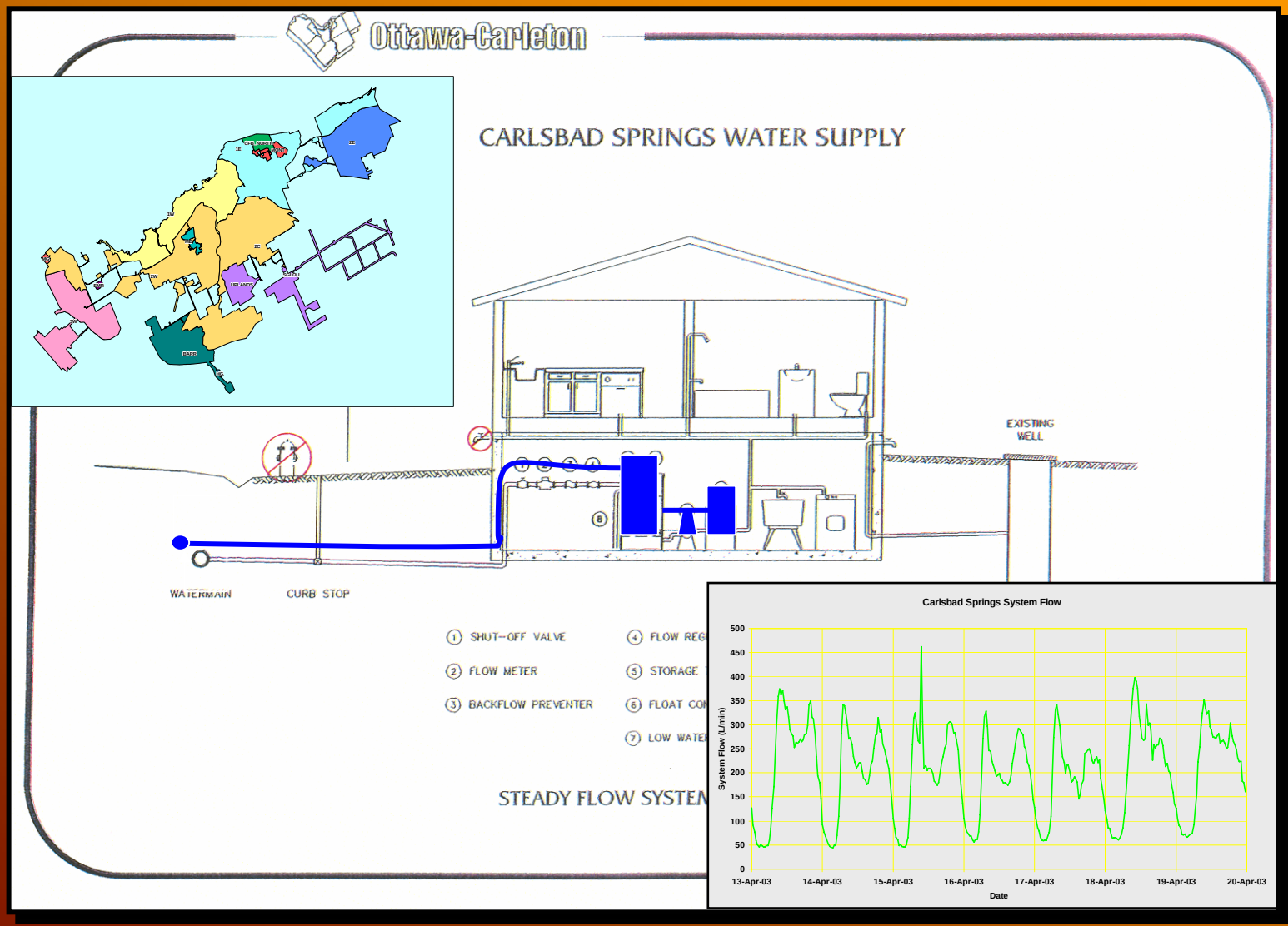
- ✓ Technology Options
  - Metering and Leakage
  - Trenchless Technologies
  - Alternate Design Standards
  - Low Cost Systems
- ✓ Management Options
  - Private Sector Participation
  - Asset Management
  - Capacity building

Small bore sewerage in Nepal

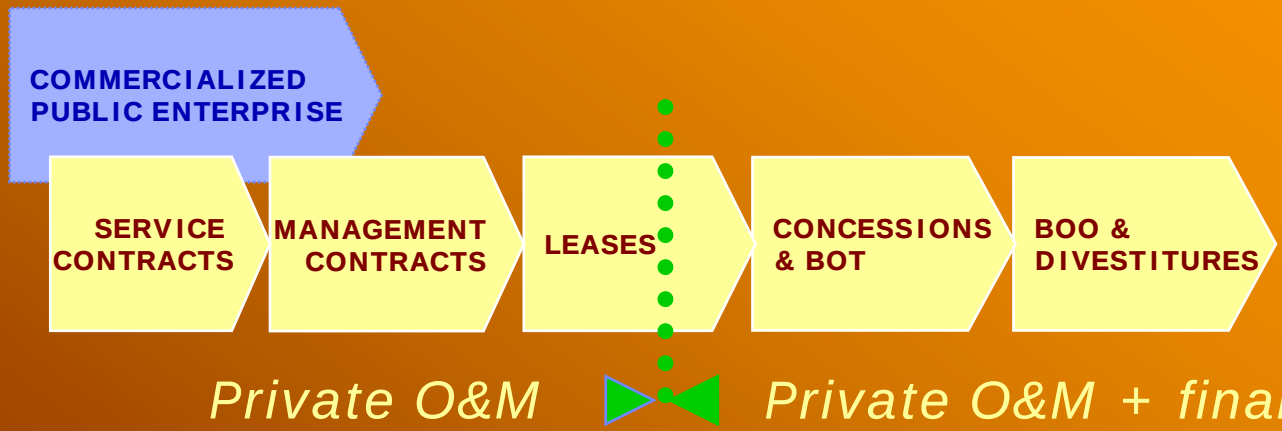




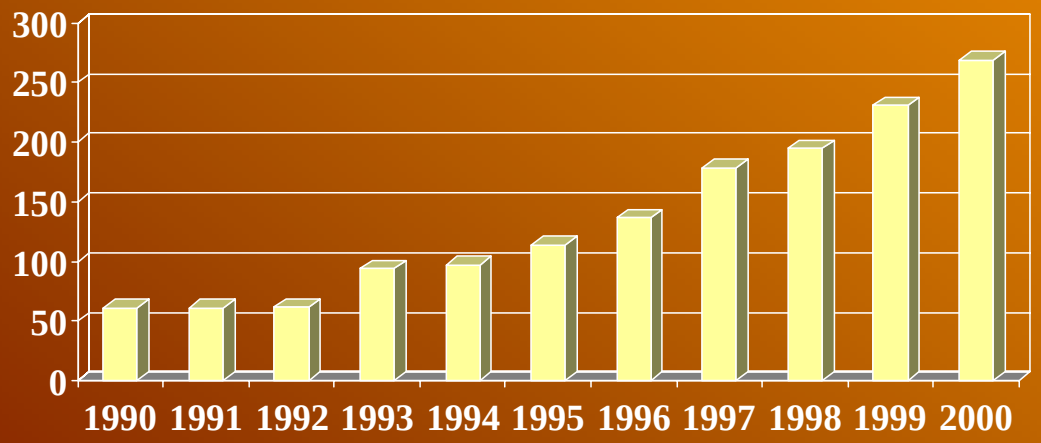
Carlsbad Springs water supply



Forms of private participation



Population served by services "privatized" since 1990 (millions)



The PUC model works well

The Public Utility

- Holds the assets.
- Employs the staff
- Manages the infrastructure and operations via a Management Agreement with the City
- Shares services and facilities via a services agreement with City
- Operates on commercial, profit making basis at arms length with the City
- Pays an annual dividend to the City

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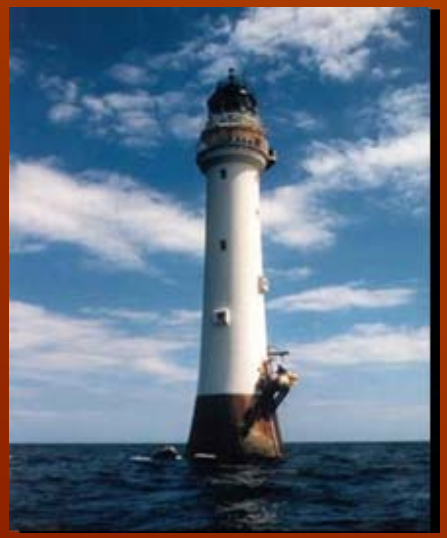
Updating the CSCE Guidelines on Sustainable Development

Ata Khan, Laurie Ford, Brian C. Burrell, Jean Heroux,
Alan Perks, and Bob Korol

Members of the CSCE Task Force on the Review and
Comparative Analysis of the CSCE Guidelines on Sustainable Development

Legacy



THE BELL ROCK LIGHTHOUSE
ROBERT STEPHENSON – 1807

THE GREAT EASTERN
I.K. BRUNEL – 1853

THE STOCKTON AND DARLINGTON RAILWAY
GEORGE STEPHENSON – 1829

THE LONDON SEWERS
JOSEPH BAZALGETTE – 1858

Legacy

THE VICTORIA BRIDGE
GEORGE STEPHENSON – 1859

THE ST. LAWRENCE SEAWAY (1957)

THE PANAMA CANAL
FERDINAND DE LESSEPS – 1894,
AND GEORGE GOETHALS – 1904

THE CONFEDERATION BRIDGE (1997)

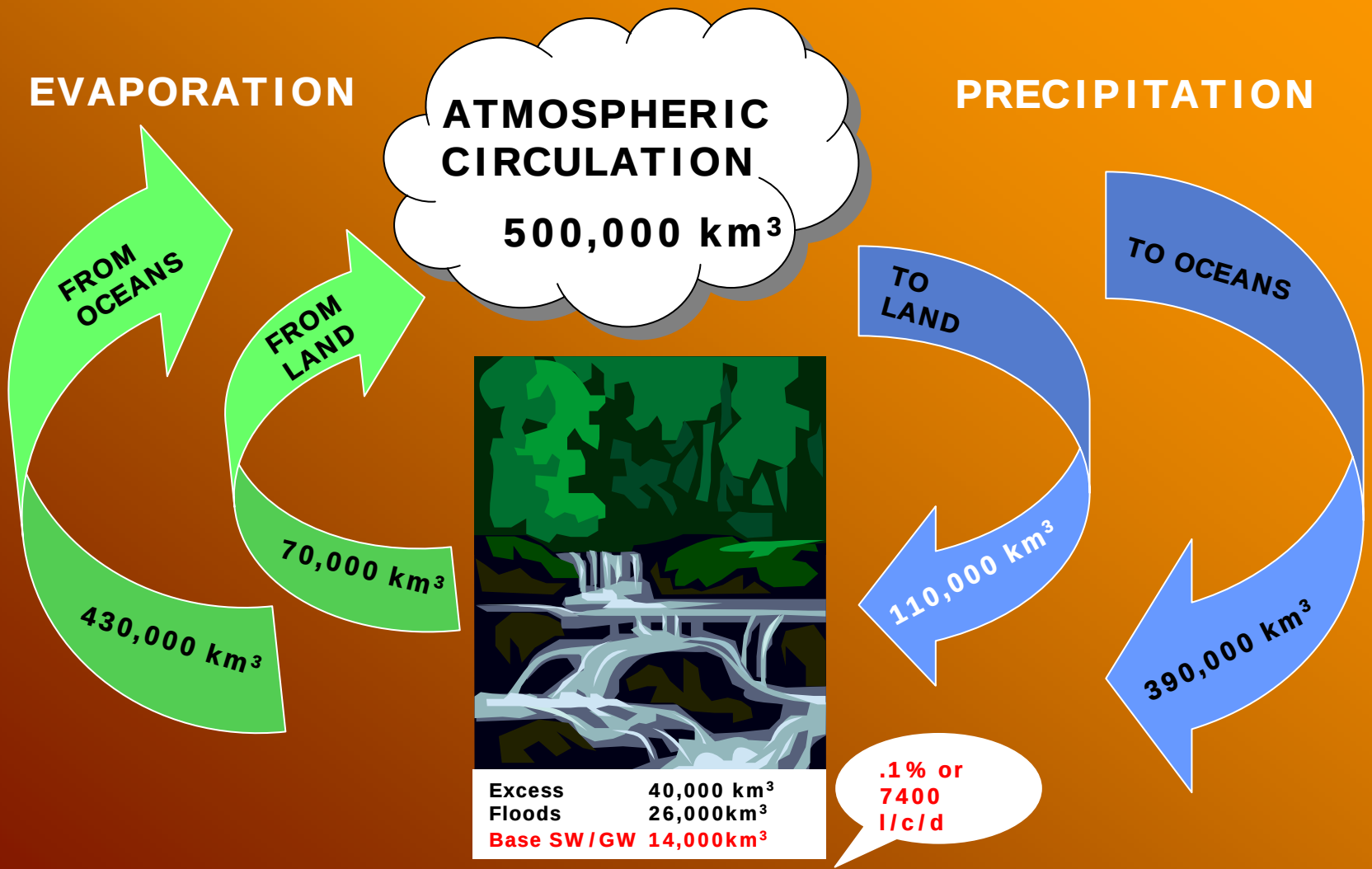
THE CANADIAN PACIFIC RAILWAY
SIR SANFORD FLEMING – 1877

Vision, mission, values

- Civil Engineering offers needed solutions.
- Increasingly populated and technology dependant.
- Need social, environmental and economic sustainability.
- Individual and collective responsibility.
- The challenge of our generation.

The global water cycle

1,360,000,000 km³ on earth **(Sandra Postel, 1997)**



This can't be good!

1 tailpipe = 5 cm = 19.625×10^{-10} km²

In North America	300 million vehicles
In Europe	300 million vehicles
In Asia, LA, Africa	400 million vehicles
Total	1 billion vehicles

Sustainable Development Guidelines

1. Natural environment
2. Financial and economic sustainability
3. Green construction
4. Human resources
5. Social, regulatory, and health concerns
6. Ethics
7. Participation
8. Implementation

Reducing the Urban Footprint

- Sustainability through innovation and "Best Practices"
- Cost efficiency through custom design
- Community amenities / value added
- "focused, cooperative, innovative and responsible"

– CLC, Queen's Land forum, 2000

Customized Design

Transportation

- Light rail
- Car alternatives
- Narrower roads

Energy Efficient Buildings

- Renewable or recyclable materials
- Solar energy orientation
- Solar roof panels
- District heating
- Green roofs
- Smart meters
- Less embedded energy

Air Quality

- Non-toxic materials
- Reduced emissions
- Improved ventilation
- Less chemical use

Customized Design

Water

- Conservation
- Small bore systems
- Rainwater harvesting
- Grey water systems

Waste

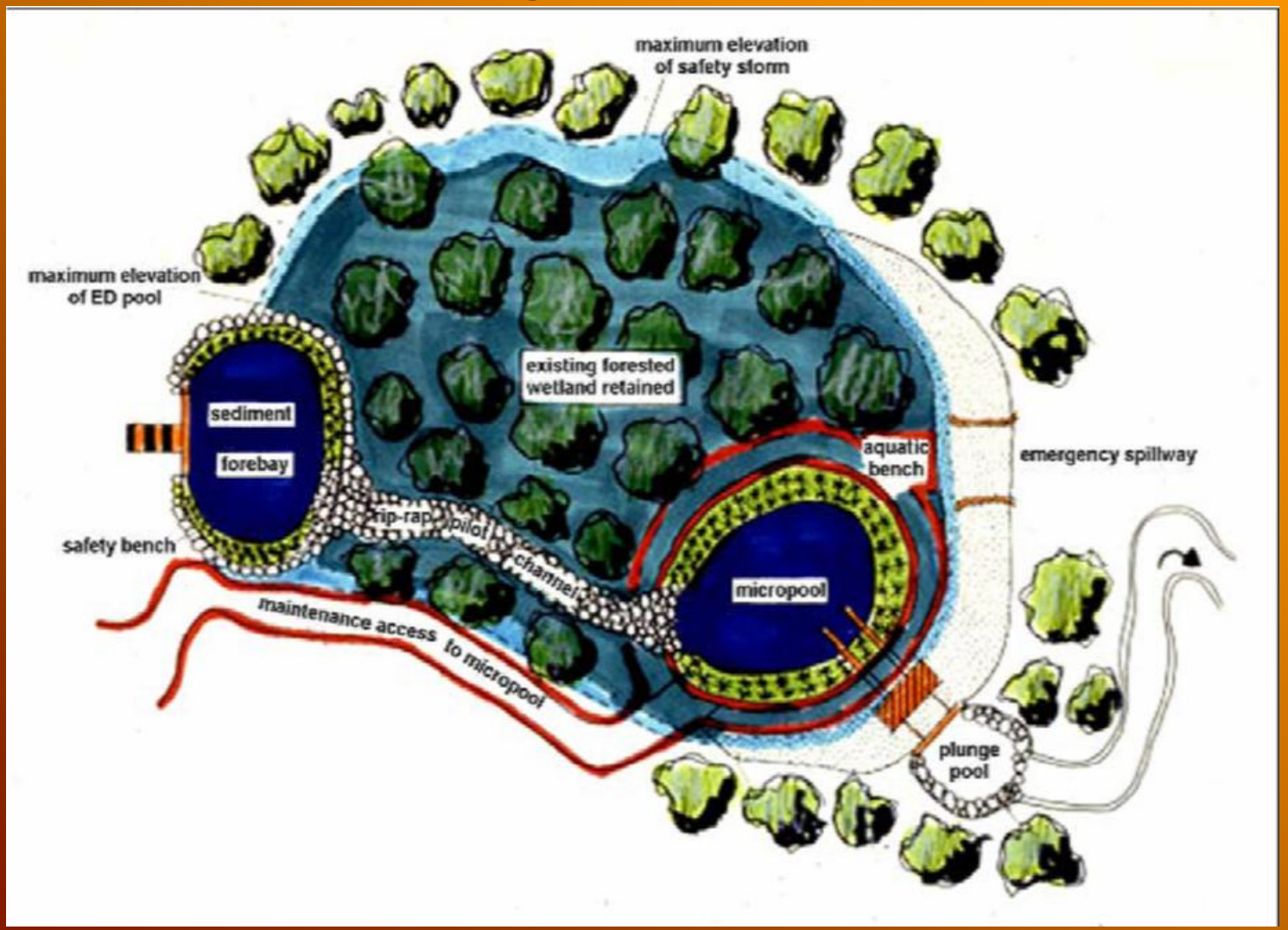
- Conservation
- Small Bore sewers
- On-site Treatment
- Composting
- Diversion
- Biogas

Storm Water

- Source Controls
- Infiltration
- Natural Drainage
- Dry / Wet Ponds
- Water Amenities

Sustainable Streetscapes

Natural Design Elements



The Road Through The Approvals Process?

Courtesy of Al Lucas, Utilities Kingston

SUMMARY - Infrastructure

It is a "Capacity Building" Challenge:

... knowledge (information and processes for sustainability)

... technology (tools to gain knowledge & support decision-making)

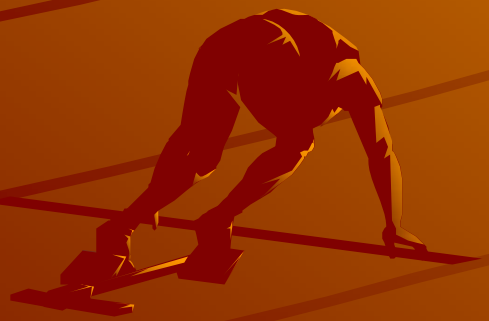
... financial (finding enough money in the industry to do the job)

it is about the ability to "spend the right amount of money, at the right time, on the right things"

SUMMARY – Sustainable Development

We are technology dependant!

- ✓ We can't go back to nature
- ✓ Sustainable Technology
- ✓ Behavior modification



THINK GLOBALLY. ACT LOCALLY.

Did you know that linens and towels washed daily by hotels worldwide use millions of gallons of fresh water and add tons of detergents to our environment?

As part of Hyatt's ongoing commitment to improving the environment by using less energy and creating less waste, we offer a solution. During your stay, we will change bed linens and towels every three days, while still refreshing your guestroom daily. If you do not wish to participate in this program, please contact guest request or the hotel operator and your linens and towels will be replaced daily.

Many of our guests have expressed interest in joining us in our efforts. We appreciate your participation. Together we can make a difference.

HYATT

SUMMARY – Sustainable Development

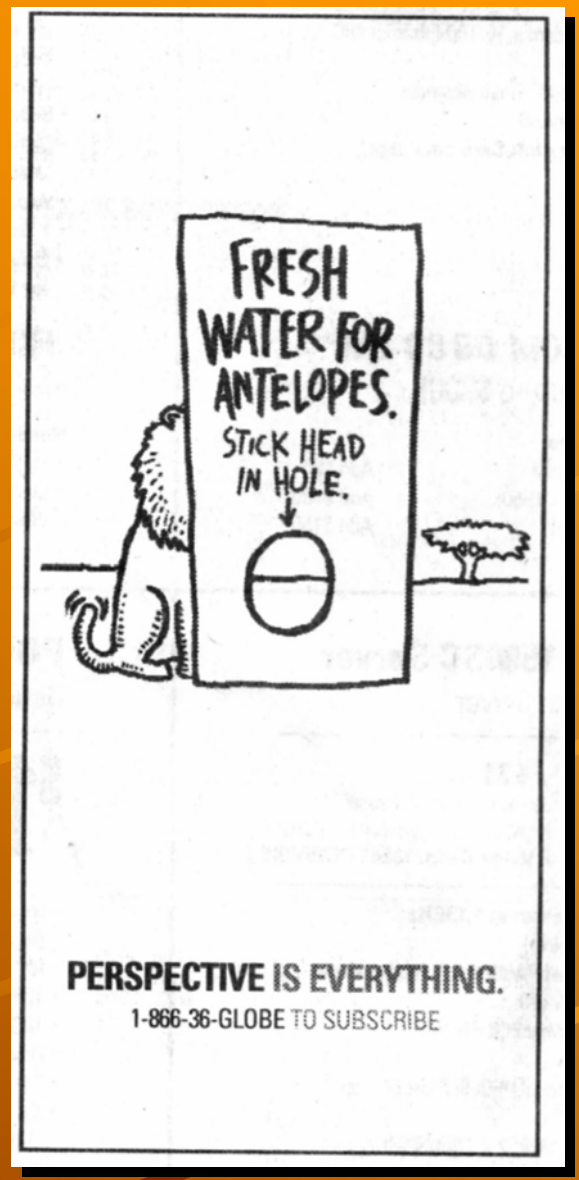
- ✓ A Gap still exists between concept and practice.
- ✓ Civil Engineers have to advocate and lead for Sustainability.
- ✓ Reduce, recycle and reuse for Civil Engineering projects – a closed circuit is the goal.
- ✓ Civil Engineering needs broader understanding of the technical, financial and social issues re public infrastructure.
- ✓ Time to “walk the talk”
- ✓ The Gorilla is waiting in the other room!

SUMMARY – Sustainable Development

"Never doubt that a small group of thoughtful, committed citizens can change the world"

Anthropologist Margaret Meade

Civil Engineers should be among those agents of change!



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Thank you for your time!
For more information please contact

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