The National Academies Program on Urban Environmental Sustainability

Building Sustainable Cities

The Challenge of Our Times

Mayor Jeremy Harris Ret.
Washington D.C.
May 17th, 2006

State of the World Today

The planet's ecosystems are under intense pressure and many are in decline.

State of the World Today

The Urban Challenge

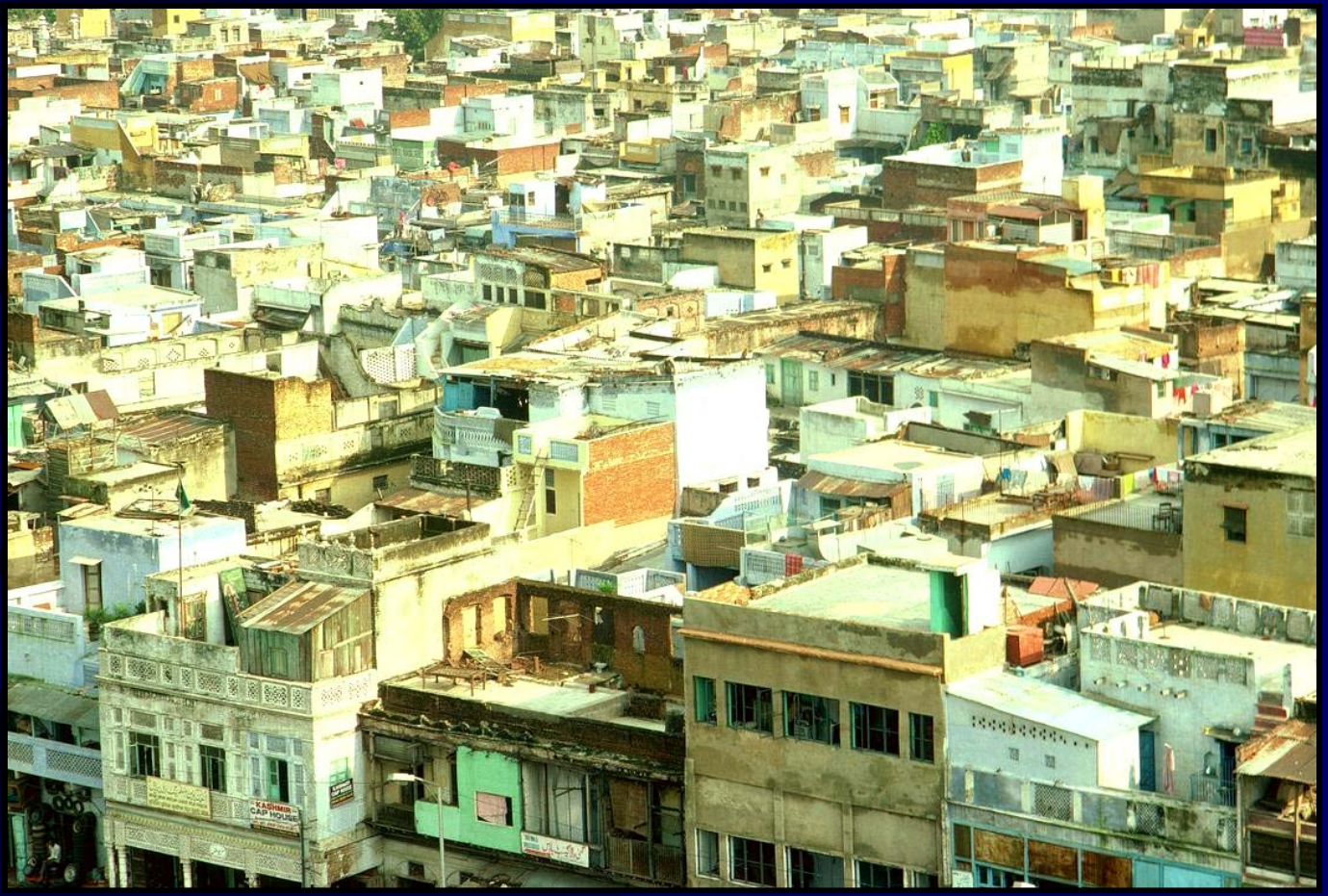
We are at a defining moment in history

Global Population

- Approximately half the world's population is now urban
- Urban areas are gaining an estimated 60 million people a year – over a million a week
- Like adding another San Francisco every five days

Source: Peopleandplanet.net

Urbanization



Most of the increase in urbanization will occur in less developed countries

Urbanization

Rapid urban growth results in environmental degradation, unemployment, lack of urban services and adequate shelter, and overburdening of infrastructure.

Non-Sustainable Urbanization

Poor Energy Policy Creates….

Demand for primary energy in Asia will double every 12 years (world average is 28 years)

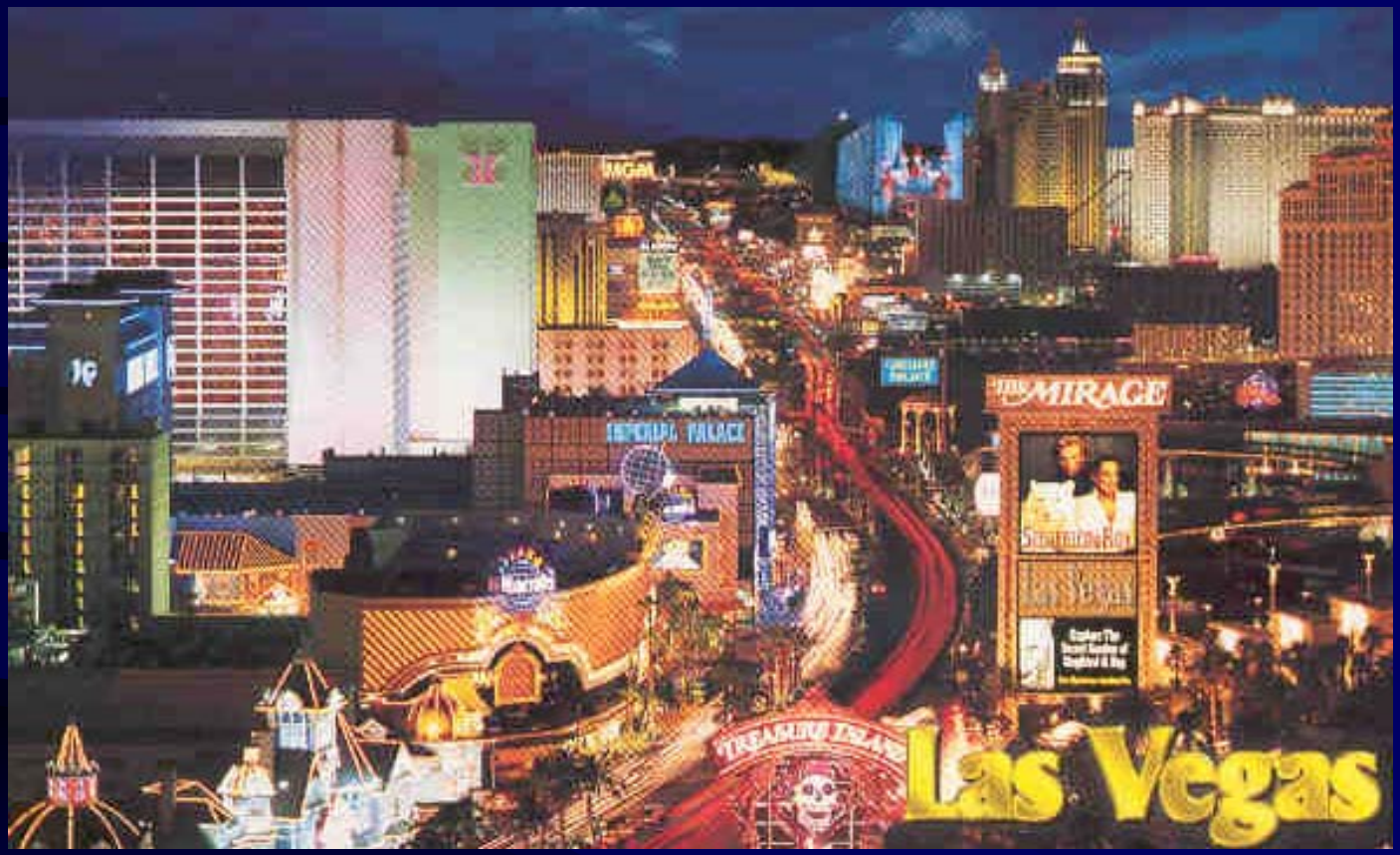
- Fossil fuels account for 80% of energy generation, coal accounts for 40%

….Overdependance on Non-renewable Energy

Global Warming

Transportation contributes
a large share of urban air pollution

Energy – Consumption

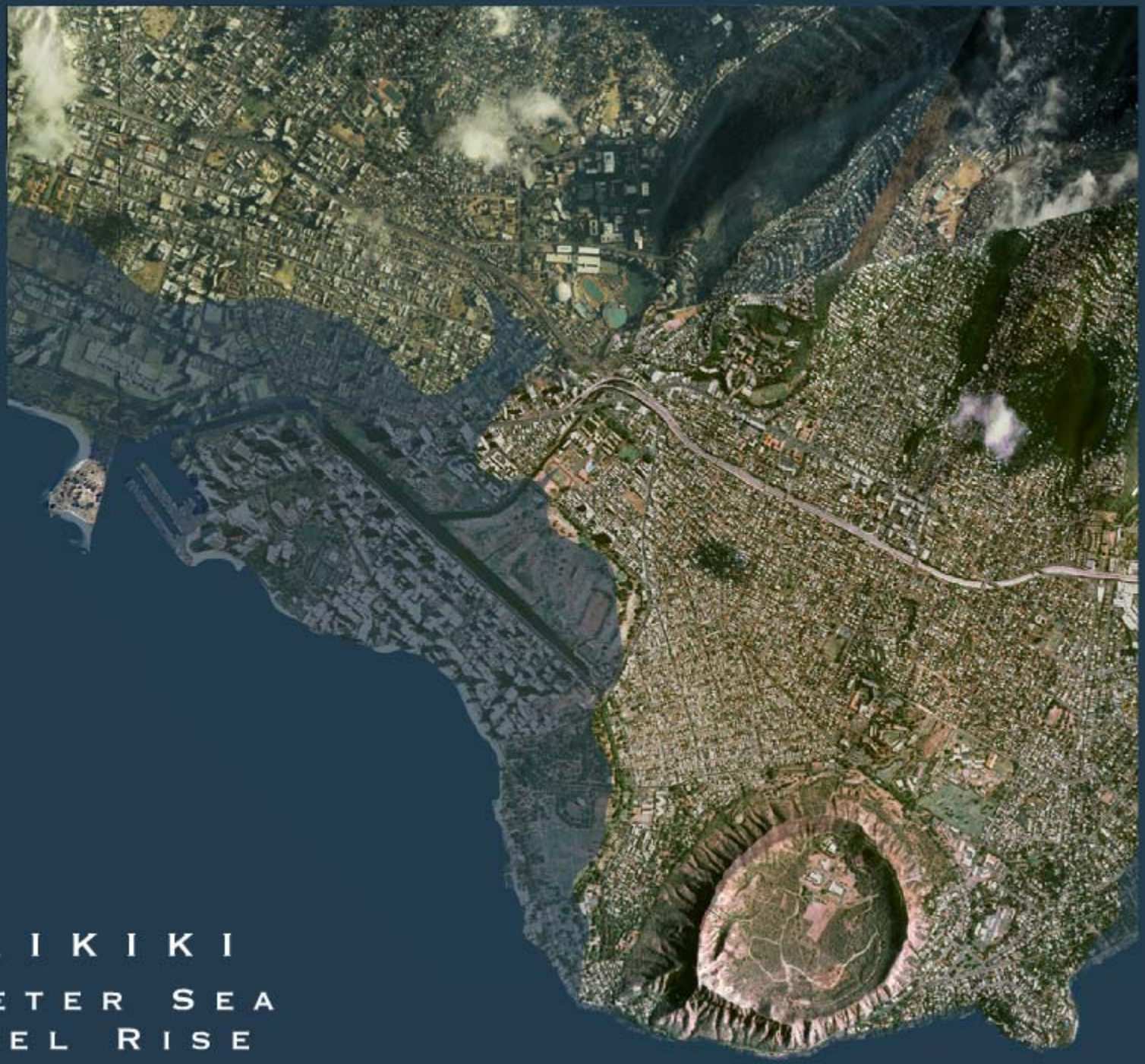


The “built environment” is designed and built without any regard to energy efficiency.

Global Warming

- Ice core readings indicate carbon dioxide readings are at the highest levels in 420,000 years
- Scientists have documented a 10-20 centimeter rise in global average sea levels over the past century


WAIKIKI
1 METER SEA
LEVEL RISE


WAIKIKI
1 METER SEA
LEVEL RISE

Environmentally-Caused Disease

Smoky indoor air from cooking and heating contributes to respiratory diseases that kill 4 million a year – mostly children under 5

Source: World Resources Institute

Loss of Biodiversity

More than 11,000 species of animals and plants are known to be threatened with extinction – a rate unmatched for 65 million years

Source: Population Reference Bureau

Desertification

Desertification threatens the livelihood
of over 1 billion people in more than 110 countries

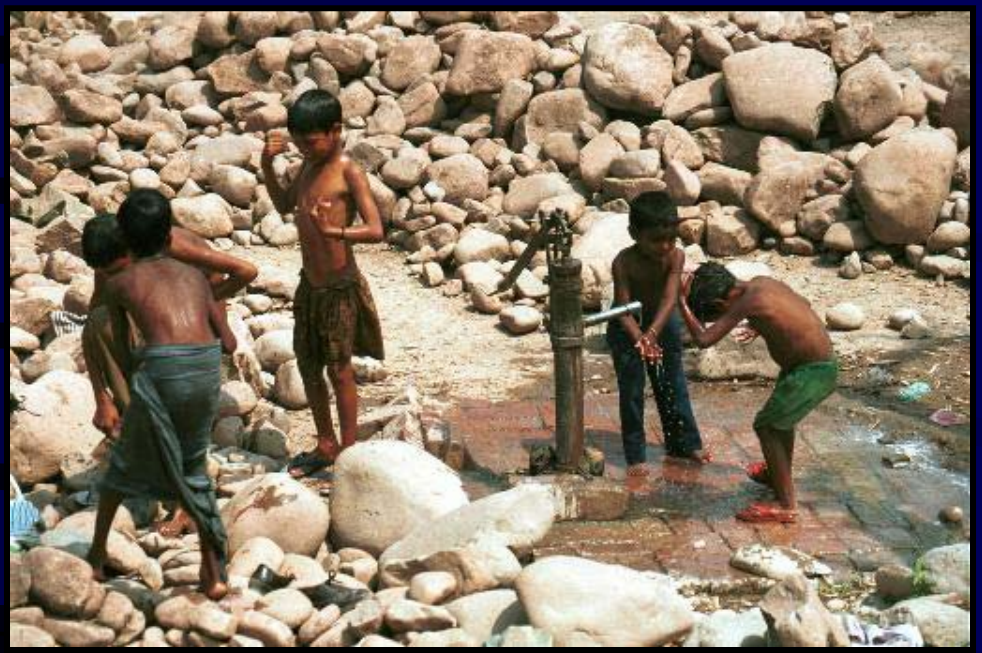
Source: United Nations

Water Pollution

Each year roughly 450 cubic kilometers of wastewater are discharged into rivers, streams and lakes

Source: Peopleandplanet.net

Environmentally-Caused Disease



High population density and poor sanitation, characteristics of urbanization, promote the spread of infectious disease

Role of the Developed World

How can the developing
world avoid making our mistakes?

Role of the Developed World

Developed nations and cities serve as bad examples for sustainability.

Path to a Sustainable World

It’s clear that for our world to be sustainable, we have to concentrate on building sustainable cities

Future Urbanization

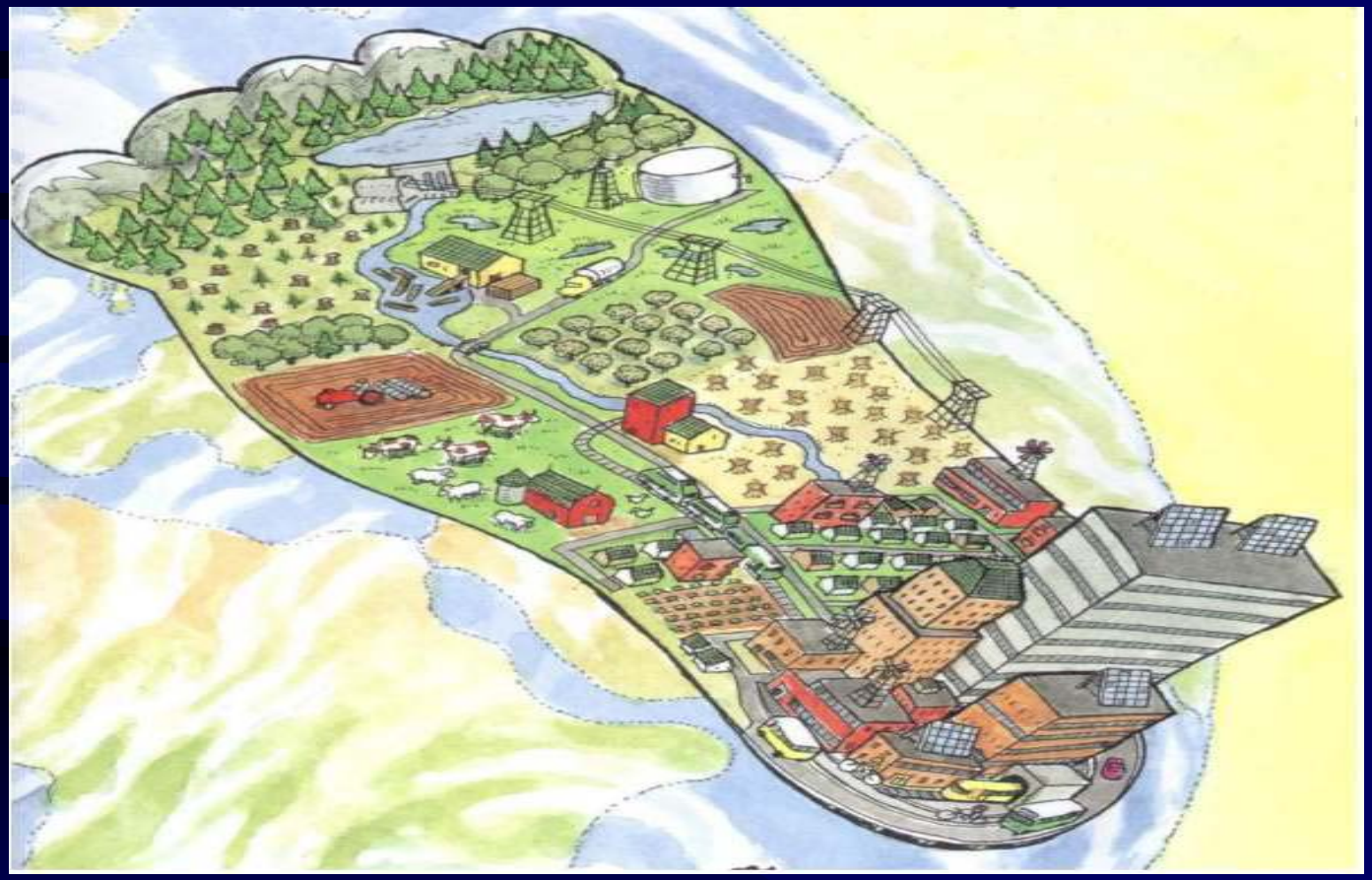
• Most of the urbanization that will exist in 2030 has not yet occurred. The urban pop. of developing nations will double by 2030 at which time…

60% of the world's people will be urbanites

Source: York Times Almanac 2004

City's Footprint

Goes well beyond city boundaries



Watersheds, air-basins, drainage basins, resource base. Regional approach needed. Multi-jurisdictional.

Changing The Paradigm

Users Not Consumers

Growing consumption
& waste generation

Minimize consumption
conservation & reuse

Fraudulent Accounting

Economic prosperity in the developed world – based on an assumption of unlimited consumption……

… and waste generation.

Path to a Sustainable World
Leapfrog – Paradigm & Technology

Leadership Development

Technical Resources

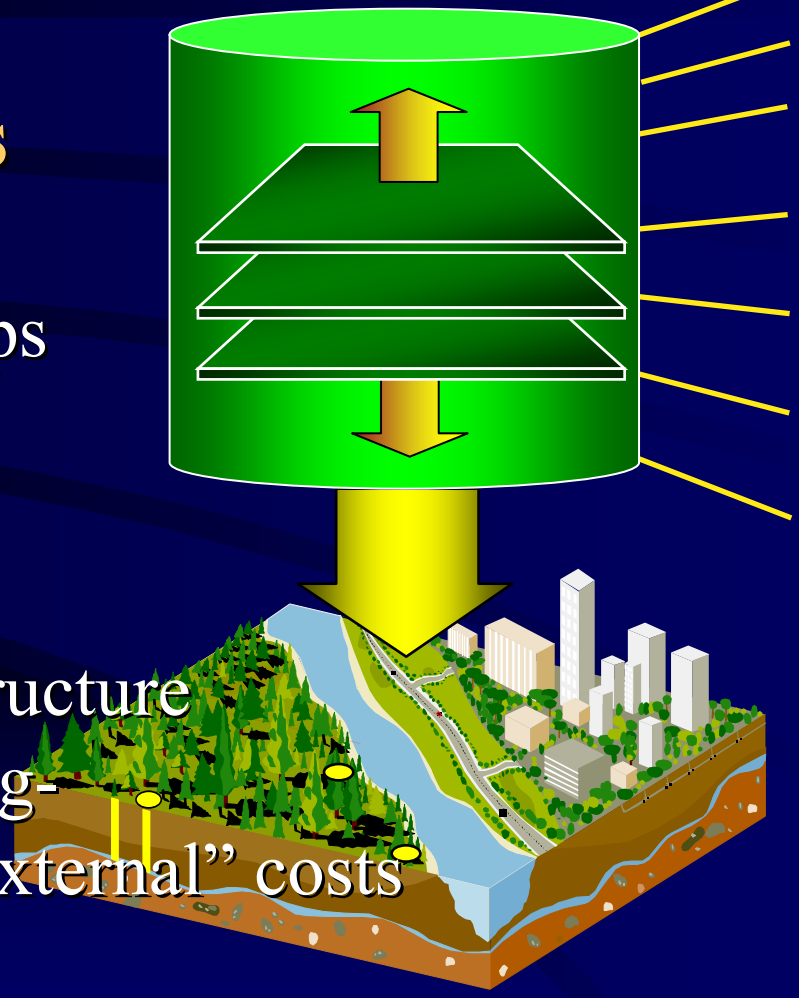
Financing

We have to provide cities with assistance in best practices to leapfrog the past mistakes of industrialization

The Sustainable City
A Systems Approach

Key Concepts

- Understanding interrelationships
- Enterprise-wide approach
- End stovepipe management structure
- Lifecycle costing- Internalizing "external" costs



The Sustainable City

Good Environmental Policy
is
Good Economic Policy

Making Our Cities Sustainable

Modeled after natural ecosystems

High productivity

All nutrients recycled/reused

All components interconnected into stable system

Planning that integrates land use, transportation, energy, natural resource and economic components

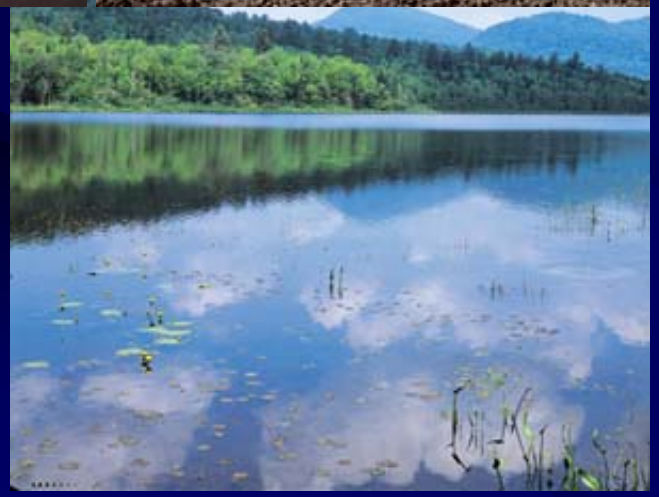
Mayors' Asia-Pacific Environmental Summit

1. Mayors Confront Urban Realities

- Wastewater treatment
- Solid waste management
- Air and water pollution
- Energy consumption
- Urban and regional planning

The MAPES Process – An Overview

2. Share Information and Best Practices



The MAPES Process – An Overview

3. Engage in Capacity Building

The MAPES Process – An Overview

4. Form Regional Partnerships

The MAPES Process – An Overview

5. Commitments to Sustainable Practices

Asia Pacific Urban Institute

Meeting the Commitment

Capacity Building

Training

Technology Transfer

Urban Alliances:
Key to a Global Sustainable Future

Land Use

Build Cities for People Not Cars

Land Use

Utilize "Smart Growth" Design

Cities – the Sustainable Prescription

Land Use

Preserve Ag Land & Open Space

Land Use

Utilize Good Urban Design

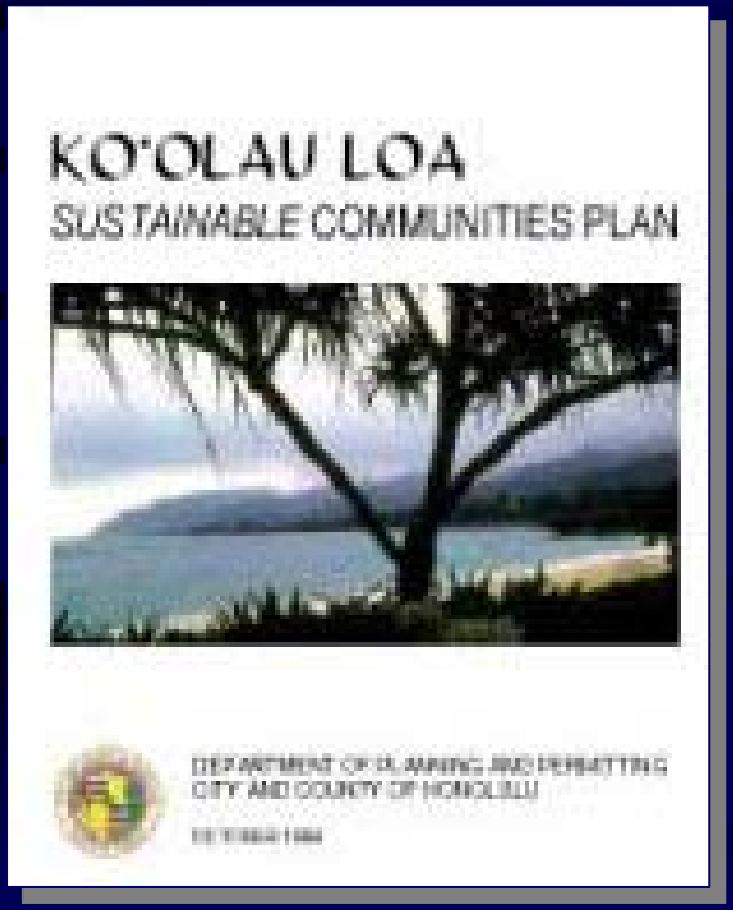
Land Use

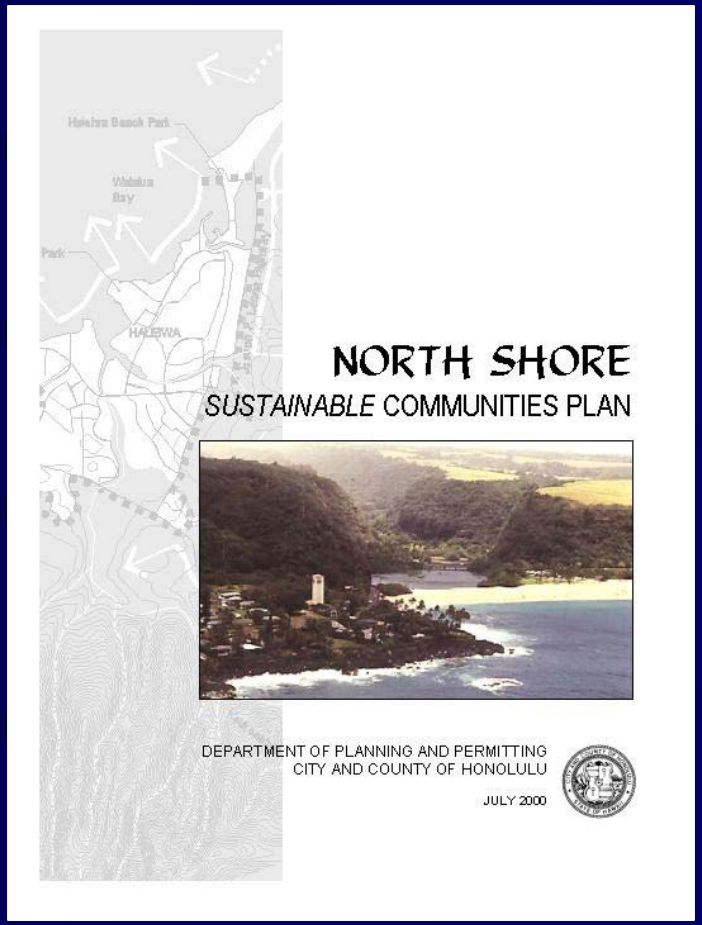
Curbing Urban Sprawl

Car First Priority - A Failed Paradigm

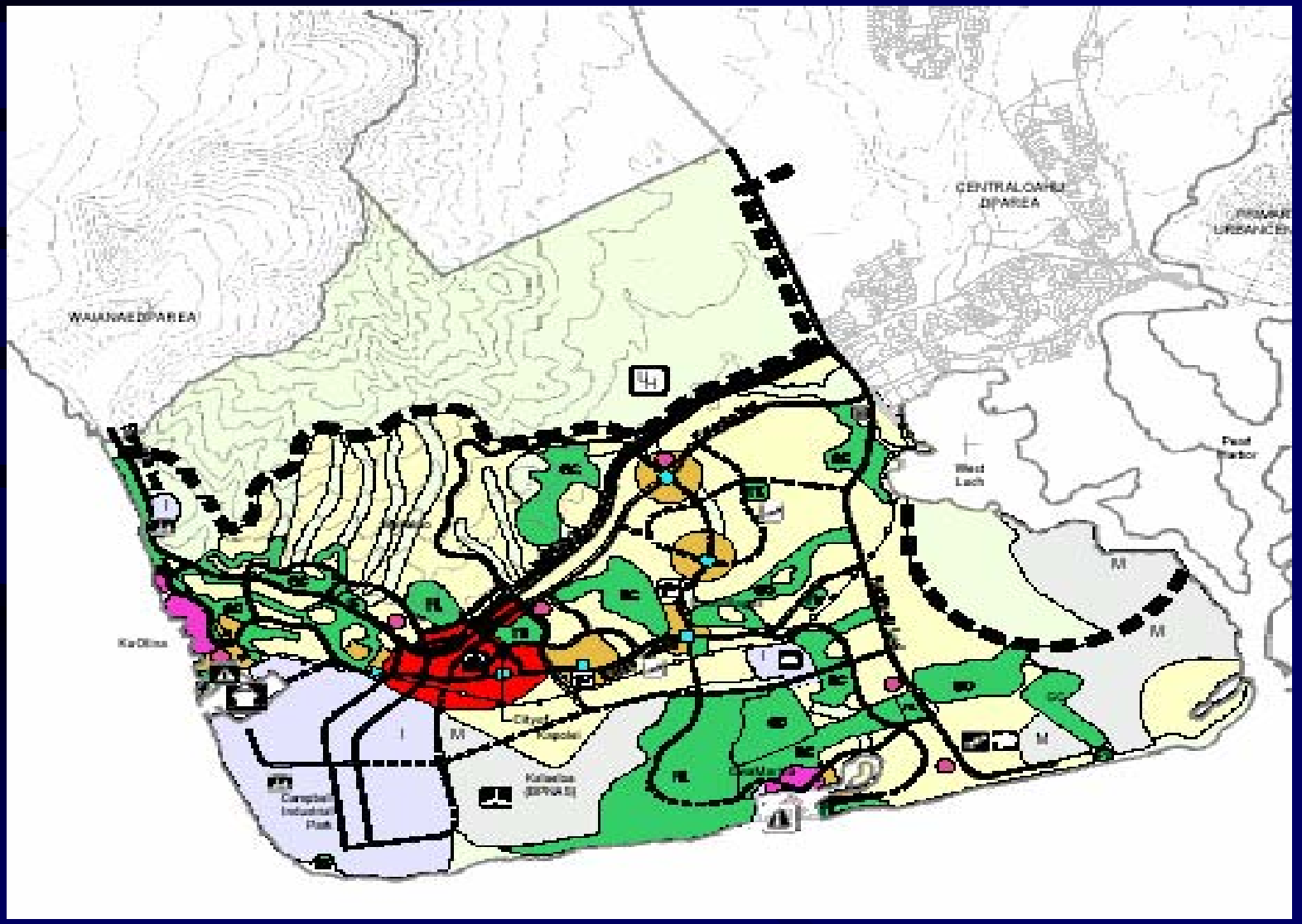
Land use should drive transportation, instead of allowing transportation to drive land use.

Sustainable Community Plans





Urban Growth Boundaries



Sustainable Design

Smart Growth

Town-Centered Development

Sustainable Design

Smart Growth

Pedestrian Friendly

Sustainable Design

Smart Growth

Livable Communities

Sustainable Design

Smart Growth

Mixed Residential, Retail & Commercial

Sustainable Design

Smart Growth

Sense of Place

Sustainable Planning

Urban Design

Sustainable Planning

Urban Design

Sustainable Planning

Urban Design

Sustainable Planning

Urban Design

Commitment – Iloilo City, Philippines

- Completion of Iloilo River Development Master Plan
- Ordinance established to protect coastal fishery
- Executive order to comprehensively upgrade the city's drainage system

Commitment – Hue, Vietnam

In response to extensive flooding and deforestation …

- Established legal framework for forest protection and management
- More than 7 million trees planted in eight provinces

Cities – the Sustainable Prescription

Transportation

Reduce Transportation Demand

Cities – the Sustainable Prescription

Transportation

Shift From Autos To Public Transit

Cities – the Sustainable Prescription

Transportation

Shift To Renewable Energy

Growth Policies Gone Wrong

Needed – A Systems Approach

Car First Priority - A Failed Paradigm

Cities must reduce demand thru land use changes & other methods, not just replace transportation technology.

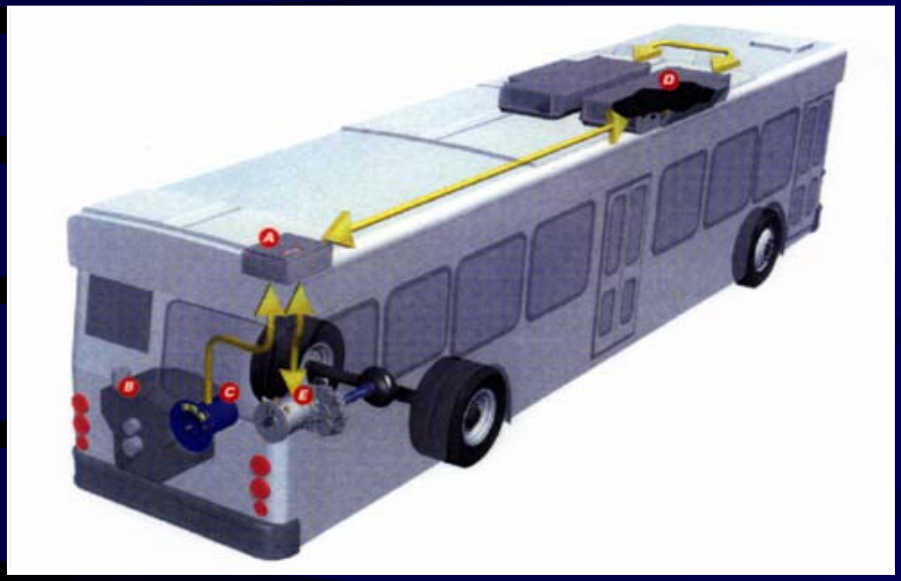
Technology – Honolulu Web Site

www.co.honolulu.hi.us

13 million hits per month – 16,000 Web pages

Best Transit System
Smart Bus Technology

The Honolulu Experience



Hybrid Electric Buses

Cycling – Multi-Modal Approach

New Technology – Traffic Control Center

Curitiba – Quest for Sustainable Transit

Karachi, Pakistan
Sustainable Transportation

Integrated Strategies to Improve Public Transport and Air Quality

Fuel Cell Technology-
Urban Purchasing Consortiums ?

Energy

Reduce Demand

Smart Growth Principles

- Mix land uses
- Compact building design
- Provide a variety of housing
- Create walkable neighborhoods
- Foster a strong sense of place
- Direct development toward existing communities
- Provide transportation options
- Encourage collaboration

Energy Star Purchasing Program

City partnership with U.S. Department of Energy

Water Conservation

- Natural Resources Conservation
- Emphasis on Reuse & Desalination
- New Technology
- Competitive Cost
- Renewable Energy

Commitment – American Samoa

Reduce per capita electricity and water consumption by 10%

Energy

Energy Efficiency

Energy Efficiency Incentives

Homeowners get low-interest loans to install solar water heating systems and rebates on energy and water efficient appliances.

City Energy Code

Over $300 million projected savings

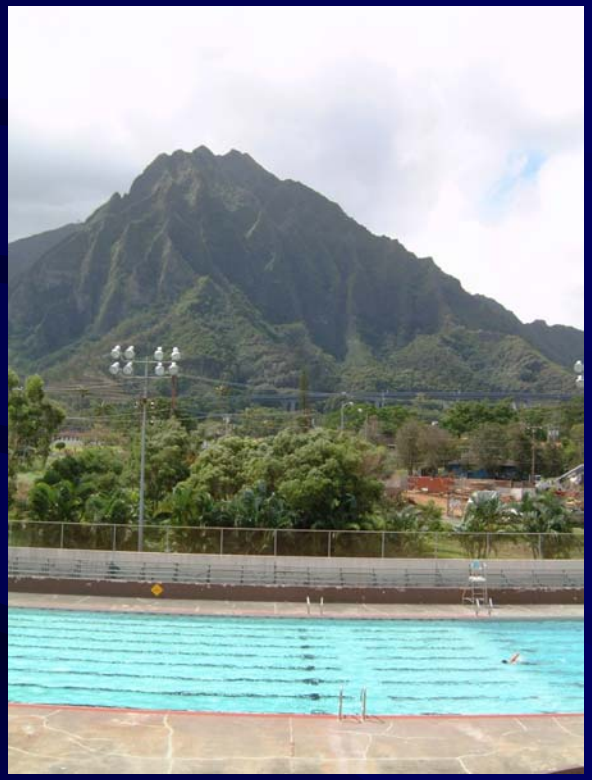
Green Building Standards

Bill before Council to establish LEED Silver Standard for all new city construction

Goal: Cut energy demand
at city facilities in half by 2010

Energy Efficiency Upgrades

City Hall



Kaneohe District Park

Kaneohe Police Station

Additional lighting upgrades at 14 city facilities

LED Traffic Signals

Replacement of traffic lights with light-emitting diodes saves $250,000 annually

Third Party Financing
Energy Efficiency Upgrades

- No up-front capital costs
- Build, own, operate, maintain
- Fixed price schedule provides a hedge against rising price of electrical power
- Clean solar power instead of power from fossil fuels

Energy

Renewable Energy Resources

Green Fleets

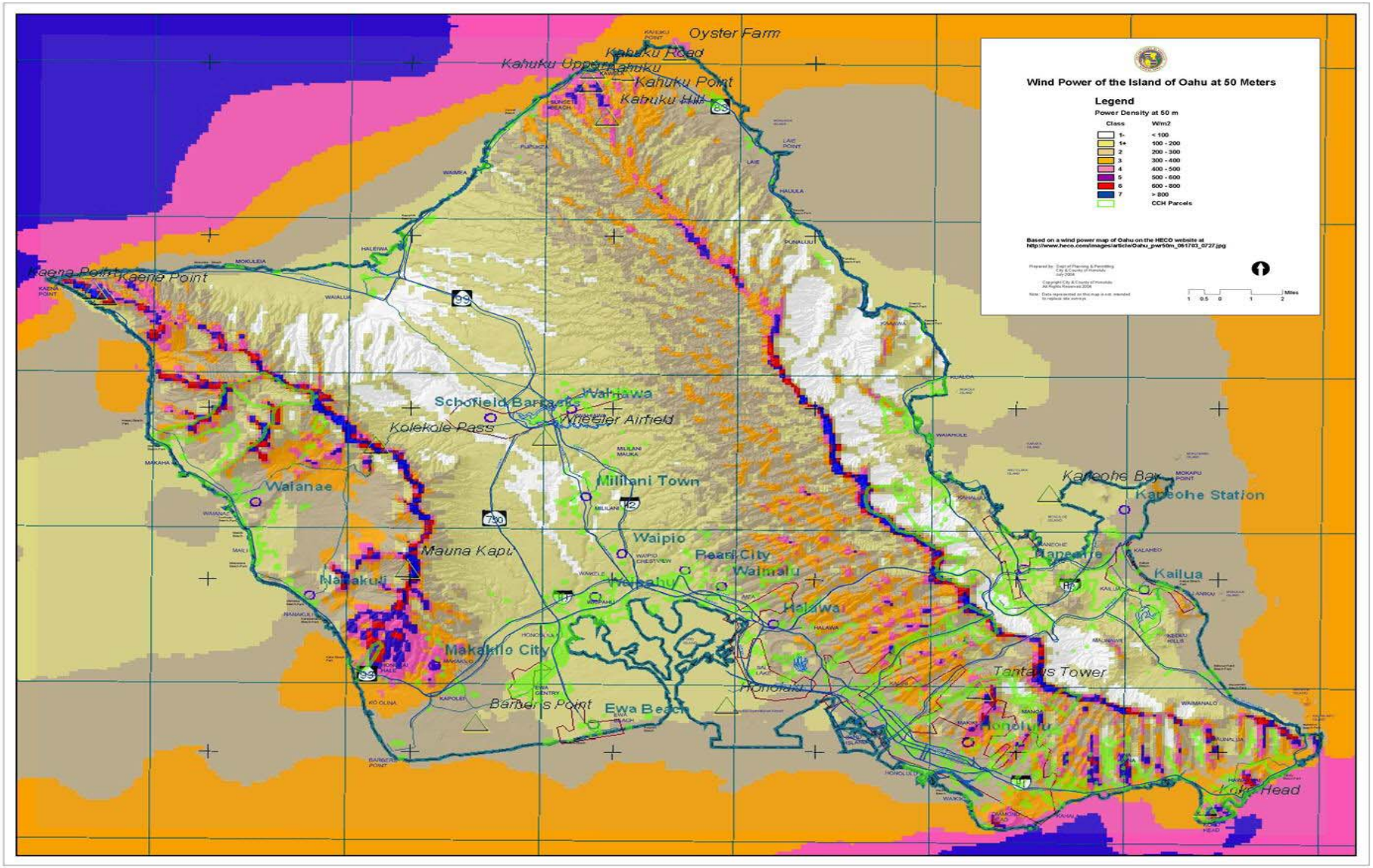
Renewable Energy – 1,000 Bio-diesel City Vehicles

Solar & Wind Power Lighting

Street light runs on solar and wind power

GIS Wind Contour Mapping

Wind Power

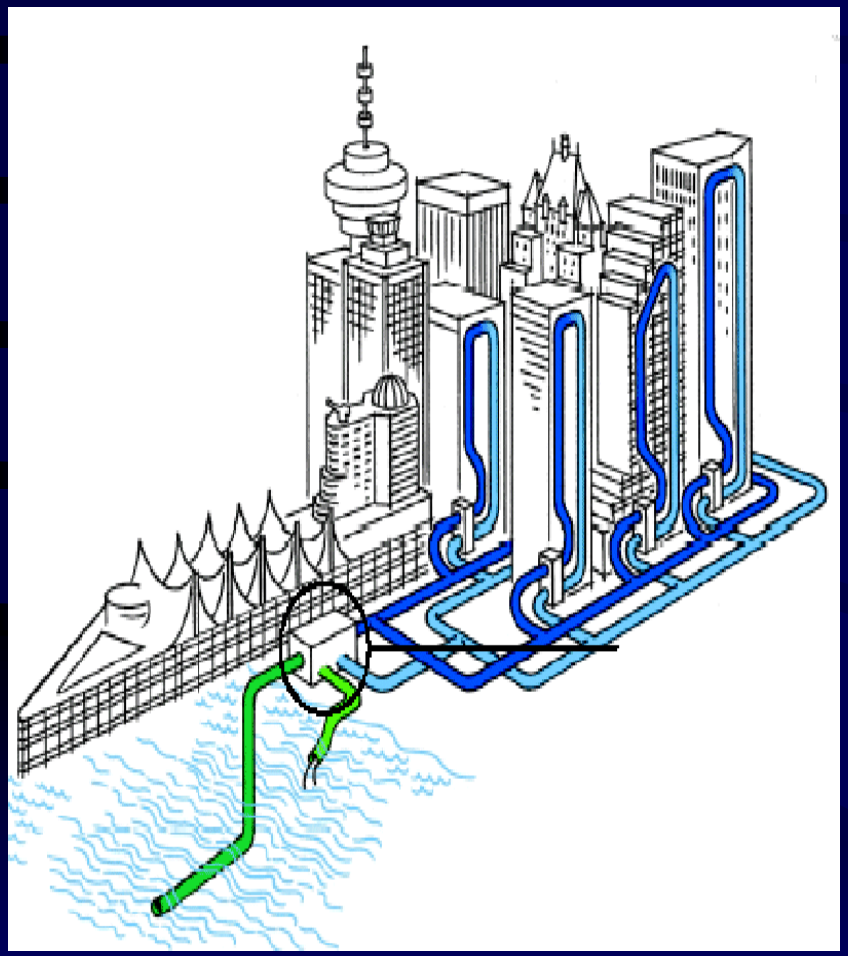

Wind Power of the Island of Oahu at 50 Meters
Legend
Power Density at 50 m
Class
W/m2
1-
< 100
1+
100 - 200
2
200 - 300
3
300 - 400
4
400 - 500
5
500 - 600
6
600 - 800
7
> 800
CCH Parcels
Based on a wind power map of Oahu on the HECO website at
http://www.heco.com/images/article/Oahu_pwr50m_061703_0727.jpg
Miles
1 0.5 0 1 2
Oyster Farm
Kahuku Road
Kahuku Upper Kahuku
Kahuku Point
Kahuku Hill
Kaena Point
Kaena Point
Schofield Barracks
Wahiawa
Wheeler Airfield
Kolekole Pass
Waianae
Mililani Town
Waipio
Pearl City
Waimalu
Mauna Kapu
Nanakuli
Halawa
Makakilo City
Barber's Point
Ewa Beach
Honolulu
Tantalus Tower
Kaneohe Bay
Kaneohe Station
Kailua
Diamond Head

GIS Solar Radiation Mapping

Renewable Ocean Energy

Ocean Thermal Energy Conversion

Deep Well District Cooling



- Delivers sustainable supply of chilled water to buildings for air conditioning
- Eliminates need for central cooling plants in buildings
- Reduces cooling tower blowdown to sewer
- Decreases energy consumption

Commitment – Likiep Atoll Marshall Islands

Allocated 85 percent of its national assistance funds to:

- solar energy
- potable water
- establish marine reserve

Energy
Distributed Energy Systems

Conservation & Co-generation

Electrical demand at City Hall cut by 80 percent

Refuse-Derived Fuel Power Plant

- Converts over 2,000 tons of waste per day
- Enough electricity for 40,000 homes
- Annual electrical revenue of over $26 million
- Reduced imported oil by 10.7 million barrels

Landfill Gas Recovery

Honolulu Bio-Power Initiative

On-site power generation uses bio-gas generated from anaerobic sludge digestion processes

Cities – the Sustainable Prescription

Solid Waste Management

Demand-Side Management

Cities – the Sustainable Prescription

Solid Waste Management

Recycle – Users Not Consumers

Cities – the Sustainable Prescription

Solid Waste Management

Energy Generation

Cities – the Sustainable Prescription

Solid Waste Management

Environmentally Safe Landfills ?

Kolkata, India
Solid Waste Management

The Honolulu Experience

Recycling

- Recycling
- Source Separation
  - Plastics
  - Metals

Environmentally Sensitive Practices

Recycling Glass

Environmentally Sensitive Practices

Recycling Green Waste

Commitment – Nonthaburi, Thailand

- Recycling and composting programs reduced solid waste by 21 percent in less than two years

Curitiba – Recycling for Food

The Honolulu Experience
Refuse-Derived Fuel Power Plant

- Converts 2,000 tons of waste per day
- Electric for 40,000 homes
- Reduced imported oil by 12 million barrels

The Future-

Plasma arc technology ?

Sustainable Landfill Management

Leachate Protection, Energy Generation, Ash Reuse-Aggregate, Construction Block

Cities – the Sustainable Prescription

Storm Water Management

Grading Controls

Cities – the Sustainable Prescription

Storm Water Management

Hazardous Chemical Controls

Cities – the Sustainable Prescription

Storm Water Management

System Design & Maintenance

Watershed Protection

Grading Controls – Detention & Retention Ponds

Watershed Protection

Controlling Non-point Source Pollution

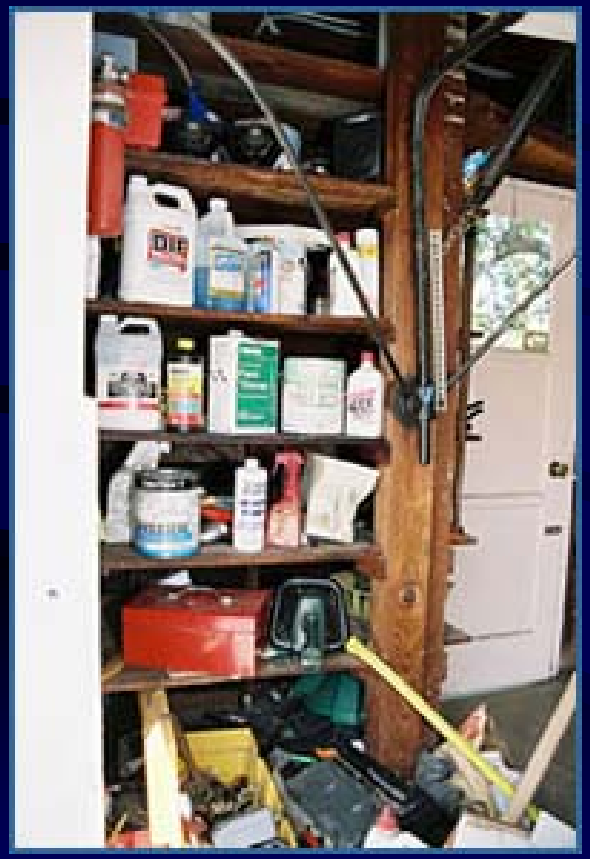
Storm-drain maintenance

et Explorer

INSPECTION					CLEANING					
INSPECTOR	STATUS	DEBRIS LEVEL	DATE / TIME		CLEANER	STATUS	START DATE / TIME		FINISH DATE / TIME	
Inspection1	Need to clean	full	10/29/02	9:18:23 AM	Cleaning1	Finished cleaning	10/29/02	10:58:29 AM	10/29/02	10:59:17 AM
Inspection2	Need to clean	three-quarter	6/20/03	9:20:16 AM						

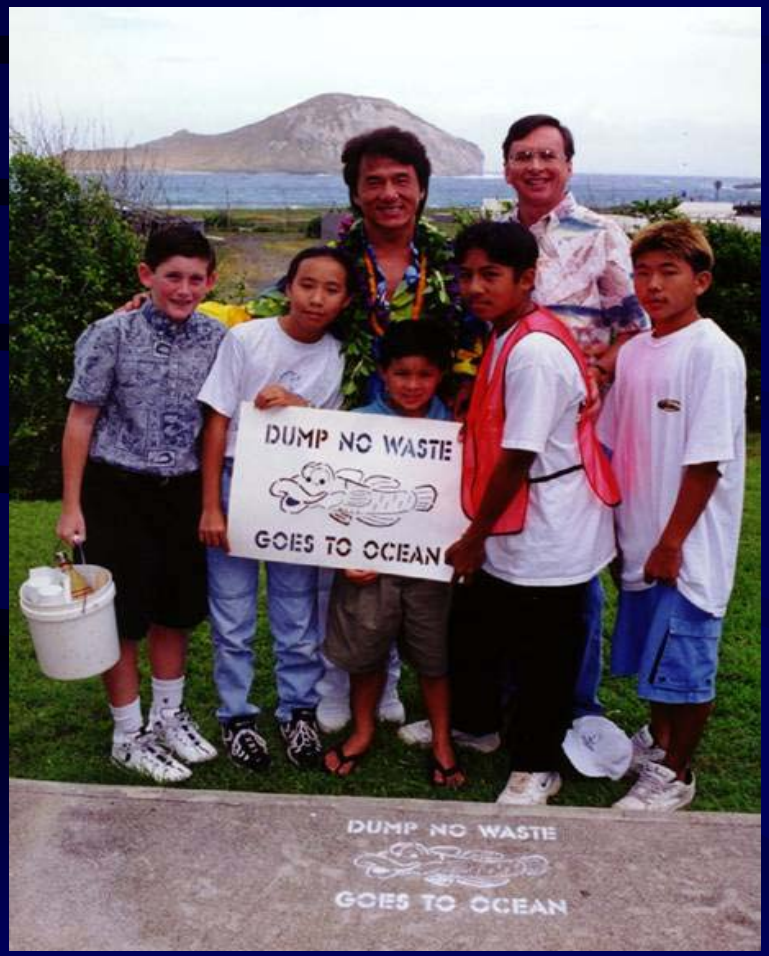
Providing field workers with real-time information

Public Education and Community Involvement



Household hazardous waste education and drop-off programs

Watershed Protection
Public Education Programs



Storm-drain maintenance

Public Education and Community Involvement

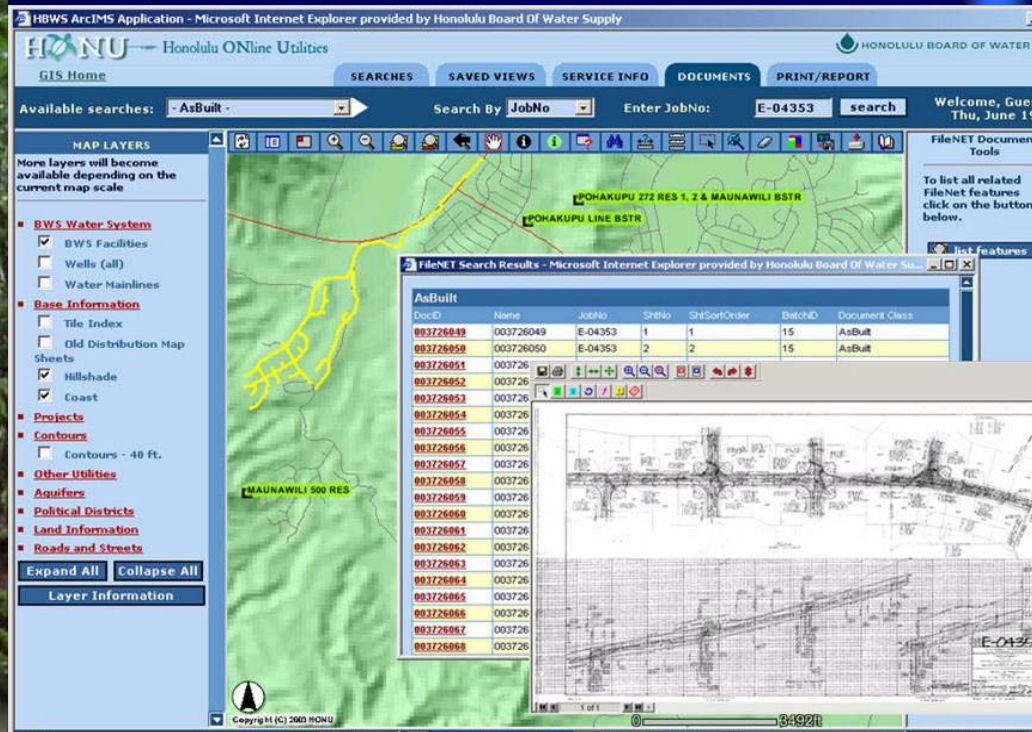
Earth Protection Agents Program

Commitment – Hanoi, Vietnam

- New waste facilities
- Industrial waste landfill
- Central city drainage system

Cities – the Sustainable Prescription

Potable Water
Watershed Management

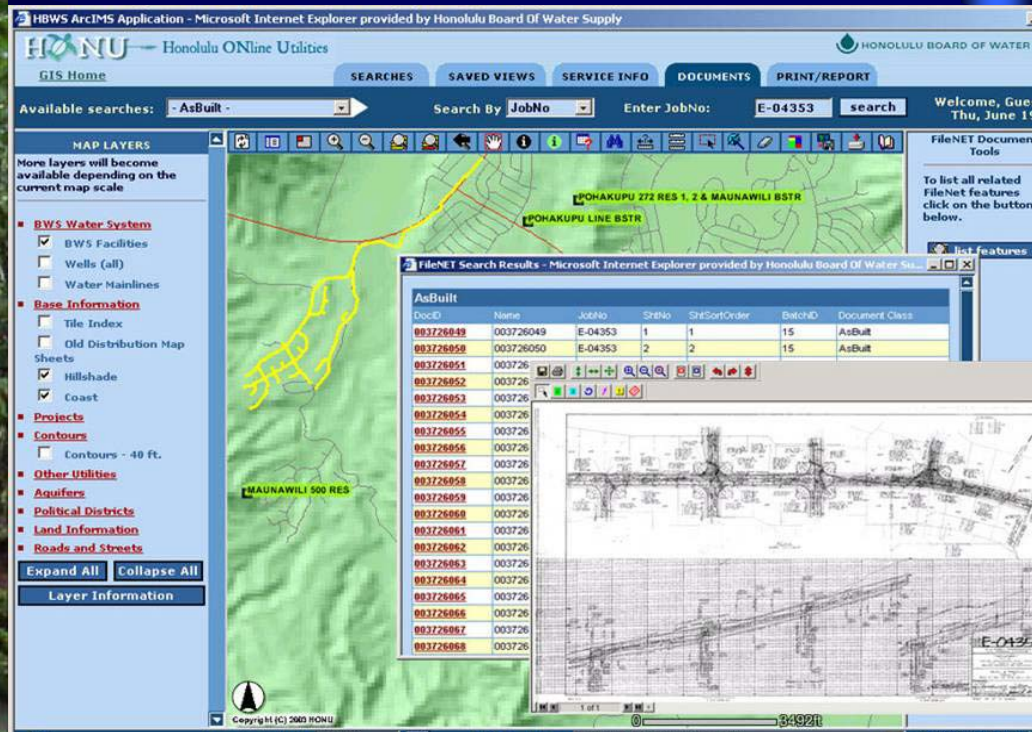


Watershed Protection

Source: Peopleandplanet.net

Cities – the Sustainable Prescription

Potable Water
Demand-Side Management

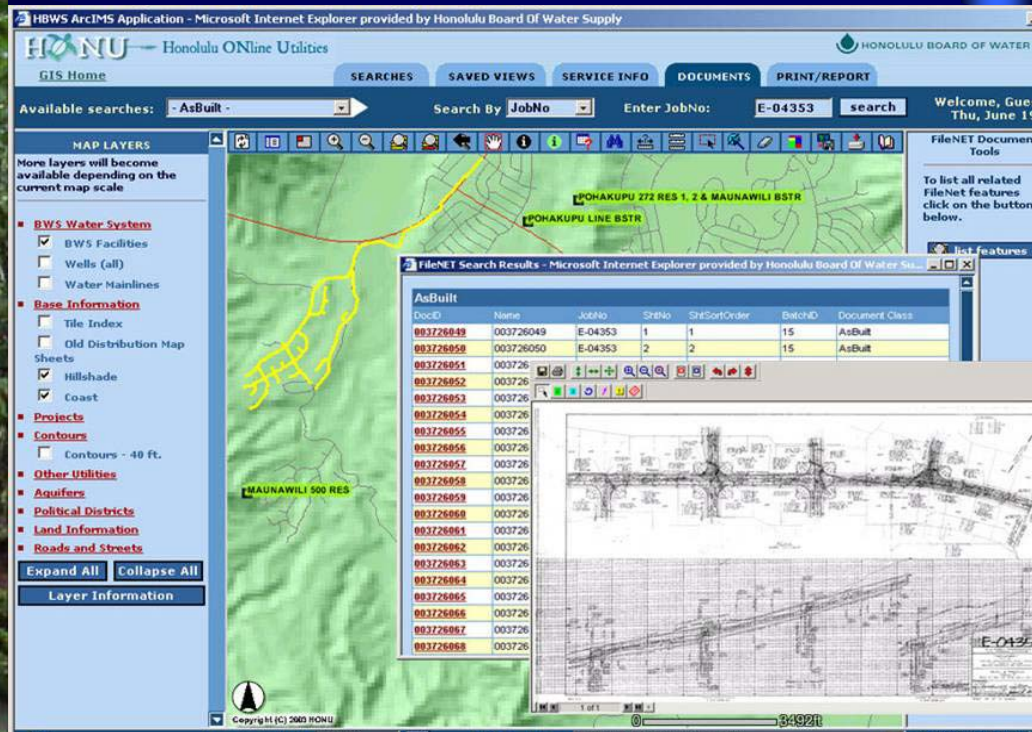


Phnom Penh, Cambodia
Water Service – Full Cost Recovery

Cities – the Sustainable Prescription

Potable Water

Improved Ag Techniques



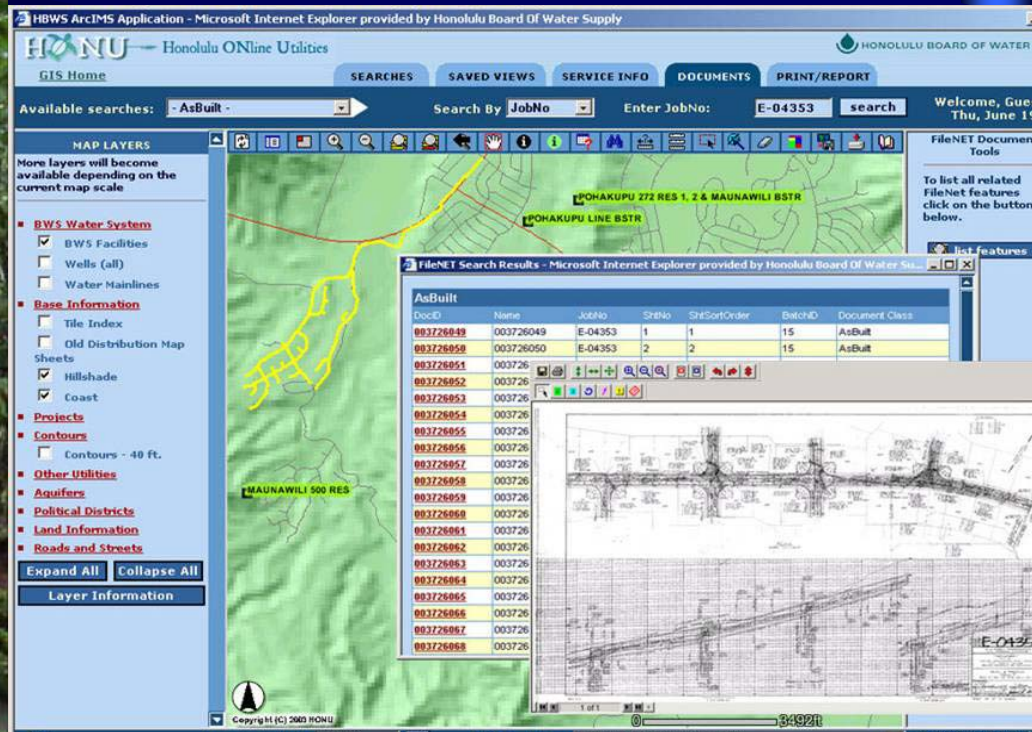
Wastewater Recycling

Agricultural irrigation

Cities – the Sustainable Prescription

Potable Water

Water Treatment & Transmission



New Technology

Electronic Meter Reading

Cities – the Sustainable Prescription

Wastewater Management

Demand-Side Management

Environmentally-Caused Disease

Estimates suggest that less than 5% of sewage in developing countries is treated before it is discharged into the environment

Source: World Resources Institute

Water Conservation

No-Flush Urinal

No-Drip Fixtures

Cities – the Sustainable Prescription

Wastewater Management

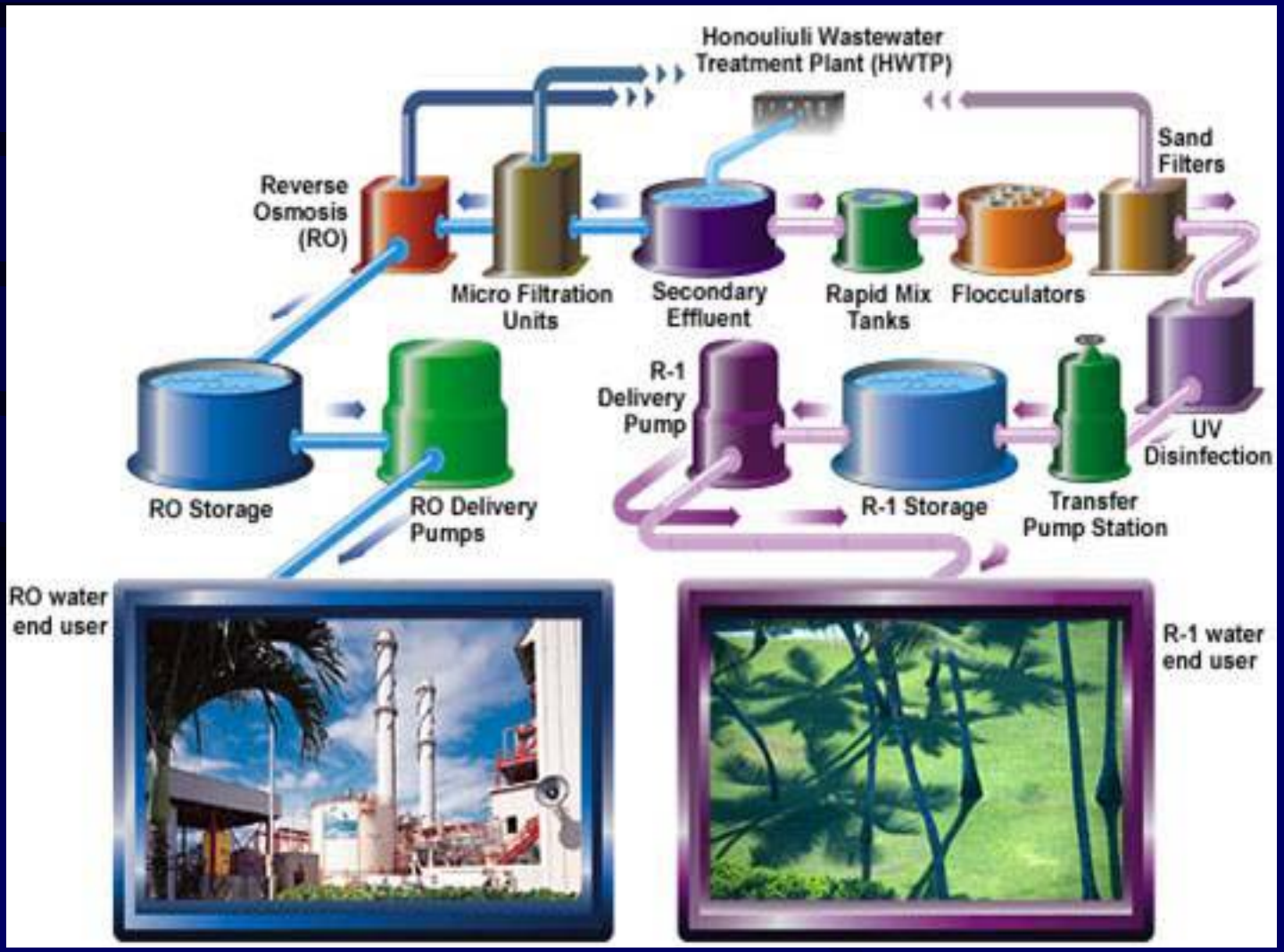
Recycling of Effluent & Solids

Commitment – Honolulu

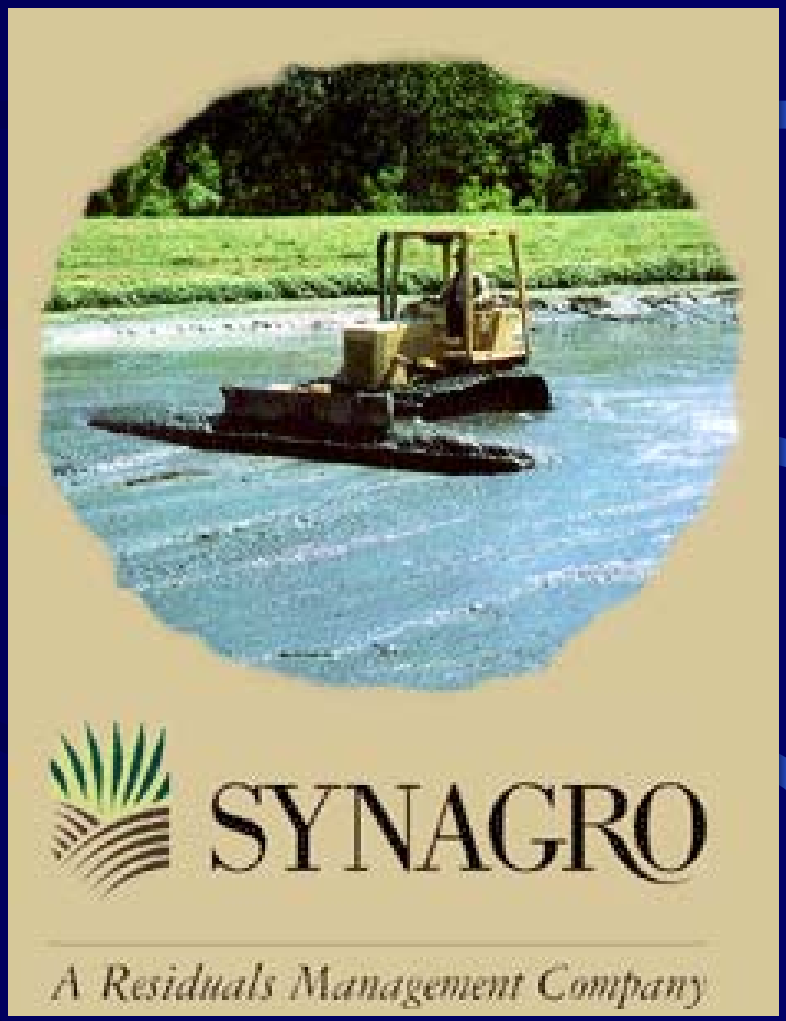
- Invest $1 billion in wastewater upgrades
- Increase wastewater recycling to 10 MGD
- Begin construction of Bus Rapid Transit

The Honolulu Experience

Wastewater Recycling Systems



Conserving Our Natural Resources



The Search for New Technologies

Wastewater Recycling

Membrane technology

Male, Maldives/Honolulu, Hawaii
SCADA Monitoring

Commitment – Vadodara, India

Increased sewage treatment capacity from 25 to 100%

Commitment – Ahmedabad, India

- City to meet its 2001 commitment target of 100 percent waste water treated by 2004
- Currently pursuing commitment to improve the quality of life of slum dwellers

Cities – the Sustainable Prescription

Financing

Lifecycle Costing

Cities – the Sustainable Prescription

Financing

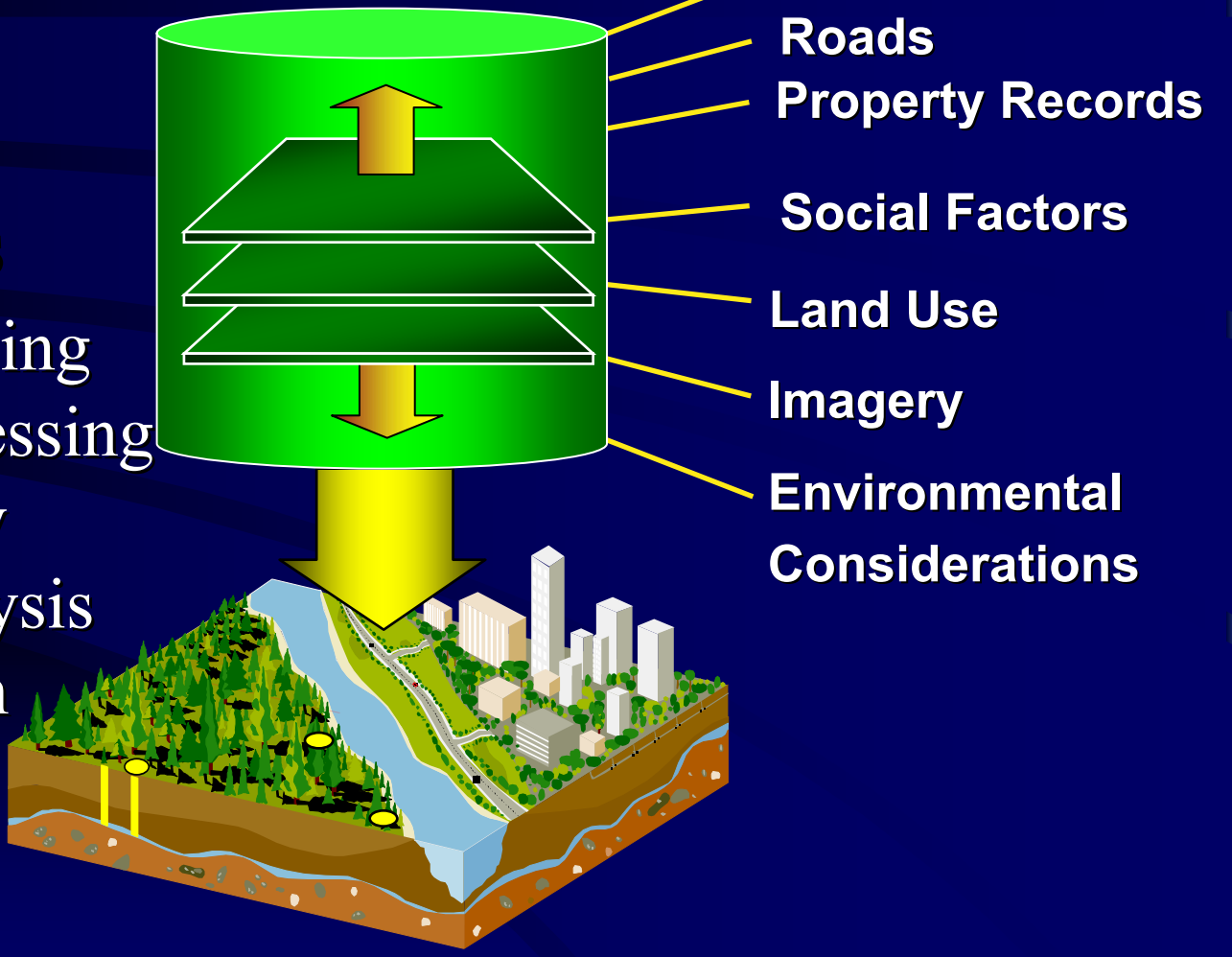
Triple-Net Analysis

FITCH

The Honolulu Experience

Enterprise-wide GIS

Integrated Decision-making Tool



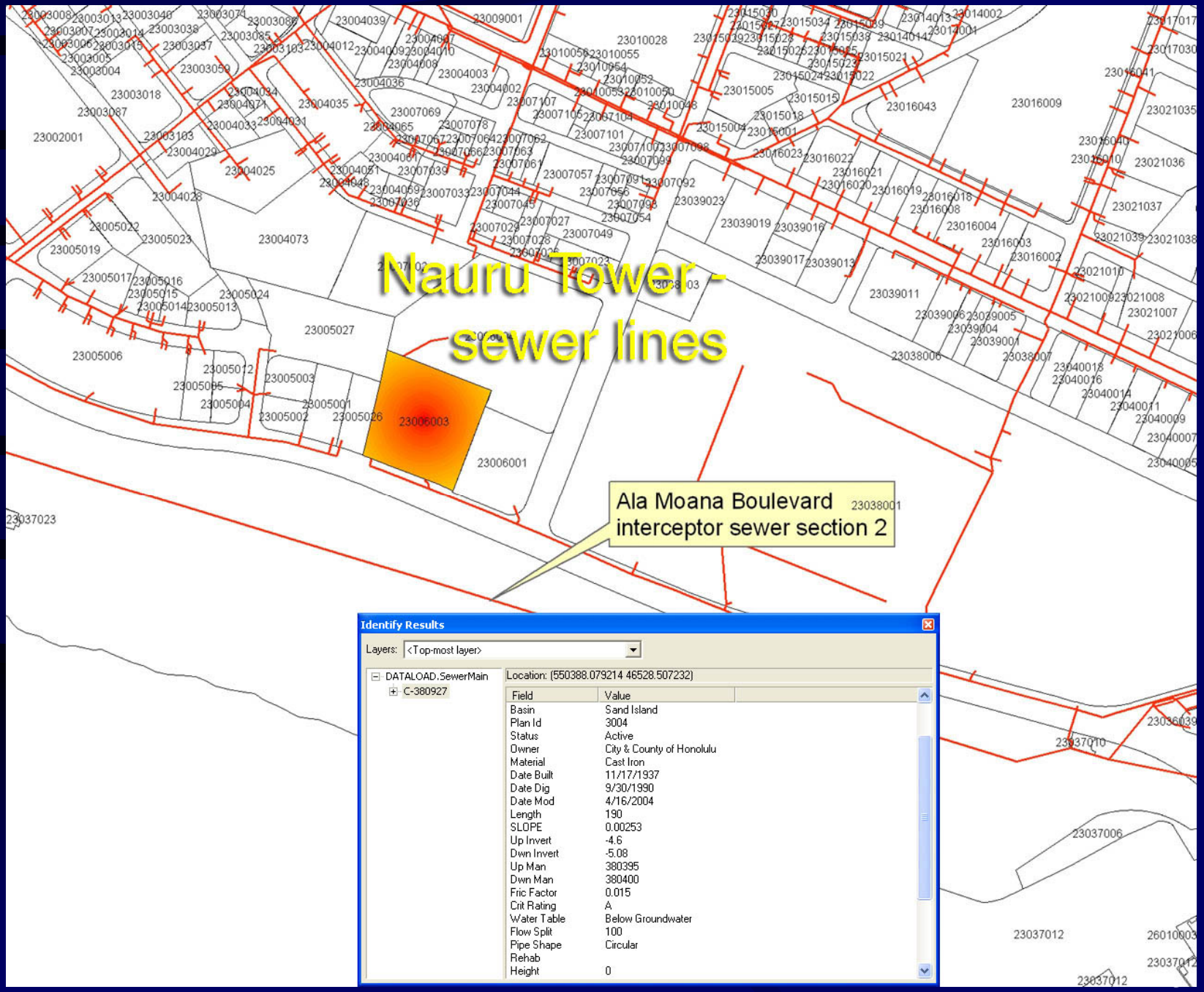
Key Concepts

- GeoReferencing
- Digital Processing
- Map Overlay
- Spatial Analysis
- Visualization

Planning for the Future

Tools - GIS

Construction Plans - GIS Virtual 3D data


Nauru Tower - sewer lines
Ala Moana Boulevard interceptor sewer section 2
23038001
23006003
23006001
Identify Results
Layers: <Top-most layer>
DATALOAD.SewerMain
C-380927
Location: (550388.079214 46528.507232)
Field
Value
Basin
Sand Island
Plan Id
3004
Status
Active
Owner
City & County of Honolulu
Material
Cast Iron
Date Built
11/17/1937
Date Dig
9/30/1990
Date Mod
4/16/2004
Length
190
SLOPE
0.00253
Up Invert
-4.6
Dwn Invert
-5.08
Up Man
380395
Dwn Man
380400
Fric Factor
0.015
Crit Rating
A
Water Table
Below Groundwater
Flow Split
100
Pipe Shape
Circular
Rehab
Height
0

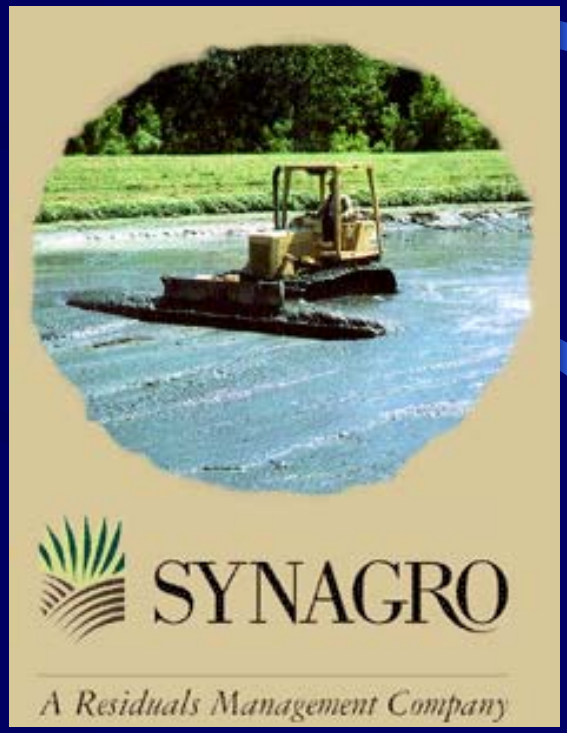
The National Academies Program on Environmental Sustainability

Goal- Help urban leaders use scientific knowledge and technology to guide economic growth sustainably to improve livelihoods and protect critical environmental and natural resources.

National Academies Program on Urban Environmental Sustainability

Objective 1

Foster the Use of Scientific Knowledge and Technology



National Academies Program on Urban Environmental Sustainability

Objective 2

Enhance Human /Institutional Capacity

National Academies Program on Urban Environmental Sustainability

Objective 3

Encourage Integrated Urban Planning and Local Environmental Leadership

National Academies Program on Urban Environmental Sustainability

Objective 4

Advance the Science of Urban Environmental Sustainability

National Academies Program on Urban Environmental Sustainability

Objective 5

Extend Successful Local Experience to Cities Worldwide

National Academies Program on Urban Environmental Sustainability

Objective 6

Evaluate Program's Impacts and Adaptively Manage the Program

Focus Cities in Four Countries

China, Mexico, South Africa, Tanzania

Proposed Activities in China

Chinese Steering Committee

Selection of Chinese Cities

Integrated Assessment

Pilot Demonstrations

Systematic Empirical Study

Independent Technical Advice

Proposed Activities in Mexico

Sustainability Steering Committee

Integrated Assessment of Challenges

Projects to Address High Priorities

Transportation & Wastewater

Proposed Activities in Tanzania
Dar es Salaam

- Data Collection and Analysis
  - Transportation database
  - Energy Source/Consumption database
  - Water Source/Use/Distrib. Database
- Linkage of Databases
- Refining Transportation Master Plans
  - Pollution Control/Abatement Policies

Global Activities

Develop Indicators For Urban Sustainable Development

Develop Two Guides to Best Practices & Technologies

Mobilize Volunteer Scientists & Engineers

Phase One – Summary of Activities

Integrated assessments of major environmental challenges and opportunities of four cities

Monitor pilot demonstrations of promising environmental technologies and practices

Create institutional arrangements with local governments and other stakeholders

Develop two easily accessible guides to technologies and best practices to address urban issues

Source: York Times Almanac 2004

Phase One – Summary of Activities

Complete a systematic empirical study of select Chinese cities in incorporating environmental sustainability principles into their development plans

Provide independent technical support to the Tianjin Economic-Technologic Development Area

Mobilize 50+ volunteer scientists & engineers to work with and mentor local scientists and engineers

Develop indicators for environmentally sustainable urban development to assess environmental status, anticipate problems, and assess impact of programs

Source: York Times Almanac 2004

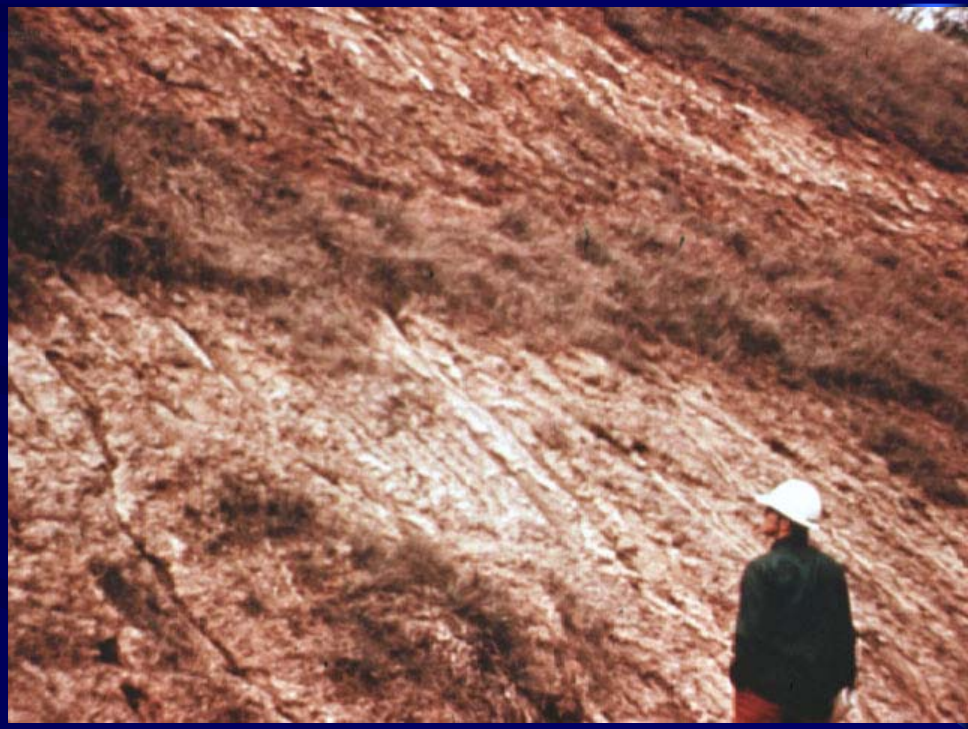

Inspiration
Ideas
Implementation

Mahalo

Sustainability in a Divided World

The developing world has plunged ahead with industrialization often ignoring the attendant challenges of environmental degradation and resource depletion

Role of the Developed World



If the developing world repeats the folly of short-term thinking, ultimately, the world will be at greater risk

Developing World's Natural Debt

The debt will eventually have to be paid by everyone: There are no boundaries in the global environment

Trade and the Environment
The Sustainability Conundrum of Our Time

- Unwilling to pay the true cost of industrial production
- Developing countries are increasing natural debt

Global Population

- Global population now exceeds 6.3 billion, more than double what it was in 1950
- Projected to grow to 8.9 billion in 2050

Source: World Population Prospects: The 2002 Revision

Global Population – Growth Rates

- Growth rate becomes negative in the more developed countries in 2030
- Population growth is expected to continue to rise in the developing world

Source: World Population Prospects: The 2002 Revision

Global Population – Least Developed

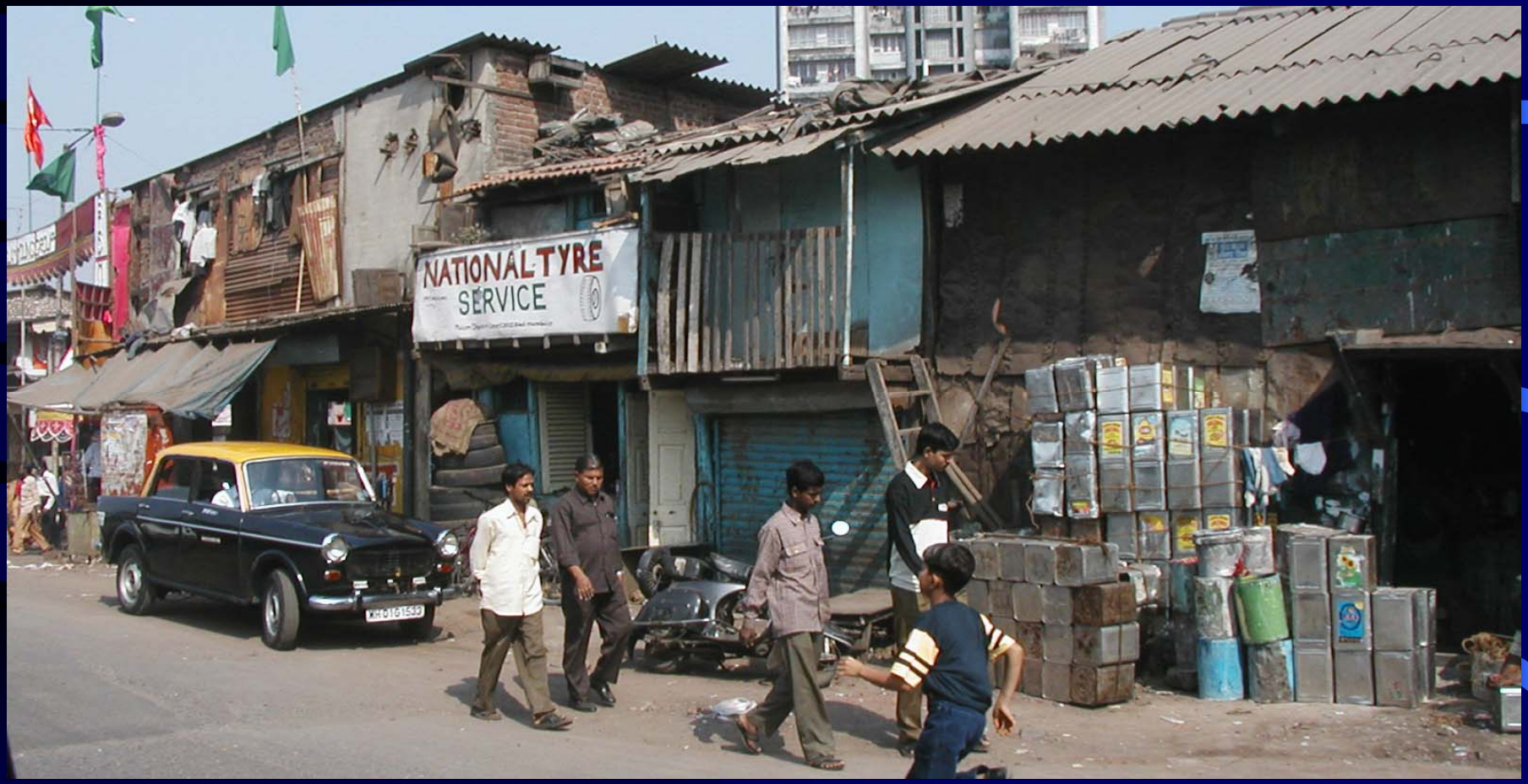
Despite high mortality, population in the least developed countries will double between 2000-2050, from 668 million to 1.68 billion

Source: World Population Prospects: The 2002 Revision

Urbanization

Rapid urban growth results in environmental degradation, unemployment, lack of urban services and adequate shelter, and overburdening of infrastructure

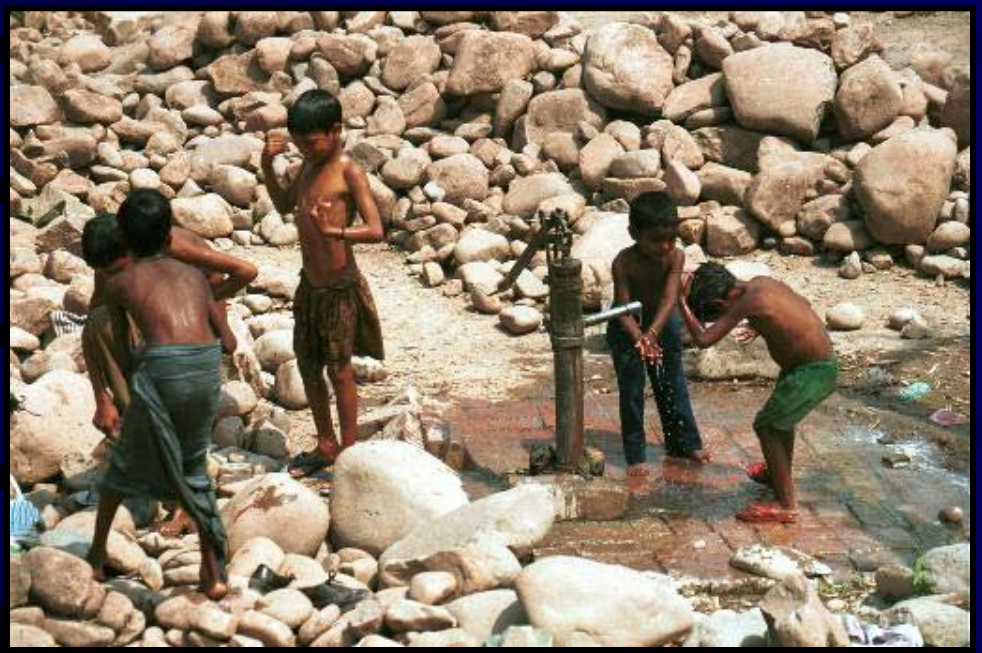
Urbanization – Poverty



Presently, over 900 million people – about 1/3 of the world's urban population, are slum dwellers

Source: Peopleandplanet.net

Environmentally-Caused Disease



High population density and poor sanitation, characteristics of urbanization, promote the spread of infectious disease

Exporting Electronic Waste

Women in a Chinese village pick over the wire remains of computers exported from the West[172]

Source: Basel Action Network

World Reliance on Fossil Fuels Continues to Grow

In 1999 fossil fuels accounted for 84.7 percent of world energy consumption

By 2020 world reliance on fossil fuels is projected to rise to 87.5 percent

Urban Alliances:
Key to a Global Sustainable Future

Cities – the Sustainable Prescription

6. Economy

Non-Point Source Pollution

- 3 billion people live within 200 kilometers of a coastline
- By 2025 that figure is likely to double

Source: Population Reference Bureau

Non-Point Source Pollution

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Sustainable Planning

Honolulu's Bus Rapid Transit: New Hybrid Electric Buses

Transportation

Shift To Renewable Energy

Global Warming

Transportation contributes
a large share of urban air pollution

Certificate in Urban Sustainability

Royal Institute of Technology

Stockholm, Sweden

Infrastructure

Land Use & Agriculture

Transportation

Energy

Natural Resources

Cities – the Sustainable Prescription

Economic Development

Primary Industry - Reuse

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Financing

Third Party Financing

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Economic Development

Service/Tourism-Grow Resources

Cities – the Sustainable Prescription

Economic Development

Manufacturing-Natural Debt Free

Deforestation

- 80% of the forests that originally covered the Earth have been cleared
- 36 million acres are destroyed each year

Source: World Resources Institute

Energy – Access Inequality

Invest in Leapfrog Technology

About 2.5 billion people have no access to modern energy services

Source: Time Almanac 2004

Cities – the Sustainable Prescription

Wastewater Management

Independent Collection Systems

The Honolulu Experience

Potable Water Filtration System

Global Warming

- Disrupts weather patterns
- Impacts coastal areas
- Spreads infectious disease
- Affects agricultural production