



Growing confidence in forestry's future

Research
Programme
2013-2019



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International Trends in Water: Issues and Forestry Research

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USDA Forest Service
SCION New Zealand



SOME “DOWN UNDER” WATER WISDOM



“Footrot Flats” by Murray Ball

SOME “DOWN UNDER” WATER WISDOM

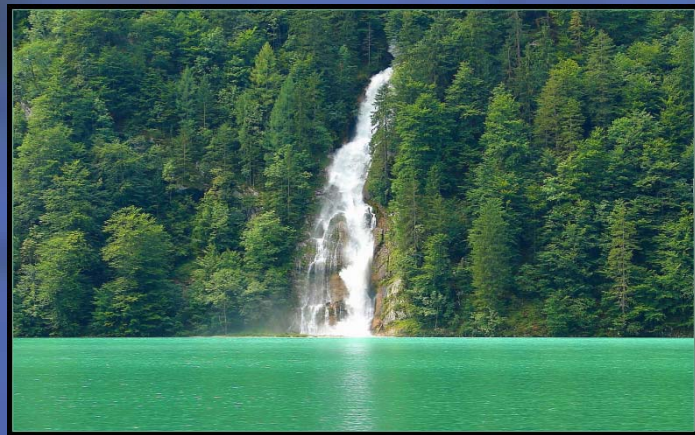


“Footrot Flats” by Murray Ball

INTRODUCTION



WATER USES IN THE 21st CENTURY



- Municipal and Rural Water Supply
- Forestry
- Agricultural Production
- Energy Production
- Manufacturing
- Wildlife Habitats
- Recreation
- Biodiversity Reservoir
- Transportation

WATER IN THE 21st CENTURY: VIEWPOINTS



- *“Water...will probably become the most critical natural resource issue...”*

- - Financial Times of London

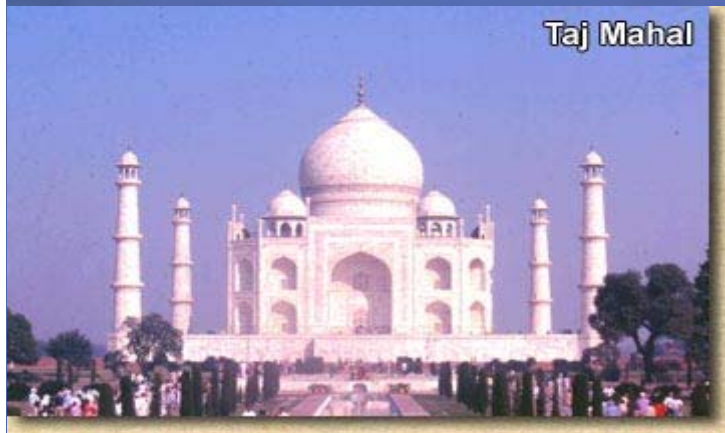


WATER VIEWPOINTS: 8th CENTURY B.C TO THE 21st CENTURY:

- *"...One should take proper managerial action to use and conserve water from mountains, wells, and rivers, and also rainwater for use in drinking, agriculture, industries..."*

Atharva Veda Verse
800 B.C. India

- Chandra 1990



Ganges
River

WATER IN THE 21st CENTURY: VIEWPOINTS FROM THE PAST

■ *"We made from
water everything."*

-The Koran 632 A.D.



WATER IN THE 21st CENTURY: VIEWPOINTS FROM THE PAST



- *“an array of indispensable structures carrying so many waters”*

Frontinus 100 A.D.

- Roman Water Engineering
 - ROME – 97 A.D.
 - 1 million people
 - 9 Aquaducts, 400 km in length
 - 450 L/Person/Day
 - 5 More Aquaducts by 300 A.D.
- **SOURCE WATER: FORESTED WATERSHEDS**

WATER IN THE 21st CENTURY: VIEWPOINTS FROM THE PAST



■ *“No one knows the value of water until he is deprived of it.”*

David Livingstone
1813-1873



WATER IN THE 21st CENTURY: VIEWPOINTS FROM THE PAST



"If we solve every other problem in the Middle East, but do not satisfactorily resolve the water problem, our region will explode."

**Yitzhak Rabin
1922-1995**



WATER IN THE 21st CENTURY: VIEWPOINTS FROM THE PAST



*"Whiskey is for
drinking, water is
for fighting over."*

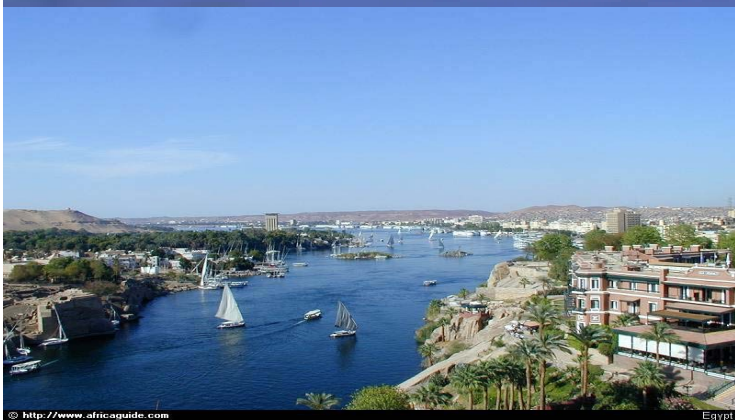
Unknown Arizona
Cowboy - 1901

WATER IN THE 21st CENTURY: VIEWPOINTS FROM THE PAST



Nile River

"...if Egypt were to ever go to war again it would be over water." Anwar Sadat – 1979



UPDATE: So far most 21st Century nation-to-nation water interactions are cooperative but conflict simmers below the surface

WATER IN THE 21st CENTURY: VIEWPOINTS FOR THE 21st CENTURY



Colorado River

■ *"Using water as we do today, just reaching the food production levels needed in 2025 could require...the annual flows of 24 Nile Rivers or 110 Colorado Rivers."*



Sandra Postel
"Pillar of Sand" -1999

PRESENTATION OBJECTIVES

- Discuss Trends in Water & Research Relative To Production Forests
 - Historical Perspective
 - International View
 - Trends



FOREST WATERSHEDS



WS 17 WEIR

COWEETA HYDROLOGIC LAB

■ WHY IMPORTANT?

- Source of Water Supply
- Consistent Flow
- High Quality
- **More Scrutiny of Uses**

GLOBAL WATER TRENDS



Black River, Arizona, USA

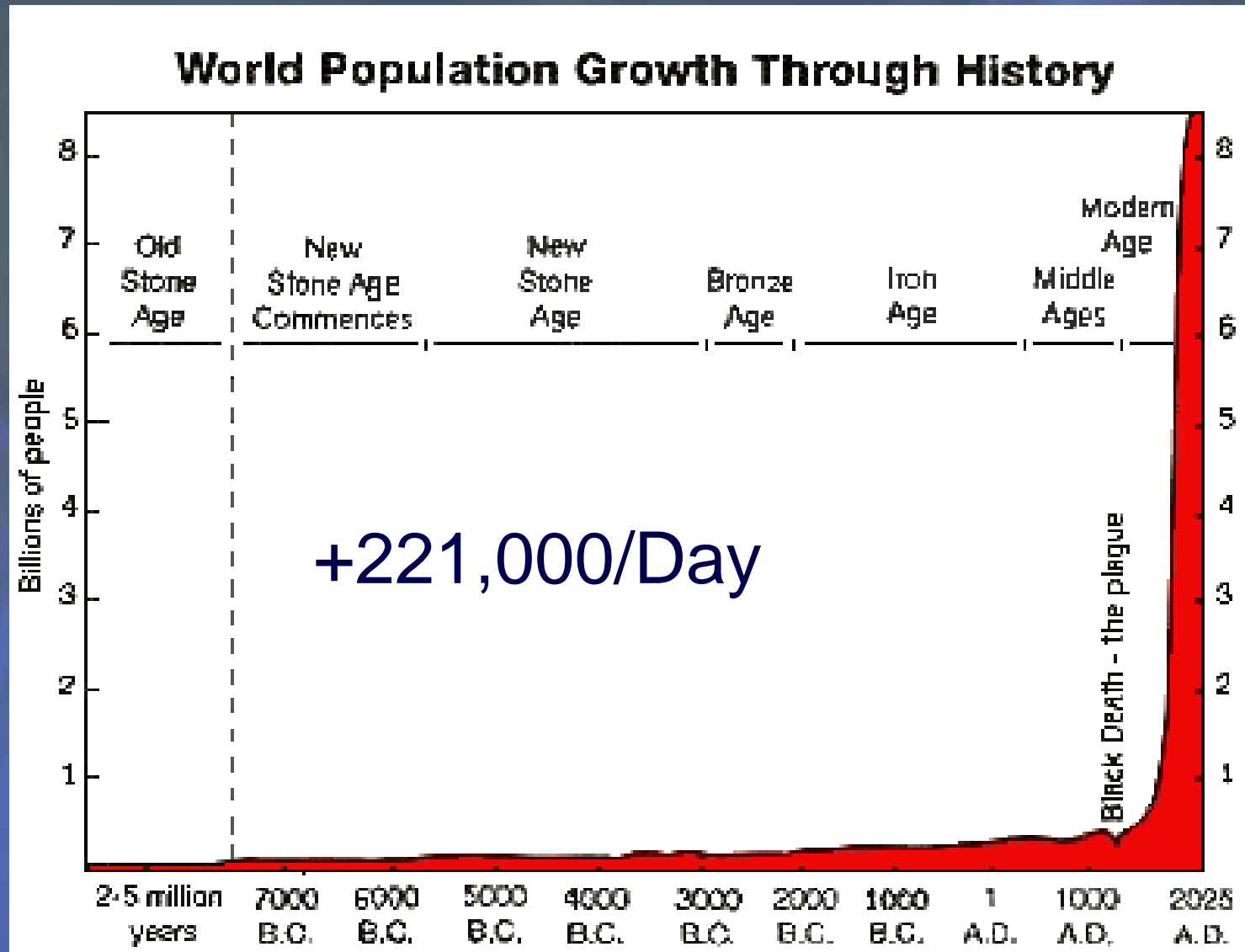


- Increasing Water Demand
- Water Scarcity
- Declining Water Quality
- Unmet Needs
- Changing Expectations
- Climate Change

INCREASING WATER DEMAND

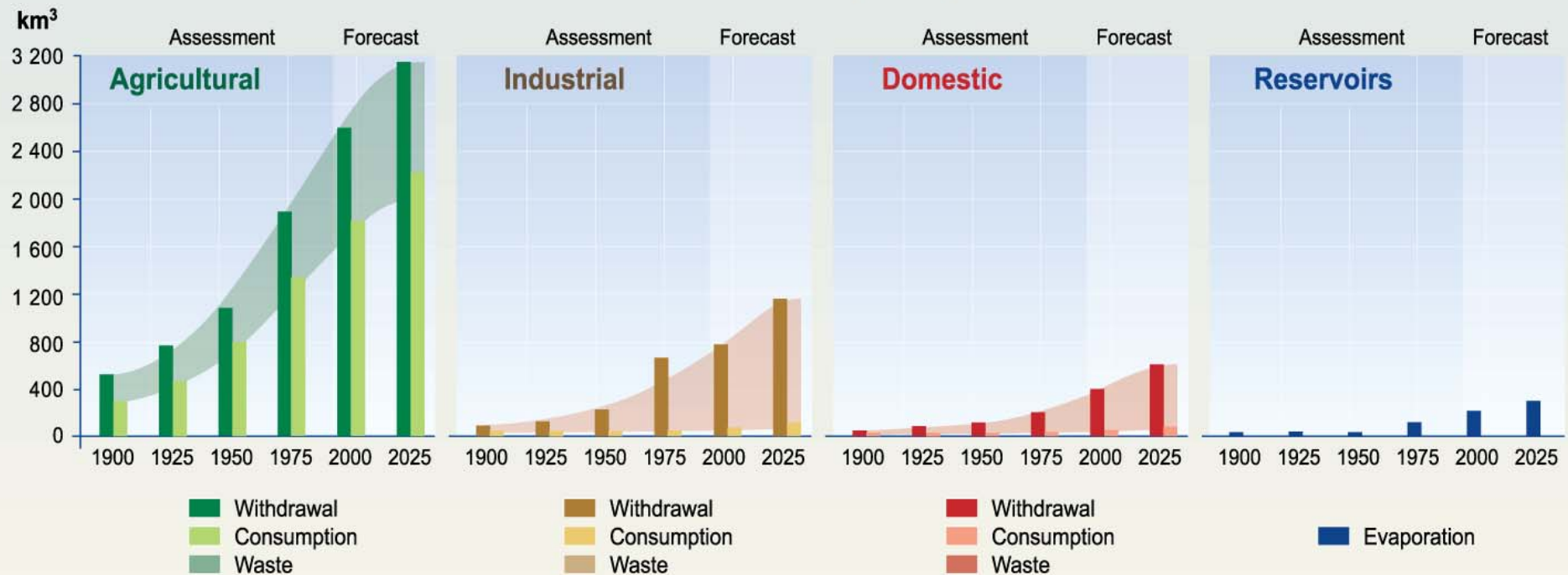


WORLD POPULATION GROWTH



INCREASING WATER DEMAND

Evolution of Global Water Use Withdrawal and Consumption by Sector



Note: Domestic water consumption in developed countries (500-800 litres per person per day) is about six times greater than in developing countries (60-150 litres per person per day).

PHILIPPE REKACEWICZ
FEBRUARY 2002

Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999.

SOURCE: UNEP

INCREASING WATER DEMAND



- Consumption 2X Since World War II
- Agriculture >67%
- Developing States
 - Ag Use >90%
- Higher Costs
- Higher Regulations
- User Conflicts

WATER SCARCITY



WATER SCARCITY

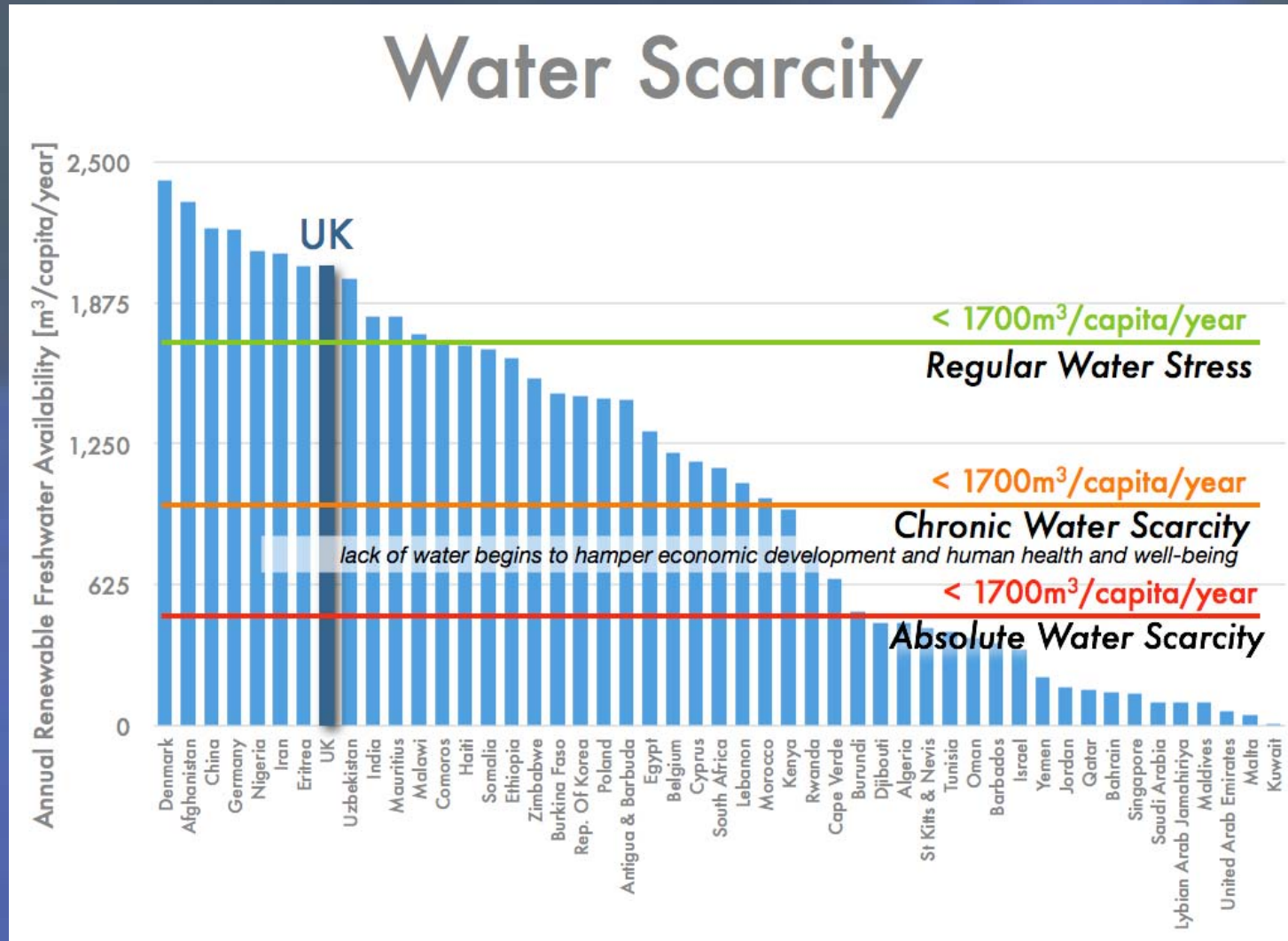


- Water Supply Issue
- Sustainability Doubtful
- NOW: 2.4 B People in Water Stressed Countries
- 2025: **5.0 B** People in Water Stressed Countries
- Ground Water Tables Declining Due to Non-Sustainable Withdrawals
- River Flows Diminished



145,000 m³/capita/yr

WATER SCARCITY

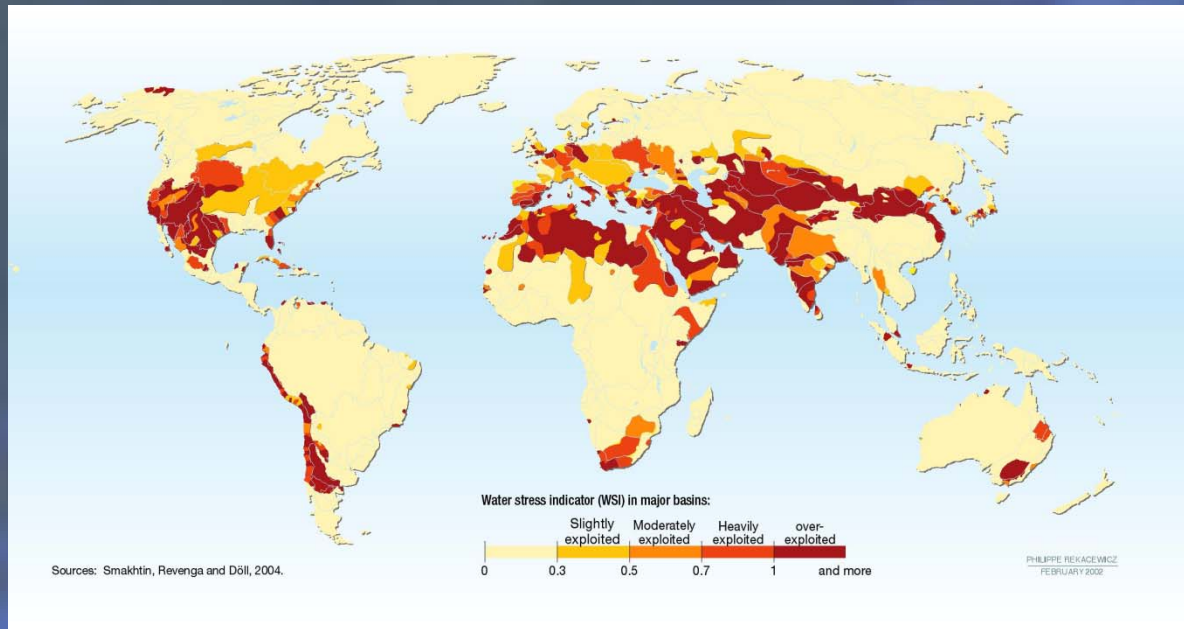


1,700

1,000

500

WORLD-WIDE WATER STRESS



■ NOTABLE AREAS

- USA, MEXICO, & CHILE &
- EUROPE, N & S AFRICA
- MIDDLE EAST
- INDIA & CHINA
- AUSTRALIA

DECLINING WATER QUALITY



DECLINING WATER QUALITY



Rio Grande River, Texas



Samrong Canal, Thailand

- #1 Global Environmental Risk (Low Water Quality)
- Physical Security Risk to Water Quality
- Economic Security Risk Due to Lack of Resources
- 900 M People Without Access to Safe Water
- 5 M Deaths/Year
- Major Cause of Child Mortality

DECLINING WATER QUALITY



- Agricultural Runoff
- Industrial Wastewater
- Inadequate Urban Wastewater Treatment
- Lack of Best Management Practices
- Livestock Concentrations
- Logging Steep Terrain
- Urbanization
- Wildfires and Erosion

DECLINING WATER QUALITY

The New Zealand Herald

“Weed killer closes dams: Herbicide found in Auckland's water-supply lakes”

12:30 PM Tuesday Oct 14, 2014

- Metsulfuron methyl
 - Aerial application
 - $<1 \text{ mg m}^{-3}$ (ppb) in reservoir water
 - At the lake head
 - No NZ standard
 - 2 dams closed 4 months
- Wairoa Dam**



DECLINING WATER QUALITY

The New Zealand Herald

“Weed killer closes dams: Herbicide found in Auckland's water-supply lakes”

12:30 PM Tuesday Oct 14, 2014

Question?
A Real Concern About a
“Toxic Chemical”
Or **Hysteria**

Science Solution?
BMPs
Proper Monitoring



Wairoa Dam

DECLINING WATER QUALITY

What never made *The New Zealand Herald*

“Herbicide applied to Hunua forests: Not found in Auckland's water-supply lakes”

- Hexazinone + Terbutylazine
- Granular formulation by ground
- Lake & streams well buffered
- Appropriate monitoring protocol used
- **RESULT:** No residues in streams or lakes



Hunua Forest

DECLINING WATER QUALITY WILDFIRES



Wallow Fire 2011, Arizona

WATER SUPPLY PHYSICAL RISKS WILDFIRES



Schultz Fire 2010, Arizona

WATER QUALITY WILDFIRES



Victoria Australia 2009 Bush Fires

WATER QUALITY WILDFIRES

2002 FIRE



**COTTER RIVER WATERSHED
CANBERRA ACT**

BIZARRE WATER QUALITY PROBLEM

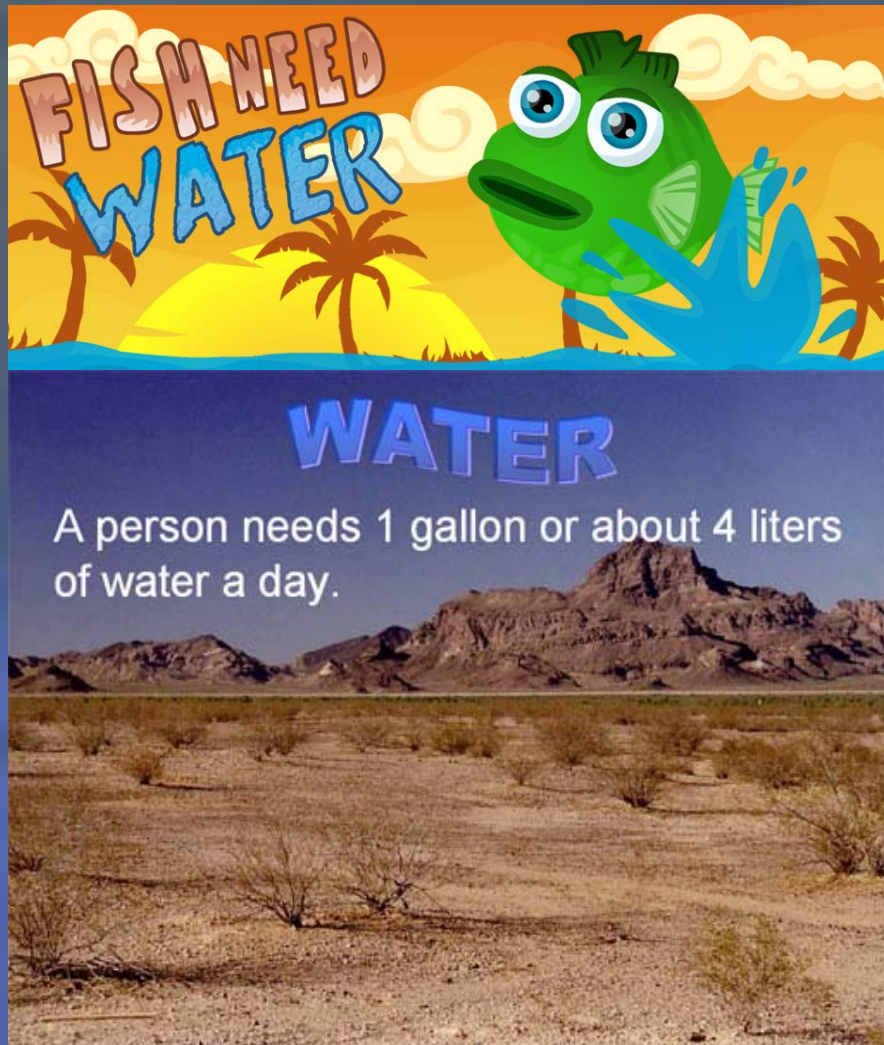
- Australia Has Over 1 M Feral Camels
- Drought Related Mortality
- Camels Dropping Dead in Water
- Major Billabong Pollution in the Outback



UNMET SOCIAL, ENVIRONMENTAL, & ECONOMIC NEEDS



UNMET NEEDS



- Environmental Flows Ignored
- Insufficient Stream Flows and Lake Levels
- Basic Water Services for the Poor Not Being Met
- Lack of Funding to Deal With Problems

CHANGING EXPECTATIONS



Klamath River, California

CHANGING EXPECTATIONS

- Environmental Sustainability & Social Responsibility Have Become Important
- To Whom?
- Investors, Consumers, General Public
- Water Related Risks Affect Business Viability



CHANGING EXPECTATIONS

- Water Sustainability Certification System
- Alliance for Water Stewardship
- Draft Verification
- April 2015



CLIMATE CHANGE



**A Fish That Didn't
Make It in Australia**

**Tough Times
For Cattle in
Texas**



CLIMATE CHANGE

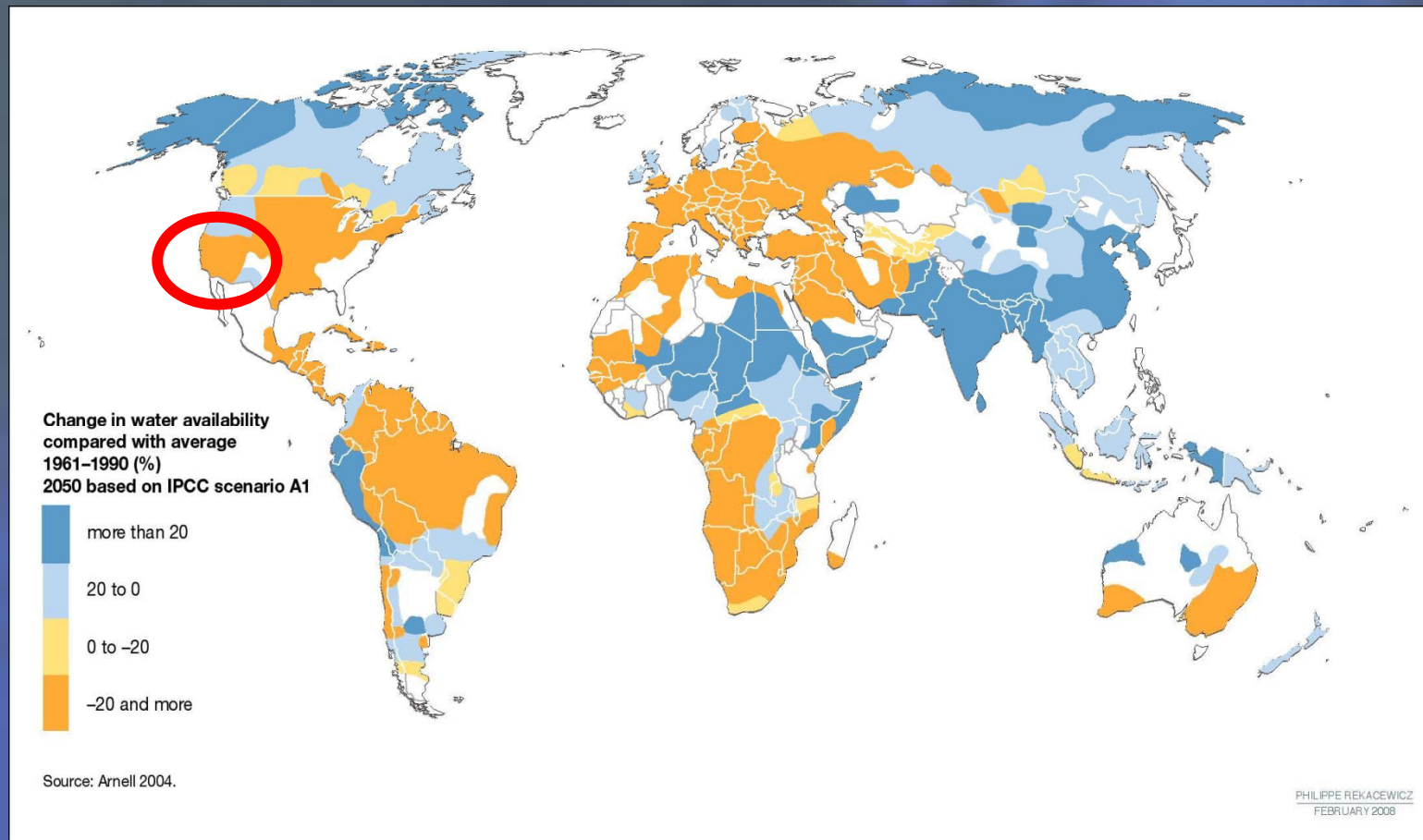


**High Severity
Wildfires
– Mt Carmel Israel**

**Floods and Cyclones
– Mississippi River
USA**



CLIMATE CHANGE IMPACT ON WATER AVAILABILITY

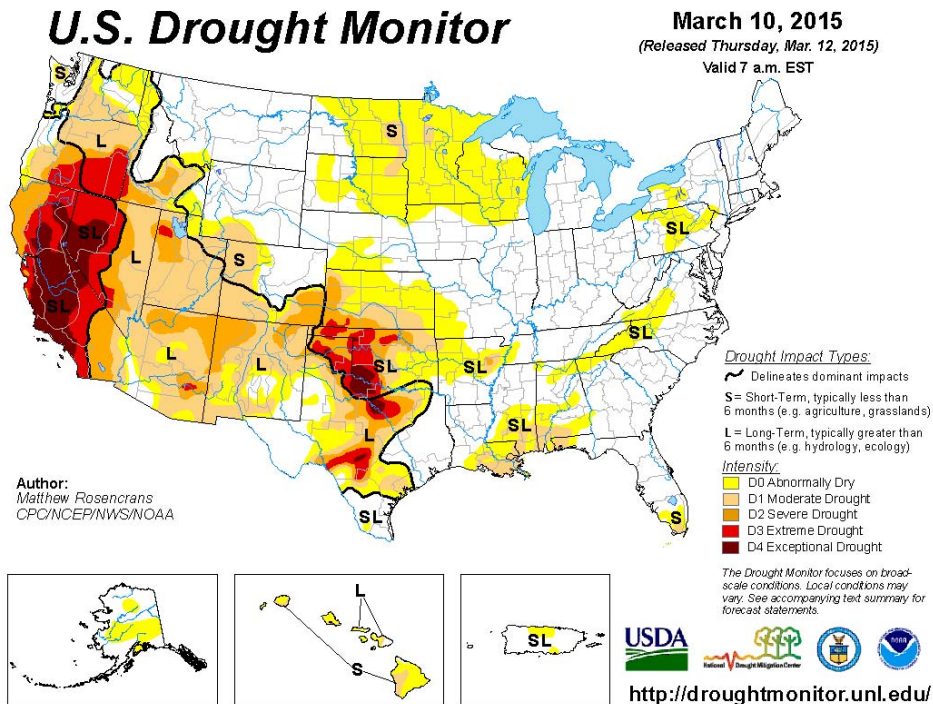


SOURCE: UNEP

CLIMATE CHANGE IMPACT ON WATER AVAILABILITY

“California has about one year of water left. Will you ration now?”

Los Angeles Times
12 March 2015



WATER & FORESTS ISSUES



■ WATER ISSUES

- Population Demands
- Increasing Scrutiny
- Climate Change
- Drought & Floods
- Fire
- Physical & Economic Security Risks

Lake Pedder Tasmania

WATER & THE FUTURE



**CASCABEL WATERSHEDS,
NEW MEXICO USA**



**BATES CATCHMENT, WESTERN
AUSTRALIA**

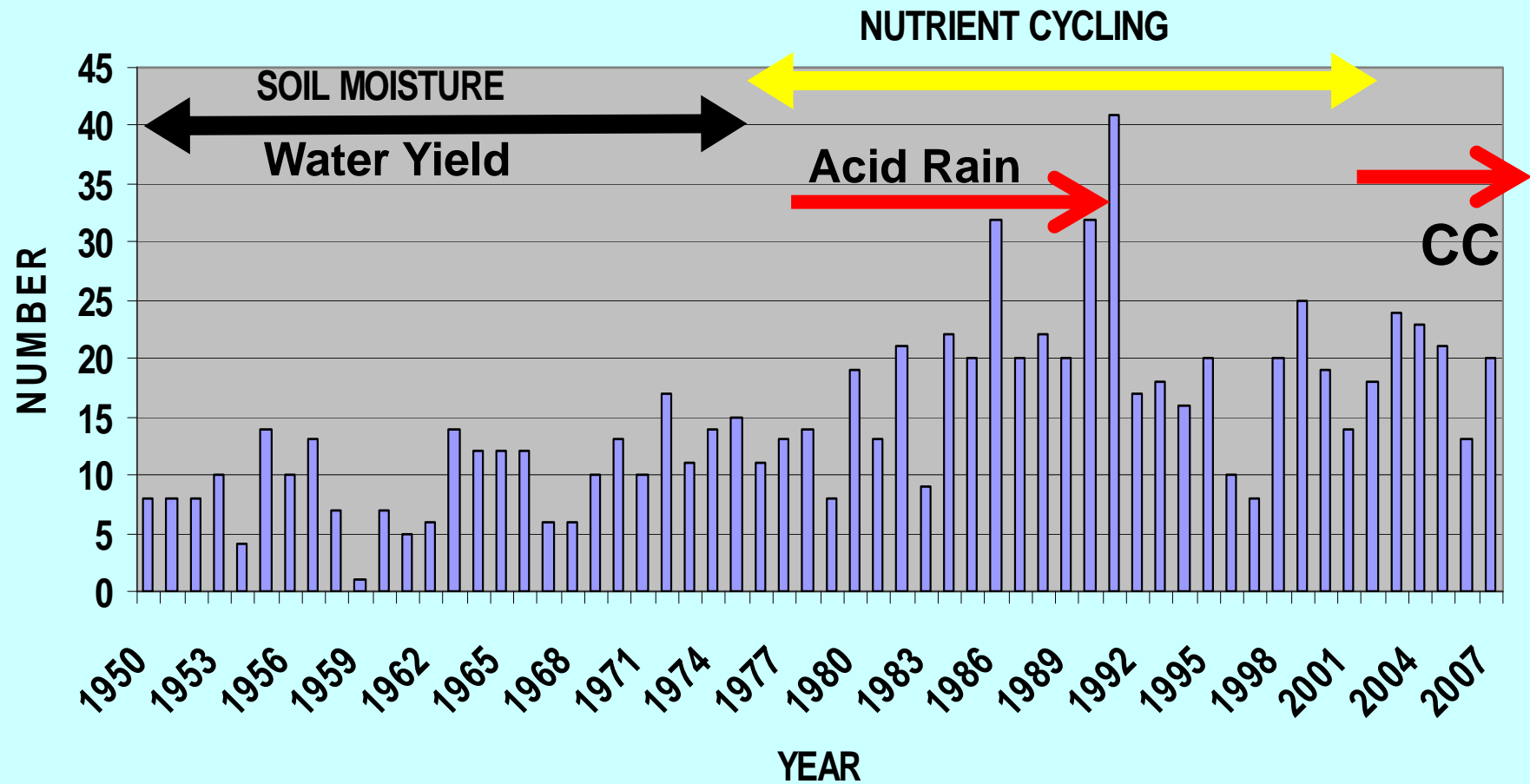
- 47% OF THE WORLD'S POPULATION - SEVERE WATER SHORTAGES BY 2030 *OECD*
- *"WHERE IS THE QUALITY WATER FOR 221,000 NEW PEOPLE ON THE PLANET EACH DAY?" US CIA*
- *"WATER IS THE NEW OIL "*
T. BOONE PICKENS

WATER RESEARCH



SSAJ PAPERS & WATER

SSSAJ S-7 PUBLICATIONS 1950 - 2007



From: Neary et al. 2009

WATER RESEARCH RECOMMENDATIONS: FORESTRY SECTOR

- Maintain funding for long-term catchment studies
- Increase hydrologic study networks
- Refine & define the range of natural variations



Battle Flat, Arizona



WATER RESEARCH RECOMMENDATIONS: FORESTRY SECTOR

- What are the climate change interactions with tree growth, soil processes, and hydrologic baseflows?
- What are the potential climate change effects on soil nutrient cycling, tree growth, and water quality?



**Bridger-Teton
National Forest,
Wyoming USA**

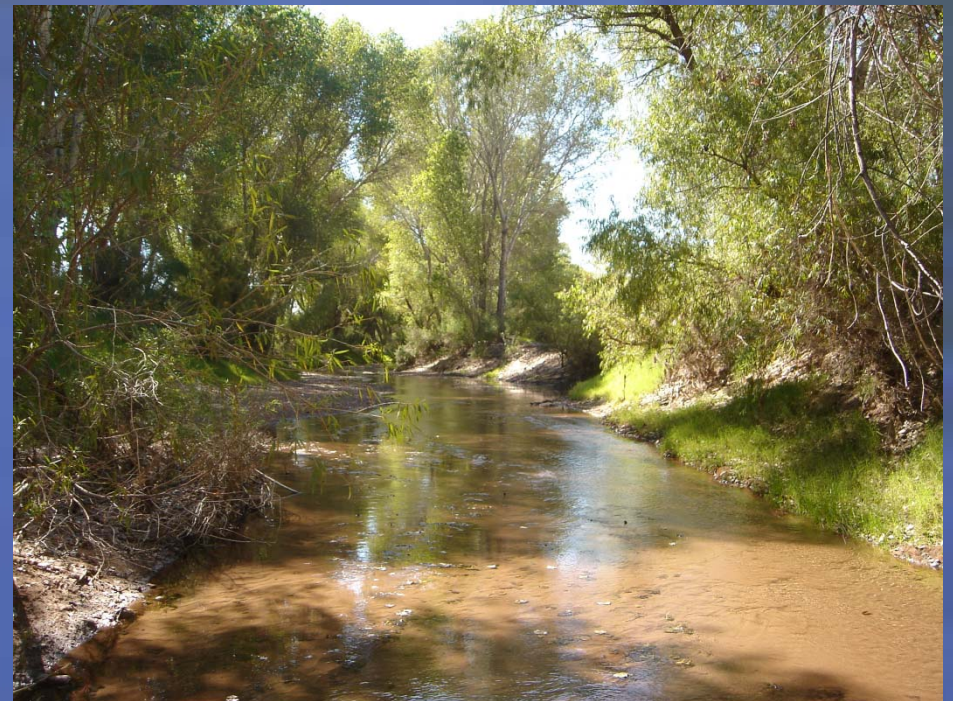
WATER RESEARCH RECOMMENDATIONS: FORESTRY SECTOR

- How much does climate change affect soil moisture, ground water, baseflows, & streamflow?
- What affects water availability most in water short regions: Plantation Forests, Agriculture, or Climate?



WATER RESEARCH RECOMMENDATIONS: FORESTRY SECTOR

- Do forest soils and water quantity & quality linkages hold up in a changing climate?



SAN PEDRO RIVER

WATER RESEARCH RECOMMENDATIONS: FORESTRY SECTOR

- Need to investigate cumulative effects of forestry on water quality
- Water quality models should be compared & validated at catchment scales to determine forestry impacts.

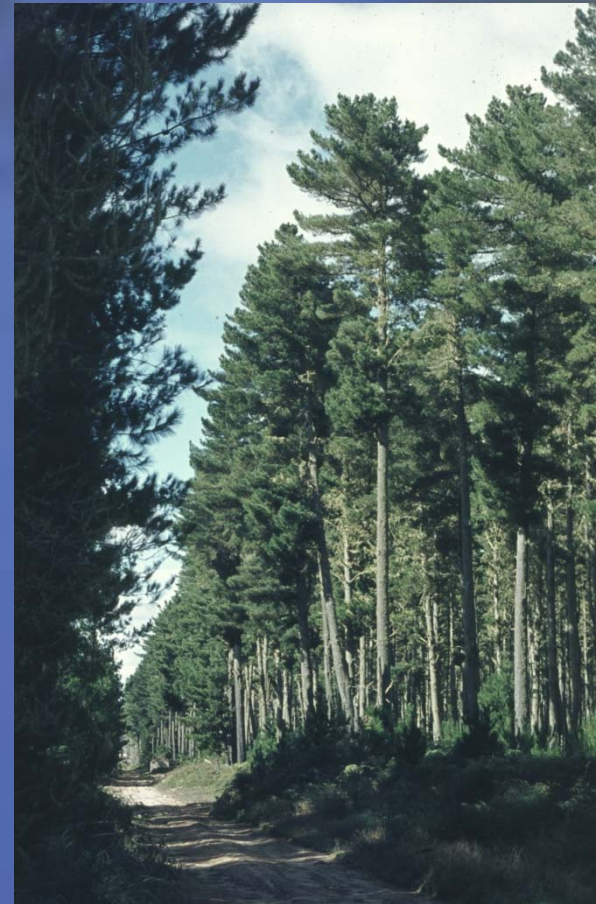


Pet River Tasmania



WATER RESEARCH RECOMMENDATIONS: FORESTRY SECTOR

- What are the relative impacts of GFCC Interventions on water quantity and quality in the short-term and long-term?



Kaingaroa Forest

WATER RESEARCH RECOMMENDATIONS: FORESTRY SECTOR

- Conduct basin-wide analyses of land use impacts to determine the relative effects of fast-growing plantation forests on large catchment water quality and quantity.



WATER WISDOM FROM THE "THE CRYSTAL BALLS"



**WERE YOU
LISTENING?**



SIDEBAR TRIVIA QUESTION



■ WHAT CAUSES THE MOST MORTALITY OF CHILDREN WORLD-WIDE?

- Crocodiles
- Communicable Disease
- AIDS
- War
- Trauma
- Dirty Water

SIDEBAR TRIVIA QUESTION



■ WHAT CAUSES THE MOST MORTALITY OF CHILDREN WORLD-WIDE?

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- **Dirty Water**

SOME PARTING DOWN UNDER WATER WISDOM



1. ULTIMATELY WATER IS EVERYTHING
2. ISSUES OF QUANTITY & QUALITY WILL NOT GO AWAY

