



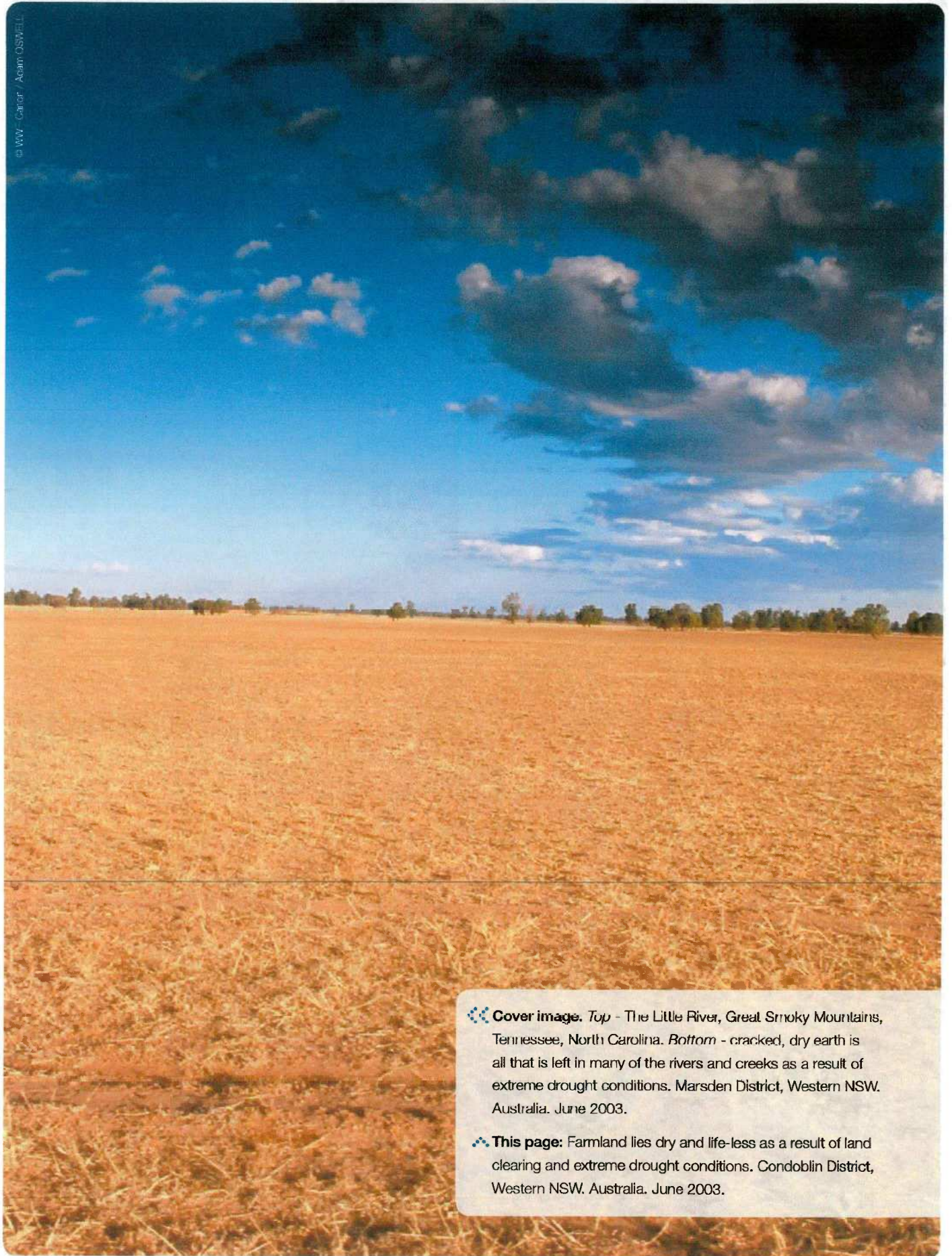
for a living planet

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**Rich countries,
Poor water** >>



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❖ **Cover image.** *Top* - The Little River, Great Smoky Mountains, Tennessee, North Carolina. *Bottom* - cracked, dry earth is all that is left in many of the rivers and creeks as a result of extreme drought conditions. Marsden District, Western NSW, Australia. June 2003.

❖ **This page:** Farmland lies dry and life-less as a result of land clearing and extreme drought conditions. Condoblin District, Western NSW, Australia. June 2003.

...in many parts of the world, available water quantity is decreasing and quality is worsening

Water in crisis - a key issue for the wealthy nations

The most recent global analysis of human access to the fresh water that underpins all societies shows a steadily worsening situation. According to the 2006 UN World Water Development Report, 1.1 billion people around the world lack access to improved water supplies and 2.6 billion lack access to improved sanitation and "in many parts of the world, available water quantity is decreasing and quality is worsening".¹ Most of these people live in the world's poorest countries, but as this report shows, there are major and mounting challenges on water facing the wealthier nations as well. The report is aptly titled "Water – A shared responsibility", a reflection of a rapidly growing realisation that the availability of adequate water is among the most basic and most urgent of the common issues faced by rich and poor nations alike.

Excluding the water of the seas and the icecaps, an astoundingly small proportion of the water essential to all terrestrial life is actually available. Per person, that small proportion of useable freshwater is also set to decrease as a consequence of population growth, climate change and substantial water supply losses through the contamination of water sources. This ethnocentric view is the cause of increasing alarm that sometimes neglects the fact that water is being lost to all life. Indeed, there is growing awareness that the last half century of human interventions with water flows have significantly altered global hydrology. Just as with the excess production of greenhouse gases, this may have consequences that are themselves threatening the conditions for life.

Terms such as "world water crisis" are not new, but they are overwhelmingly applied to the unmet water needs and the looming water catastrophes of the developing world. This survey finds that the world's wealthier nations also face a water crisis, as the profligate water use and abuse of the past and new requirements for "environmental water" confront and in some cases outrun available supplies.

In Europe, countries fronting the Atlantic Ocean are suffering recurring droughts, while water intensive tourism and an explosion of irrigated agriculture are endangering the water resources of the Mediterranean. It is now apparent that intensive pollution remediation in Europe's heartland will not be able to salvage some contaminated water sources – while the much worse contamination issues of Eastern Europe are yet to be substantially addressed. The European Union Water Framework Directive is a much needed initiative to systematically tackle Europe's water issues by 2015, but implementation is patchy in some countries.

In the USA, large areas are already using substantially more water than can be naturally replenished. This situation will only be further exacerbated by climate change scenarios of lower rainfall, increased evaporation and changed snowmelt patterns. Salinity threatens important irrigation areas and there is increasing anxiety over the level of contamination with chemicals and pathogens in water sources and water supplies. The main mechanisms for controlling pollution are themselves under threat

In Australia, the driest continent is well on its way to becoming drier. Nearly all of Australia's major cities have applied water restrictions and efficiency measures while they grapple with current and projected shortages in supply. Salinity is a major threat to a large proportion of Australia's key agricultural areas and the drinking water supplies of the nation's fifth largest city. Saving the country's largest river system has become a flagship programme with some restoration of environmental flows announced but much more needed.

Japan has high rainfall, but high population can mean surprisingly low levels of water per capita. Japanese cities can suffer both shortages of water and damaging floods. Contamination of water supplies, including groundwater aquifers, is an extremely serious issue in many areas. However, there is also a serious commitment to better management of Japan's water resources, which extends to repairing and better protecting damaged natural areas and to exporting expertise in better water management and protection.

¹ World Water Assessment Programme, Water – A shared responsibility, The United Nations World Water Development Report No 2, 2006 Executive summary p43. (www.unesco.org/water/wwap)

... water is now a key – sometimes the key – political issue at the local, regional and national level.

Water is an essential economic commodity.

Common first world water issues

Problems common to most of the developed world include:

Exhaustion of water supplies

Supporting large scale industry and growing populations using water at high rates has come close to exhausting the water supplies of some first world cities and is a looming threat for many if not most others. Most long established cities have already exploited their naturally or politically feasible options for reservoir capacity and many are seeing levels dropping in the groundwater supplies they have become heavily and in some cases exclusively dependent on. Among the options being considered and in some cases implemented are rainfall capture, water recycling and “sewer mining”, water transport from ever more remote locations, buying in of water and desalinating seawater.

(See Thirsty Cities, The assault on groundwater, The unravelling of supply-side solutions)

Water-related conflict

From Seville to Sacramento to Sydney, water is now a key – sometimes the key – political issue at the local, regional and national level. Significant water related conflicts commonly arise over infrastructure proposals, between catchments, between rural and urban water users, and between irrigators and virtually all other water users. Much of the conflict is over environmental issues such as the protection of catchments, maintaining flow in rivers and responsibility for pollution.

Water contamination

Although there have been improvements in many areas, many first world waters still suffer from serious and long lasting contamination. The main contaminant is salt, a particular problem for many irrigated areas and coastal areas with over-exploited aquifers. The next most commonly detected contaminants by far are fertilizer and pesticide residues from agriculture which in some areas have percolated down to deep aquifers. But the full list of potential contaminants is long and incomplete, and contains numerous chemicals never tested for their toxicity, human pathogens, and toxic soil components such as arsenic mobilised by poor water management processes. New reasons for anxiety emerge

regularly – the USA’s worst water poisoning incident was caused by a pathogen identified less than 20 years earlier and a wide class of chemicals known as “endocrine disruptors” are under suspicion for their suspected ability to disrupt body functioning. Investigations are beginning into the effects of minute but accumulating pharmaceutical, medicinal and veterinary wastes.

Degraded landscape functioning

Catchments that have been cleared, rivers that don’t flow, floodplains that have been developed and wetlands that have been drained are not performing their ecosystem functions within the landscapes of the developed world. More and more the consequences of this degraded functioning are needing to be addressed to reduce health and economic impacts, to protect key environmental or economic assets or to reduce the likelihood of catastrophic events.

(See The High Cost of Cleaning Up).

Economic burdens

Water is an essential economic commodity. Increases in the costs of sourcing, supplying and treating water to an acceptable standard have been steadily escalating, as have been the costs of treating and disposing of waste water. Moreover, the trend to more environmentally and economically appropriate pricing of water however still has some way to go. Still to come in most developed countries is the proper valuation of water used in agriculture, in most nations by far the largest user of freshwater. Such measures drive efficiency, but are also adding to the cost base of the economy. Many first world cities are losing massive amounts of water and risking community health and groundwater contamination through leaks from mains and sewers. Dealing with this issue, often the single most effective urban conservation measure, is both costly and a source of conflict between privately operated water providers and regulatory bodies.

Even in the best performing countries, conservation has a long way to go.

...water must be used more efficiently...

Choices for the future

At the rhetoric level, it is now generally well accepted in the developed world that water must be used more efficiently and that water must be made available again to the environment in sufficient quantity for natural systems to function and deliver what are sometimes called their "ecosystem services". Many countries also recognise that extensive – and very expensive – repairs are required to reduce some of the damage inflicted on water systems and catchments in the past. Putting the rhetoric into practice in the face of habitual practice and intense lobbying by vested interests has been very difficult.

What the developed world has, however, is choice. It can persist with business as usual under a veneer of rhetoric about conservation and face the consequences further down the track – harder to secure supplies of water, ever more expensive treatment, ever increasing impacts on the economy and ever larger exposure to catastrophic events. Or it can, as several countries have been doing, continue with the effort to match current water use with natural water realities and, as much as possible, build the resilience of human and natural water systems against challenges such as increased demands in the face of greater climate variability.

Even in the best performing countries, conservation has a long way to go. The seven key challenges are to:

- 1 **Properly value water** and the natural features and services offered by catchments, streams, aquifers, floodplains and wetlands. Conserve the environment of watersheds as the source of water for people and nature. Establish an organisation to manage each river basin.
- 2 **Agree on the balance** between conservation and water consumption so that the quantity and timing of water abstractions leave sufficient "environmental flows" to maintain ecological health of rivers, lakes and other wetland habitats at acceptable levels.
- 3 **Change attitudes to water.** For instance, it is becoming accepted that the effort to prevent all flooding leads to more catastrophic floods and that it is not only safer but also beneficial to give rivers room and restore or mimic natural systems that accommodate periodic flooding.
- 4 **Modify or repair** aging or inappropriate infrastructure, to reduce wastage, contamination and disruption to natural processes
- 5 **Bring agriculture into line.** In general the largest by far water user, agriculture, faces lower prices for water and lower expectations that it will use water efficiently and manage its wastes. Agricultural chemicals are, after salt, the most common contaminants of water. As sewage treatment improves, intensive livestock farming and aquaculture become the largest source of pathogens in water.
- 6 **Reduce the contamination** of water. A staggering array of contaminants is finding its way into water supplies. Only a minority are tested for. A recent history of nasty surprises suggests that the effects of some of these substances are not yet known, and that some we do know are damaging will later be found to be more damaging than suspected at smaller concentrations than were previously thought acceptable.
- 7 **Build up our knowledge.** Understanding of natural water cycles and processes remains sketchy, particularly on elements of water systems that are not immediately visible or obvious such as vapour cycles and aquifers. We are continually reminded that all the elements of the system are interconnected and that the more uninformed our interventions are, the greater the likelihood of unexpected outcomes.

Daily per capita use of water in residential areas is estimated at...

350 litres in North America and Japan

200 litres in Europe

10-20 litres in sub-Saharan Africa²

Obligations to the world

For the developed world, while local action is clearly needed, it is not sufficient to act locally.

The world's water is not equally shared and there is deservedly a focus on the unmet water needs of the world's poor. Daily per capita use of water in residential areas is estimated at 350 litres in North America and Japan, 200 litres in Europe and 10-20 litres in sub-Saharan Africa²:

In general, the first world has more of the world's freshwater resources and uses more of the world's freshwater resources – either directly or more indirectly as when the poor world's water is disproportionately used or contaminated in growing the cash crops or providing the minerals and energy consumed by the relatively wealthy.

Sometimes measured as “virtual water”, the inflows of water embodied in imported products mean that the “water footprints” of developed nations can be out of all proportion to domestic water supplies. The UNESCO-HE Water Institute cites the examples of China with a water footprint of 700 cubic metres per capita per year overwhelmingly sourced from within China and Japan, where 65 per cent of the 1150 cubic metre per capita per year water footprint is sourced from outside Japan.

First world institutions have also played a role in some of the more damaging water infrastructure projects undertaken in the third world. While some water infrastructure projects have produced great benefits, in many the dislocations, disruptions to natural flow patterns that sustain food and fibre supplies and extensions to the range of disease carrying organisms have imposed great suffering on communities that enjoy few of the benefits. Processes to prevent such mistakes in the future, such as those set out by the World Commission on Dams, are still a long way from proper implementation.

Fairly and sustainably using the world's limited supplies of freshwater and ensuring that sufficient water is available to perform essential environmental functions are local, regional and global issues for all.

Global average virtual water content of some selected products. per unit of product

Product	Virtual water content (litres)
1 glass of beer (250ml)	75
1 glass of milk (200ml)	200
1 glass of wine (125ml)	120
1 glass of apple juice (125ml)	190
1 cup of coffee (125ml)	140
1 cup of tea (125ml)	35
1 slice of bread (30g)	40
1 slice of bread (30g) with cheese (10g)	90

Product	Virtual water content (litres)
1 potato (100g)	25
1 bag of potato crisps (200g)	185
1 egg (40g)	135
1 hamburger (150g)	2400
1 cotton T-shirt (medium, 500g)	4100
1 sheet A4 paper (80g/m ²)	10
1 pair of shoes (bovine leather)	8000
1 microchip (2g)	32



❖ Dry river bed of the Tossa river running through the busy tourist centre of Tossa on the Costa Brava, Catalonia, Spain.

What the developed world needs to do with water.

1 Implementing the framework of existing agreements

Many of the negotiations that are the key to effective international action on water have already been conducted, agreements have been reached and much of the machinery set in place. What often is lacking is commitment on the part of governments to these agreements and their implementation. Key agreements under which governments have obligations to act include:

The Convention on Wetlands (Ramsar Convention 1971) – Vital wetlands in developed countries are still being lost or placed under threat despite most developed nations being parties to the Ramsar Convention. Coverage of wetlands in developed nations is highly uneven and not all listed wetlands are receiving levels of protection appropriate to the threats they face.

United Nations Convention on the Law of the Non-navigational Uses of International Watercourses – Agreed by the UN General Assembly in 1997 this important agreement to provide a consistent legal framework for the “protection, preservation and management” of rivers forming or crossing international boundaries. Many major developed nations have failed to sign or ratify this treaty and it is yet to enter into force.

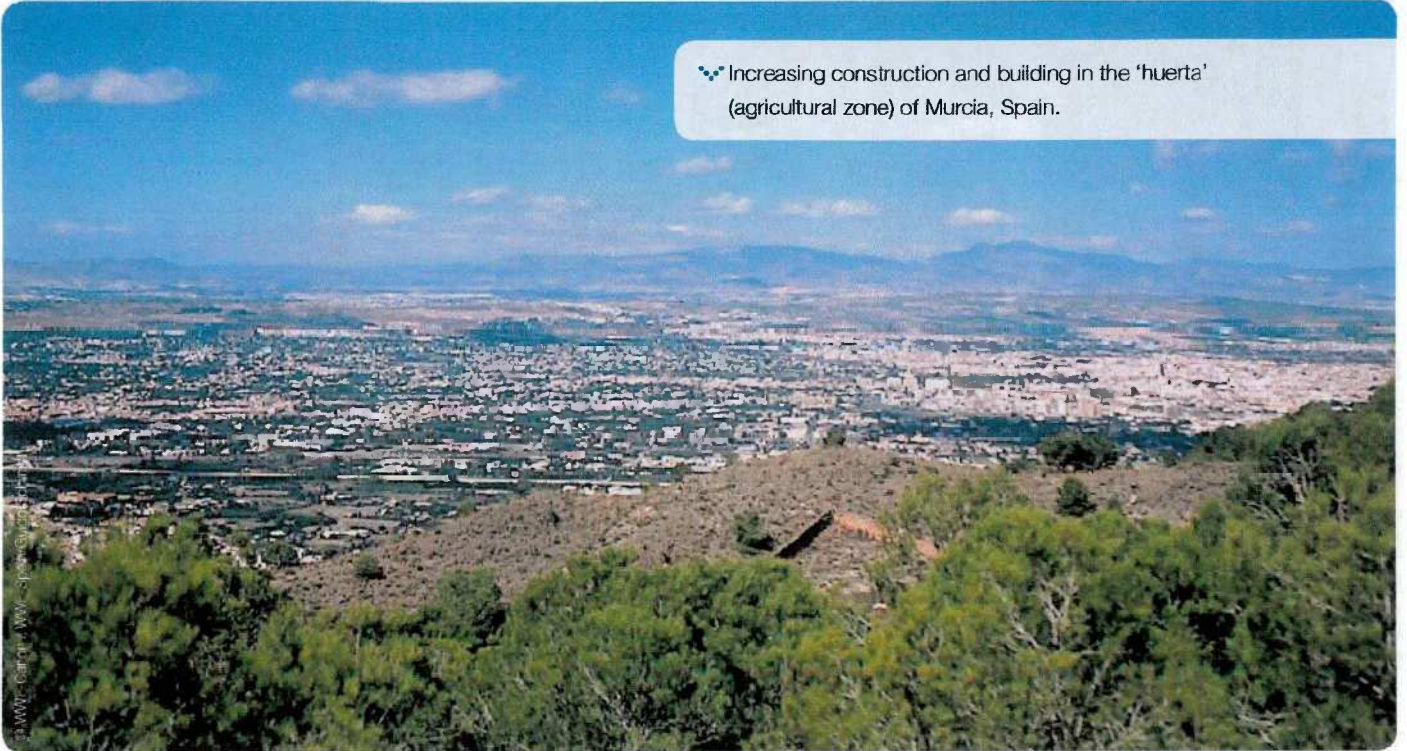
The World Commission on Dams (2000) was a major, comprehensive and consultative study of the costs and benefits of major dams and recommended significant changes to the way such dams are planned and approved to prevent some of the disastrous outcomes inflicted on human and natural communities. But implementation of these recommendations is proceeding at a glacial pace while large dams continue to be planned and built with inadequate study of impacts.

Nations also have obligations to protect aquatic environments under other international, multilateral and bilateral agreements including conventions on biodiversity and toxic chemicals, and multilateral and bilateral agreements on specific rivers such as the Rhine, Danube, Great Lakes and St Lawrence Seaway and the Rio Grande.

Much could be achieved towards improving water security and the functioning of vital ecosystems if these existing agreements were properly implemented.

Continued ➤

Increasing construction and building in the 'huerta' (agricultural zone) of Murcia, Spain.



Continued

2 Changing our attitude to water

It is clear that fresh water has long been an under-appreciated and undervalued resource and the attitudes of developed country governments, industries and populations to water need urgent revision. This involves:

- 1 Proper and equitable pricing of water and the ecosystem services provided by fresh water flows and features. End the subsidies that encourage wasteful use and discriminate in favour of wasteful sectors.
- 2 Conserving water – using water efficiently, minimising evaporation and leakage losses, recycling.
- 3 Review the contribution, costs and performance of existing water infrastructure (particularly in the context of planning new infrastructure). For many cities the repair of leaking water mains would equate to a new reservoir or two.
- 4 Keep and restore the functioning of aquatic ecosystems, in large part through the restoration of sufficient and appropriate environmental flow regimes. Protect or restore catchments as the key means of lifting or preserving the quality of water available for human and natural systems.
- 5 Recognising that our knowledge of the functioning of many aquatic ecosystems and of hydrological flows generally is extremely limited and working to extend our knowledge.

3 Dealing openly and accountably with water

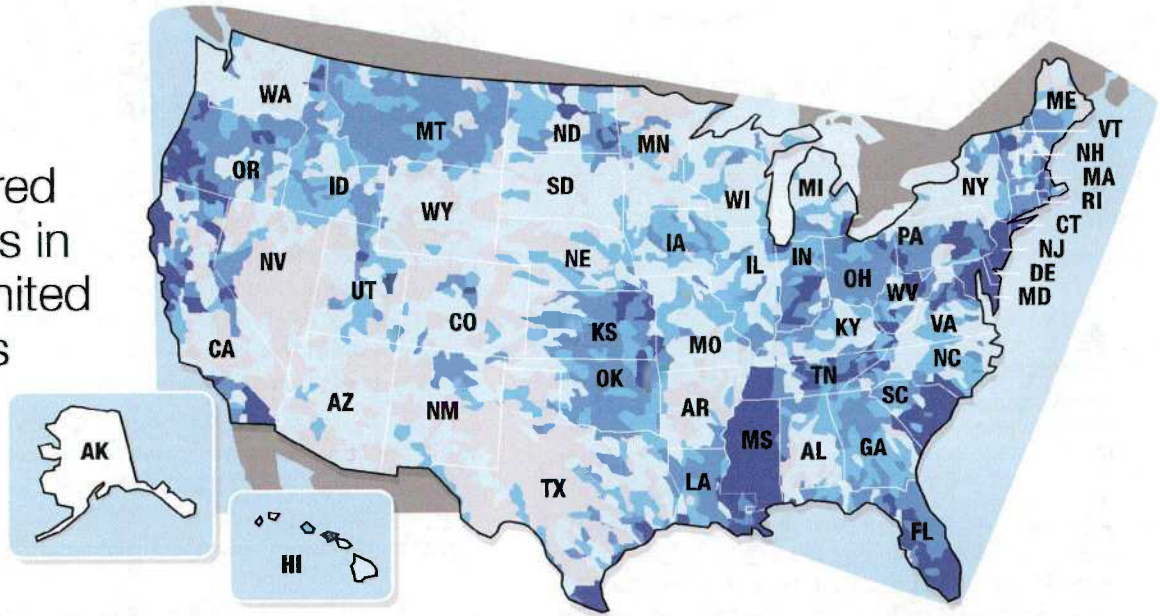
Current or future water problems from the local to the global scale are commonly associated with inequitable or unaccountable arrangements for dealing with water. It is essential to:

- 1 Recognise the many stakeholders in freshwater, crucially including the water needs of natural systems and aquatic species.
- 2 Have informed, participatory and accountable processes for water allocation and water infrastructure planning and development.
- 3 Adopt a precautionary principle where knowledge of impacts on natural systems is inadequate.
- 4 Account must be taken of cumulative impacts on human and natural water systems, a factor often ignored in one-off project impact assessments.
- 5 Address key weaknesses of much major water infrastructure planning which result in pronounced tendencies to over-promise and under-deliver on most projects. These include over-emphasis on supply side solutions, failure to examine all options particularly on the demand side, optimistic costings of projects and water supply projections and under-assessment of environmental costs and degrading of ecosystem services of natural systems.

Per capita, citizens of the USA are the most profligate water users on the planet.

Canada and the USA – Declining availability, concerns on quality

Impaired Waters in the United States



Percent of Impaired Waters – 1998



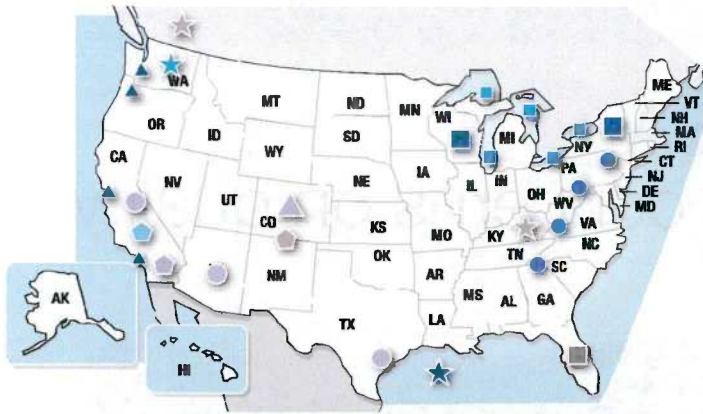
Impaired waters in the United States, as mapped (1998) by the US EPA. Impaired waters are defined under the federal Clean Water Act as waters that are not meeting State water quality standards or use designations.

Per capita, citizens of the USA are the most profligate water users on the planet. Such high rates of water use run headlong into the reality that many areas of the country are naturally dry. The shortfall has generally been met by tapping into groundwater supplies but many aquifers – including the largest, the vast Ogallala Aquifer – are now showing signs of severe depletion. There are concerns also about high levels of water contamination. In 1998, the US EPA noted that ‘Of the 3,000 chemicals that the US imports or produces at more than 1 million lbs/yr, a new EPA analysis finds that 43% of these high production volume chemicals have no testing data on basic toxicity and only seven percent have a full set of basic test data. “The study has not been updated and regulatory controls have if anything been weakened in recent times.”’

Source Water Protection

City	Rating
Albuquerque	Poor
Atlanta	Poor
Baltimore	Fair
Boston	Good
Chicago	Fair
Denver	Good
Detroit	Poor
Fresno	Failing
Houston	Poor
Los Angeles (imported)	Poor
Los Angeles (local)	Fair
Manchester	Good
New Orleans	Poor
Newark	Fair
Philadelphia	Poor
Phoenix	Poor
San Diego (imported)	Poor
San Diego (local)	Fair
San Francisco	Good
Seattle	Excellent
Washington, D.C.	Fair

Source: National Resources Defence Council.



■ Pathogens in water have caused mass illnesses and deaths in recent years. WHO notes that the origin of many drinking water associated disease outbreaks in the US was not identified.

▲ Old pipes and sewers are contaminating drinking water supplies with lead, as well as wasting large quantities of water and leaking contaminants into groundwater aquifers.

★ Long the main mechanism for cleaning up and protecting US rivers and water supplies, the 1972 Clean Water Act, is coming under increasing attack and legal challenge from industry and development lobbyists. By international standards, the US is slow to grade water contaminants, slow to strengthen standards on health and environmental grounds and slow to implement protection programs for catchments, rivers and wetlands. State of the Environment Reporting in the US is far patchier than in comparable countries.

A 2001 study of 19 major US cities found poor water quality and compliance with standards on the part of Albuquerque, Boston, Fresno, Phoenix and San Francisco. Only one city, Chicago, scored an excellent grading. Only Seattle scored an "excellent" on protection of its source waters, with Fresno rated a "fail" and nine other cities doing poorly. The correlation between water quality and the level of protection of catchments and water sources is strong.

● The newly reinstated practice of mountaintop removal mining destroys catchments and streams, increasing erosion and flooding risks in rivers emanating from the Appalachian Mountains.

■ Florida's famous Everglades is now the subject of a \$7.8 billion 30 year rescue plan after their survival was threatened by water diversions, pell mell development, and agricultural and industrial pollution.

◆ California has lost around 90 percent of its wetlands. Nationally, about half of all wetlands have been lost and development pressure is high on many remaining wetlands.

▲ The Colorado River, site of the first of the world's megadams, has been harnessed for both agriculture and the sprawling suburban areas of southern California. Today just 0.1 per cent of its flow reaches its delta.

◆ The Rio Grande, dammed by Elephant Butte Reservoir in the arid Chihuahuan Desert, evaporates enough water each year to support a city of 400,000 people by US standards. Interstate compacts prevent the storage of this water in cooler, higher elevation climates, despite the recurrence of serious drought and the need for water rationing. This border river, called the Rio Bravo in Mexico, is shared under an inadequate century old treaty with disputes being frequent.

★ Acid rain was causing widespread damage to lakes and rivers in the north eastern North America. National and joint US and Canadian efforts have seen sulphur dioxide emissions reduced although less progress has been made with nitrous oxides. Acid deposition has decreased, with surveyed Canadian lakes now mostly classified as improving or stable. But 800,000 square kilometres of Canada and large areas of the US continue to receive ecosystem impairing levels of deposition.

Much of Canada is well watered, but water shortages as a result of drought, infrastructure problems, or growing consumption were reported in a quarter of municipalities from 1994 to 1999. Canadians are yet to significantly respond to pleas to conserve water- the proportion with metered water remains low at around 60%.

○ Over-exploitation of groundwater for urban and agricultural use has caused serious land slumping. Other aquifers may have been permanently damaged by over-exploitation.

■ The Great Lakes are one of the world's most significant freshwater resources but they suffered severely from gross contamination until a two nation effort to clean them up. While this work continues, there are new anxieties that more water is taken from the vast basin than is being replenished. The ecosystem of the Lakes is being severely impacted by invasion by exotic species due to poor quarantine controls.

Arsenic from soil or industrial sources is a significant water contaminant in the United States. No level of arsenic in water is considered safe, but the USA has only recently lowered its acceptable arsenic standard from 50 to 10 ppb – still well above the exposure levels considered acceptable for other contaminants. A survey of American cities expressed "high concern" over drinking water arsenic levels in Albuquerque, Houston and Phoenix.

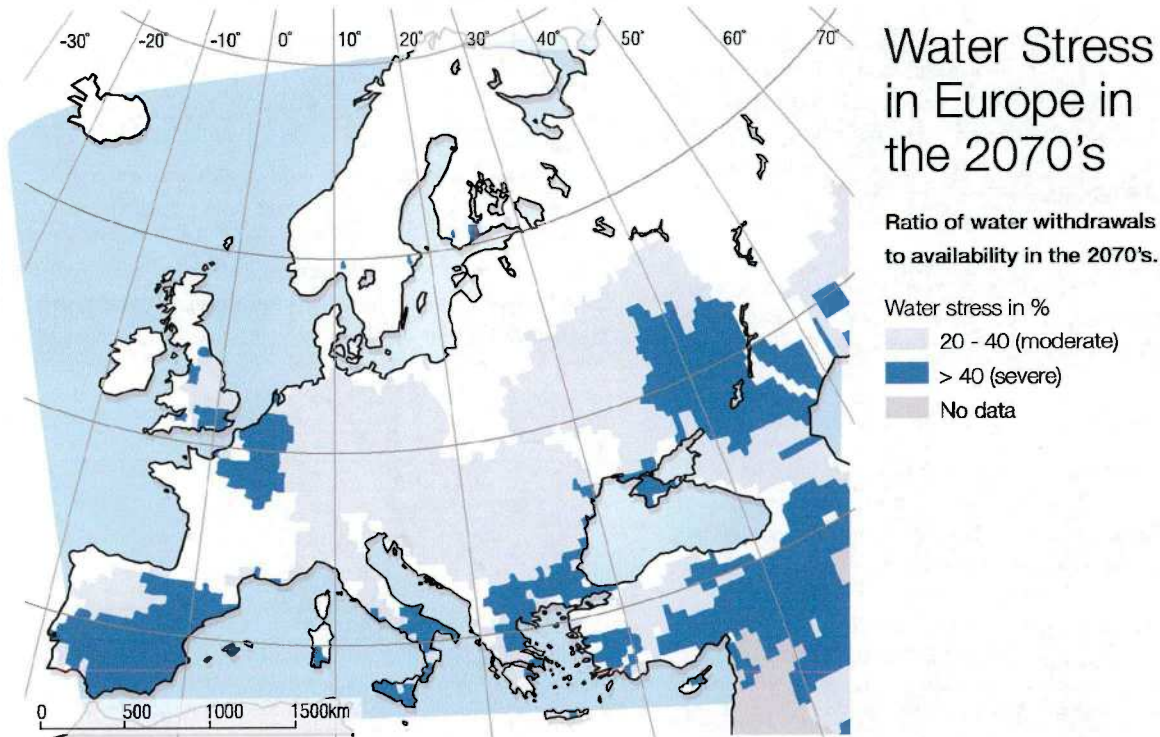
◆ About 20 million Americans have rocket fuel ingredient perchlorate present as a contaminant in their tap water. No safe level has been established for the chemical which can disrupt thyroid function and cause cancer.

★ Excessive agricultural fertiliser pollution in rivers entering the Gulf of Mexico, especially from the Mississippi River, has created a 'dead zone' in the middle of the Gulf of Mexico.

Extreme floods are Europe's most frequent natural disaster. They will become even more frequent...

Europe - droughts, floods and contamination

Source: Henrichs and Alcamo, 2001.



"(Europe has) also a wide variety of water uses, pressures and management approaches. A succession of floods and droughts in recent years has illustrated Europe's vulnerability to hydrological extremes. However, there are many other water-related pressures on Europe's environment. River systems and wetlands are increasingly at risk. The quality of Europe's rivers, lakes and groundwater is being threatened by the discharge of sewage and industrial waste and by excessive application of pesticides and fertilizers. Climate change and sea level rise add other potential pressures on European water resources and management."

European Environment Agency 2005.

Extreme floods are Europe's most frequent natural disaster. They will become even more frequent in central, northern and northeast Europe as a result of climate change. Researchers have noted that the extent of urban roofing and paving is adding to Europe's flood problem. Also expected to increase are sudden, localised flooding events in the south of Europe, which cause a disproportionate number of casualties. The proposed EU Flood Management Directive is an opportunity to give rivers room to flood safely rather than relying on flood 'control' infrastructure that has failed too often in recent years.

A major chemical fire and spill near Basel in Switzerland in 1986 reinforced the Rhine's reputation as being "the sewer of Europe". The disaster fuelled a multi-country effort to clean up the river generally, with salmon returning in 1995. But large areas of groundwater in the basin, contaminated over long periods by agricultural and mining activities, are considered beyond recovery. Meanwhile, widely heralded moves to restore some areas of wetland and floodplain for ecological reasons and to naturally mitigate flooding have been only patchily implemented.

▲ **Europe's glaciers** are in dramatic retreat as a result of climate change, changing river flow and annual flooding patterns, which may shift from spring to winter and be shorter but higher. This is in part why floods are becoming more damaging but also has adverse implications for groundwater recharge.

★ **SE Europe** is already becoming dryer as a result of climate change and will become dramatically dryer this century. Average run off is predicted to decrease by 20-30% by 2050 and 40-50% by 2075.

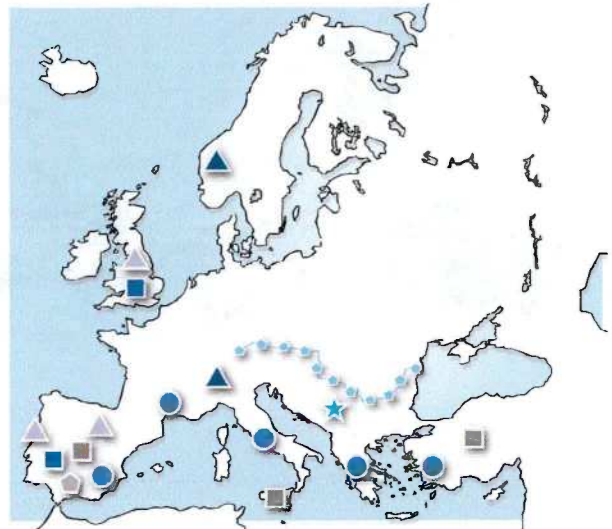
● **Tourism in the Mediterranean** has not only become more prevalent, it has become much thirstier as it caters to homebuyers and golfers. Under pressure are coastal streams and wetlands. Groundwater in particular is being drawn down unsustainably with the risk of seawater infiltration into aquifers.

■ **Scarce waters** from streams and underground are being poured into irrigated crops, many of which are earning subsidies rather than a place in the market. Much of the extraction is illegal or unregulated, and groundwater levels in particular are plummeting, with the risk of permanent damage to aquifers.

◆ **The world's most international river basin** is the Danube, governed by 18 countries. Since the fall of the iron curtain in 1989, cooperative management has improved through the establishment of the International Commission for the Protection of the Danube River and the EU Water Framework Directive. However major threats remain, most notably the 'TENS-T' plans to canalize the most ecologically significant reaches to increase shipping, and the proposed construction of 8 large new dams in the basin.

■ **Desalination of seawater** is being touted as one answer to water shortages but this is expensive, makes energy demands that can contribute to greenhouse gas emissions and can pose pollution issues with ultra-saline discharges. Solar powered desalination may be a positive alternative but less available, higher cost water is already becoming a considerable economic burden in some areas.

◆ **Half a century of large dam and water transfer projects** have not stopped Europe's thirstiest country becoming thirstier, partly as a result of mismanagement and subsidies for profligate agricultural water use. The previous Spanish Government's solution was a plan for more dams and transfers which could include drawing water from France's Rhone River. But the Spanish people are increasingly thinking otherwise and the most controversial of the dam and transfer projects has been cancelled amid calls for "a new water culture".



▲ **Changed Atlantic Ocean weather patterns** are leading to recurrent droughts. Resulting forest fires are degrading catchments, rivers have reduced flows to cope with wastes, aquifers are suffering reduced recharge and water shortages are evident or looming for many cities, including the UK capital London.

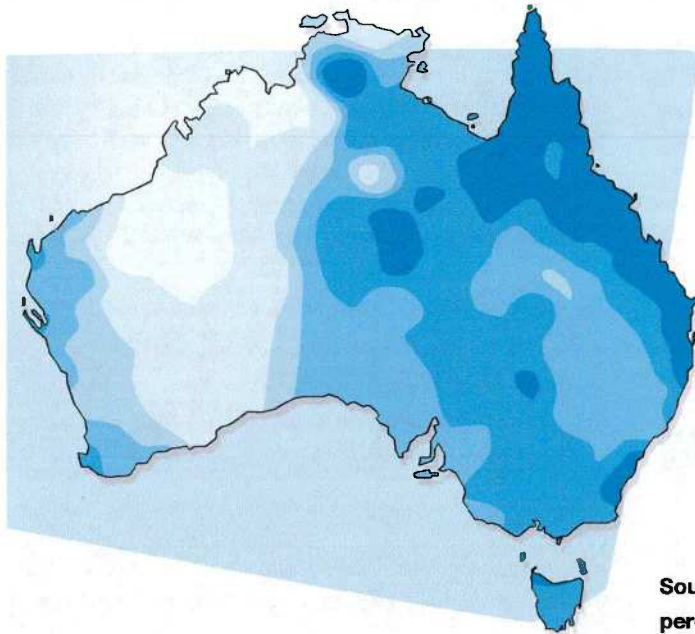
Plans for new housing in south east England threaten to stretch the region's water supplies to breaking point.

Water scarcity has made water metering a contentious issue in the UK both for consumers and between water providers and regulatory authorities. Elsewhere meter introduction has been found to be an effective way of reducing water consumption.

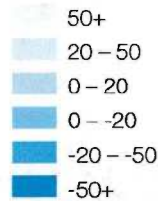
Southern areas of Western Australia abruptly lost 15 percent of their rainfall in the 1970s...

Australia – the driest continent gets drier

Source: Australian Government Bureau of Meteorology

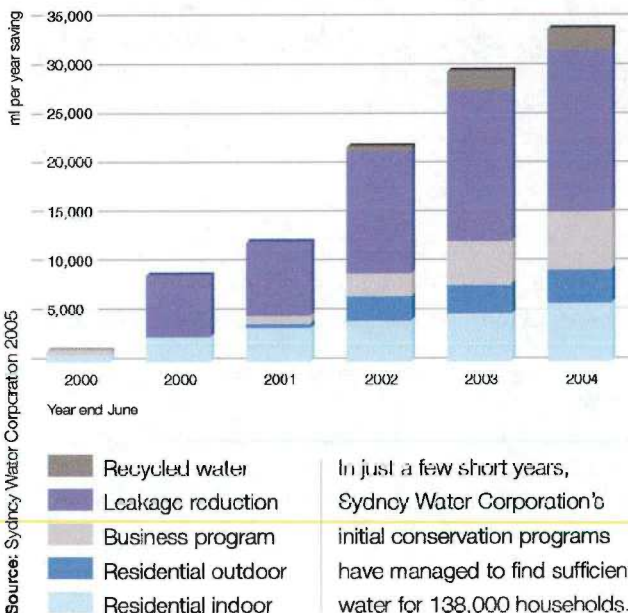


Trend in Annual Total Rainfall 1970-2005 (mm/10 yrs)



Southern areas of Western Australia abruptly lost 15 percent of their rainfall in the 1970s, causing severe water stress to Australia's fourth largest city of Perth, which resorted initially to over-exploiting its aquifer, and is now building a costly (AUD \$350 million (\$US 260m) for 45 Gl pa) desalination plant and considering long distance water transport.

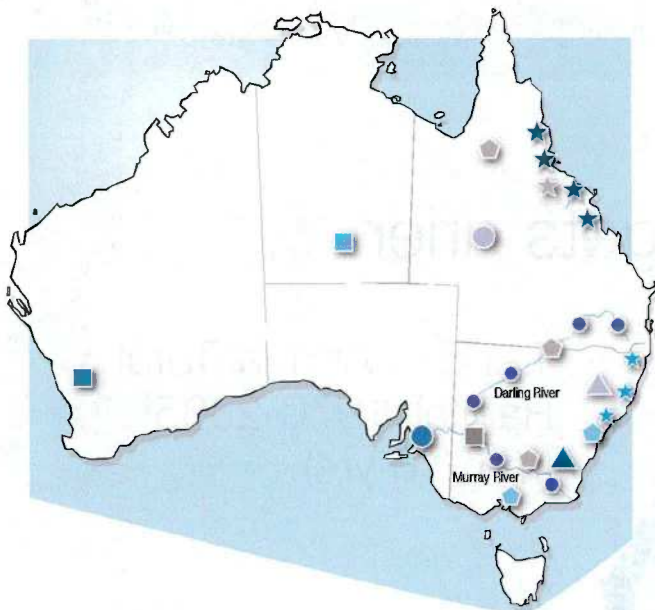
Water Savings Achieved Since 1999



In just a few short years, Sydney Water Corporation's initial conservation programs have managed to find sufficient water for 138,000 households.

Water holes that once provided habitat for birds and wildlife in the Lachlan river system, lie dry and lifeless during extreme drought conditions. Condoblin District, Western NSW, Australia. June 2003.





■ **Major wheat growing areas** in WA are the site of some of the world's worst cases of dryland salinity, following inappropriate vegetation clearance decades ago.

● **Major government commitments** were made to bring Australia's largest river system, the Murray-Darling, back from the brink, after toxic algae suddenly infested hundreds of kilometres of the Darling River. Problems included insufficient flows, an end to natural flood cycles as a result of irrigators creaming off flood flows, loss of wetlands and fisheries and nutrient overloading from town and agricultural wastes. AUD \$2 billion (\$US 1.5 billion) has been allocated since 1996 to restore environmental flows by 500 Gl per year and re-establish migratory fish passage up the first 1800 km of the Murray River.

★ **Drainage of the basins** of coastal rivers has exposed acid sulphate soils to oxidation, leading to massive fish kills. Further investigations have shown susceptible soils to be extremely common in coastal Australia.

▲ **Acid mining wastes** poisoned the river flowing through the valley where Canberra, Australia's national capital, is situated. Remediation goes on, at a cost far higher than the value of mine production.

■ **Irrigation has brought wealth** to the Murray, but it has also mobilised the salts of an ancient sea. The scale of the problem has forced Australia's national and state governments to commit to a National Action Plan to halt the loss of land and the increasingly saline flows into the river.

● **Salinity remains a threat** to the water supplies of Australia's fifth largest city Adelaide, which draws its water mainly from the Murray River.

⬠ **Declining rainfall** combined with rising populations have threatened the water supplies of Australia's largest two cities, Sydney and Melbourne. Severe water restrictions apply in Melbourne, which in other ways benefits from one of the best protected catchments in Australia. Fierce debate in both cities rages over whether to build desalination plants or instead recycle waste water and reduce demand.

▲ **Misconceptions that groundwater** was a resource to be "mined" have led to dropping groundwater levels in the important irrigation area of the Namoi River, leading to conflict as authorities attempt to impose urgently needed limitations on past and promised water allocations.

★ **Artificial recharge** is being used to keep seawater from infiltrating the groundwaters sustaining the major Burdekin irrigation district, but recent projections suggest this will not be enough.

■ **Alice Springs** is a town relying on an ancient aquifer no longer being recharged and dropping water levels are feeding growing concerns about how long the waters will last and how much the town can afford to grow. Alternatives water sources are likely to be both expensive and similarly limited.

⬠ **The appropriation of water** in dry areas for cotton and rice irrigation has been highly controversial and a source of much conflict, but despite this record irrigators continue to search for unexploited areas such as the highly seasonal rivers flowing into the Gulf of Carpentaria.

● **A century of tapping** into the Great Artesian Basin left a legacy of abandoned bores and dropping pressures in this enormous groundwater resource. A program of capping bores and replacing channels with pipes has only partly redressed this problem.

★ **A mounting body of evidence** has linked agricultural run-offs – sediment, excess fertilisers and trace herbicides – to damage to Australia's premier tourist attraction, the Great Barrier Reef. A Reef Water Quality Plan is slowly being implemented to reduce the threat to the reef.

...an estimated 403,000 people became ill and 69 died when the Wisconsin water supply was infected with cryptosporidium...

...tap water can potentially contain thousands of chemical pollutants, many of which have received little to no study of their long term health effects...

Emerging water related health problems

Over the last few decades, more and more health risks have emerged in water used for water supplies and recreation. In 1993, in the largest documented outbreak of waterborne disease in the USA, an estimated 403,000 people (or around one quarter of the population) became ill and 69 died when the Wisconsin water supply was infected with cryptosporidium – a pathogen identified only in the 1970s.³ Australia's largest city, Sydney, also detected cryptosporidium and other pathogens, temporarily disrupting its drinking water supply as it was preparing to host the 2000 Olympic Games.

Health problems linked to ingestion or contact with cyanobacterial toxins have caused health problems in a number of first world countries including Australia, the USA, the UK and South Africa. Cyanobacteria thrive in eutrophied water bodies; a spectacular outbreak over extensive stretches of Australia's largest river system in 1991-92 was linked to urban and agricultural pollution, unsustainable irrigation demands and insufficient environmental flows.

The safety of drinking and recreational water in developed countries will continue to be a concern, with WHO noting that *"despite advances in diagnostic technology water-related disease of unknown etiology remains a significant percentage of the total outbreaks of disease. Published statistics from the USA show that between 1991 and 2000, the etiological agent (precise cause) of around 40% of drinking-water associated (disease) outbreaks was not identified"*.⁴

Dangerous pollutants

In addition to pathogens, tap water can potentially contain thousands of chemical pollutants, many of which have received little to no study of their long term health effects or what they do in combination with other chemicals. A 2001 survey of urban drinking water in the United States found repeated occurrences of toxic lead (from pipe corrosion) and arsenic (present in the water of 22 million Americans), the pesticide atrazine, chlorination byproducts trihalomethanes and haloacetic acids (implicated in cancer, reproductive problems and miscarriage) and perchlorate from rocket fuel (present in the water supplies of more than 20 million Americans). In general, these were not detected at higher than EPA standards, but the report also criticised US standards as being set too low.⁵

Nitrate contamination is the most common drinking water problem in Europe, with the European Environment Agency also reporting that *"at least 12% of citizens in EU15 countries were potentially exposed to microbiological and some other undesirable contaminants that exceeded Maximum Allowable Concentrations as laid down in the EC Drinking Water Directive, in the years reported."*⁶



³ Corso PS, Kramer MH, Blair KA, Addiss DG, Davis JP, Haddix AC. Cost of illness in the 1993 Waterborne Cryptosporidium outbreak, Milwaukee, Wisconsin. *Emerg Infect Dis* [serial online] 2003 Apr [date cited]. Available from: URL: <http://www.cdc.gov/ncidod/EID/vol9no4/02-0417.htm>

⁴ WHO. 2003 Emerging Issues in Water and Infectious Diseases, p13

⁵ National Resources Defense Council 2003, What's on tap? Grading drinking water in US cities, www.nrdc.org/water

⁶ European Environment Agency 2003, Indicator Fact Sheet (WEU10) Drinking Water Quality

Over-use and deterioration of groundwater supplies threatens overall food production...

...many aquifers are under severe stress...

The assault on groundwater

The harnessing of electricity and improved drilling and pumping technologies have resulted in what has been called “an assault” on world groundwater resources over the last half century. Many aquifers as a result are now showing signs of collapse and contamination.

Some may recover if the water take is relaxed to allow recovery and any subsequent management regime pays careful and conservative attention to the concept of sustainable yield. But many deep aquifers containing water which may have taken millennia to accumulate may take correspondingly long time frames to replenish. Soil deterioration and land cover changes in recharge areas also hinder replenishment and complicate the calculation of sustainable yield.

Some former aquifer strata can be physically or chemically damaged by over-exploitation, with surprisingly common consequences including widespread land subsidence, pH changes and the mobilisation of toxic oxidation byproducts such as arsenic compounds. In Japan, for instance, falling groundwater levels have exposed clays which have shrunk to such an extent that some areas are now below sea level and exposed to catastrophic flooding.⁷

Once seriously contaminated, difficulties of access make aquifer restoration extremely problematic. The combination of falling aquifer levels and rising sea levels due to climate change is expected to lead to far more extensive salt intrusion.

Over-use and deterioration of groundwater supplies threatens overall food production, the water supplies of large populations in both the developed and developing world, river, stream and wetland viability and vegetation cover. Scientists caution the extremely sketchy knowledge of most major aquifers and doubt the validity of some current methodologies for estimating yields.⁸

Groundwater resources are stressed in first world countries in North America, Europe and Oceania, and in Japan, from both over-extraction and contamination. Problems with contamination include seawater intrusion, seepage from rural septic and urban sewage systems, leakage from landfill, leakage of petroleum and industrial chemicals from old, abandoned and damaged tanks, urban stormwater, and agricultural and livestock wastes, pathogens and chemicals. Research is now turning to the possible consequences of contamination with minute amounts of pharmaceuticals, animal growth hormones, antibiotics and a host of potential “endocrine disruptors”.

Taking too much in the USA

More than half the US population is dependent on groundwater, but many aquifers are under severe stress. In Arizona, the most groundwater dependent state, recharge is believed to be only half of the amount extracted, with the average decline in groundwater levels being around a metre per year since the early 1900s. The depletion extends to the huge Ogallala Aquifer of the American west, with localised level drops of up to 30 m.⁹

Beyond repair in Europe

Contamination, particularly with nitrates, is a major groundwater issue in Europe. But by the time the problem is recognised, the damage is often done. After 15 years, a major international effort to revive the Rhine after decades of intense urban, industrial and chemical pollution has achieved many successes with the river. But it has had to concede that for large areas of the basin achievements of its objectives for groundwater are “unlikely”.¹⁰

⁷ Ministry of the Environment, Quality of the Environment in Japan, 2005 (<http://www.env.go.jp/en/w-paper02/2005/02.pdf>)

⁸ Foster, S.S., and P.J. Chilton. 2003. “Groundwater: The Processes and Global Significance of Aquifer Degradation.” *Philos. Trans. R. Soc. Lond. B Biol. Sci.* 358 (1440), 1957–1972.

⁹ Morris 2003 p19.

¹⁰ Co-ordinating Committee Rhine, No Frontiers for the Rhine; Inventory 2004 in the Rhine River basin.

“Less than half of our urban rivers are of good quality because of pollution from road surfaces and sewers”

One fifth of the world's fresh water lies in the Great Lakes of North America...

New challenges in lifting water quality

Raising environmental awareness has driven great improvements in rivers and water quality in many countries since the days when pollution load lead to a US river famously catching fire.¹¹ Much of the improvement has been driven by tackling large point sources of pollution and diverting at least some flows to the maintenance of freshwater environments. Now the challenges to water management in most developed countries are becoming more complex and the improvements more incremental than dramatic.

The damages of diffuse pollution

After a decade of rapid improvement in the chemical and biological quality of British rivers, the Environment Agency has noted that the improvement has stabilised. Agricultural run-off, as always, is a clear culprit with half of England's rivers having high levels of phosphate and a quarter having high levels of nitrate. Additionally, the agency noted “Less than half of our urban rivers are of good quality because of pollution from road surfaces and sewers”. Also of concern are airborne pollutants settling on water surfaces; with particular concern being raised about the methyl mercury from power station smokestacks finding its way into the human food chain through fish.

While less toxic waste is being released by industry, new concerns are being raised about pathogens and chemicals that can be harmful in minute and often difficult to detect quantities. These can include medicinal, veterinary and hormonal wastes that can affect biological processes, such as the so-called endocrine disruptors.

According to the EA, “Tap water quality continues to be excellent but we are spending more to take pollutants out, to keep it this way. For example, water companies spend £136 million (\$US 253 million) each year taking out pesticides and nitrates.”¹²

Slow revival of the Great Lakes

One fifth of the world's fresh water lies in the Great Lakes of North America, sustaining 33 million people and some of the largest cities and most economically significant areas of Canada and the United States. Overuse, neglect and a long tradition of depositing municipal and industrial wastes into the water seriously degraded water quality for most of the last century. International shipping has brought in major pest species. Major clean-up efforts by communities and all levels of government are starting to restore the lakes but serious problems remain.¹³ Some species are coming back but many remain in decline. Pathogens in waters supplies have caused serious health incidents as communities that have depleted groundwater reserves turn more and more to lake or catchment surface water. Many lake fish are unfit for human consumption and many beaches unsuitable for recreation.

From prosecuting polluters to land use planning

Dealing with diffuse pollution is difficult and progress can be difficult to measure as historic pollution continues to be released from soils and river sediments. As Britain's Environment Agency notes, the culprits are now only marginally the installations amenable to licensing and regulation. Much more concern is now being raised about what is running off the road, what is coming off the fields, what is drifting down from the air and what is percolating its way down to the aquifers. Facing these concerns multiplies the number of agencies involved and strays into the difficult realm of land use planning.

¹¹ Cleveland, Ohio's grossly contaminated Cuyahoga River caught fire in June 1969, an event that lent impetus to the push for federal clean water legislation.

¹² UK Environment Agency, Water – how it is in State of the Environment 2005, www.environment-agency.gov.uk

¹³ Environment Canada & US Environmental Protection Agency 2004, Our Great Lakes <http://binational.net/ourgreatlakes/ourgreatlakes.pdf>

...many first world cities are outgrowing their freshwater resources.

Other issues include persistent arsenic and radon contamination.

Thirsty cities

Even without the potential complications of climate change, many first world cities are outgrowing their freshwater resources. Others are wrestling with the costs of not protecting their water supplies from contamination and some are having to cope with both inadequate and contaminated water supplies. Strikingly, the cities with fewer water issues tend to be those with longer traditions of conservation in their catchment areas and expansive green areas within their boundaries.

Houston, USA

The USA's fourth largest city, sometimes celebrated as the oil capital of the world, has had repeated difficulties securing the water it needs. Initially, both oil fields and rapidly growing populations drew on groundwater supplies, but dramatic subsidence lead to a gradual switch to mainly surface supplies from the 1970s.¹⁴ Despite a major effort to reduce water contamination, problems remain. The US EPA rates the Jacinto River, a major source of supply as contaminated or at risk of being contaminated with pathogens and pesticides, urban and agricultural run-off. Other issues include persistent arsenic and radon contamination. Continuing growth is maintaining the pressure on surface and groundwater supplies, and threatening vital water flows to the economically and environmentally important Galveston Bay.¹⁵

London, UK

London is the largest significantly groundwater dependant city in the developed world, consuming more of its region's renewable supplies than anywhere else in the UK and pressure is growing with new housing developments proposed in the surrounding and most water scarce parts of SE England. Additionally, the environment is being adversely affected, with the water take in some areas having to be wound back just so that rivers like North Kent's River Darent can run again.¹⁶ London's long term water security is thus far from assured. In southern England generally, a slowdown in winter rain has seen some groundwater levels decline to the lowest levels in more than 70 years.¹⁷ A controversial proposal to build a desalination plant in the Thames River estuary was recently rejected. But a more immediate problem arises from the leakage and loss of about 300 olympic swimming pools of water a day from ageing water mains and frequent raw sewage overflows from antiquated sewers coping with a much greater population than Victorian engineers could envisage. Massive investments are required to renew this aged and inadequate infrastructure. A complicating factor is the high levels of tension between a privatised water industry, regulators and consumers. For example, reducing water pressure takes stress off distribution networks but makes water supply uncertain to the upper extremities of the high rise city.¹⁸

Tokyo, Japan

Enjoying all the advantages of Japan's high rainfall, Tokyo may have set the world water supply and sanitation standard as far back as medieval times. The quality of engineering is still much envied, but the legacy of rapid growth and industrialisation is also a legacy of periodic water shortages, flooding and ground subsidence due to over-extraction of groundwater. Chemical contamination, particularly in groundwater, is an increasing issue. Japan is seeking a reputation of world excellence in responding to some of these issues, with the Tokyo area municipality of Sumida City receiving international accolades for rainwater harvesting projects which augment water supplies, reduce sewage discharge and flooding and recharge local aquifers.¹⁹

¹⁴ Harris-Galveston Subsidence District (HGSD), www.subsidence.org

¹⁵ National Resource Defense Council 2003, What's on Tap: Grading Drinking Water in US cities.

¹⁶ Morris 2003, p20

¹⁷ Water UK briefing 18 November 2005 – Water Resources: Lessons of the 2005 drought and future prospects

¹⁸ London's water supply: A report by the London Assembly's Public Services Committee, October 2003

¹⁹ United Nations Environment Programme, Dams and Development Project.http://hq.unep.org/dams/documents/cell.asp?story_id=3

The issue of future water supplies is now one of the major social, health and political issues...

...some Australian cities would face up to a ten-fold increase in water costs over the next 25 years.²¹



❖ The River Thames, London, UK. Only 340 km long, the River Thames is the principal river of England. Over 7 million people depend on the river for water and 124 sewage treatment works carry away the sewage of the 11 million who live in the Thames Valley. It suffered badly from pollution from Victorian times onwards, but was cleaned up during the 1960s.

Sydney, Australia

Large dams and favourable topography have not saved Australia's largest city from a looming water crisis brought on by declining rainfall, booming population and the realisation that urgent action was required to restore the health of waterways afflicted by blocked flows, contamination and algal blooms. The issue of future water supplies is now one of the major social, health and political issues facing Sydney and most other large Australian cities. Water restrictions, rainwater tanks, water recycling, desalination and demand management are among the measures being considered or implemented as the city tries to recover from regularly exceeding long term renewable supplies for more than two decades.²⁰

More cities face thirsty future

Many other developed nation cities are facing a constrained water future. These problems will be made much worse in areas where development and land use planning decisions are taken without regard to renewable water resources. Areas where rapid development is proceeding despite clear evidence that water supply limits are being approached or exceeded include south east England, southern California, Mediterranean coastal areas of Europe and coastal areas of Australia. Desalination, sometimes embraced as a panacea for water problems, is energy intensive, economically expensive and has effluent issues with highly saline discharges to marine environments.

One factor receiving comparatively little attention is the economic flow-on effects of dramatic increases in the price of a commodity as basic and essential as water. One recent analysis suggests that even with some water efficiency measures, some Australian cities would face up to a ten-fold increase in water costs over the next 25 years.²¹

²⁰ New South Wales Independent Pricing and Regulatory Tribunal 2005 Investigation into Water and Wastewater Service Provision in the Greater Sydney Region

²¹ Mike D. Young, Wendy Proctor, M. Ejaz Qureshi and Glyn Wittwer, Without Water: The economics of supplying water to 5 million more Australians. CSIRO Water for a Healthy Country Flagship report, CSIRO, May 2006

{Dam building has} not solved Spain's water problems; indeed, it may well have increased them.

The unravelling of supply side solutions - a Spanish case study

Historically, the answer to water issues has been to tap into new sources of supply – build more dams, drill deeper, pipe water from ever more remote locations. As the environmental and social costs of this approach have become more apparent, it is increasingly obvious that increasing water supply is not increasing water security. Spain provides a clear current case of the unravelling of the supply side solution.

Spain's main answer to historic and looming water shortages has been centred around ambitious infrastructure plans which made it one of the world's top five dam building countries with more dams per capita than any other nation and a large scale diversion of water from the Tagus River to the basins of the Júcar and Segura Rivers. This had not solved Spain's water problems; indeed, it may well have increased them. Many Spanish dams have failed to achieve their planned capacity or objectives and growing demand for tourism and agriculture in Mediterranean catchments is consuming water now sorely missed in central Spain and Portugal. This has been a recipe for water conflict.

On the analysis of WWF and Spanish scientists from a variety of specialities, the Tagus-Segura water transfer link has failed on environmental, economic and social grounds. Unregulated water take-up in the receiving basin and poor adherence to permissible flows in the donor basin mean that water shortages have become more, not less, widespread. Other unintended consequences have been greater levels of pollution, an expansion of irrigated areas, an illegal market in water which discriminates against traditional land uses and a dramatic expansion of illegal immigration and labour exploitation.²²

Despite these difficulties, the much-vaunted Spanish National Hydrological Plan, legislated in 2001, was centred around €23 billion (\$US 29 billion) in more dams and diversions. The largest project, to take water from the Ebro to four more southerly basins provoked conflict between regions, opposition across Spanish society and record representations to the European Union as a key funds provider. The project was abandoned in 2004, replaced with a proposal which placed its supply side emphasis more on expanding Spain's already considerable desalination capacity.

Perverse subsidies push irrigation

The presumption that water will always be found – from adding more reservoirs to the existing total of unfilled Spanish reservoirs, from some other river basin, from underground or from the sea – is one linchpin of the unsustainable expansion of irrigation in the Mediterranean river basins of southern Spain. Another is the availability of subsidies – crops are being grown not in response to market demand but in response to the availability of subsidies. A WWF analysis determined that water used per year in producing surplus quantities of the four crops corn, cotton, rice and alfalfa was the equivalent of the domestic water consumption of 16,338,000 Spaniards.²³ In this case, "surplus" is defined as in excess of Spain's quota under the European Common Agricultural Policy. Not counted are the often large quantities of higher value and generally thirstier crops such as tomatoes and strawberries which are withheld from the market – less euphemistically, thrown away – in order to maintain prices. Nor does it include the growing trend to irrigate the olive grove and the vineyard once rightly celebrated for their relatively sustainable place in the Mediterranean landscape. Olive groves are now the major water consumers in the overstretched Guadalquivir basin. In the case of wine, especially, the receiving systems of markets and market supports is having difficulty digesting the new "surplus" production, with Spain attempting recently to claim most of the EU "voluntary distillation" subsidy to remove the water from surplus wine.

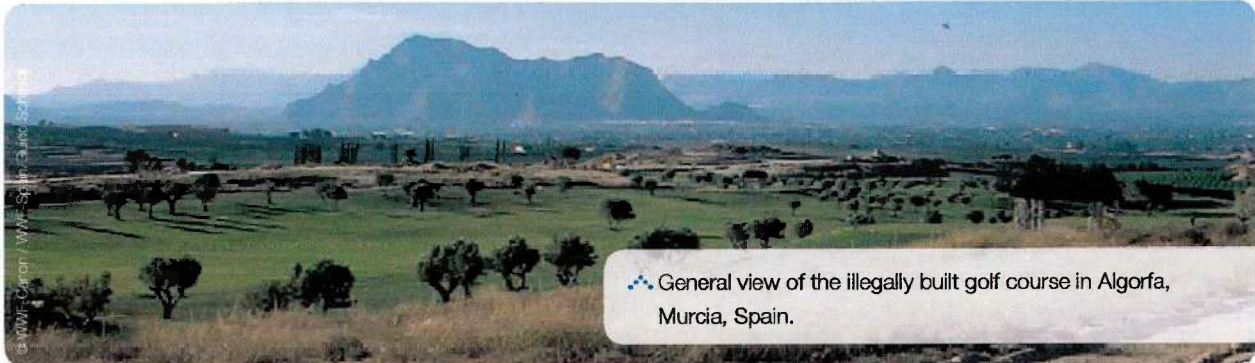
A key issue in Spain, as in most developed economies, is that agricultural producers rarely have to meet any more than a small fraction of the real costs of the water they use. This provides no incentives to efficient irrigation.

²² WWF 2003, Water transfers are increasing the water crisis, The case of the Tagus-Segura Transfer in Spain

²³ WWF, 2005 Agricultural surpluses "drink" the water of 16 million Spanish people: An analysis of irrigation overproduction in Spain.

Estimates vary, with one being that only 25 per cent of boreholes are legal.²⁵

...groundwater depletion alone was estimated at 130 per cent of available renewable water resources in 1995.²⁷



General view of the illegally built golf course in Algorfa, Murcia, Spain.

Thirsty tourism

The cloud free skies and low rainfall of southern Spain and its Mediterranean islands have long been a tourist drawcard. But as tourism expands and becomes more water intensive, those same clear skies are increasingly at odds with the pell-mell expansion of resorts with their textured lawns and expansive swimming pools, residential estates with their textured lawns and multiple swimming pools and golf courses with their well sprinkled fairways. Tourism sees its main growth potential in “second house tourism” which can consume twice the water of the apartment-based dwelling model.

Water infrastructure for tourism also has to be provided on a peak demand basis, with the peak coinciding with major agricultural demands. Best practice integrates development with resource and environmental constraints but Spanish mechanisms for integrating land use planning and river basin management are deficient both on paper and in practice.

Regulating demand for some and not others

Greater reliance on market mechanisms such as more realistic pricing for water is having the desired impact in some of Spain's cities. In Seville, water demand in the severe drought year of 2005 was 134 million m³ per year, a long way short of the 175 million m³ forecast as justification for the controversial Melonares Dam.²⁴

But any gains made here are quickly eroded by the expansion of profligate water use in agriculture and tourism. Demand regulation here often occurs only in theory, with a high level of tolerance for Spain's substantial infrastructure of unregulated and illegal water extraction and marketing, much of it very recent in origin. Estimates vary, with one being that only 25 per cent of boreholes are legal.²⁵ Some smaller groundwater aquifers have recorded startling drops in water levels – up to 170 metres in less than 20 years in the Alt Vinalopó valley of Alacant province.²⁶

The calculations underlying the Tagus-Segura transfer were almost immediately undermined by an increase in illegal extractions in the receiving basins. Illegal and unregulated extractions and the private water market they supply are a major support for the growth of water uses in tourism and agriculture to unplanned, unforeseen and unsustainable levels. In the Segura, groundwater depletion alone was estimated at 130 per cent of available renewable water resources in 1995.²⁷ Flow on effects including the perverse trend to irrigate the formerly dryland agriculture of the olive grove and the vineyard, the expansion of glasshouse cultivation, a landscape contaminated and polluted by agricultural waste including horrendous quantities of plastic and the fostering of a demand for cheap, often illegal immigrant labour which has been linked to social unrest.

²⁴ WWF 2005, To dam or not to dam? Five years on from the World Commission on Dams

²⁵ Spanish White Book on Water, 2000

²⁶ Morris, B L, Lawrence, A H L, Chilton, P J C, Adams, B, Caiow R C and Kilnick, B A. (2003) Groundwater and its Susceptibility to Degradation: A Global Assessment of the Problem and Options for Management. Early Warning and Assessment Report Series, RS. 03-3. United Nations Environment Programme, Nairobi, Kenya. p19

²⁷ Morris 2003, p19

Spain [also] recorded the worst result (more than 60 percent) for the frequency of nitrates being recorded in groundwater²⁸ and exceeding nitrates in drinking water³⁰

WWF is also seeking to have up to 13 existing dams decommissioned...

Water quality in question

One justification for Spain's National Hydrological Plan was that the newly dammed or diverted waters would not be used to expand irrigation. While such promises always fly in the face of the high level of illegal extractions, they have also been undermined by the poor quality of the water for proposed non-agricultural uses. In the case of the Tagus-Segura transfer, water quality suffered in both basins. The Tagus, with often less flow than specified in the scheme parameters, was less able to deal with the waste waters generated by Madrid. Expanded agriculture increased the chemical and sediment load while also robbing the rivers of additional flow. Saltwater intrusion into over-exploited groundwater aquifers is a problem around the entire Mediterranean Spanish coast.²⁸ Spain also recorded the worst result (more than 60 percent) for the frequency of nitrates being recorded in groundwater²⁹ and exceeding nitrates in drinking water³⁰ and the second worst result for compliance with inland water bathing quality standards.

Call for a new water culture

By convention, a country is not considered under any form of water stress if its water exploitation index (WEI) – extractions as a proportion of long term renewable resources – is less than 10 percent. Severe water stress sets in with a WEI index level of 40 percent. Spain, consuming nearly 35 percent of its long term renewable water resources, is the third most water stressed nation of Europe, behind only the not particularly comparable states of Bulgaria (marginally) and Cyprus (significantly). Much of Europe has also been reducing its water take over the last decade, mainly by pricing water more realistically, using water more efficiently in cities and industry and in particular, by irrigating less or more efficiently.

These trends are evident in Spain, but the predominant policy concern remains the improvement or redistribution of water supplies. However, the cancellation of the Ebro transfer as the centrepiece of the National Hydrological Plan after widespread public opposition has created opportunities for Spain to evolve a new policy direction and one more in line with its obligations under the European Water Framework Directive.

Spearheading this move is the New Water Culture Foundation, set up by prominent scientists and civil society figures calling on Spanish government and society “to admit and understand that a river is much more than a H₂O channel, in the same way that we already admit that a forest is much more than a wood store. To understand the social, cultural and identity values of rivers, lakes and wetlands; to know the complex life pyramid they host; to value the importance of the balances and functions of the natural hydrological cycle and the services it gives to us; to recover the leisure use and the aesthetic value of water, both in nature and in cities...; everything without forgetting the need of an efficient management of the economic uses of water as a productive resource, are the keys of that New Water Culture”.³¹ It is a call that is rapidly finding adherents outside Spain as well, particularly in Latin America.

WWF's major project in this area “Water infrastructure in Spain” is seeking to halt remaining dam and water transfer vestiges of the National Hydrological Plan and to shift the focus of Spanish water policy towards Integrated River Basin Management. WWF is also seeking to have Spain adhere to the World Commission on Dams guidelines for new projects. WWF is also seeking to have up to 13 existing dams decommissioned as a key step in the recovery of Spanish rivers and natural resources.



Irrigation fields in the dry Moratalla area, Murcia, Spain.

²⁸ European Environment Agency 2003: Europe's water: An indicator-based assessment

²⁹ EEA 2003: Europe's water p30

³⁰ EEA 2003: Europe's water p46

³¹ www.unizar.es

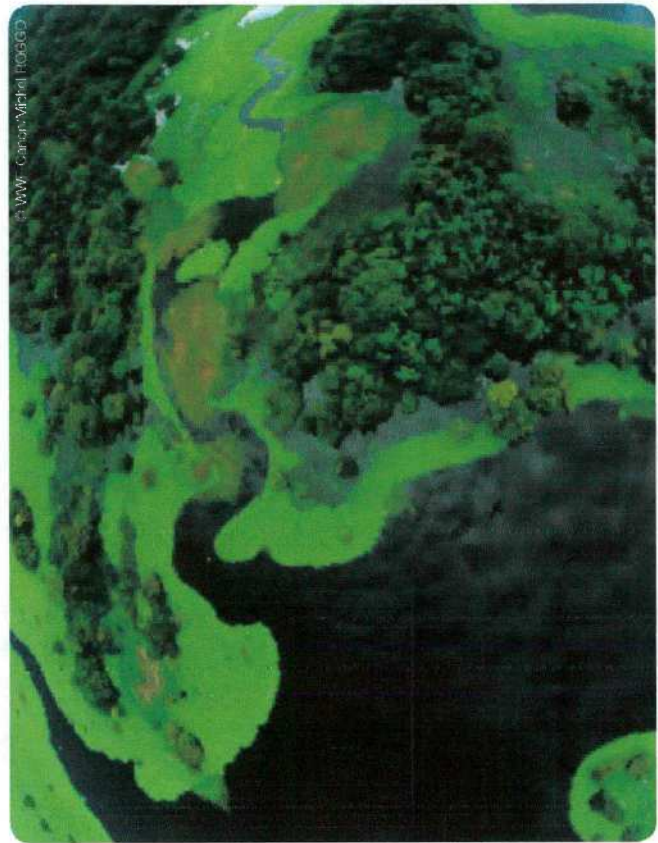
In the era of rapid economic development, the environment was there to be used. Such an approach has steadily become less tenable in the developed world...

Accepting the need for environmental flows

In the era of rapid economic development, the environment was there to be used. Such an approach has steadily become less tenable in the developed world as environmental costs mount to unacceptable levels and an increasing weight of science, public opinion and consumer sentiment compels the attention of politicians and business. Water related environmental issues are now high on the agenda of many governments and multilateral institutions in the developed world.

Invariably, the consensus is that what the environment needs is water – sufficient water for the rivers to flow, for the aquifers to remain charged, for channels to flush, and for water quality to be maintained. Providing sufficient water – in river basins where water is often over-allocated and where water take is often unregulated – is a major and costly challenge to governments in Europe, North America, Australia and Japan.

The emerging science of environmental water allocation has defined environmental flows as “The quality, quantity and distribution of water required to maintain the components, functions and processes of riverine ecosystems on which people depend”. This underlines the complexity of the task of modifying river flows and the need to consider issues of water quality and the timing of flows as well as the quantities of water required. A key measure is that “the maintenance of natural biodiversity is the key to the health of ecosystems and their sustainable management”.³² In this regard, it is of note that WWF’s Living Planet Index shows greater declines for populations of freshwater species than for species generally. For the 200 freshwater species analysed, population declines of more than 50 percent since 1970 were recorded, compared to just 30 percent for the marine and forest biomes.³³



Going, going... The first world’s wetlands

Many of the wetlands of the western world have been lost to agriculture and other development and many that remain are in a degraded state. Much of this damage occurred in the second half of the last century, just as appreciation was growing of the valuable and highly varied role played by wetlands in flood mitigation, flow control, waste absorption, nutrient recycling and habitat provision. In France, for instance, 67 % of wetlands were lost between 1900 and 1993 while the Netherlands lost 55% of its wetlands between 1950 and 1985.³⁴ California is one of seven US states to have lost more than 80 per cent of their original wetlands, while nationally around half of all wetlands have been lost.

³² Jay O’Keefe, An introduction to Environmental Water Allocation.

³³ WWF, Living Planet Report 2004, WWF, Gland, Switzerland.

³⁴ WWF 2004, The Economic Values of the World’s Wetlands p19

"Our analyses suggest that it costs between ten and a hundred times more to repair a damaged natural system than it does to maintain it".³⁵

Once labelled "the sewer of Europe" the Rhine is now on its way back to health...

The high cost of cleaning up

The key lesson emerging from the clean up of damaged freshwater systems are the huge investments required in time, money and institutional support. Taking water back in an over-allocated system is also politically very difficult to achieve. The clean up cost is emerging as a compelling new reason for protecting any relatively pristine systems and arresting the decline in degrading systems as quickly as possible. A group of eminent scientists advising Australia's Prime Minister put it this way: "Our analyses suggest that it costs between ten and a hundred times more to repair a damaged natural system than it does to maintain it".³⁵

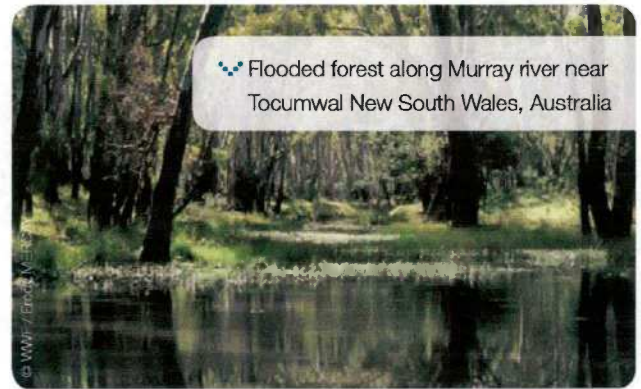
Saving the Everglades

Florida's Everglades are one of the world's best known wetlands, but by 1998 the wetlands were down to half their original area even including areas isolated by roads, canals and other developments. Wading bird populations had collapsed, 68 species were endangered or threatened, exotic species were everywhere a problem, and high levels of phosphorous and other contamination were a major water quality and health issue. Waters seeping or diverted from the Everglades were damaging the coastline and were implicated in a 10-fold increase in coral diseases recorded from 1980. The Comprehensive Everglades Restoration Plan was agreed on 1999 and in 2000 the US Army Corps of Engineers was enabled to implement it over a period of 30 years at an estimated cost of \$7.8 billion. "Reviving a dying ecosystem", even only partially, is proving to be politically divisive, highly expensive and a long term commitment.³⁶

Saving the Murray-Darling

The poor health of Australia's main river system, the Murray-Darling, was starkly highlighted by blue green algae infections over hundreds of kilometres in 1991-92, revelations that water supplies for the nation's fifth largest city were well on their way to being too salty to use, and a requirement to constantly dredge the river mouth to keep it flowing to the sea. Over the last decade, federal and state governments have committed to "saving the Murray-Darling" with large programs including the "Living Murray", a first step \$500 million AUD (commitment

over five years to restore 500 gigalitres of annual flow to six ecological assets including the river mouth and channel).³⁷ An extra AUD \$500 million (\$US \$374 million) has just been announced for the 2008-11 period and it is beyond dispute that further commitments will be required beyond that period. A related commitment is the AUD \$1.4 billion (\$US 1.04 billion) National Action Plan for Salinity and Water Quality, with around half of the 21 priority areas being within the Murray-Darling basin.³⁸



Flooded forest along Murray river near Tocumwal New South Wales, Australia

Saving the Rhine

Once labelled "the sewer of Europe" the Rhine is now on its way back to health following a major effort supported by five governments which commenced in earnest in 1987. The total amount spent by governments, communities and industry is not known but, considering that around €13 billion (\$US 16.6 billion) was spent on river restoration in one six year period, it can safely be described as a major and continuing investment. The recent return of salmon and trout to the river has been heralded a significant achievement. The International Commission for the Protection of the Rhine is now pursuing its objectives in line with the European Water Framework Directive.³⁹

³⁵ Prime Minister's Science, Engineering and Innovation Council, Australia, May 2002.

³⁶ www.evergladesplan.org

³⁷ Murray Darling Basin Commission, www.mdbc.gov.au

³⁸ National Act on Plan for Salinity and Water Quality www.napswq.gov.au/

³⁹ International Commission for the Protection of the Rhine, www.iker.org

Scientists now believe that large scale human alterations to the world's fresh water flows – both planned and unintended – also have consequences which remain largely unstudied and unknown.

Fiddling with water flows ...the global dimension

Particularly over the last decade, the world has realised that even relatively minor modifications to the composition of gases in the atmosphere can have major consequences in a changing climate. Global flows of water and water vapour have also been subject to dramatic modification while being little understood, and increasing scientific attention is now being paid the possible consequences.

If, as seems increasingly likely, there are adverse global effects flowing from such major modifications of the world's hydrology, a disproportionate share of the major interventions have been within or at the bidding of the world's wealthier nations. Just as in the case of climate change, more of the responsibility and possibility of remedial action also lies there.

Large scale changes to world climate and hydrology

Climate change, triggered extensively by the greenhouse gas emissions of the developed world, will profoundly alter the world's rainfall patterns, river flows and freshwater reserves.

In some areas, such as southern Australia, the coming of a drier climate is already well-established. Other areas of Australia will become wetter, but they are smaller, sparsely inhabited and much less suitable to agriculture.⁴⁰

Reduced Atlantic Ocean storm activity has been linked to a pattern of recurring drought in Portugal, Spain and southern France and possibly parts of the United Kingdom. This has been putting cumulative pressure on water stores and river flows in those countries. A drying climate and changing snow melt patterns will adversely affect areas of the United States that are currently a massive contributor to global food supplies.

Scientists now believe that large scale human alterations to the world's fresh water flows – both planned and unintended – also have consequences which remain largely unstudied and unknown. Hydrology on a global scale is a study still in relative infancy but recent papers highlight serious shortages of knowledge about what could be significant risks on their own, let alone in their complex interactions with climate change.

According to the scientific consensus of the recently convened Global Water System Project, "Evidence now shows that humans are rapidly intervening in the basic character of the water cycle over much broader domains. The collective significance of these many transformations on both the Earth system and human society remains fundamentally unknown... Many basins have been dramatically transformed, with some of the world's largest rivers showing a complete or nearly complete loss of perennial discharge to the ocean (e.g. the Colorado, Yellow, and Nile Rivers). Global manifestations include a doubling-to-tripling of the residence time of continental runoff in otherwise free-flowing rivers, a 600–700% increase in fresh water stored in channels, and a 30% decrease in global suspended sediment delivery to the oceans. Dam construction has resulted in a worldwide pattern of habitat fragmentation that threatens the biodiversity, structure, and function of aquatic ecosystems... Like other components of the Earth system, the Global Water System could also have significant linkages, feedbacks, and thresholds that are yet to be discovered. A modified hydrologic cycle could lead to abrupt change and surprises, such as a potential shutdown of North Atlantic deep water formation and ocean circulation arising from changes in Eurasian river discharge, or the emergence of anoxic dead zones near the mouths of rivers heavily polluted by upstream agriculture and urbanization".⁴¹

⁴⁰ Pittock, B. (ed.) (2003) Climate Change: An Australian Guide to the Science and Potential Impacts. Australian Greenhouse Office, Canberra, ACT, Australia

⁴¹ Vörösmarty, C.; Lettenmaier, D.; Leveque, C.; Meybeck, M.; Pahl-Wostl, C.; Alcamo, J.; Cosgrove, W.; Grassl, H.; Hoff, H.; Kabat, P.; Lansigan, F.; Lawford, R.; Naiman, R. (as members of the Framing Committee of the GWSP) (2004): Humans Transforming the Global Water System. Eos, Transactions, American Geophysical Union, 85:48 (30 November 2004).

Few of the world's rivers flow free any more...

Effects [of this] reduced sediment flow include significant depletion of the good agricultural soils vital to feeding an increasingly populated world...

Changing the vapour flow

On a global scale the negative effect on vapour flows of deforestation is believed to be only marginally more than the positive effect of reservoir creation and irrigation. However, this rough balance obscures major changes to vapour flow patterns. In two developed world examples, the 120 % increase in vapour flows from irrigated former steppe in Colorado, USA, has led to more rain, lower temperatures and more thunderstorms, while deforestation in Australia has caused reduced continental vapour flows by 10% "with consequent widespread and irreversible dryland salinity that has reduced crop productivity in some regions and made farming impossible in others." Projections of future land use changes affecting vapour flows raise the possibility of disruptions to major world weather cycles.⁴²

Cutting the flow

Few of the world's rivers flow free any more and while the consequences of this are now better understood at the river basin level, the global extent of the damming and the channelling is now understood to have much wider effects.

Many river systems are coping with increased pollution loads at the same time as decreased flows. Natural features that contribute to flow control and water quality maintenance – notably floodplains and wetlands – have been extensively modified and degraded.



❖ Dry riverbed of the Rio Grande upstream of the town of Anthony in New Mexico, close to the border with Texas.

Many of the world's most modified rivers are those of the developed world, and some, like North America's Colorado and Rio Grande and Australia's main river system the Murray-Darling have been modified to the point of only intermittently meeting the sea. Other rivers, like some in the United Kingdom, have been depleted at source by excessive groundwater extraction.

Just as rivers have been extensively modified, so has the life within them. Habitat change, water contamination, the interruption of flow patterns and the widespread dispersion of invasive species from elsewhere have had catastrophic effects on the aquatic organisms of the first world.

Sediments lost, sediments gained

The balance between increased sedimentation as a result of erosion and the trapping of sediments in reservoirs has been calculated at an annual 1.4 billion tonne reduction in global sediment flows. Over 100 billion tonnes of sediment which had system functions including the replenishment of soil fertility and coastline formation is now trapped in impoundments, most of this amount having accumulated in the last fifty years. Effects of this reduced sediment flow include significant depletion of the good agricultural soils vital to feeding an increasingly populated world, and accelerated rates of coastal erosion which will be considerably exacerbated by the sea level rises expected as a consequence of global warming. Accelerated erosion hotspots so far identified include areas of high population and huge real estate valuations in the US Gulf and California and the French and Italian Riviera frontages to the Mediterranean. Areas of Scandinavia and Japan are also at risk. The opposite problem, increased sedimentation, is also manifest in areas of California, as well as Spain, northern European Baltic and North Sea coasts, and estuaries fronting Australia's premier tourist attraction, the Great Barrier Reef.⁴³

⁴² Falkenmark, M.; Folke, C.; Gordon, L.; Johannessen, A.; Jönsson, B; Steffen, W. (2005): Human modification of global water vapour flows from the land surface. Proceedings of the National Academy of Sciences of the United States of America (PNAS) Volume 102, No. 21.

⁴³ Syvitski, J.; Vörösmarty, C; Kettner, A.; Green, P. (2005): Impact of Humans on the Flux of Terrestrial Sediment to the Global Coastal Ocean, Science Vol. 308: 376-380.

Regrettably, it appears rather that the bulk of these nations have been seduced by the lure of major infrastructure plans...

An opportunity to learn from the errors of the past

Most of the developed countries are showing at least some signs they have learned from the mistakes of their past management of water resources – and the great and often insurmountable costs of repairing just some of the past damage. The next group of rapidly developing economies has the opportunity not to repeat these errors and to avoid the costs of attempting to restore lost functioning in vital freshwater ecosystems. Regrettably, it appears rather that the bulk of these nations have been seduced by the lure of major infrastructure plans with inadequate consideration of whether such ambitious projects will meet water needs or inflict ultimately unacceptable human and natural costs.

Brazil

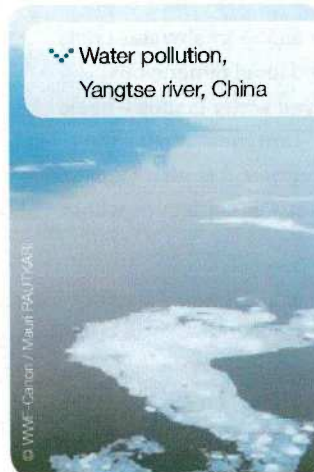
Brazil has led Latin America and many other world nations by approving in 2006 a national water resources plan that, if implemented well, will help address the needs of the country's many poor people lacking access to adequate and safe water and sanitation, take a basin approach to the conservation and equitable use of natural freshwater assets, and improve and broaden participation in water policy and planning.

However concerns remain over some existing dam proposals, particularly on the major Madeira River tributary complex in the Amazon basin. The Madeira has survived as a highly significant free flowing river but is threatened by plans for up to six proposed dams which will not only disrupt its flows but bring a cascade of highly damaging land use changes in their wake.

India

Much of India's agriculture is under threat from the consequences of rampant over exploitation of water resources, with groundwater reserves in particular dropping dramatically in many areas under a system where those drilling ever deeper win the water. In some areas, the dropping water levels have liberated dangerous contaminants including arsenic and fluoride into human water supplies with devastating long term health consequences for large populations.

Better known internationally are India's extensive dam and water transfer projects, which continue to go ahead despite the considerable human and environmental costs of past megadam projects and their failures to produce their forecast benefits. The hugely costly River Interlinking Project, planned to



take water sourced from rivers fed by the Himalayas into India's drier south threatens to provoke conflict on a large scale, both within India and with Bangladesh, which is dependent on the flows of rivers such as the Bhramaputra. Further, the Indian government is assessing proposals for a further 162 large hydropower dams, mostly in the north east of their country.

China

Like India, China has raised international concerns with the scale and possible ecological and human costs of some of its massive water infrastructure plans. Little of the growing disquiet over mega-dams seems to have influenced China's water planning. Two canal and reservoir links in a massive south to north transfer scheme to divert water over 1,200 Km from the Yangtze River to northern China are under construction and a third is planned. In the Yangtze River basin alone a further 105 large dams are planned or under construction.

The recent high profile pollution event which temporarily deprived the major city of Harbin of water underlined concerns about the risks to rivers and water quality in China from rapid and relatively unregulated industrial development. Waste disposal in large and rapidly expanding urban areas is also an issue.

WWF is particularly concerned over plans for a cascade of dams down the Salween River, which together with further dams proposed in Myanmar will destroy the natural connection between the Tibetan Plateau, south west China and the Andaman Sea with devastating ecological consequences.

What the first world cannot do is disengage from the water issues being faced in the developing world.

Rarely are agricultural water users asked to pay the full costs of the water they use.

What needs to be done

What is increasingly referred to as the freshwater crisis has global, regional, national and local dimensions.

While many of the most publicised water issues – basic access to water and sanitation – are most obviously associated with developing countries, it is also clear that the developed nations face serious water issues within their own borders.

What the first world cannot do is disengage from the water issues being faced in the developing world. First, there is the growing awareness that disruptions to global water flows can have global consequences. Tackling the issues will take institutional, financial and technological resources that are predominately in the developed world.

Second, it is undeniable that the wealthy nations have made and continue to make demands on the water resources of the developing world. We eat, drink and wear the third world's water... and it is a component of our jewellery, motor vehicles and much else. Additionally, the rich nations and institutions centred mostly in the rich nations provided the lead to the rest of the world on how best to develop and harness their water resources – a lead that in hindsight has brought benefits but inflicted significant human and ecological damage. Continuing developed world involvement is both morally imperative and required to remedy the effects of such over exploitation, inappropriate infrastructure development and contamination.

Tackling perverse outcomes by tackling perverse subsidies

The highly privileged position of agriculture is a common feature of most advanced economies. Rarely are agricultural water users asked to pay the full costs of the water they use and almost invariably they are considerably advantaged compared to industrial or domestic water users. This is the formal picture, worsened substantially in most countries with high levels of illegal, unregulated or uncounted water abstractions for agricultural use. The Australian example, of the flood flows of the country's longest river and lifeblood of some of its most parched landscapes simply being diverted into a single cotton enterprise in return for the payment of a purely nominal sum, might be extreme but it is unfortunately far from atypical.⁴⁴

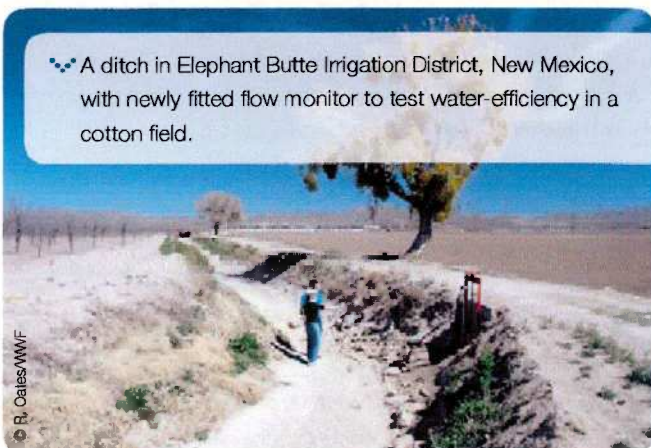
The consequences of the myriad explicit and implicit subsidies to unsustainable agriculture are relatively well-known, including the highly damaging irrigation of unsuitable soils and landscapes, ground and surface water depletion and pollution, degradation and destruction of environmental assets and high levels of conflict between different classes of agricultural users and other sectors – often for the production of wasteful surpluses or crops of marginal economic value. What sustains these subsidies are the high political costs of applying the same ground rules to agriculture as to other water users.

Nevertheless, the political difficulties must be faced in the interests of the efficient, equitable and sustainable use of water.

Recognising the many stakeholders in water

WWF's many projects in freshwater sustainability have been devoted to having due recognition given to the water needs of the environment. One of the strengths of the approach to these projects has been the recognition of all the relevant stakeholders and the explicit attempt to devise a beneficial and sustainable outcome for all stakeholder groupings. WWF is committed to the principles of information sharing and involvement as an approach that is both fair and effective.

A ditch in Elephant Butte Irrigation District, New Mexico, with newly fitted flow monitor to test water-efficiency in a cotton field.



© R. Cates/WWF

⁴⁴ Queensland's Cubbie Station may be the largest privately owned irrigated farm in the southern hemisphere. A journalistic treatment "The rise and rise of Cubbie Station" can be found at www.melaleucamedia.com

Too often, water projects have led to unintended and adverse consequences because water has been considered in an isolated way as an economic resource.

Free flowing rivers are a vital but precipitously declining resource...

The functioning ecosystem approach

Too often, water projects have led to unintended and adverse consequences because water has been considered in an isolated way as an economic resource. These problems could have been avoided if water had been seen as part of a functioning, living landscape which is co-dependent on both visible water in rivers, lakes, wetlands and as precipitation and the invisible vapour flows and aquifers. Integrated catchment management and similar concepts are worthy ways of dealing with water in context.

An important caution is that even in the most advanced countries with the most abundant research capabilities, we know relatively little about the overall functioning of such complex systems. Major interventions in the absence of knowledge are prone to unanticipated consequences. The more major the intervention, the greater the need to apply the precautionary principle.

Restore and protect environmental flows

Maintaining natural biodiversity is emerging as a key indicator of the quantity, quality and timing of flows needed to maintain functioning freshwater ecosystems and landscapes. Many riverine systems in the developed nations lack the flows they need to maintain their sustainable delivery of ecosystem services to human communities. The analysis of required environmental water allocations also needs to be firmly entrenched in the planning and consideration of all future flow modifications. Existing water infrastructure needs to be modified to release appropriate environmental flows.

Strengthen national commitment to IWRM planning

In 2002, as a key part of the MDG process, all governments committed to prepare national Integrated Water Resource Management Plans by 2005. Sadly, however, performance on this vital measure intended to provide basic national frameworks for overall action on the sustainable and equitable use of national and shared water resources has been lacking. Developed nations need to look to their own performance on IWRM plans and to their level of assistance to IWRM planning in the poorer nations – an area where only Canada and Denmark have been making significant contributions.

Conserve remaining free flowing rivers

Free flowing rivers are a vital but precipitously declining resource that are vital to protecting biodiversity and to developing our understanding of the functioning of freshwater ecosystems. With the majority of long rivers in particular now highly fragmented it is essential to develop plans to protect as many as possible of the world's free flowing rivers and tributaries. WWF recommends that as part of the commitments made by governments to conserve biodiversity they designate "conservation rivers" that remain free from modification and that wherever possible dams not be constructed on the main stems of rivers and tributaries to maintain remaining unbroken links from source to sea. WWF also recommends that this protection extend to as many types of river as possible.

Dam right, not dam wrong

Dams are the most damaging water infrastructure projects. A once exclusive focus on the benefits of dams is now very substantially tempered with realisations of their great cost. The major, multi-stakeholder work of the World Commission on Dams produced a framework for proceeding with dam projects that can dramatically improve dam decision making processes, principally by ensuring that the interests of all stakeholders, the environment and the possible alternatives are properly considered. This framework is still far from being adequately implemented. WWF is committed to the implementation of the WCD framework.

Improve multilateral water arrangements

Many rivers form or flow over international boundaries and as such are resources that can only be sustainably protected and managed through cooperative international agreements. However, many such rivers are not covered by any or adequate international arrangements paying due regard to the environmental needs of catchments or taking account of all the stakeholders in water. There is also a growing need for international agreements to govern the exploitation of bodies of underground water that are common to several nations. WWF is committed to the creation and improvement of international agreements to provide for the continued environmental functioning of multinational water resources and their equitable and sustainable use.

...developed nations need to take the lead on ratifying the 1997 UN Convention on the Law of the Non-Navigational Uses of International Watercourses...

Urban water use is one of the fastest growing demands on global water resources...

Ratify the UN Convention on Watercourses

In this regard, WWF believes that the developed nations need to take the lead on ratifying the 1997 UN Convention on the Law of the Non-Navigational Uses of International Watercourses which would provide a legal framework and dispute resolution mechanism for the "protection, preservation and management" of many significant rivers and their waters. The treaty needs 35 parties to come into effect and currently has only 14. Among the developed countries, only Finland, Hungary, the Netherlands, Norway, Portugal and Sweden have ratified and ratification is in process in Germany. Significant wealthy countries with transboundary rivers that have yet to sign or ratify include Austria, Belgium, Canada, France, Spain, Switzerland, and the United States.

Implementing the European Framework Directive on Water

The European Water Framework Directive on Integrated River Basin Management in Europe is a leading example of an initiative setting out clear goals for the improvement by 2015 of degraded water-based environments in Europe and the sustainable use of water by the domestic, industrial and agricultural sectors. Implementing the framework directive is an ambitious enterprise that has given leadership and focus to water conservation efforts over one of the most intensively developed areas on earth. WWF intends to remain fully involved in steps to improve compliance with the directive.

The vital link – pure fresh water and natural areas

A recent WWF study showed graphically that cities with extensive protected areas in their catchments are relatively free of the water issues bedeviling cities that draw water from settled or agricultural areas. Similar links are now showing up between relatively intact recharge areas and assured, quality groundwater supplies. The role of wetlands and floodplains in flood mitigation and flow regulation is also being appreciated, so much so that the International Commission on the Rhine is considering ways of restoring floodplain areas along "shipping channel" reaches of western Europe's largest river system.

Manage urban water use

Urban water use is one of the fastest growing demands on global water resources, with many cities in the developed as well as the less developed world at outrunning or at high risk of outrunning existing water supplies or posing major contamination risks to their rivers and groundwater catchments. In the developed world, there are major issues with aging infrastructure. Proper water pricing, rainwater capture, requirements for water efficient appliances and the repair of leaking water mains and sewers have been found to contribute significantly to water conservation and reducing contamination risks in many cities. Another issue yet to be significantly addressed in urban areas is the extent to which the area of roofing and paving modifies water flows, reducing recharge to aquifers and increasing flooding and contamination risks. With flooding generally a major risk to urban areas, some cities have been experimenting with reducing the amount of channelling of urban streams and restoring the natural protective function of wetlands and floodplains. A striking finding of many reports is the extent to which cities with extensive internal green areas and protected and particularly forested catchments cope better with looming water challenges and face lower costs.

WWF's freshwater targets

WWF's Global Freshwater Programme is a network of staff on the ground and in the halls of international institutions, governments and business, working alongside partners and NGOs to meet crucial targets

- Ensuring healthy environmental processes in at least 50 river basins and ecoregions, including some threatened by unsustainable infrastructure, by 2010.
- Promoting adoption by government and industry of policies and techniques that conserve life in rivers and reduce poverty for dependent communities by 2010.
- Protecting and sustainably managing 250 million hectares of representative wetlands by 2010.



The mission of WWF is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by:

- conserving the world's biological diversity
- ensuring that the use of renewable resources is sustainable
- reducing pollution and wasteful consumption

WWF Global Freshwater Programme

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