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Water Resources in the United States: Perspectives and Challenges

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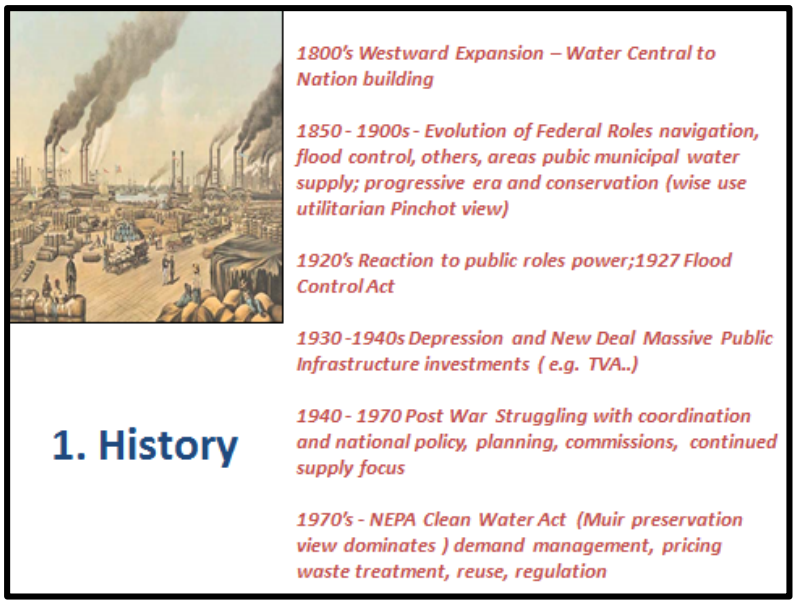
Wuhan University, ASCE, colleagues, ladies and gentlemen, thank you for inviting me to this NSFC-U.S. Joint Workshop. Today I want to share some historical and current perspectives on U.S. water resources management and polices to help frame our workshop dialogs. Many points in this talk parallel water management and policy interests raised by Minister Chen Li; especially in his recent keynote presentation "Strengthening Water Conservation." at Budapest Water Summit. I might add; I have spent over a decade helping build collaboration between Chine MWR and the USG and USACE.

I will briefly look at:

1. **Historical – Institutional Context of Water policy in the US;**
2. **Current situation: Financing and ageing infrastructures;**
3. **Recurrent themes of water policy in the U.S.;**
4. **Water Policy and IWRM today;**
5. **Institutional Integration;**
6. **Public and Stakeholder Involvement;**
7. **Water Related Disaster Risk Reduction;**
8. **Additional Aspects of Water and Security Summary;**
9. **Concluding thoughts**

1. Historical – Institutional Context of Water policy in the US



The early years of the U.S., the 1800's, were characterized by Westward Expansion. During this time water was central to nation building on the continent.

From 1850 to the 1900s, there was an evolution of the U.S. national Federal government roles in water, specifically on navigation and flood control and State and local public municipal water supply. The end of this period saw the emergence of environmental concerns with what we call our "progressive era." Conservation in resources, which meant wise use of resources, started to drive water resources policy but also came into conflict with emerging idea of preservation.

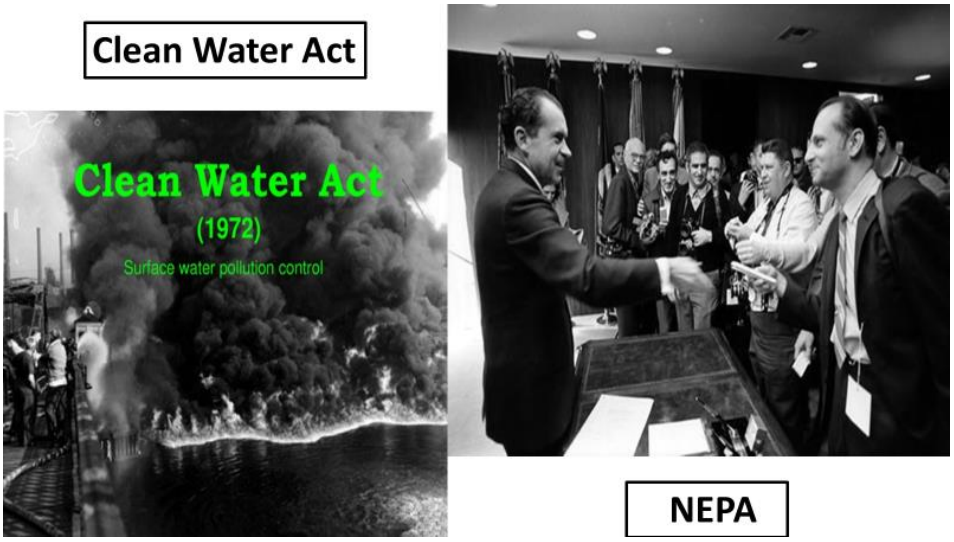
The 1920's saw reaction to public roles power generation and greater movement to private power generation which at this time was heavily hydropower. In addition, the great floods of the late 1920's fundamentally changed water policy with the 1927 Flood Control Act; this act authorized the largest expenditure of Federal funds for water resources, if measured as percent of GDP, in US history.

The 1920s floods transformed the political landscape in the US. These floods on the Mississippi helped create a great migration from south to north; they transformed political allegiances of major social groups; they forced a change from "levees only" to "control structures" for flood defense, and; they were a major reason for the election of Herbert Hoover as President on the U.S.

During the great depression of the 1930s President Roosevelt's New Deal included massive public infrastructure investments (e.g. TVA...) to help create jobs, to transform regions of U.S and to spur the

economy. It also generated interest in multipurpose water projects and river basin organizations (RBOs).

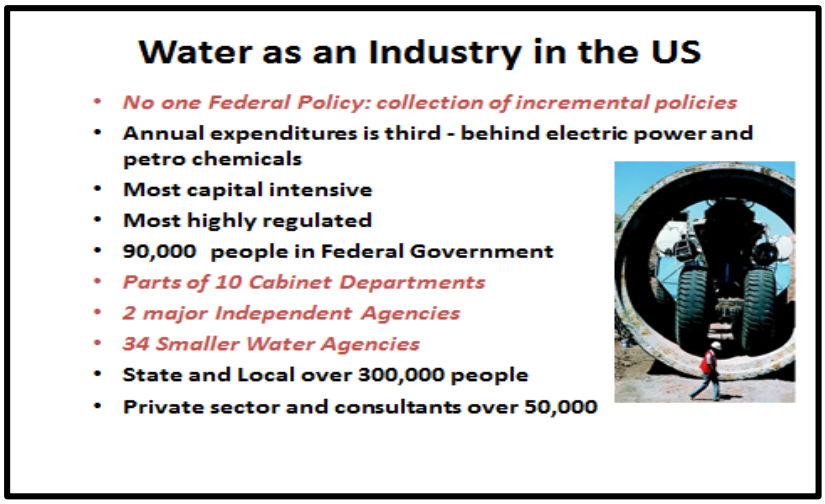
The 1940 - 1970 post war era was dominated with concerns over coordination and national policy, planning, Presidential commissions on water, and a continued supply focus for water projects.



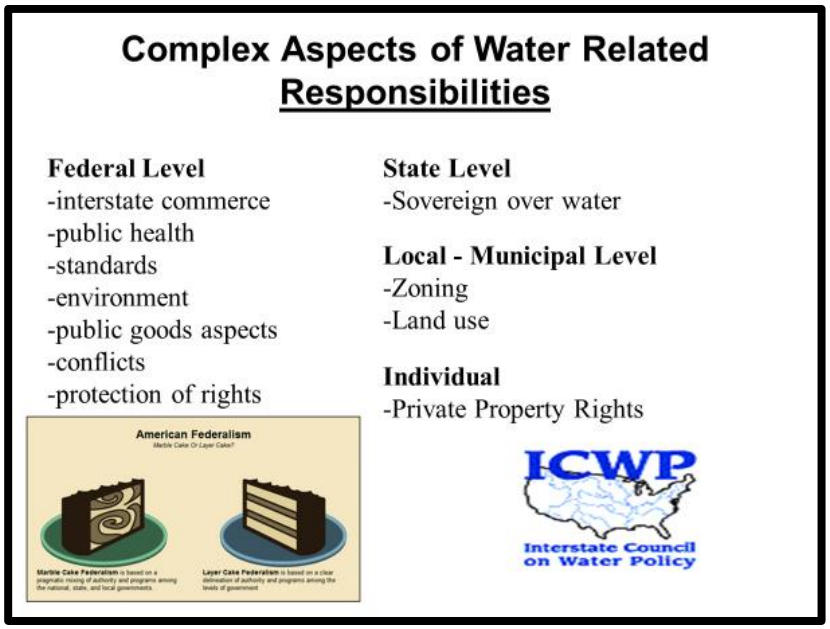
All that changed in 1970's with the passage of the National Environmental Policy Act 1969 and the Clean Water Act in 1972. Water policy began focusing on demand management, pricing, waste treatment, reuse, regulation and moved away from supply side approaches.

The U.S. is a Federal System composed of sovereign States which have the primary control of water. The national government's federal interest in water is based on authorities, evolved over 100 years; to assure interstate commerce, to help achieve national economic benefits, environmental and public health, and managing transboundary conflicts. There are two main legal traditions of water rights: Riparian in East and Prior Appropriation in West with reserved rights along with Native American Rights.

Unlike the East, the Federal government owns large amounts of land in the West. There are reserved water rights associated with these lands as well as the lands of indigenous people and both are still being defined. Like most parts of the world, ground water is still not well monitored. Ground Water: follows Rule of Capture, Riparian, Reasonable use. Most people in the U.S. are served by public water supplies.



If you looked at the US water sector as an industry you would see:



- No one Federal Policy: rather a collection of incremental policies
- Annual expenditures are a third - behind electric power and petrol chemicals
- Most capital intensive
- Most highly regulated
- Roughly 90,000 people in Federal Government
- Parts of 10 Cabinet Departments
- 2 major Independent Agencies
- 34 Smaller Water Agencies
- State and Local over 300,000 people
- Private sector and consultants over 50,000

Public infrastructure investment declined from 3.9% of Federal budget in 1960 to less than 3% today. Of this water declined to around .2% There are 83,000 dams, of which 2,000 are owned by Federal Government and the average age is 50 years+. Almost 1,600 significant hazard dams are within one mile of a downstream city.

Water use per capita has been decreasing since the late 1990s; and has been doing so at a time of increasing population and even during periods of increased economic growth. There are many reasons for this such as energy prices, efficiencies, changing patterns of demand and new technology. This experience is important as it essentially "delinks" the notion of direct correlations of increasing population and increasing per-capita water use.

These trends are creating some anomalies. In most major U.S. cities water use is declining while rates to residential customers is increasing. There are sustained declines in residential water use, dropping 22 percent since 1999, due to a variety of conservation measures and market regulations. Tariffs rose 5 percent last year, according to "Circle of Blue's annual survey of 30 major U.S. cities." "The median increase was 3.5 percent. At same time utilities, must ensure that rates are fair: affordable for the poorest and somehow discourage water waste. This increase reflects investment in seriously ageing infrastructure and a response to declining water sales. This means consumer conservation is perversely "rewarded" with higher tariffs! The average tariff climbed 48 percent since 2010."

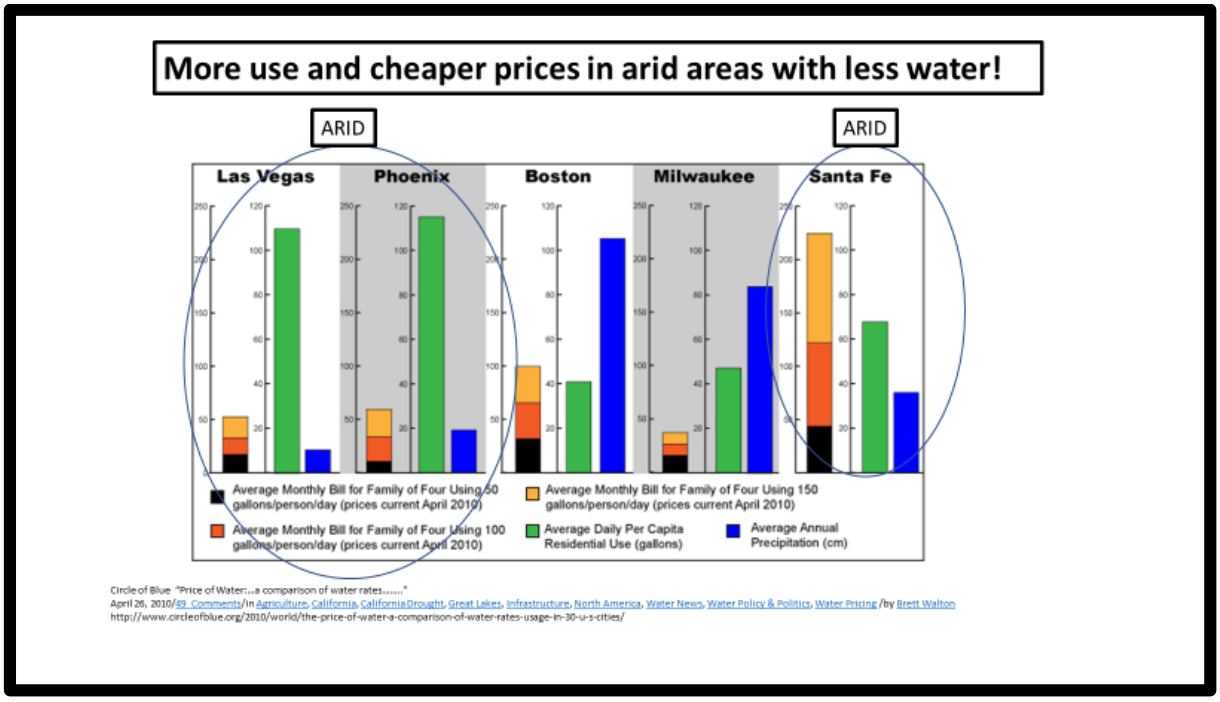
However, as the slide depicts U.S. tariffs remain considerably lower than most places in the world.

Water Rates World Cities

	Ranking		Cost (US¢)	Change
	Current	Prior	Cubic meter	Year On Year
Germany	1	1	178.1	0.0%
Denmark	2	2	172.0	+0.8
United Kingdom	3	3	123.2	+3.2%
The Netherlands	4	4	113.8	-0.5
France	5	5	108.3	+3.3
Belgium	6	6	101.9	+3.9%
Italy	7	7	72.7	+1.5%
Spain	8	8	71.2	+3.5%
Finland	9	9	64.3	+4.9%
Sweden	10	10	61.5	+1.1%
Australia	11	11	54.7	+4.7%
United States	12	12	54.3	+4.0%
South Africa	13	14	42.8	+20.4%
Canada	14	13	37.6	+2.9%

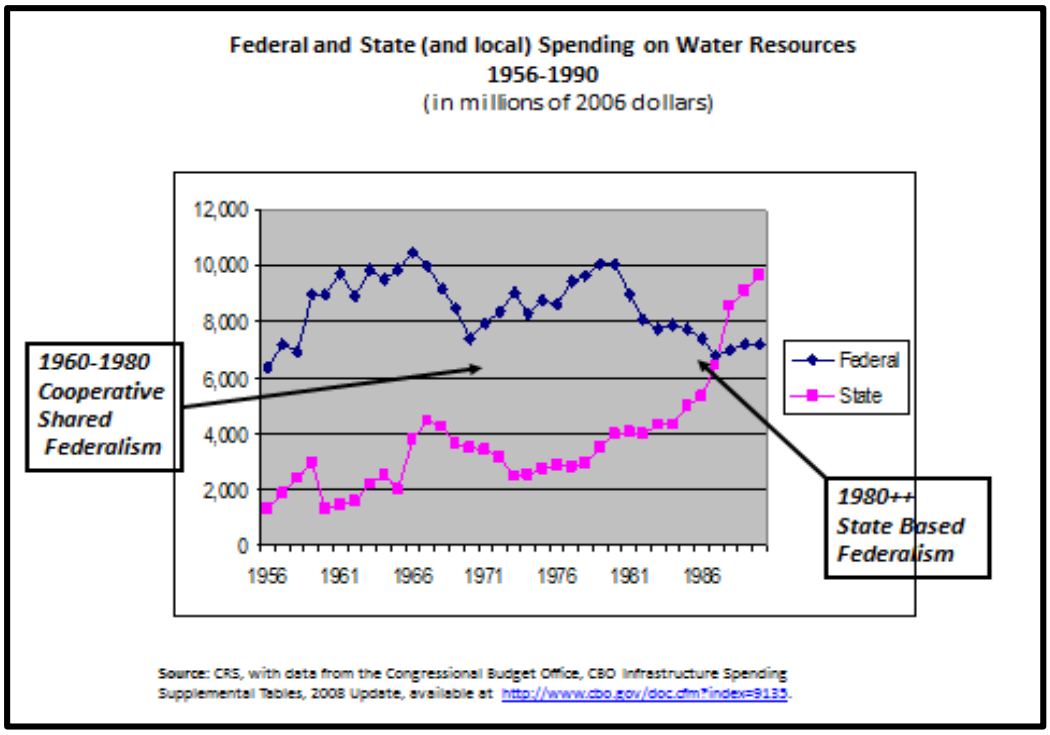
Water World http://www.waterworld.com/articles/print/volume-19/issue-1/editorial-focus/survey-finds-world-water-rates-rising.html

At the same time, as the following slide ___- depicts, water tariffs in the most arid regions are often much less than in the humid regions of the U.S.! This is partly the result of large Federal multipurpose water investments which were often driven by national reasons like economic development or western expansions or other macro social goals and included large subsidies. But today the demographics of the arid areas have changed; meaning the demands (or underlying values) of water use are changing but the subsidies underlying the infrastructure resist change.

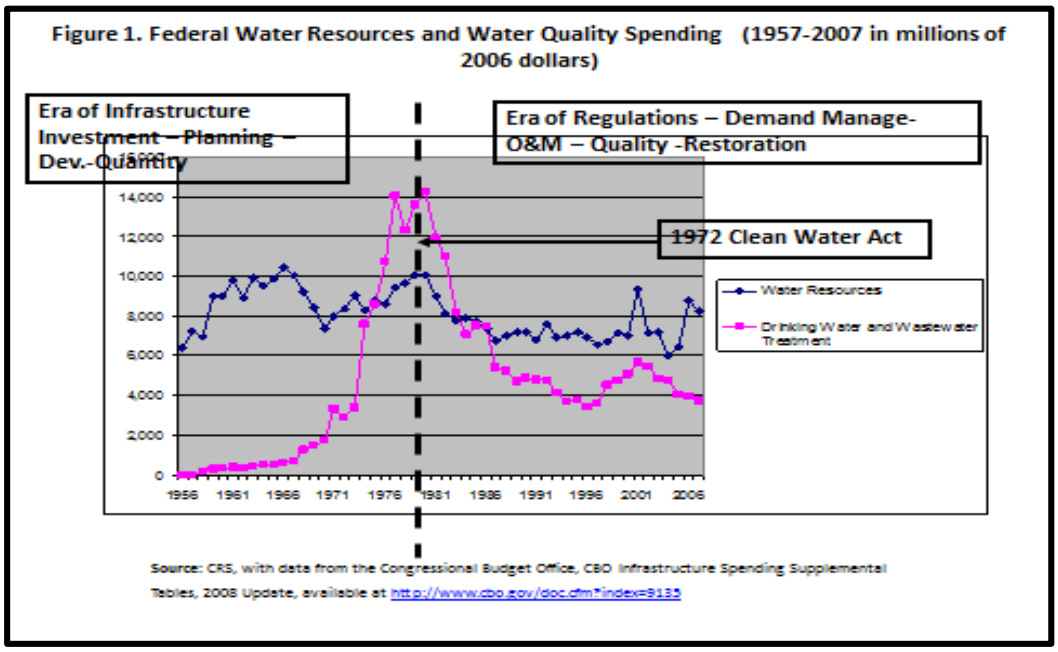


Thus, the U.S. has an aging infrastructure with serious needs for reallocating water and finding methods to fund new and rehab investments. States are now experimenting with private public partnerships, new tariff structures, a variety of reallocating mechanisms such as water banking, regulated markets and others.

Federal Water Resources Spending as a Percentage of GDP (1956 -2007) has been steadily decreasing since the early 1960s. This is an important underlying cause of our critical issue of aging water infrastructure.

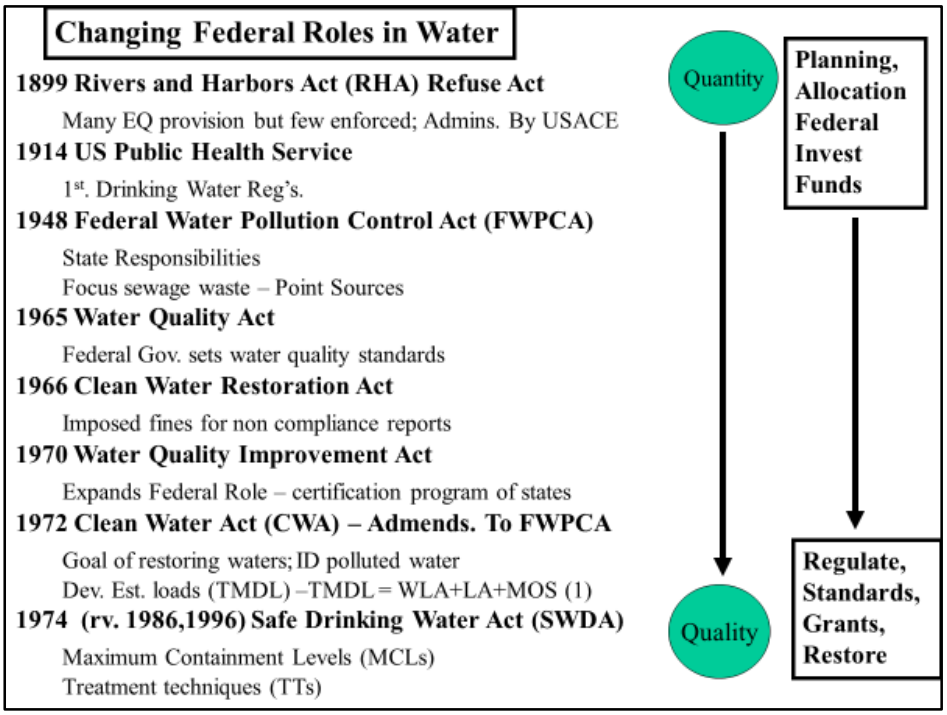


At the same time, State and local spending on water has begun to surpass that of the Federal government.



At the mid-1970s, the dawn of our environmental era, you can see that drinking water and water expenditures started to rise. As noted, the mid 1970s can be seen as the end of the era of large infrastructure investment and the beginning of the era of water quality concerns with emphasis on approaches such as demand management, conservation, regulation versus planning, and environmental restoration.

As slide depicts, since the 1970s the national federal government focus has moved from quantity to quality; from planning and allocating money for direct federal investment to regulating, creating standards, restoration, offering grants and loan funds.



2. Current situation: Financing and ageing infrastructures

AWWA and ASCE estimate that over the next 20 years, maintaining and expanding our water service infrastructure will require $1 trillion—more than twice the current level of investment by all levels of government. The Bureau of Economic Analysis (BEA) at the US Department of Commerce estimates that for every dollar spent on water infrastructure, $2.63 is generated in the private economy. And for every job added in the water workforce, the BEA estimates that 3.68 jobs are added in the national economy

New financing options that allow private capital to invest in water resources are being developed, including conservation financing (e.g., "green bonds" or impact investing), blended public-private capital, and philanthropy. The rise of private investment has also increased interest in alternative water management approaches. (Duke)

Most of the large U.S. infrastructures, including 80,000+ dams, 25,000+ mile of levees, 35,000+ treatment plants were financed through conventional public funding, including municipal and local district debt combined with large-scale federal funding and financing.

The American Society of Civil Engineers (ASCE) estimates that repairing high hazard dams would cost $21 billion. Most dams are privately owned and would necessitate private financing.

At the state and local service delivery level the United States has nearly 170,000 public water systems and 15,000 large wastewater treatment plants. ASCE estimates that the United States has more than one million miles of water mains and nearly as many miles of sewer mains with many nearing the end of their average life expectancy.

Our urban water infrastructure was initially developed and financed by private water companies. As private systems failed, local and state governments took up financing water systems., The use of general obligation bonds and revenue bonds that began in the 19th century is the financial structure that is predominately used today. (from Duke 2016)

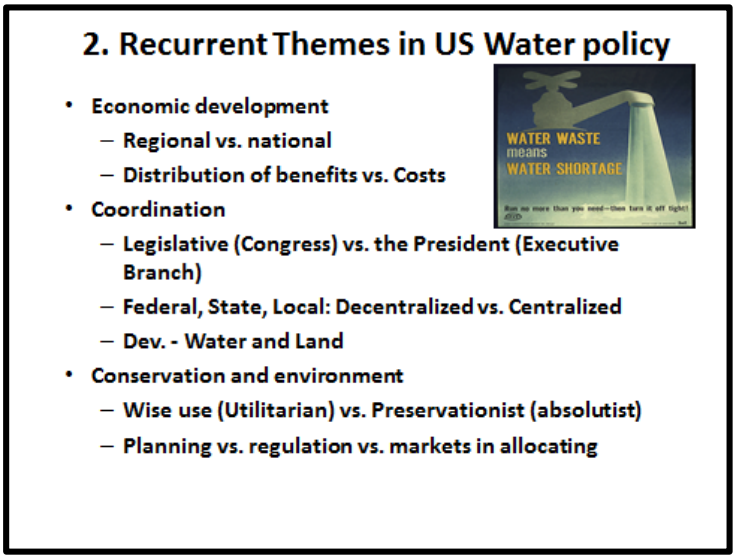
As our understanding of ecosystem impacts of infrastructures grows so to does ecosystem expenditures They are often driven by regulatory compliance, such as mitigation banking to offset impacts of development. There is also interest in using ecosystem services to provide lower costs for comparable water resources, whether reducing the costs of water treatment or reducing flood peaks.

Grants programs, were phased out at the end of the Reagan administration in favor of loan funds for, sewers and drinking water. However, today the funds are now often too small to access the municipal bond market, more is likely need. (Duke study)

As we enter the 21 century, U.S. politics is beginning to react to the large transaction costs of increasing regulations; to capital flows for investment; and to our national capacity to plan and implement needed water programs. For examples, there are various calls for benefit cost analysis of regulations and impact assessments of regulations.

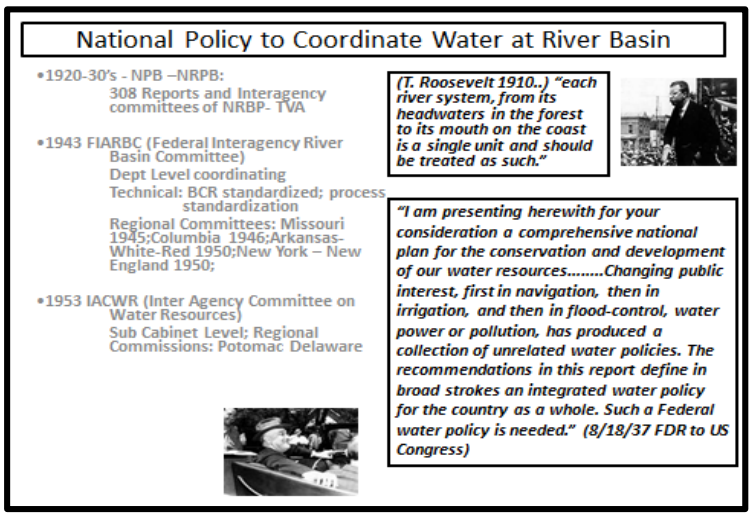
Congress passed a Water Infrastructure Finance and Innovation Act (WIFIA) to help access low interest financing of infrastructure projects(duke). The Obama administration established the Water Infrastructure and Resiliency Finance Center to assist communities to evaluate financing options or planning projects. During our recent Presidential election, both parties were advocating national infrastructure bank.

3. Recurrent themes of water policy

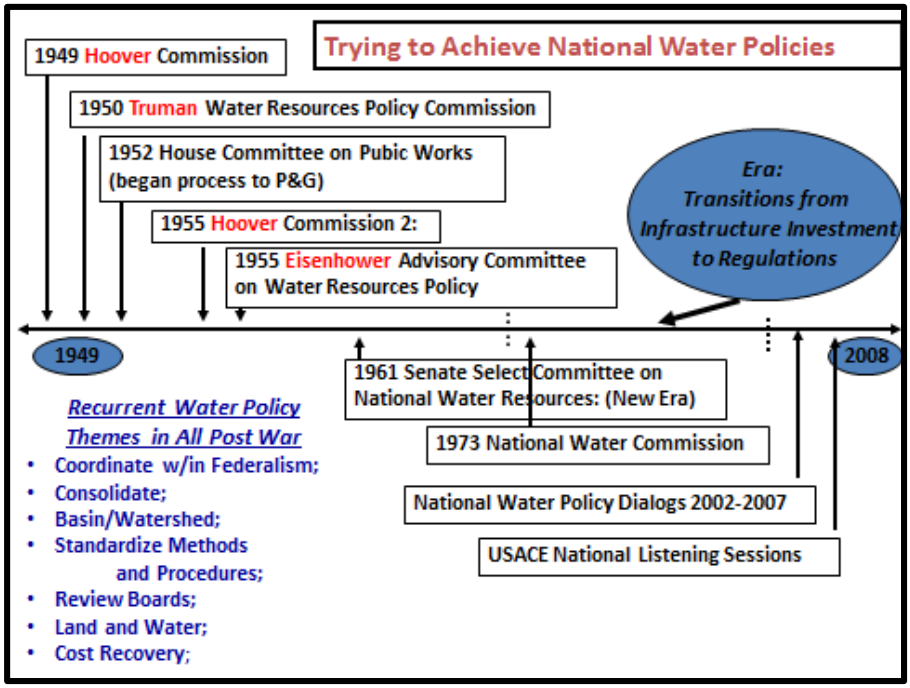


While there is not one National Water policy, there are however recurrent themes in the continual debates over US Water policies, such as:

- Economic development:
  - Regional vs. National
  - Distribution of benefits vs. Costs
- Coordination:
  - Legislative (Congress) vs. the President (Executive Branch)
  - Federal, State, Local: Decentralized vs. Centralized
  - Dev. - Water and Land
- Conservation and environment:
  - Wise use (Utilitarian) vs. Preservationist (absolutist)
  - Planning vs. regulation vs. markets in allocating



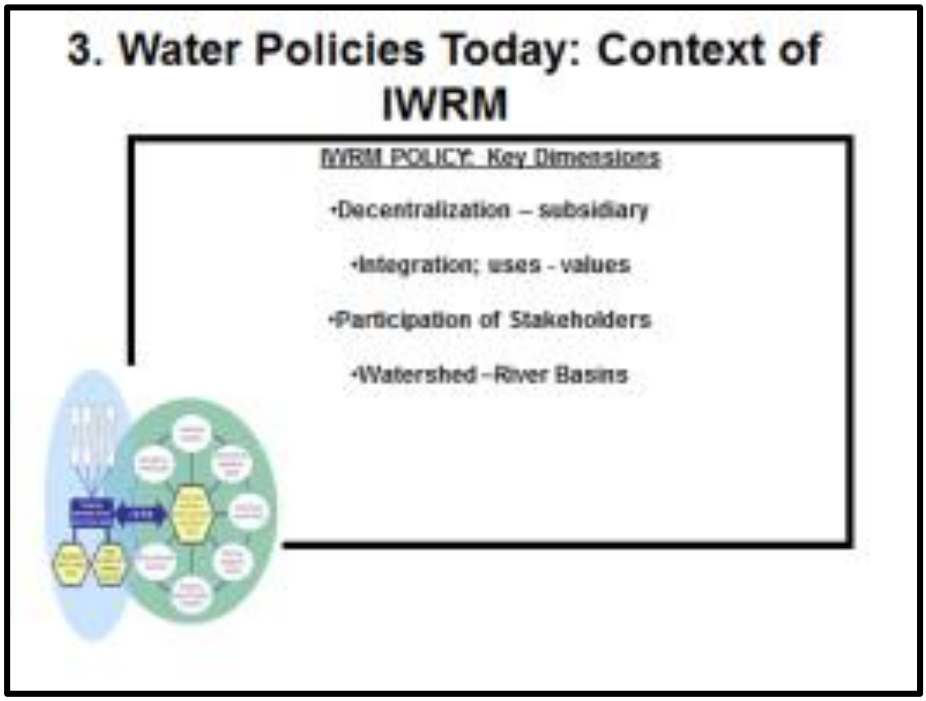
In the 1920s a national planning board and a national resource planning board were established which included water management issues but then disbanded. In the 1940s sub-cabinet level, interagency river basin committees were created and in 1953 an interagency committee on water resources was established. From the late 1940s through the early 1950s powerful political figures tried to establish regions organized like the TVA to coordinate development and water management. None were established. The attempts were defeated by sovereign states and agencies within the Federal government that perceived their power to be threatened. These are depicted in the slide.



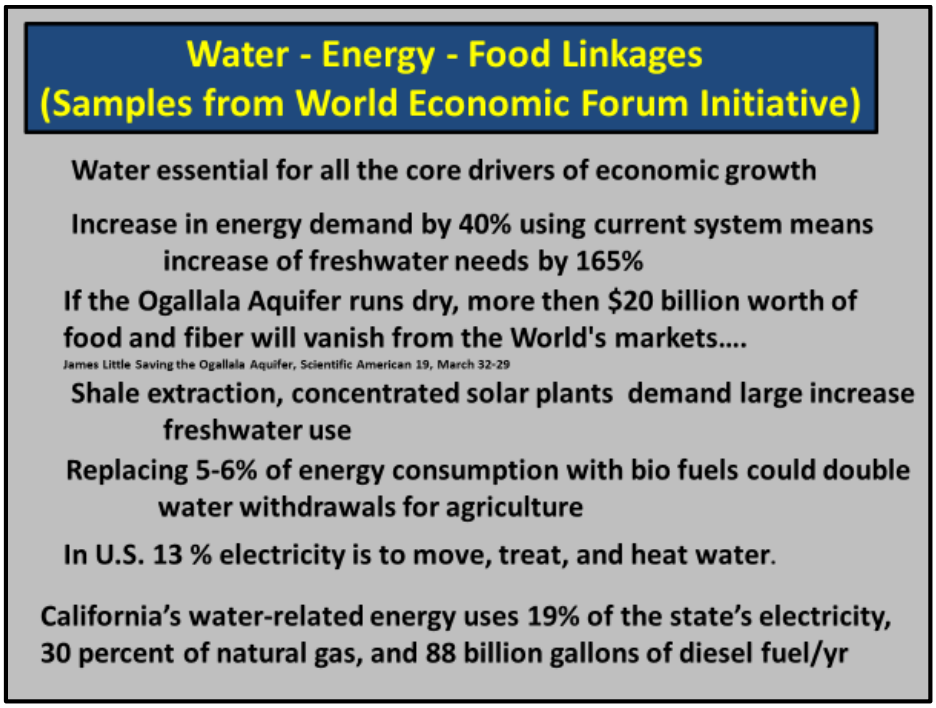
From the 1950s to the early twenty first century numerous special commissions were established; all had recommendations and each focused on the recurrent themes: how to coordinate within Federalism; how to consolidate; how achieve basin/watershed management; how to standardize methods and procedures for evaluating projects; how to review proposed investments; how to connect land and water, and; cost recovery.

Today the question of a national water policy continues to be debated and most of that debate revolves around issues of sovereignty between states and the federal government.

4. Water Policy and IWRM today



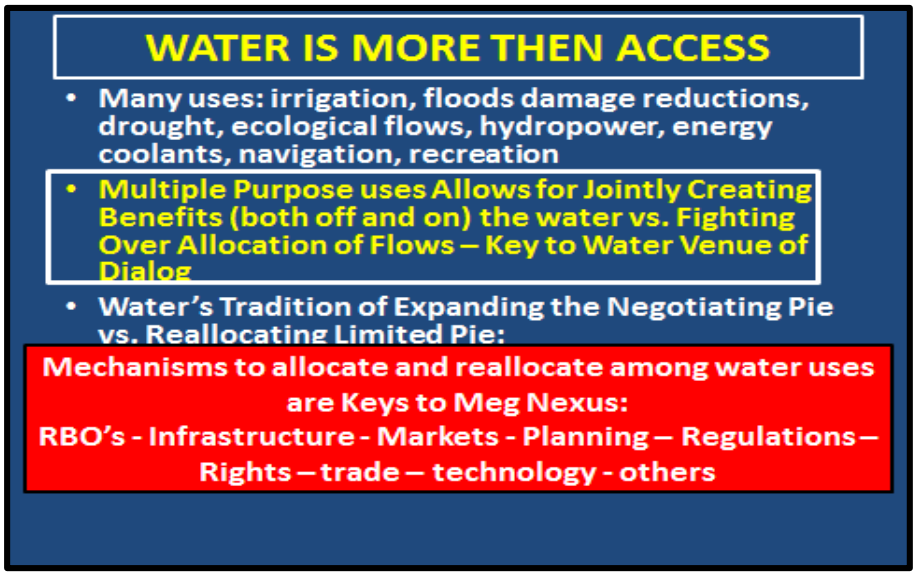
Never the less attempts to better integrate water resources management or what we call today Integrated Water Resources Management (IWRM) continue. Actually, IWRM has its roots in what was formerly called multipurpose planning.



Today the importance of integration of water across sectors abounds. For examples the WEF notes that an increase in energy demand by 40% using current system means increase of

freshwater needs by 165%. If the Ogallala Aquifer in the US runs dry, more than $20 billion worth of food and fiber will vanish from the World's markets…. (James Little Saving the Ogallala Aquifer, Scientific American 19, March 32-29). Shale extraction, concentrated solar plants demand large increase freshwater use. In U.S. 13 % electricity is to move, treat, and heat water. California's water-related energy uses 19% of the state's electricity, 30 percent of natural gas, and 88 billion gallons of diesel fuel/yr. (WEF)

As you know well here in China, water is more than access. It can be put to many uses: irrigation, floods damage reductions, drought, ecological flows, hydropower, energy coolants, navigation, and recreation. Far from only creating conflicts these multiple uses can also allow for jointly creating benefits (both off and on the water) vs. fighting over allocation of flows.



However, the ability of stakeholders and sectors to understand this capacity and to actually jointly create options that increase benefits based on integrating multiple uses depends on political will and institutions that encourage such dialog.

Today interest in watershed and river basin coordination has reasserted. Indeed, allocating and reallocating water among uses are keys to managing the food, water, and energy nexus. Each of the sectors needs water to achieve social goals; but collectively the water may not be available for demand. So, it is water that becomes the constraint and the point at which tradeoffs among water uses to support various sector goals becomes apparent.

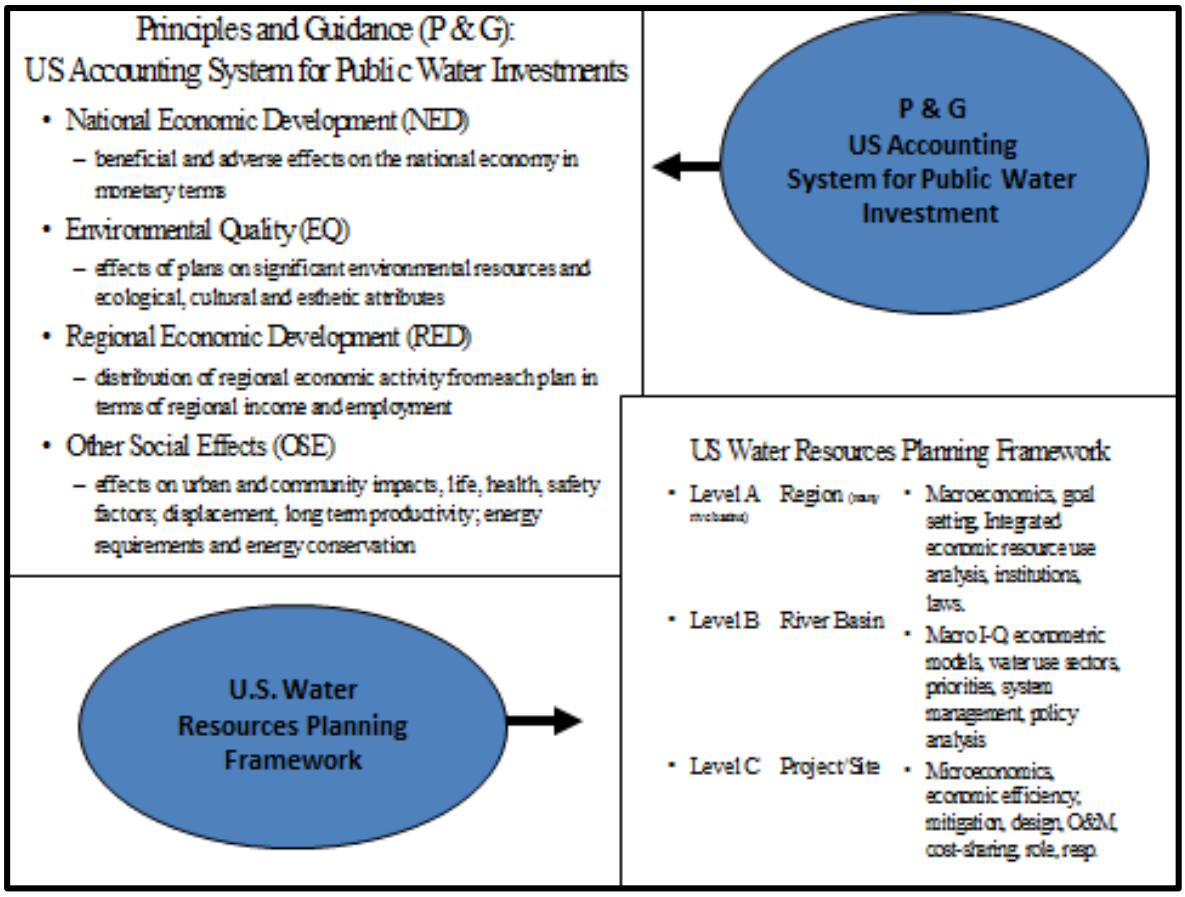
Many institutional mechanisms have been tried to deal with such trade-offs such as river basin organizations (RBO's), smart infrastructure, water markets, more interactive planning, benefit-cost analysis of regulations, clarifying water rights, administrative edicts, technology and others.

While different for each state, the potential for market opportunities in water are increasing. (Nicholas center). Water quality trading came into existence with regulatory support following EPA's 2003 National Water Quality Trading Policy. The federal government created a market for mitigation banking under section 404 of the Clean Water Act, to help restore streams and wetlands.

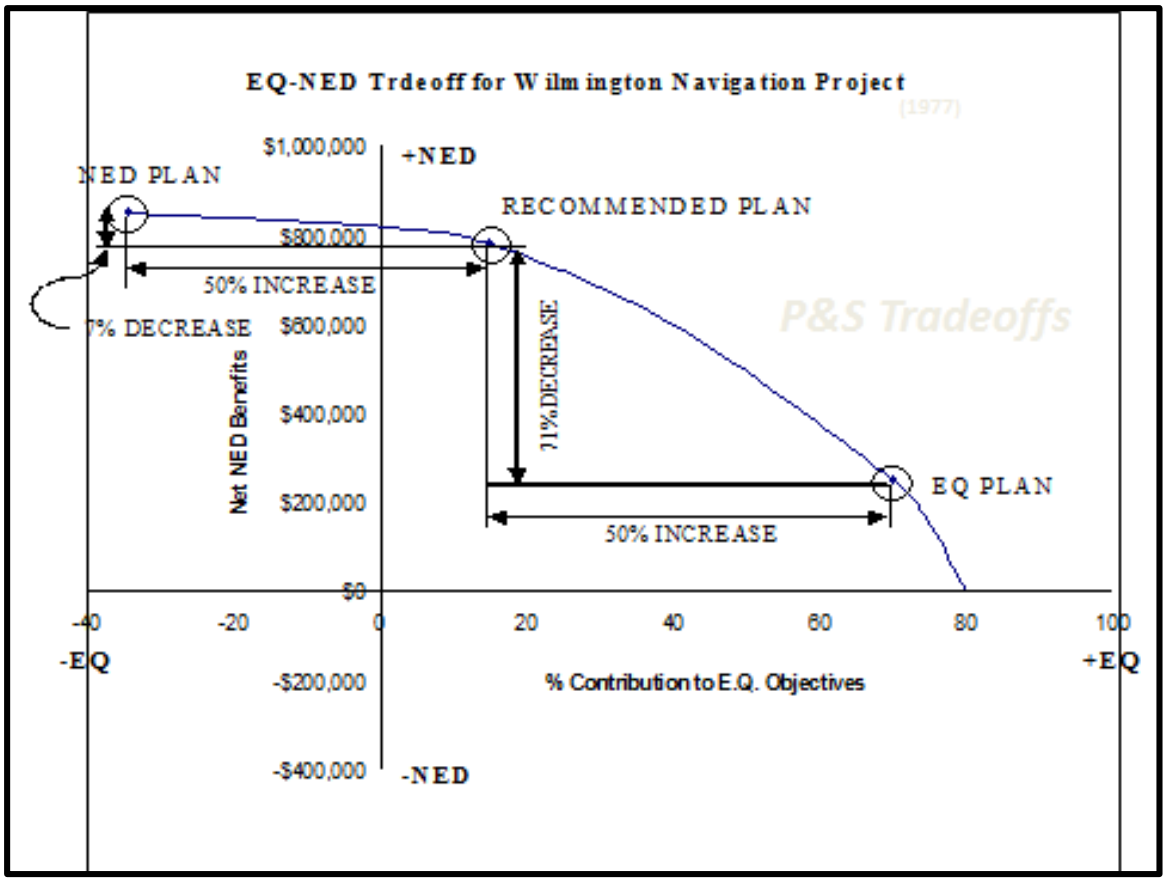
Water markets currently work well where substantial infrastructure and storage already exist. (**CONSERVATION FINANCE & IMPACT INVESTING FOR U.S. WATERA REPORT FROM THE 2016 ASPEN-NICHOLAS WATER FORUM)** However, there has been little large inter sectoral trading and inter-basin transfer in the U.S. is politically very difficult.

In the US integrating uses in large MOP projects must be achieved through complex ratios of cost sharing that vary by water uses or purposes; and lead to calculation of benefit-cost ratio (BCR) at the Federal level. For examples; flood risk reduction with its widely distributed benefits is essentially a public good which if beneficial can be funded with Federal money; navigation is both a distributed public good and a private good and thus this purpose is funded through a cost shared

formal of about 50-50; hydropower is clearly vendible with broad benefits and it is more fully funded through nonpublic sources; eco systems restoration and low flow assurance are still very much in debate as to how much public versus other funding must be shared; irrigation is also vendible and it is cost shared between public and other funds; water supply is clearly vendible and fully paid for using entities.



Our main water resources planning guidance, the Principles and Standards (P&S), now called Principles and Guidance (P&G) in the US, tries to capture this complexity through national accounting categories of benefits and costs that includes; National Economic; environmental quality; regional economic; and other social effects.



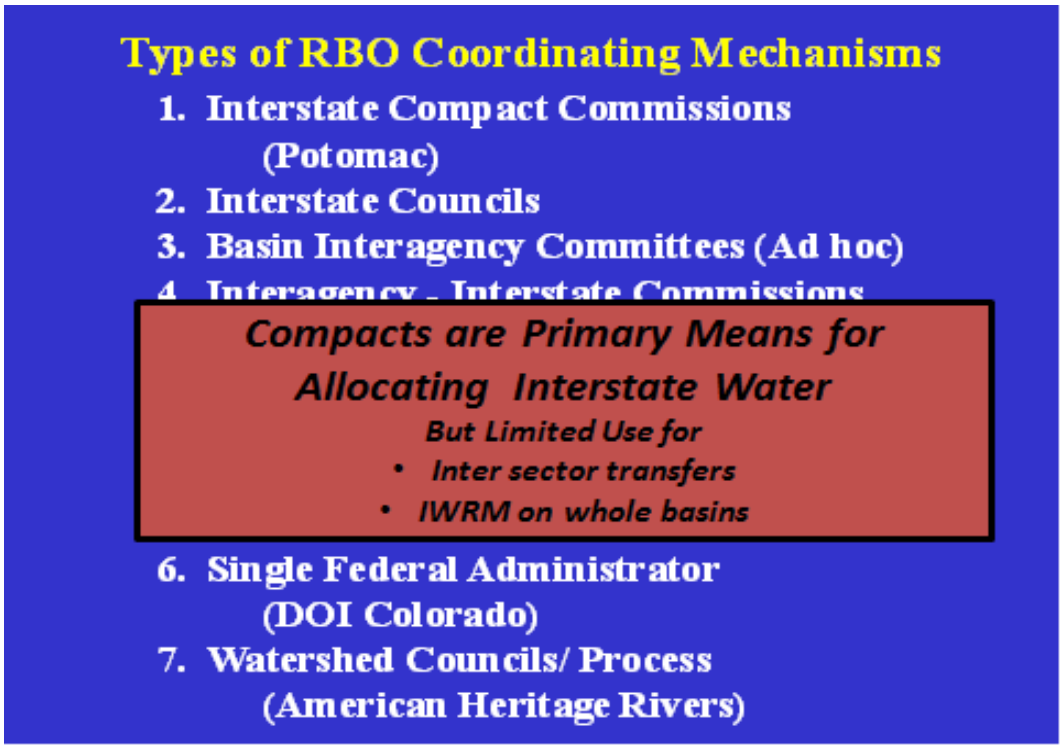
The goal is to reach some clarification of trade-offs among various projects or alternatives. For example, the slide __ shows trade-offs among benefits and costs of environmental quality (EQ) and national economic development (NED) for an actual navigation project's alternative plans. The NED plan had high NED benefits and negative environmental quality benefits. The EQ plan had high environmental benefits but 71% reduced national economic benefits. The recommended plan was one that has a 50% increase in EQ benefits with only a 7% decrease in NED benefits. This is the type of dialog that institutions, using such methods, seek to encourage in water resources planning. Hopefully such dialog provides more incentive and rationality to the political debates over authorizations which are carried out in within our multiple sovereignties.

But how to finance MOP infrastructure, versus doing BCA, is remains a problem both within the USG and especially for developing countries most in need of such infrastructure.

5. Institutional Integration

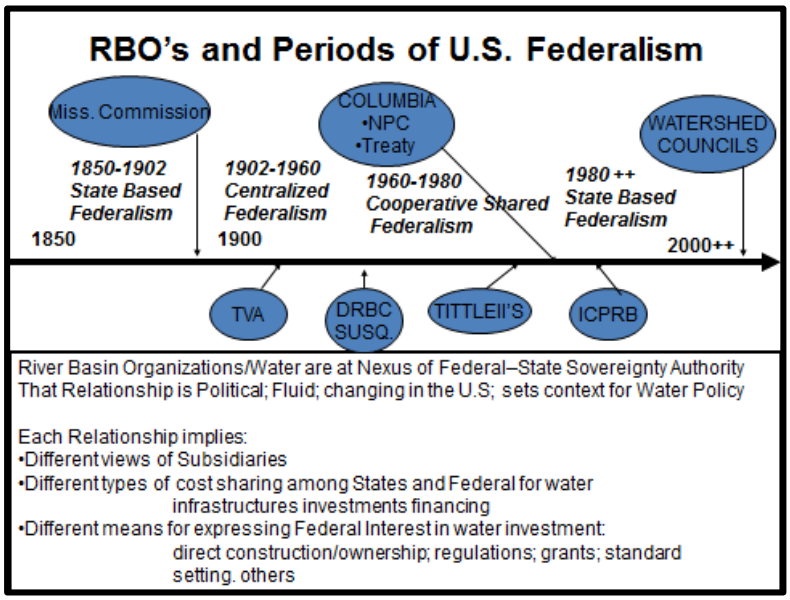
Paralleling these analytical tools, various institutional mechanisms have been developed to better integrate water uses. Initially, the founding fathers of the U.S. thought that water conflicts that crossed the boundaries of states would be handled through interstate compacts. Indeed, these compacts have been the chief mode to do so in the U.S. Interstate compacts look much like international treaties or agreements among sovereign nation states; after all they are agreements among sovereign states that are part of a U.S. federation. They usually outline water delivery responsibilities at borders during a variety of conditions of weather or seasons.

As demands driven by social objectives and changing demographics have increased, simply managing water quantity delivery at borders of U.S. states is not enough. We need to find mechanisms to manage the whole basin in more integrated ways: thus, the concept of river basins organizations (RBO). Of course, managing according to hydrological units such as river basin organizations (RBOs) of a basin does not fit with either sector or sovereign legal realities.



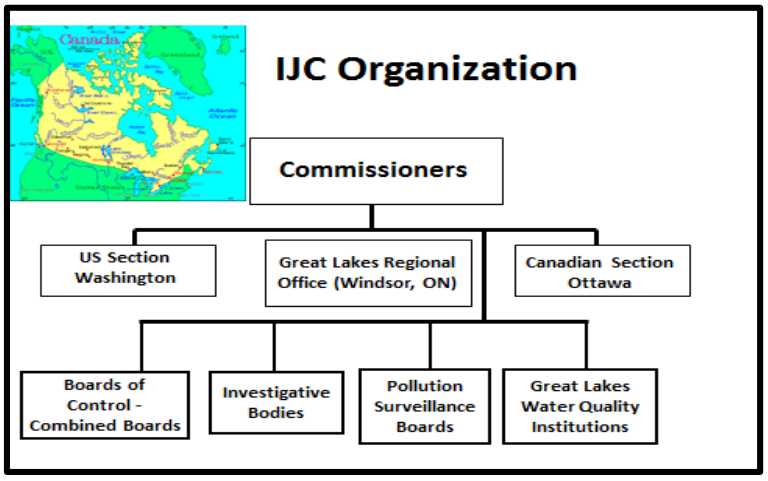
The Slide shows basic types of RBOs that have emerged within the US: some remain and some have failed.

Interestingly these RBOs have different characteristics depending on their locations but also on political climate of the time that defines the relationship between political power of states versus or federal government; quite apart from water resources, that is a relationship that continually changes. This is mapped out in the following slide five different periods of Federal State power relationship and types of RBOs that emerged in the U.S.



We have learned that no one size fits all; that geography, issues and political culture differ; that sui generis vs. top-down are the ones that survive; that it is essential to bring the political into IWRM to manage essential technical and political dialog.

Beyond RBOs and interstate compacts, North America has two unique transboundary Institutions to manage conflicts arising on waters that cross international boundaries. The International Joint Commission (IJC) between Canada and the U.S. and the International Boundary Waters Commission (IBWC) between Mexico and the U.S. These are not RBOs. While structurally different, they both function as means to anticipate conflicts and to devise means to manage or resolve such conflicts arising around the many waters that cross the boundaries in the south and north. In fact, the IBWC was born out of cross border war as a means to avoid such conflicts in the future.



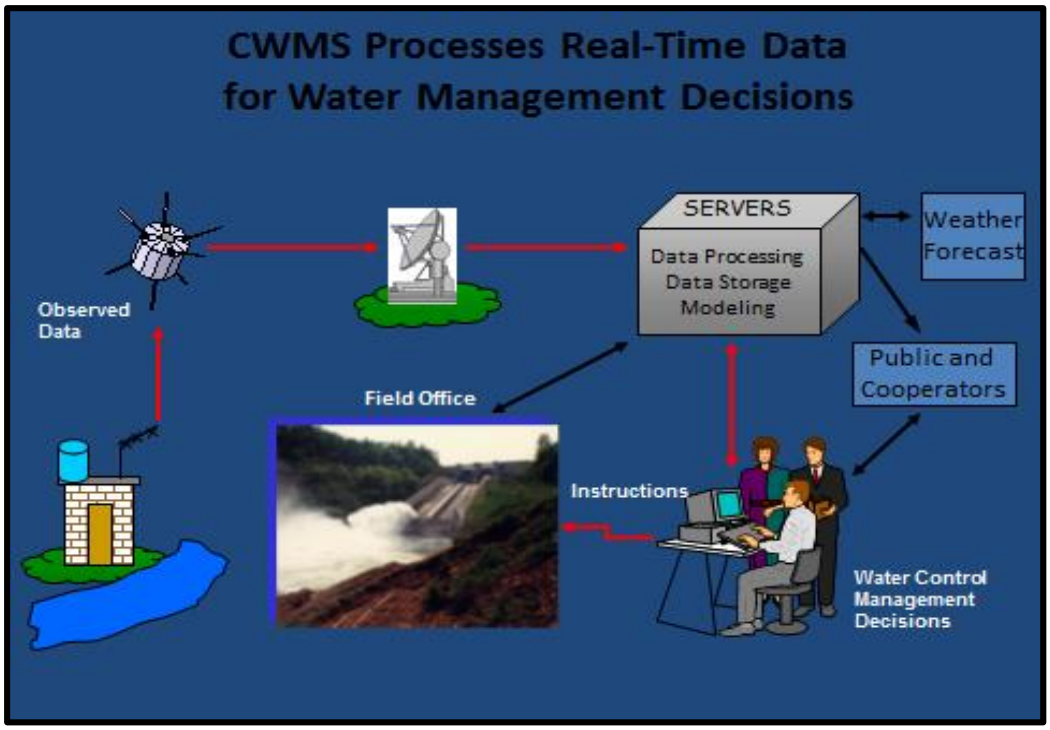
Some of the key lessons we have learned about design principles for RBOs, are to:

- Obtain High Political (Ministerial) commitment
- Provide for meaningful community input
- Move beyond “impact fixation”

- Bring operational and implementation interest into design
- Open and transparent rules of behavior
- Foster norms of collaboration
- Create trusted technical capacity
- Establish means for resolving disputes
- Separate administrative and policy
- Promote flexibility and creativity
- Foster regional shared visions of river

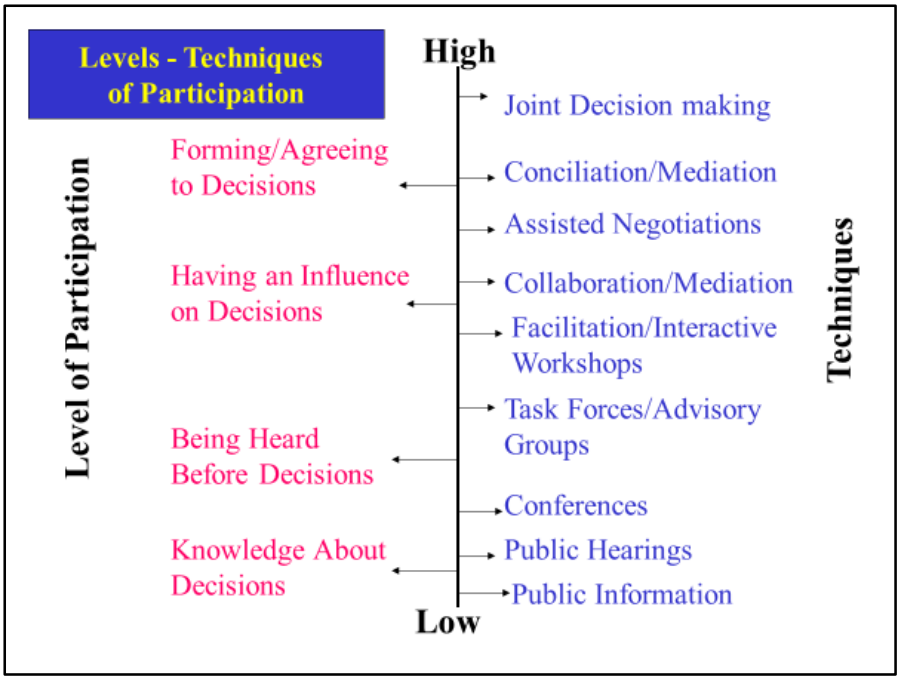
6. Public and Stakeholder Involvement

Public involvement (PI) is a widely-acknowledged necessity in water resources planning and management. But how it is done and what it means varies depending on political culture. In the U.S., recent PI was an attempt to make the executive bureaucracy and administrative state more responsive to new values making claims on water such as ecological flows and restoration.



Today, significant software and hardware advances are enhancing traditional "process" methods and helping achieve more effective PI and to integrate technical and process aspects of water management For example, the USACE Water Management System (CWMS) is a process that provides real-time data for water management decisions across all districts in the U.S. Data from various sources such as weather and stream data is fed into data storage and models including reservoir operations.

Shared vision planning (SVP) and collaborative modeling is another example. Using interactive meta-model building SVP includes stakeholders in the technical process of creating the algorithms that will then be used to describe water systems. If stakeholders feel ownership in the algorithms used rather than simply being fed outputs done by black boxes (often manipulated by technical experts, they already do not trust) they will participate more seriously in trade-off analysis and alternative generation. Our software and hardware advances now make this possible at reasonable costs.



Slide _____ outlines one of the most important principles for designing public participation. PI programs must seek to match the technique used to the level of participation sought or allowed.

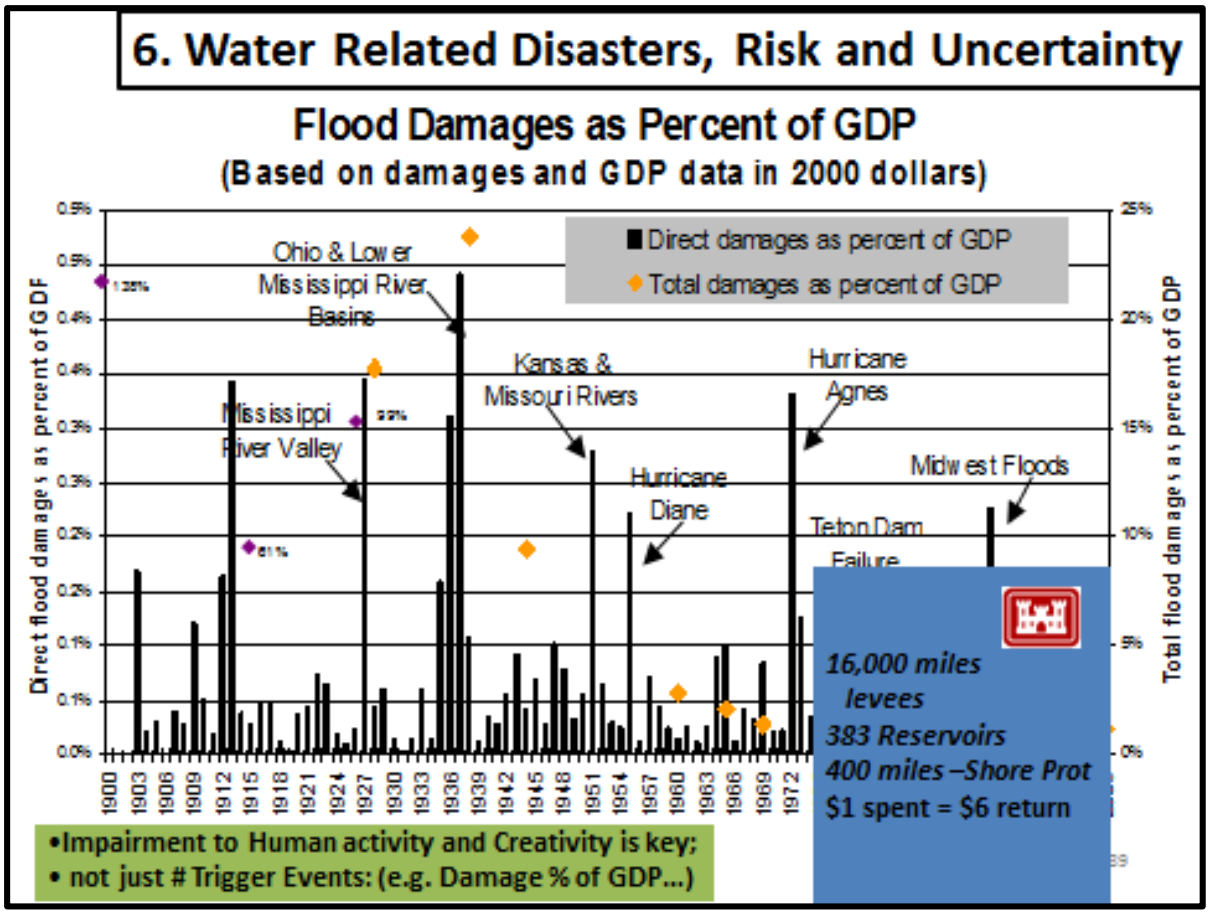
7. Water Related Disaster Risk Reduction;

The ability to manage uncertainties of water related disasters are critical to maintaining social stability and to creating platforms for growth. The World Bank has noted that the variations in GDP due to the inability of dealing with variations in rainfall might account for almost 25 -30 % of variations in GDP in developing countries.

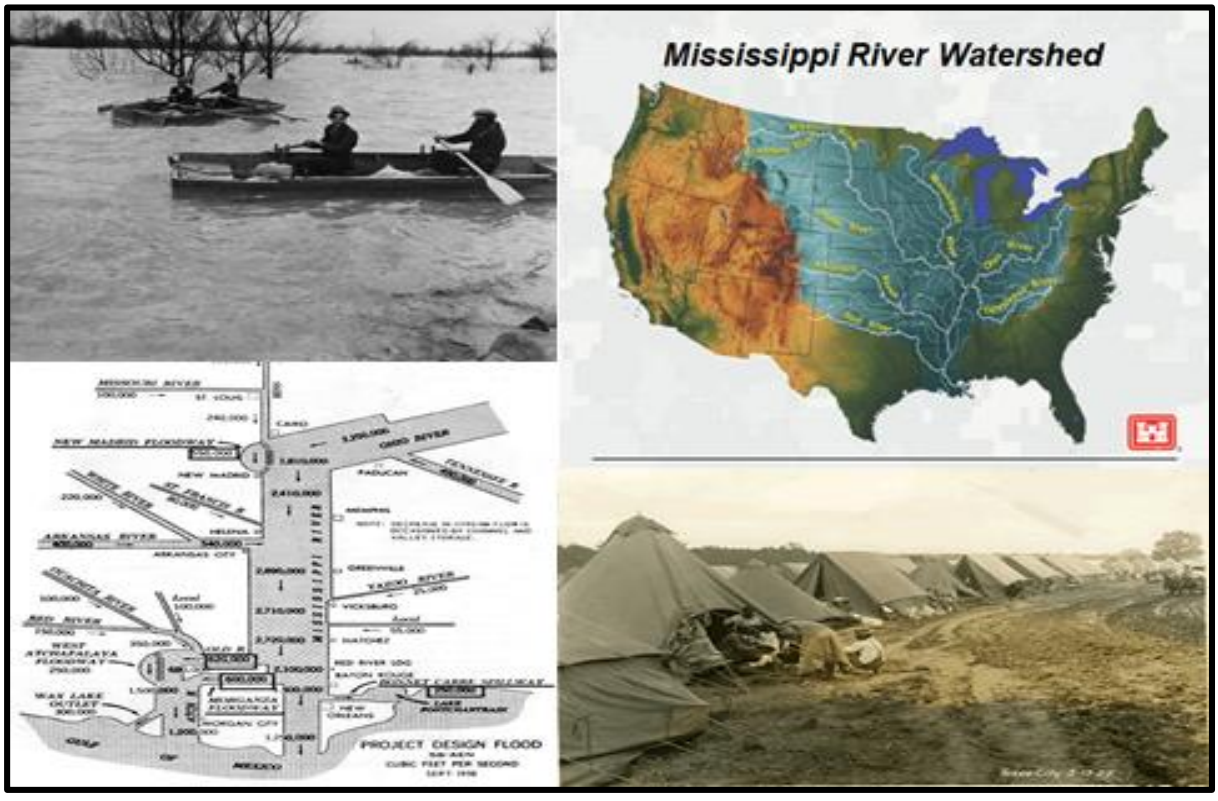
The International Water Management Institute (IWMI) notes that:

> *"Ethiopia's…. limited ability to cope with droughts and floods…. are estimated to cost the economy one-third of its growth potential."*

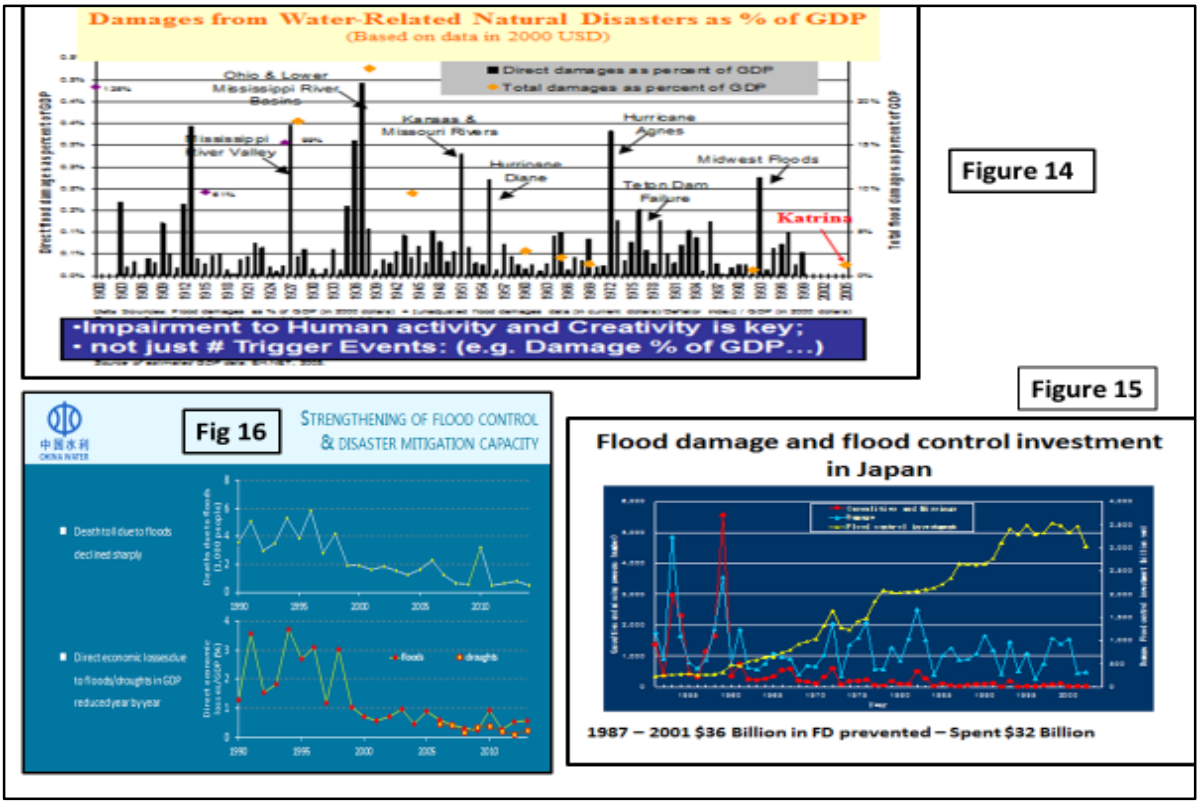
Through investments in water infrastructure, most developed countries are able to keep that figure to about 5% of GDP. In short impairment to human activity and creativity is key; not just the number of events is what matters.



For examples; the slide shows that while damages have increased; direct damages as a percentage of GDP have been declining.



This has paralleled experience in other richer nations such as in Japan, and here is China as seen in slide_____



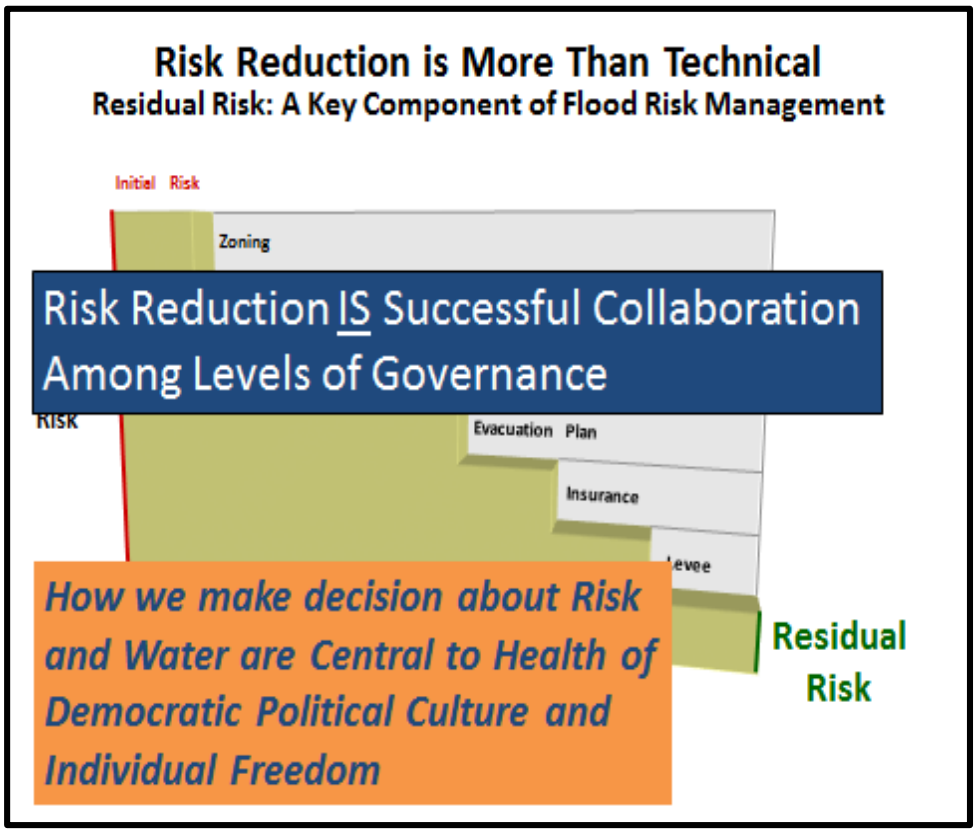
We have learned and relearned some important lessons from the recent Katrina, Sandy and 2011 Mississippi floods. For examples: the events taught us that it is important to maintain a clear view of the whole system of flood defense (structural and non- structural), over the years of their implementation and to avoid the loss of system perspectives. We lost this perspective in the Katrina event; it was, however, maintained in the 2011 Mississippi event, it somehow was rarely salient in pre-event times in the NYC- NJ areas and the results show.

Communication of and participation in choosing risk was mixed with Katrina; it was clear, and transparent in the recent Mississippi floods, and; it seemed rarely discussed in the case of Sandy until the event. The aftermath of Sandy, like the successful management of the 2011 flood of record on the Mississippi, clearly demonstrated the importance of structural measures as well as nonstructural measures.

In contrast to the 1927 flood damages, over 4.0 million people were protected in 2011 flood which was about the same size as the 1927 event. The 80 years of investment realized provided large returns on public investment well beyond BCRs of 1. After 2013 Hurricane Sandy on the East

Coast, it was clear the damages were substantially reduced in those areas with structural measures.

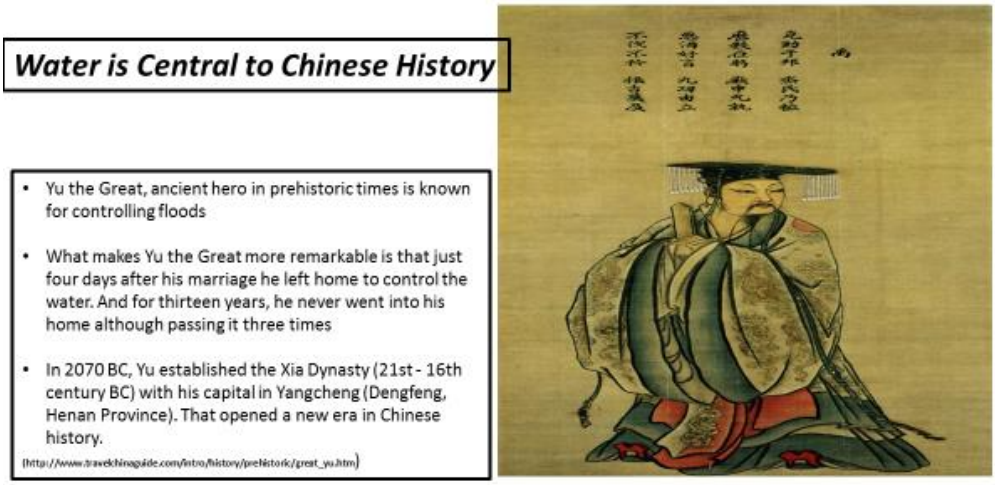
But no matter what the mixture of non-structural and structural approaches, resiliency and redundancy must be built in. Multiple defenses are critical. However, our traditional methods of calculating risk which ultimately underpin all these BCA analytics are in the midst of significant challenge with the non-stationarity debates.



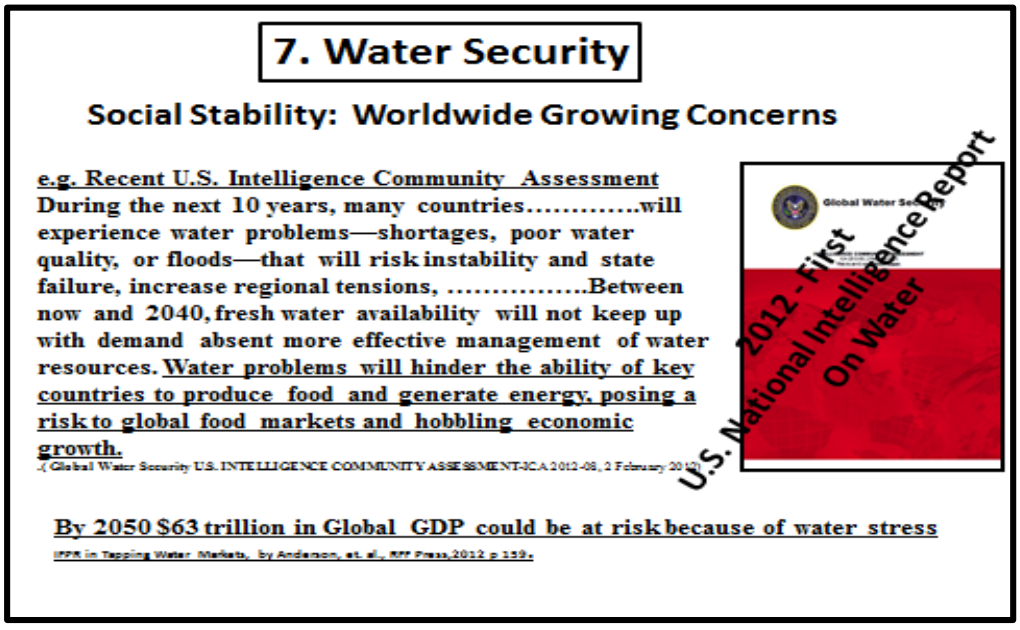
Perhaps the most important impact of these recent events is that we now define risk differently: as shown in the slide. Rather than being defined primarily by engineering solutions and starting with structural measures, we now understand that all stakeholders contribute to risk reduction through a variety of structural and non-structural means. This means we start with policies such as zoning, building codes, outreach, and evacuation plans, warning, insurance, and then come to using structures; as you see in the bottom right.

No matter what policies emerge residual risk remains and this is among the most difficult of concepts to communicate and speak with our publics/stakeholders. In the end risk reduction strategies, really are collaborative efforts among all levels of our governments.

8. Additional Aspects of Water and Security



Water security has now become a major part of the world debate on water. Much of this revolves around the political economy of water; on how to politically adapt the demand curves for water use to changing values emerging from demographic or socio economic status; on balancing the productive uses with managing vulnerabilities to its destructive power on balancing access to it with living with acceptable levels of risks.



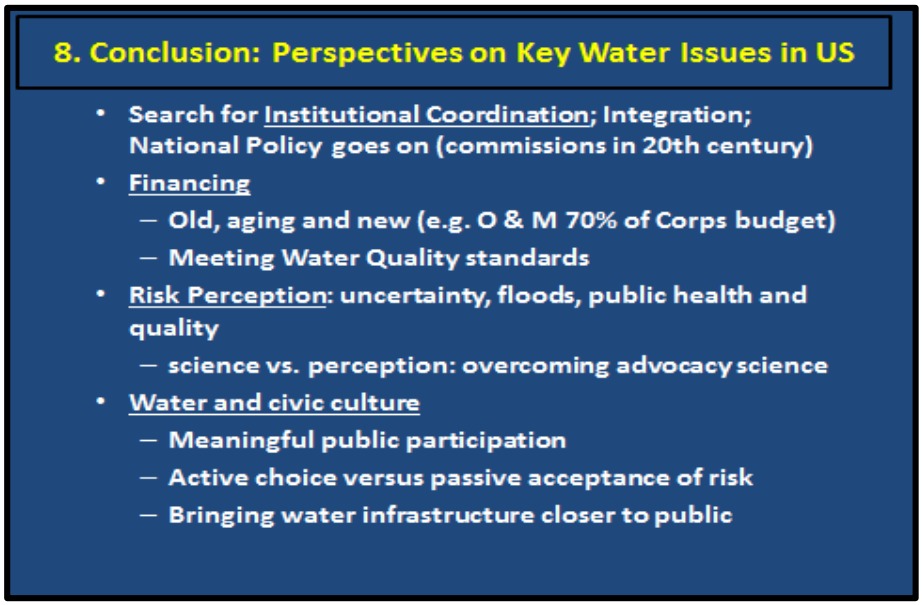
A new dimension of water security has begun to emerge in the U.S. The recent and I believe the first, U.S. Intelligence Community Assessment of water resources worldwide states:

> *"…During the next 10 years, many countries……. will experience water problems—shortages, poor water quality, or floods—that will risk instability and state failure, increase regional tensions, ……. Between now and 2040, fresh water availability will not keep up with demand absent more effective management of water resources. Water problems will hinder the ability of key countries to produce food and generate energy, posing a risk to global food markets and hobbling economic growth…." (fig __)*

In short, there is a link between water security and social stability and national and international security interests. This link goes much farther than the water community 's balancing of supply and demand for water. It speaks to the potential role of water in helping to create social stability. As mentioned earlier such notions actually formed much of the young US viewed its use of water. It is now remerging even in our U.S. national security strategies.

So; rather than simply surveying the world and asking where supply does not fit demand, we might also fruitfully look at places posing international security risks and ask, "…. what water investment may or may not be able to do to increase internal security?" Such questions will bring yet another sector, currently absent, into the cross sectorial dialog with water; the national security sectors.

9. Summary and Conclusions: Perspectives on Key Water Issues in U.S.



To summarize what I have been saying;

- The search for institutional coordination; integration; and debate over national policy within our U.S. Federal system goes on.
- Regarding financing, all aspects of our water infrastructure are old, aging: for example, operations & maintenance now approaches 70% of USACE budget.
- Meeting Water Quality standards continues to challenge us especially non-point sources.

- As we move more toward risk based decision making, understanding perceptions of risk and uncertainty and communicating risks are increasingly important but difficult to achieve for water related disaster.
- We struggle with overcoming "advocacy science" or what I call "dueling experts."
- The links between water decisions and civic culture are clearer and call for meaningful public involvement and for bringing water infrastructure closer to publics and other stakeholders who traditionally have not participated in water decision making.
- Reapportioning and reallocating legally established water uses, to fit new demographic and sectorial realties is a major challenge primarily for our political systems.
- The process of delinking water rights and land ownership continues.
- The process of clarifying and codifying water rights, especially in the U.S. West continues.
- There is a growing awareness of the value of ecological services in looking at benefits and costs of projects; especially when costs of our historically highly beneficial projects are analyzed today.
- Investments in ecological restoration are growing; however it is becoming clearer that our perspectives of ecological preservation need to more realistically be seen as co-designing our future with nature.
- Large scale wetland loss remains a major problem, even with "no net loss" policies.
- Ground water monitoring and protection remain major challenges.
- Non-point source pollution remains difficult to regulate.
- Adaptive management is necessary to make sustainability and integrated management operational.
- We still deal with regional water imperatives versus realities of legal jurisdictions.
- Most of our large water infrastructure is aging and beyond originally planned life: financing new rehab and how we decide to recapitalize are growing concerns.

A new administration is starting in the U.S. and we have yet to learn the directions of water policies and investments. Most likely these directions will revolve around water infrastructure investments, methods for reallocating water, regulatory reforms and most of all new mechanisms for funding including private and public money.

Building on Minister Chen Li's recent suggestions at Budapest Water Summit, this list of U.S. Water policy and management issues clearly supports the notion that broader collaboration and sharing among water resources managers could greatly benefit both our countries in many areas. Not the least of which is with new technologies. But also on policy experiences such as; integrating water uses;

applying tools of participation; experiences with conservation, on setting water use goals, on monitoring and tracking programs especially sharing Chinese experiences on CAP, the Redlines and four tier river systems, exchanges and cooperation such as study tours and perhaps even joint project planning. Perhaps even in some joint projects.

I also think that China's long recorded history of the relationships among water, nature, people, policies and technologies (such as recorded by MWR History division) could greatly inform the growing debate over the futures of water resources management and global changes.

When writing about water and civilization for UNESCO, I was struck by Lao Tze's words from 2000 years ago ++ here in China. He noted:

> *"……The sage's transformation of the World arises from solving the problem of water. If water is united, the human heart will be corrected. If water is pure and clean, the heart of the people will readily be unified and desirous of cleanliness. Even when the citizenry's heart is changed, their conduct will not be depraved. So the sage's government…. consists of talking to people and persuading them, family by family. The pivot (of work) is water…"*

Thank you for your Attention