Water Innovations Alliance

Proposed Committee to Develop use of Advanced IT in Water Management

WIA Conference

May 18th 2009

Agenda

- Big Green Innovations
- IBM and Water Management
- WIA - IT Committee

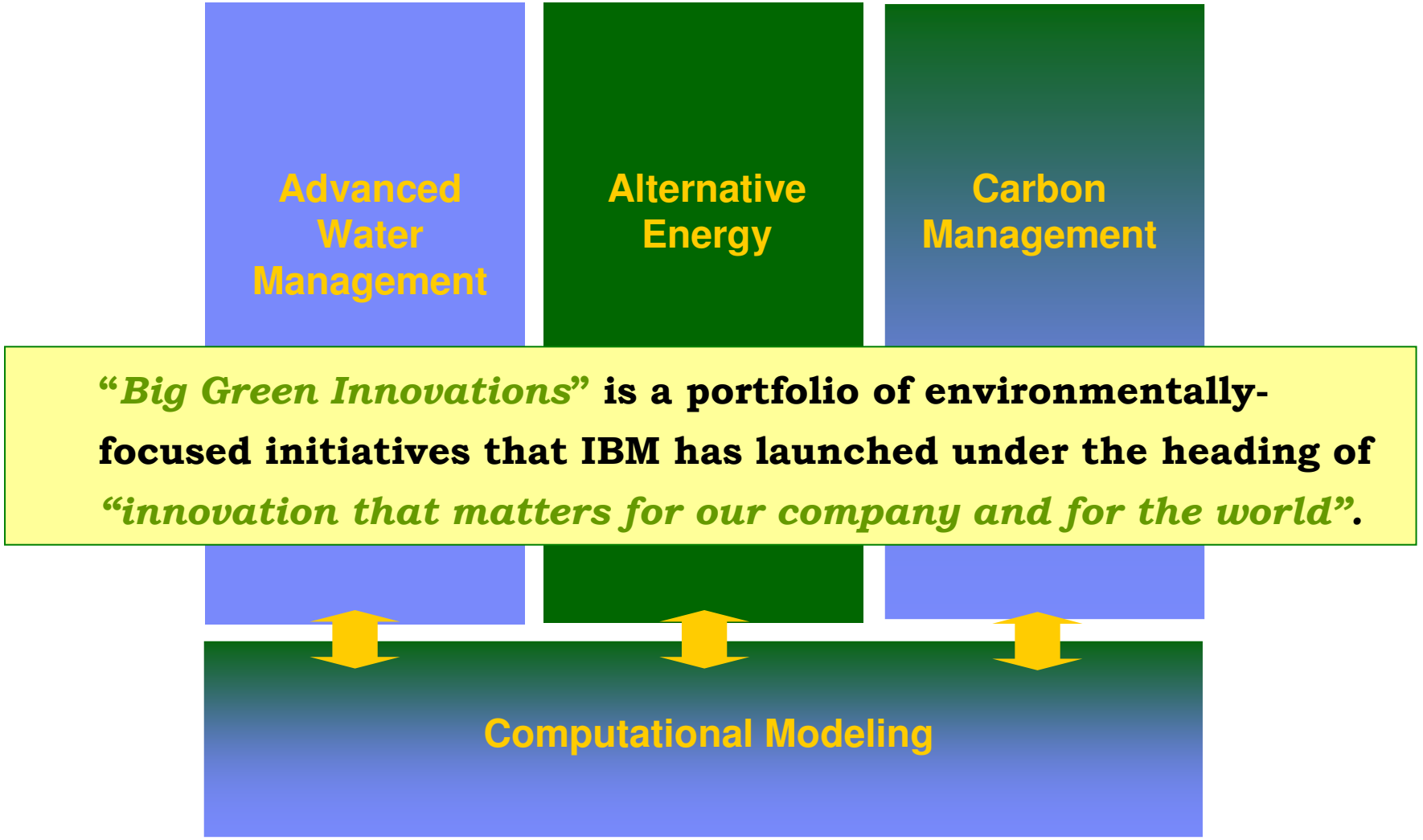



Big Green Innovations

Big Green Innovations is the latest step in a journey that IBM began 35 years ago

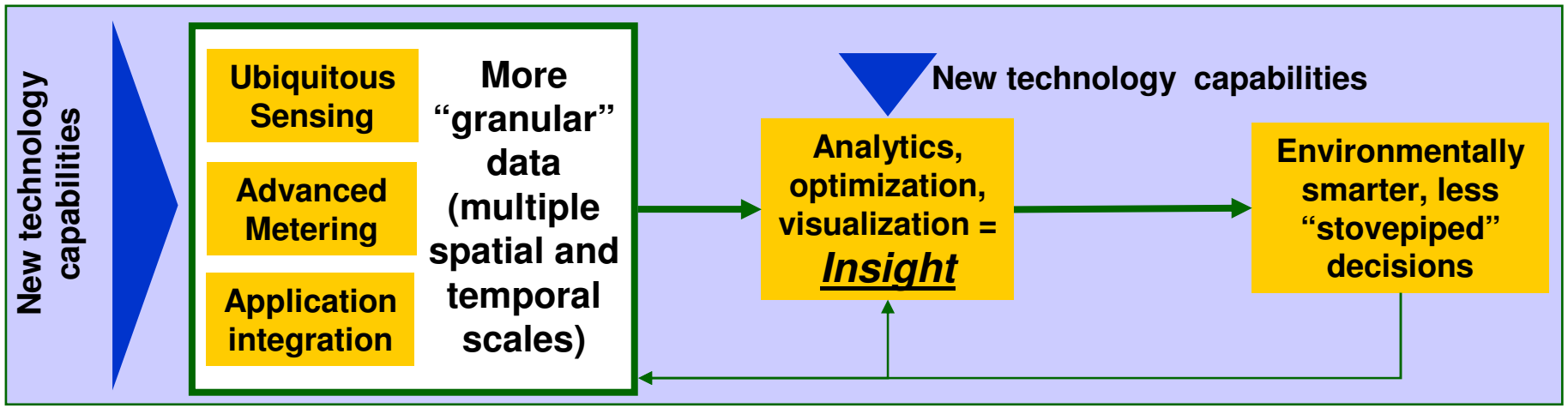
- 1971 - First corporate policy on the environment
- 1976 - Think! (IBM magazine) devoted whole issue to IBM conservation programs
- 1987-2006 - 95% reduction in hazardous waste
- 1989 - First take-back program
- 1990-2006 - saved 18.8 billion kwh of energy (= 9.7 million tonnes CO2), valued at $291m
- 1992 - Founder member of EnergyStar
- 1996 - Cited by Al Gore for our PFC reductions
- 1997 - First major corporation to gain global ISO 14001 certification
- 2006 - 96% of each computer we recycle is reused
- 2007 - 100,000 IBMers are mobile or work from home, saving $90m per year in real estate costs

Big Green Innovations' portfolio has four core areas - several have connections to water management



"Instrumenting the planet" - the trend will apply to water, just as it does to areas such as Smart Grid and GHG management

- Much of Big Green Innovations is based on enhanced understanding of planetary & human systems, and their interactions



- Sensing and metering will be in ever greater detail and ever closer to real time/ continuous.
- Modeling & optimization will be "whole business, real-world, operational", no longer "function-based, off-line, advisory"
- Decisions can be taken at the scale of the problem - not just subsets of it

Instrumented → **Interconnected** → **Intelligent**

IBM and Water Management

Much of water management is information management

*"One barrier to better management of water resources is simply **lack of data** — where the water is, where it's going, how much is being used and for what purposes, how much might be saved by doing things differently. **The water problem is largely an information problem.** The information we can assemble has a huge bearing on how we cope with a world at peak water."*

Source: Wired Magazine, "Peak Water: Aquifers and Rivers Are Running Dry. How Three Regions Are Coping", Matthew Power, April 21st, 2008

*"Today's decisions and policies will shape our water future…The effectiveness of those decisions **depends on the quality of information** …In addition to improved water data the United States should **develop and expand …forecasting and predictive models and systems**… to educate and influence water use behavior of individual[s], businesses and resource managers"*

***Source*:** NSTC, "A Strategy For Federal Science And Technology To Support Water Availability And Quality In The United States, - Report Of The National Science And Technology Council Committee On Environment And Natural Resources Subcommittee on Water Availability and Quality", September 2007

IBM applies information management to water at three "scales"

Natural scale

- Water resource mapping and availability
- Water quality monitoring and management (surface and subsurface)
- Land use management
- Extraction monitoring (surface and subsurface)
- Flood control

Utility scale

- Water quality, flow and usage
- Discharge and CSO
- Leak management
- Energy management
- Asset management
- Weather event assimilation
- "Smart levees" and monitoring systems

Enterprise Scale

- Water usage tracking
- Water quality control (into and within plants, discharges)
- Supply chain optimization
- Energy management
- Business process improvements
- Metrics and management

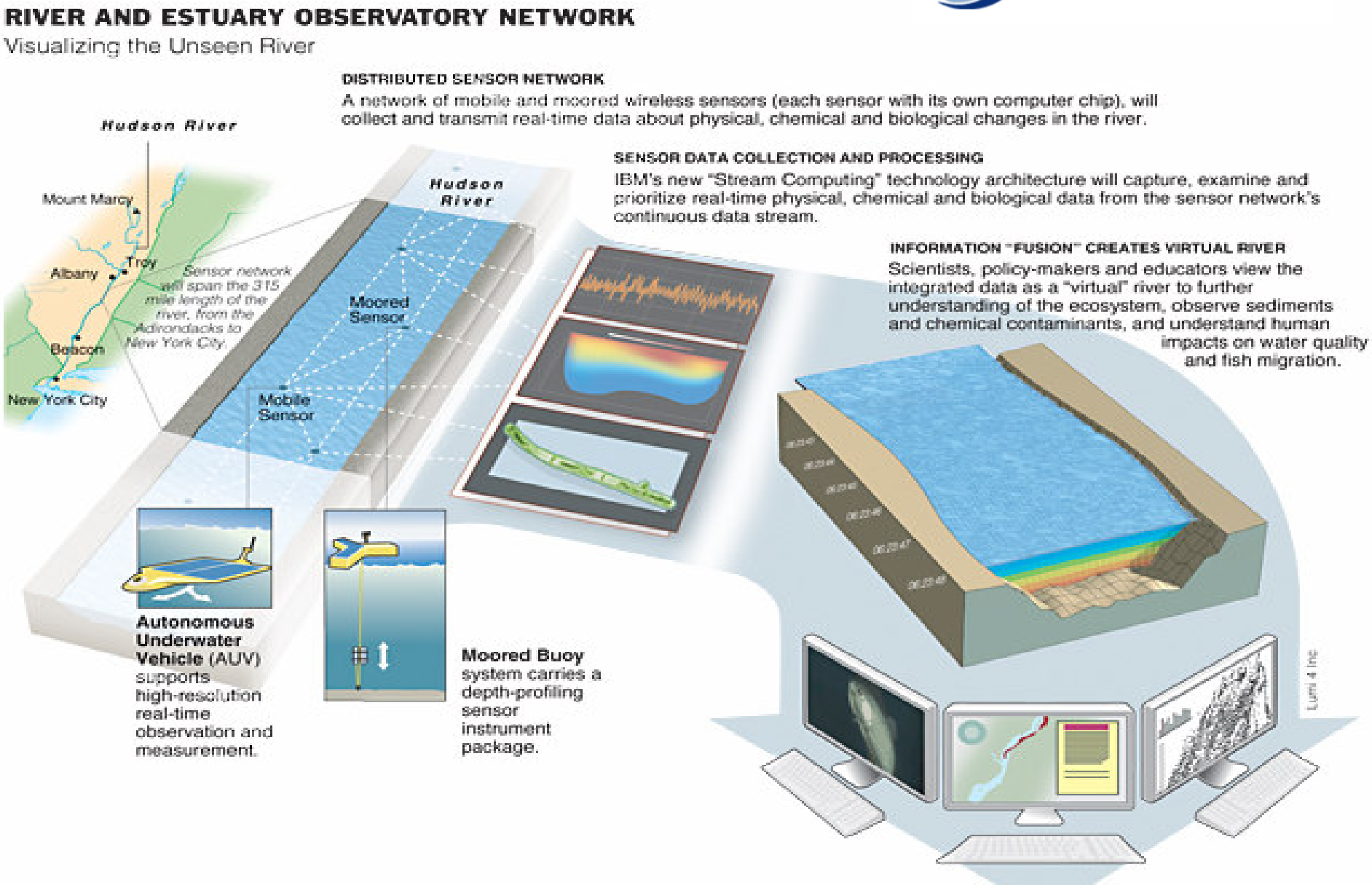
What does a computer company offer to water management?

- **Smart grid** technologies
  - Sensing, Advanced Metering
  - Grid management and integration
- World class **modeling and information management**
- **"System S"** - streaming data and streaming modeling
- **Maximo** asset management tool
  - Integrates with ESRI ArcGIS
- **Cognos**, **CognosNow** and ILOG business intelligence
- **"Deep Thunder"** weather forecasting
- World class **systems integration**
- **Original research** and custom development from IBM Research

- **In partnership with:**
  - Civil engineering companies
  - Sensor companies
  - NGOs
  - Universities
  - Research labs
  - Others

IBM example 1: REON

The Beacon Institute
For Rivers and Estuaries



IBM example 2: Smart Bay (Galway Bay, Ireland)

- Shared information/ collaboration platform for all stakeholders (coastguard, fishing, leisure, shipping etc)
- Will allow conclusions to be drawn from real time, streaming data:
  - Weather
  - Pollution alerts
  - Algal bloom prediction
  - Rogue waves, etc

IBM example 3: Ijkdijk ("Calibration Levee")

IJkdijk

smart levee solutions, from finger in the dike to finger on the pulse

- Netherlands project to understand what this instrumented levee will "look and feel like" as it breaks
- Multiple sensor types create a reference real-time "signature" from inside the levee, as hydraulic pressure builds up. Also tests:
  - Effectiveness of different sensor types
  - Applicability of numerical models
- IBM is undertaking integration task, working with TNO (NL Government scientific research organization)

"A more accurate and more continuous insight into the functional quality of water management infrastructures will become increasingly important…occasional measurement and manual data processing procedures will no longer be sufficient…" *Source: "The Ijkdijk" (Ijkdijk brochure)*

IBM example 4: Great Rivers* project

The Nature Conservancy
Protecting nature. Preserving life.™

- Science-driven conservation with I/T expertise and computing power
- Modeling framework and decision support system to simulate behavior of river basins around the world
- Inform policy and management decisions regarding land use and management tradeoffs
- Data: climate, rainfall, land cover, soil moisture, land use, etc.
- Software:
  - Scenario forecasting tools
  - Integrative modeling framework
  - 3-D visualization

* Now renamed “Water for Tomorrow”

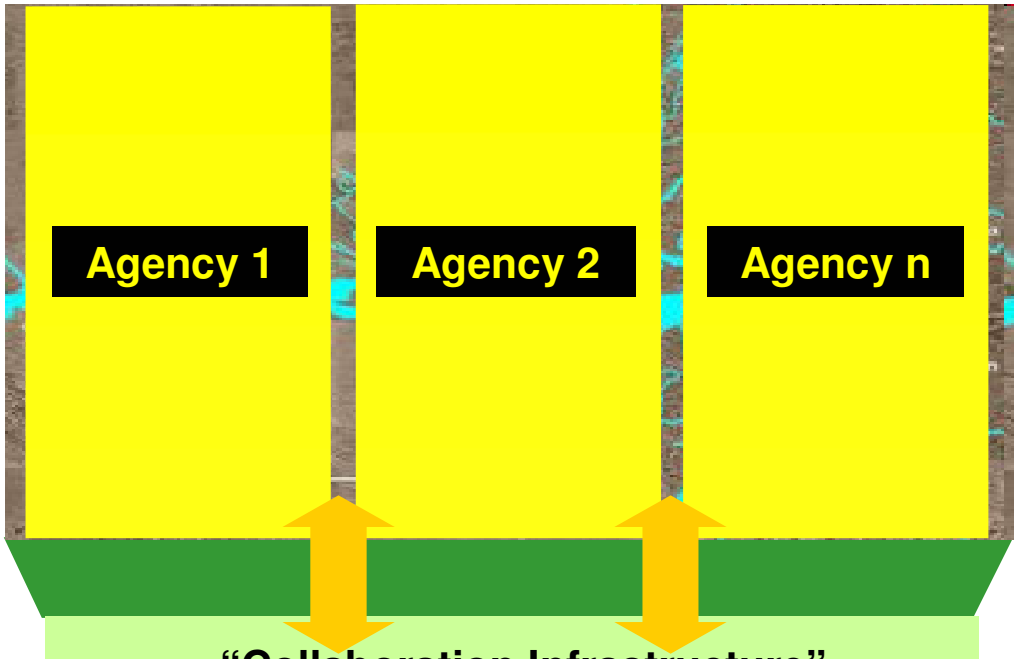
Learning theme from the examples - water "data pathologies"

- **No data**
- Data is in the **wrong scale** (spatial or temporal) for the decision
- Data is **fragmented** between different stakeholders:
  - Different formats, scales, frequencies, standards, collection methods
  - Re-capture of data many times
- **Too much data** to use
- **Incompatible or incomplete models** mean that data is not leveraged
- **Poor visualization** of information impedes effective decision-making
  - "So what's this telling us?" syndrome

- *Prediction:*
  - *"Unless we solve these problems, some percentage of whatever we invest in water management (let's say, 30-50%) will be wasted.*
  - *But we won't know which 30-50% until something major breaks".*

Learning theme from the examples - the need to support collaboration

- Collaboration can be built on shared information that:
  - Integrates existing and new, sensed & manual data sources
  - Serves all stakeholders with "one version of the truth"
  - Addresses the "data pathologies" just listed
- The platform could support projects and needs as yet unthought-of - saves recreation from scratch
- Business case is based on risk mitigation and valuation of ecosystem services



Water Innovation Alliance - IT Committee

Problem statement

The problem

- Government, water agencies and utilities are responsible for the following, that for varying reasons they increasingly find problematic:
  - Ensuring water availability at the required quality, while respecting the environment
  - Ensuring water security
  - Replacing an ageing water infrastructure
  - Managing weather impacts

Root causes

- Lack of awareness of how advanced IT can improve water management decisions
- Lack of data in the right temporal or spatial scales to support the decisions required
- Fragmentation of existing sensing capabilities, data and models
- Fragmentation of organizational span of control and overlapping jurisdictions
- Water pricing fails to reflect its value

How the IT Committee would help

- **Articulate a vision** of how advanced IT will benefit water management and enable collaboration
- **Create supporting collateral -** reference architectures, ROI tools, data and modeling standards, etc and work for adoption
- **Sponsor & stimulate pilots** for:
  - Wide-scale sensing, advanced analytics and visualization
  - Data and model integration on the scale of the water resource being managed - so creating a “single version of the truth” for the water resource that all stakeholders can access
  - Learning about what does and does not work

What else?

Stop press: Public Law 111-11* may provide a start point…?

- Measurement and estimation of water usage and availability nationwide
  - Assessment of additional data needs
- Data management and communication protocols to exchange water data
- "Data portals" to enhance access to data for each water resource
- "Hydrologic and other models" to allow surface/ground water interactions to be understood - requirements "to maintain ecological resiliency"
- Measurement of "stream-flow and related environmental variables in nationally significant watersheds"
  - similar management steps for groundwater and brackish water
- Improvement of methodologies for "the analysis and delivery of data"
- In-depth study of extreme events such as floods and droughts
- Significant extension to national network of stream gauges, groundwater monitoring wells and water quality sensors

**Signed by President Obama on March 30th 2009*

"Articulate a vision…" Would it be something like this example?

Data types (as examples) (from multiple sources and systems)

- Usage and Discharge
- Run-off
- Quantity
- Quality
- Environment/ Ecology
- Climate
- Economic
- Geology/ hydrology
- Energy data

"An integrated set of technologies, federated data and tools"

Stakeholders (as examples)

SCWA	Contractors/ customers	The public
Agriculture	Leisure industry	Local governments
Federal agencies	Other water agencies	The Environment

Collaborative uses (as examples)

Water quantity/ source mgmt	Water quality management	Water allocation
Habitat conservation	Research	Public awareness
Energy Management	Compliance	Land use planning

"Articulate a vision" - benefits…

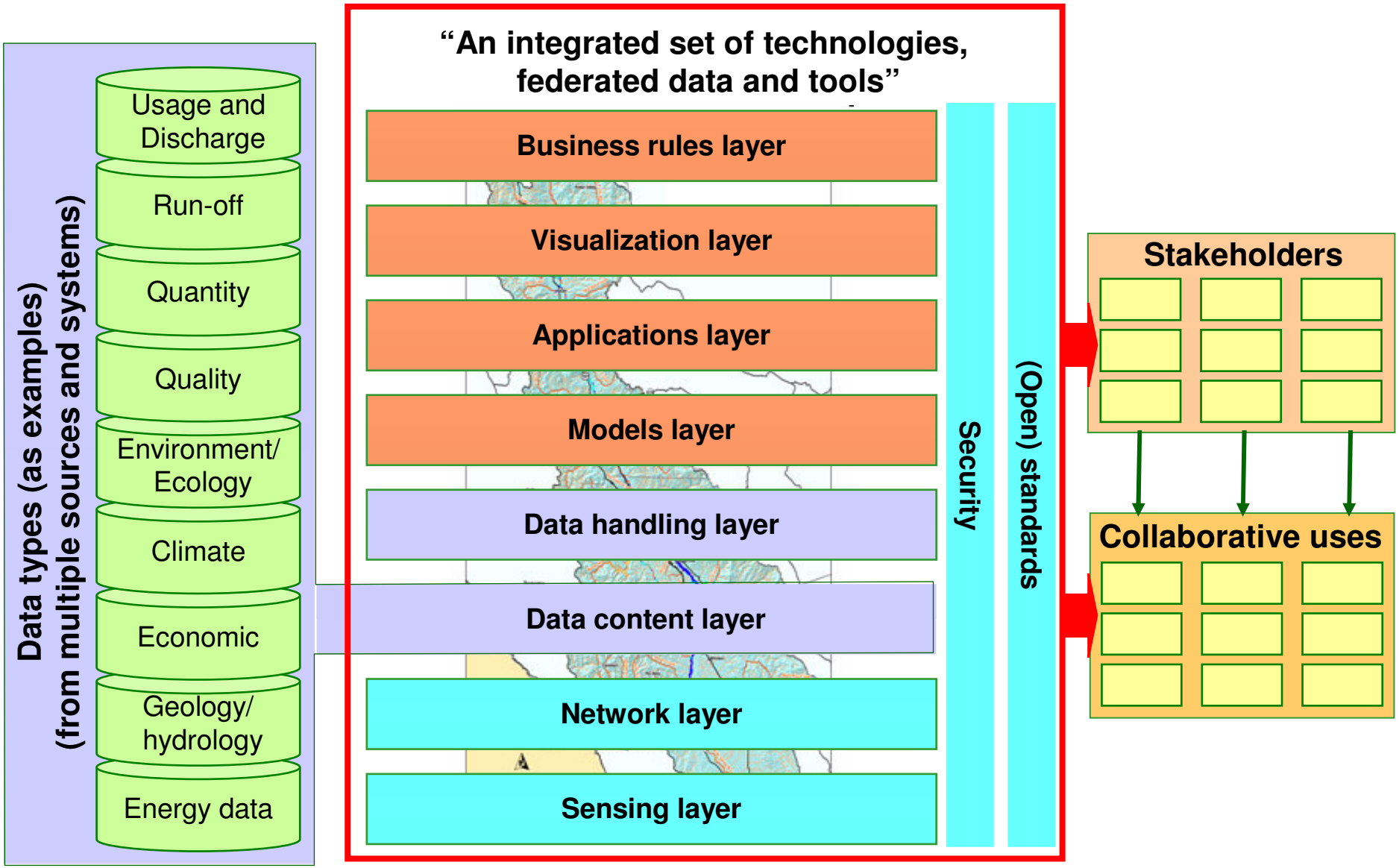
"An integrated set of technologies, federated data and tools"

- **Builds trust between different stakeholders -** less "my data says this, your data says that", greater disclosure
- Enables higher levels of collaborative decision-making
- More rational water management decisions - greater likelihood of data being available as required to enable the best decision
- Provides a "roadmap" for coordinated information systems development

- **Reduced operational risk - integration of drought management, flood control, pollution management**
- Enables coordinated system-wide response to issues such as climate change and development
- Reduces redundant effort on data collection - information more likely to be available and integrated when needed
- Reduces marginal cost of future data collection and research exercises

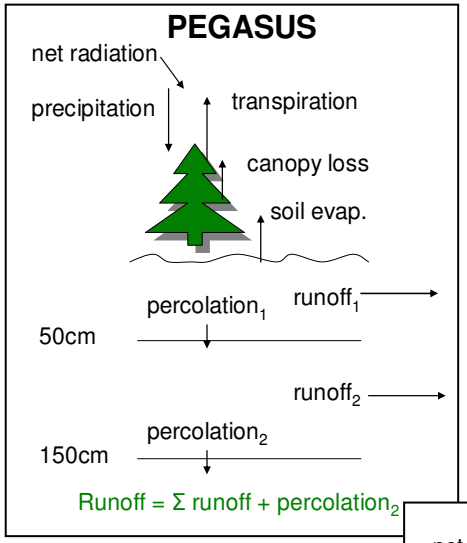
- Could be readily integrated with existing national resources - and add up to create a national "system of systems" on water management (cf Nationwide Health Information Network).

"Create support collateral…" Reference technology architecture

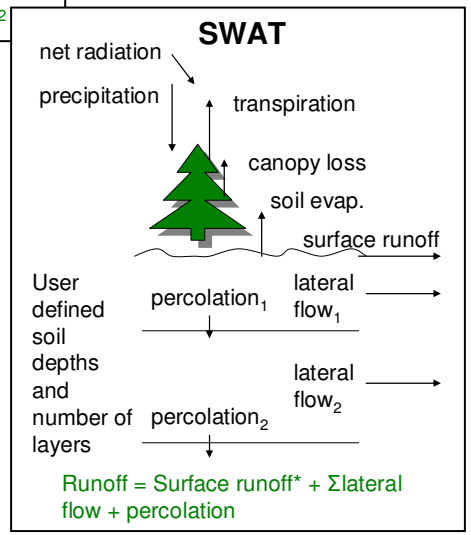


"Create supporting collateral…" Other possibilities?

- ROI tools?
  - Show how economies of scale and ROI could be achieved from collaboration
    - Ecosystem service value?
    - Supply chain value?
- Standards?
  - Data, transactions, reporting, model interoperability
    - Possible examples - CUAHSI/WaterML, XBRL, OGC, other?
  - Strong desire by IBM for open and not proprietary standards
- Models?
  - Agree and promote a reference set of models for water management needs?
  - Enable them to plug and play - harmonize semantic definitions, create framework to enable modules to be combined?
- **What else?**



Example of semantic differences: how two well known models handle run-off. "Similar - but different".



Similar issues might apply, for example, to models for infrastructural issues such as pump optimization.

"Sponsor and stimulate pilots…" Possible pilot selection criteria?

- Focused on applying sensing, data integration, modeling, visualization to an entire water resource (river-basin, watershed, aquifer etc) or region
  - Support improved water management and decision making for that resource
  - Demonstrate technologies and approaches that are widely applicable
  - Demonstrate the value of collaboration
  - Therefore, by definition, multi agency
- "Start a ball rolling" for the water resource in question - commitment to fund and continue the work if the pilot is successful
  - And/or "pump-prime" projects that become financially self-sustaining?
- Attract Federal interest and financial support
- Attract private sector interest and financial support
- Careful monitoring of issues, lessons learned, benefits and ROI
- Highly publicized, available as reference sites
- Multi-vendor

"Sponsor and stimulate pilots…" What would WIA actually do to sponsor and stimulate pilots?

- Possibilities include any or all of:
  - Assistance with selection of pilot schemes (see possible criteria on previous slide)
  - Publicizing pilot schemes
  - Assist with design of pilots, definition of requirements and creation of business cases
  - Supporting funding applications
  - Facilitating agency and/or vendor collaboration
  - Evaluation of pilot outcomes and creation of reference materials

- WIA would not assist with solicitation and evaluation of vendor bids, because of the obvious potential for conflicts of interest with individual vendors who may be WIA members, or partners or competitors of members.
  - For the same reasons, WIA would not advocate particular products.

Illustrative U.S. government agency activities related to water infrastructure information *

Endorsing	Facilitating	Partnering	Mandating
▪ *Provide Recognition for Smarter Water Management* ▪ *Discuss the need for Smarter Water Infrastructure Information in public speeches*	▪ *Provide Better Water Infrastructure Information* ▪ *Provide Grants to address Water Infrastructure Information issues*	▪ *Facilitate public-private partnerships – eg promote/join Water Innovations Alliance* ▪ *Convene Stakeholders – Build on ACWI work*	▪ *Mandate specific Data standards, collection and reporting information (eg NEST, Water for America)* ▪ *Regulate Water Infrastructure Information related issues*

* Illustration based on World Bank construct

Federal agencies whom we are approaching

- Environmental Protection Agency
- Department of Interior
  - US Geological Survey
  - Bureau of Land Management,
  - Bureau of Reclamations
  - Fish and Wildlife Service
- US Army Corps of Engineers
- US Department of Agriculture
  - US Forest Service
  - National Resource Conservation Service
- Department of Commerce - National Oceanic and Atmospheric Administration
- Department of Energy
- Possibly, Department of Homeland Security (although interest in the environmental aspects of what we propose will be lower).

Draft objectives and scope for the IT Committee

- "Building on existing initiatives, to:
  - Secure the participation of Federal and State water organizations, water utilities and other businesses in defining how IT should evolve to support water management.
  - Articulate and gain consensus behind a vision that sets this out
  - Create reference open architectures for water industry IT to maximize ease of collaboration around data sharing and co-working
  - Via other standards bodies, create data exchange and business process standards to support water management.
  - Via subgroups, create supporting tools and collateral such as models, ROI calculators, case studies and so on.
  - Define and secure funding for pilot implementations of water management solutions that engage multiple stakeholders and jurisdictions responsible for entire water resources (river basins, watersheds, aquifers) or major pieces of infrastructure.
    - Monitor and publicize the outcomes of those pilots".

Next steps: what we are looking for at this stage

- Organizations willing to contribute time to create the IT Committee, set its agenda, engage others who may be interested, and start work!
- We actively seek:
  - Water companies
  - Water agencies at Federal, state and local levels
  - NGOs and non-profits
  - Universities
  - A broad spectrum of IT vendors

Copies of these slides and the prospectus are available on request from peter.r.williams@us.ibm.com

Thank you!

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What each layer of the reference architecture contributes

"An integrated set of technologies, data and tools"

Layer	Commonality	Contents		
Business rules layer	Some common rules (eg for coordinated responses)	Determines how systems, actuation should respond - operating parameters, SC limits, pattern definition, required responses	**Security** Access to data at all levels Security of sensors and readings Needs to be agreed and trusted between all stake-holders	**Standards** Selection of open standards at all layers (maximizes ease of co-working with other stakeholders; avoids proprietary "lock-in"). Need to be agreed between agencies
Visualization layer	Probably specific to each agency, though could be shared if desired	Enables management decisions - geographical, business data, simulations etc		
Applications layer	Specific to each agency, but agreed interfaces	Provides systems functionality - asset management, dashboards, portals, SCADA etc, plus interfaces		
Models layer	Common core set shared by all agencies	Identifies models and required integration points - integration framework, metadata, semantics, calibration etc		
Data handling layer	Specific to each agency, though aspects could be shared if desired	Manages data flows - streaming data, data cleaning, reformatting, mappings, error checking, also some pattern detection		
Data content layer	**Common to all agencies!!**	Defines data - data definitions, formats, required granularity, volumes		
Network layer	Economies of scale if common	Communications, format and protocol management, sensor management,		
Sensing layer	Could be common, integrating existing sensors	Sensors, linked to SCADA		