DB Sediments®
System Sensitive Solutions

Handling Sediment Transfer in Practice
Gaining from Sediments

SedNet

9th International SedNet Conference
23-26 September 2015 Krakow Poland
Solving societal challenges; working with sediments

PLATTS 2013 GLOBAL ENERGY AWARDS FINALIST

INNOVATIONSPREIS DER DEUTSCHEN WIRTSCHAFT
Finalist 2015

9th International SedNet Conference
Krakow, Poland, 23.09.2015

Dr. Dietrich Bartelt, DB Sediments GmbH

Member of
German Water Partnership

DB Sediments GmbH

Based on Environmental Know how

- Founded on 09.03.2009 in Duisburg, Germany
- Founders – experts each with more than 20 years of international utility back ground, project management, renewable energies
- Management experience, environmental leadership
- International research programs since 1994 (i.e. 5th EU FWP, …)
- Innovation Management
- Environmental Technology „Made in Germany“ Headquarter at Tectrum – Technologie Zentrum

DB Sediments

Member of German Water Partnership (GWP)

German Water Partnership
Solutions you can trust.

Federal Ministry of Education and Research
Federal Ministry for Economic Cooperation and Development
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
Federal Ministry of Economics and Technology
Federal Foreign Office
AHK
IHK
KFW
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GERMANY TRADE & INVEST

- The German Water Partnership is a joint initiative of the German private and public sectors, combining commercial enterprises, government and non-government organizations, scientific institutions and water-related associations.
- Founded in April 2008, it has now 370 member companies
- Achieve international awareness of German excellence in water technology and water management
- Germany has more than 150 years of experience in successful water management. Efficiency in plant engineering, consulting and operation is complemented by unparalleled expertise in scientific research, education and training, and by high levels of institutional and administrative knowledge.

EU Water Framework Directive

Court of Justice of the EU, 01.07.2015

Press and Information

Court of Justice of the European Union
PRESS RELEASE No 74/15
Luxembourg, 1 July 2015

Judgment in Case C-461/13
Bund für Umwelt und Naturschutz Deutschland eV v Bundesrepublik Deutschland

The obligations laid down by the Water Framework Directive concerning enhancement and prevention of deterioration apply to individual projects such as the deepening of a navigable river

The environmental objectives that the Member States are required to achieve involve two obligations, namely to prevent deterioration of the status of all bodies of surface water (obligation to prevent deterioration) and to protect, enhance and restore all those bodies of water with the aim of achieving good status by the end of 2015 at the latest (obligation to enhance).

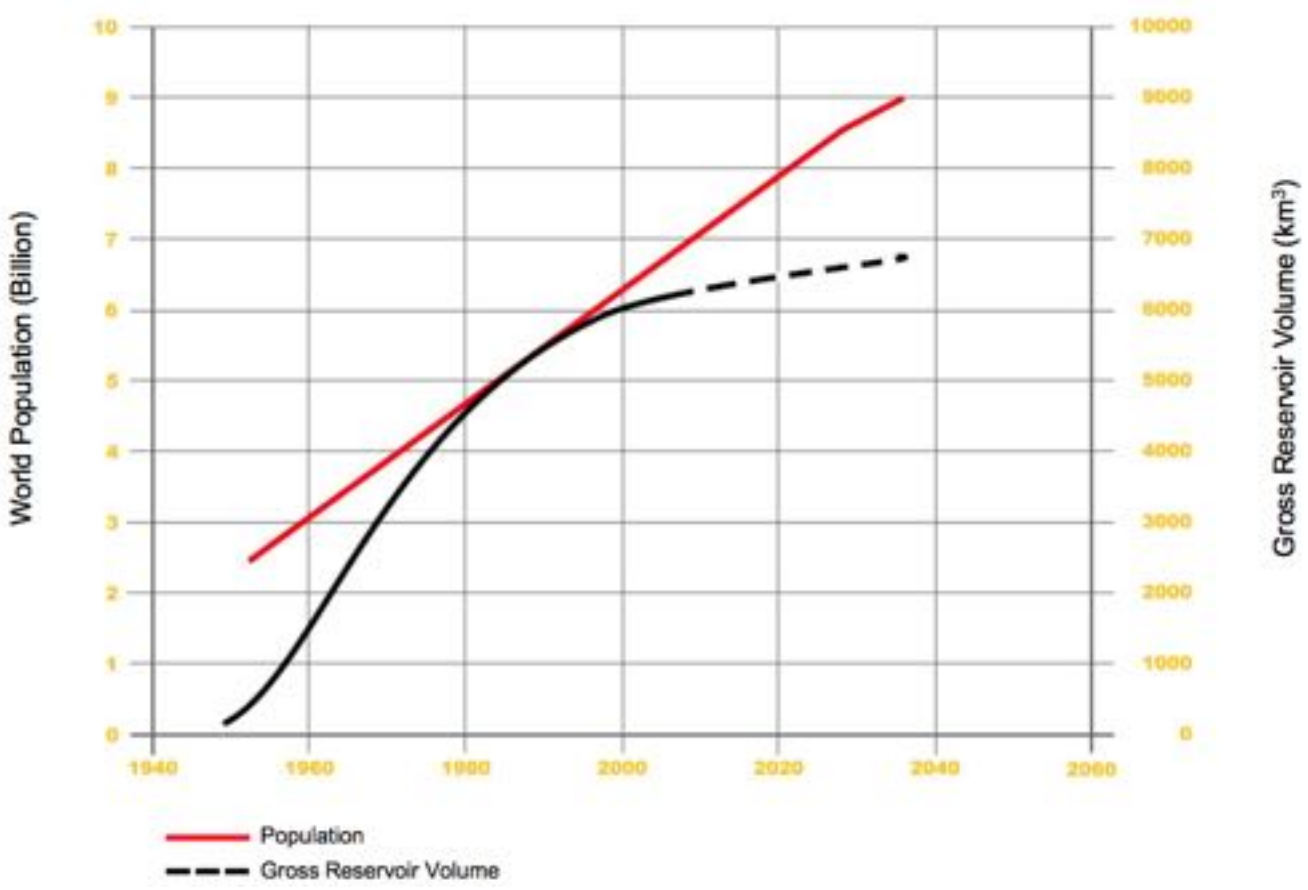
World Bank:

"The last century was used to build reservoirs.

This one will be used
to solve sediment problems."

Global Water Storage Capacity

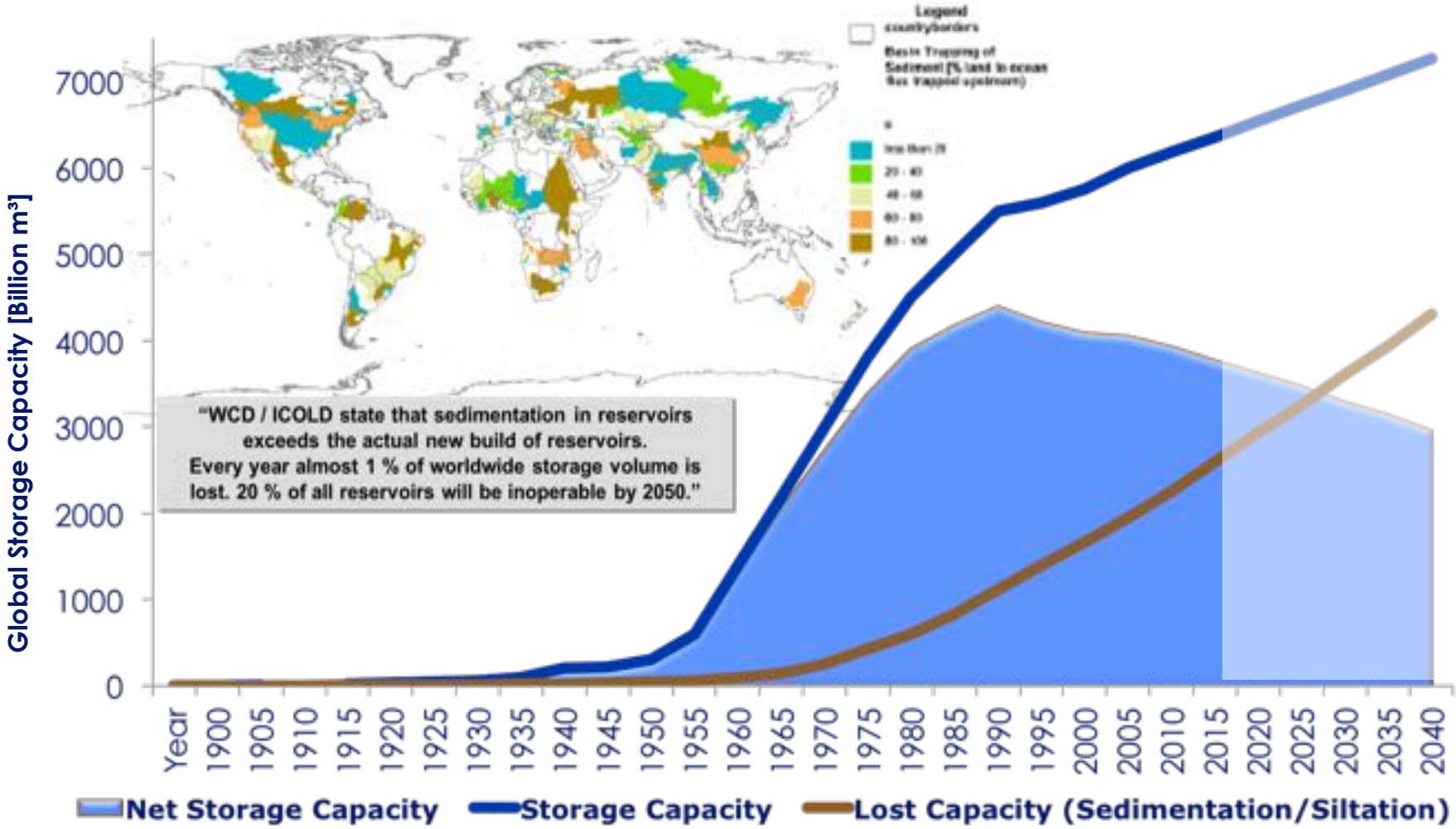
DAM CONSTRUCTION AND GLOBAL POPULATION



Source: Annandale, G. (2014) Sustainable SUSTAINABLE WATER SUPPLY AND CLIMATE CHANGE

Global Water Storage Capacity

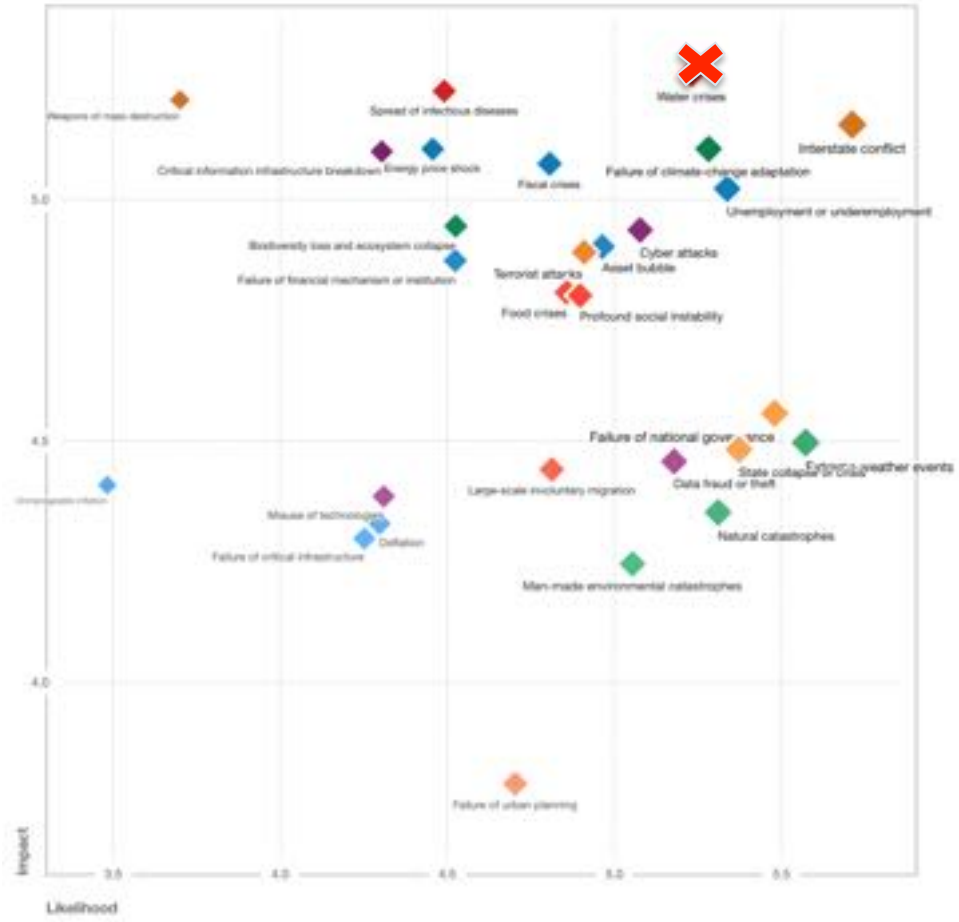
Increasing Loss



Source: Based on data from Jenzer and Cesare (2005) and GWSP Digital Water Atlas (2008)

Global Risk Perception Survey

Environmental Risks are most likely and have highest impact



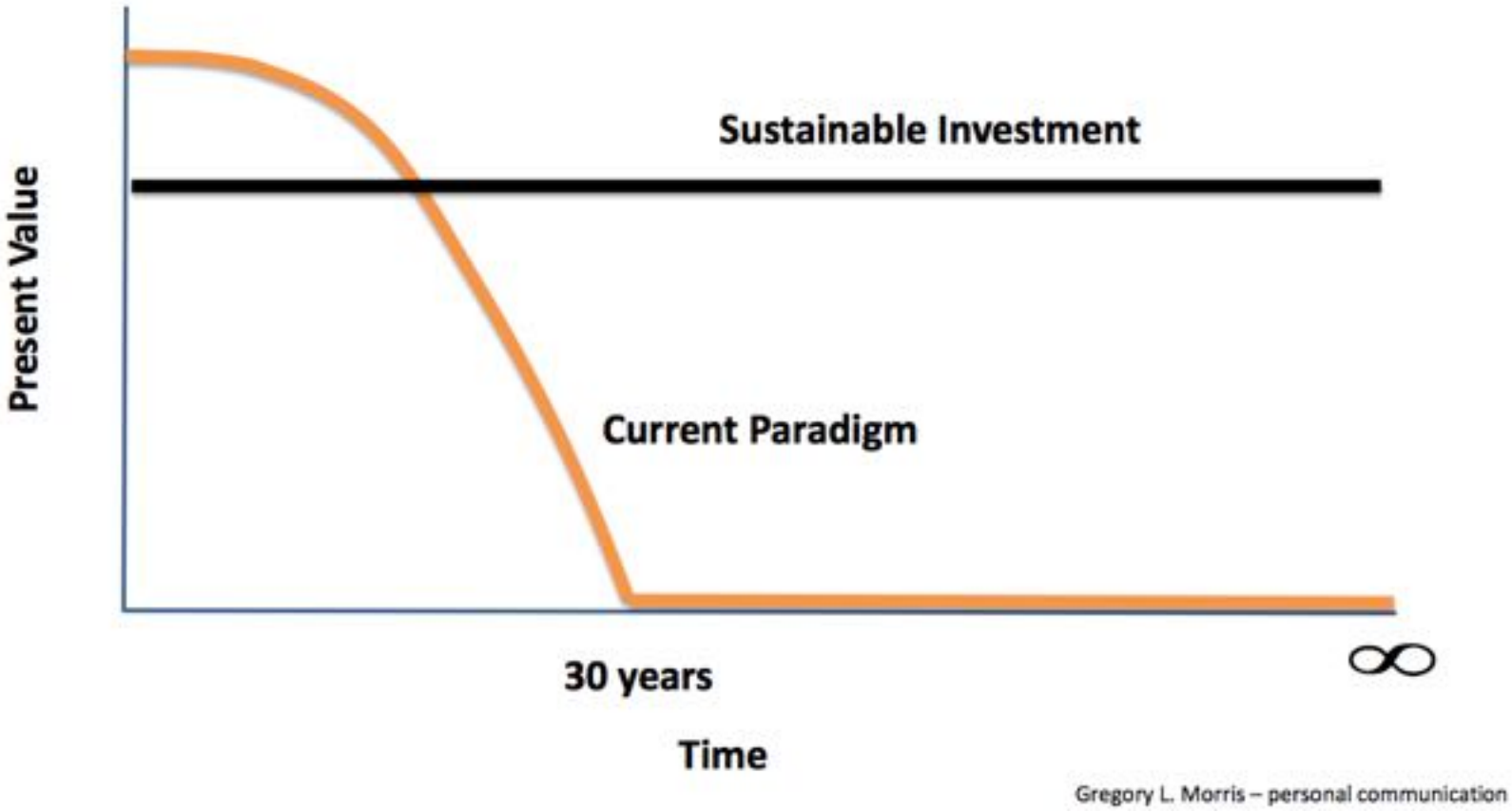
Environmental Risks, directly and indirectly related to sedimentation

- Water Crisis is number one!
- Extreme weather events
- Natural catastrophes
- Man-made environmental catastrophes
- Biodiversity loss and ecosystem collapse
- Climate change

Source: World Economic Forum; Global Risks Perception Survey 2014-2015; www.weforum.org/risks.

Value of Water Storage

Decreasingly falling without/stable with Sediment Management

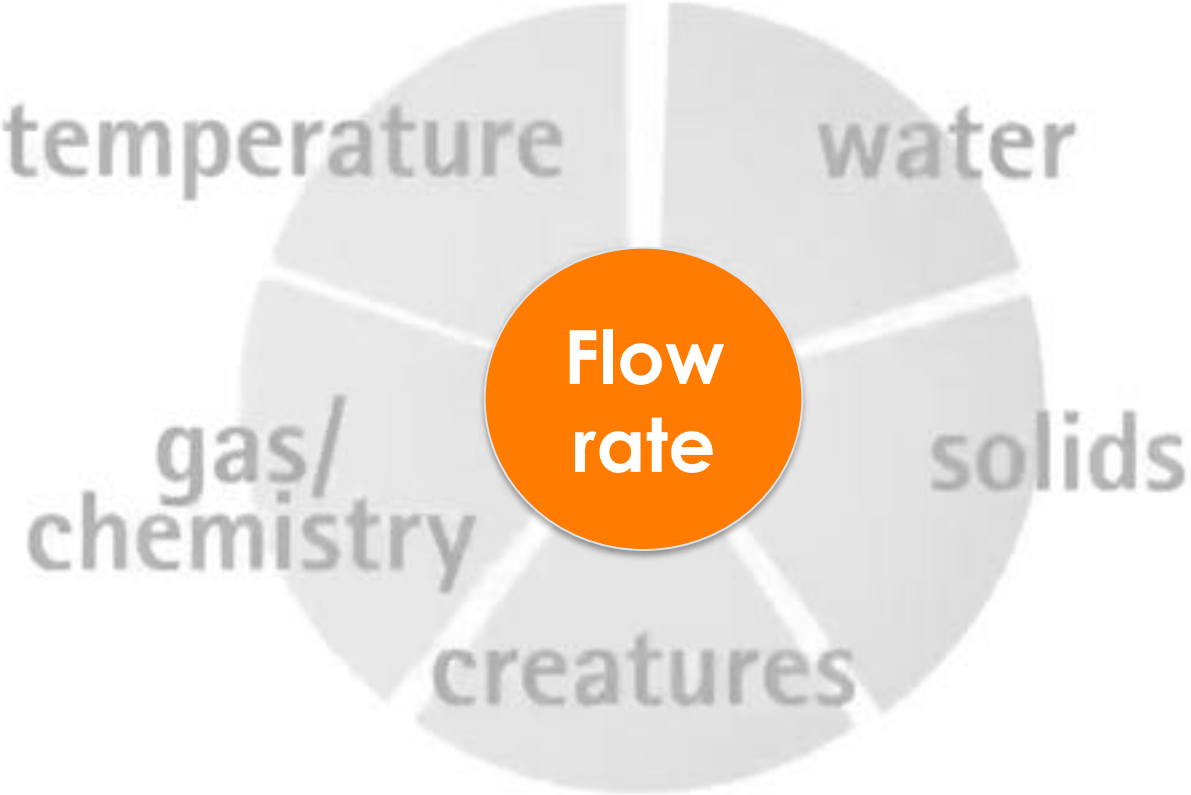


Gregory L. Morris – personal communication

DB Sediments:
“Sediment is not a problem.
It is a challenge.”

Natural Water

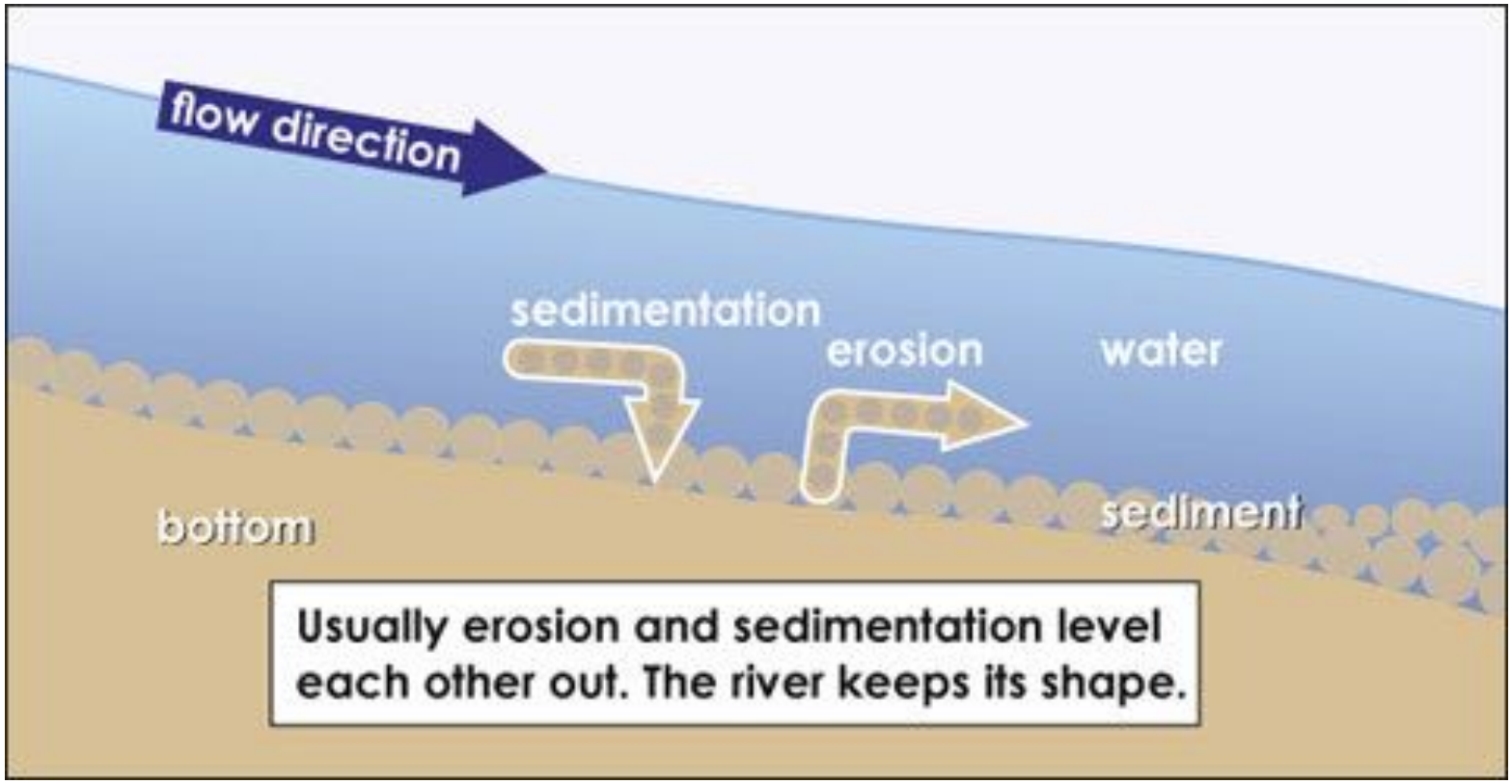
The flow connects five natural elements



Sediment

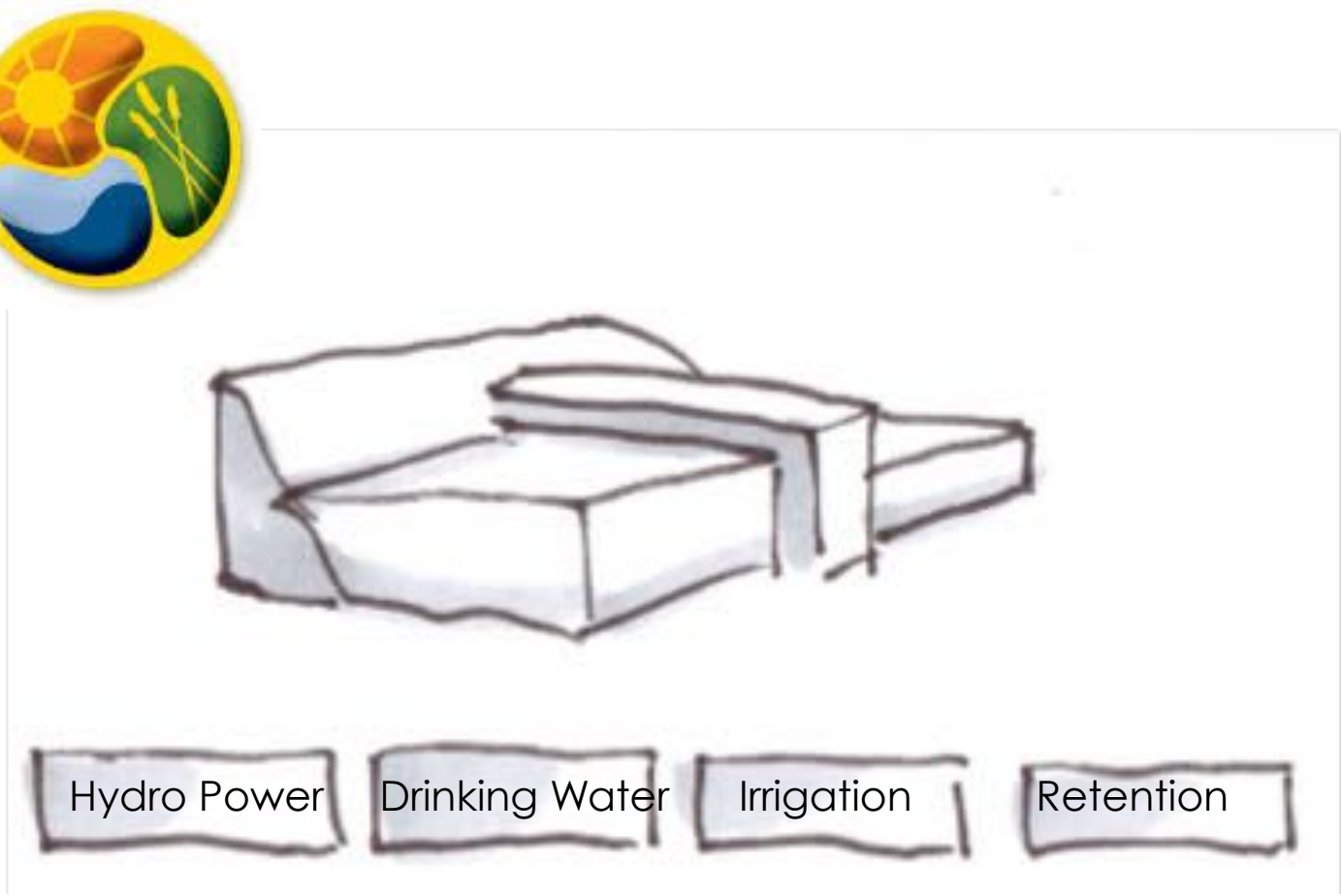
Integral Part of every River

➔ **Any streaming water contains and transports sediment** (upstream less, downstream more):



Use Water – Store Water

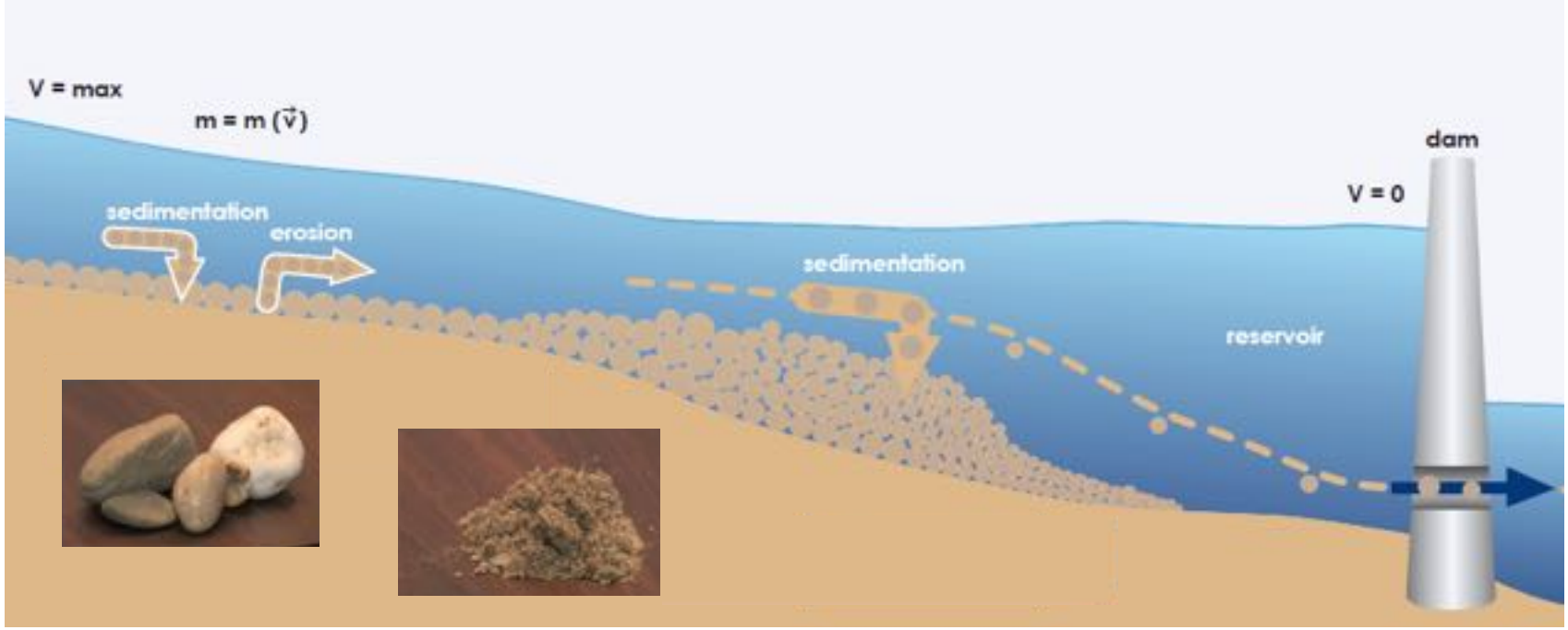
Impact to the river as an ecosystem



The Use of Water
Impact to the Ecosystem

There is more than water that "flows" in a river

The reduction of velocity causes sedimentation and siltation



The Two Sides of Sediment

Within the Reservoir: Sediment Surplus

Sediment accumulation in reservoirs leads to:

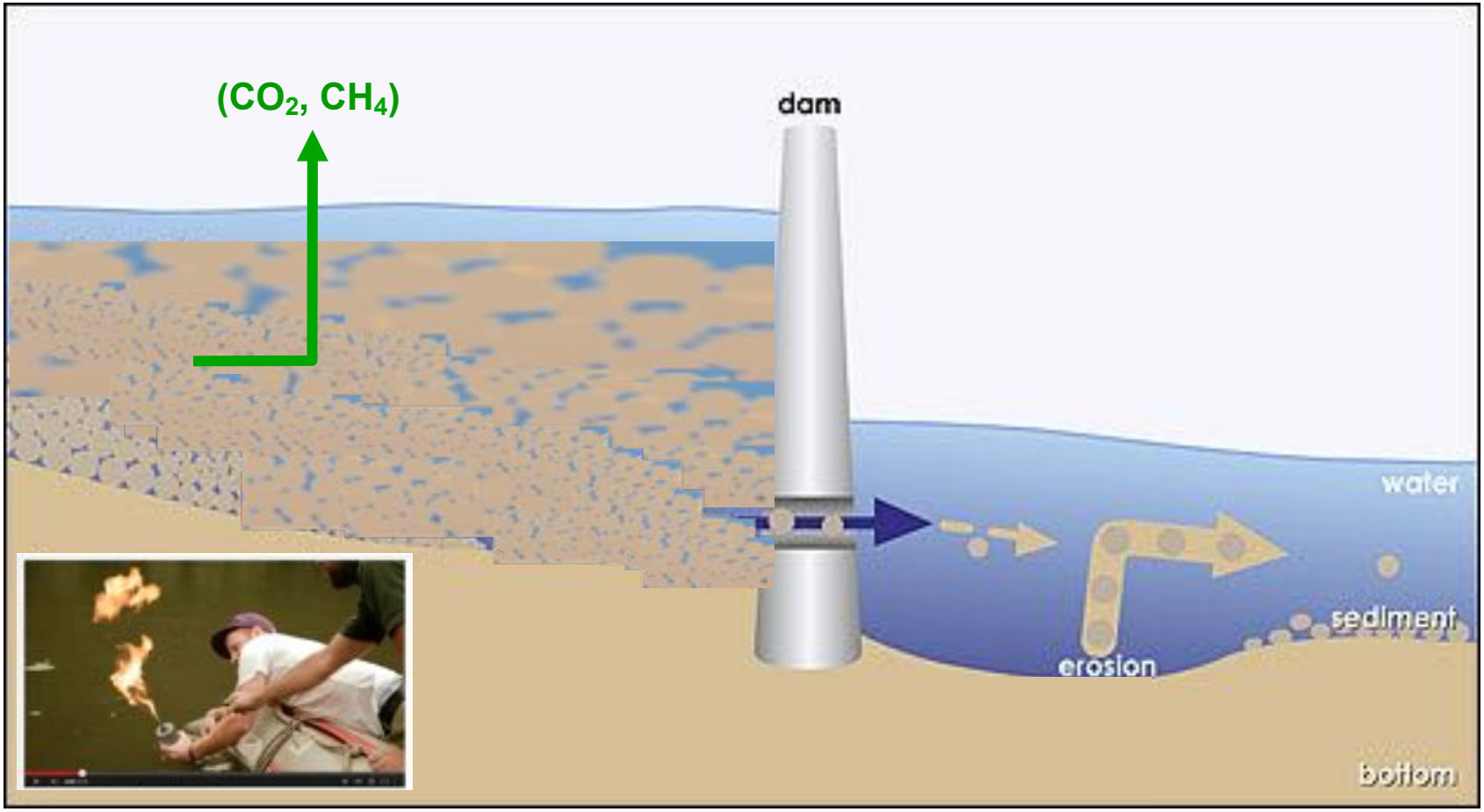
Picture: Süddeutsche Zeitung 06.06.2014, http://tinyurl.com/kdme64h

- Reduced flood protection
- Reduced storage capacity for
  - hydro power peaking/seasonal storage
  - irrigation / drinking water supply
- Reduced biodiversity inside the reservoir
- Higher temperatures, less oxygen
- Methane emissions from impounded rivers
- WCD / ICOLD state that sedimentation in reservoirs exceeds the actual new build of reservoirs.
- Every year almost 1 % of worldwide storage volume is lost.
- 20 % of all reservoirs will be inoperable by 2050.

➔ **sediment management is an urgent issue**

The Two Sides of Sedimentation

Sediment Surplus upstream / Sediment Deficit downstream



Source: Lorke, Andreas (2013) Methanproduktion in Staustufen der Saar: https://www.youtube.com/watch?v=gW_LOHbff5Y

Problems without Sediment

Example: Sediment deficit River Rhine

River bed erosion and bank erosion*

<u>Sedimentdeficit</u>
D/NL-boarder:
about **2.500.000 t/a**

<u>artificial adding of Sediments</u>
about 230.000 t/a

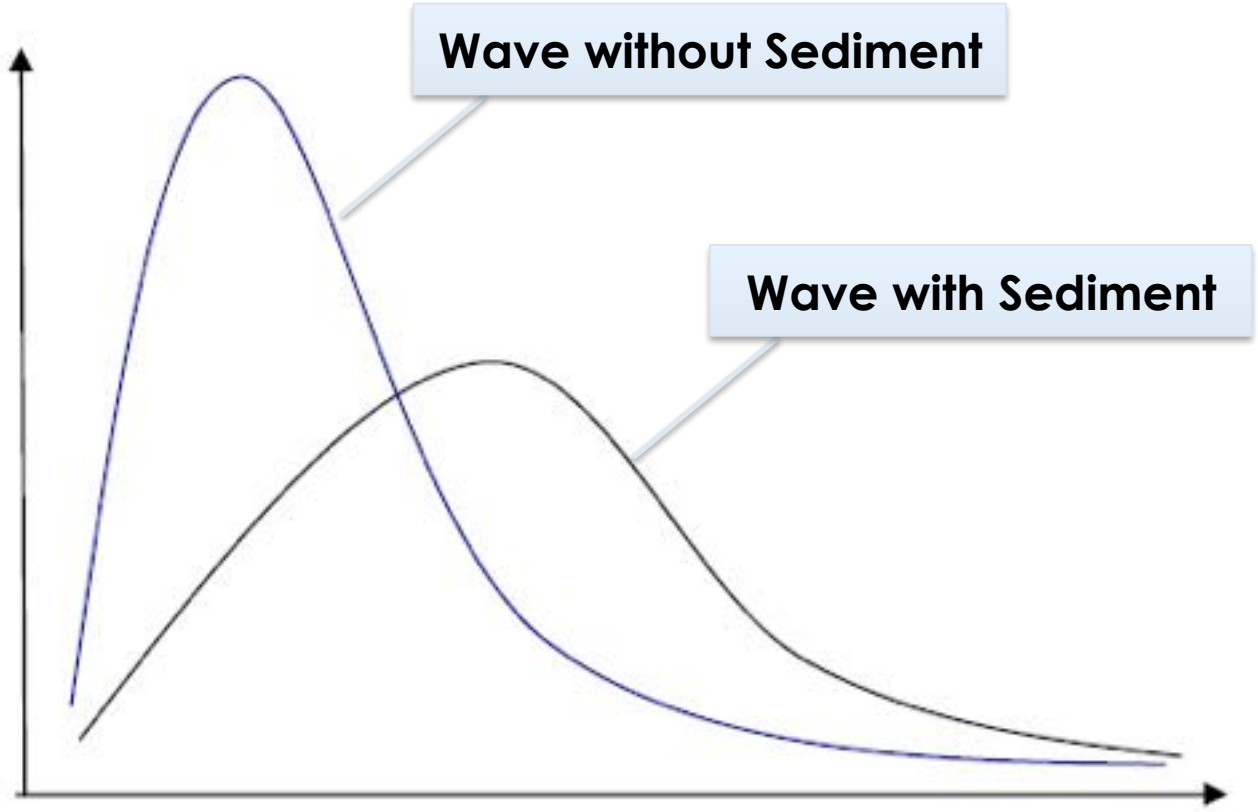
Locks Iffezheim:
about 400.000 t/a

- ➔ Adding Sediments is expensive
- ➔ 2012: WSA Duisburg 24 Mio. €

Source: Alpreserve *, Bundesanstalt für Wasserbau (Koblenz), Hülskens Wasserbau (Wesel) WSA DU, http://www.wsv.de/ftp/presse/2012/00191_2012.pdf

Wave Dynamics

Qualitative Change with/without Sediment Transport



A river is an Eco-system

Sediments are an integral part of this system

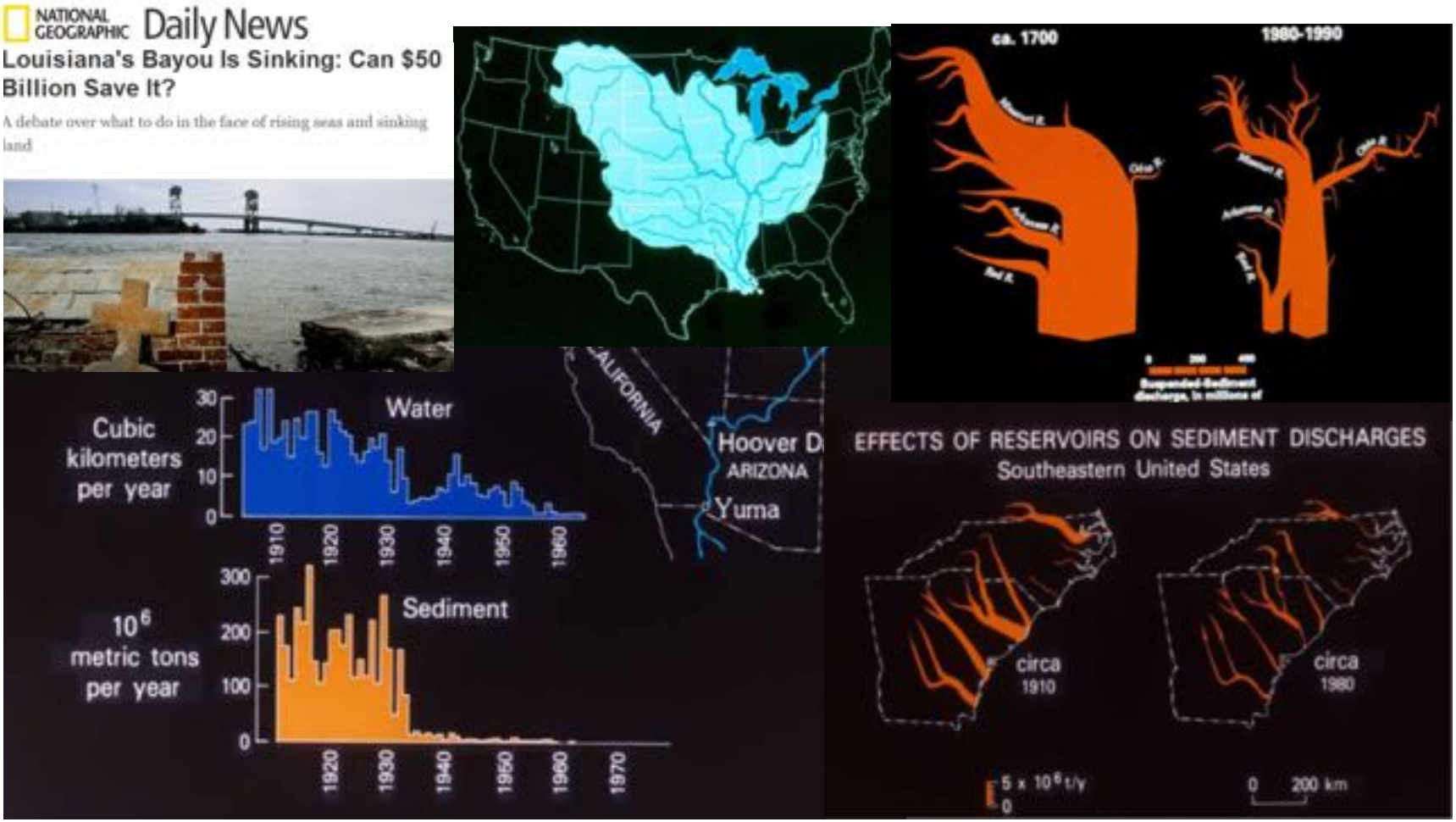
Sediment Deficit

Coast Erosion (e.g. Egypt,…)

Source: Google Maps (2011)

Mississippi River System

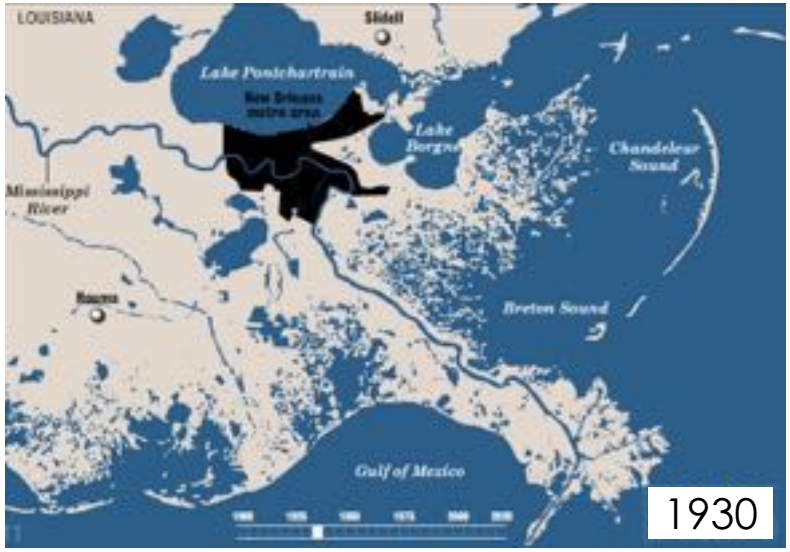
Decoupling of water and sediment flows

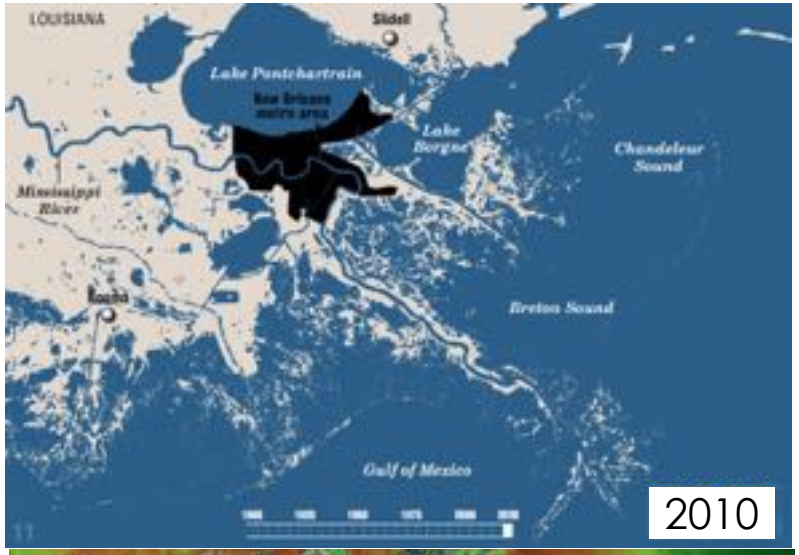


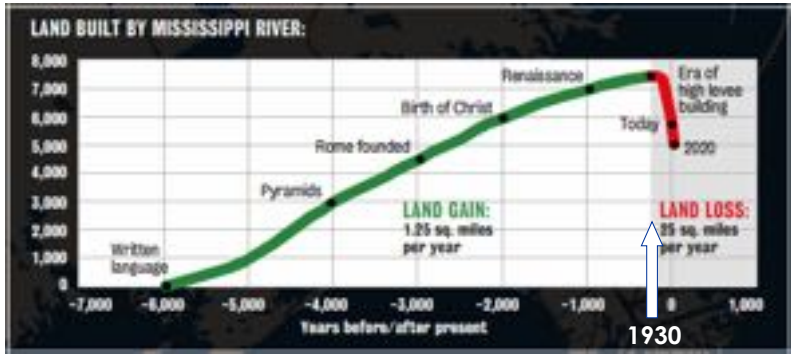
Quelle: Meade, R. H. (2010). Sediment Transport and Deposition in Rivers: The Case for Non-Stationarity. In World Bank Group (Ed.): World Bank Document, A REVIEW OF SELECTED HYDROLOGY TOPICS TO SUPPORT BANK OPERATIONS. Papers from the Workshop (pp. 69-76, Annex)., National Geographics, May 2014

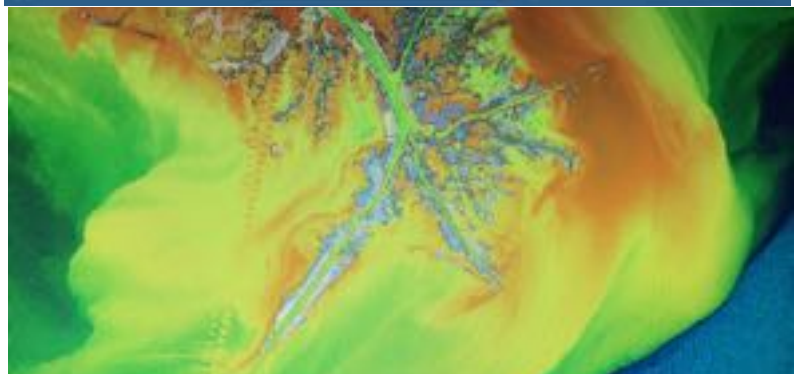
Sediment Mismanagement

Death Threat to the Delta (eg Mississippi)









Source: Don Swenson (2012) The Rise and Disappearance of Southeast Louisiana.
http://www.nola.com/speced/lastchance/multimedia/flashlandloss1.swf

The Two Sides of Sediment
Downstream: Sediment Deficit

Missing sediment/changed morphology downstream of reservoirs cause:

- Riverbed and bank erosion
- Foundation failure of civil hydro structures
- Agricultural substrate deficit
- Change of aquatic ecosystem
- Re-infiltration of saltwater into groundwater at river delta/coastline
- Coastline erosion

➔ **Replacement of missing sediment is costly (e.g. Colorado, Rhine)**

Handling Sedimentation Issues

Current Ways and attempts to solve the problem

„Not doing anything“

Flushing

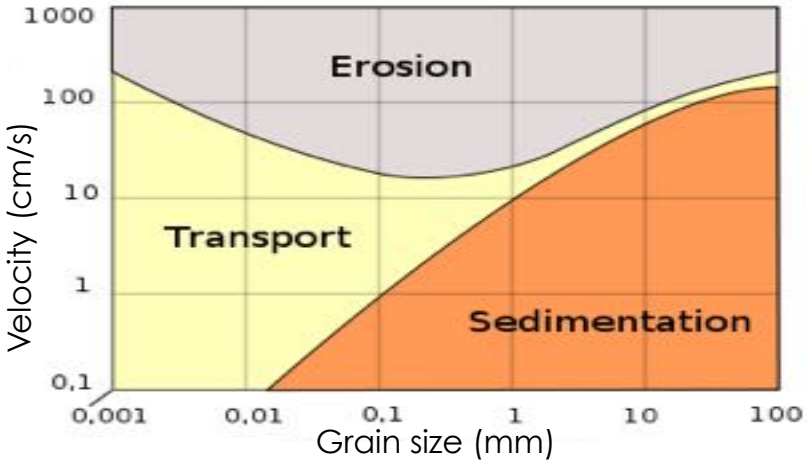
„Dig and Dump“

„Dredge, Spill, Dig and Dump“

Flushing of a Reservoir

Very ineffiencent and very expensive

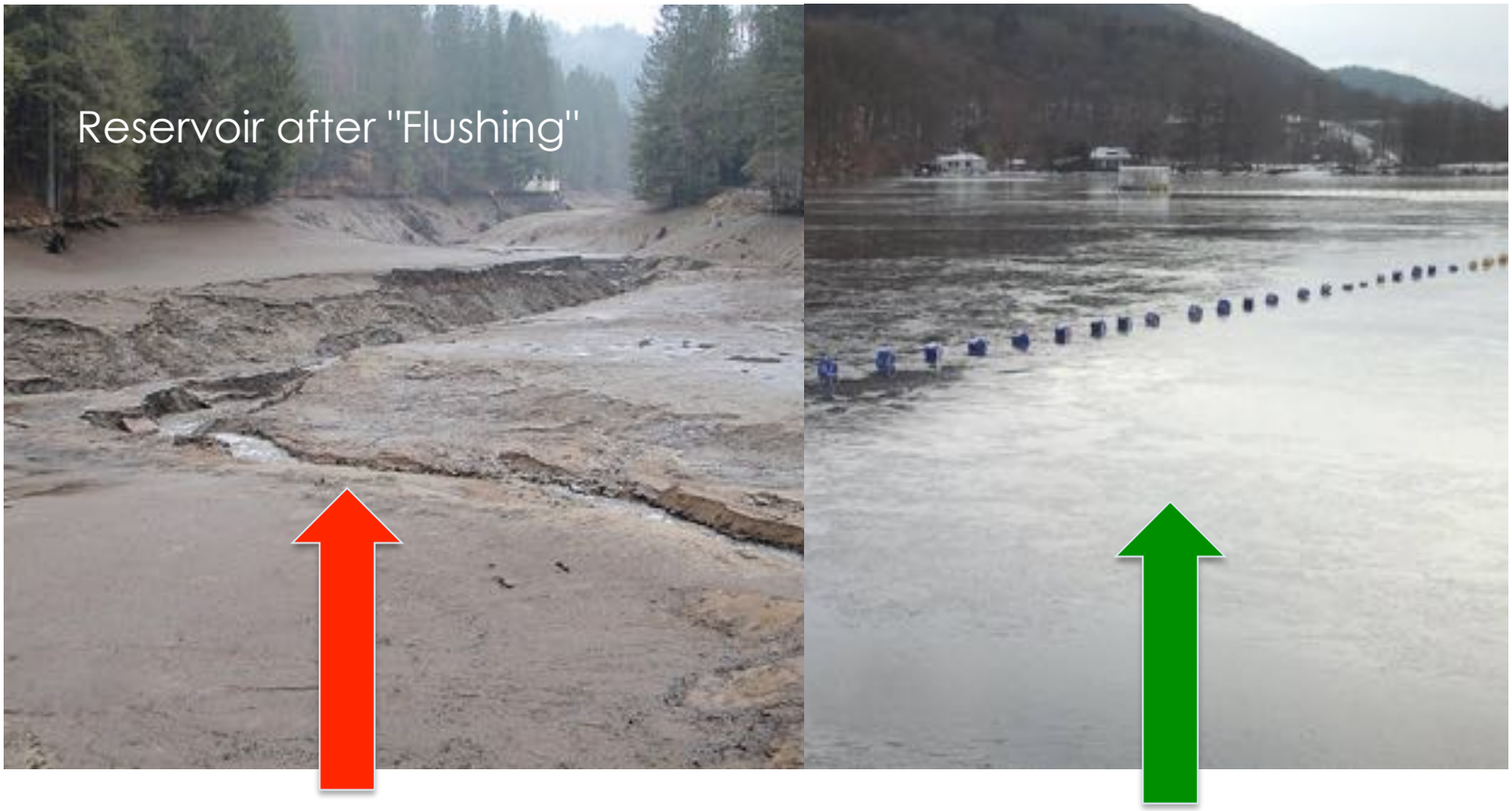
ECONOMICAL LOSS:
6 Mio. $ per flushing !



source: URL: http://www.welt.de/wissenschaft/article1766616/Der_Grand_Canyon_wird_geflutet.html

„Flushing“ and the sustainable Alternative

Langmannsperre, Austria, 2008-2009



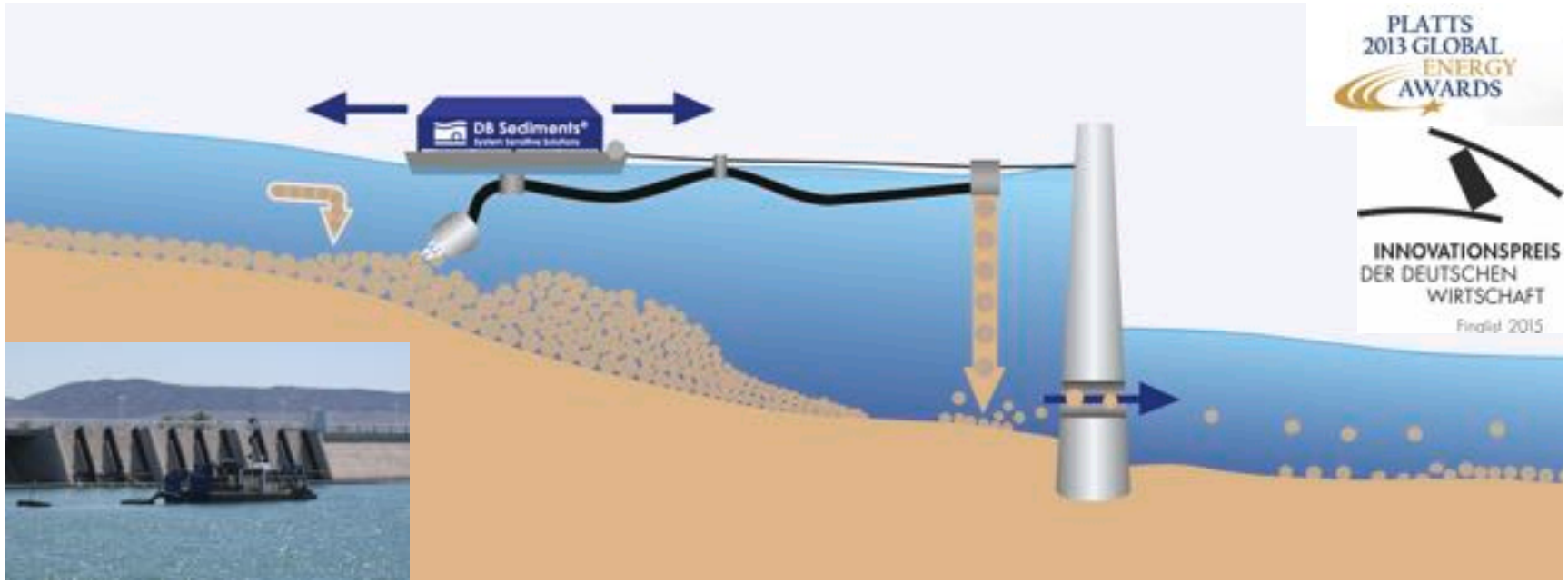
Very inefficient and very expensive

The sustainable alternative of DB Sediments®

ConSedTrans – Method

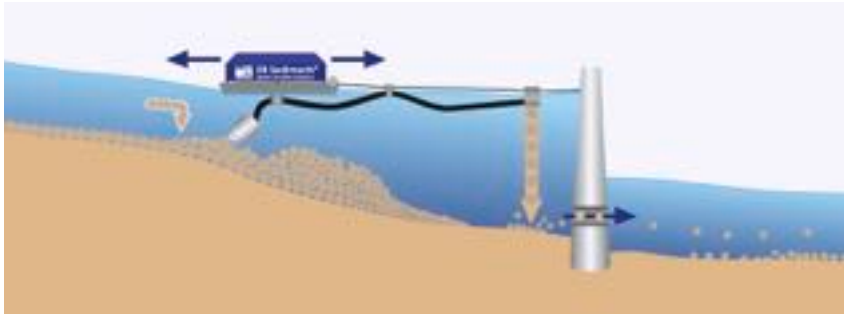
System Sensitive Solution - Continuous Transfer of Sediments

Specially equipped hydraulic tools in very different sizes and dimensions dredge the sediment from areas where the flow rate is too slow for natural sediment transport, pump it through a piping system and deposit it into areas where the flow rate is known and big enough for a quasi-natural transport of sediments into the downstream area of the river.



ConSedTrans – Method

Sustainable solution with production of renewable energy



The continuous transfer of sediments can be combined with the optimized regeneration of renewable energy.

Source: DB Sediments (2014); WGZ Bank (2012); www.wgzbank.de; http://tinyurl.com/pbggxk4

Businessplan Example

Overcome Dig&Dump Method

- Digging: twice, every 10 years
- Costs about 2.6 to 3.0 Mio. Euro

Problem, shortly after digging, the reservoir is continuing filling again

ConSedTrans - Management

- Continuing transfer
- cost about 1.5 Mio. Euro (distributed over 20 years)

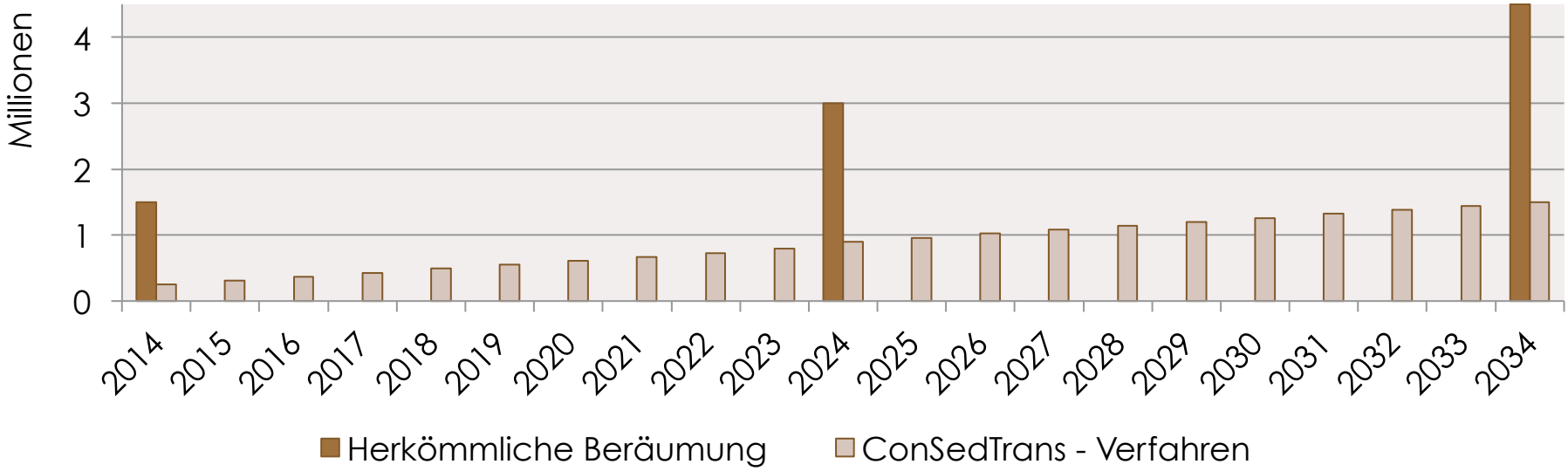
Always 100 % of the reservoir capacity/no outage

Savings of about 50 % of direct costs

Business Case (small case)

Compare: common and sustainable approach

- Common approach:
  - Clearing of the reservoirs
  - Necessary every 10 years
  - Costs: about 1.2 to 1.5 Mio. Euro
- ConSedTrans – Approach of DB Sediments ®
  - Costs of continuous transfer:
  - Installation: 0.2 – 0.3 Mio. Euro
  - Operation&Maintainance: 0,06 Mio. Euro/a



Olsberg Reservoir (Germany)

Suitable equipment
System Sensitive Solution

- automated vessel size 1

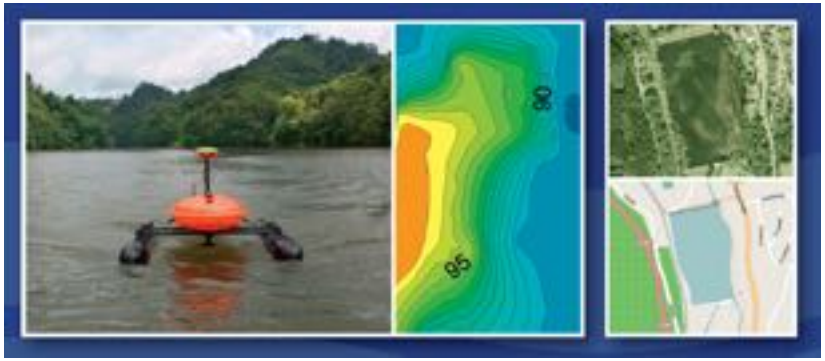
- Electric driven dredge vessel
  - depth up to up to more than 40 m

- dredge vessel size 2
  - diesel driven
  - depth up to 15 m

- Larger/other/additional and customized equipment upon request:
  - electric or diesel driven
  - dredging depth up more than 200 m
  - unlimited capacity and/or sediment transfer range

Risk Analysis
Existing and Projected Dams

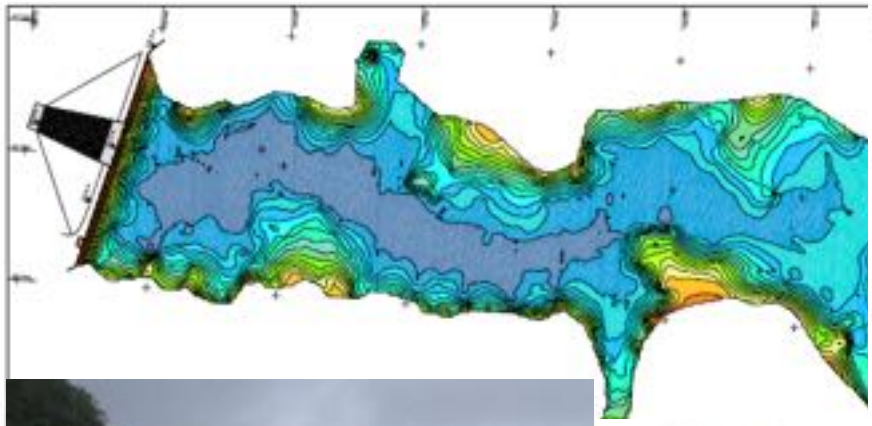
- Assessment of the original storage volume
  - by processing of the original layout of the reservoir
- Determination of
  - the lost, silted or sedimented volume of the reservoir,
  - the silting rate of the dam, and
  - the estimation of the probable dam life, under consideration of the necessary operational range of the reservoir.

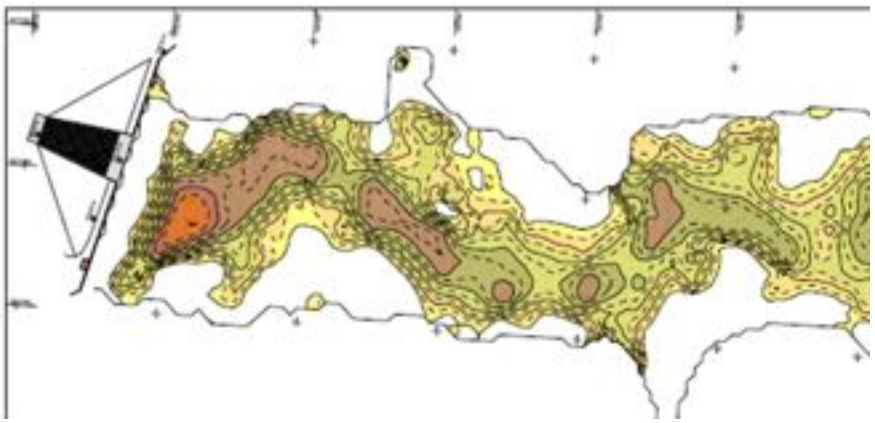


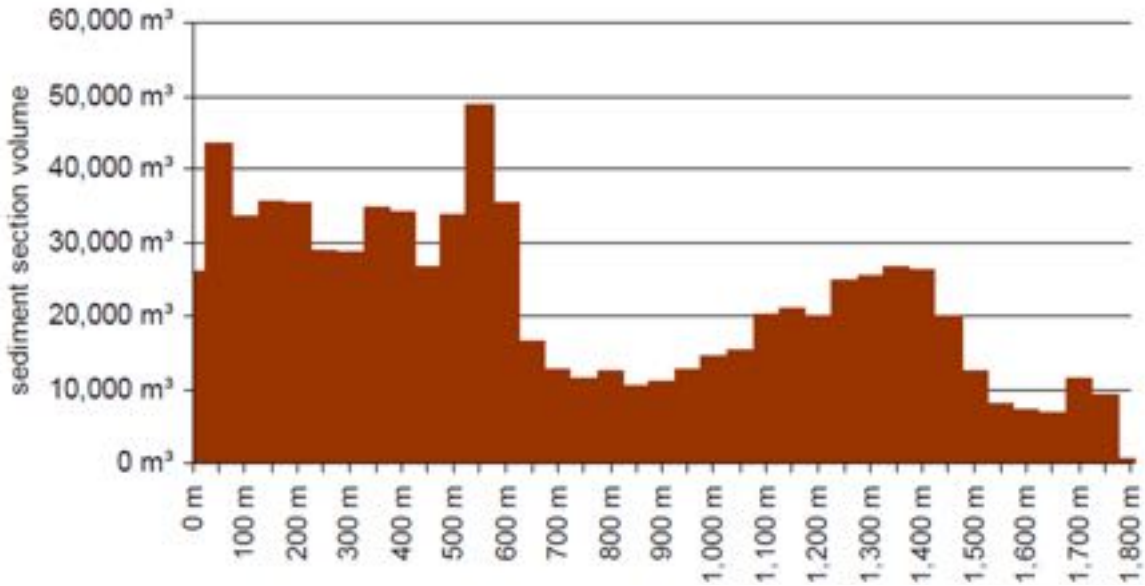
- Furthermore, an analysis will comprise
  - possible consequences, like the blockage of the bottom outlet of the dams by sliding sediments and
  - risk of flooding caused by the reduction of the retention volume of the reservoir.

Roseau Reservoir St. Lucia

Risk Analysis / Rehabilitation Dam/Reservoir







Nurek Dam, Tajikistan

Site, Sedimenttransport

Source: Google Maps (2013)

The new process spends multiple benefit.

- **Positive operational and economical effects:**
  - The reservoir can be used completely again.
  - Avoidance of enormous dump costs and/or
  - Avoidance of generation losses.
  - Reduction of flood risk
  - Sediments in the river will reduce erosion and keep ports “on level”
  - Navigation needs proper and continuous sediment management

Continuous Sediment transfer
… is fish friendly

riverbed gravel (Interstitial)

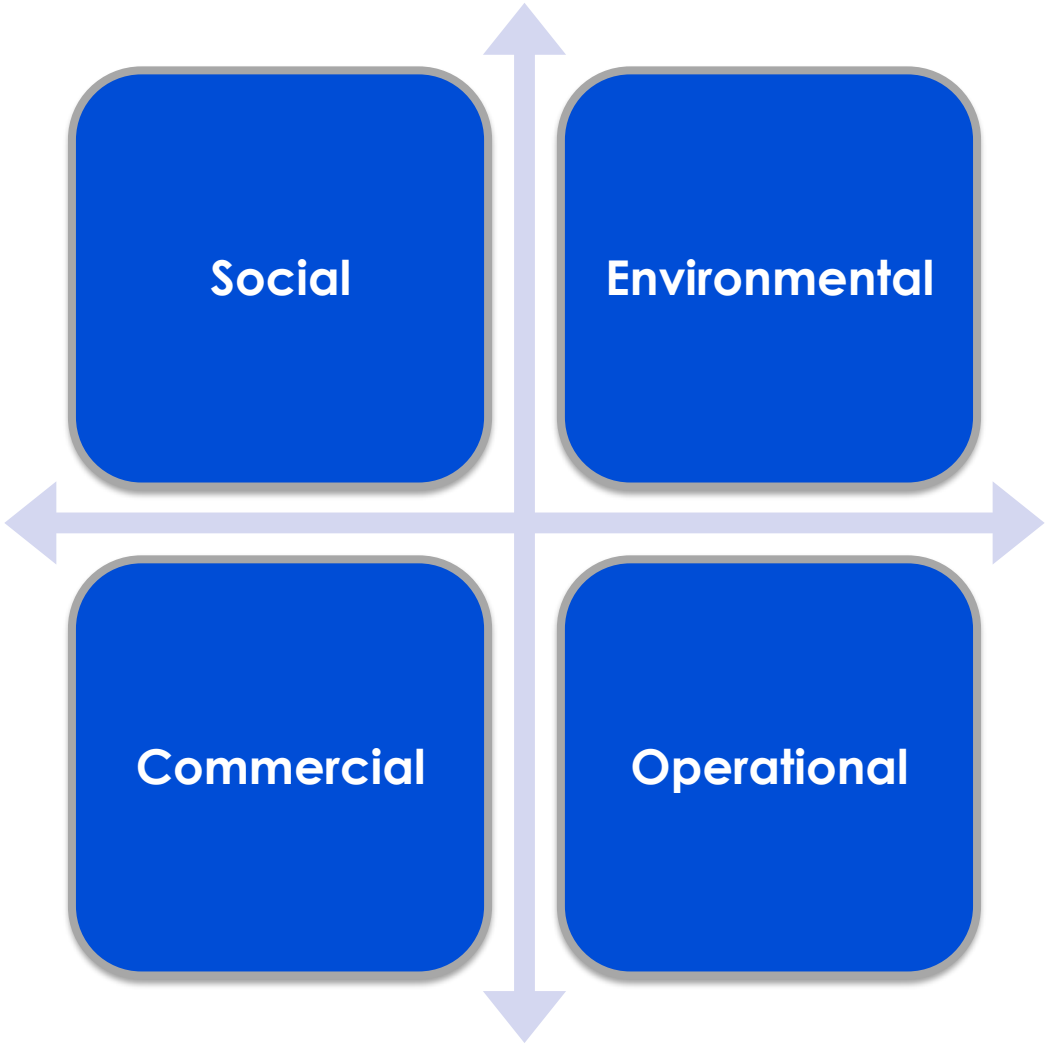
- Stretches of coarse sediment is important for fish requiring spawning gravel (z. B. greyling, trout).
- Reservoir flushing / sluicing will severely affect spawning gravel.
- Continuous Sediment Transfer restores a near nature sediment ratio (load/time)
- **Nature shows certain variation on sediment load, too.**

The new process spends multiple benefit

- **Positive environmental effects:**
  - The process restores (and improves) natural river morphology.
  - Sediment "in Flow".
  - It is environmentally and fish friendly.
  - Keep quality and level of groundwater.
  - Biodiversity in the river and in the coastal areas of the oceans.

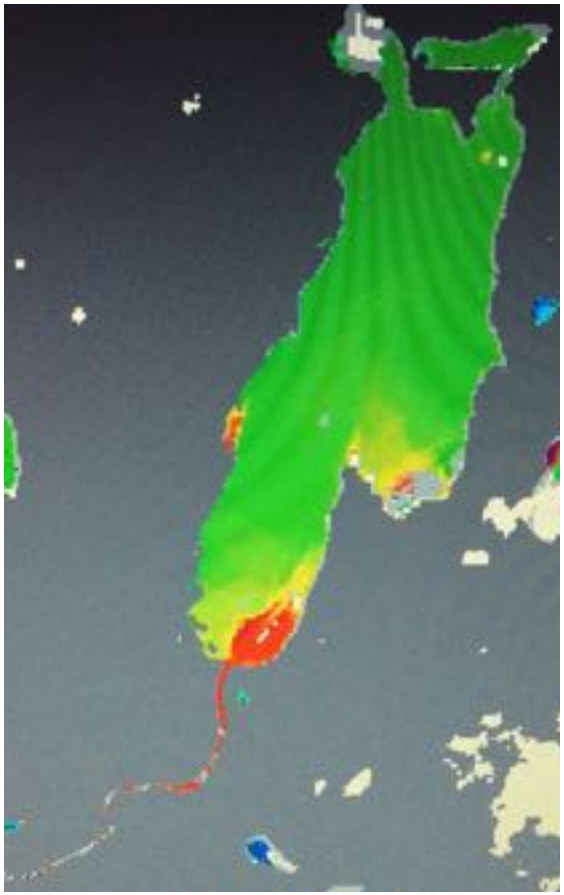
Holistic Solution with SECO – Benefits

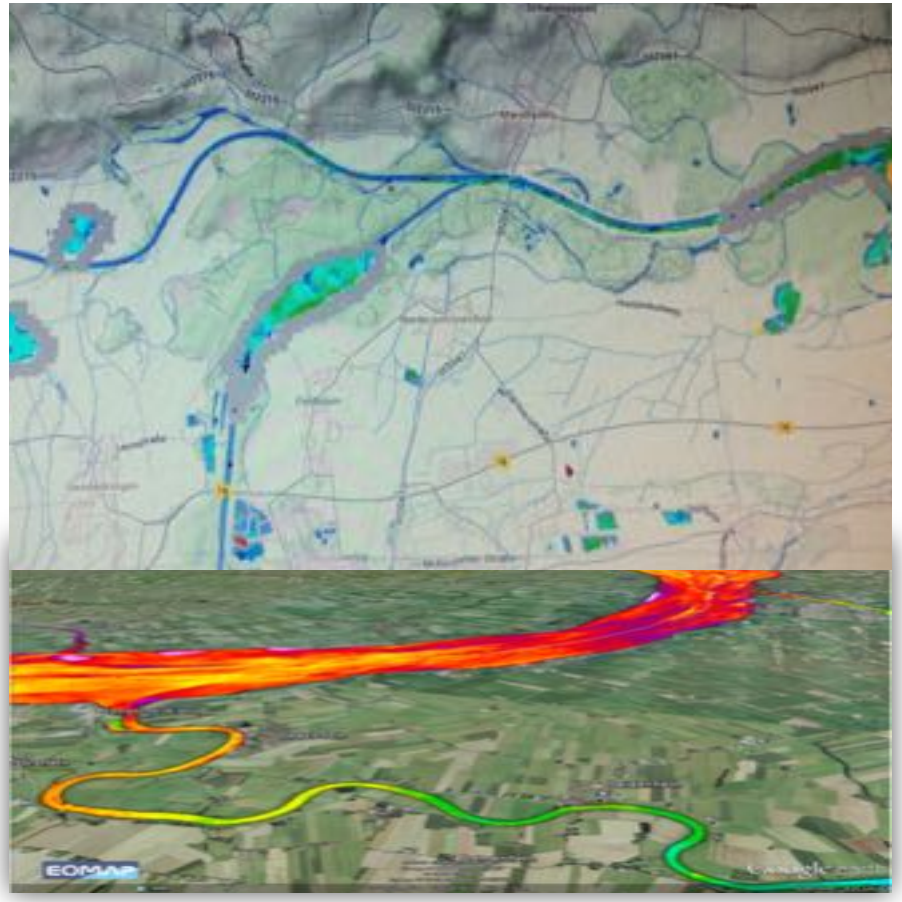
Multidimensional Benefits



River Rehabilitation

Identify problem (i.e. Forggensee, Lech) and monitor solution





Source: EOMAP (2014) Turbidity Flows on Lech / Donau

DB Sediments Customers

RWE

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

kfw ENTWICKLUNGSBANK

Vorarlberger Illwerke AG

Schluchseewerk

NEPAL ELECTRICITY AUTHORITY नेपाल विद्युत प्राधिकरण

Mülheim an der Ruhr Stadt am Fluss

WMR Wasserbeschaffung Mittlere Ruhr GmbH

Heilenbecke Wasserverband

BitburgerLand BITBURG | SPEICHER | KYLLBURG

DB Sediments Partners

ADM Group

AURECO automatisierung regelung consulting

DHI

DRAGFLOW ULTIMATE EFFICIENCY

EOMAP

Fachhochschule Köln
Cologne University of Applied Sciences

Ferrostaal

Ferrostaal DB Sediments

FICHTNER WATER & TRANSPORTATION

German DLR Aerospace Center

DUIVENVOORDE
Grond, Weg & Waterwerken

IWW | RWTH AACHEN UNIVERSITY

GEO-DV

KISTERS

Little Environments LLC

GWSP
Global Water System Project

HEIDE-PUMPEN®

IMS A COMPANY IN RAMBØLL

IRS Stahlwasserbau Consulting AG

STELLBA Hydro

Van Oord

… and many others

Awards and Recognitions

Leading Global Sustainable Technology

**

- * Picture right: Award of Excellence in New York on Wall Street, December 2011, Platts Global Energy Awards and Fortune Magazine. (Nominations in 2011, 2012 a. 2013)
- ** Picture left: Nomination Innovationspreis der Deutschen Wirtschaft 2015

Final Remarks

- Dramatic developing decrease of global storage capacity for water
- The River is an Ecosystem - Sediments are an important part of the system
- Proper Flood Management needs Proper Sediment Management
- There is an urgent need for a holistic sediment management in rivers and reservoirs
- The ConSedTrans- Method can contribute to handle the risk of sedimentation and siltation, flooding, soil and coast erosion, and saltation of groundwater
- Continuous sediment management brings Rivers back to balance and saves enormous costs

If you consider sediment transfer to be costly – try siltation.

“If you cut the transport of sediment in a river – you kill life in the river, as well as in the delta area of the river in the ocean”.

Juan Pablo Orrego Silva, Alternative Nobel Prize Winner,
Bonn, Germany, 15.11.2011,
referring to studies of Hucke-Gaete, Viddi and Bello, 2006

DB Sediments®
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