Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

Monitoring Water Quality

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Content

- Monitoring
  - Delta
  - Monitoring networks and types
  - Monitoring Cycle
- Examples of networks
- Information Use and Products
- Recent Developments

Delta of 4 international rivers
- Rhine
- Meuse
- Scheldt
- Ems

Marine waters
- North Sea
- Wadden Sea

Watermanagement is required for good governance

Based on integrated approach

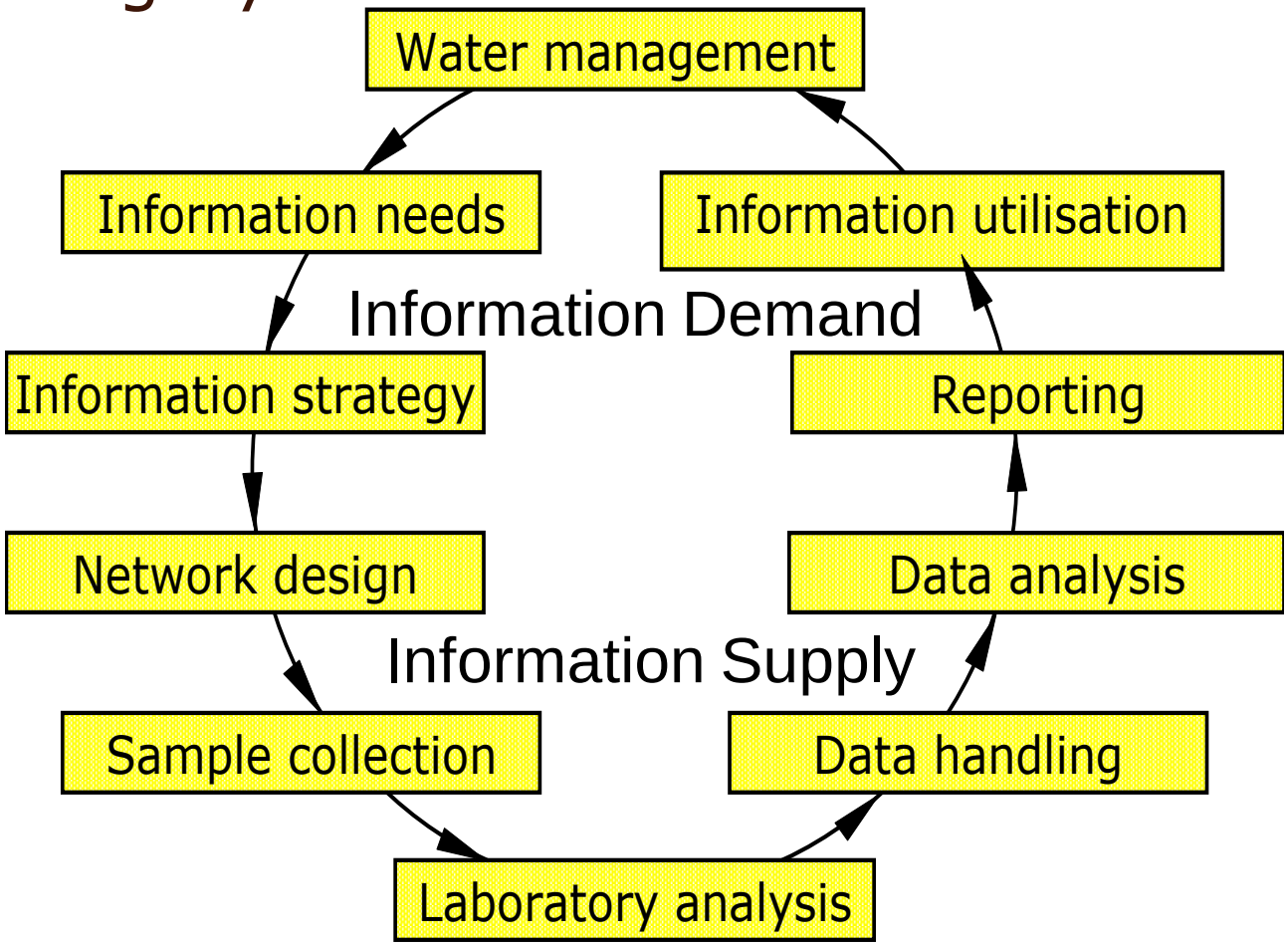
Monitoring is important source for information

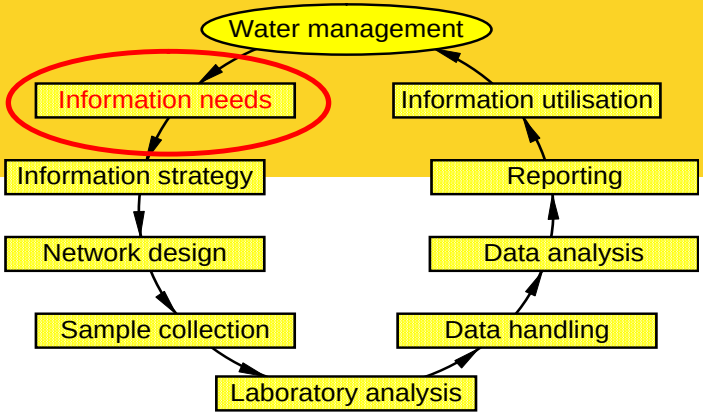
Monitoring Networks

- Physical monitoring - since ± 1800
- Chemical monitoring – since 1952
- Biological monitoring - since 1992

- Automated water quality monitoring – since 1978

Monitoring Cycle





Information Needs

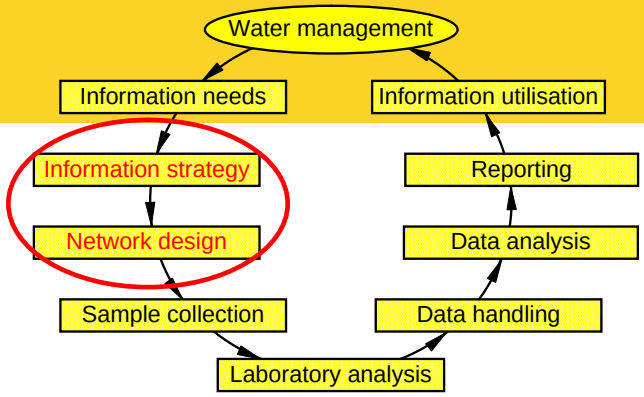
Water quality monitoring necessary for:

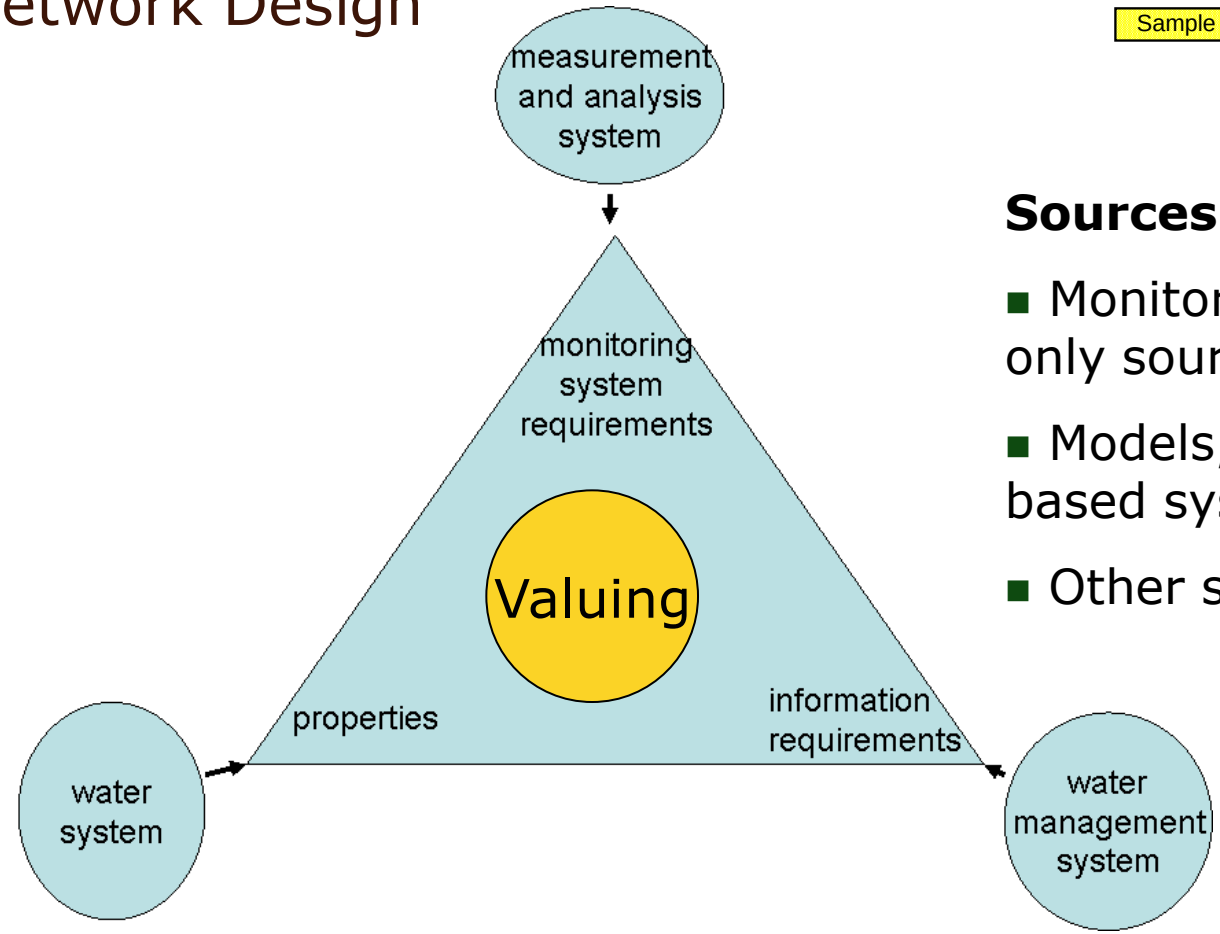
- **National water management**
  - policy evaluation
  - determination of measures and assessment of their effectiveness
  - status and trends in concentrations and in loads
  - compliance testing

- **International agreements / obligations**
  - OSPAR
  - TMAP
  - International River Commissions

- **EU (European Union) obligations**
  - Water Framework Directive (WFD)
  - Marine Strategy Framework Directive (MSFD)
  - Nitrate Directive
  - Natura 2000

Information Strategy & Network Design

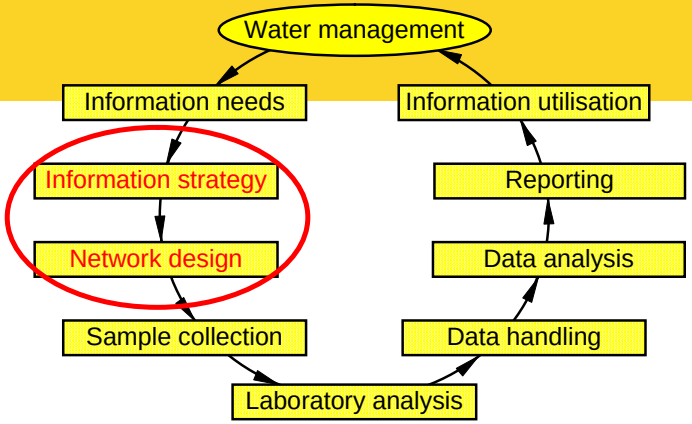




Sources of Information

- Monitoring is not the only source
- Models, knowledge based systems
- Other sources

Design of Monitoring Networks

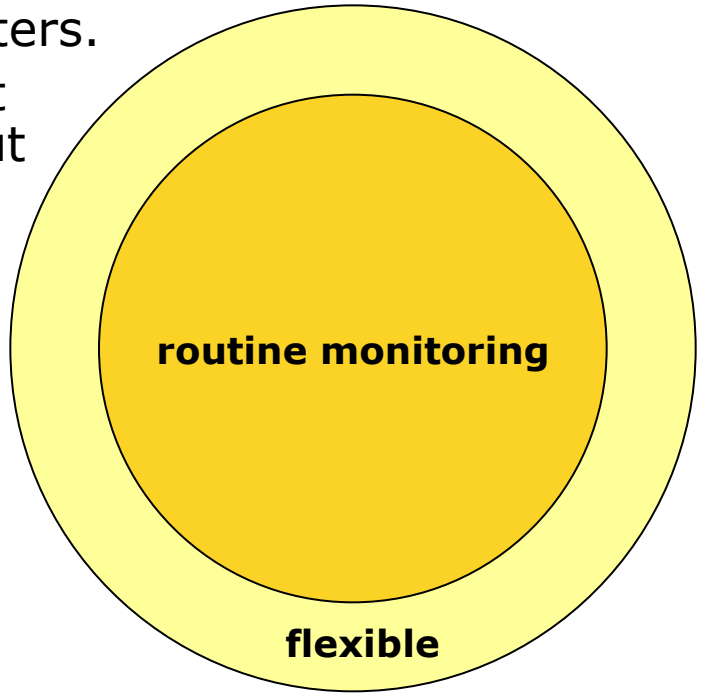


- Locations
- Frequency
  - 1- 52 times a year
- Compartment
  - Water
  - Suspended matter
  - Sediment
  - Biota
- Parameters
  - general parameters (nutrients, T)
  - organic micro pollutants (pesticides)
  - inorganic micro pollutants (heavy metals)
  - radiochemical parameters
  - species groups

Monitoring Strategy of Chemical Networks

- **routine monitoring**
  - Regular samples of ~ 250^{+} parameters.
  = the backbone of the policy relevant information, and is sufficient for about 80% of the international needs for information

- **project (flexible) monitoring**
  - Temporary
  - Inventories (pesticides, medicines, hormone disrupting substances)
  - Investigative monitoring



Chemical monitoring network

Compartments:

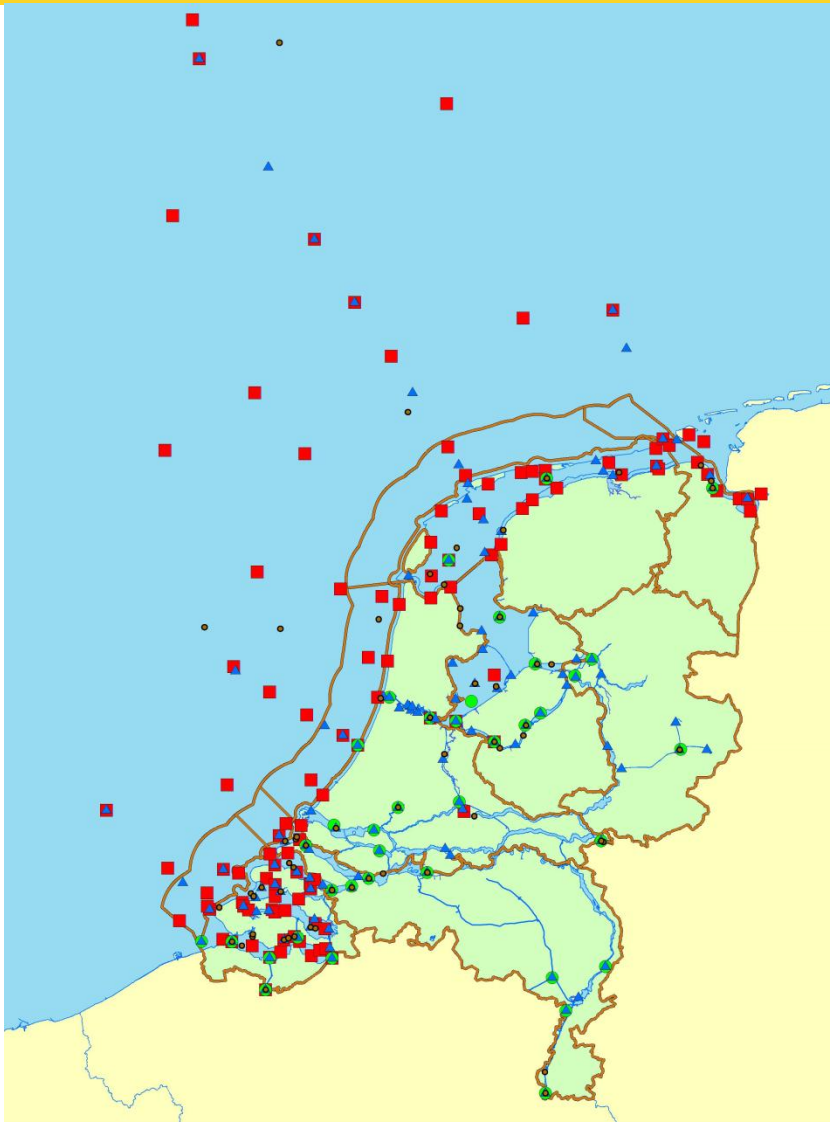
- Biota
- Water
- Suspended solids
- Sediment

Marine waters

Water:	37 loc's, 280 par's
Suspended solids:	4 loc's, 140 par's
Sediments:	107 loc's, 130 par's
Biota:	39 loc's, 10-80 par's

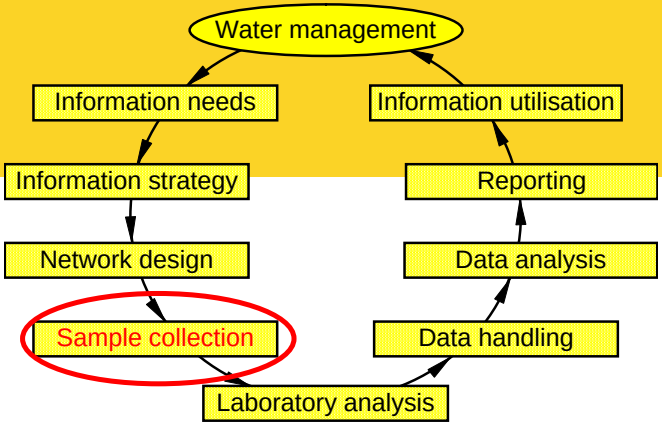
Inland waters

Water:	52 loc's, 340 par's
Suspended solids:	21 loc's, 160 par's
Sediment:	1 loc, 95 par's
Biota:	18 loc's, 45 par's



Biological Monitoring Network

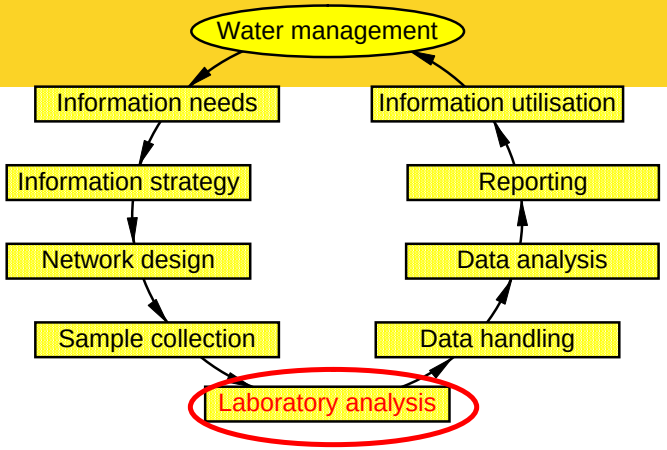
Quality Elements	< 1992	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Phytoplankton	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Zooplankton		x	x	x	x	x	x	x	x	x												
Macrozoobenthos			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Phytobenthos													x	x	x	x	x	x	x	x	x	x
Macrophytes – water plants			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Seagrass	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Waterside plants						x	x	x	x	x	x	x	x	x	x	x	x					
Ecotopes										x	x	x	x	x	x	x	x	x	x	x	x	x
Salt marsh mapping		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Fish (active / passive)		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Waterbirds		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Breeding birds									x	x	x	x	x	x	x	x	x	x	x	x	x	x
Scoter			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Seabirds and mammals	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Ecotoxicology						x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x



Sample collection

- Monitoring stations Eijsden and Bimmen-Lobith
- RWS Regional services (MID)
- Cooperation with drinking water companies
- Commercial companies
- Research institutes, voluntary organizations

Laboratory analysis



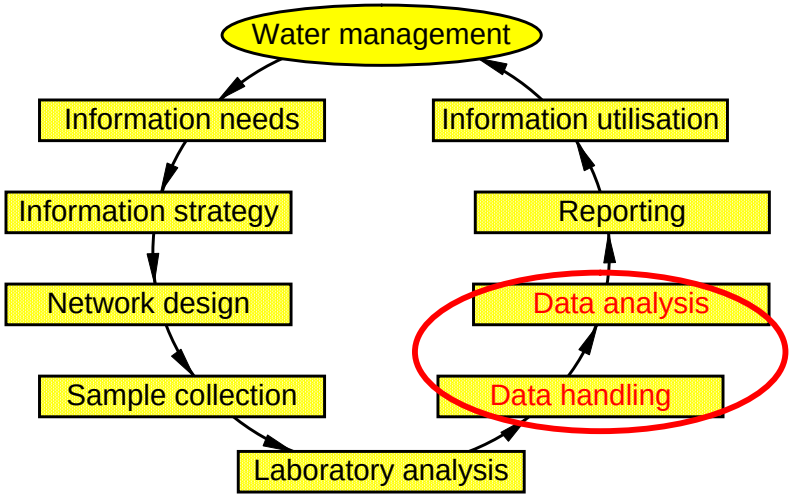
- Laboratory of Centre for Water Management
- Commercial laboratories
- Drinking water companies (data exchange)

Data Handling and Data Analysis

- Control of completeness
  complete conform planning? → complete
  double data? (data from different methods possible) → another project code

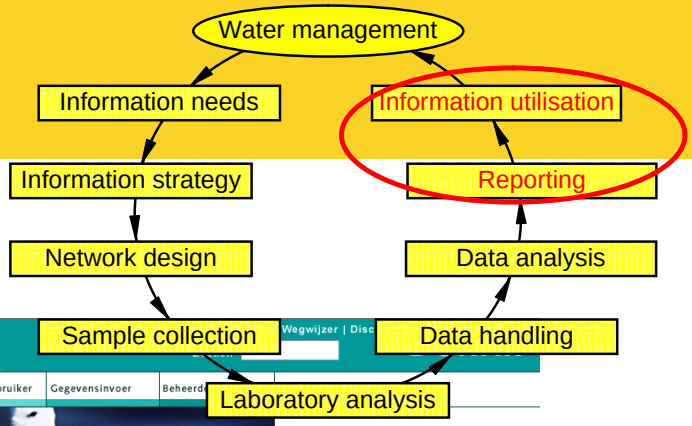
- Control of plausibility
  faults? → remove
  outliers → flag

- Calculation of statistical means
  annual year concentration, P90



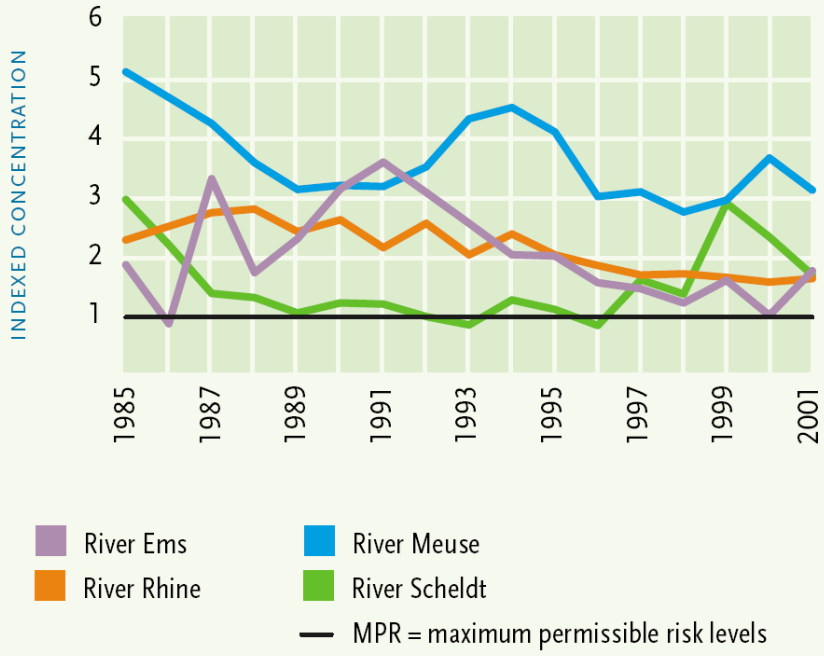
Information Reporting en Utilisation Use and Products

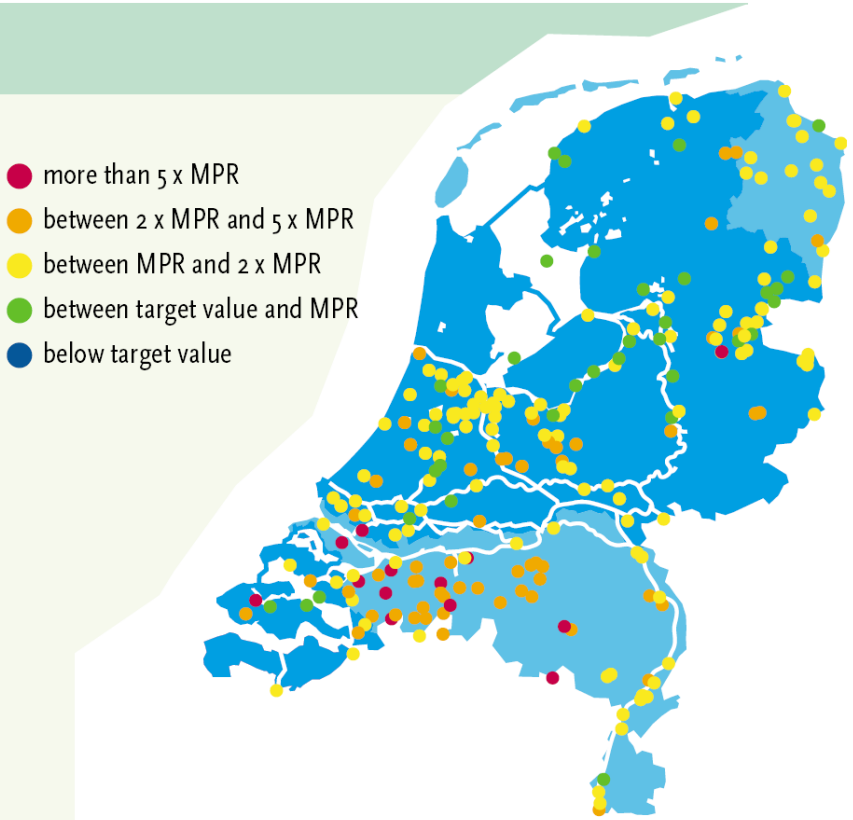
- Central database
- International Reporting
- Primary Reports
- Water system Reports
- Thematic reports
- Operational Plans
- Products of Others



Reports to national parliament
EU-reports
Reports for international commissions

2.1.4 Copper in surface water





Trends in water management and monitoring

- Information needs exploration
- Information strategy development
- Innovation:
  - ✓ remote sensing,
  - ✓ smart buoys,
  - ✓ ferrybox, flowcytometer,
  - ✓ use of models,
  - ✓ DNA techniques
- National and international cooperation (IHW, IHM)
- Exchange of data and information (EMODNET)

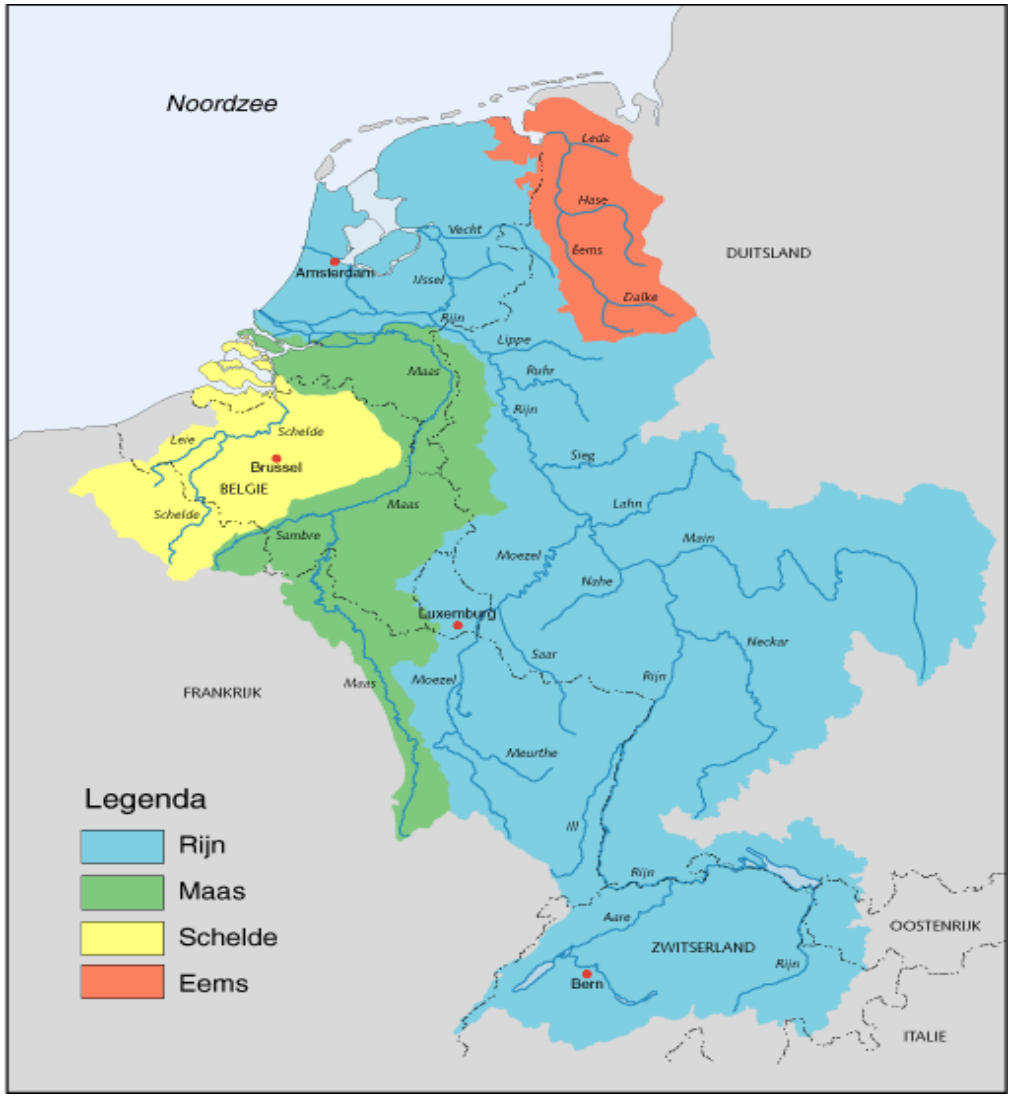
Water Framework Directive (WFD)

Environmental Objectives (**Article 4)**:

"Member States shall protect, enhance and restore all bodies of surface water … with the aim of achieving good surface water status at the latest 15 years after the date of entry into force of this directive **(2015)**"

- River Basin approach
- Good Ecological Status by 2015
- In every water body
- Monitoring is a MUST

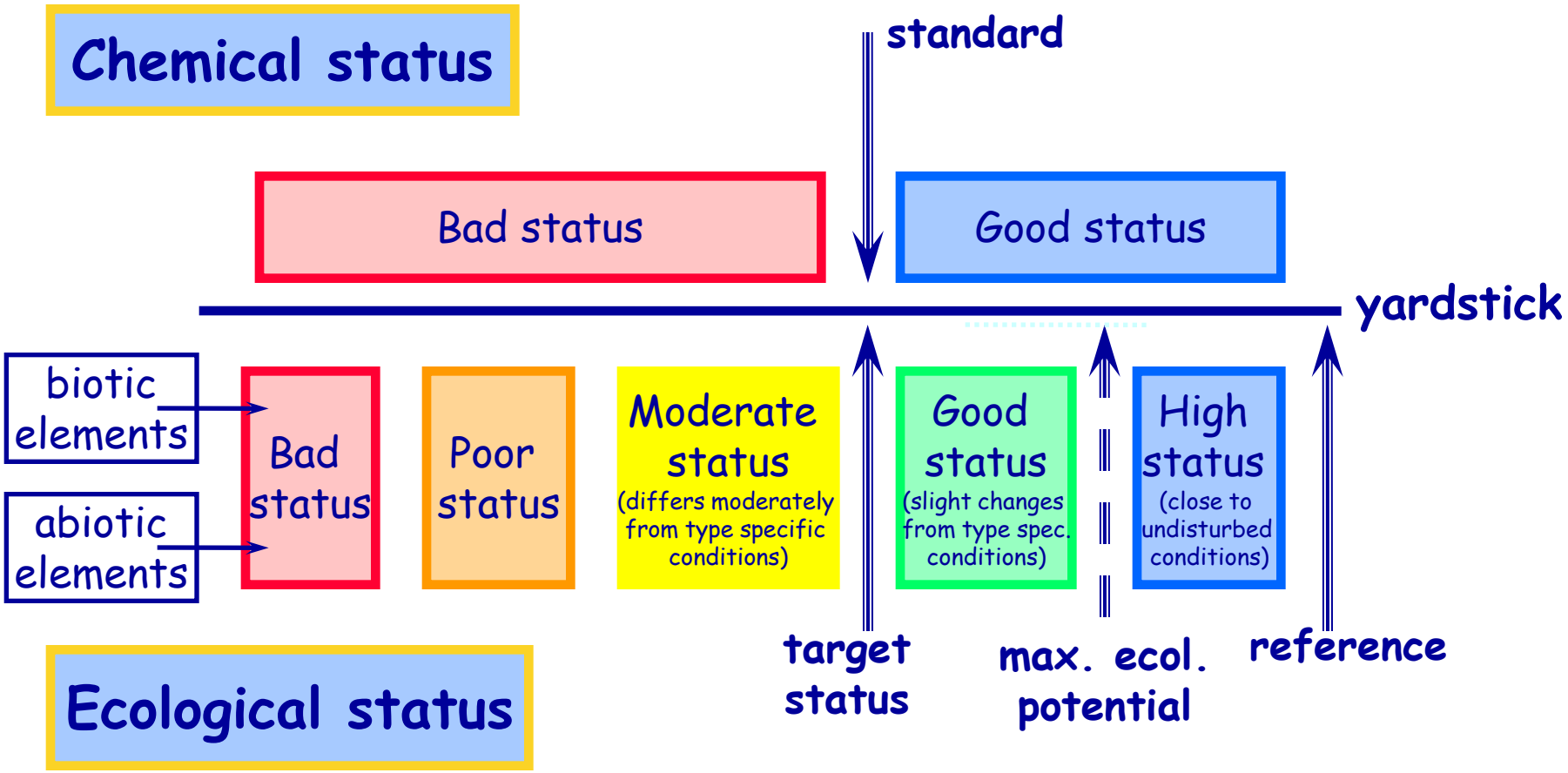
- **One out all out**
- **Programmes of measures**



Ecological assessment (EU Water Framework Directive) classification & presentation

nee

Water-quality status = Chemical status + Ecological status / potential



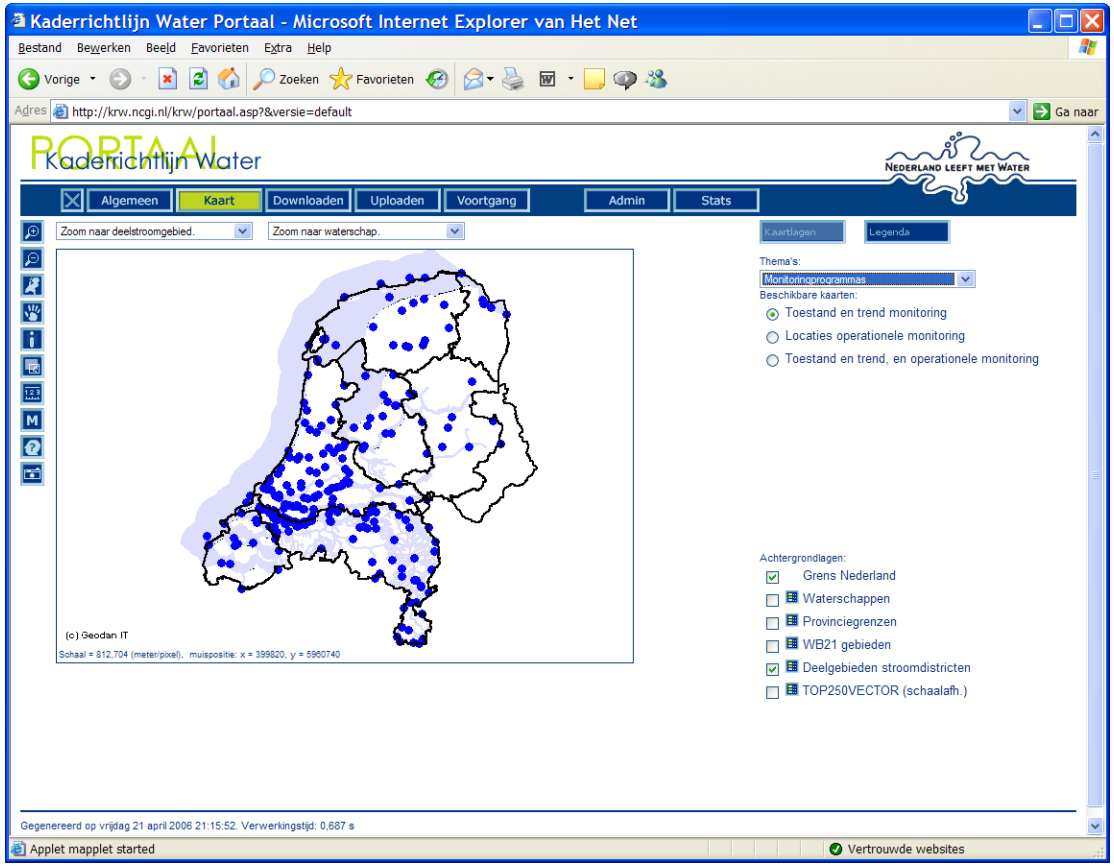
Water Framework Directive
Quality Elements and Frequencies

Discipline	Quality element	measuring frequencies (yr^{-1})			
		R rivers	L lakes	TW transit waters	CW coastal waters
Biology	phytoplankton		6	6	6
	phytobenthos	1	1		
	macrophyten	1	1		
	marcoalgae			1	1
	angiosperms			1	1
	macrofauna	1	1	2	1
	fish	1	1	2	
Chemistry	priority substances	12	12	12	12
	other substances	4	4	4	4
	physico-chemical parameters	4	4	4	4
Hydro-morphology	hydrologic regime	conti-nuously	high frequent	high frequent	high frequent
	river continuity	1			
	morphology	1	1	1	1

Water Framework Directive Portal
Surveillance & Operational Monitoring

- Internet based database
- Interactive

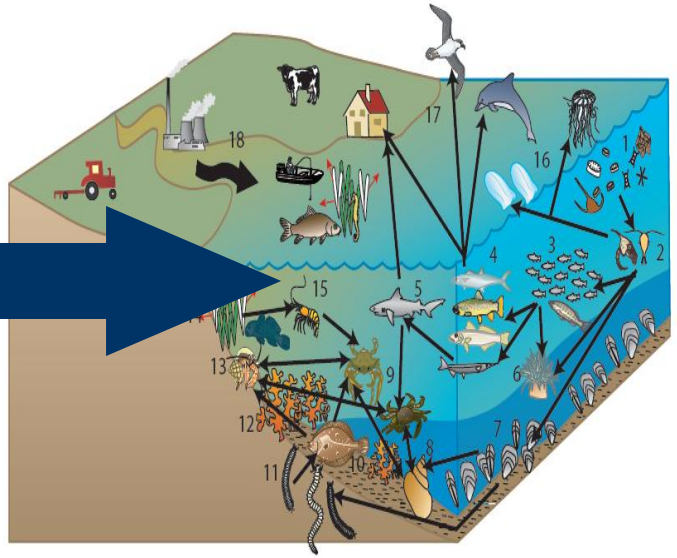
- http://krwportaal.nl/portaal/
- http://www.informatiehuiswater.nl
- http://www.helpdeskwater.nl



Marine Strategy Framework Directive

An integrated approach to the ecosystem: effects of human activities on marine ecosystem

- Fisheries
- Shipping
- Winning of oil and gas
- Wind energy
- Cables and pipes
- Military activities
- Recreation and tourism
- Emissions from air or land
- …….
- …….



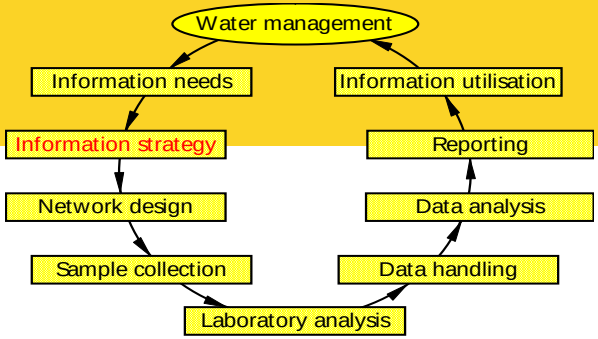
11 Descriptors of Good Environmental Status

- Biological diversity
- Non-indigenous species
- Commercial fish
- Food webs
- Eutrophication
- Sea-floor integrity
- Hydrographical conditions
- Contaminants in water, sediment and biota
- Contaminants in fish and seafood (for human consumption)
- Marine litter
- Energy

Monitoring Types

- Types of Monitoring
  - Routine monitoring
    long-term, status and trends, compliance testing, less frequent, equidistant, policy
  - Operational monitoring (early warning)
    continuous monitoring, fast response
  - Project monitoring
    research, short-term
- Differences in monitoring frequency, parameters, locations
- Combination of different types of monitoring

Information Strategy



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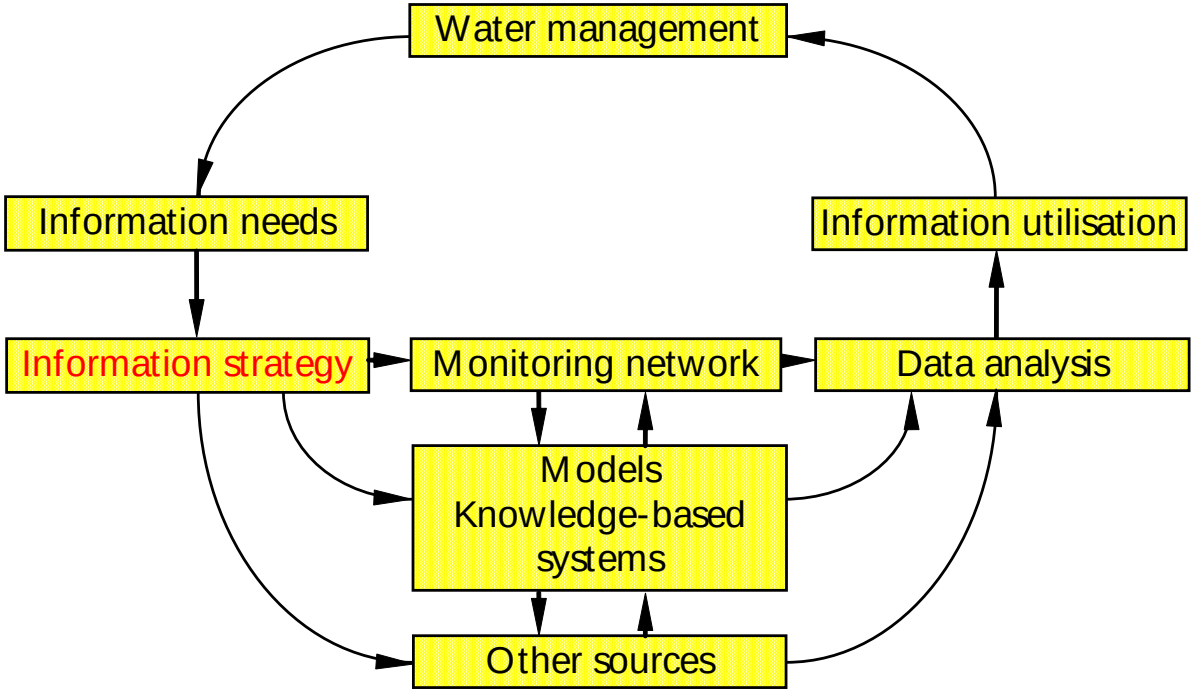
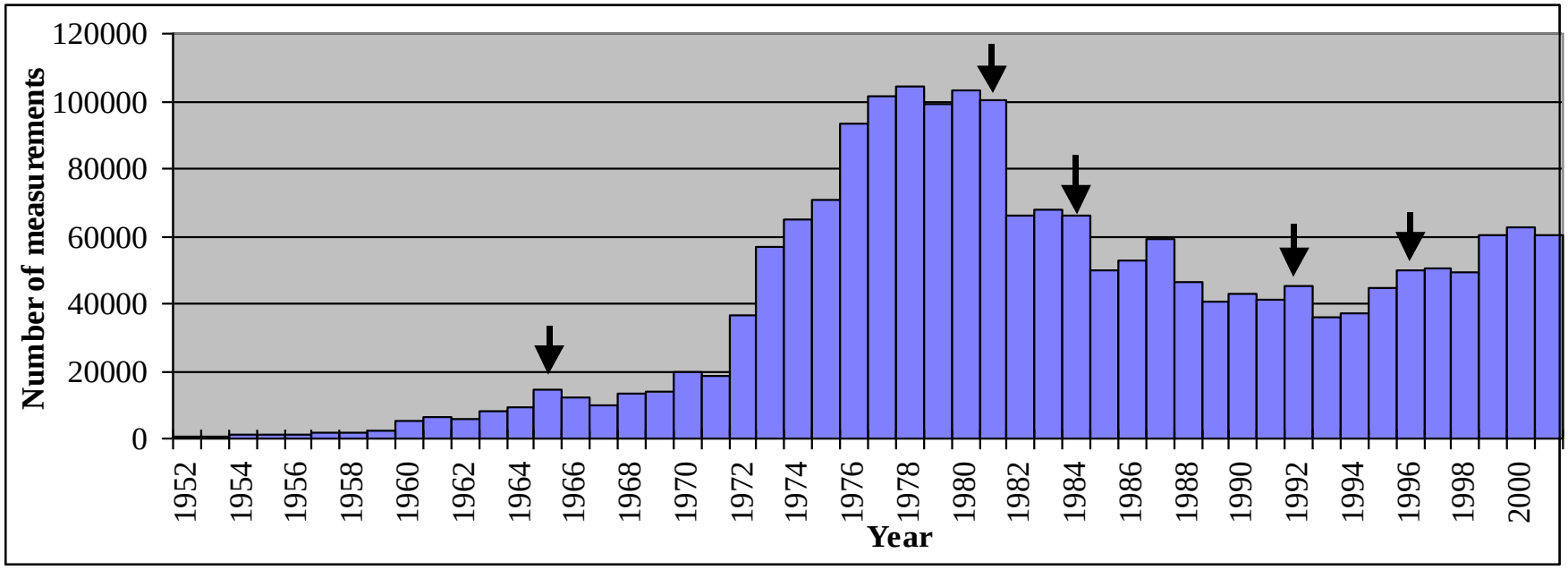
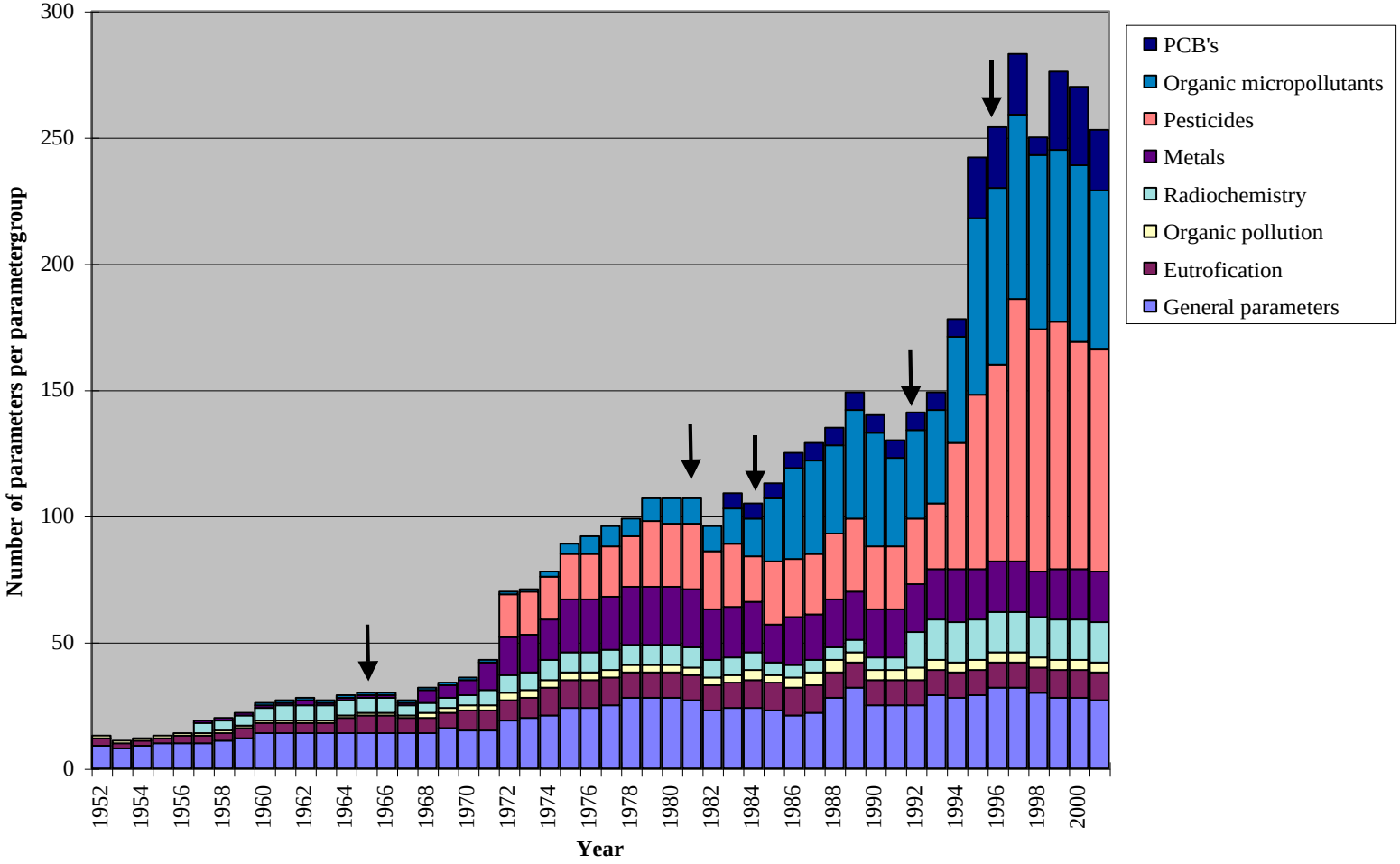


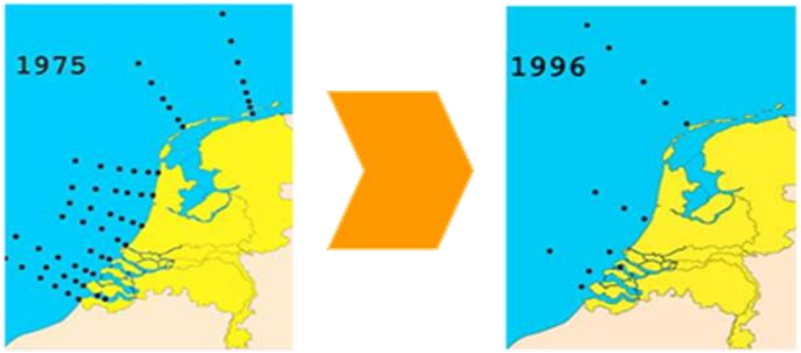
Monitoring Strategy - number of measurements

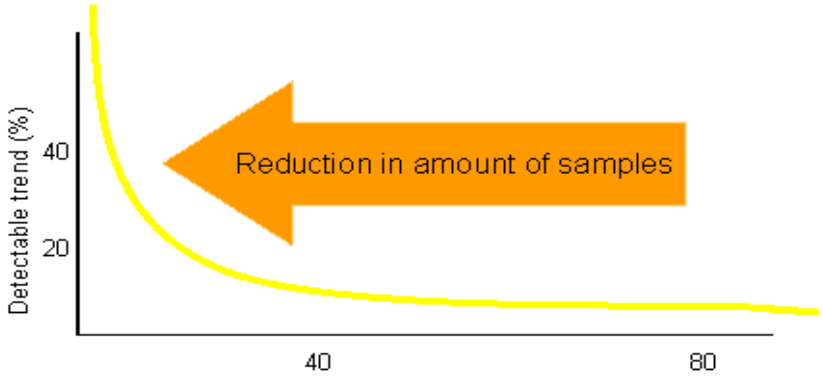


Monitoring Strategy - number of parameters



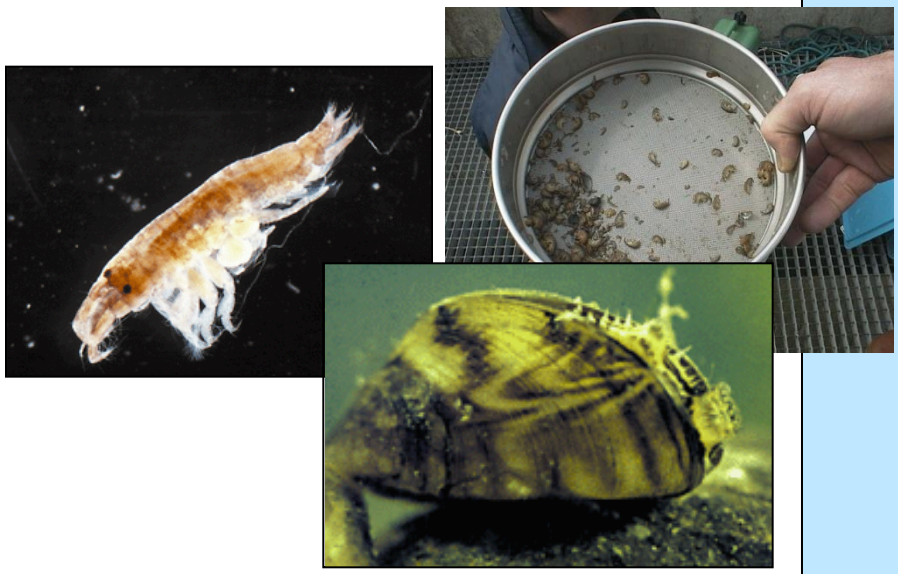
Monitoring Strategy- number of locations





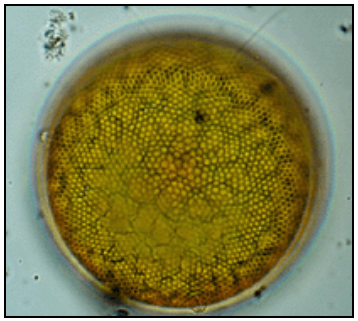
- *Sampling locations in the Dutch coastal zone at the start of the monitoring program in 1975 (about **80** locations) could be reduced to **40** locations keeping the same detectable trend*

Macro invertebrates



- Frequency once every three year
- Every biotope is sampled
  (stones, sand, silt, clay)

Phytoplankton



- Frequency:
  - Freshwater: yearly, 13 x / yr.
  - Saltwater: yearly, 4-19 x / yr
- Method:
  - Chlorophyll-a
  - Analysis of algae groups

Fish

- Frequency: yearly, partly once every 3 year
- Methods:
  - Active fishery – quantitative, electric fishing, trawler-net fishing
  - Passive fishery – qualitative, fyke nets

Informatiestrategie – trend bij Rijkswater

- **Meer samenwerking/kennisuitwisseling**
  - Nationaal (instituten, NWO-projecten, andere disciplines)
  - Internationaal (Noordzeelanden, Grensmaas)
- **Minder lab-analyses, meer in-situ metingen**
- **Data-assimilatie (meer meten met modellen)**
- **Voorzien in grotere informatiebehoefte met minder mensen**