



Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

Monitoring Water Quality

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Rijkswaterstaat WVL



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





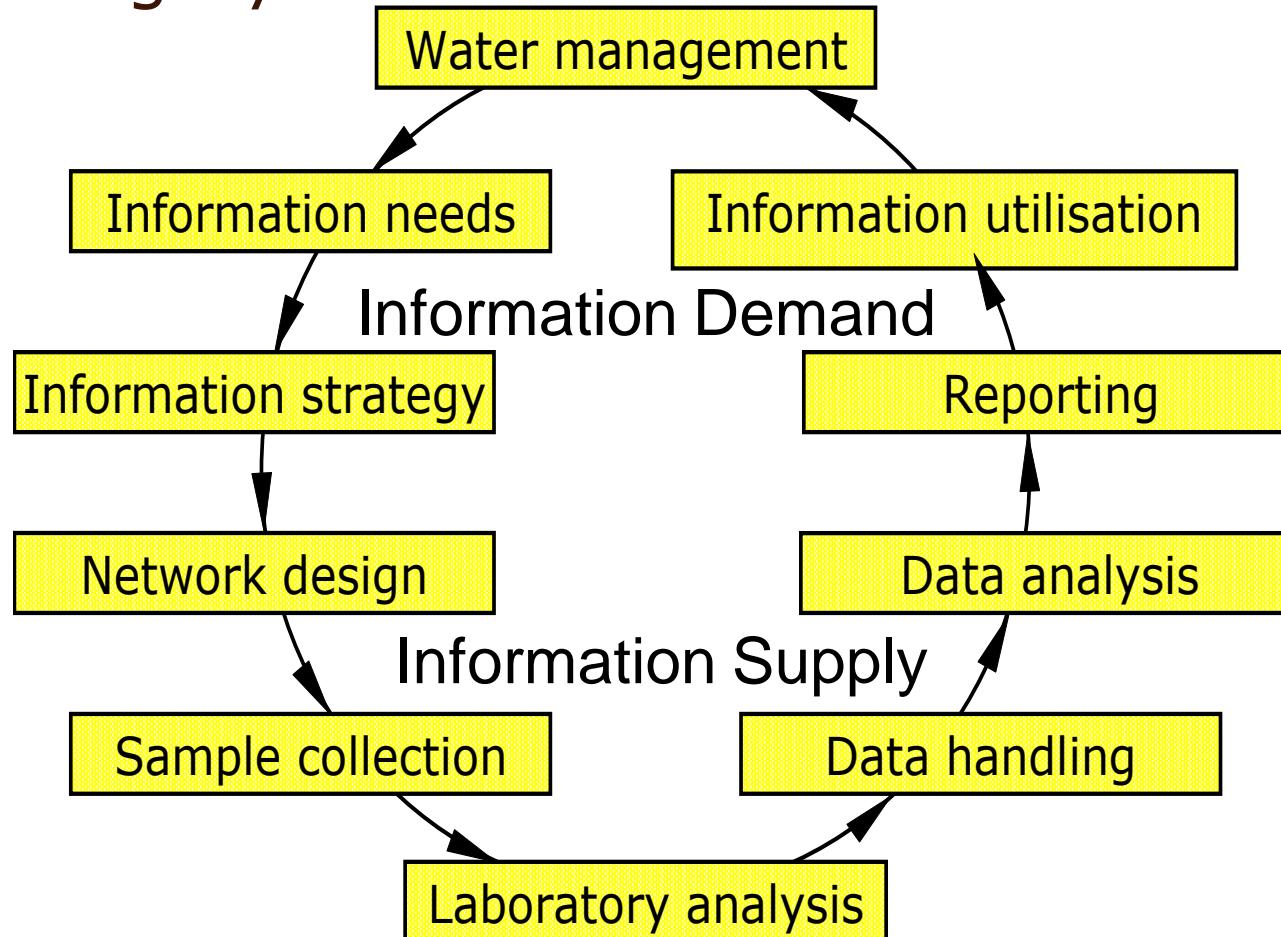
Monitoring Networks

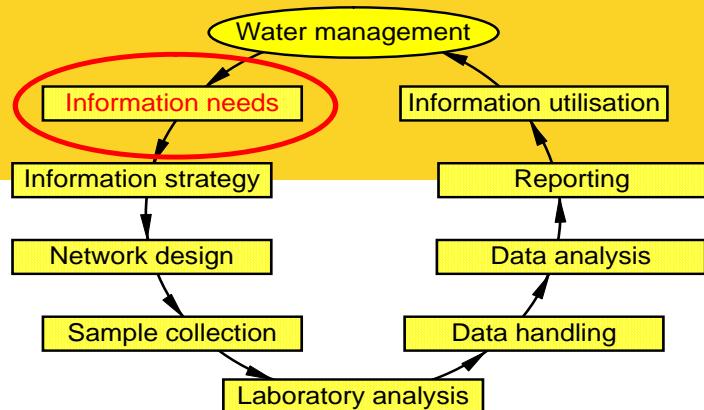
- Physical monitoring - since ± 1800
- Chemical monitoring – since 1952
- Biological monitoring - since 1992
- Automated water quality monitoring
– since 1978





Monitoring Cycle





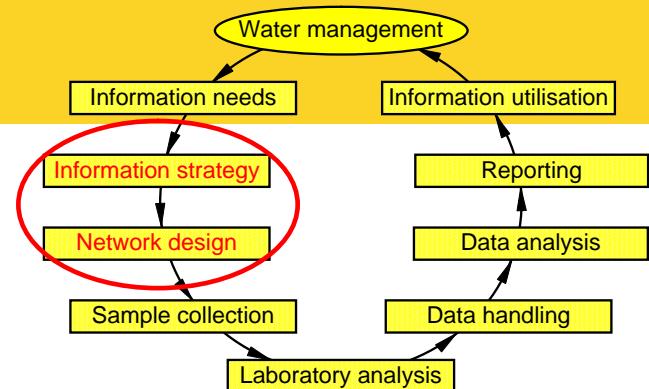
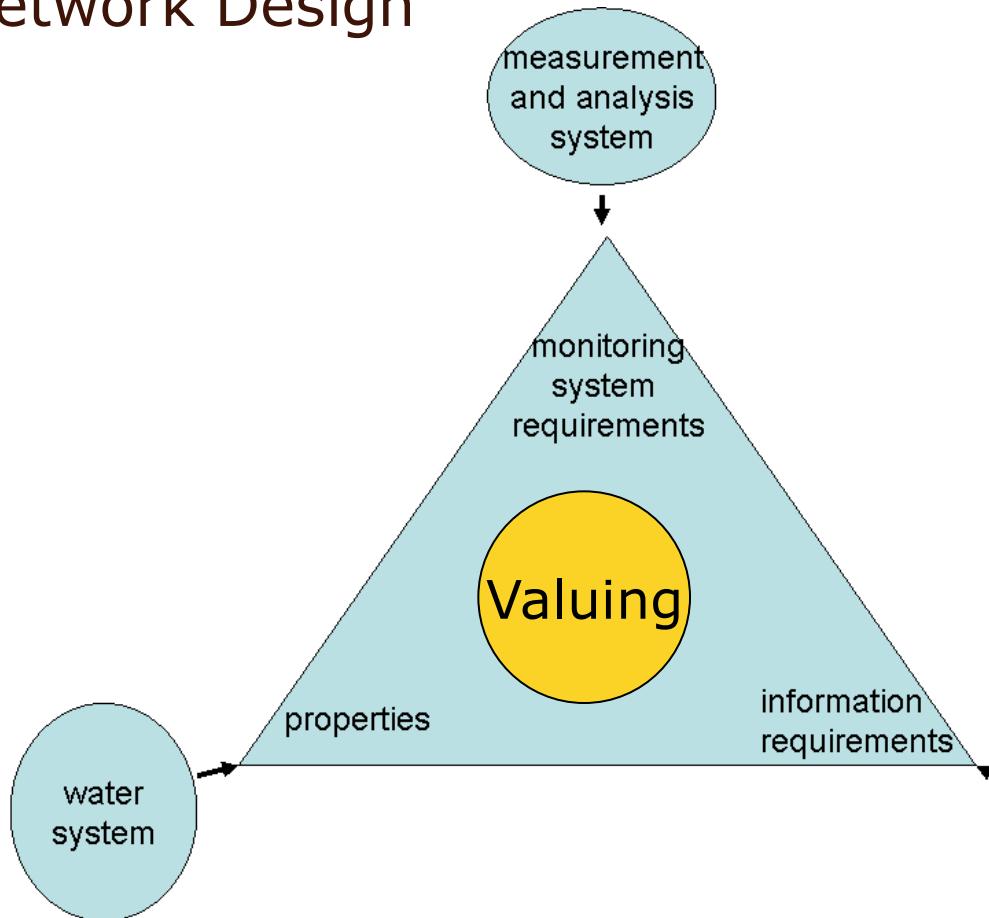
Information Needs

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

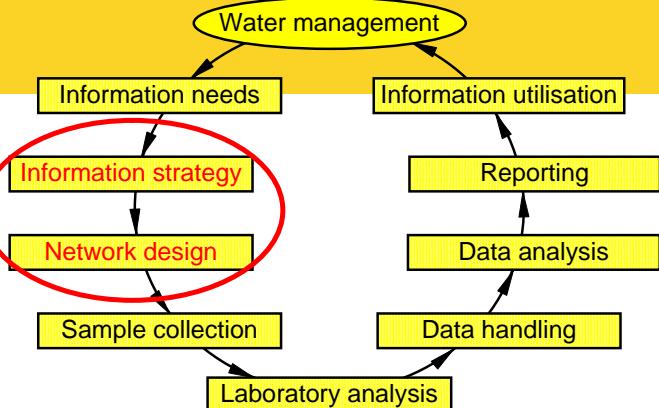


Information Strategy & Network Design



Sources of Information

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



Design of Monitoring Networks

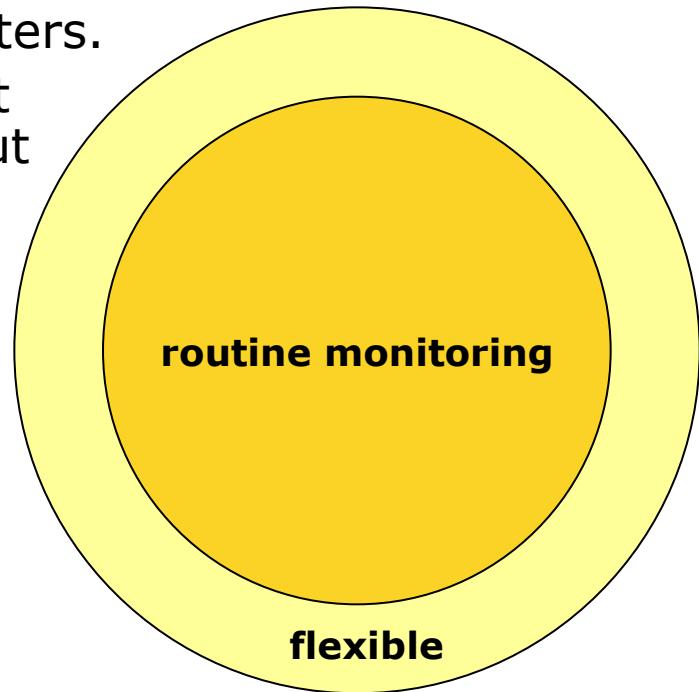
- Locations
- Frequency
 - 1- 52 times a year
- Compartment
 - Water
 - Suspended matter
 - Sediment
 - Biota
- Parameters
 - general parameters (nutrients, T)
 - organic micro pollutants (pesticides)
 - inorganic micro pollutants (heavy metals)
 - radiochemical parameters
 - species groups





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:

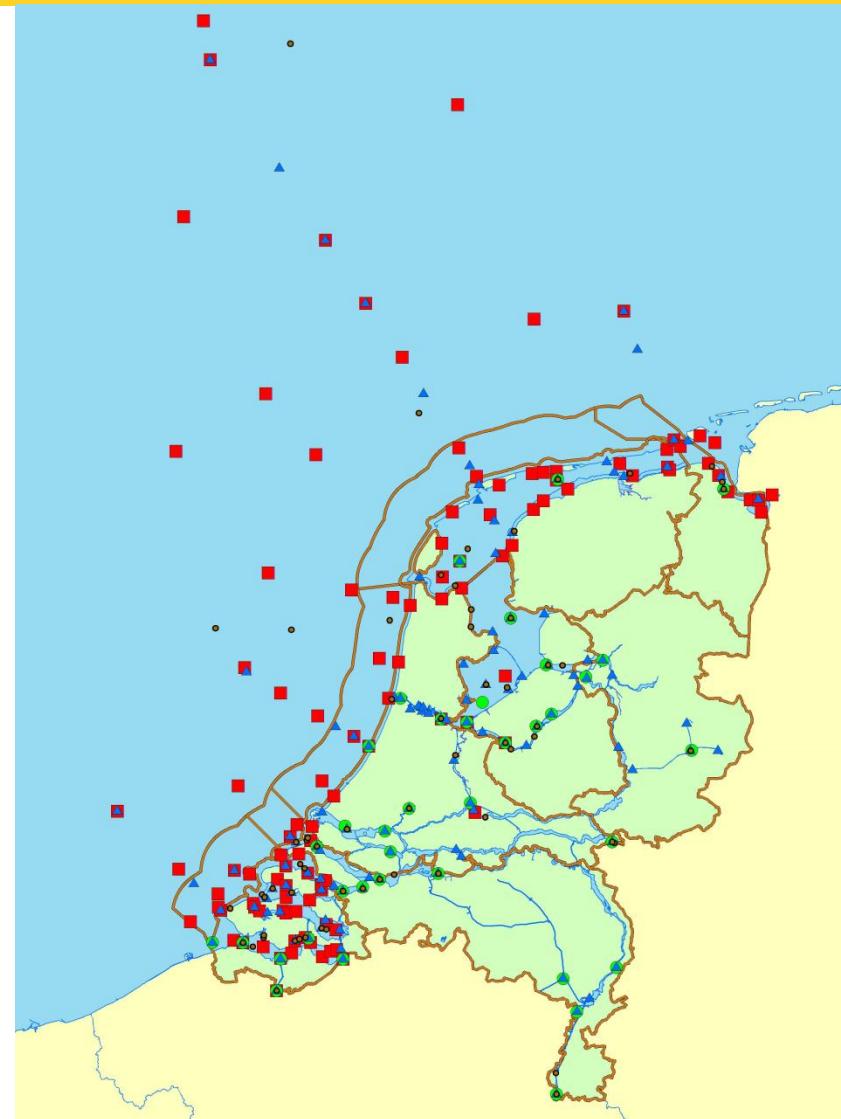
- Biota
- ▲ Water
- Suspended solids
- Sediment

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

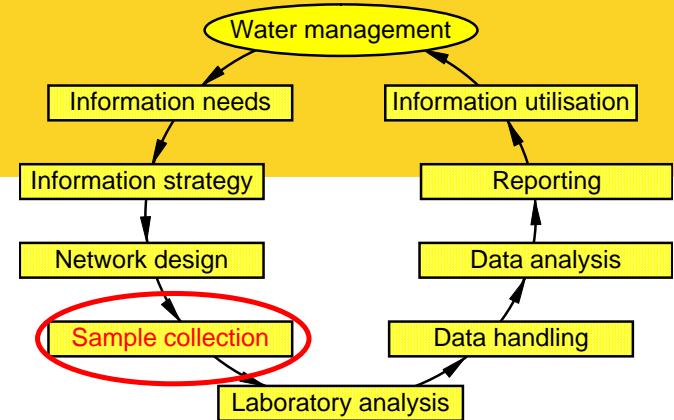
Water:	52 loc's, 340 par's
Suspended solids:	21 loc's, 160 par's
Sediment:	1 loc, 95 par's
Biota:	18 loc's, 45 par's





Biological Monitoring Network

Quality Elements	<																			
	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
Phytoplankton	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											
Macrozoobenthos			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
Macrophytes – water plants			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
Waterside plants					x	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
Salt marsh mapping	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
Waterbirds	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
Scoter		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
Ecotoxicology					x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x



Sample collection

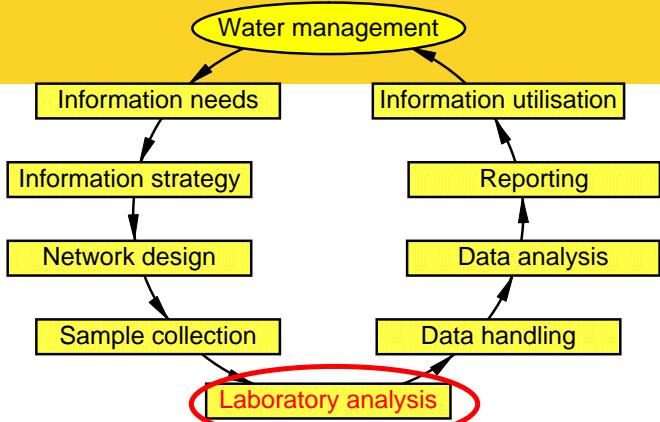
- Monitoring stations Eijsden and Bimmen-Lobith
- RWS Regional services (MID)
- Cooperation with drinking water companies
- Commercial companies
- Research institutes, voluntary organizations





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

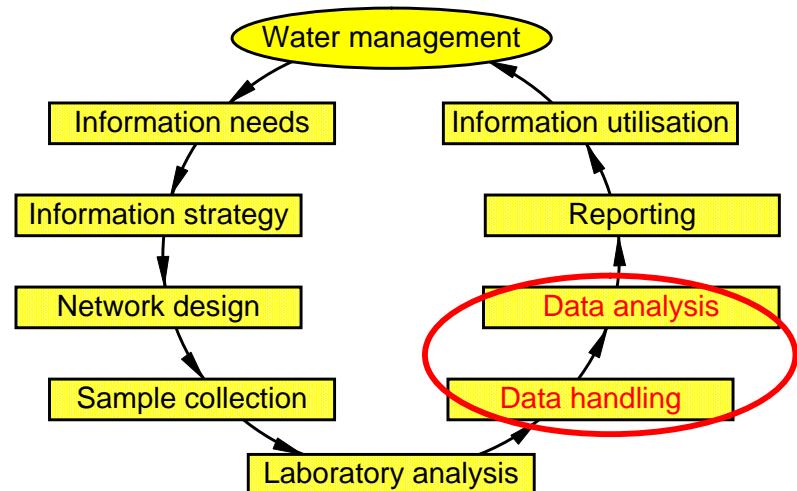
- Control of plausibility

faults? → remove

outliers → flag

- Calculation of statistical means

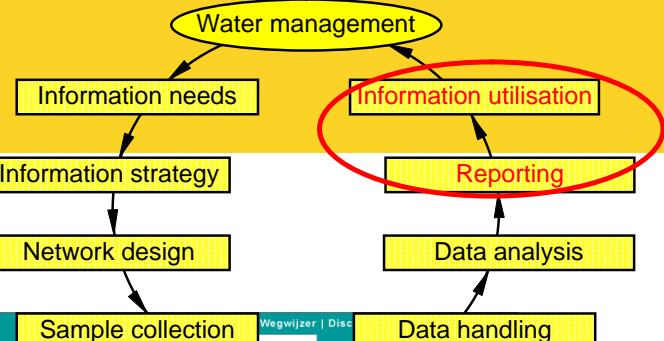
annual year concentration, P90





Information Reporting en Utilisation Use and Products

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

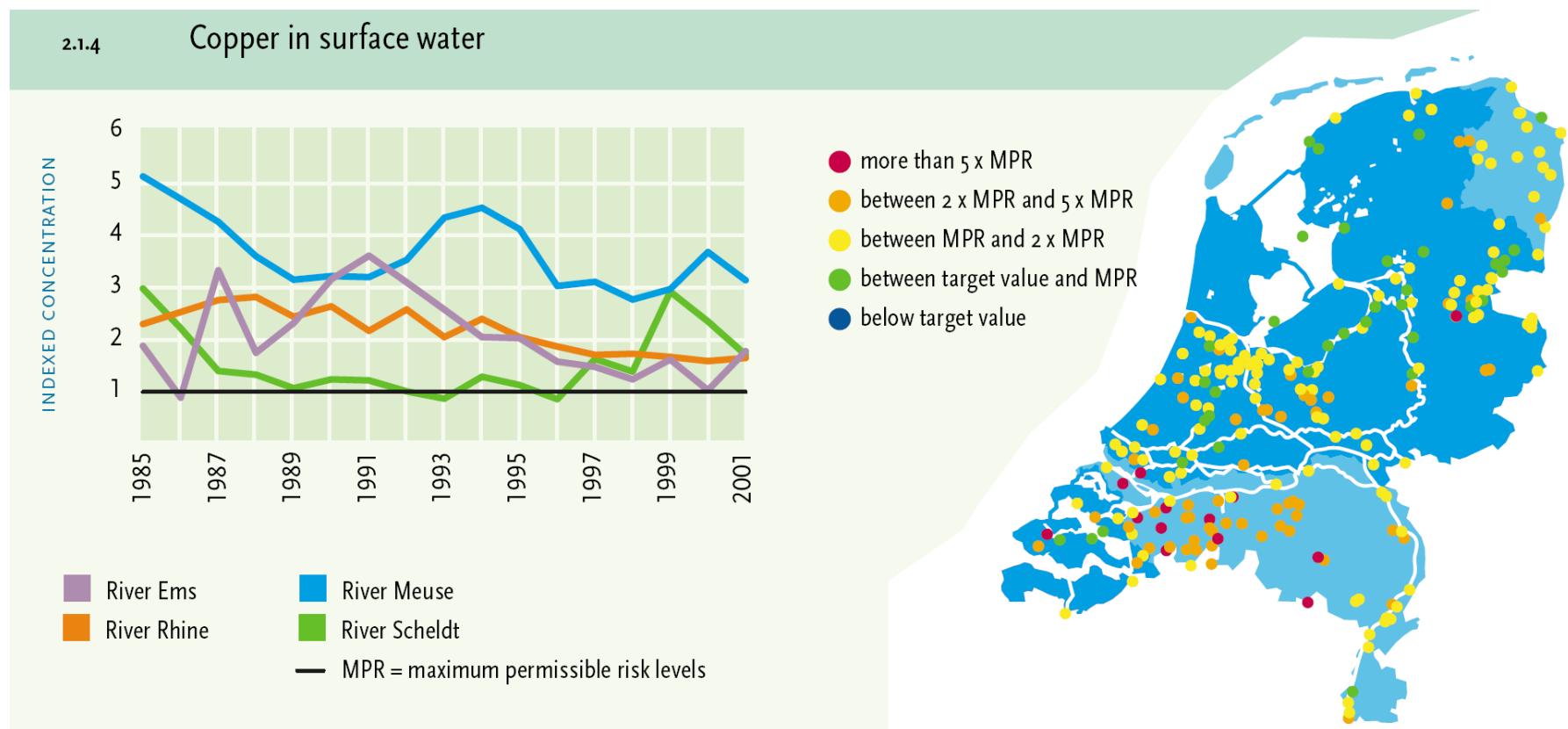


The image shows three screenshots of Dutch government websites related to water monitoring and reporting:

- Top Screenshot:** A dashboard from the 'Ministerie van Verkeer en Waterstaat' (Ministry of Transport and Water Management) titled 'Sample collection'. It includes tabs for 'Geïnteresseerde' (Interested party), 'Gegevensgebruiker' (Data user), 'Gegevensinvoer' (Data entry), and 'Beheerder' (Manager). Below the tabs is a large image of a seagull over water. To the right, there's a section for 'Laboratory analysis' and 'Data handling'.
- Middle Screenshot:** A map titled 'Biologische monitoring zoete rivieren' (Biological monitoring of sweet rivers) showing the Rijn and Maas river systems. It features a central map with a bird icon and text about waterbirds as indicators of trends. The URL 'RWA rapport 2004-002 SOVON onderzoek' is visible.
- Bottom Screenshot:** A map titled 'WEET WAT ER LEEFT LANGS RIJN EN MAAS' (Know what lives along the Rhine and Maas) with the subtitle 'ECOLOGISCHE TOESTAND VAN DE GROTE RIVIEREN IN EUROPEES PERSPECTIEF'. It shows a landscape with construction equipment and a river. The URL 'RWA rapport 2004-002 SOVON onderzoek' is visible.
- Left Screenshot:** A detailed page from the 'Ministerie van Verkeer en Waterstaat' titled 'Meetresultaten biologie' (Monitoring results biology). It lists categories like 'Fytoplankton', 'Zeebras', 'Kwelders', 'Deltavogelatlas', and 'Ecotoepassen'. Each category has a small thumbnail image and a brief description.



Reports to national parliament EU-reports Reports for international commissions

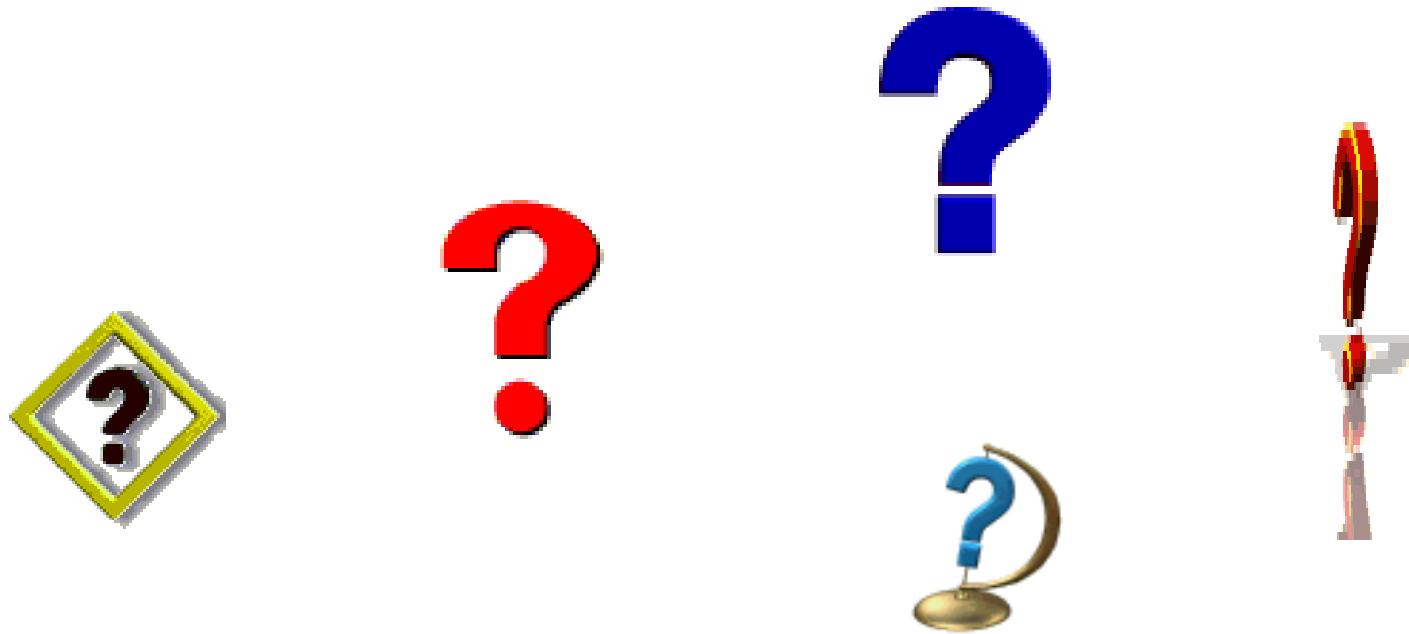




Trends in water management and monitoring

- 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)





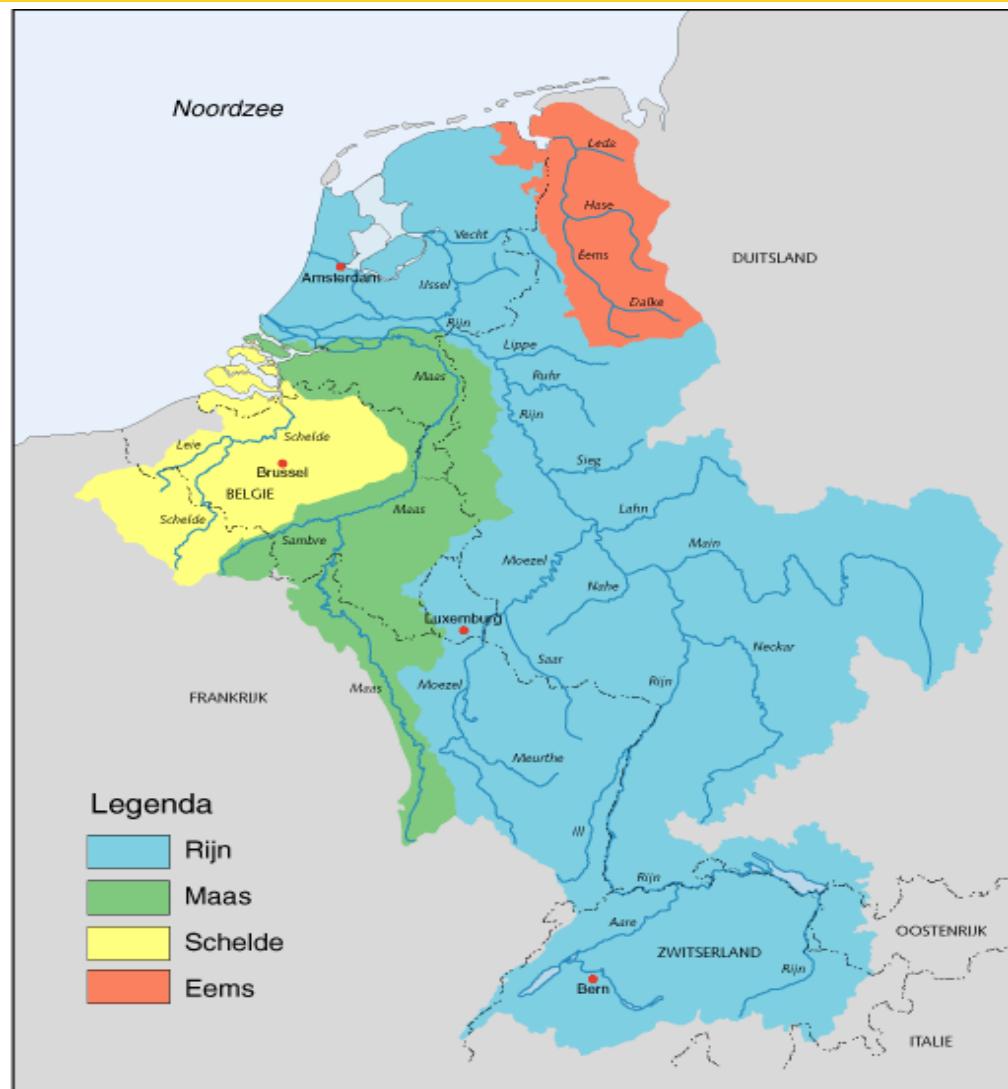


Water Framework Directive (WFD)

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**)”

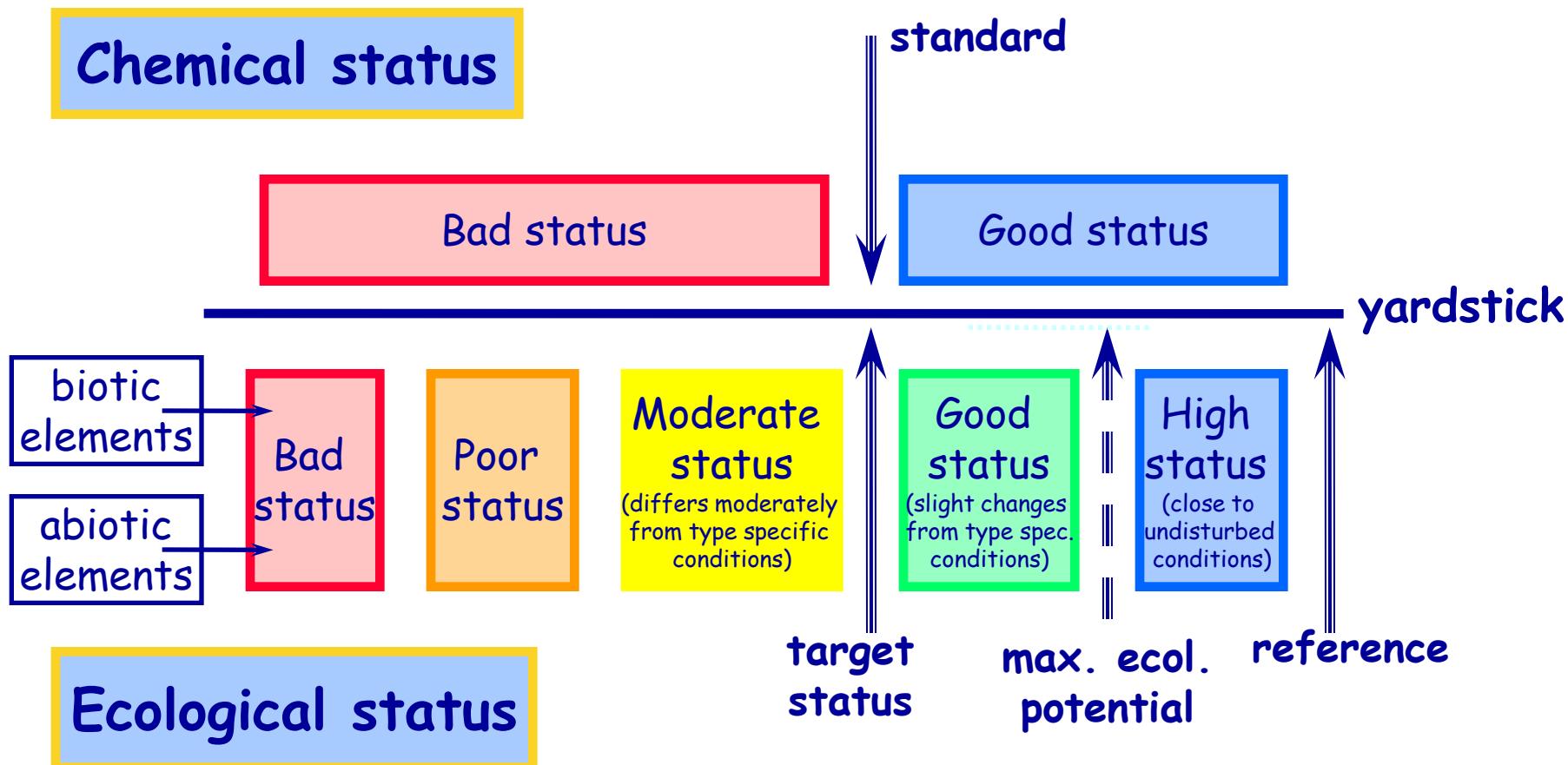
- River Basin approach
- Good Ecological Status by 2015
- In every water body
- Monitoring is a MUST
- **One out all out**
- **Programmes of measures**



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		
	macroalgae			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	continuously	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>

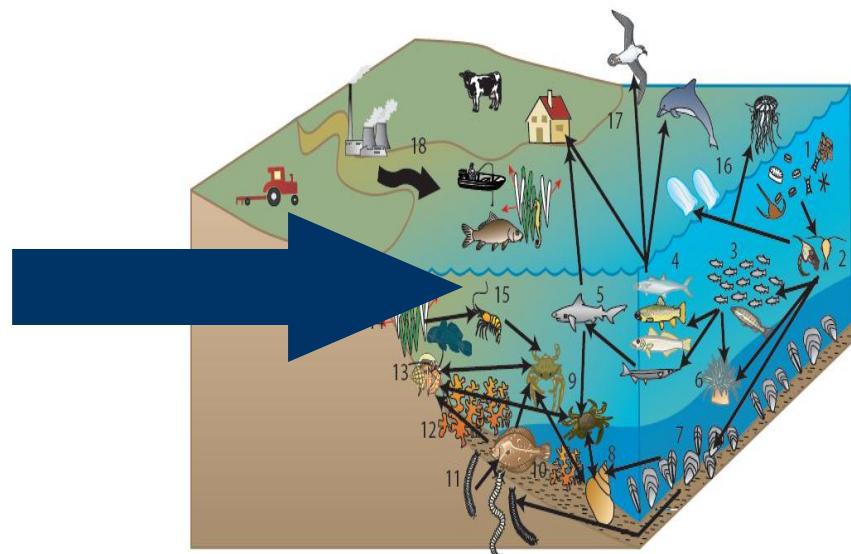
The screenshot shows a Microsoft Internet Explorer window titled "Kaderrichtlijn Water Portaal - Microsoft Internet Explorer van Het Net". The address bar contains the URL <http://krw.ncgi.nl/krw/portaal.asp?&versie=default>. The main content area displays a map of the Netherlands with numerous blue dots representing monitoring locations. The map is overlaid with administrative boundaries and river basin district boundaries. A legend on the right side indicates different monitoring themes: "Monitoringprogrammas" (selected), "Toestand en trend monitoring", "Locaties operationele monitoring", and "Toestand en trend, en operationele monitoring". Other options in the legend include "Grens Nederland", "Waterschappen", "Provinciegrenzen", "WB21 gebieden", "Deelgebieden stroomdistricten", and "TOP250VECTOR (schaalafh.)". The bottom of the screen shows standard browser status bars including "Applet mapplet started" and "Vertrouwde websites".



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
-
-





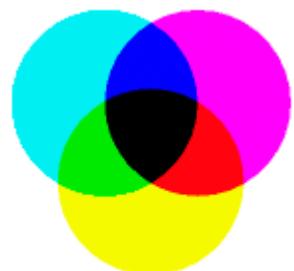
11 Descriptors of Good Environmental Status

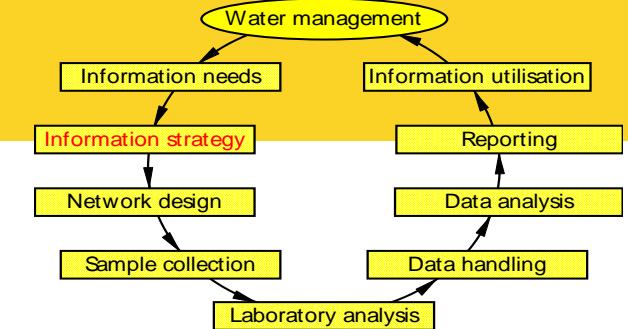
- Biological diversity
- Non-indigenous species
- Commercial fish
- Food webs
- Eutrophication
- Sea-floor integrity
- Hydrographical conditions
- Contaminants in water, sediment and biota
- Contaminants in fish and seafood (for human consumption)
- Marine litter
- Energy



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

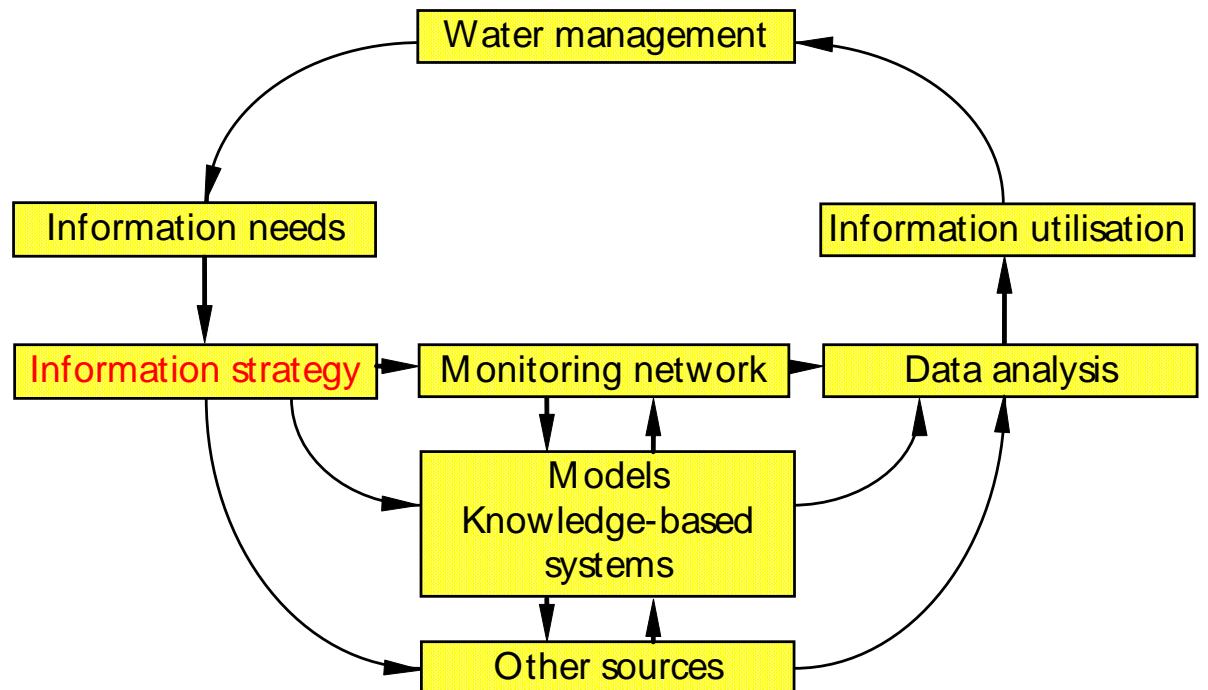




Information Strategy

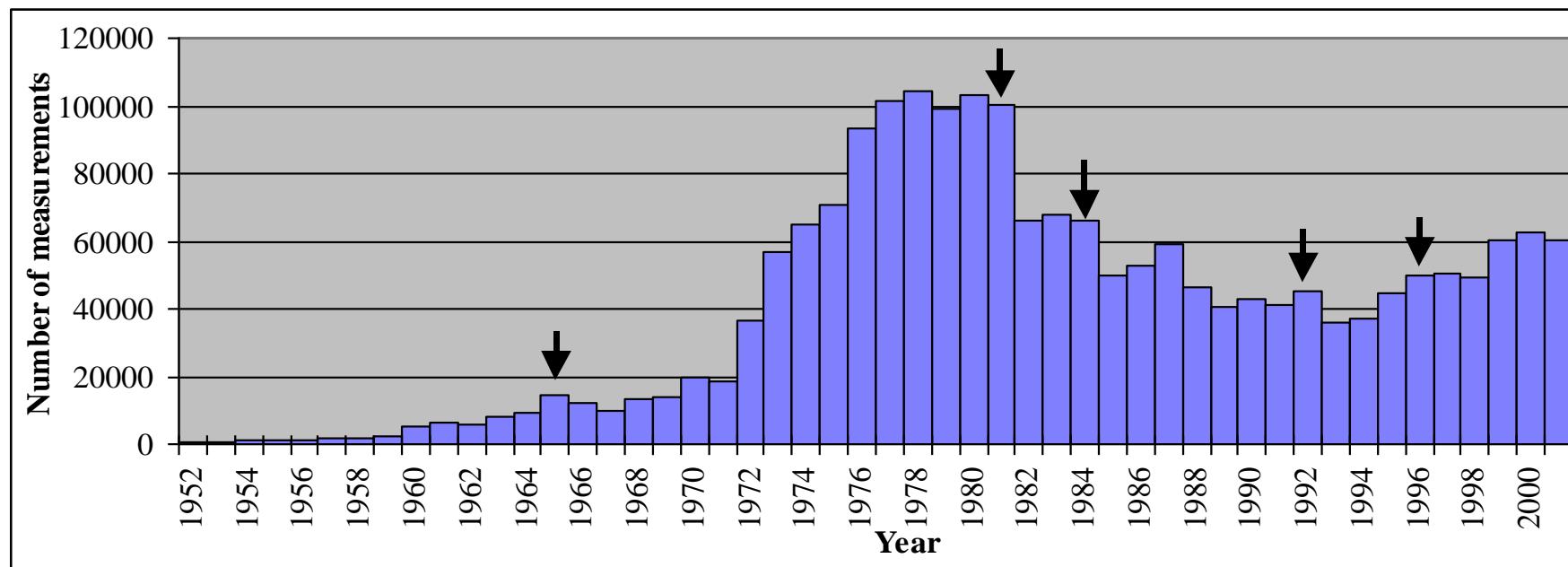
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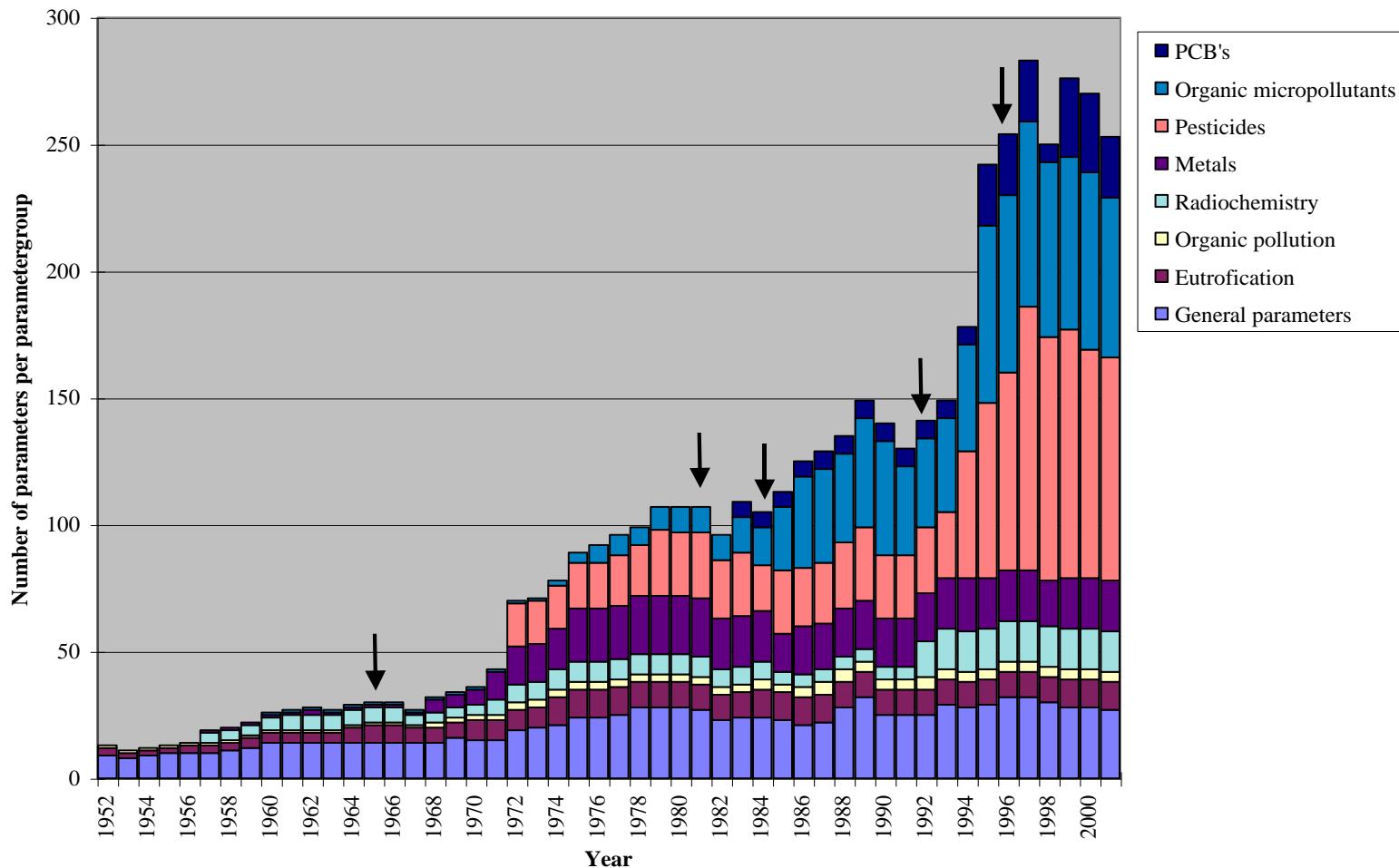


Monitoring Strategy - number of measurements

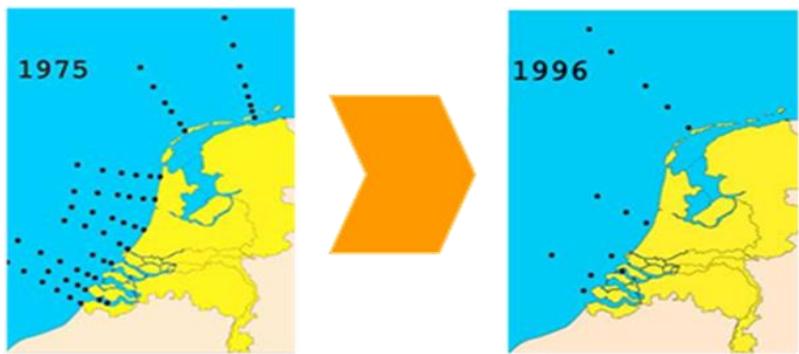




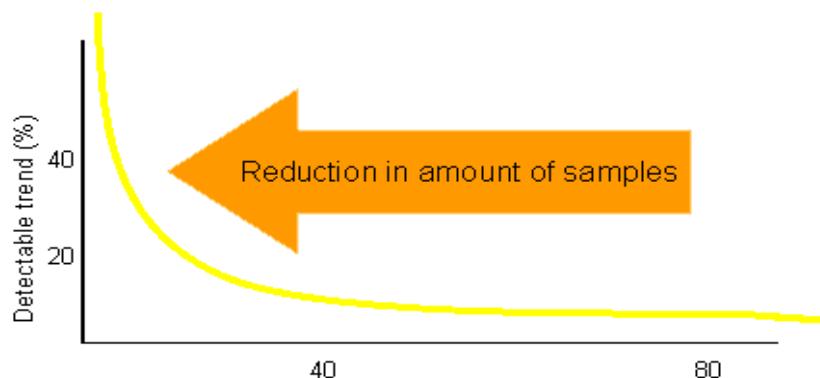
Monitoring Strategy - number of parameters



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*





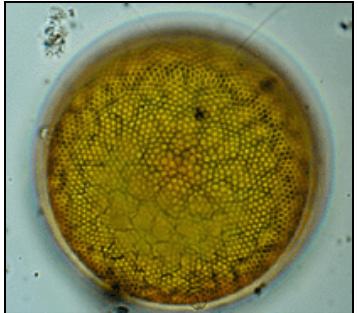
Macro invertebrates



- 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 years
- Methods:
 - Active fishery – quantitative, electric fishing, trawler-net fishing
 - Passive fishery – qualitative, fyke nets



Rijkswaterstaat



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**