

<b>Table 1 – Overview of modules in the Core Program</b>			
	<b>Water Management</b>	<b>Environmental Science</b>	<b>Municipal Water and Infrastructure</b>
<b>1</b>	WM01 Introduction to Water Management	Human Dimensions of Environmental Issues	Introduction (to Municipal Water & Infrastructure)
<b>2</b>	WM02 Water Resources System	Natural Environment	Urban Water Engineering & Management
<b>3</b>	WM03 Research & Management Skills	Solutions & Technologies	Project Cycle & Management
<b>4</b>	WM04 Geo-Information Management	Integration	Infrastructure Finance and Planning

<b>Table 2 – Overview of modules in the Specialisations</b>			
	<b>A Water Resources Management</b>	<b>B Water Quality Management w/ Environmental Science</b>	<b>C Water Services Management w/ Municipal Water &amp; Infrastructure</b>
<b>5</b>	WM05 Water Systems Modelling	WM11 Water Quality Assessment	WM14 Water Services Management
<b>6</b>	WM06 Water Resources Planning	WM12 Wetlands for Water Quality Management	WM15 Water Supply & Sanitation Systems
<b>7</b>	WM07 Environmental Planning		WM16 Operations Management
<b>8</b>	WM08 Watershed & River Basin Management		WM17 Financial Management
<b>9</b>	WM10 Managing Organisations & Change	WM13 Human Impacts on Ecosystems	WM10 Managing Organisations & Change
<b>10</b>	WM09 Water Law and Institutions		WM18 PPP (Elective)
<b>11</b>	Fieldtrips	Fieldtrips	Fieldtrips
<b>12</b>	Groupwork	Groupwork	Groupwork
<b>13</b>	Individual Study	Individual Study	Individual Study
<b>14</b>	MSc. Preparation	MSc. Preparation	MSc. Preparation
<b>15</b>	Examinations		
<b>16</b>	MSc. Research	MSc. Research	MSc. Research

**MASTERS PROGRAMME**

Academic Year: 2003/2004  
 Specialisation: Core Programme

**WATER MANAGEMENT**

## MODULE SHEET

<b>Module Name</b> <b>Introduction to Water Management</b>	<b>Module Code</b> <b>WM01</b>	<b>Credit Points</b> <b>5</b>
<b>Target Group</b> Young and mid-career professionals, engineers and (middle-level) decision makers interested in a basic and broad understanding of main issues in the water management context.	<b>Prerequisites</b> Preferably a relevant water science or management related Bachelor's degree; some experience in the water sector; good command of the English language (reading, writing, speaking).	
<b>Learning Objectives</b> To familiarize professionals with the latest insights, context and concepts in integrated water resources management, that are under debate in international fora and in different parts of the world. On conclusion of the module, the participant will have an integrated view of the field of water resources management and the main issues of debate, including: water as an economic good, the role of government, the role of the private sector, demand management, the role of water pricing, water for sustainable development, institutional arrangements, etc.		
<b>Syllabus</b> Concepts in Water Management: Context, developments, perspectives, issues and debates in Integrated Water Resources Management; Concepts and Tools in Integrated Water Resources Management; Coping with uncertainty, Involvement of stakeholders; Types of water resources; Concepts of Environmental Quality; Time scales of water resources processes; Types of planning; Human interference in the water system; Simple reservoir models; Water Resources: Groundwater-surface water interactions; Catchment yield; Water Demand: Water Demand Projections; Demand management; Elasticity of water demand; Water pricing; Water Resources Systems: Flexible tools for simulation; River basin models for water distribution and water quality; Role play demand management; Principles of management; Water using activities and water functions; Institutional arrangements for water services delivery. Environmental Quality: Interactions between people, environment and development; Local, regional and global dimensions; Interrelationships between land, water & atmosphere; Gaia; Ecosystems, biodiversity & water resources; Rio Earth Summit, Agenda 21 & Sustainable Development; Environmental Pollution; Water Using Activities/Water for Agriculture: Soil-Plant relationships; Crop Water Requirements; Yield Response to Water; Water Distribution		
<b>Didactics</b> Lectures, lecture notes, role play, structured discussions, exercises; self study of recommended literature.	<b>Subjects</b> 1. Concepts in WM 2. Environmental Quality 3. Water Services Delivery 4. Principles of Management 5. Water Using Activities  <b>Assessment</b> Written examination	
<b>Lecturing Materials</b> Lecture Notes & Reader		
<b>Lecturing Staff</b> Prof. H.H.G. Savenije, Prof. H. Gijzen, Prof. Dr. M.P. van Dijk, Assoc. Prof. J.C. Heun, Dr. H. van Bruggen		

## Module WM01: Introduction to Water Management

No	Subject/Topic	LEC	WSH	LAB	EX	FLT	CU	SLH	CP	Lecturer
<b>0</b>	<b>Introduction to Issues</b>	<b>16</b>					<b>16</b>	<b>32</b>	<b>1.1</b>	Gijzen e.a.
	Various Subjects									
<b>1</b>	<b>Concepts in Water Management</b>	<b>24</b>	<b>8</b>				<b>32</b>	<b>48</b>	<b>1.7</b>	
1.1	Issues in IWRM									Savenije
1.2	Human Interference in the Water System									Savenije
1.3	Water Resources									Savenije
1.4	Water Demand									Savenije
1.4	Water Demand Management Roleplay		8				8	8		Schotanus, Heun
1.5	Water Resources Systems									Savenije
<b>2</b>	<b>Environmental Quality</b>	<b>12</b>					<b>12</b>	<b>24</b>	<b>0.9</b>	
2.1	People, Environment and Development									Van Bruggen
2.2	Local, Regional & Global dimensions									Van Bruggen
2.3	Land, Water & Atmosphere									Van Bruggen
2.4	Ecosystems, Biodiversity & Water Resources									Van Bruggen
2.5	Sustainable Development									Van Bruggen
<b>3</b>	<b>Water Using Activities</b>	<b>8</b>			4		<b>12</b>	<b>20</b>	<b>0.7</b>	
3.1	Soil-Plant Relationships									Heun
3.2	Crop Water Requirements									Heun
3.3	Yield Response to Water									Heun
3.4	Water Distribution									Heun
<b>4</b>	<b>Fieldtrip</b>					8	8	8	<b>0.3</b>	Kelderman
	<b>Totals</b>	<b>60</b>	<b>8</b>			<b>8</b>	<b>78</b>	<b>128</b>	<b>4.7</b>	

**MASTERS PROGRAMME**

Academic Year: 2003/2004  
 Specialisation: Core Programme

# WATER MANAGEMENT

**MODULE SHEET**

<b>Module Name</b> <b>Water Resources System</b>		<b>Module Code</b> <b>WM02</b>	<b>Credit Points</b> <b>5</b>
<b>Target Group</b> Young and mid-career professionals, engineers and (middle-level) decision makers interested in understanding the bio-physical system as a sound basis for water management.		<b>Prerequisites</b> Preferably a relevant water science or management related Bachelor's degree; some experience in the water sector; good command of the English language (reading, writing, speaking). Preferably in conjunction with (after) WM01.	
<b>Learning Objectives</b> To understand how the physical system works. The interaction between quantity and quality (chemical, biological, ecological), between surface water, soil water and groundwater, between stocks and fluxes. To understand how the water resources system is affected by human interference and water uses, and how water using activities rely on water resources. On conclusion of the module, the participant has a full understanding of the complexity of the water resources system and how it interacts with water uses, both in quantitative and qualitative terms. He/she can make a water resources assessment and design a simple water resources system model. He/she can make an assessment of water using activities and the interaction with the water resources system.			
<b>Syllabus</b> Principles of hydrology of surface and groundwater; water resources assessment; simple models for water resources analysis and modelling; the river system; floods and droughts; workshop hydrology on analysis of water balance components; Water chemistry, Aquatic ecosystems; Photosynthesis, Eutrophication, Aquatic Sediments; Groundwater Pollution; Global Water Scarcity, Closing the Water Cycle, Composition of waste water, water quality requirements for crops and irrigation, nitrogen balance, salinity, leaching, relation between sanitary and irrigation engineering, matching water demand to supply; Natural functions and human use of rivers, threats from rivers, rivers as input-output systems, water quality and riverine ecosystems, environmental controls on rivers, river characteristics.			
<b>Didactics</b> Lectures, lecture notes, workshop hydrological exercises, Laboratory work, self study of recommended literature.		<b>Subjects</b> 1 Hydrology 2 Hydrology Workshops 3 Water Quality 4 River Systems	
		<b>Assessment</b> Exercises & Assignments Written examination	
<b>Lecturing Materials</b> Lecture Notes			
<b>Lecturing Staff</b> Prof. P. de Laat, Prof. C. van den Akker, Dr. P. Kelderman, Dr. H. Lubberding, Ir. J. Nonner, Ir. G.J. Klaassen			

## Module WM02: The Water Resources System

No	Subject/Topic	LEC	WSH	LAB	EX	FLT	CH	SLH	CP	Lecturer
<b>1</b>	<b>Hydrology</b>	<b>20</b>					<b>20</b>	<b>40</b>	<b>1.4</b>	
1.1	Concepts of Hydrology, Hydrological Cycle, Water Balance									De Laat
1.2	Precipitation									De Laat
1.3	Evaporation & Transpiration									De Laat
1.4	Groundwater Resources									Nonner
1.5	Surface Water Resources									De Laat
1.6	Rainfall – Runoff Relationships									De Laat
<b>2</b>	<b>Hydrology Workshops</b>		<b>20</b>				<b>10</b>	<b>20</b>	<b>0.7</b>	
2.1	Rainfall Data Collection & Analysis									De Laat
2.2	Runoff Data Collection & Analysis									De Laat
2.2	Evapo(transpi)ration Calculations									De Laat
2.3	Reservoir Operation & Optimisation									De Laat
<b>3</b>	<b>Water Quality</b>	<b>28</b>					<b>28</b>	<b>56</b>	<b>2.0</b>	
3.1	Water Chemistry & Aquatic Ecosystems	16					16	32		Kelderman
3.2	Groundwater Pollution	6					6	12		Van den Akker
3.3	Waste Water Reuse	6					6	12		Lubberding
<b>4</b>	<b>River Systems</b>	<b>6</b>					<b>6</b>	<b>12</b>	<b>0.4</b>	Klaassen
<b>5</b>	<b>Fieldtrip</b>					<b>8</b>	<b>8</b>	<b>8</b>	<b>0.3</b>	Kelderman
	<b>Totals</b>	<b>54</b>	<b>20</b>			<b>8</b>	<b>72</b>	<b>136</b>	<b>4.8</b>	

**MASTERS PROGRAMME**

Academic Year: 2003/2004  
 Specialisation: Core Programme

**WATER MANAGEMENT**

## MODULE SHEET

<b>Module Name</b> <b>Research and Management Skills</b>		<b>Module Code</b> <b>WM03</b>	<b>Credit Points</b> <b>5</b>
<b>Target Group</b> Mid-career professionals, managers and middle level decision makers.		<b>Prerequisites</b> BSc; basic PC-computer knowledge (MS-Windows, MS-Office); good English command.	
<b>Learning Objectives</b>  The aim of this module is to develop participants' general research and managerial skills and to provide tools for the conduct of research, studies and management. Upon course completion the participants should be able to: <ul style="list-style-type: none"> <li>• Undertake literature studies and train interview techniques.</li> <li>• Describe and apply tools that can be used for management purposes.</li> <li>• Explain why personal management skills are important for managers and convey the theoretical concepts behind these skills.</li> <li>• Acquire the principles of social science research, including formulation of research strategy, development of research instruments, sampling and hypotheses testing</li> <li>• Exercise and apply the newly gained research and management skills throughout the academic year at IHE.</li> </ul>			
<b>Syllabus</b> Basic research skills, literature reviews, interview techniques. Formulation of research strategy, research instruments, hypothesis testing. Management tools, objective oriented project planning (problem/objective analysis, option analysis), logical framework. Management skills, technical writing, presentation, communication, teamwork, negotiation, decision-making, time management.			
<b>Didactics</b> The contact hours in the module include lectures, group works, workshops, and case studies. The lectures are accompanied by overhead sheets and PowerPoint-presentations that are made available to the participants for self-study		<b>Subjects</b> - Basic Research Skills - Management Tools - Personal Management Skills	
		<b>Assessment</b> Literature Study – 50% First Assignment – 25% Second Assignment – 25%	
<b>Lecturing Material / Recommended Reading</b> Text book on research strategies Handbook on research methods in social science Material on management			
<b>Lecturing Staff</b> Marco Schouten, W. Sturrock, GL, A. Bos, M.P. van Dijk, A.Wijffels			

### Module WM03: Research & Management Skills

No	Subject/Topic	LEC	WSH	LAB	EX	FLT	CH	SLH	CP	Lecturer
<b>1</b>	<b>Literature studies &amp; interview techniques</b>	<b>12</b>	<b>4</b>		<b>20</b>		<b>16</b>	<b>48</b>		
1.1	Technical Writing	2	2				4	8		Sturrock
1.2	Presentation Skills	2	2				4	8		Sturrock
1.3	Literature Study	4			20		4	28		Sturrock
<b>2</b>	<b>Research Skills</b>	<b>10</b>	<b>10</b>				<b>20</b>	<b>30</b>		
2.1	Formulation of research strategy: res. questions	2	2				4	6		Van Dijk
2.2	Development of research instruments	2	2				4	6		Van Dijk
2.3	Sampling and formulating hypotheses	2	2				4	6		Van Dijk
2.4	Testing a questionnaire	2	2				4	6		Van Dijk
2.5	Analysis and hypothesis testing	2	2				4	6		Van Dijk
<b>3</b>	<b>Management Skills</b>	<b>22</b>	<b>10</b>				<b>32</b>	<b>54</b>		
3.1	Communication	6	2				8	14		Wijffels
3.2	Negotiation	4	2				6	10		Gupta, Bos
3.3	Teamwork	4	2				6	10		Bos, Schouten
3.4	Time Management	4	2				6	10		Schouten
3.5	Effective Meeting Skills	4	2				6	10		Schouten
<b>4</b>	<b>Fieldtrip</b>					<b>8</b>	<b>8</b>	<b>8</b>		Kelderman
	<b>Total</b>	<b>44</b>	<b>24</b>		<b>20</b>	<b>8</b>	<b>72</b>	<b>140</b>		

**MASTERS PROGRAMME**

Academic Year: 2003/2004  
 Specialisation: Core Programme

# WATER MANAGEMENT

MODULE SHEET

<b>Module Name</b> <b>Geo-Information Management</b>		<b>Module Code</b> <b>WM04</b>	<b>Credit Points</b> <b>5</b>
<b>Target Group</b> Young and Mid-career professionals, engineers, technicians, administrators and researchers dealing with or interested in various aspects of mapping, analysing and modelling for water resources management.		<b>Prerequisites</b> Computer literacy. Affinity with quantitative approaches is required. Good command of English (reading, writing, speaking).	
<b>Learning Objectives</b> Upon the conclusion of the module, the successful participant will be able to understand basic scientific concepts of modelling real world objects in geographic information systems and databases and use available technology to capture, store, process, analyse and visualise data to facilitate the management of natural resources with a particular emphasis on river basin management.			
<b>Syllabus</b> Data and Information. Locations and characteristics of entities in a complex world. Data formats and compatibility. Data collection, storage and processing techniques. Scale and projections. Technology and Society Issues. Vector-based geographic data processing. Linking spatial references to attribute data. Digitising. GIS analysis and visualisation. Exercises with the Environmental Science Research Institute's Arc-View GIS. Analysis of satellite imagery. Sources, formats. Enhancement. Feature extraction. Multi-spectral, supervised, unsupervised classification. Geo-referencing. Exercises with ESRI's ArcView Image Analysis. Model-based decision support systems. Main components of DSS related to water resources. Main types of the supporting technologies and models. Integration of various DSS components. Hydroinformatics as an enabling technology for DSS. Demonstration of a DSS used in a flood warning system. Main components: meteorological model, hydrological model, GIS visualisation module, GSM and Internet-based communication modules. Practical aspects of the development and deployment of a DSS.			
<b>Didactics</b> Lectures, GIS & RS Computer Lab Exercises, Outdoor GPS Exercises, Field Visits, Groupwork, Case Studies, Literature & Internet Study. The lectures are accompanied by the PowerPoint-presentations and individual and group-based analysis, modelling and spatial planning exercises.		<b>Subjects</b> 1. Understanding Geographic Data 2. Vector Data Analysis 3. Raster Data Analysis 4. Image Data Analysis 5. Database Systems and Geo-Databases 6. Hydrological Modelling with GIS 7. DSS, MIS and ERP 8. Case Study	
		<b>Assessment</b> GIS, RS & DB Exercises – 60% Case Study – 20 % Paper – 20%	
<b>Teaching Materials</b> Lecture Notes on GIS, RS, DBMS, DSS, MIS, ERP Background Papers & Articles, Powerpoint Presentations, GIS & RS Software, Video(s) ESRI Virtual Campus Tutorials			
<b>Lecturing Staff</b> Ir. T.D. Schotanus, Dr. D. Solomatine, Prof. Dr. R. Price, ir. S. Velickov, Dr. I. Popescu			

## Module WM04: Geo-Information Management

No	Subject/Topic	LEC	WSH	LAB	EX	FLT	CH	SLH	CP	Lecturer
<b>1</b>	<b>Understanding Geographic Data</b>	<b>2</b>		<b>2</b>	<b>8</b>		<b>4</b>	<b>17</b>	<b>0.6</b>	
1.1	Data & Attribute Mapping	1					1	3		Schotanus
1.2	Data Formats	1					1	3		Schotanus
1.3	Scale & Projections			2			2	3		Schotanus
1.4	Technology & Society Issues				8			8		Schotanus
<b>2</b>	<b>Vector Data Analysis</b>	<b>2</b>		<b>8</b>			<b>8</b>	<b>15</b>	<b>0.5</b>	
2.1	Vector-based geographic data processing	2					2	6		Schotanus
2.2	Linking spatial references to attribute data			2			2	3		Schotanus
2.3	Digitising			2			2	3		Schotanus
2.4	GIS analysis and visualisation			2			2	3		Schotanus
<b>3</b>	<b>Raster Data Analysis</b>	<b>2</b>		<b>6</b>			<b>8</b>	<b>15</b>	<b>0.5</b>	
3.1	Grid-based geographic data processing	2					2	6		Schotanus
3.2	Surface Interpolation and Analysis			2			2	3		Schotanus
3.3	Map Overlays & Algebra			2			2	3		Schotanus
3.4	Modelling GIS Procedures			2			2	3		Schotanus
<b>4</b>	<b>Image Data Analysis</b>	<b>2</b>		<b>6</b>			<b>8</b>	<b>15</b>	<b>0.5</b>	
4.1	Image Data Collection & Formats	2					2	6		Schotanus
4.2	Geo-referencing & Mosaicking Images			2			2	3		Schotanus
4.3	Extracting & Classifying Features			2			2	3		Schotanus
4.4	Change Detection			2			2	3		Schotanus
<b>5</b>	<b>Database Systems and Geo-Databases</b>	<b>2</b>		<b>6</b>			<b>8</b>	<b>15</b>	<b>0.5</b>	
5.1	Knowledge Management	2					2	6		Solomatine
5.2	Database Management Systems			2			2	3		Solomatine
5.3	Querying & Managing GIS Data			2			2	3		Schotanus
5.4	Linking GIS to External Databases			2			2	3		Schotanus
<b>6</b>	<b>Hydrological Modelling with GIS</b>	<b>2</b>		<b>4</b>			<b>6</b>	<b>12</b>	<b>0.4</b>	
6.1	Watershed & Stream Network Delineation using DEMs	1		2			3	6		Schotanus
6.2	Linking GIS to External Hydrological Models	1		2			3	6		Velickov, Popescu
<b>7</b>	<b>DSS, MIS and ERP</b>	<b>3</b>		<b>6</b>			<b>9</b>	<b>18</b>	<b>0.6</b>	
7.1	Decision Support Systems	1		2			3	6		Solomatine
7.2	Management Information Systems	1		2			3	6		Price, Velickov, Popescu
7.3	Enterprise Resource Planning	1		2			3	6		Price, Velickov, Popescu
<b>8</b>	<b>Case Study</b>	<b>2</b>		<b>10</b>			<b>12</b>	<b>16</b>	<b>0.6</b>	Schotanus
<b>9</b>	<b>Fieldtrip</b>					<b>8</b>	<b>8</b>	<b>8</b>	<b>0.3</b>	Kelderman
	<b>Totals</b>	<b>17</b>		<b>48</b>	<b>8</b>	<b>8</b>	<b>71</b>	<b>131</b>	<b>4.5</b>	

**MASTERS PROGRAMME**

# WATER MANAGEMENT

Academic Year: 2003/2004  
 Specialisation: Water Resources Management

MODULE SHEET

<b>Module Name</b> <h2 style="text-align: center;">Water System Modelling</h2>	<b>Module Code</b> <h2 style="text-align: center;">WM05</h2>	<b>Credit Points</b> <h2 style="text-align: center;">5</h2>
<b>Target Group</b> Young and mid-career professionals, managers, engineers and technicians dealing with or interested in various aspects of water resources modelling.	<b>Prerequisites</b> Computer literacy (experience with spreadsheets); Affinity with quantitative approaches is required. Good command of English (reading, writing, speaking).	
<b>Learning Objectives</b> To introduce the participants to the basics of hydrological modelling and water system modelling. To introduce a number of tools for modelling water resources systems in support of the analysis for planning and management For the participants to acquire skills for building (simple) models for the analysis of systems and management strategies On conclusion of the course, the participants should have a better understanding of the principles of modelling and the participants should be able to built their own (simple) model with the provided tools. A better insight into the possible applications of models within the concept of integrated river basin management should be acquired.		
<b>Syllabus</b> Introduction. Principles of hydrological modelling, including: prescriptive versus descriptive models, deterministic versus stochastic versus conceptual modelling, lumped versus distributed modelling, complex versus simple models, calibration, validation, issues in modelling. Principles of water system modelling with specific attention to simple (spreadsheet) models, including: spreadsheet modelling, use of macro's, optimisation techniques, introduction to WAFLEX, STELLA, RAINRU, RESSIMFL and RESSIMOP and possibly other (spreadsheet) models to be defined later on.		
<b>Didactics</b> The contact hours in the module include lectures, computer exercises and a water management case study based on the model developed during the exercises. The lectures are accompanied by PowerPoint-presentations and interactive computer workshops to get hands-on experience in developing simple water system models from scratch with world wide available tools such as MS Excel. The developed river basin simulation model (WAFLEX) will be an input into the water management case study. This case study will increase the understanding of the participants in the possible applications of water system modelling within the concept of integrated river basin management.	<b>Subjects</b> 1. Basic of hydrological modelling and water system modelling 2. Special Topics: - River basin simulation - Hydrological modelling - Applications of models	
		<b>Assessment</b> Examination – 50 % Assignment WAFLEX – 30% Case study – 20%
<b>Lecturing Materials</b> Ir. M.L. Mul, Water system modelling, IHE lecture notes Ir. M.L. Mul, Water system modelling, exercises Prof Schultz, Hydrological modelling, IHE lecture notes Software applications: WAFLEX (MS Excel), ACRU model and one of the models mentioned below: -Reservoir model (STELLA), -Water management models, such as RESSIMFL and RESSIMOP (MS Excel), -RAINRU (MS Excel)		
<b>Lecturing Staff</b> Prof. R. Price, Ir. M.L. Mul, prof. R. Schulze and guest lecturers		

## Module WM05: Water system modelling

No	Subject/Topic	LEC	WSH	LAB	EX	FLT	CH	SLH	CP	Lecturer
<b>1</b>	<b>Hydrological modelling</b>	<b>20</b>			<b>4</b>		<b>24</b>	<b>68</b>	<b>2.4</b>	
1.1	Introduction	2					2	6		Schulze
1.2	Principles of hydrological modelling	2					2	6		Schulze
1.3	Prescriptive versus descriptive models	2					2	6		Schulze
1.4	Deterministic vs stochastic vs conceptual modelling	2					2	6		Schulze
1.5	Lumped versus distributed modelling	2					2	6		Schulze
1.6	Complex versus simple models	2					2	6		Schulze
1.7	Calibration	2					2	6		Schulze
1.8	validation	2					2	6		Schulze
1.9	Issues in modelling	4					4	12		Schulze
1.10	Exercise ACRU			4			4	8		Schulze
<b>2</b>	<b>Water system modelling</b>	<b>8</b>		<b>12</b>			<b>20</b>	<b>48</b>	<b>1.7</b>	
2.1	Water system modelling	2					2	6		Price
2.2	Simple spreadsheet modelling	2					2	6		Mul
2.3	Exercise WAFLEX	3		9			12	27		Mul
2.4	Exercise other models	1		3			4	9		Mul
<b>3</b>	<b>Case Study</b>	<b>2</b>	<b>10</b>				<b>12</b>	<b>16</b>	<b>0.6</b>	Mul
<b>4</b>	<b>Fieldtrip</b>					<b>8</b>	<b>8</b>	<b>8</b>	<b>0.3</b>	Kelderman
<b>Totals</b>		<b>30</b>	<b>10</b>	<b>14</b>	<b>4</b>	<b>56</b>	<b>64</b>	<b>140</b>	<b>5</b>	

**MASTERS PROGRAMME**

# WATER MANAGEMENT

Academic Year: 2003/2004  
 Specialisation: Water Resources Management

MODULE SHEET

<b>Module Name</b>	<b>Module Code</b>	<b>Credit Points</b>
<b>Water Resources Planning</b>	<b>WM06</b>	<b>5</b>
<b>Target Group</b> (Water sector) professionals, staff of government institutions, university staff and consultants; middle level management; professionals who have the ambition to judge, participate in and guide multi-disciplinary water resources planning studies.	<b>Prerequisites</b> Basic understanding of the water resources physical system. Understanding of water using activities such as agriculture, water supply, hydropower, and environmental demands. Module on water system modelling. Computer skills and spreadsheet operations.	
<b>Learning Objectives</b> Successful participants will be able to evaluate, participate in and guide water resources planning activities applying planning techniques and water resources system analytical methodologies. Successful participants will be acquainted with the economic concepts of water resources planning and communicate with economists on the issues involved.		
<b>Syllabus</b> <u>Framework for Analysis</u> : Principles of processes of water resources planning at national and river basin level. Water sector analysis. Situation and function analysis. Analytical hierarchy process of objectives and criteria. Analysis of activities and natural systems. Formulation and evaluation of strategies. Multi-criteria analysis. Case studies on Bangladesh, Egypt, Indonesia The Netherlands. <u>Systems Analysis</u> : (1) Linear programming: Simplex method, benefit cost optimisation; Crop-land-water optimisation. (2) Project management: multi-hierarchical project planning; planning of an irrigation project; <u>Economic Planning</u> : Economic history and basic economic principles. Micro-level: the economic planning of the farmer. Meso-level: the economic planning of a sector or region. Macro-level: the economic planning of society as a whole. Environmental and ecological economics (sustainability, valuation, discounting trade-offs). <u>Integrated Case study</u> : The subjects Framework for Analysis and Economic Planning are exercised in an assignment on a common case study (Incomati), which is also addressed by the subjects of the modules GIS, Water System Modelling, Environmental Planning, Watershed Management and Water-Law & Institutions		
<b>Didactics</b> <ul style="list-style-type: none"> <li>- Lectures</li> <li>- Exercises and assignments</li> <li>- Workshops and role play</li> <li>- Field-trip(s)</li> </ul>	<b>Subjects and Contact Hours</b> 1. Framework for Analysis of water resources planning 2. Economic Planning 3. System Analysis 4. Case study 5. Field-trips	
	<b>Assessment</b> Written Examination – 80% Case Study – 20%	
<b>Lecturing Materials</b> Lecture Notes: - Framework for Analysis for Water Resources Planning (J.C.Heun) - Economic Planning (A.T.M. Wijfels and A.J.A. de Wit) - Systems Analysis (W. Spaans, D.P. Loucks) Handouts: - Examples of case studies - Selected background reading Software: Excel Spreadsheets, Cosmo DSS, Expert Choice (MCA), Lingo, Microsoft On-target		
<b>Lecturing Staff</b> Ir. J.C. Heun, Drs. A.T.M. Wijfels, Drs. A.J.A de Wit, Ir. W. Spaans, Prof. Dr. D.P. Loucks (?)		

## Module WM06: Water Resources Planning

No	Subject/Topic	LEC	WSH	LAB	EX	FLT	CH	SLH	CP	Lecturer
<b>1</b>	<b>Framework for Analysis</b>	<b>9</b>	<b>2</b>		<b>7</b>		<b>18</b>	<b>34</b>	<b>1.2</b>	
1.1	Planning Principles	2					2	4		Heun
1.2	Problem Analysis	2			1		3	6		Heun
1.3	Objectives & Criteria	2			2		4	8		Heun
1.4	Strategy Formulation	1			1		2	4		Heun
1.5	Strategy Evaluation	2			3		5	10		Heun
1.6	Miscellaneous		2				2	2		Heun
<b>2</b>	<b>Economic Planning</b>	<b>24</b>					<b>24</b>	<b>48</b>	<b>1.7</b>	
2.1	Basics	6					6	12		Wijfels, de Wit
2.2	Macro Planning	6					6	12		Wijfels, de Wit
2.3	Meso Planning	6					6	12		Wijfels, de Wit
2.4	Micro planning	6					6	12		Wijfels, de Wit
<b>3</b>	<b>Systems Analysis</b>	<b>2</b>	<b>20</b>				<b>22</b>	<b>24</b>	<b>0.9</b>	
3.1	Linear Programming	2	6				8	10		Spaans
3.2	Project Planning		14				14	14		Spaans
<b>4</b>	<b>Case Study</b>		<b>6</b>		<b>6</b>		<b>12</b>	<b>18</b>	<b>0.6</b>	
4.1	Situation Analysis 1		2		2		4	6		Heun, Mul
4.2	Situation Analysis 2		2		2		4	6		Heun, Wijfels
4.3	Objectives & Criteria		2		2		4	6		Heun, Wijfels
<b>5</b>	<b>Fieldtrip</b>					<b>8</b>	<b>8</b>	<b>8</b>	<b>0.3</b>	Kelderman
	<b>Totals</b>	<b>35</b>	<b>28</b>		<b>15</b>	<b>8</b>	<b>84</b>	<b>132</b>	<b>4.7</b>	

**MASTERS PROGRAMME**

# WATER MANAGEMENT

Academic Year: 2003/2004  
 Specialisation: Water Quality Management

MODULE SHEET

<b>Module Name</b> <b style="font-size: 1.2em;">Environmental Planning</b>	<b>Module Code</b> <b style="font-size: 1.2em;">WM07</b>	<b>Credit Points</b> <b style="font-size: 1.2em;">5</b>
<b>Target Group</b> Professionals involved in environmental resources management or river basin planning with an interest in issues and decision-making problems that require a broad view on development and resources utilisation.	<b>Prerequisites</b> Basic knowledge of causes and consequences of typical environmental problems such as resource overexploitation and pollution.	
<b>Learning Objectives</b> The aim of the module is to make the student familiar with: 1. basic environmental concepts (such as sustainable development, carrying capacity, ecological footprint), 2. tools for environmental planning (such as use of environmental indicators, proper valuation of natural resources, environmental impact assessment, natural resources accounting, risk assessment), and to learn the student how to apply these concepts and tools for typical environmental problems (such as pollution, deforestation, erosion, loss of wetlands, habitat fragmentation, and climate change);		
<b>Syllabus</b> <ul style="list-style-type: none"> <li>• Concepts and principles of sustainable development. Environmental management in relation to economic development, spatial planning, poverty alleviation and human health.</li> <li>• Environmental policy analysis (problem analysis, target setting, systems analysis, design of alternative measures and strategies, policy assessment and evaluation). Illustration of each stage with examples, case studies and exercises. Examples in the areas of resource use/overexploitation, pollution, land degradation and climate change. Risk assessment, uncertainty analysis.</li> <li>• Environmental information management (environmental indicators, natural resource accounting, environmental monitoring, management information systems).</li> <li>• Environmental economics; Ecological economics.</li> <li>• Environmental impact assessment.</li> </ul>		
<b>Didactics</b> Lectures Two group games on common pool resource use Fieldtrip(s)	<b>Subjects</b> 1 Sustainable development 2 Environmental Policy Analysis 3 Environmental Information Management 4 Environmental Economics 5 Environmental Impacts Assessment	
	<b>Assessment</b> Case Study – 20% Written examination – 80%	
<b>Lecturing Materials</b> Lecture notes.		
<b>Lecturing Staff</b> Sustainable development: A.Y. Hoekstra Environmental policy analysis: A.Y. Hoekstra + guest lecturer somebody from RIVM Environmental information management: Helmer + guest lecturer from RIVM? Environmental economics: A.Y. Hoekstra + guest lecturer (IvM/ISS/EUR?) Environmental impact assessment: Vis, Fuller or other guest lecture		

## Module WM07: Environmental Planning

No	Subject/Topic	LEC	WSH	LAB	EX	FLT	CH	SLH	CP	Lecturer
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**MASTERS PROGRAMME**

# WATER MANAGEMENT

Academic Year: 2003/2004

Specialisation: Water Resources Management & Water Quality Management

MODULE SHEET

<b>Module Name</b> <h2 style="margin: 0;">Watershed &amp; River Basin Management</h2>	<b>Module Code</b> <h2 style="margin: 0;">WM08</h2>	<b>Credit Points</b> <h2 style="margin: 0;">5</h2>
<b>Target Group</b> Professionals (scientists, decision-makers) with a background in water management, environmental management, and / or watershed management.	<b>Prerequisites</b> Bachelor degree in e.g. hydrology, development economics, agronomy, geography and preferably experience in watershed management and / or river basin.	
<b>Learning Objectives</b> <ul style="list-style-type: none"> <li>▪ The student will describe the main <i>natural and human elements and their interactions</i> at a watershed scale;</li> <li>▪ The student will be familiar with <i>the role of water</i> in sustaining different land uses, including ecosystems, at a watershed scale;</li> <li>▪ The student will be familiar with <i>management of soil and water</i> at the watershed scale and with <i>planning approaches and methodologies</i> for watershed planning;</li> <li>▪ The students will construct a simple <i>water balance for different land use systems</i> at the watershed scale, and add water system innovations;</li> <li>▪ The student will be able to assess <i>consequences of human interventions</i> in watersheds at the river basin scale.</li> </ul>		
<b>Syllabus</b> <ul style="list-style-type: none"> <li>▪ River basin and watershed hydrology</li> <li>▪ Soil and water management</li> <li>▪ Erosion control</li> <li>▪ Water harvesting</li> <li>▪ Waste water reuse</li> <li>▪ Watershed planning and management</li> <li>▪ Socio-economics of watershed management</li> <li>▪ River basin and watershed scale linkages</li> <li>▪ Use of Bayesian Networks in river basin management</li> </ul>		
<b>Didactics</b> The module will be based primarily on lectures, group discussion and a case study. The case study (Incomati in Southern Africa) will be used to practice the material taught. Students will work in small groups on a number of assignments. In a last session students will present the results of the assignments. There are an 61 contact hours, which amounts to roughly 45 % of the time allocated for the module. The rest of the time is to be used for self-study.	<b>Subjects</b> <ul style="list-style-type: none"> <li>▪ Introduction to river basin and watershed management</li> <li>▪ Water and food: soil and water management in agriculture</li> <li>▪ Water and ecosystems</li> <li>▪ From watershed to river basin scale</li> <li>▪ Watershed planning and management approaches</li> <li>▪ Case study Incomati</li> </ul>	
<b>Lecturing Materials</b> Lecture notes and handouts, incl. workbook and assignment of the Incomati case.		<b>Assessment</b> Written examination – 80% Case Study – 20%
<b>Lecturing Staff</b> IHE: Rockstrom, Klaassen, Lubberding, Douven Guest lecturers: vd. Akker (TUD), Sterk (WUR), Fox (Stockholm University), Hong Yang (CH), Moriarty (IRC)		

## Module WM08: Watershed & River Basin Management

No	Subject/Topic	LEC	WSH	LAB	EX	FLT	CH	SLH	CP	Lecturer
<b>1</b>	<b>Introduction</b>	<b>2</b>					<b>2</b>	<b>5</b>	<b>0.2</b>	
1.1	Introduction to Watershed & River Basin Management	2					2	5		Douven, Rockström
<b>2</b>	<b>Water &amp; Food: Soil &amp; Water Management in Agriculture</b>	<b>16</b>					<b>16</b>	<b>40</b>	<b>1.4</b>	
2.1	Soil & Water Management	8					8	20		Rockström
2.2	Erosion Control	4					4	10		Steerk
2.3	Water Harvesting	4					4	10		Fox
<b>3</b>	<b>Water &amp; Ecosystems</b>	<b>8</b>					<b>8</b>	<b>20</b>	<b>0.7</b>	
3.1	Eco-Hydrology	4					4	10		Rockström
3.2	Biodiversity	2					2	5		Klaassen
3.3	Ecosystem Restoration / Natural Conservation	2					2	5		Klaassen
<b>4</b>	<b>From Watershed to River Basin Scale</b>	<b>8</b>					<b>8</b>	<b>20</b>	<b>0.7</b>	
4.1	Hydrological Scale Issues in River Basin Management	4					4	10		Rockström
4.2	System Analysis of River Basin Management	4					4	10		Douven
<b>5</b>	<b>Watershed Planning &amp; Management</b>	<b>10</b>					<b>10</b>	<b>25</b>	<b>0.9</b>	
5.1	Watershed Planning & Management	4					4	10		Rockström
5.2	Organisational & Institutional Issues (incl. Link to River Scale)	4					4	10		Jaspers
5.3	Participatory Approaches in Watershed Development	2					2	5		Hong Yang
<b>6</b>	<b>Case Study</b>	<b>2</b>	<b>10</b>				<b>12</b>	<b>16</b>	<b>0.6</b>	Rockström
<b>7</b>	<b>Fieldtrip</b>					<b>8</b>	<b>8</b>	<b>8</b>	<b>0.3</b>	Kelderman
	<b>Totals</b>	<b>46</b>	<b>10</b>			<b>8</b>	<b>56</b>	<b>134</b>	<b>4.8</b>	

**MASTERS PROGRAMME**

# WATER MANAGEMENT

Academic Year: 2003/2004

Specialisation: Water Resources Management & Water Quality Management

MODULE SHEET

<b>Module Name</b> <b>Water Law and Institutions</b>	<b>Module Code</b> <b>WM09</b>	<b>Credit Points</b> <b>5</b>
<b>Target Group</b> Young & Mid-career professionals and middle level decision makers dealing with water management.	<b>Prerequisites</b> Relevant water science related BSc degree; some experience in water management; good command in English.	
<b>Learning Objectives</b> Participants gain a basic knowledge of (international) water and environmental legislation, institutional, management arrangements with the emphasis on the application of principles of IWRM. Participants acquire a thorough understanding of water allocation criteria, water rights, water (effluent) permit systems and contract management. Participants get acquainted with legal procedures for international water conflict resolution gain experience in the application thereof. Participants are introduced in the analysis and the application of models for institutional development with emphasis on water sector reform, river basin management, integrated planning, commercialisation, private sector participation. On conclusion of the course, the participants should have a better understanding of the mentioned subjects and improved skills of and attitudes towards the application modalities		
<b>Syllabus</b> Principles, concepts and tools of (international) water law, the UN system, conflict resolution, from conflict to co-operation, decentralisation, river basin organisations, contract management, water institutions, water allocation and water rights, management arrangements, strategy development, shared vision development, institutional reform, public private partnerships, stakeholder participation, water allocation from international rivers.		
<b>Didactics</b> The contact hours in the module include a series of interactive lectures, question and answer games, workshops, role plays, meta plan sessions. The lectures are accompanied by Power-Point-presentations and interactive Internet based lecture notes with accompanying exercises and related literature. Further, a selection of relevant field trips is embedded in the module.	<b>Subjects</b> Water Law, Water Institutions, Public Private Partnerships, Stakeholder Participation, Conflict Resolution, Contract Management, Strategy & Vision Development, Culture of Management	
	<b>Assessment</b> Case Study – 20% Written examination – 80%	
<b>Lecturing Materials</b> Drs.ing. F.G.W. Jaspers, Institutions for Integrated Water Resources Management, IHE lecture notes Drs.ing. F.G.W. Jaspers, Role play International Rivers, IHE lecture notes Drs.ing. F.G.W. Jaspers, Introduction in Contract Management, IHE lecture notes Prof. Dr. J. Gupta, International Water Law and Institutions, IHE lecture notes Prof. Dr. H.S.A. Savenije, Management Arrangements, IHE lecture notes		
<b>Lecturing Staff</b> Prof. J. Gupta, Prof. H.S.A. Savenije, Drs.ing. F.G.W. Jaspers, Drs. K.Schwartz, Ir. J. Bos, Dr. E. Mostert, Mr. v.d. Beesen		

## Module WM09: Water Law & Institutions

No	Subject/Topic	LEC	WSH	LAB	EX	FLT	CH	SLH	CP	Lecturer
1	Introduction Water Law	4					4	8	0.3	Gupta
2	Conflict Resolution	4					4	8	0.3	Gupta
3	Environmental Law	4					4	8	0.3	Gupta
4	Institutions	12					12	24	0.9	Jaspers
5	Decentralisation	4					4	8	0.3	Jaspers
6	Contract Management	6	2				8	14	0.5	Jaspers
7	Stakeholder Participation	4					4	8	0.3	Bos
8	Cultures of Management	2	4				6	8	0.3	Savenije, v.d. Beesen
9	<b>Elective 1*:</b>									
9.1	International Water Law*	4					4	8	0.3	Gupta
9.2	Water Allocation*	4					4	8	0.3	Jaspers
9.3	Private-Public Partnerships*	4	4				8	12	0.4	Schwartz
10	<b>Elective 2*:</b>									
10.1	Shared Vision Development Role Play*		8				8	8	0.3	Jaspers
10.2	Water Allocation International Rivers*	2					2	4	0.1	Jaspers
10.3	Policy Development*		8				8	8	0.3	Jaspers
10.4	EU Framework Directive*	4	4				8	12	0.4	Jaspers
10.5	Dutch Water Organisations*	4					4	8	0.3	Mostert
11	<b>Case Study</b>	2	10				12	16	0.6	Jaspers
12	<b>Fieldtrip</b>					8	8	8	0.3	Kelderman
<b>Totals</b>		<b>46+</b>	<b>16+</b>			<b>8</b>	<b>70-86</b>	<b>130-150</b>	<b>4.6-5.4</b>	

\* May not all be offered every year

**MASTERS PROGRAMME**

# WATER MANAGEMENT

Academic Year: 2003/2004  
 Specialisation: Water Services Management

MODULE SHEET

<b>Module Name</b> <div style="text-align: center; font-size: 1.2em; font-weight: bold;"> <span style="border-bottom: 1px solid black; display: inline-block; width: 100px; margin-right: 5px;"></span> <b>Managing Organizations and Change</b> </div>	<b>Module Code</b>  <div style="text-align: center; font-size: 1.2em; font-weight: bold;">WM10</div>	<b>Credit Points</b>  <div style="text-align: center; font-size: 1.2em; font-weight: bold;">5</div>
<b>Target Group</b> This module is designed for mid-career professionals with an interest in organisational and change management aspects of water organisations.	<b>Prerequisites</b> BSc; basic PC-computer knowledge (MS-Windows, MS-Office); good English command.	
<b>Learning Objectives</b> The aim of this course is to provide participants with a comprehension of essential elements within the field of organisational and change management. It considers managerial and change management aspects of organisations in transition and will give a practical insight into concepts, tools and systems. Upon course completion the participants should be able to: <ul style="list-style-type: none"> <li>• Compare and contrast between the characteristics of bureaucratic and organic organisations</li> <li>• Describe the study of management and organisational behaviour</li> <li>• Undertake institutional analysis</li> <li>• Explain the concepts of change and why the study of organisations and change is important for managers</li> <li>• Distinguish between models and types of change and describe why change is often resisted</li> <li>• Delineate the steps in managing the change process</li> <li>• Identify factors that influence human resources management in an organisation and how these factors impact on change within the organisation.</li> <li>• Describe and apply a range of tools and systems that can be used for the guidance, implementation, and management of change.</li> </ul>		
<b>Syllabus</b> Organisational perspectives; organisations and institutions, institutional analysis (PEST & SWOT) organisational behaviour, organisational structure, the behaviour of people in organisations and the behaviour of organisation. Understanding change; concepts of change, models of change, drivers for change, categories of change (including tactical and strategic), barriers / resistance, managing the process of change. . Human resources management, organisational culture, leadership and management style, teamwork, influencing, change and stress. Systems for change; total quality management, management information systems		
<b>Didactics</b> The contact hours in the module include lectures, workshops and case studies. The lectures are accompanied by overhead sheets and PowerPoint-presentations that are made available to the participants for self-study. Also videos are also used during the lectures. A one-day fieldtrip is organised.	<b>Subjects</b> <ul style="list-style-type: none"> <li>- Organisational Perspectives and Analysis</li> <li>- Understanding Change</li> <li>- Human Resources Management</li> <li>- Systems for Change</li> </ul>	
		<b>Assessment</b> Development of Change Management Plan – 50% First Assignment – 25% Second Assignment – 25%
<b>Lecturing Material / Recommended Reading</b> Bos – Managing organisations and change – IHE Lecture Note		
<b>Lecturing Staff</b> Module Coordinator: Bos, Lecturing Staff: D. Schotanus, M. Schouten, A. Bos		

## Module WM10: Managing Organisations and Change

No	Subject/Topics	LEC	WSH	LAB	EX	FLT	CH	SLH	CP	Lecturer
<b>1</b>	<b>Understanding Change</b>									
1.1	Concepts, Models, and Categories of change	3					3			Bos
1.2	Barriers / Resistance to Change	3					3			Bos
1.3	Managing the Change Process	3					3			Bos
<b>2</b>	<b>Organisational Perspectives</b>									
2.1	Organisational Behaviour	3					3			GL
2.2	Organisational Structure	2	2				4			Bos
<b>3</b>	<b>Human Resources and Change</b>									
3.1	HRD and Capacity Building in the Water Sector	4					4			Blokland (?)
3.2	Leadership, Management Styles, and Teamwork	4					4			Bos
3.3	Organisational Culture	3	1				4			IHE
3.4	Influencing	3	3				6			GL
3.5	Change and Stress	2					2			GL
<b>4</b>	<b>Systems for Change</b>									
4.1	Benchmarking & Performance Management	4					4			Schouten
4.2	Total Quality Management	4					4			Bos
4.3	Management Information Systems	4					4			Schotanus
4.4	The use and application of GIS		8				8			Schotanus
<b>5</b>	<b>Fieldtrip</b>					4	4			Bos
	<b>Total</b>	<b>42</b>	<b>14</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>60</b>			

**MASTERS PROGRAMME****WATER MANAGEMENT**

Academic Year: 2003/2004

Specialisation: Water Quality Management

## MODULE SHEET

<b>Module Name</b> <b>Module Water Quality Assessment</b>		<b>Module Code</b> <b>WM11</b>	<b>Credit Points</b> <b>5</b>
<b>Target Group</b> Professionals (scientists, decision-makers) with a background in water management		<b>Prerequisites</b> Bachelor degree in e.g. chemistry, chemical engineering, biology, environmental science, hydrology, geography.	
<b>Learning Objectives</b> After the three week module, successful participants will be able to: <ul style="list-style-type: none"> <li>▪ Evaluate the fates and risks of important environmental pollutants in the aquatic environment;</li> <li>▪ Apply a number of water quality models as a tool in water management;</li> <li>▪ Present the results of water quality monitoring in an organised, systematic manner;</li> <li>▪ Construct sustainable water quality monitoring programmes;</li> <li>▪ Be a successful actor in the introduction and evaluation of these water quality monitoring programmes in water shed and river basin management.</li> </ul>			
<b>Syllabus</b> <ul style="list-style-type: none"> <li>▪ Water quality and monitoring</li> <li>▪ Data analysis and presentation</li> <li>▪ Aquatic ecotoxicology</li> <li>▪ Water quality modelling</li> <li>▪ Case study: construction of a water quality monitoring programme.</li> </ul>			
<b>Didactics</b> Lectures, computer exercises, group discussions, fieldtrips, fieldwork.		<b>Subjects</b>	
		<b>Assessment</b> Case Study – 20% Written examination – 80%	
<b>Lecturing Material / Recommended Reading</b> <ul style="list-style-type: none"> <li>▪ Lecture notes</li> <li>▪ Water quality software</li> <li>▪ Laboratory and field kit instructions</li> </ul>			
<b>Lecturing Staff</b> IHE: Kelderman, Kruis, Mul  Guest lecturers: De Kruijf, Minns, van Gils, Vermaat			

## Module WM11: Water Quality Assessment

No	Subject/Topic	LEC	WSH	LAB	EX	FLT	CH	SLH	CP	Lecturer
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**MASTERS PROGRAMME**

# WATER MANAGEMENT

Academic Year: 2003/2004  
 Specialisation: Water Quality Management

MODULE SHEET

<b>Module Name</b> <b>Wetlands for Water Quality</b>	<b>Module Code</b> <b>WM12</b>	<b>Credit Points</b> <b>5</b>
<b>Target Group</b>	<b>Prerequisites</b>	
<p><b>Learning Objectives</b>                  To make participants aware of the value of wetlands, and to provide them with information about the usefulness of the use of natural and constructed wetlands for the treatment of wastewater, and an integrated production system..                  At the end the participants should be able to understand the concept of waster purification by macrophytes, and they should be able to design such a system and an integrated production system.</p>		
<p><b>Syllabus</b>                  Introduction on wetlands: what are wetlands, where are wetlands, and the role of wetlands. The role of wetlands in the catchment area: general aspects, hydrological aspects, wetlands as buffers and the role in relation to climate. Natural wetlands being used for wastewater treatment: the basic principles, the advantages and disadvantages, the risks. Examples in a temperate climate and examples in the tropics. Constructed wetlands for wastewater treatment: the different types, the design and criteria for design. Advantages and disadvantages. The Dutch situation, case studies in the tropics. Waste stabilisation ponds. Integrated production systems: examples, advantages, disadvantages, economics, nutrient flows. Modelling of integrated production systems. Field visits.</p>		
<p><b>Didactics</b>                  The contact hours in the module include lectures, workshops, and computer exercise. The lectures are accompanied by the PowerPoint-presentations. Many lectures will be given both for students at IHE and students at the University of Dar es Salaam and Makerere University. They will be given by a video conferencing technique. Part of the lectures will be given in Kampala, Dar es Salaam and Prague, and can be followed by the students in Delft through a video conferencing technique as well Field visits to constructed wetlands are organised.</p>		<p><b>Subjects</b>                  3. Introduction on natural wetlands                  4. Natural wetlands for wastewater treatment                  5. Constructed wetlands for wastewater treatment                  6. Integrated production systems                  -</p> <p><b>Assessment</b>                  Overall examination – 50 %                  Assignment nutrient modelling – 50 %</p>
<p><b>Lecturing Materials</b>                  Powerpoint presentations                  Case studies                  Reference materials</p>		
<p><b>Lecturing Staff</b>                  Prof. Dr. P. Denny, Dr. J.J.A. van Bruggen, Dr. P. de Laat, J. Pokorny, Dr. J. Vymazal, Prof. Dr. H.J. Gijzen, Dr. T. Okurut, Prof. Dr. T. Mbwette, Dr. A. van Dam, Dr. F. Kansime, Dr. B. Ottow</p>		

## Module WM12: Wetlands for Water Quality

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**MASTERS PROGRAMME**

# WATER MANAGEMENT

Academic Year: 2003/2004  
 Specialisation: Water Quality Management

MODULE SHEET

<b>Module Name</b> <b>Human Impacts on Aquatic Ecosystems</b>		<b>Module Code</b> <b>WM13</b>	<b>Credit Points</b> 5
<b>Target Group</b> Mid-career professionals and middle level decision makers dealing with water management.		<b>Prerequisites</b> Relevant water science related BSc degree; some experience in water management; good command in English.	
<b>Learning Objectives</b> After successful completion of this module participants will be competent in a range of field, mesocosm and laboratory techniques and will be able to: <ul style="list-style-type: none"> <li>▪ carry out experimental field and laboratory research, including statistical data analysis and reporting/presentation</li> <li>▪ analyse the impacts of human activities on aquatic ecosystems</li> <li>▪ integrate ecological knowledge into the management of aquatic ecosystems</li> </ul>			
<b>Syllabus</b>			
<b>Didactics</b> Lectures, laboratory experiments, fieldwork, computer simulations.		<b>Subjects</b> <ul style="list-style-type: none"> <li>- Experimental manipulations (lake eutrophication)</li> <li>- Computer simulation on lake restoration</li> <li>- Integrated fieldwork (water quality assessment, river discharge, land-use and soil quality, GIS)</li> <li>- Ecological functions and values in river basins</li> <li>- Soil quality and management</li> </ul>	
		<b>Assessment</b> <ul style="list-style-type: none"> <li>▪ Written examination at the end of the module (60%)</li> <li>▪ Individual performance during laboratory and field activities (10%)</li> <li>▪ Written group report and oral presentation (30%)</li> </ul>	
<b>Lecturing Materials</b> Lecture notes, practical and field guides, library references.			
<b>Lecturing Staff</b> de Ruyter van Steveninck, Lubberding, Venneker, Schotanus, Kruis, <i>Hartemink</i>			

## Module WM13: Human Impacts on Aquatic Ecosystems

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**MASTERS PROGRAMME****WATER MANAGEMENT**

Academic Year: 2003/2004

Specialisation: Water Services Management

## MODULE SHEET

<b>Module Name</b> <b>Water Services Management</b>		<b>Module Code</b> <b>WM14</b>	<b>Credit Points</b> <b>5</b>
<b>Target Group</b> Young and Mid-career professionals who are 1) working at middle and upper management level in a water utility 2) employed in policy making institutions in the water sector or 3) working for NGOs engaged with aspects of water services provision.		<b>Prerequisites</b> BSc; basic PC-computer knowledge (MS-Windows, MS-Office); good English command.	
<b>Learning Objectives</b> The aim of this module is to provide participants a general introduction to the subject of water services management. On conclusion of the course participants will be able to demonstrate a general understanding of the service provision process (in terms of infrastructure, organization and management) from the source to the customer. Upon module completion the participants should be able to: <ul style="list-style-type: none"> <li>• Share insight in the management approach to water sector issues</li> <li>• Provide and overview of the tools available to water sector managers</li> <li>• Provide arguments in favour and against private sector involvement in the water sector and illustrate this in the water sector</li> <li>• Explain customers management</li> <li>• Analyse institutional arrangements for water services provision</li> </ul>			
<b>Syllabus</b> Introduction water services management. Introduction Porter's Value Chain: primary activities for service delivery (including operations, marketing and sales, services), support activities for service delivery (including infrastructure, human resource management, procurement). Strategic management: vision, mission, goals, objectives. Business Processes Management: Customer orientation, market-orientation, delegation of authority in the utility, accountability for results. Institutional Arrangement: decentralization, public-private partnerships, regulation, models of service delivery.			
<b>Didactics</b> The contact hours in the module include lectures and casestudies. The lectures are accompanied by the overhead sheets and PowerPoint-presentations that are made available to the participants for self-study and while working on the case studies. In addition, a one-day fieldtrip is organised to expose participants to the main issues facing the water service providers.		<b>Subjects</b> - Porter's Value Chain - Business Processes - Strategic Management - Institutional Arrangements for Water Services Provision	
		<b>Assessment</b> Examination – 70% Assignment – 30%	
<b>Lecturing Material</b> IHE Lecture Notes			
<b>Lecturing Staff</b> Module Coordinator: K. Schwartz. Lecturing Staff: M.P. van Dijk; M. Schouten; A.Bos; K. Schwartz			

## Module WM14: Water Services Management

No	Subject/Topic	LEC	WSH	LAB	EX	FLT	CH	SLH	CP	Lecturer
	<b>Basics of Water Services Management</b>									
1	Introduction Water Services Management	2	2				4	8		Van Dijk
2	Typology of goods	2	2				4	8		Van Dijk
3	Introduction Strategic Management	2	2				4	8		Bos
4	Vision, mission, goals, objectives	2	2				4	8		Bos
5	Porter's Value Chain	2	2				4	8		Schouten
6	Primary activities	2	2				4	8		Schouten
7	Support Activities	2	2				4	8		Schouten
9	Business Processes Analysis	2	2				4	8		GL
10	Customer-oriented services	2	2				4	8		GL
11	Market-oriented service delivery	2	2				4	8		GL
12	Accountability	2	2				4	8		Schwartz
13	Introduction Institutional Arrangements	2	2				4	8		Schwartz
14	Decentralization	2	2				4	8		Schwartz
15	Public-private partnerships	2	2				4	8		Schouten
16	Regulation	2	2				4	8		Van Dijk
17	Models for service delivery	2	2				4	8		Schwartz
18	Fieldtrip Water Services Management					8	8	8		Schwartz
	<b>Total</b>	<b>32</b>	<b>32</b>			<b>8</b>	<b>72</b>	<b>140</b>		

**MASTERS PROGRAMME****WATER MANAGEMENT**

Academic Year: 2003/2004

Specialisation: Water Services Management

## MODULE SHEET

<b>Module Name</b> <b>Water Supply and Sanitation Systems</b>		<b>Module Code</b> <b>WM15</b>	<b>Credit Points</b> <b>5</b>
<b>Target Group</b> Mid-career professionals dealing with planning and management aspects of water supply and sanitation infrastructure, working for municipalities, ministries, water and sewerage agencies or consulting firms.		<b>Prerequisites</b> Bachelors degree in Engineering or equivalent technical background meeting the IHE's M.Eng. programme entry requirements.	
<b>Learning Objectives</b> To provide the general overview and systems level knowledge on the technical and engineering aspects of water supply and sanitation infrastructure. On conclusion of the module, the participant should: acquire and master knowledge on different types of water supply and sanitation systems and suitability of application under different conditions, be familiar with the treatment processes, structural components, function and performance of water supply and sanitation systems, and obtain sufficient technical background for system level planning and operation and maintenance of the associated facilities.			
<b>Syllabus</b> <u>Water Supply Systems:</u> Introduction, Raw water quality, water source selection, general considerations for drinking water, drinking water quality standards, raw water (surface and groundwater) abstraction, pre-treatment and storage, conventional water treatment methods (aeration, filtration, coagulation, sedimentation, disinfection), water treatment processes and plants, water transport and distribution (system components, unaccounted-for water). <u>Sanitation Systems:</u> Introduction, On-site and off-site sanitation systems, sewerage and drainage systems (combined and separate sewerage, components of the sewerage system), wastewater treatment processes (removal of organic matter, nitrogen and phosphorus) and plants (primary, secondary and tertiary treatment), sludge management (treatment, disposal and reuse), and solid waste management (technological options for waste collection, transport, transfer, treatment and disposal).			
<b>Didactics</b> The contact hours in the module include lectures, design exercise and field visit. The lectures are accompanied by the PowerPoint-presentations, slide shows and are interactive. Additionally, field visit will be made to a water treatment plant and a wastewater treatment plant in The Netherlands.		<b>Subjects</b> 1. Water Sources and Treatment 2. Water Transport and Distribution 3. Sewerage and Drainage 4. Wastewater treatment 5. Solid Waste Management	
		<b>Assessment</b> Written Examination Design Exercise/Assignments	
<b>Lecturing Material / Recommended Reading</b> New module (Lecture materials to be prepared or revised/collated from the related previous lecture notes).			
<b>Lecturing Staff</b> Dr. D. Brdjanovic, Ir. J.P. Buiteman, In N. Trifunovic, Dr. S. Sharma, Dr. E. Akinyemi, Dr. L. Rodic, Ir S. Veenstra			

## Module WM15: Water Supply and Sanitation

No	Subject/Topic	LEC	WSH	LAB	EX	FLT	CH	SLH	CP	Lecturer
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**MASTERS PROGRAMME****WATER MANAGEMENT**

Academic Year: 2003/2004  
 Specialisation: Water Services Management

## MODULE SHEET

<b>Module Name</b> <b>Operations Management</b>		<b>Module Code</b> <b>WM16</b>	<b>Credit Points</b> 5
<b>Target Group</b> Mid-career professionals who are 1) working at middle and upper management level in a water utility 2) employed in policy making institutions in the water sector or 3) working for NGOs engaged with aspects of water services provision.		<b>Prerequisites</b> BSc; basic PC-computer knowledge (MS-Windows, MS-Office); good English command.	
<b>Learning Objectives</b> The aim of the module is to acquire operational management skills. On conclusion of the course participants should be able to: <ul style="list-style-type: none"> <li>• explain what operations management is and identify its important features.</li> <li>• design appropriate operations and maintenance routines for water utilities</li> <li>• demonstrate understanding of the basics of make-or-buy decision making</li> <li>• identify and compare key performance indicators and their relevance to the benchmark process</li> <li>• identify the importance of customer orientation for commercial operations</li> </ul>			
<b>Syllabus</b> Operations management; managerial objectives and operational routines; performance targets and indicators; asset management; maintenance; management strategies, stores management; maintenance information systems; Marketing consumer segmentation, price and service differentiation, education and communication, public relations			
<b>Didactics</b> The contact hours in the module include lectures and case studies. The lectures are accompanied by overhead sheets and PowerPoint-presentations that are made available to the participants for self-study. Moreover, a one-day fieldtrip is organised.		<b>Subjects</b> <ul style="list-style-type: none"> <li>- Operations Management</li> <li>- Performance targets and indicators / Benchmarking</li> <li>- Asset management</li> <li>- Maintenance information systems</li> <li>- Marketing</li> </ul>	
		<b>Assessment</b> Examination – 50% First assignment – 25% Second assignment – 25%	
<b>Lecturing Material</b> O.Braadbaart – Handbook Utility Operations and Maintenance - IHE Lecture Notes			
<b>Lecturing Staff</b> Module Coordinator: M. Schouten Lecturing Staff: M. Schouten, Okke Braadbaart, A. Bos			

## Module WM16: Operations Management

No	Subject/Topic	LEC	WSH	LAB	EX	FLT	CH	SLH	CP	Lecturer
<b>1</b>	<b>Basics of Operations Management</b>						<b>48</b>			
1.1	Introduction operations management	4	0	0		0	4			Schouten
1.2	Managerial objectives and operational routines	4	0	0		0	4			Schouten
1.3	Performance targets and indicators	4	2	0		0	6			Bos
1.4	Asset management	4	4	0		0	4			GL
1.5	Maintenance	4	4	0		0	6			GL
1.6	Why things break down	4	0	0		0	4			GL
1.7	Procurement management	4	2	0		0	6			Schouten
1.8	Stores management	4	2	0		0	6			Schouten
1.8	Marketing & Sales	4	4	0		0	8			GL
1.9	Management information systems	8	0	0		0	8			GL
<b>2</b>	<b>Special Topics</b>									
2.1	Fieldtrip Operations Management	0	0	0		8	8			Schouten
	<b>Total</b>	<b>44</b>	<b>16</b>				<b>60</b>			

**MASTERS PROGRAMME**

# WATER MANAGEMENT

Academic Year: 2003/2004  
 Specialisation: Water Services Management

MODULE SHEET

<b>Module Name</b> <b>Financial Management of Utilities</b>	<b>Module Code</b> <b>WM17</b>	<b>Credit Points</b> <b>5</b>
<b>Target Group</b> This module is designed for young and mid-career professionals with an interest in financial management aspects of water utilities and people who are 1) working at middle and upper management level in a water utility 2) employed in policy making institutions in the water sector or 3) working for NGOs engaged with aspects of water services provision.	<b>Prerequisites</b> BSc; basic PC-computer knowledge (MS-Windows, MS-Office); good English command.	
<b>Learning Objectives</b> The module financial management deals with the finance issue at the level of the utility and suggests different ways of financing water companies and sanitation units. The objectives of this module are to provide: the principles of financial management for staff from water companies and government water departments, the participants with different options for financing recurrent cost and investments of water companies, desalination and waste water treatment plants, and to provide examples of alternative approaches to financing. On conclusion of the module participants will be able to: <ul style="list-style-type: none"> <li>• demonstrate the need for commercial accounting and the components of standard financial statements in water services entities;</li> <li>• Assess the financial position of a water organisation through an analysis of financial statements;</li> <li>• Prepare a financing plan for sustainable water and sanitation delivery</li> </ul>		
<b>Syllabus</b> Finance for water supply and sewerage: types of costs; cost & fixed asset accounting; Financial statements – Balance Sheet and Income and Expenses Statement; Profitability & financial ratio analysis; Demand assessment; affordability and willingness to pay; direct and contingent valuation; vendors; economics: supply & demand curves; marginal costing, price and income elasticity; tariffs: average historical costs, long run marginal costing; metering, billing & collection; budgeting, zero & priority based budgeting; Sources of finance for capital investment; bond markets; development banks; project finance; retained earnings. Case Studies in financial management;		
<b>Didactics</b> The contact hours in the module include lectures, workshops and case studies. The lectures are accompanied by overhead sheets and PowerPoint-presentations that are made available to the participants for self-study. Also videos are also used during the lectures. A one-day fieldtrip is organised.	<b>Subjects</b> <ul style="list-style-type: none"> <li>- Accounting systems</li> <li>- Financial statements</li> <li>- Financial ratio analysis</li> <li>- Demand assessment</li> <li>- Affordability and willingness to pay</li> <li>- Economics</li> <li>- Tariffs</li> <li>- Sources for finance</li> </ul>	
	<b>Assessment</b> Exam – 50% First Assignment – 25% Second Assignment – 25%	
<b>Lecturing Material / Recommended Reading</b> Reader composed by van Dijk		
<b>Lecturing Staff</b> Module Coordinator: K. Schwarz. Lecturing Staff: M. Schouten, Prof dr. M.P. van Dijk, C.Figueres, K. Schwarz		

## Module WM17: Financial Management of Utilities

No	Subject/Topic	LEC	WSH	LAB	EX	FLT	CH	SLH	CP	Lecturer
1	Introduction Financial management	2	2				4	8		Schwartz and Schouten
2	Cost & fixed accounting	2	2				4	8		GL
3	Financial statements	2	2				4	8		Schouten
4	Profitability & financial ratio analysis	2	2				4	8		GL
5	Present value and cost of capital	2	2				4	8		Van Dijk
6	Demand assessment, affordability/willingness to pay	2	2				4	8		GL
7	Direct and contingent valuation	2	2				4	8		Schouten
8	Supply and demand curves	2	2				4	8		GL
9	Marginal Costing, price and income elasticity	2	2				4	8		GL
10	Tariffs and pricing of water services	2	2				4	8		GL
11	Metering billing and collection	2	2				4	8		GL
12	Budgetting, zero and priority based budgeting	2	2				4	8		GL
13	Access to capital markets	2	2				4	8		Van Dijk
14	Issuing bonds vs obtaining a loan	2	2				4	8		Van Dijk
15	Credit rating agencies	2	2				4	8		GL
16	Comparing different sources of finance	2	2				4	8		GL
17	Financial Management in the Dutch water sector	2	2				4	8		Figueres
18	Fieldtrip Financial Management in the Dutch water sector					8	8	8		Schwartz
	<b>Total</b>	<b>34</b>	<b>34</b>			<b>8</b>		<b>144</b>		

**MASTERS PROGRAMME****WATER MANAGEMENT**

Academic Year: 2003/2004

Specialisation: Water Services Management

## MODULE SHEET

<b>Module Name</b> <b>Public Private Partnerships</b>		<b>Module Code</b> <b>WM18</b>	<b>Credit Points</b> <b>5</b>
<b>Target Group</b> This module is designed for young and mid-career professionals with an interest in financial management aspects of water utilities and people who are 1) working at middle and upper management level in a water utility 2) employed in policy making institutions in the water sector or 3) working for NGOs engaged with aspects of water services provision.		<b>Prerequisites</b> BSc; basic PC-computer knowledge (MS-Windows, MS-Office); good English command.	
<b>Learning Objectives</b>  <b>PPP module as designed for POWER</b>			
<b>Syllabus</b>			
<b>Didactics</b>		<b>Subjects</b> -	
		<b>Assessment</b> Exam – 50% First Assignment – 25% Second Assignment – 25%	
<b>Lecturing Material / Recommended Reading</b>			
<b>Lecturing Staff</b> Module Coordinator: Prof dr. M.P. van Dijk			

*Note: Elective Module for WSM Specialisation*

### Module WM18: Public Private Partnerships (Elective)

No	Subject/Topic	LEC	WSH	LAB	EX	FLT	CH	SLH	CP	Lecturer
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