Subject name: Technology and water management
Subject key:76970
Type of subject: Optative
No. of credits approved:
Last date of curricular review: September 2020
Subject matter and subject code requirement: None

A) COURSE NAME: TECHNOLOGY AND WATER MANAGEMENT

Synthetic Program									
Technology and water management									
General information									
Type of proposal to curriculum:	New	x	Restructuring				Adjustment		
Type of subject:	Mandatory		Optative	x	Complementary		Other		
Matter shared with another EP or academic entity	(x) No ( ) Yes What PE is shared? _____ What semester? _____ What academic entity? _____								
Produced by:	Juan Alberto Velázquez Zapata / Abraham Cárdenas Tristán								
Reviewed by:	Abraham Cárdenas Tristán								
Semester	**Hours of theory per week**		**Hours of practice per week**		**Hours additional work student per week**		**Credits**		
	3		1		1		6		
Overall objective	Learn the basics of water management for the proper management of the resource according to the different environments and ecosystems of the cities.								

Synthetic Program		
Specific professional competence (s) that the subject develops	• The student can determine the variables that structures a water management system according to the complex relationship between physical, social and environmental elements. • The student will have the basis for conceptualizing a plan of water management, from identifying the needs of a locality to determine a specific strategy. • The student may specify the use of techniques and geospatial tools for the development of a water management plan .	
Performance tasks of the specific professional competence to those which contribute to develop the subject	• Students will analyze and discuss case studies on the topics of sustainable water management, with emphasis on Mexico, Latin America and other environments and ecosystems of the different territories of the planet. • They will evaluate the characteristics of the arid and humid areas of the region. • Students will be capable to discuss so critical about the various scientific and technical texts in which the program is based and express oral and written arguments.	
Transversal professional competence (s) that contribute to the development of the subject	The student will be able to diagnose fundamental elements of the integral management of water, such as: • The implementation of sustainability for water management • The environmental impact assessment in water management processes • The diagnosis of social and urban needs	
Units	**Units**	**Contents**
	1. Sustainable management of hydric resources	Students will understand the concept of sustainable management of water resources as an alternative part to the action of the water management and hydrological cycle in different environments. In addition, students will learn about the approach to integrated water resources management with emphasis on case studies in Mexico, Latin America and other environments and ecosystems in the territory.
	2. Social and environmental aspects of water resources management	Students will understand the complex relationship between social and environmental elements that involve water management. They will know the concept of the human right to water and the implications of scarcity, pollution and the availability of water in sustainable development. Finally, students will learn about management strategies, planning and distribution as a tool for water management.

Synthetic Program			
	3. Hydrological studies	Students will identify the importance of conducting hydrological studies before any development of water or hydraulic projects. This implies that after having diagnosed about aspects related to social, environmental problems and geomorphological soil conditions, a project proposal for water management can be established.	
	4. Management of surface and groundwater	Students will know the fundamental strategies and elements on the management of surface and groundwater. Likewise, they may design a specific basin and sub-basin approach, which is determined as a provider of water resources both at the surface level and in the deep subsoil.	
Method and practice	**Method**	The course will be organized as a seminar, through guided reading, presentation of the topics by the teachers and the collective dialogue of the different topics. It is also sought that the student proposes readings and documents (written or video, for example) that support the dialogue of the topics.	
	Practices	The course will be organized as a seminar, through guided reading, presentation of the topics by the teachers and the collective dialogue. It is also sought that the student proposes readings and documents (written or video, for example) that support the dialogue of the topics.	
Evaluation method	**Midterm exam**	25%	Evaluation based on unit 1
		25%	Evaluation based on unit 2
		25%	Evaluation based on unit 3
		25%	Evaluation based on unit 4
	Final exam	The ordinary evaluation will be elaborated through the average of the partial units.	
	Other activities	If necessary, field trips would be proposed in which the student will have to prepare a report.	

References and digital resources	**References**	Akhmouch, A., And Delphine, C. (2016) "Stakeholder engagement for inclusive water governance:"Practicing what we preach" with the OECD water governance initiative." Water8.5 (2016): Castro, José Esteban.(2005) Water, power and citizenship: social struggle in the Basin of Mexico. Springer. CENAPRED. Atlas Nacional de Riesgos. Accessed February 28, 2019 http://www.atlasnacionalderiesgos.gob.mx/ Cisneros, B. J., & Rose, J. B. (2009). Urban water security: managing risks: UNESCO-IHP. CRC Press COHRE, AAAS, and UN-HABITAT SDC. (2007) Manual on the Right to Water and Sanitation." COHRE, Geneva (2007). Accessed February 28, 2019 from http://www.worldwatercouncil.org/fileadmin/wwc/Programs/Right_to_Water/Pdf_doct/RTWP__20Manual_RTWS_Final.pdf Comisión Nacional del Agua (2009). - Manual de Agua Potable Alcantarillado y Saneamiento: -Datos Básicos para Proyectos de Agua Potable y Alcantarillado Metodologías de Evaluación Socioeconómica y Estructuración de Proyectos de Inversión (Agua Potable, Alcantarillado, Saneamiento, Mejoramiento de Eficiencia y Protección a Centros de Población)" D.W. Pepper and A. Brebbia eds. (2011). Water and Society, University of Nevada-Las Vegas, USA and, Wessex Institute of Technology, UK EPA (2012). Planning for Sustainability. A Handbook for Water and Wastewater Utilities. Accessed February 27 2019 from https://www.epa.gov/sustainable-water-infrastructure/handbook-planning-sustainability-water-and-wastewater-utilities.

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		EPA. Water Data and Tools Accessed February 28, 2019 https://www.epa.gov/waterdata European Union. Handbook on Sustainable Urban Drainage Systems (SUDS). Accessed 1 march 2019 from https://drainforlife.eu/attachments/article/64/DFL%20SUDS%20Handbook%20final.pdf Fletcher, T., & Deletic, A. (2014). Data Requirements for Integrated Urban Water Management: Urban Water Series-UNESCO-IHP. CRC Press. Gómez, A. (2009). Conceptos de Geomática y estudios de caso en México (No. 526.982097 C6). IANAS The Inter-American Network of Academies of Sciences and UNESCO (2015). Urban water challenges in the Americas: a perspective from the Academies. of Sciences. Accessed February 28, 2019 from https://unesdoc.unesco.org/ark:/48223/pf0000246414 INEGI. Simulador de Flujos de Agua de Cuencas Hidrográficas (SIATL) Accessed February 28, 2019. http://antares.inegi.org.mx/analisis/red_hidro/siatl/# Maderey Rascon, L. E., & Roman, J. (2005). Principios de hidrogeografía. Estudio del ciclo hidrológico. UNAM. Marsalek, J., Karamouz, M., Cisneros, B. J., Malmquist, P. A., Goldenfum, J. A., & Chocat, B. (2014). Urban water cycle processes and interactions: Urban Water Series-UNESCO-IHP. CRC Press. Mays, L. (2014). Integrated Urban Water Management: Arid and Semi-Arid Regions: UNESCO-IHP. CRC Press.

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		Mcnabb, D.E. (2019). Global Pathways to Water Sustainability. Springer.343 pp. Rojas, H.R., Guerrero, G.E.D. (2018) Water Policy in Mexico: Economic, Institutional and Environmental Considerations. Vol. 20. Springer. -Servicio Meteorologico Nacional. Climatología. Accessed February 28, 2019 https://smn.cna.gob.mx/es/climatologia UN (United Nations). 1992. The Dublin Statement on water and sustainable development. from http://www.wmo.int/pages/prog/hwrp/documents/english/icwedece.html. Accesed February 15 2019 UNDP (United Nations Development Program). 2017. Goal six targets. Accessed February 15 2019from www.undp.org/content/undp/en/home/ UNESCO (2012). The United Nations world water development report 4: managing water under uncertainty and risk, executive summary. Accessed February 17, 2019 from https://unesdoc.unesco.org/ark:/48223/pf0000217175?posInSet=32&queryId=N-EXPLORE-97376300-9c74-4170-af2f-e5ec105dc4d3 Vegas Niño et al. (2018) Using the EPANET Toolkit v2.00.12 With Different Programing Environments. Jiutepec, Mor. Mexican Institute of Water Technology, 2018. 119 p. Whiteford, L., & Whiteford, S. (2005). Globalization, water & health: resource management in times of scarcity. James Currey Ltd. WHO (World Health Organization). 2017. Progress on drinking water, sanitation, and hygiene, update and sustainable development goals. World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) Joint

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		Monitoring Program (JMP). Accessed February 15, 20179 from http://apps.who.int/iris/bitstream/10665/258617/1/9789241512893-eng.pdf?ua=1. WMO (2009) WMO Report No 168. Guide to Hydrological Practices Volume II: Management of Water Resources and Application of Hydrological Practices. World Meteorological Organization, Geneva.
	Digital resources	CENAPRED. Atlas Nacional de Riesgos. Accessed February 28, 2019 http://www.atlasnacionalderiesgos.gob.mx/ EPA. Water Data and Tools Accessed February 28, 2019 https://www.epa.gov/waterdata INEGI. Simulador de Flujos de Agua de Cuencas Hidrográficas (SIATL) Accessed February 28, 2019. http://antares.inegi.org.mx/analisis/red_hidro/siatl/# Servicio Meteorologico Nacional. Climatología. Accessed February 28, 2019 https://smn.cna.gob.mx/es/climatologia U.S. Geological Survey. Water resources in the United States Accessed February 28, 2019 https://water.usgs.gov/maps.html

B) CONTENTS AND METHODS BY UNITS AND TOPICS

Unit 1 . Sustainable management of water resources		**10h**
Topic 1.1 Sustainable water development		**3h**
Subtopic	1.1.1 Integrated water resources management approach 1.1.2 The urban hydrological system and its components 1.1.3 Challenges to sustainability in water resources management	
Topic 1.2 The urban water cycle		**4h**
Subtopic	1.2.1 The hydrological system in nature	

	1.2.2 The urban hydrological system and its components 1.2.3 Impact of urbanization on water resources		
Topic 1.3 Urban water systems in different regions			**3h**
Subtopic	1.3.1 Water resources management in different ecosystems and territories 1.3.2 Water resources management in Latin America and other different environments and ecosystems 1.3.3. Water resources management in arid ecosystem areas		
References and digital resources	**References**	1.1.1 **The integrated water resources management approach** WMO (2009) WMO Report No 168. Guide to Hydrological Practices Volume II: Management of Water Resources and Application of Hydrological Practices. World Meteorological Organization, Geneva. 1.1.2 **Historical perspective of integrated water resources management** UN (United Nations). 1992. The Dublin Statement on water and sustainable development. from http://www.wmo.int/pages/prog/hwrp/documents/english/icwedece.html. Accesed February 15 2019 UNDP (United Nations Development Program). 2017. Goal six targets. Accessed February 15 2019from www.undp.org/content/undp/en/home/ WHO (World Health Organization). 2017. Progress on drinking water, sanitation, and hygiene, update and sustainable development goals. World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) Joint Monitoring Program (JMP). Accessed February 15, 20179 from http://apps.who.int/iris/bitstream/10665/258617/1/9789241512893-eng.pdf?ua=1.	

		1.1.3 **Challenges to sustainability in water resources management** Mcnabb, D.E. (2019). Global Pathways to Water Sustainability. Springer.343 pp. UNESCO (2012). The United Nations world water development report 4: managing water under uncertainty and risk, executive summary. Accessed February 17, 2019 from https://unesdoc.unesco.org/ark:/48223/pf0000217175?posInSet=32&queryId=N-EXPLORE-97376300-9c74-4170-af2f-e5ec105dc4d3 **1.2.1 The hydrological system in nature** Maderey Rascon, L. E., & Roman, J. (2005). Principios de hidrogeografía. Estudio del ciclo hidrológico. UNAM. **1.2.2 The urban hydrological system and its components. & 1.2.3 Impact of urbanization on water resources** Marsalek, J., Karamouz, M., Cisneros, B. J., Malmquist, P. A., Goldenfum, J. A., & Chocat, B. (2014). Urban water cycle processes and interactions: Urban Water Series-UNESCO-IHP. CRC Press. **1.3.1 Water resources management in North America & 1.3.2 Water resources management in Latin America** IANAS The Inter-American Network of Academies of Sciences and UNESCO (2015). Urban water challenges in the Americas: a perspective from the Academies. of Sciences. Accessed February 28, 2019 from https://unesdoc.unesco.org/ark:/48223/pf0000246414 **1.3.3. Water resources management in arid areas** Mays, L. (2014). Integrated Urban Water Management: Arid and Semi-Arid Regions: UNESCO-IHP. CRC Press.
	Digital resources	
Teaching methods and learning activities	The course will be organized as a seminar, through guided reading, presentation of the topics by the teachers and the collective discussion of the different topics. It is also sought that the student proposes readings and documents (written or video, for example) that support the discussion of the topics.	

Unit 2 . A spects social and environmental of l management of water resources			10h
Topic 2 .1 Social aspects of water management in different ecosystems and environments			**3h**
Subtopic	2.1.1 Access, to water human right and sanitation 2.1.2 Social actors in water management 2.1.3 Social conflicts over water		
Tema 2.2 Environmental aspects in water management			**3h**
Subtopic	2.2.1 Water quality, water pollution and damages to health 2.2.2 Availability, Scarcity and risk Management on water management 2.2.3 Risks by hydrometeorological phenomena and changing climate		
Topic 2.3 Water Management Plans			**4h**
Subtopic	2.3.1 Evaluation of domestic and industrial water demand 2.3.2 Planning of water management systems in different environments and ecosystems. 2.3.3 Urban water management systems planning 2.3.4 Case studies		
References and digital resources		**2.1.1 Access, to water human right and sanitation** COHRE, AAAS, and UN-HABITAT SDC. (2007) Manual on the Right to Water and Sanitation." COHRE, Geneva (2007). Accessed February 28, 2019 from http://www.worldwatercouncil.org/fileadmin/wwc/Programs/Right_to_Water/Pdf_doct/RTWP__20Manual_RTWS_Final.pdf D.W. Pepper and A. Brebbia eds. (2011). Water and Society, University of Nevada-Las Vegas, USA and, Wessex Institute of Technology, UK **2.1.2 Social actors in water management** Akhmouch, A., And Delphine, C. (2016) "Stakeholder engagement for inclusive water governance:“Practicing what we preach” with the OECD water governance initiative." Water8.5 (2016): **2.1.3 Social conflicts over water**	

		Castro, José Esteban.(2005) Water, power and citizenship: social struggle in the Basin of Mexico. Springer. Rojas, H.R., Guerrero, G.E.D. (2018) Water Policy in Mexico: Economic, Institutional and Environmental Considerations. Vol. 20. Springer.
		2.2.1 Water quality, water pollution and health effects Cisneros, B. J., & Rose, J. B. (2009). Urban water security: managing risks: UNESCO-IHP. CRC Press Whiteford, L., & Whiteford, S. (2005). Globalization, water & health: resource management in times of scarcity. James Currey Ltd. **2.2.2 Availability, scarcity and risk management in the urban water cycle** Oswald, U. (2011). Water resources in Mexico: scarcity, degradation, stress, conflicts, management, and policy. Hexagon series on human and environmental security and peace (vol. 7). World Economic Forum Water Initiative. (2012). Water security: the water-food-energy-climate nexus. Island Press. **2.2.3 Risks by hydrometeorological phenomena and changing climate** Martínez, M. F. (2006). Más allá del Cambio Climático: las dimensiones psicosociales del cambio ambiental global. Instituto Nacional de Ecología. Parry, M. L. et al. (eds) Climate Change (2007): Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge Univ. Press).

		2.3.1 Evaluation of domestic and industrial water demand Baumann, D. D., Boland, J., & Hanemann, W. M. (1998). Urban water demand management and planning (pp. 1-10). New York: McGraw-Hill. **2.3.2 Planning of water management systems in different environments and ecosystems** Maheepala, S., Blackmore, J., Diaper, C., Moglia, M., Sharma, A., & Kenway, S. (2010). Integrated urban water management planning manual. Accesed February 25 2018 from https://publications.csiro.au/rpr/download?pid=csiro:EP10449&dsid=DS1
Teaching methods and learning activities	The course will be organized as a seminar, through guided reading, presentation of the topics by the teachers and the collective discussion of the different topics. It is also sought that the student proposes readings and documents (written or video, for example) that support the discussion of the topics.	

Unit 3 . Hydrological studies		**14h**
Unit 3 .1 Diagnosis of the study area		**4h**
Subtopic	3.1.1 Geomorphological study of a basin according to its environment and ecosystem 3.1.2 Climatic study	
Topic 3 .2 Water supply systems		**6h**
Subtopic	3.2.1 Demand and water sources 3.2.2 The expense-runoff calculation 3.2.3 The disinfection and purification process 3.2.4 Water distribution systems according to diverse environments and ecosystems	
Topic 3 .3 Water sanitation systems		**4h**
Subtopic	3.3.1 Combined and separate domestic and storm water drainage systems 3.3.2 USDS (Urban sustainable drainage systems) 3.3.3 Water sanitation methods	

References and digital resources		Comisión Nacional del Agua (2009). - Manual de Agua Potable Alcantarillado y Saneamiento: -Datos Básicos para Proyectos de Agua Potable y Alcantarillado -Integración de un organismo operador -Metodologías de Evaluación Socioeconómica y Estructuración de Proyectos de Inversión (Agua Potable, Alcantarillado, Saneamiento, Mejoramiento de Eficiencia y Protección a Centros de Población) EPA (2012). Planning for Sustainability. A Handbook for Water and Wastewater Utilities. Accessed February 27 2019 from https://www.epa.gov/sustainable-water-infrastructure/handbook-planning-sustainability-water-and-wastewater-utilities. European Union. Handbook on Sustainable Urban Drainage Systems (SUDS). Accessed 1 march 2019 from https://drainforlife.eu/attachments/article/64/DFL%20SUDS%20Handbook%20final.pdf Marsalek, J., Karamouz, M., Cisneros, B. J., Malmquist, P. A., Goldenfum, J. A., & Chocat, B. (2014). Urban water cycle processes and interactions: Urban Water Series-UNESCO-IHP. CRC Press
Teaching methods and learning activities	The course will be organized as a seminar, through guided reading, presentation of the topics by the teachers and the collective discussion of the different topics. It is also sought that the student proposes readings and documents (written or video, for example) that support the discussion of the topics.	

Unit 4 . Management of surface and groundwater	**14h**
Unit 4 .1 Hydrological basin modeling	**4h**
Subtopic	4.1.1 The basin design 4.1.2 The determination of sub-basins

	4.1.3 The modeling of the basin and sub-basin 4.1.4 Use of geospatial technologies for basin modeling		
Topic 4 .2 Surface waters			**6h**
Subtopic	4.2.1 Identification of the physical components of drains and runoff 4.2.2 The meteorological-climatic aspects that affect surface water supplies 4.2.3 Wastewater 4.2.4 Rainwater 4.2.5 Water distribution and administration 4.2.6 Surface water modeling in Geographic Information Systems		
Tema 4.3 Groundwater			**4h**
Subtopic	4.3.1 Identification of the geomorphology of the subsoil and groundwater 4.3.2 Identification, extraction and hydrological balance of groundwater 4.3.3 Piezometric census and water management by extraction 4.3.4 The process of extraction, management and distribution of groundwater 4.3.5 Groundwater modeling in Geographic Information Systems		
References and digital resources	**References**	**Topic 4.1 Acquisition and validation of data & 4.2 Integration of the components of an integrated urban water management system** Fletcher, T., & Deletic, A. (2014). Data Requirements for Integrated Urban Water Management: Urban Water Series-UNESCO-IHP. CRC Press. **Topic 4.3 Computer tools for water management**Gómez, A. (2009). Conceptos de Geomática y estudios de caso en México (No. 526.982097 C6). Vegas Niño et al. (2018) Using the EPANET Toolkit v2.00.12 With Different Programing Environments. Jiutepec, Mor. Mexican Institute of Water Technology, 2018. 119 p.	
	Digital resources	CENAPRED. Atlas Nacional de Riesgos. Accessed February 28, 2019 http://www.atlasnacionalderiesgos.gob.mx/ EPA. Water Data and Tools Accessed February 28, 2019 https://www.epa.gov/waterdata	

		INEGI. Simulador de Flujos de Agua de Cuencas Hidrográficas (SIATL) Accessed February 28, 2019. http://antares.inegi.org.mx/analisis/red_hidro/siatl/# Servicio Meteorologico Nacional. Climatología. Accessed February 28, 2019 https://smn.cna.gob.mx/es/climatologia U.S. Geological Survey. Water resources in the United States Accessed February 28, 2019 https://water.usgs.gov/maps.html
Teaching methods and learning activities	The course will be organized as a seminar, through guided reading, presentation of the topics by the teachers and the collective discussion of the different topics. It is also sought that the student proposes readings and documents (written or video, for example) that help to discuss the topics, such as the development of practical exercises with the use of geospatial technologies.	

C) TEACHING AND LEARNING STRATEGIES

The course will be organized as a seminar, through guided reading, presentation of the topics by the teachers and the collective dialogue of the different topics. It is also sought that the student proposes readings and documents (written or video, for example) that support the dialogue of the topics.

D) EVALUATION AND ACCREDITATION

Preparation and / or presentation of:	**Periodicity**	**Covers**	**Weight of each partial in relation to the ordinary**
First partial exam: Written and oral essay presentation	At the end of Unit 1	Unit 1	25%
Second partial exam: Written and oral essay presentation	At the end of Unit 2	Unit 2	25%
Third partial exam: Written and oral essay presentation	At the end of Unit 3	Unit 3	25%
Fourth partial exam: Written and oral essay presentation	At the end of Unit 4	Unit 4	25%
Field practice	-	-	
		TOTAL	100%

Ordinary Exam	The ordinary final grade will consist of the 4 partial grades (80%) and the field practice report rating (20%).
Other required academic activities	Special non-mandatory activities will not have a value in the partial evaluation. This consists of attending special events on the subject or participation as organizers in events of the discipline, whether from the Faculty or outside it as dissemination and training activities.

E) REFERENCES AND DIGITAL RESOURCES

Main texts

Akhmouch, A., And Delphine, C. (2016) "Stakeholder engagement for inclusive water governance:“Practicing what we preach” with the OECD water governance initiative." Water8.5 (2016):

Castro, José Esteban.(2005) Water, power and citizenship: social struggle in the Basin of Mexico. Springer.

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Cisneros, B. J., & Rose, J. B. (2009). Urban water security: managing risks: UNESCO-IHP. CRC Press

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Integración de un organismo operador

Metodologías de Evaluación Socioeconómica y Estructuración de Proyectos de Inversión (Agua Potable, Alcantarillado, Saneamiento, Mejoramiento de Eficiencia y Protección a Centros de Población)"

D.W. Pepper and A. Brebbia eds. (2011). Water and Society, University of Nevada-Las Vegas, USA and, Wessex Institute of Technology, UK

EPA (2012). Planning for Sustainability. A Handbook for Water and Wastewater Utilities. Accessed February 27 2019 from https://www.epa.gov/sustainable-water-infrastructure/handbook-planning-sustainability-water-and-wastewater-utilities.

EPA. Water Data and Tools Accessed February 28, 2019 https://www.epa.gov/waterdata

European Union. Handbook on Sustainable Urban Drainage Systems (SUDS). Accessed 1 march 2019 from https://drainforlife.eu/attachments/article/64/DFL%20SUDS%20Handbook%20final.pdf

Fletcher, T., & Deletic, A. (2014). Data Requirements for Integrated Urban Water Management: Urban Water Series-UNESCO-IHP. CRC Press.

Gómez, A. (2009). Conceptos de Geomática y estudios de caso en México (No. 526.982097 C6).

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Maderey Rascon, L. E., & Roman, J. (2005). Principios de hidrogeografía. Estudio del ciclo hidrológico. UNAM.

Marsalek, J., Karamouz, M., Cisneros, B. J., Malmquist, P. A., Goldenfum, J. A., & Chocat, B. (2014). Urban water cycle processes and interactions: Urban Water Series-UNESCO-IHP. CRC Press.

Mays, L. (2014). Integrated Urban Water Management: Arid and Semi-Arid Regions: UNESCO-IHP. CRC Press.

Mcnabb, D.E. (2019). Global Pathways to Water Sustainability. Springer.343 pp.

Rojas, H.R., Guerrero, G.E.D. (2018) Water Policy in Mexico: Economic, Institutional and Environmental Considerations. Vol. 20. Springer.

-Servicio Meteorologico Nacional. Climatología. Accessed February 28, 2019 https://smn.cna.gob.mx/es/climatologia

UN (United Nations). 1992. The Dublin Statement on water and sustainable development. from http://www.wmo.int/pages/prog/hwrp/documents/english/icwedece.html. Accesed February 15 2019

UNDP (United Nations Development Program). 2017. Goal six targets. Accessed February 15 2019from www.undp.org/content/undp/en/home/

UNESCO (2012). The United Nations world water development report 4: managing water under uncertainty and risk, executive summary. Accessed February 17, 2019 from https://unesdoc.unesco.org/ark:/48223/pf0000217175?posInSet=32&queryId=N-EXPLORE-97376300-9c74-4170-af2f-e5ec105dc4d3

Vegas Niño et al. (2018) Using the EPANET Toolkit v2.00.12 With Different Programing Environments. Jiutepec, Mor. Mexican Institute of Water Technology, 2018. 119 p.

Whiteford, L., & Whiteford, S. (2005). Globalization, water & health: resource management in times of scarcity. James Currey Ltd.

WHO (World Health Organization). 2017. Progress on drinking water, sanitation, and hygiene, update and sustainable development goals. World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) Joint Monitoring Program (JMP). Accessed February 15, 20179 from http://apps.who.int/iris/bitstream/10665/258617/1/9789241512893-eng.pdf?ua=1.

WMO (2009) WMO Report No 168. Guide to Hydrological Practices Volume II: Management of Water Resources and Application of Hydrological Practices. World Meteorological Organization, Geneva.

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CENAPRED. Atlas Nacional de Riesgos. Accessed February 28, 2019 http://www.atlasnacionalderiesgos.gob.mx/

EPA. Water Data and Tools Accessed February 28, 2019 https://www.epa.gov/waterdata

INEGI. Simulador de Flujos de Agua de Cuencas Hidrográficas (SIATL) Accessed February 28, 2019. http://antares.inegi.org.mx/analisis/red_hidro/siatl/#

Servicio Meteorologico Nacional. Climatología. Accessed February 28, 2019 https://smn.cna.gob.mx/es/climatologia

U.S. Geological Survey. Water resources in the United States Accessed February 28, 2019 https://water.usgs.gov/maps.html