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**ENVIRONMENTAL SYSTEMS AND SOCIETIES  
STANDARD LEVEL  
PAPER 2**

Friday 11 May 2012 (morning)

2 hours

# **RESOURCE BOOKLET**

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**INSTRUCTIONS TO CANDIDATES**

- Do not open this booklet until instructed to do so.
- This booklet contains **all** of the resources required to answer question 1.

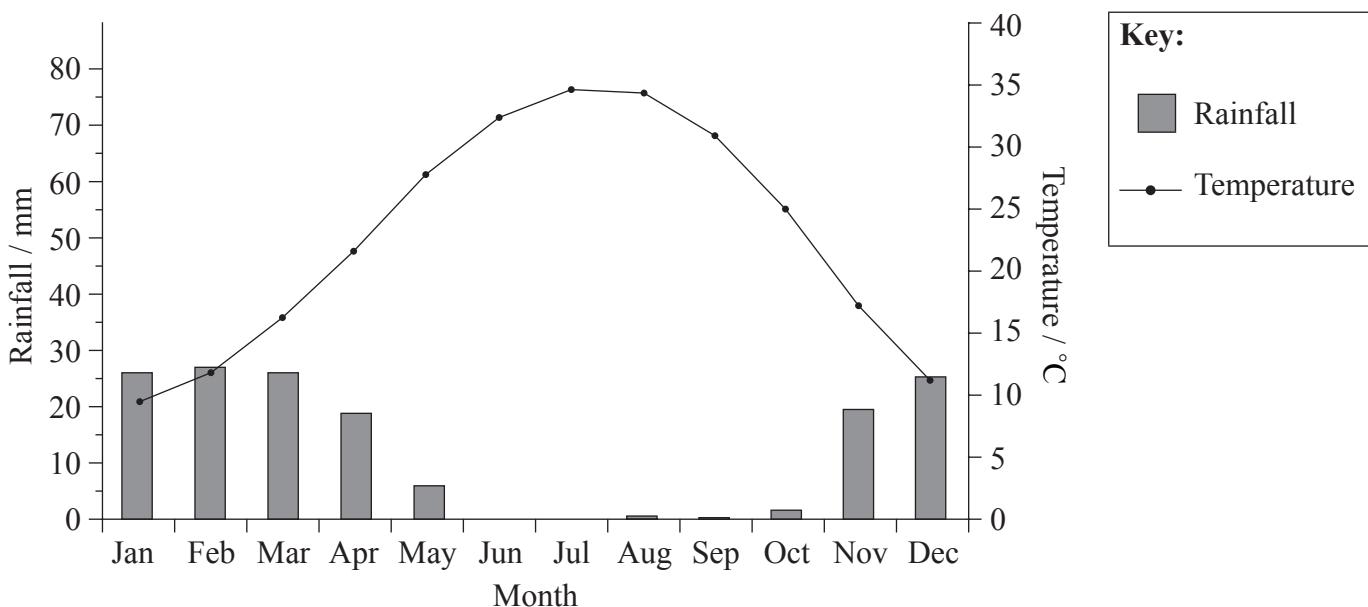
**Figure 1** World map showing the location of Iraq



[Source: world map adapted from [www.un.org/depts/cartographic/map/profile/world.pdf](http://www.un.org/depts/cartographic/map/profile/world.pdf)  
Iraq map adapted from <http://jeffweintraub.blogspot.com>]

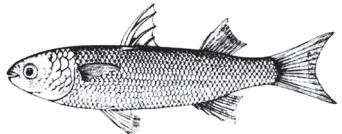
**Figure 2 Factfile on Iraq and Iran marshes**

- The marshlands in Iraq and Iran once covered an area of approximately 15 000 km<sup>2</sup>.
- The marshes get only 100 mm of rainfall annually. More than 2500 mm of water evaporates, leaving behind a salty body of water.
- Snow in the high mountains of Iran and Turkey melts in spring and the resulting water formerly flowed down to the marshes carrying sediment and washing away the salty water.
- A unique wetland ecosystem developed with many endemic species (species found only in this area). The wetlands vegetation also filtered out pollutants in the water.
- A human culture developed which was highly adapted to this environment. Food systems were based on fishing and the use of water buffalo. Reeds from the marshes were used for construction.

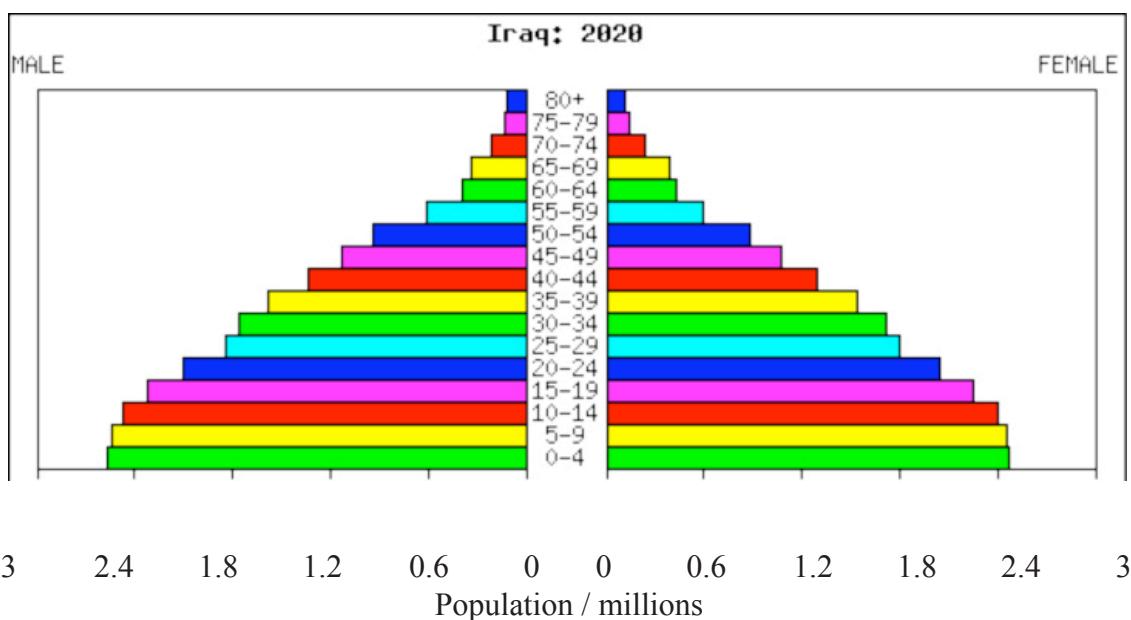
**Figure 3 Climate graph of Baghdad, Iraq**

[Used with permission]

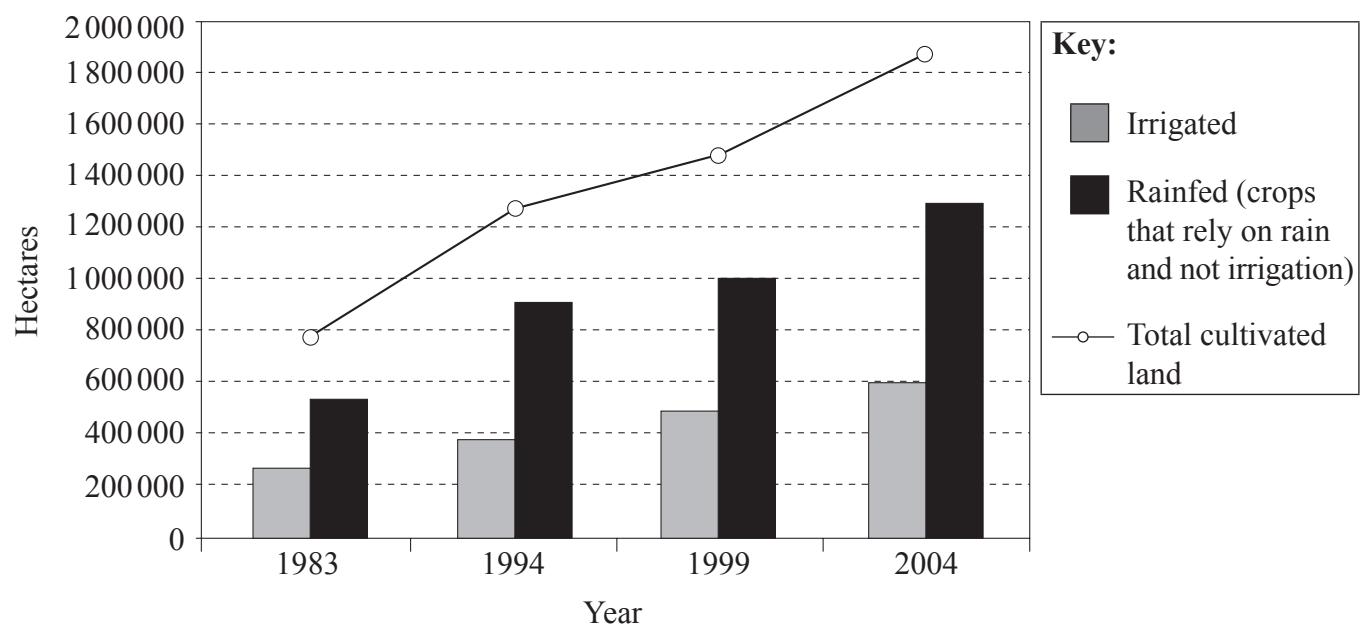
**Figure 4 Species found in the Iraq marshes**

Species	Conservation status	Species	Conservation status
 Abu mullet ( <i>Liza abu</i> )	Not evaluated (NE)	 Bunni ( <i>Barbus sharpeyi</i> ) [http://www.arabhunter.com/fishing/images/carp.gif]	Least concern (LC)
 Rigid Hornwort ( <i>Ceratophyllum demersum</i> )  [From: http://upload.wikimedia.org/wikipedia/commons/a/a2/Ceratophyllum_demersum_var._demersum.JPG]	Not evaluated (NE)	 Marsh reed ( <i>Phragmites australis</i> )  [http://en.wikipedia.org/wiki/File:Phragmites_australis_Schilfrohr.jpg, created by Darkone.]	Not evaluated (NE)
 Marbled Teal ( <i>Marmaronetta angustirostris</i> )  From: http://en.wikipedia.org/wiki/File:Marbled_Teal_(Marmaronetta_angustirostris)_RWD2.jpg. Created by Dick Daniels (http://carolinabirds.org/).	Vulnerable (VU)	 Basra Reed Warbler ( <i>Acrocephalus griseldis</i> )  [Photo by O. Fadhil, Nature Iraq.]	Endangered (EN)
 Bunn's Short-tailed Bandicoot Rat ( <i>Nesokia bunnii</i> )  [From: http://en.wikipedia.org/wiki/File:NesokiaHuttoni.jpg. Taken from: Eastern Persia: An Account of the Journeys of the Persian Boundary Commission 1871-72-73 by India Persian boundary commission, William Thomas Blanford, Zoology, 1876]	Endangered (EN)	 Smooth-coated Otter ( <i>Lutrogale perspicillata</i> )  From: http://en.wikipedia.org/wiki/File:Smooth-coated_Otter_%28Lutrogale_perspicillata%29.jpg, by Lip Kee Yap.	Vulnerable (VU)

[©Food and Agriculture Organization of the United Nations. Used with permission.]

**Figure 5 2009 age/sex pyramid for Iraq**

[Data taken from the US Census Bureau International Database.]

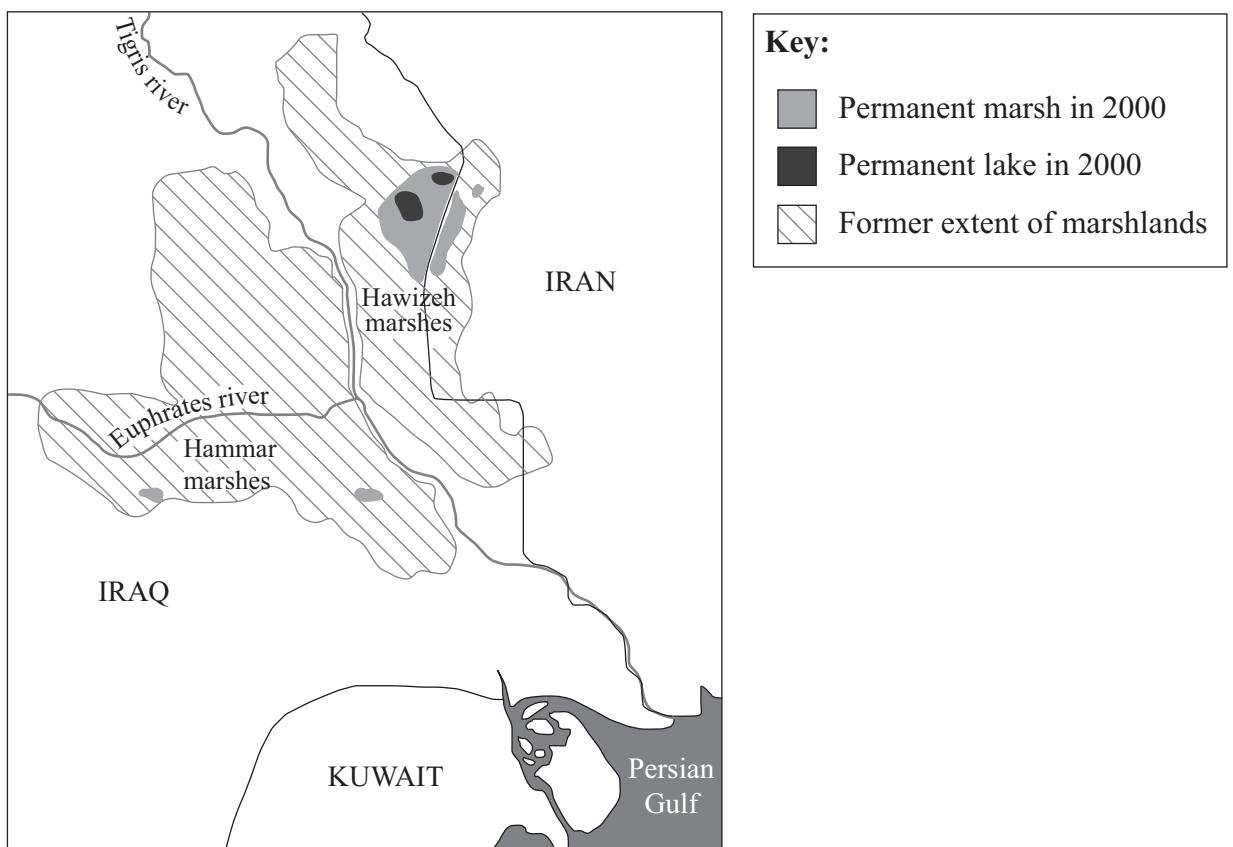
**Figure 6 Graph showing the area of irrigated, rainfed and total cultivated land in Iraq**

[Source: adapted from <http://adamisenn.blogspot.com/2009/09/populationpyramidIraq2009.html>]

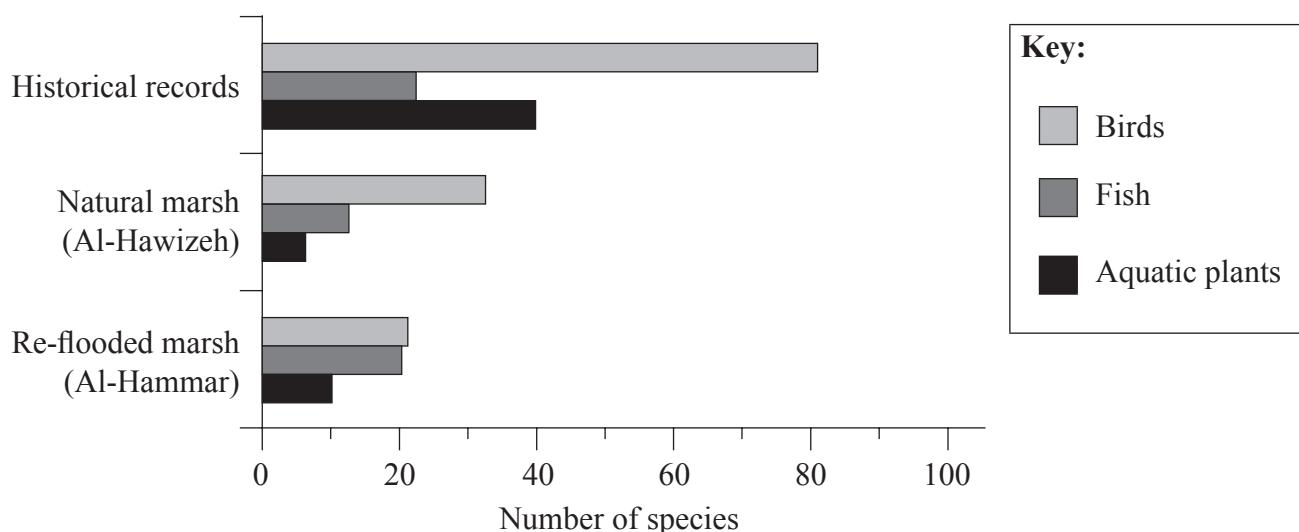
**Figure 7 Human impacts on the marshes**

- From the early 1950s, engineers in Turkey, Syria, Iran and Iraq built a series of huge dams across the Euphrates and Tigris rivers. This reduced the flow of water to the marshes.
- After the 1991 Gulf War the marshes were drained by diverting (changing) water flow away from the area. This lead to desertification of the wetlands and displacement of indigenous (original) people.
- By 2002, the marshlands had diminished to 760 km<sup>2</sup>.
- In 2003, floodgates were opened and the embankments that had been built to drain the marshlands were broken down. Partial re-flooding has since occurred in some areas but not to historic levels.
- Despite re-flooding in some areas, high salt concentrations have prevented the restoration of the ecosystem.

**Figure 8 A map showing the reduction in area of marsh between 1973–2000**



**Figure 9 Graph showing the number of species of birds, fish and aquatic plants in a natural marsh and a re-flooded marsh.**



[Curtis J. Richardson and Najah A. Hussain, "Restoring the Garden of Eden: An Ecological Assessment of the Marshes in Iraq", in *BioScience*, vol. 56, no. 6 (June 2006), pp. 477—489. (C) 2006 by the American Institute of Biological Sciences. Published by the University of California Press.]

**Figure 10 Water quality of a natural marsh and two re-flooded marshes. The natural marsh can be used as an indicator of normal ecosystem function.**

Component	Natural marsh (Al-Hawizeh)	Re-flooded marsh (Al-Hammar)	Re-flooded marsh (Al-Sanaf)
Salinity / ppt	0.87	0.96	17.49
pH	7.64	7.95	9.40
Total nitrogen / ug L <sup>-1</sup>	464	1652	2050

**Figure 11 Changes in soil and water characteristics in the Iran and Iraq marshlands over the last 5000 years**

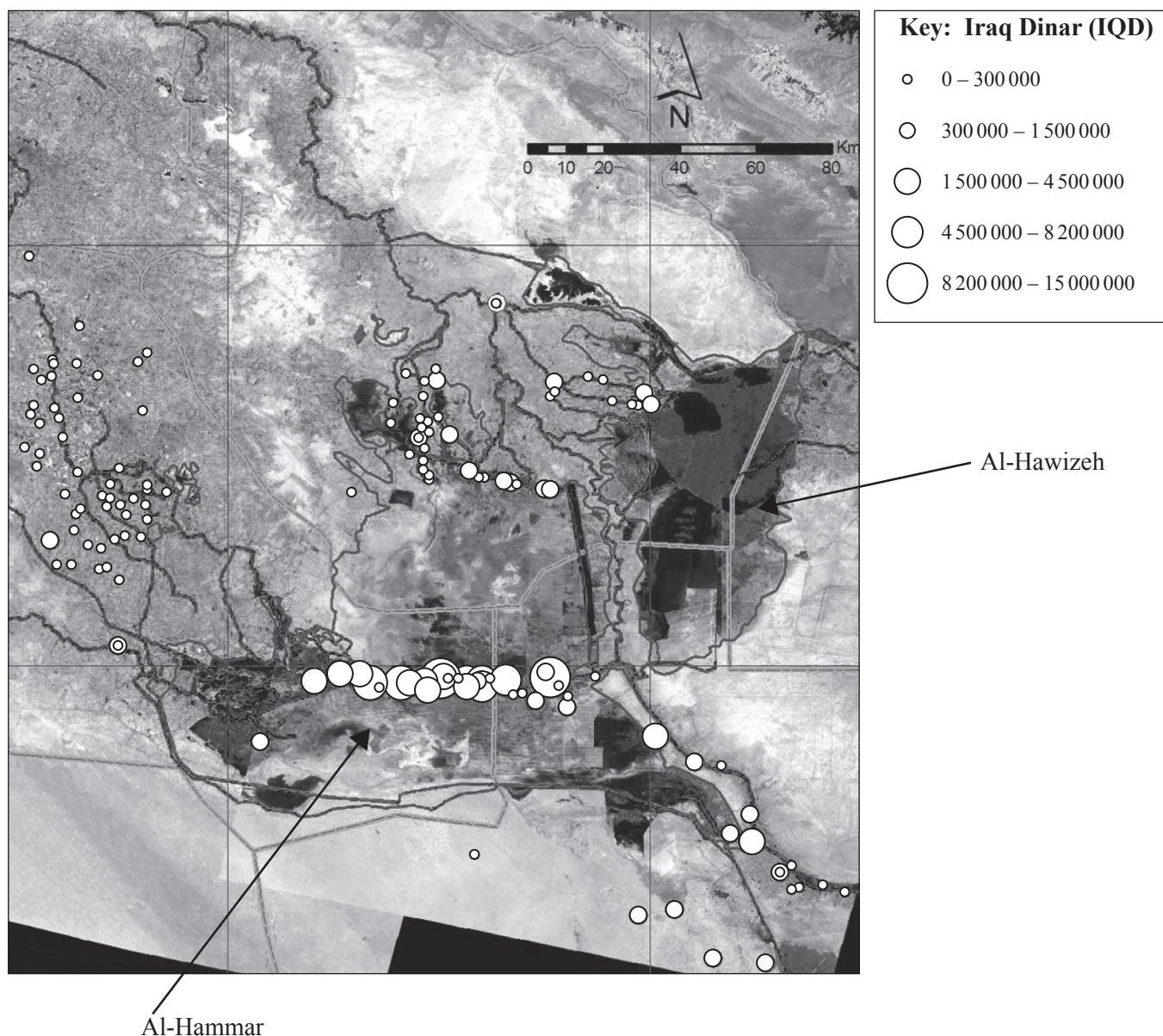
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[Please refer to the images on page 1 of <http://www.clw.csiro.au/publications/consultancy/2004/Mesopotamian-marshlands-soil.pdf>]

**Figure 12 (a) How to place a value on an ecosystem**

One method of valuing ecosystems is to place a monetary value on sources of natural income. An alternative is to survey stakeholders (people affected) and ask them how much they would be willing to pay to preserve a species or habitat. Villagers in South Eastern Iraq were asked how much they would be willing to pay to completely restore the marshes. Figure 12 (b) is a map, based on a satellite image, showing the results of this survey.

**Figure 12 (b) Results of monetary value survey**



[Source: adapted from New Eden master plan for integrated water resources management in the marshlands area Iraq,  
Ministries of Environment, Water Resources, Municipalities and Public Works 2005]