THE TAGUS BASIN; GROUNDWATER AND TRANSBOUNDARY AQUIFERS

SPRINGS OF THE CUERVO RIVER (TAGUS BASIN)

PHOTO: F. FERREIRO, JANUARY 2010

MARÍA CASADO SÁENZ
TRANSBOUNDARY AQUIFERS

DISTRIBUTION OF MOST IMPORTANT AQUIFERN FORMATIONS IN SPAIN
SPANISH TAGUS RIVER BASIN

THE TAGUS RIVER BASIN
THE TAGUS RIVER BASIN IN SPAIN
SOURCE OF THE TAGUS RIVER IN LA MUELA DE SAN JUAN, MONTES UNIVERSALES
THE TAGUS RIVER BASIN IN SPAIN
BOLARQUE RESERVOIR IN THE TAGUS

Jurassic and Cretaceous folded limestones
THE TAGUS AND THE VILLAGE OF TRILLO; NUCLEAR POWER PLANT OF TRILLO
THE TAGUS RIVER BASIN IN SPAIN
TAJUÑA RIVER, IRRIGATED AREA.

204,220 ha: Irrigated Surface in the Spanish Tagus basin

Surface Water Demand: 1.551 Mm$^3$/year
Ground Water Demand: 135 Mm$^3$/year

PÁRAMO LIMESTONES FORMATION

SILT AND CLAYS

TAJUÑA RIVER
Mean Flow: Around 40 m$^3$/s (1975-2006 Period)
THE TAGUS RIVER BASIN IN SPAIN

[Map of the Tagus River Basin in Spain]
Tagus in Alcántara

Mean inflow in Alcántara: 190 m³/s

Dam and Roman Bridge of Alcántara,
<table>
<thead>
<tr>
<th></th>
<th>UNITS</th>
<th>Spanish Tagus</th>
<th>Spain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surface</strong></td>
<td>km²</td>
<td>55.870</td>
<td>506.470</td>
</tr>
<tr>
<td><strong>Habitant in 2004 (</strong>)**</td>
<td>Habitants</td>
<td>6.994.774</td>
<td>39.238.000</td>
</tr>
<tr>
<td><strong>Mean rainfall for 1949-2000 period</strong></td>
<td>mm</td>
<td>655</td>
<td>684</td>
</tr>
<tr>
<td><strong>Surface Runoff</strong></td>
<td>Mm³</td>
<td>11.235</td>
<td>113.812</td>
</tr>
<tr>
<td><strong>Specific runoff (1949-2000)</strong></td>
<td>Mm³/km²</td>
<td>0,219</td>
<td>0,225</td>
</tr>
<tr>
<td><strong>Storage Capacity</strong></td>
<td>Mm³</td>
<td>12.000</td>
<td>56.063</td>
</tr>
<tr>
<td><strong>Groundwater Runoff</strong></td>
<td>Mm³</td>
<td>1.565</td>
<td>20.881</td>
</tr>
<tr>
<td><strong>Groundwater Storage in Aquifers</strong></td>
<td>Mm³</td>
<td>4.700</td>
<td>180.000</td>
</tr>
</tbody>
</table>

Some basic data for the Spanish Tagus Basin.

From:

“La cuenca del Tajo en Cifras” (2002) and
(* Water Basin Organism (2006 and 2009)
SPRING OF “LAS AGUAS PEÑAS”, (CHECA, GUADALAJARA)

- Keuper Formation
- Travertine
- Jurassic Limestone
EL TOBAR WETLAND IN THE GUADIELA RIVER, TAGUS AFFLUENT

Jurassic Limestones

Gypsum and Marls
VIEW FROM GAUGING STATION E-3005 IN TRILLO, TAGUS RIVER, UPSTREAM NUCLEAR POWER PLANT

MEAN FLOW:
22 m³/s (1935-1980)
13 m³/s (1980-2005)
TAGUS RIVER DISCHARGE IN TRILLO GAUGING E-3005 (1955-1980)

Q90: Monthly discharge that was surpassed the 90% of the studied months

River Flow on monthly basis

Stream Discharge in Mm³/month
TAGUS RIVER DISCHARGE IN TRILLO GAUGING E-3005 (1980-2005)

River Flow on monthly basis

Q90: Monthly discharge that was surpassed the 90% of the studied months

Stream discharge in Mm$^3$/month

[Line chart showing the discharge in Mm$^3$/month from 1980 to 2005, with high peaks in 1995 and 1997, and a general increase in discharge after 1992.]
GROUNDWATER BODIES IN THE TAGUS BASIN

TAJUÑA-MONTES UNIVERSALES GW BODY

MADRID TALAVERA AQUIFER: 4 GW BODIES

MORALEJA GW BODY

WATER DISTRICTS IN SPAIN

FRANCE

PORTUGAL
Piezometer Code: 03.13.002 Cilleros
Piezometer Depth: 92 m
Surface Datum: 290 mosl (meters over sea level)

MORALEJA TRANSBOUNDARY
UNIT:
PIEZOMETRIC CONTOURS AND
PIEZOMETRIC EVOLUTION

LEGEND

PORTUGAL

GW WATERSHED

RIVERS
TOWNS
MUNICIPALITIES
PIEZOMETRIC CONTOURS
PIEZOMETERS
RESERVOIRS
AQUIFERS
MORALEJA AQUIFER
DETritical Tertiary Unit
FLOW LINES

Aprox. Scale
0 7 km
HYDROGEOLOGICAL CROSS SECTION OF THE MORALEJA AQUIFER IN THE SPANISH ZONE: CONCEPTUAL MODEL

- **Tinaja Stream**: $K = 9-0.09 \text{ m/día}$
- **Rivera de Gata Stream**: $K = 0.009-0.00009 \text{ m/day}$

Legend:
- **Quaternary sediments** (Conglomerates, sand and clay)
- **Tertiary sediments** (sand, silt and clay)
- **Precambrian Schists and slates**
- **Groundwater flow direction**
EVOLUTION IN NITRATE CONCENTRATION IN MORALEJA GROUNDWATER BODY
GENERAL VIEW OF THE TYPICAL TERTIARY SEDIMENTS OF THE TAGUS BASIN

TERTIARY SEDIMENTS

BASIN BORDER

09/08/2005
GROUNDWATER BODIES IN THE AQUIFER OF MADRID-TALAVERA: PIEZOMETRIC NETWORK

Piezometer Code: 03.05.90 Cazalegas
Piezometer Depth: 305 m
Surface Datum: 441

Piezometer Code: 03.05.67 Villaviciosa de Odón
Piezometer Depth: 60 m
Surface Datum (mosl): 618 m

Groundwater Depth (m)

Area of Groundwater protection around Madrid

Water level over the ground (m)
1. LACK OF KNOWLEDGE: ENHANCE IT PROMOTING NEW STUDIES

2. NITRATE PROBLEMS: REGULATIONS IN ORDER TO APPLY THE BEST AGRICULTURAL CODE PRACTICES AND SAFETY PERIMETERS

3. NETWORKS: IMPLEMENTING THEM

4. QUANTITATIVE PROBLEMS: STRONGER REGULATIONS AND USERS COMUNITIES

GROUNDWATER RELATED PROBLEMS IN THE TAGUS BASIN AND AND SOME OF THE UNDERTAKEN MEASUREMENTS