MAR SOL MANAGED AQUIFER RECHARGE SOLUTIONS

Tragsa GrupoTragsa SEPI

MARSOL Workshop
Technical Solutions for Managed Aquifer Recharge

MARENALES

Wednesday, March 11th 2015. 10 h.
Centro cultural "Las Fuentecillas", C/ Alta, nº 21 -23. Gomezserracín (Segovia)
Activity to involve groundwater users.

Collaborate:

Comunidad de regantes Cubeta de Santiuste... · Comunidad de Regantes El Carracillo · Instituto Geológico y Minero de España · Junta de Castilla y León · plan 2020 AIMCRA · M.A.R. TO MAR-kEt · WIRE EIP Water · Plataforma Tecnológica Española del Agua · dina-MAR

Exmo Ayto. de Santiuste de San Juan Bautista

Ayuntamiento de Gomezserracín

Ayuntamiento de Alcazarén

This initiative takes place in the framework of "FP7-ENV-2013 **MARSOL** (GA 619.120). Demonstrating Managed Aquifer Recharge as a Solution to Water Scarcity and Drought (WP5)" with the support of the European Commission, however it reflects the views only of the authors, and the Commission cannot be held responsible of any use which may be made of the information contained therein.

http://www.marsol.eu/

Comisión Europea

MARENALES

Within the framework of MARSOL project (FP7, Water Innodemo call) are intended activities regarding "Training of project participants' staff, researchers, industry/SMEs, and end users on Managed Aquifer Recharge (MAR) and new developments in this field, to foster knowledge among all project partners and to ensure that the project's RTD and DEMO results effectively reaches the end-users." In this context, the main objectives for this training workshop are:

- *To expose the technical solutions applied by the partner's expertise regarding each demo-site, studying the applicability to be used in other equivalent environments.*
- *Exposition of successful construction criteria (specific designs, materials...)*
- *Exposition of successful water management criteria, mentioning the "must" as well as the "musn't".*
- *Criteria for cleaning and maintenance of the existing structures lengthening the infiltration capacity and the life-span of the structures.*
- *Other criteria that the expert speakers could include in their presentations regarding technical solutions, benchmarking, indicators and dissemination procedures.*
- *Response to all the questions that could arise along the full workshop.*

The activity is directed to MARSOL partners, technicians, practitioners, public authorities, farmers and irrigation communities' board, as well as students and the population in general.
Important notice: As it is a rural area, speakers will employ a colloquial language in their expositions.

FINAL PROGRAM

10:00 – 10:10	**Welcome.** Mr. Enrique Herranz. ATE. President of the Carracillo Irrigation Community. Chairwoman: Ms. Elvira del Pozo Campos. Agronomic Engineer (TRAGSATEC)
10:10 – 10:30	**MAR and water footprint** • Ms. Elvira del Pozo Campos. Agronomic Engineer (TRAGSATEC)
10:30 – 10:55	**Methodology for probabilistic risk evaluation linked to MAR activities based on fault tree analysis.**
10:55 – 11:1	**Practical technical solutions for Managed Aquifer Recharge facilities** • Dr. Enrique Fernández Escalante. Hydrogeologist (TRAGSA, MAR to MAR-kEt)
11:15 – 11:35	**Urban rain water harvesting and infiltration. Architectonical designs and solutions** • Mr. Ignacio Prieto Leache. Architect (TRAGSATEC, DINA-MAR)
11:35 – 12:00	**Coffee break**
12:00 – 12:20	**Low impact MAR activities and benchmarking** • Dr. Jon San Sebastián Sauto. Biologist (TRAGSATEC, DINA-MAR)
12:20 – 12:40	**MAR, energy efficiency and use of alternative energy systems for irrigation. Tech. solutions** • Mr. Francisco de Borja González Herrarte. Agronomic Engineer (TRAGSA)
12:40 – 13:00	**ICTs solutions for MAR activities** • Ms. María Eugenia García de Garayo y Millán. Telecom. Eng (TRAGSA-WIRE AG)
13:00 – 13:20	**Technical solutions for MAR experiences in Spain. State of the art and future panorama** • Dr. José Antonio de la Orden Gómez. Mining Dr Engineer (Spanish Geological Survey).
13:20 – 13:35	**Premiere of the film "MAR Technical solutions in Arenales aquifer"**
13:35 – 14:00	**Open debate.** Rapporteur: Dª Elvira del Pozo Campos (TRAGSATEC)
14:00	**Clausure.** Sra. Dª. Laura del Río Arranz. Mayor of Gomezserracín (TBC).

TBC: To be confirmed.
This schedule, approved in principle, might be subject to modification. Organized by:

MAR SOL MANAGED AQUIFER RECHARGE SOLUTIONS

MARENALES SPANISH TRAINING WORKSHOP 2015 MARCH · PASSIVE INTERMITTENT · GrupoTragsa

Comisión Europea

Soluciones tecnológicas prácticas para dispositivos de recarga gestionada /

Practical technical solutions for Managed Aquifer Recharge facilities

By Enrique Fernández Escalante
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*http://www.marsol.eu

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2. MARSOL INVENTORY FOR MAR FACILITIES
3. PROPOSAL FOR TECHNICAL SOLUTIONS TO BE APPLIED IN ANALOGOUS SCENERIES AND EXAMPLES
4. COROLLARY OF SAT TECHNIQUES
5. CONCLUSIONS

MAR SOL MANAGED AQUIFER RECHARGE SOLUTIONS

TECHNICAL SOLUTIONS FOR MANAGED AQUIFER RECHARGE

MARENALES

INTRODUCTION

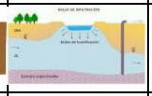
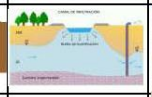
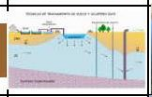
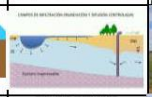
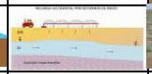
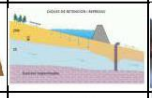
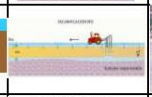
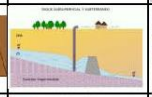
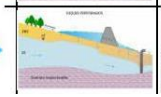
ADOPTION OF SPECIFIC TECHNOLOGICAL SOLUTIONS IN DIFFERENT MANAGED AQUIFER RECHARGE (MAR) EXPERIENCES AROUND THE WORLD, IN ORDER TO:

- **INCREASE THE RATE OF INFILTRATION**
- **INCREASE THE EFFECTIVENESS OF THE EXISTING FACILITIES**
- **CREATING DESIGN CRITERIA FOR FUTURE ONES**

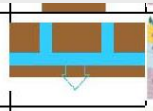
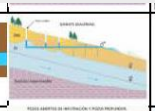
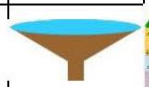
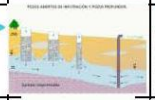
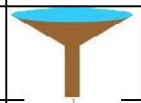
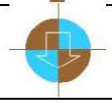
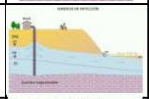
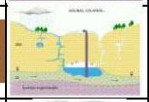
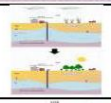
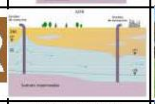
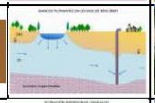
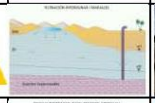
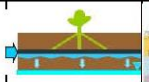
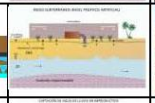
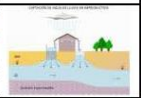
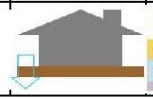
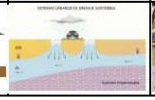
“PROBLEM-SOLUTION” BINOMIALS BASED ON:

- **ENGINEERING CRITERIA**
- **RISK ASSESSMENT**
- **ENVIRONMENTAL IMPACT**

MARSOL INVENTORY FOR MAR FACILITIES

N	SYSTEM	MAR DEVICE	LOGO	FIGURE	PHOTO	LEGEND	1: Lavrion, Greece	2: Algarve and Alentejo, Portugal	3: Los Arenales, Spain			4: Llobregat River, Spain	5: River Brenta, Italy	6: Serchio River, Italy		7: Menashe, Israel	8: South Malta, Malta
									SANTIUSTE	CARRACILLO	ALCAZAREN						
1	DISPERSE	INFILTRATION PONDS/WETLANDS				Artificial wetland to recharge in Sanchón, Coca, Arenales aquifer			✓	✓							
2		CHANNELS AND INFILTRATION DITCHES				Artificial recharge channel of the Basin of Santiuste, Segovia, Spain, operative since 2002.			✓	✓	✓						
3		RIDGES/ SOIL AND AQUIFER TREATMENT TECHNIQUES	SAT			Furrows at the bottom of a infiltration pond in Santiuste basin (Arenales)			✓								
4		INFILTRATION FIELDS (FLOOD AND CONTROLLED SPREADING)				Infiltration field in Carracillo, Arenales aquifer				✓							
5		ACCIDENTAL RECHARGE BY IRRIGATION RETURN				Artificial recharge by irrigation return. Extremadura, Spain. Photo: Tragsa			✗	✗	✗						
6		BOFEDALES WETLANDS				Bofedales (Colombia)			✗	✗	✗						
7	CHANNELS	RESERVOIR DAMS AND DAMS				Artificial recharge dam in Arenales. Segovia, Spain.			✓	✓	✓						
8		PERMEABLE DAMS				Permeable dam in Huesca, Spain. Photo: Tragsatec.			✗	✗	✗						
9		LEVEES				Levees in Santa Ana river, Orange County, California, USA. Photo: A. Hutchinson.			✗	✗	✗						
10		RIVERBED SCARIFICATION				Scarification at Besós riverbed, Barcelona, Spain. Photo: J. Armenter.			✗	✗	✗						
11		SUB-SURFACE/ UNDERGROUND DAMS				Sub-surface dam in Kitui, Kenya. Photo: Sander de Haas.			✗	✗	✗						
12		DRILLED DAMS				Drilled dam. Lanjarón, Granada, Spain. Photo: Tragsatec.			✗	✗	✗						

MARSOL INVENTORY FOR MAR FACILITIES

13	WELLS	QANATS (UNDERGROUND GALLERYS)				Qanat at Carbonero el Mayor, Segovia, Spain. Photo: E.F. Escalante				✓								
14		OPEN INFILTRATION WELLS				Passive infiltration well. Santiuste basin			✓	✓								
15		DEEP WELLS AND BOREHOLES				Artificial recharge well. Menashe. Israel. Photo: EFEscalante			✗	✗	✗							
16		BOREHOLES				Borehole in Israel. Photo: EFEscalante			✗	✗	✗							
17		SINKHOLES, COLLAPSES...				Sinkhole called"El Hundimiento". Alicante, Spain. Photo: DINA-MAR			✗	✗	✗							
18		ASR				ASR device in Scottsdale, Arizona, USA. Photo: DINA-MAR			✗	✗	✗							
19		ASTR				ASTR device in California, USA.			✗	✗	✗							
20	FILTRATION	RIVER BANK FILTRATION (RBF)				MAR RBFsystem in Villeguillo, Arenales, Spain			✓									
21		INTERDUNE FILTRATION				Interdune filtration in Carracillo Eastern site. Arenales, Spain				✓								
22		UNDERGROUND IRRIGATION				Underground irrigation in Andalucía, Spain. Photo: Tragsa.			✗	✗	✗							
23	RAIN	RAINWATER HARVESTING IN UNPRODUCTIVE				Rainwater harvesting in unproductives for MAR techniques.			✗	✗	✓							
24	SUDS	ACCIDENTAL RECHARGE PIPES AND SEWER SYSTEM				Artificial recharge from sewer system in Arenales, Spain					✓							
25		SUSTAINABLE URBAN DRAINAGE SYSTEMS				SDUS. Gomeznarro park. Madrid, Spain. Photo: E.F. Escalante.			✗	✗	✗							

Modified from Dina-mar, 2009

PROPOSAL FOR TECHNICAL SOLUTIONS TO BE APPLIED IN ANALOGOUS SCENERIES

SOME TECHNICAL SOLUTIONS (DESIGNING)

- **Micro-topography studies**
- **Pipelines connecting a river and the quaternary aquifer without any pumping (passive system)**
- **Possibility of electricity supply**
- **Control of the aquifer base level by means of a dam to get a higher groundwater level in the wells (water level about 2 meters over expected)**
- **Pumping cost savings until 48 % in about 100 wells**
- **MAR water pre-treatment (at heading and intermediate filters)**
- **pH control by means of mudstone gravel filters**
- **High efficiency of old wells connected to the MAR system (reuse)**

" do not close a well, reuse it"

(invisible MAR structure connected to canals or to infiltration ponds)

Mustien gravel filters

Dam controling the aquifer base level

Well connected to the MAR canal

OPERATIVITY
TECHNICAL SOLUTIONS


MAR management by valves / flow meters

- Avoid gas clogging (cascading effect, water shaking…)
- Avoid over-spilling controlling valves and spillways
- Pay attention to the "alert depth", recommended 1,5 m
- Avoid water thickness in infiltration ponds over 140 cm
- Manual management depending on rainfall and freezing conditions
- Maximum infiltration rates (%) with flow rates about 200 L/s in canals
- Ploughing infiltration ponds bottom (80 cm)


Water thickness controlled in ponds


Avoid gas clogging in the aquifer

MANAGEMENT TECHNICAL SOLUTIONS

- Aquifer as a huge water store and a pipeline
- Surface deposits (for zones with very low sand thickness)
- Fishbone pipelines according to the aquifer properties
- Wells used as water stores in low permeability areas
- Wells drilled in aquifer drainage areas
- Users / use registry
- Minimize perching flow rates from the superficial to the depth aquifer
- Users management in order to improve the effectiveness


MAR Well used for water management


Stagnation system in infiltration ponds


Stagnation system in the heading

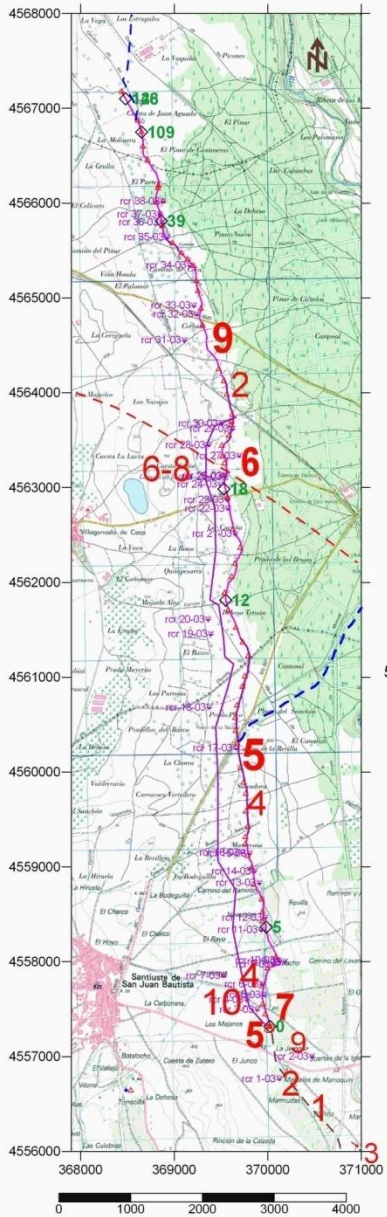
10- Tests in channels with geofabrics

6-8 Hydric restoration of wetlands by means of MAR techniques

4- High diameter MAR well

2- Pipes sealed across MAR zones

1- Pipe instalation in sand soil



9- Improvement of MAR boreholes designs

7- Furrows designs for infiltration ponds

5- Stpping devices affected by cascading effect

3- RBF system besides a damm

SANTIUSTE BASIN MAR FACILITIES
OPERATIVE PROBLEMS DETECTED

Steps forwards a higher water management efficiency for irrigation

1- Pretreatment filters
2- Invisible conductions
3- Valves for manual management
4- Wells without gas clogging /clay
5- Ideas to avoid cascading effect (gas clogging)
7- How to increase water salinity for salt lakes restoration
8- Ponds and canals with bottom ploughed and stable slopes
9- Wells reused
10- Modify the morphology of the canals and ponds, and design specific cleaning techniques

Some solutions proposed for the environmental impacts and dysfunctions have involved several years of research and progressive improvements:

1-2. Recharge devices inserted into pipes for MAR *"in itinere"*

3. New boreholes drilled related to MAR facilities

4. The newly constructed artificial recharge wells with decanters and filters

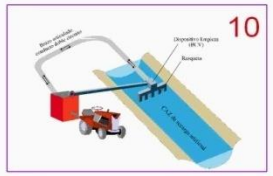
5. Communicating vessels below stopping devices to avoid gas clogging

6-7. Devices have been designed for the induced modification of the quality of artificial recharge waters destined for environmental purposes

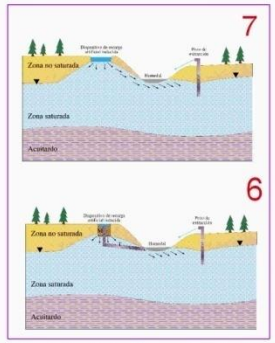
8. Ploughed furrows 80cm equidistant ridges have provided higher infiltration values

9- wells with specific designs

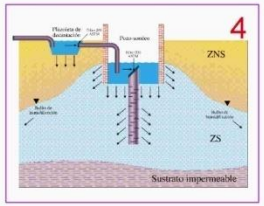
10. In order to improve cleaning and maintenance operations, a specific Basin Cleaning Vehicle (BCV) has been designed



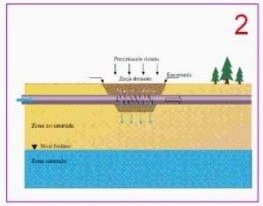
10- Specific design for a Basin Cleaning Vehicle (BCV) for MAR channels



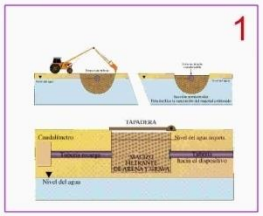
6-8- Wetlands hydric restoration by means of indiced MAR facilities



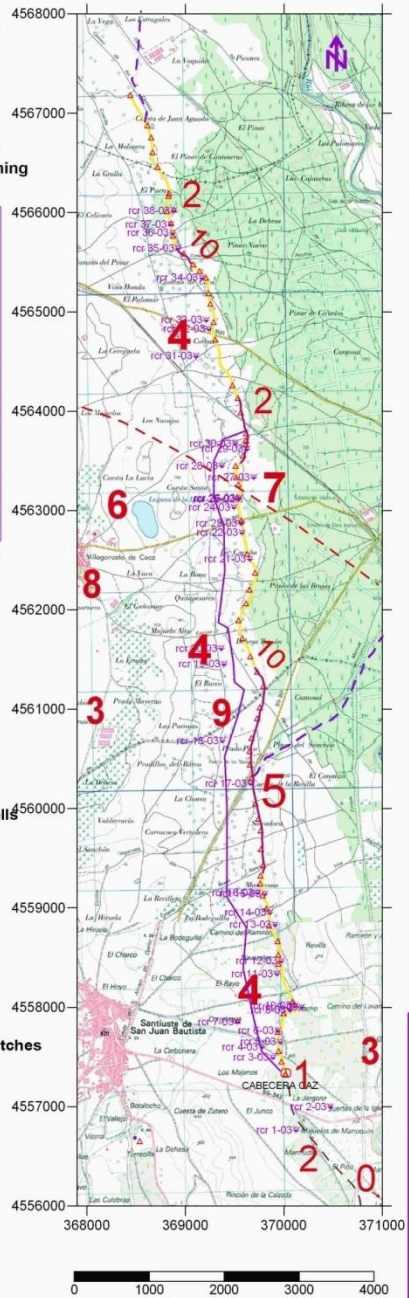
4- High diameter artificial recharge wells

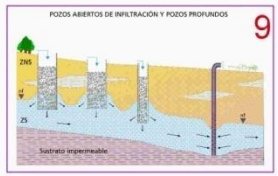


2- Filter pipes located into recharge ditches

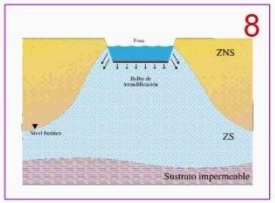


1- Sandy filter and flow meter at the head device

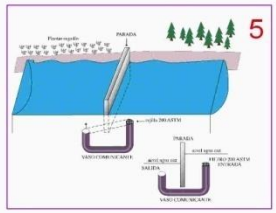




9- Equipment for wells medium-high depth



7- Furrows design for channels and infiltration ponds



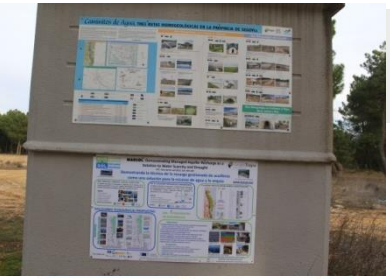
5- Communicating vessels designs against Lisse and cascading effects

3- River Bank filtration (RBF) devices next to Voltoya river (MAR source)

LEGEND:

- Urban sites
- Rivers
- Roads
- High speed train
- 1-10 Location of the proposed SAT devices
- MAR channels
- MAR channels over low infiltration rate
- Pipe lines
- Channels´ head
- Stopping water gates
- Overflow channels
- Piezometers location
- 0 MAR water Origin (damming at Voltoya river)

SANTIUSTE BASIN. SAT TECHNIQUES AND STRUCTURAL DESIGNS APPLIED



Disseminating technical solutions

MARSOL. Demonstrating Managed Aquifer Recharge as a Solution to Water Scarcity and Drought

FP7. Inno-demo call 2013. GA: 619.120

GrupoTragsa
Partners in excellence

Balsa de infiltración en zona agroindustrial

Demostrando la técnica de la recarga gestionada de acuíferos como una solución para la escasez de agua y la sequía

Presa que determina el nivel de base del acuífero

www.marsol.eu/

WP5 "DEMO Site 3: ARENALES, Santiuste, Castilla y León.

El objetivo principal es demostrar la eficiencia de la técnica de la recarga gestionada en una zona regable desarrollada, con objeto de alcanzar soluciones tecnológicas avanzadas mediante la I+D+i.

TAREAS

1: Área de ejecución
2: Canales, tuberías y conducciones
3: Estudios de colmatación gaseosa
4: Estudios sobre SAT-MAR
5: Humedales artificiales

Socios participantes: Tragsa, LNEC, UPC, coordinador

WP 13. SOLUCIONES TECNOLÓGICAS Y BENCHMARKING

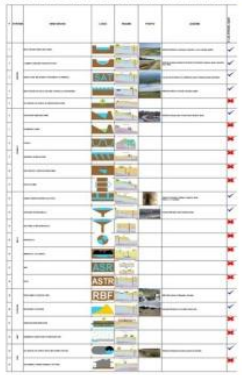
El objetivo principal es demostrar la eficiencia de la técnica de la recarga gestionada (o MAR) en los *"demo sites"*, con objeto de proporcionar nuevas soluciones técnicas mediante la permanente I+D y comunicación.

TAREAS:

1: Soluciones tecnológicas
2: Técnicas de recarga y parámetros técnicos
3: Directrices de implementación MAR
4: Benchmarking (adopción, evolución y agrupamiento)

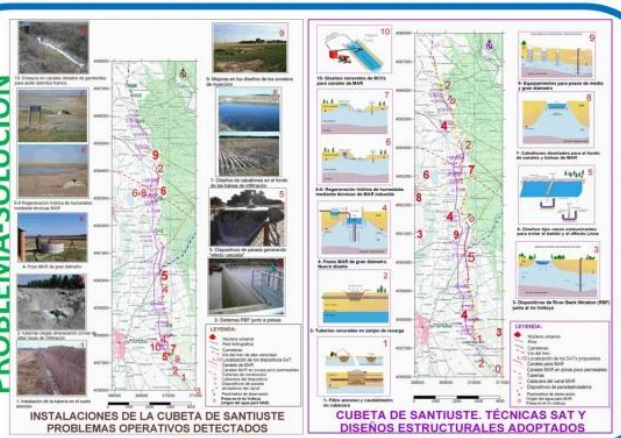
Socios: Tragsa, UPC, MRA, TARH, coordinador

EL ACUÍFERO. REDES DE CONTROL MARSOL Y DISPOSITIVOS MAR



SOLUCIONES TECNOLÓGICAS PROPUESTAS:

BINOMIOS PROBLEMA-SOLUCIÓN



SOL. TECNOLÓGICAS EN DESARROLLO:

Operativas:

- Se debe pretratar el agua, evitar batirla y mantener los dispositivos
  - Filtrado y decantación en cabecera y filtros intermedios
  - Control del ph del agua (lechos de piedra caliza)
- Evitar desbordamientos mediante gestión de válvulas y aliviaderos
- Profundidad de alerta recomendada: 1,5 m
- Profundidades por encima de ±140 cm de compacta el fondo
- Gestión supeditada a meteorología (lluvias y heladas)
- Tasas de infiltración más altas con caudales en torno a 200 l/s
- Evitar el batido del agua para reducir la entrada de aire al acuífero
- Labrado balsas: distancia caballones: 80 cm

De gestión:

- Uso del acuífero como almacén y como "tubería"
- Zanjas drenantes y conducciones enterradas en "raspa de pescado"
- Uso del pozo como almacén (zonas menos permeables)
- Perforación de pozos en las zonas de drenaje del acuífero
- Registro de usuarios
- Reducir efecto "descuelgue" al acuífero profundo

"TRIPLETA" DE SANTIUSTE: DEPURADORA-BIOFILTRO- HUMEDAL ARTIFICIAL (2 km)

Control del nivel del agua en balsas

Uso de la termografía de infrarrojos para detectar procesos colmatantes

Solución tecnológica en los dispositivos de parada para evitar el batido del agua

Labrado de caballones en balsas

Solución tecnológica de diseño de los canales (taludes e infiltración máxima)

NO CIERRES UN POZO: "REUTILÍZALO"
(conexión al canal de recarga mediante tubería y relleno de grava

Con el apoyo de: Ayto. de Santiuste de San Juan Bautista

European Commission

This initiative takes place in the framework of "FP7-ENV-2013 *MARSOL* (GA 619.120). Demonstrating Managed Aquifer Recharge as a Solution to Water Scarcity and Drought (WP5)" with the support of the European Commission, however it reflects the views only of the authors, and the Commission cannot be held responsible of any use which may be made of the information contained therein.

Más Info en: http://www.dina-mar.es

La destrucción de esta placa está penada por la Ley

MARSOL. Demonstrating Managed Aquifer Recharge as a Solution to Water Scarcity and Drought

FP7. Inno-demo call 2013. GA: 619.120

mostrando la técnica de la recarga gestionada de acuíferos como una solución para la escasez de agua y la sequía

Solución tecnológica: depuradora-biofiltro- humedal artificial

Presa que determina el nivel de base del acuífero

http://www.marsol.eu/

WP5 "DEMO Site 3: ARENALES, Carracillo, Castilla y León.

El objetivo principal es demostrar la eficiencia de la técnica de la recarga gestionada en una zona regable ampliamente desarrollada, con objeto de alcanzar soluciones tecnológicas avanzadas mediante la I+D+i.

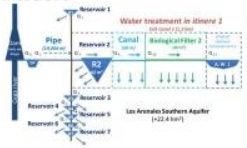
TAREAS

1: Área de ejecución
2: Canales, tuberías y conducciones
3: Estudios de colmatación gaseosa
4: Estudios sobre SAT-MAR
5: Humedales artificiales

Socios participantes: Tragsa, CEDEX, UPC, coordinador

WP 13. SOLUCIONES TECNOLÓGICAS Y BENCHMARKING

El objetivo principal es demostrar la eficiencia de la técnica de la recarga gestionada (o MAR) en los *"demo sites"*, con objeto de proporcionar nuevas soluciones técnicas mediante la permanente investigación y comunicación.



TAREAS:

1: Soluciones tecnológicas
2: Técnicas de recarga
3: Parámetros técnicos
4: Directrices de implementación de la técnica MAR
5: Benchmarking (adopción, evolución y agrupamiento)

Socios: Tragsa, UPC, MRA, TARH, coordinador

SITUACIÓN

Bajo el sector oriental de la comarca de "El Carracillo" se encuentra situado el acuífero cuaternario superficial, entre los ríos Cega y Pirón. Los diferentes dispositivos de recarga gestionada se concentran en los sectores oriental y sur.

EL ACUÍFERO

Se trata de un acuífero Cuaternario de espesor inferior a 30 m y de gran permeabilidad (arenas sobre un sustrato impermeable).

Se han diferenciado dos zonas, denominadas "zona almacén" y "paleoforma".

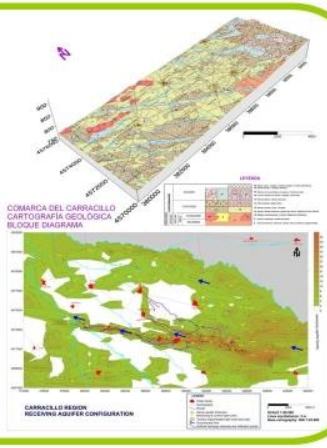
- La "zona almacén" se encuentra en el sector oriental del acuífero. Posee una alta capacidad de almacenamiento de agua.

- La "paleoforma" se sitúa en el sector occidental, bajo una zona regada. Es alargada y estrecha, y está sometida a fuertes extracciones en verano

OBJETIVOS PRINCIPALES

-Estudiar el funcionamiento hidrológico general

-Mejorar la eficiencia hídrica y energética de la agroindustria mediante soluciones tecnológicas



SOLUCIONES TECNOLÓGICAS:

De diseño:

FACTORES EN ESTUDIO PARA LA CONSOLIDACIÓN DEL REGADÍO EN LA ZONA NORTE

Almacenamiento más profundo al sur y más somero al norte

- Orografía de la zona y presencia de la zona almacén
- Trasvase bajo tubo desde el río Cega hasta el acuífero cuaternario
- Existencia de un punto geográfico alto próximo a los dos sectores
- Línea eléctrica cercana
- Segmentación de las tarifas eléctricas

CONTROL DEL NIVEL DE BASE DEL ACUÍFERO (PRESA): EL NIVEL DE BASE DEL RÍO INFLUYE EN EL NIVEL DE BASE DE LOS POZOS

Si el nivel del agua está cerca de dos metros por encima del "natural"...
¿cuál es el ahorro de energía en el bombeo de más de 100 pozos para riego?

PRETRATAMIENTO DEL AGUA DE RECARGA:

- Filtrado y decantación en cabecera y filtros intermedios
- Control del ph del agua (lechos de piedra caliza)

EFICIENCIA POZOS ENTERRADOS CONECTADOS:

NO CIERRES UN POZO: "REUTILÍZALO"

Lecho de piedra caliza

Presa que controla el nivel de base del acuífero

Operativas:

- Se debe pretratar el agua, evitar batirla y mantener los dispositivos
- Evitar desbordamientos mediante gestión de válvulas y aliviaderos
- Profundidad de alerta recomendada: 1,5 m
- Profundidades por encima de ±140 cm de agua provoca que su propio peso compacte las arenas del medio receptor
- Gestión supeditada a meteorología (lluvias y heladas)
- Tasas de infiltración más altas con caudales en torno a 200 l/s
- Labrado balsas: distancia caballones: 80 cm

Válvulas y caudalímetros para la gestión

Control del nivel del agua en balsas

Control de aire en el acuífero

De gestión:

-Gestión a cargo de los usuarios para aumentar la efectividad

- Uso del acuífero como almacén y como "tubería"
- Aljibes (en zonas con escaso espesor de arenas) y depósitos elevados
- Zanjas drenantes y conducciones enterradas en "raspa de pescado"
- Uso del pozo como almacén (zonas menos permeables)
- Perforación de pozos en las zonas de drenaje del acuífero
- Registro de usuarios
- Reducir efecto "descuelgue" al acuífero profundo

Pozo como sistema de explotación y almacenamiento

Decantadores en balsa de Gomezserracín

Decantador en cabecera

Corolario SATs

Agua de recarga (cantidad)

Agua de recarga (calidad)

Medio receptor (suelo y acuífero)

Criterios / códigos de gestión / buenas prácticas

Con el apoyo de: Junta de Castilla y León, AIMCRA, MAR TO MAR-tCI, Euro Ayto. de Santiuste de San Juan Bautista, Ayuntamiento de Gomezserracín

European Commission

This initiative takes place in the framework of "*FP7-ENV-2013 MARSOL (GA 619.120). Demonstrating Managed Aquifer Recharge as a Solution to Water Scarcity and Drought (WPS)*" with the support of the European Commission, however it reflects the views only of the authors, and the Commission cannot be held responsible of any use which may be made of the information contained therein.

MAR TO MAR-tCI

Más Info en: http://www.dina-mar.es

La destrucción de esta placa está penada por la Ley

COROLLARY OF SAT TECHNIQUES FROM OTHER MAR EXPERIENCES

There have been distinguished **four sorts of operations**:

- applied to water from its original source (in both quantity and quality)
- to the receiving medium (in both soil and aquifer)
- to the combination of all of them
- management parameters plus cleaning and maintenance operations

Recharge water (quantity)

- **Temporary storage** in surface reservoirs
- Control of the **flow velocity** of recharged Waters
- **Avoid** operations in **freezing weather /season /cycles**
- Use of thermostatic cameras/chambers
- **Selective criteria at origin**
- **Cleaning and maintenance**

Recharge water (quality)

- **Preselecting:** selective criteria for the origin of recharge waters: **Filtering and decantation waters**, etc (membranes, mud lines, filters, packets?
- **Overflow/run-off** tramps and decantation structures and stagnation structures
- Anticorrosion **devices**
- **Design** and preservation of **slope** (rubble works, gabions...)
- **Design of channel bottoms** (furrows), use of geofabrics
- **Limitation of the water layer height: Pretreating** type ***DBP*** *(Disinfection by Products):* Cl2, I, O3, H2O2, UV rays, etc.
- Cleaning **vegetation** during AR / Specific plantation during summer season
- **Avoid aeration** on AR waters: communicating vessels, open structures, velocity / reduce the speed of waters in channels
- **De-aeration** using piezometers, increase distance between injection-extraction points
- **Dual systems**: Algae drying, natural bed drying, cryotreating, cracking (cake), scarification of silting zones and cleaning /replacement
- **Isolation** from atmosphere/sunlight
- **Specific fishes (e.g. *medaka*)**.
- **Filtering beds and chemical additives**, to eliminate clogging layers
- Avoid recycling effect
- **Denitrification** (e.g. annamox): irrigation / watering tuning the deep of pump placement
- **Avoid natural salinization**: Induced recharge. Barriers in salty areas

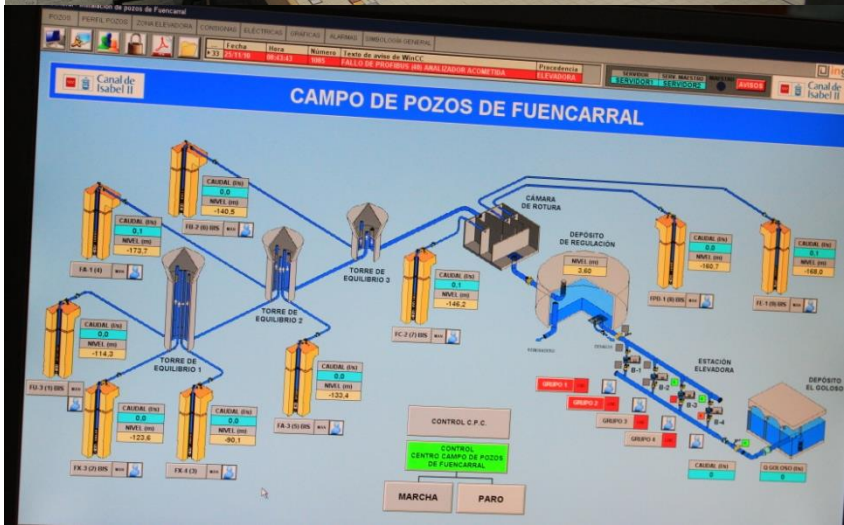
Receiving medium (soil and aquifer)

- **Pre-treating of water for MAR**
- **Natural drying** of bed, and cracking
- **Cryotreating**
- Use of **dual systems** allowing cleaning of one of them whilst the other is operating
- **Inverse pumping** in wells pits close to canal
- **Alternate normal and inverse pumping**
- **Backwashing** in geo fabrics, membranes and filters
- **Use of jet type** cleaning techniques
- Mechanical (wall brushing and scratching) and chemical (use of chemical additives) techniques for the **regeneration** for recharge **wells**
- **Cleaning** techniques with the highest possible frequency
- **Injection well daily pumping**
- **Use of Basic Cleaning Vehicles (BCVs)**

Management/good Practices/ use criteria and codes

- Choosing the **most adequate period &place**
- Initiate '**soft' MAR cycles**
- Input **flow** and **speed control**
- **Monitoring chemical properties** of MAR water during recharge cycles
- Use of **protection devices** for fauna and people
- Early adoption of the **best available techniques**
- Design and adoption of a proper Watching and **Control Program**
- Specific protocol for **clogging control**
- Protocol for proper **hydro-mechanical** aspects in space and time
- **Integral systems**: all elements are interconnected
- Limit fertilizers
- **Promote participation of farmers** in water management
- Installation of adapted waste water treatment plants and decrease untreated spilling
- **Protected perimeter**
- **Public use regulation**

* Modificado de Fernández Escalante, 2005



CONCLUSIONS

- NEGATIVE ENVIRONMENTAL IMPACTS FROM MAR ACTIVITIES CAN BE RESOLVED. MANY OF THESE BY ADOPTING SAT TECHNIQUES, NEW STRUCTURAL DESIGNS AND CHANGES TO MANAGEMENT PARAMETERS

- THE MAJORITY OF IMPACTS DETECTED CORRESPOND TO CLOGGING PROCESSES, EXCESSIVE INTAKE OF AIR INTO THE AQUIFER AND LIMITED PRE-TREATMENT OF THE RECHARGE WATER

- THE DESIGN CHANGES AND MANAGEMENT PARAMETERS MUST BE CREATED "A LA CARTE", DEPENDING ON THE CLIMATE AND CHARACTERISTICS OF EACH SYSTEM

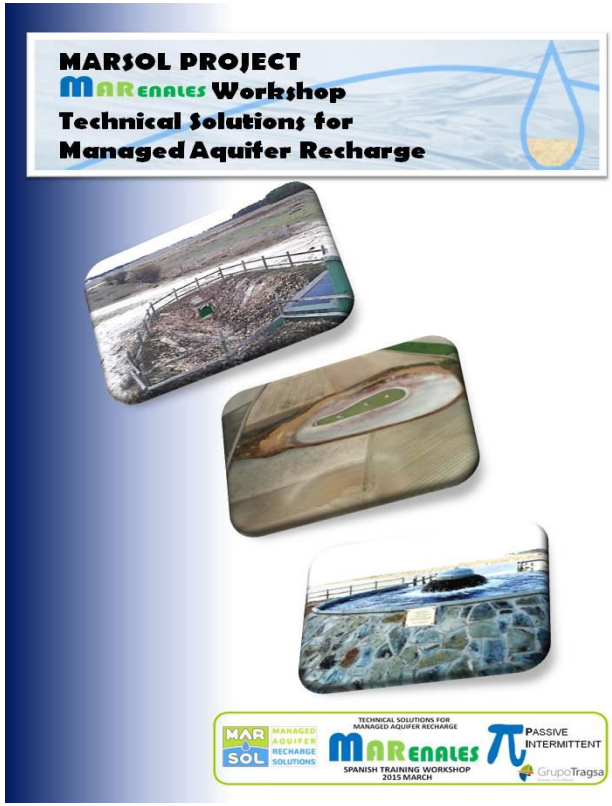
- A COROLLARY HAS BEEN PROPOSED WITH THE AIM TO PRESENT A SERIES OF OPTIONS TO BE CONSIDERED WHEN IMPLEMENTING A SOLUTION (DSS INSTRUMENT)

- THE PROCESS IS OPENED. EACH IMPROVEMENT APPLIED BECOMES A NEW ELEMENT TO IMPROVE

- FRUGAL INNOVATION: INGENUITY AT WORK IN ADVERSITY, FOR DOING MORE WITH LESS:

1. *KEEP IT SIMPLE*
2. *DO NOT REINVENT THE WHEEL*
3. *THINK HORIZONTALLY*

JUGAAD SOLUTIONS



Thank you

Gomezserracín, 2015 March 11th

Collaborate:

Exmo Ayto. de Santiuste de San Juan Bautista

Ayuntamiento de Alcazarén

Ayuntamiento de Gomezserracín

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