Project: Sustainable Hydro Assessments and Groundwater Recharge Projects
Project acronym: SHARP

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APPENDIX: Long version of good practices

GP 7	Aquifer recharge project

Project Partner:
Local Councils' Association (LCA)

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Acronyms

MRA	The Malta Resources Authority
MEPA	The Malta Environment and Planning Authority
MEDIWAT Project	The Mediterranean Islands Network for the Implementation of Innovative Best Practices for Managing Water Scarcity
WFD	The Water Framework Directive

1. Introduction

This report has been prepared as one of the deliverables by AIS Environmental for the Local Council Association in relation to the SHARP/01/2010 – Provision of Research and Consultancy on Sustainable Hydro Assessment and Ground Water Recharge Project. This report gives an overview of the recharge of the aquifers being done as a pilot project by the Water Services Corporation at Bulebel.

The availability of water is a key factor in socio-economic development. In view of Malta's hydroclimatological conditions, including small surface area, low rainfall and high evapotranspiration rate and the relatively dry season, Malta has limited natural water resources which have to be safeguarded, however, it does not suffer from lack of drinking water (Micallef et, al, 2004). This is due to the fact that it is met through the use of groundwater and through a network of reverse osmosis.

Malta's accession to the European Union has placed immediate obligations on the Directorate in view of the transposition of EU Directives pertaining to water management.

2. Water Demand in Malta

Water is a basic necessity for life. It is not only essential for survival; it also enhances the quality of life. The management of water resources is a shared responsibility among all users, be they public, government, industrial and commercial. The multiple uses of water dictate that there are many players in its management. Without a plan of action at national level to bring together these different players, water resources cannot be properly managed.

The Maltese Islands are densely populated but poorly endowed with freshwater resources. Hence, sustainable water resources are vital to Malta's long-term prosperity.

Water is necessary for drinking and it supports everyday life at work, at home and at leisure. Water is essential to agricultural activities and to the health of the natural environment that supports all human activities. Every sector of the economy depends on secure and sustainable access to water. Despite the very limited resources of the islands and the importance of water to a healthy future, water has not to date been valued as the precious resource that it is. There are no easy solutions to Malta's water shortage, yet the nation requires water security for the future.

Water Framework Directive

The European Union identified the need to create a legal framework for the protection and restoration of all types of waters, be it:

- surface water body (water courses and other inland waters);
- transitional waters (brackish water where freshwater meets seawater);
- coastal waters; and
- groundwater bodies.

This integrated framework is known as the Water Framework Directive (WFD) and was adopted by the EU in 2000. The main purpose of the directive is to prevent further deterioration, protect and enhance the health of all water resources and by doing so, sustain the natural ecosystems that depend on them. The Directive has two principal concerns: to reduce all forms of water pollution and to promote sustainable water use so that there could be long-term protection of available water resources for future generations (MEPA, 2011).

The implementation of the Directive will also contribute to lessen the effects of floods and droughts. In order to translate all these aims into action, it introduces a management tool called a River Basin Management Plan. In Malta this plan has been renamed the Water Catchment Management Plan for the simple reason that no rivers are present here (MEPA, 2011).

3. Recharge of Aquifers

Recharge of aquifers started being subjected to regulation, with the publication of the 2002 Regulations on the Protection of Groundwater from Dangerous Substances and the 2004 Water Policy Framework Regulations. These regulations in fact include as a basic measure:

> *Controls, including a requirement for prior authorization of artificial recharge or augmentation of groundwater bodies. The water used may be derived from any groundwater provided that the use of the source does not compromise the achievement of the environmental objectives established for the source or the recharges or augmented body of groundwater (Borg, 2004).*

The "*basic measures*" are the minimum requirements the competent authority takes with respect to the programme of measures, it is obliged to conclude for each water catchment district.

Under the 2002 Regulations regulating Groundwater from Dangerous Substances, the Malta Resources Authority may authorize discharges into the aquifer due to reinjection of water used for geothermal purposes, after it carries out "*prior investigations*". Artificial recharges, under these regulations may only be granted "if there is no risk of polluting the ground water".

Artificial recharge of aquifers is also subject to an Environment Planning Statement under the Environment Impact Assessment Regulations (Legal Notice 204 of 2001), if such a recharge into the aquifer is annually equivalent to or exceeds a volume of 10 million cubic metres.

Furthermore, artificial recharge of aquifers by the Malta Resources Authority or any public entity will be subjected to a Strategic Environment Assessment because water management plans and programmes fall within the scope of regulations transposing the EU Directive 2001/42/EC on the Assessment of the Effects of Certain Plans and Programmes on the Environment.

Pilot Study for recharge of aquifers

A Pilot Artificial Recharge project implemented under the MEDIWAT Project (Mediterranean Islands Network for the Implementation of Innovative Best Practices for Managing Water Scarcity and is part-financed by the European Union under the MED-Programme) is currently being implemented by the MRA and the WSC at Bulebel, Zejtun on a reservoir which takes in water from the Sant'Antnin treatment plant.

The plant at Sant'Antnin, which was transferred to Malta from Ras il-Hobz in Gozo, takes the second class water treated at the Marsascala plant and runs it through an ultra filtration unit, which removes the large impurities in the water. It is then run through a reverse osmosis plant.

This pilot project to replenish the water table using treated sewage water will test the qualitative and quantitative impact of a direct artificial recharge exercise on the mean sea level aquifer system. Indeed, this project is aimed at *starting a process to recharge the aquifer in order to reverse its depletion after years of over-pumping through legal and illegal bore holes - causing the quality of the remaining water to deteriorate* (Sapiano, 2011).

It should be noted that the area chosen for this experiment to be carried out, falls outside the Groundwater Protection Zone.

Figure 1: Polishing Plant.

Currently, water from Sant Antnin sewage purification plant is being pumped to Bulebel where a small water filtration unit treats it further and takes away most of its impurities. The production of the demonstration polishing plant which involves ultra-filtration followed by reverse osmosis assuming an 80% recovery approximates $80m^3$ of water per day.

This test will give an indication of the recharge rate which needs to be applied. Recharge will be applied to one of the boreholes and water level/quality meters will be installed in the others (Figure 2).

The main benefits that are expected out of this pilot project are mainly:

- The potential of the chosen treatment in eliminating contaminants;
- The mechanisms involved in artificial recharge;
- The best recharging methodology;
- The effect of recharge using polished treated sewage effluent on the groundwater on local and regional levels.

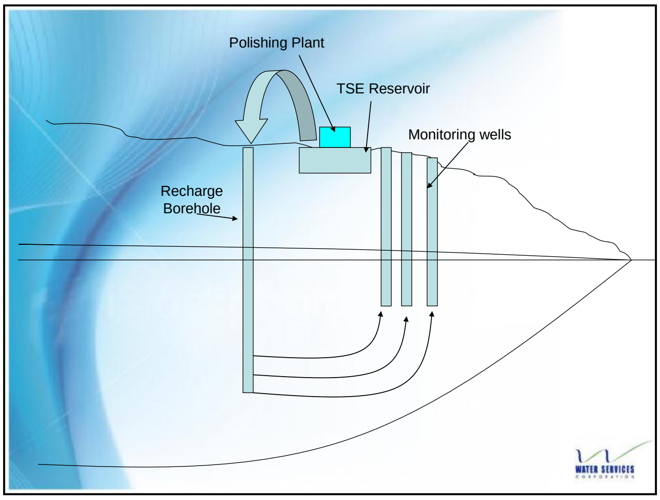

Figure 2: The process.

The main limitations of this pilot project are mainly:

- The hydrogeological setting since the chosen site falls exactly on a 2km2 where an impermeable geological formation is located. It should be noted that the site selection was dictated at this stage by the availability of TSE in Bulebel and also the availability of already sunk boreholes;
- The potential of emerging pollutants which could still remain after the polishing phase;
- Problems with MEPA and MRA in the implementation stage;

The pilot project at Bulebel as pointed out by the MEPA and MRA (2010) will be divided into four main stages:

1. Testing of the resulting effluent
   Four indicator parameters will be identified through a pollution-risk analysis of the main-sewer catchment area feeding into the Malta Sant'Antnin Wastewater Treatment Plant. These parameters will be chosen in such a way as to reliably represent the potential content of emerging industrial pollutants in treated wastewaters. Regular analysis will be undertaken on these parameters in conjunction with other basic chemical parameters, in order to assess the suitability of the resulting effluent for artificial recharge.
2. Artificial Recharge
   Subject to the determination of the suitability of the resulting effluent, direct aquifer recharge with the resulting effluent will be undertaken in a well at Bulebel. Recharge volumes and rates will be determined through a pumping test of the recharge well.
3. Monitoring
   Monitoring will be undertaken in three wells lying hydraulically downstream of the recharge well. This exercise will investigate both quantitative (water level) and qualitative (basic parameters) aspects. It is envisaged that monitoring will be continuous through the use of automated probes, which will be acquired as part of the project. Monitoring will be enhanced with a weekly profiling exercise, carried out in the central deeper monitoring well, in order to investigate the vertical impact of the artificial recharge experiment

4. Analysis

Analysis of the monitoring data will be undertaken in order to assess the aquifer response to the artificial recharge experiment. In particular, this project will try to determine if the impact of such a recharge exercise is direct (short term) or more long term following regional groundwater flow paths. It is envisaged that this result will have a determining importance on the eventual identification of aquifer protection policies.

Figure 3: Site characterization.

Figure 4: Pumping tests.

The water after purification will be fed back into the underground aquifer through boreholes after the Malta Resources Authority establishes that it is safe. It would be passed through further barriers – the porous rock leading down to the aquifer, taking a long time to seep through, which would also rid it of any viruses there might have been.

Until the WSC's tests are completed, the treated water still ends up in the drain, but it would subsequently start to recharge groundwater through a borehole. Three other boreholes were drilled nearby to monitor the effect on the groundwater.

Expected results from this Pilot Study include:

- A detailed characterisation of highly polished effluent with regards to the presence of unconventional pollutants;
- The reaction time of the aquifer system to direct artificial recharge; and
- The potential qualitative and quantitative benefits of recharging the aquifers with high quality water.

4. References

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