



# Institutional framework and decision-making practices for water management in Algeria

*Towards the development of a strategy for water pollution prevention and control in the Seybouse River Basin*



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Prepared by the Agence de Bassin Hydrographique Constantinois-Seybousse-Mellegue

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## PREFACE

In all countries of the Mediterranean Basin, water quality degradation is gradually being perceived as a problem of equal importance to water scarcity. Intense urbanization combined with tourism development, rapid industrial growth and pollution from agrochemicals have all contributed to the degradation of available surface and groundwater supplies. The long-lasting inability to forecast and address the issue has exacerbated the problem in many regions, posing risks to human health and threatening the sustainability of water supplies. Water pollution prevention and control cannot be achieved through infrastructure development alone; policies are needed to encourage water users towards environmental protection, to promote Best Available Technologies and to raise awareness among polluters and the general public. A key premise for the achievement of this goal is the empowerment of institutions to act locally, enforce regulations on discharge standards, and encourage capacity building efforts in the industrial and agricultural sectors.

This volume of the INECO publishable reports outlines the analysis of the institutional framework and decision-making practices for water management in Algeria. It presents the main constraints faced in the water sector today and significant water management challenges that need to be addressed at the national level. On the regional level, this report presents a water management issue that is of alarming importance: the degradation of water quality in the Seybouse River Basin. Along the Seybouse river and its tributaries, pollution originates mostly from the discharge of untreated domestic and industrial effluents; recent efforts undertaken by the State aim primarily on building infrastructure for sewage collection and treatment. However, it has become evident that the minimization of industrial pollution should be based on a policy that encourages and provides appropriate incentives and disincentives rather than on the traditional command-and-control approach.

Responding to this challenge, the INECO project implemented a participatory approach for identifying alternative institutional and economic instruments for mitigating water pollution in the Seybouse River Basin. Emphasis is placed on collaborative planning and participation, and on providing appropriate incentives to the industrial sector. Issues discussed also concern the subject of adequate recovery of water service costs, especially with regard to the wastewater collection and treatment schemes under development in the area.

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## PART I: WATER MANAGEMENT IN ALGERIA: SETTING THE SCENE



## GENERAL CONTEXT – COUNTRY OVERVIEW

Algeria, with an area of 2.4 million km<sup>2</sup>, is the largest country of Northern Africa. Most of this surface is occupied by the Sahara Desert, an area rich in mineral resources. More than 90% of the population lives in the northern part of the country that includes the coastal Mediterranean zone, mountainous areas, plains and highlands. In this part of the country, the annual amount of rainfall varies between 300 and 1000 mm/yr, whereas in the Sahara region and southern of the Saharian Atlas, the annual amount of rainfall does not exceed 100 mm.

The country is divided into 17 major hydrographical basins, of which 5 are transboundary: the Medjerda basin is shared with Tunisia, and the Tafna, Draa, Guir and Daoura basins are shared with Morocco. In terms of administration, the country is divided into 48 wilayas (provinces), 567 dairas (counties) and 1540 municipalities.



**Figure 1: General map of Algeria**

According to the 1998 official census data, Algeria had a population of 29.27 million inhabitants. This figure corresponds to an annual growth rate of 2.28% since the previous (1987) census, when a population of 22.71 million was recorded. The share of urban population has been continuously increasing from 56.1% in 1966 to 61.2 in 1977, to 70.8% in 1987 and to 80.8% in 1998. The 5 wilayas of Algiers, Setif, Oran, Tizi Ouzou and Batna group more than 25% of the total population. Irrigated agriculture accounts for approximately 65% of the total water consumption, as modern irrigation techniques have not been extensively applied yet. According to the 1998 census, 70.78% of households are connected to the drinking water supply network, and 66.34 % to the sewerage network. It should be noted that the average household size was reduced from 7.54 members in 1987 to 7.14 in 1998; this is the first time since the country's independence that such a decrease was recorded.

The average annual water crop is estimated at 100 billion m<sup>3</sup>, of which approximately 80% is lost as evapotranspiration. Freshwater resources are equal to 19.1 billion m<sup>3</sup>, of which

12.4 billion correspond to surface water run-off and 6.7 billion to groundwater. Of the total surface run-off of 12.4 billion m<sup>3</sup>, only 6 billion can be exploited by means of dam construction. At present, the 110 dams of the country mobilize 4 billion m<sup>3</sup>. Between 1995 and 1998, the average annual regularized volume was equal to 2.7 billion m<sup>3</sup>. From the 6.7 billion m<sup>3</sup> of groundwater, 5.1 billion are located in the Sahara. The remaining 1.6 billion m<sup>3</sup> are exploited at a rate of 80%, principally through wells and boreholes.

Therefore, it is evident that an additional volume of 7.6 billion could become available for meeting domestic, agricultural and industrial water needs, at least theoretically. This amount, according to recent studies, would be sufficient only up to 2015. Afterwards, it will be necessary to seek alternative water sources, by employing solutions such as wastewater reclamation and reuse, seawater desalination, and pumping of non-renewable groundwater resources from the northern Sahara, in order to meet increasing water needs.

## GOVERNING WATER – THE FRAMEWORK

### THE INSTITUTIONAL SETTING

#### Institutions & responsibilities

At present, water management falls solely under the responsibility of the **Ministry of Water Resources**, established in 2000. Before that, water management operations were divided between several ministries, whose name was regularly changed (e.g. State Department of Hydraulics, Ministry of Hydraulics, Territorial Development and the Environment, Ministry of Infrastructure). The Ministry is responsible for water resource planning, investments on all issues relevant to water resources protection and exploitation, such as hydraulic infrastructure, inter-basin transfers, drinking water supply networks, and sewage treatment plants. It is also responsible for allocating available water among the different uses (agricultural, domestic and industrial), and for controlling all water-related infrastructure (public and private). Additional tasks include the monitoring of water resources, in terms of both quantity and quality; for achieving this task, the Ministry can undertake all the necessary surveys and assessments, and is responsible for data collection on all the above issues.

Following its central role in water management, the Ministry also has control over:

- Five national agencies: Agence Nationale des Barrages et des Transferts (National Dam and Inter-Basin Transfer Agency), Agence Nationale des Ressources Hydrauliques (Hydraulic Resources National Agency), Office National de l' Irrigation et du Drainage (National Office for Irrigation and Drainage), Office National d' Assainissement (National Office for Sanitation) and the Algérienne des Eaux.
- Five hydrographical basin agencies, which undertake water management operations at the regional level.

The roles and responsibilities of the above institutions are summarized in Tables 1 and 2. Furthermore, the Ministry of the Environment and the Ministry of Water Resources are responsible for defining the overall policy towards environmental protection in the country, the latter being responsible for water pollution issues. Although legislation on emissions is in place, there are problems in law enforcement, as most industries could not afford wastewater treatment. It therefore becomes evident that State incentives should be offered either in the form of grants or in the form of rebates on environmental taxes.

It should be noted that water management responsibilities have been modified several times during the past 15 years. Water distribution in particular has often been centralized and then decentralized. For example, irrigation water, previously managed by the Ministry of Agriculture (see below), is now managed by the Ministry of Water Resources through the corresponding agency. The frequent changes have not assisted in simplifying the overall water management framework and in developing the appropriate technical and human capacity and resources in the different departments/agencies.

**Table 1: The organisation of the water sector**

Domain	Ministry of water resources	National Agencies	Local Administration	End-users
<b>Planning</b>	Direction of planning and economic assessment (DPAE)		Regional directions at the wilayas	
<b>Large hydraulic infrastructure</b>	Direction for water resources mobilization and planning (DMRE)	National Agency of dams and transfers (ANBT) – Feasibility studies – Implementation and management		
<b>Irrigation</b>	Direction of agricultural hydraulics (DHA)	National Office for Irrigation and Drainage (ONID) – Management of irrigation perimeters		Farmers & irrigation associations
<b>Water Distribution</b>	Direction of potable water (DAEP) Planning and legislation	Algerienne des Eaux (ADE) – Elaboration of feasibility studies – Implementation of water works – Overall management	-	-
<b>Sewage collection and treatment</b>	Direction of sewage (DAPE) Planning and legislation	National Office for Sewerage (ONA) – Feasibility studies – Implementation and management		
<b>River Basin Management/ General studies</b>	Direction of studies and hydraulic development (DEAH)	Hydrographic Basin Agencies (ABH) National Agency for Water Resources (ANRH)		

Before the establishment of the Ministry of Water Resources, the **Ministry of Agriculture** was in charge of all issues related to agricultural water use. However, at present it is only considered as representing a major water user. In collaboration with the Ministry of Water Resources, the **Ministry of Health** is responsible for monitoring drinking water quality, especially with regard to microbiological parameters.

In spite of the creation, in 2004, of the Algerienne des Eaux (ADE) and the Office National d' Assainissement (ONA), there are municipalities (falling under the responsibility of the **Ministry of the Interior**), which are still responsible for the management of drinking water and sewerage networks. However, it is expected that their involvement will be gradually reduced, as the ADE and ONA are progressively taking charge of all networks.

**Table 2: Water resources planning matrix**

ACTIVITY	MWR	ANB	ANRH	ADE	ONA	ONID	ABH
<b>Surface waters</b>							
Use		X					
Storage		X					
Groundwater recharge		X					
Diversion		X					
Quality monitoring		X	X				X
Assessment		X					
<b>Groundwater</b>							
Use							
Storage			X				
Recharge							
Quality monitoring			X				X
Assessment							
Well permits							
<b>Irrigation network</b>							
Rehabilitation						X	
Modernisation						X	
<b>Reuse</b>							
Drainage water					X		
Wastewater					X		
<b>Desalination</b>							
Introduction of technology				X			
<b>Efficient water utilisation</b>							
Domestic				X			
Industrial				X			
Agricultural						X	
<b>Legislation</b>							
Regulation and codes	X						
Standards	X						
Enforcement							
<b>Policy setting</b>							
<b>Water allocation</b>	X						
<b>Project financing</b>	X						
Project design		X	X	X	X	X	X
Project implementation		X	X	X	X	X	
Operation and Maintenance		X	X	X	X	X	
<b>Pricing (tariffs)</b>	X						
<b>Water data records</b>			X				

## Legislation

Water-related legislation mainly comprises three laws and their amendments:

- The Water Law ("Code de l'eau") of July 1983;
- The Law of June 1996. which amended the Code de l'Eau;

- The law of August 2005, dealing with water-related issues.

Specific regulations and norms, issued in the form of additional laws and decrees, are elaborated by the Ministry of Water Resources. The main points of water-related legislation are summarized in Table 3, and further discussed below.

**Table 3: Water-related legislation**

Reference	Focus	Content	Implementation Status
<b>Water Law no 83-17 16 July 1983</b>	General provisions on water governance, allocation and water rights	On the uses of water, public property of water resources and the rights of consumers	Generally implemented. Some aspects, especially with regard to monitoring and control are not enforced.
<b>Law 96-13 15 of June 1996 Amending and completing the Water Law of 1983</b>	Establishment of a new water policy framework	Introduces the concept of Integrated Water Resources Management. Provides for the establishment of the Hydrographical Basin Agencies.	In the process of implementation, but possibly with some delay.
<b>Water Law no 05-12 4th August 2005</b>	Introduction of the general principles of environmental sustainability, and provisions for new tools in water resource planning.	About the sustainable management of water in relation to the environment. Provides for the drafting of the National Water Management Plan and for the corresponding Regional Water Development Programmes.	Recent law, not yet fully implemented, especially with regard to the development of Regional and National Water Management Plans.

The Water Law of 1983 set the framework for water management in Algeria, defining the public ownership of water resources (surface and groundwater) of the country, and the priorities for water allocation, which are of the following order: first priority is given to domestic water use, second to agriculture, and finally, to the industrial sector. Furthermore, the Law introduced the concept of issuing private contracts for providing public services. The 1983 Water Law was significantly amended in 1996. The new law allowed for extending contracts for water service provision to private companies. It also introduced the concept of river basin management, through the definition of hydrographical basins as the level for water resource planning and management. Additionally, the 1996 amendment established the National Consultation Council for Water Resources (Conseil National Consultatif des Ressources en Eau), for discussing on the National Water Management Plan, and acting as a consulting body on the development of water management strategies at the national level. At present, the Council's procedures have not been yet defined.

Water-related legislation was further updated in 2005; this reform introduced the concepts of environmental sustainability and defined the necessary planning framework, through the development of regional water management plans, to be elaborated at the hydrographical basin level. The 2005 law also introduces the participation of stakeholders, policy and decision-makers on all water-related decisions.

Water quality standards for physico-chemical parameters are national and based on those published by WHO. The ANRH (Agence Nationale des Ressources Hydrauliques) and the hydrographical basin agencies monitor, through a network of measurement points for both

surface and groundwater, all relevant parameters and regularly publish maps for water pollution in each region.

Overall, the continuous updating ensures that water-related legislation meets emerging needs and concepts and the increased concern over the environmentally sustainable management of water resources. However, law enforcement, especially with regard to water abstraction and pollution control can possibly be considered insufficient.

## VALUING WATER: COST RECOVERY & FINANCING

At present, all water sector investments are public and financed from the national budget. A distinction can be made between:

- Funds provided to the Ministry of Water Resources, to finance “sectorial” projects, such as dams, water transfers, assessments, important networks for water supply and sewerage, drinking water and wastewater treatment plants and irrigation perimeters. These funds are then allocated or distributed among the different agencies, controlled by the Ministry.
- Funds provided to the local administration (wilayas and municipalities), aimed at financing small-scale networks at the local level.

Although the pertinent legislation provides the relevant opportunities, the private sector is not yet actively involved. During the past two years there has been an extensive debate on involving foreign investment parties in the management of the Algerienne Des Eaux and the Office National d’ Assainissement (ONA). This initiative is now in the process of implementation.

Water tariffs for each use are decided at the national setting, without regional differentiation. Additional environmental taxes that were introduced in 1996 include: (a) a water abstraction charge and (b) a water pollution charge. These are paid by all consumers connected to a water supply network (domestic, agricultural or industrial). An additional tax was introduced in 2005 for industrial and other (service) facilities, which operate their own water supply infrastructure with the aim to progressively introduce and apply the “polluter-pays” principle.

Mostly due to social and political reasons, charges for industrial and agricultural water supply are well below the real cost of water provision. This imposes a financial burden on public companies responsible for water distribution, which are further subsidized through the national budget.

It should be noted that the country experiences a serious lack of information with regard to cost accounting and financial and economic assessments. At present, there are no general or important assessments of investments and water pricing, although several attempts have been made in the past.

## CONCLUDING REMARKS: CONSTRAINTS FACING THE WATER SECTOR AT THE NATIONAL LEVEL

Algeria, due to its climate, is a country with limited water availability and increasing water scarcity. The mobilization of groundwater (with the exception of the Sahara mineral resources – the albian nappe) has been nearly completed.

Damming started recently, in the late 1980s, and is still being pursued. It is expected that in the next 25 years nearly all exploitable surface waters will have been mobilised. Furthermore, the Ministry of Water Resources has begun to implement seawater desalination projects for some major cities of the coast (Algiers, Oran, Skikda). Algeria has an extensive coastline of about 1,000 km and all major cities are ports. The concept would be to employ desalination for meeting urban and industrial water needs along the coastal zone, and to divert surface and groundwater supply to the interior of the country.

There is need for significant efforts for rehabilitating existing water distribution networks, where the estimated losses account for nearly 50% of water distributed, an enormous amount when compared to the increasing water scarcity the country is facing. The Ministry of Water Resources initiated a relevant programme for three major cities of the country, Algiers, Oran and Constantine, which is expected to be extended to at least 10 other important cities. Similarly, important efforts are under way for managing water resources in a way that ensures environmental protection.

Overall, the Algerienne des Eaux, created in 2001, and in charge of the drinking water supply networks throughout the country, should become more efficient in reducing water leaks, and in the recovery of its costs. In this field, the country seeks technical and economic assistance from foreign companies through international tenders. The first contract was initiated in Algiers in 2006, with Suez Environnement (France), and in Constantine in 2008. Other contracts are under preparation .

Another issue concerns the lack of information on the real economic value of water and the actual water exploitation cost. There are no analytical accounts from the companies previously in charge of water service provision, and the establishment of the Algerienne des Eaux is too recent to result to an adequate dataset. Enhancing the knowledge-base upon these issues is an emerging need that should be addressed in the next years. Water tariffs are decided by national authorities and are uniform throughout the country. There is no actual information about costs and the costs of “reasonable” management and water supply provision; therefore, there is no estimate of whether consumers are actually charged with the real cost of water.

In the coming years, water pollution will be a major problem, due to two major causes:

- Increasing urbanization has rendered cities major contributors to river pollution (most rivers are “oueds”. i.e. of seasonal flow and dry during the summer). Furthermore, the programme for building sewage treatment plants has been significantly delayed, and at present only a few cities are serviced by a wastewater treatment plant.
- Agricultural development, liberated in the 1990s after a long socialist period, has resulted in the significant use of fertilizers, with the aim to further increase agricultural production. This is now clearly manifested in the increasing concentrations of nitrates in both surface and groundwater.

Furthermore, a large number of wells and boreholes are being drilled, in many cases without prior authorization or permit. In 2006, authorities decided to develop an inventory of water extraction points; however, this is considered a difficult task as the number of illegal wells or boreholes is at present estimated at several thousands.

Similarly, data and information systems and analytical tools on water resources have to be created, maintained and regularly updated. Towards this end, an effort was initiated at the

national level by the Ministry of Water Resources, and at the regional level, through the Basin Agencies, in order to collect and organise all existing water-related data. Along the same line, simulation tools on water resource assessment, demand and allocation are being implemented by the Basin Agencies. As mentioned above, several environmental taxes were introduced during the past decade. Basin Agencies are, according to the relevant legislation, in charge of collecting the 2005 tax for industrial and service facilities, but actually lack sufficient human resources to undertake the task.

Although the pertinent legislation advocates the principle of public participation, the participation of the different actors is rather weak, with all important decisions being taken at the national level. Basin Committees were established in 1996 (at the same time as the Basin Agencies), but are not fully operating for the time being.

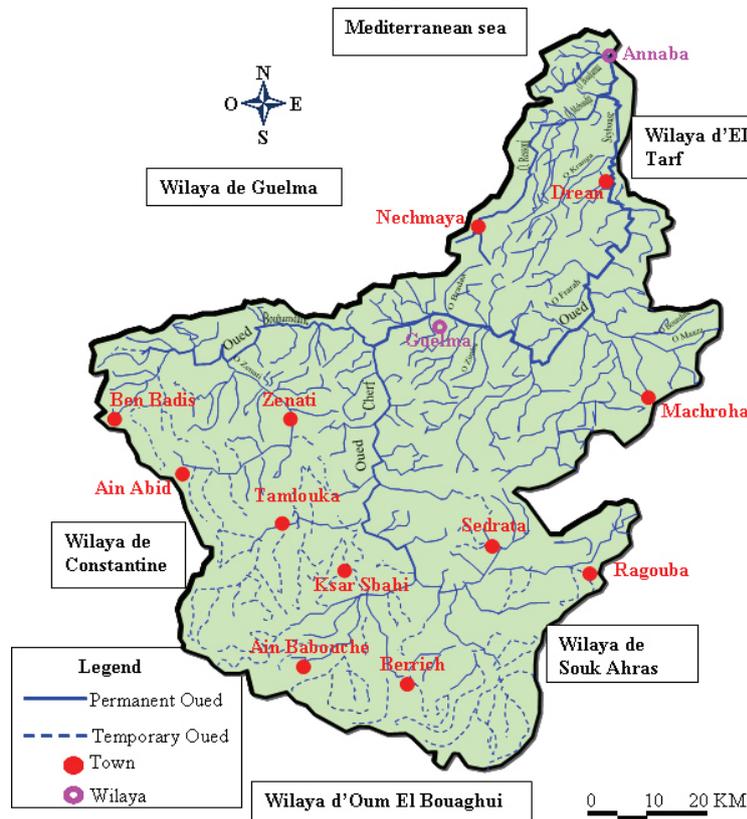
PART II: THE INECO ALGERIA CASE STUDY:  
POLLUTION OF THE SEYBOUSE RIVER



## BACKGROUND AND MOTIVATION

As detailed in Part I of this report, the water sector in Algeria faces different challenges related to limited and variable water availability, demand growth, intense urbanization and water quality degradation. In addition to technical challenges and constraints, problems are further exacerbated by lack of knowledge and efficient monitoring, deficiencies in legislation enforcement and the fact that capacity in the water sector is under development.

All the above constraints and problems are encountered throughout the country; the Seybouse River in Northern Algeria in particular, faces increasing water quality degradation, due to pollution from agrochemicals, industrial effluents and domestic sewage. The alarming situation (presently, in terms of water quality, the state of the largest part of the river is characterized as “bad” or “excessively polluted”) is mainly attributed to the intense industrial activity in the River Basin. The foreseen development of sewage collection and treatment schemes is expected to widely contribute to problem mitigation; it becomes however evident that there is need to activate mechanisms and incentives towards industrial pollution prevention and abatement, through the installation of end-of-pipe systems, but also through the wider implementation of cleaner production concepts and technologies.



**Figure 2: The Seybouse River Basin**

In the above context, the INECO project focused on fostering a constructive dialogue process on alternative institutional and economic instruments for mitigating the water pollution problems experienced in this area. In response to the needs of stakeholders, who are alarmed by the significant degradation of water quality and the health risks entailed, discussed options focused on: (a) ways to enable the effective implementation of pollution prevention measures and (b) developing wider processes towards enhanced engagement of actors and citizens in environmental protection.

REGION OVERVIEW

Geography

The Seybouse River Basin extends over an area of 6,471 km<sup>2</sup>, is located in the northern part of Algeria and has a permanent population of approximately 1,300,000 inhabitants (Figure 2). The River Basin lies within the territories of the wilayas of Guelma, El-Tarf (by Drean) and Annaba. It is limited in the north by the Mediterranean Sea, in the south by the Wilaya of Souk-Ahras, in the west by the Edough Massif, lake Fetzara, Ain Berda, and in the east by the Mafragh oued.

The Seybouse River, of 240 km total length, is an important water source, used mainly for the irrigation of large agricultural plains, extending from the Guelma region up to the city of Annaba. Overall, the basin extends over the administrative boundaries of 68 municipalities located in 7 wilayas. Its water resources are vital for sustaining the majority of economic activities in the wider region.

Climate, hydrology and hydrogeology

The climate of the basin varies from typical Mediterranean along the coast to semi-arid. The mean annual precipitation ranges between 700 mm and 400 mm, reaching a monthly maximum in the range of 90-120 mm in December/January. Minimum and maximum temperatures are observed in December-January (less than 10°C) and in July or August (between 25°C and 30°C) respectively. The average annual infiltration is about 162 mm, whereas surface run-off accounts for 79 mm/yr.

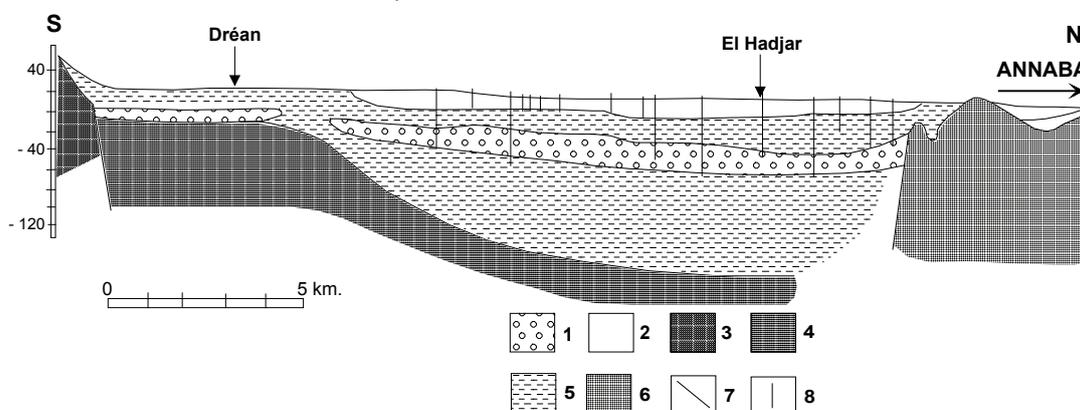


Figure 3: Hydrogeology of the Seybouse riverbed in the plain of Annaba<sup>1</sup>

In terms of hydrogeology, the Seybouse River flows through depressions containing an alluvial water table (Djabri, 1996). These formations distinguish two aquifers (Figure 3), which communicate through the Oued Meboudja, the superficial aquifer of Annaba and the Alluvial aquifer of high terraces (Djabri et al. 2007, & Hani 2003). In the Guelma region, identified aquifers are alluvial and calcareous.

The lake Fedzara is the only significant aquatic ecosystem in the region, and recently acquired official protection status through the Ramsar Convention. The dimensions of the lake are

<sup>1</sup> (1) pebbles and gravels; (2) sand; (3) numidian clay; (4) cenomanian marl and marly limestone; (5) plio-quaternary detrital clays; (6) metamorphic formations; (7) fault; (8) drillings.

17 km from west to east and 13 km from north to south and the lake water is characterized by high salinity (Debieche, 2002).

## Socio-economic characteristics

### *Demography and population growth*

As mentioned above, the global population estimate in the Seybouse River basin is around 1,300,000 inhabitants. The demographic evolution of the region follows the national trends, and can be divided in two main periods.

The first period is marked by the urbanization wave that followed the independence of the country in 1962, when local population migrated to cities after the departure of colonists.

The second period of urbanization took place in the period 1990-2000, when the population of the country increased from 25.6 million to 31.8 million persons. The result was the expansion of existing urban areas and the development of new cities (e.g. Sidi Amar: 100,000 inhabitants, El Hadjar: 120,000 inhabitants, El Bouni: 130,000 inhabitants, Annaba: 600,000 inhabitants). The large population increase compelled the Government to foster urban development, but did not allow enough time for the planning and development of the corresponding facilities required, such as distribution networks and sewage collection and treatment schemes.

### *Agriculture and industry*

Agriculture is the main economic activity in the upper Charef Basin, whereas irrigated cultivations equipped according to modern standards can be found in the lower Seybouse. The main crops cultivated in the river basin's irrigation perimeters comprise cereals and vegetables.

Industrial activities are very important in the area, and are mostly concentrated around the city of Annaba (steel, chemical fertilizers and industrial tomato industries) and Guelma (sugar industry and motorcycle manufacturing). The main factories are listed in Table 4.

**Table 4 : Main industrial units in the Seybouse River Basin**

Industrial sector	Industrial unit/Number of employees
Fertilizers	ASMIDAL, 3000 employees
Steel industry (El-Hadjar)	15000 workers
Dairy	ORELAIT, 1400 employees
Bicycles	1200 employees
Metals processing	SN METAL, 1300 employees
Ceramics	3000 employees
Sugar	1000 employees

## WATER-RELATED DRIVERS & CHALLENGES IN THE RIVER BASIN

### Water use and demand

There is increased competition among water uses in the Basin. Overall, agriculture consumes more than 70% of the available water, while the domestic and industrial sectors utilise the remaining 30%. With regard to groundwater, nearly two-thirds (2/3) are used for irrigation

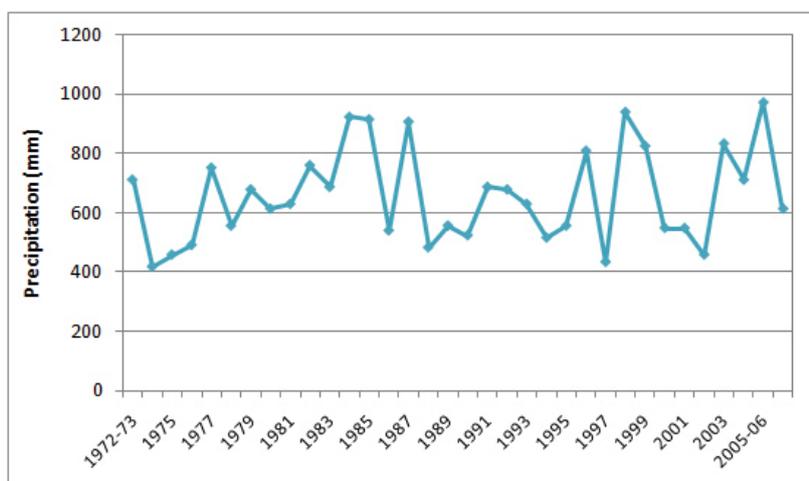
and 1/3 for potable and industrial use. Table 5 summarizes projected water availability and demand patterns in the basin (year 2020), portraying the expected disparity between supply and demand.

**Table 5: Water availability and demand in the Seybouse River Basin (Rhumel-Seybouse and Medjerda Basin Agency, 2000)**

Resources/demand by 2020	Volume in million m <sup>3</sup> /yr
Regulated surface water	118
Groundwater	94.6
<b>Total water resources</b>	<b>212.6</b>
Demand for drinking and industrial water	138.4
Demand for irrigation water	75.8
<b>Total demand</b>	<b>241.2</b>
<b>Balance</b>	<b>-30.2</b>

#### Vulnerability to extreme hydrological events and climate change

The Seybouse River Basin is highly vulnerable to climate variability and change. Several flood and drought events have been reported in the last decades (Figure 4), including those experienced during the period 1990-2000, when precipitation maxima did not exceed 600 mm/year.



**Figure 4: Precipitation variability in the Seybouse River Basin**

#### Land and water quality degradation

Land degradation is becoming a serious problem in the area; erosion is the main cause for siltation problems in storage reservoirs. Furthermore, and as analysed in the following section, the Seybouse River receives significant pollution loads from many cities (Berriche, Guelma, Bouchegouf, Drean, etc.) and industries. Excessive pollution renders the water unsuitable for human use and crop irrigation, particularly in the downstream areas of the Basin.

WATER QUALITY ASSESSMENTS

In order to evaluate the current state of the river and local aquifers, a survey was carried out during the period 1998-2003. Measured quality parameters included nitrates, nitrites, chloride, conductivity and turbidity, COD and BOD, dissolved oxygen and ammonia. The survey, the results of which are presented in Annex I, revealed an increase of the concentrations of various pollutants, originating from agricultural, industrial and domestic sources. Furthermore, results indicated that there has been a significant gradual deterioration of water quality during the examined 5 year-period, affecting both surface and groundwater resources. A summary of the results from this assessment is presented in Figure 5, whereas the identified major sources of domestic and industrial pollution are depicted in Figure 6.

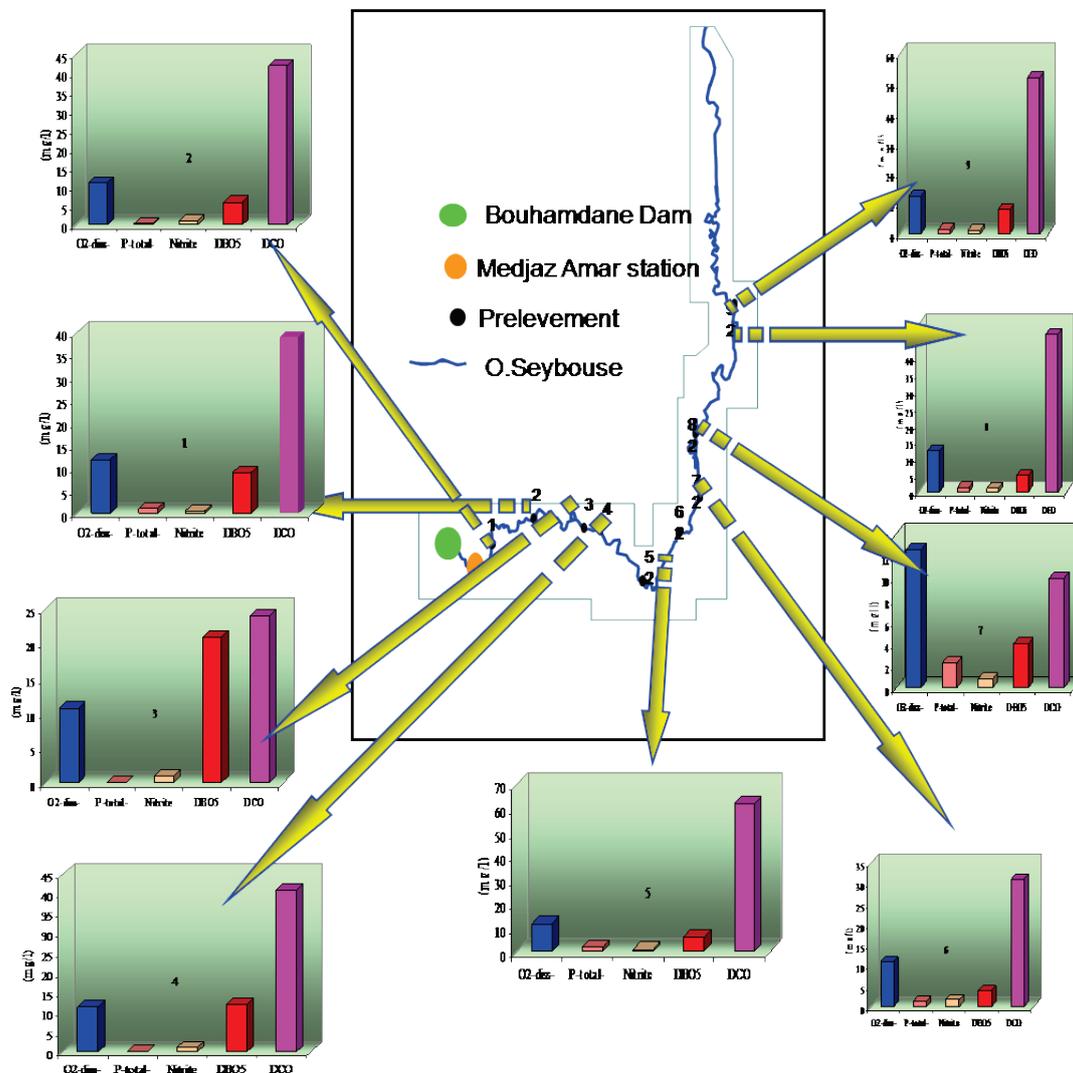


Figure 5: Summary of water quality analysis results in the Seybouse River Basin

As projects for the development of sewage collection and treatment plants are underway and will have been fully implemented by 2012, urgent measures are needed for reducing pollution of industrial and agricultural origin. If no action is taken, there is strong possibility for irreversible damage to groundwater bodies.

## INDUSTRIAL POLLUTION

Of the 86 major industrial units currently operating in the region, only 8 have their own wastewater treatment facilities (Figure 7). Some factories, especially those located in the Guelma region, are highly polluting industries (e.g. paper and dairy production units). At present, there is no clear picture of the total volume of wastewater produced by each industry and of the actual pollution loads produced and discharged by each. For addressing the lack of relevant data, a project will be launched in order to collect precise data on water pollution sources.

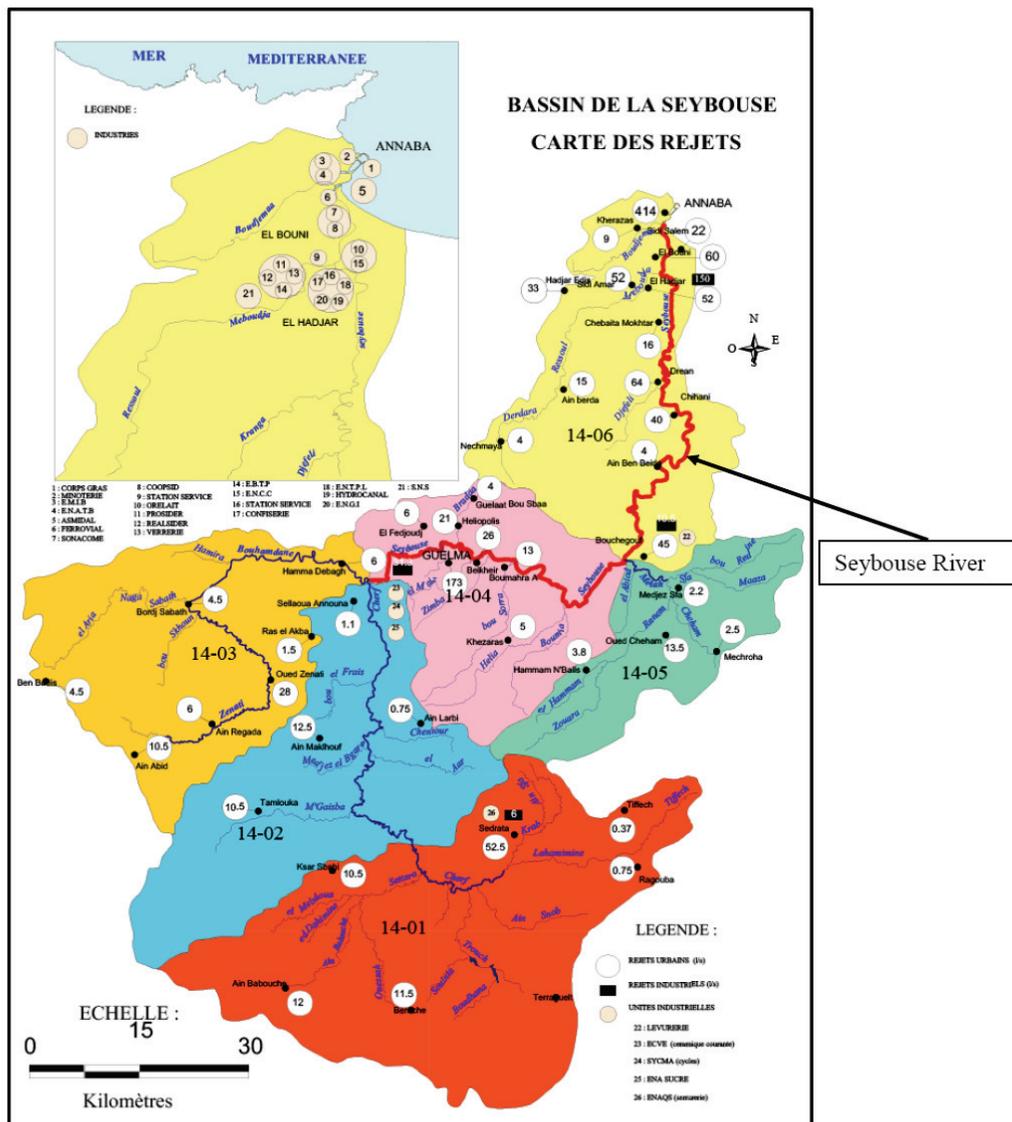


Figure 6: Location of main pollution sources in the Seybouse River Basin

## DOMESTIC POLLUTION

Overall, domestic effluents in the basin are not treated; presently, there is only one wastewater treatment plant in Guelma, which was inaugurated in 2008. The plant has a capacity of 200,000 equiv. inh. and can treat up to 32,000 m<sup>3</sup>/day. Four more units, with a total capacity of 97,000 m<sup>3</sup>/d, are under construction, whereas two more treatment plants in Annaba and Oued Zenati are in the planning stage and will be operational by 2010.

**Table 6: Sewage treatment plants under construction and planning in the Seybouse River Basin**

Treatment Plant	Capacity	
	Population equivalents	m <sup>3</sup> /day
<b>Under construction</b>		
Sedrata	100,000	25,000
El Fedjoudj	5,000	2,000
MDaourouch	64,533	10,000
Bir Bouhouche	10,580	60,000
<b>Planning stage</b>		
Oued Zenati	100,000	20,000
Annaba	780,700	156,000



**Figure 7: Map of quality measurement points and major industrial units**

## THE “GOVERNING” DIMENSION OF THE ISSUE

### Institutions and actors involved

The ANRH (Agence Nationale des Ressources Hydrauliques - National Agency of Hydraulic Resources), controlled by the Ministry of Water Resources, is the main institution responsi-

ble for the implementation of different pollution abatement measures in the area. Currently, the Ministry of the Environment is pursuing the installation of dedicated laboratories for monitoring water, soil and air pollution in the River Basin. Furthermore, the administrative (and local) Directions of Hydraulics are in charge of implementing different projects, such as water distribution and sewerage networks, sewage treatment plants, etc.

The corresponding River Basin Agency (ABHCSM - Agence de Bassin Hydrographique de Constantinois, Seybouse Melegue) is responsible for collecting data for analyzing the general condition of water resources in the basin and for proposing appropriate actions for mitigating water management issues. Additionally, one association, the ANPEP (Association Nationale de Protection de l' Environnement et de lutte contre la pollution – National Association for the Protection of the Environment and for Pollution Abatement), is leading various efforts to raise awareness and mobilize citizens on water pollution issues experienced in the area. Within this framework of efforts, the ANPEP and the ABHCSM co-organized a dedicated meeting on water pollution issues on February 2<sup>nd</sup> 2009.

#### Efforts and local initiatives

The current efforts undertaken by the Ministry of Water Resources concern the reduction of pollution from domestic effluents, through the construction of sewage treatment plants for servicing major cities of the River Basin (see Table 6). Concerning industrial pollution, the Ministry of Environment is in the process of preparing relevant legislative texts.

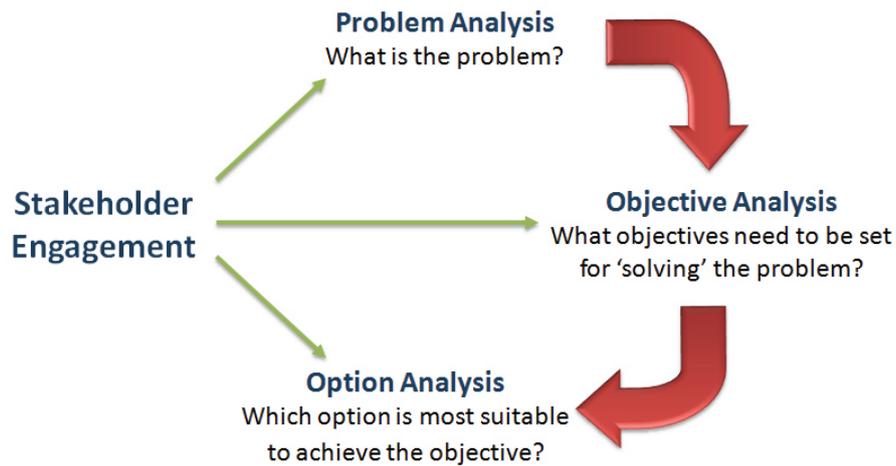
## DISCUSSING WITH LOCAL STAKEHOLDERS – THE APPROACH

The INECO approach towards the development of a participatory process for discussing alternative institutional and economic instruments to address water management issues was based on the Objective Oriented Project Planning method.

The method, which is similar to the Logical Framework Approach, has been suggested as a tool to support urban participatory decision-making. In INECO, this method has been used to frame discussions with stakeholders, focusing on a water management problem that is commonly perceived as significant (focal) in the region of interest.

The followed approach was divided in three stages (Figure 8):

1. The first stage, **Problem Analysis**, involved the identification of stakeholders and the mapping of their key problems, constraints and opportunities, and the definition of the key water management issue in the region of interest. Furthermore, this stage included the identification and analysis of cause and effect relationships between threats and root causes of the issue at hand;
2. Next, the **Analysis of objectives** concerned the development of policy objectives from the identified problems, and the identification of means-to-end relationships;
3. The final stage, **Option analysis**, concerned the identification of different options that can contribute to the achievement of the agreed objectives. Options were subsequently evaluated by stakeholders to formulate the most suitable strategy for problem mitigation.



**Figure 8: The framework for public participation and engagement in INECO**

The overall process was articulated through individual (preparatory or consultation) meetings with key stakeholders (decision and policy makers, representatives of key water users), workshops and public meetings open to stakeholders and all citizens concerned, surveys, discussion fora, and dedicated questionnaires. Emphasis was given to the openness of the process; special care was given to inform stakeholders of all outcomes and replies of other parties, whereas all information collected was made accessible to the public through the distribution and web uploading of material.

The following paragraphs describe the overall implementation of this approach for deriving regional policy recommendations for mitigating the water pollution issues faced in the Seybouse River Basin.

## PROBLEM ANALYSIS

The first stage of the developed process concerned the identification of key stakeholders with a role or concern over the pollution of the Seybouse River, including:

- The authorities involved in the management of water resources and pollution abatement;
- Representatives of industrial associations and major industries of the area;
- Local university researchers and members of the academia, involved in research concerning hydrology and the assessment of pressures exerted on the water bodies of the Basin.

The first workshop, open to all parties, was held on January 19<sup>th</sup> 2008, in Annaba. The event gathered 50 participants, including representatives of public authorities and ministries dealing with various issues related to water pollution abatement, NGOs, water user associations and members of the local research and academic community. The primary aim of the workshop was to discuss the problem with the local stakeholders, through the development and consolidation of a “Problem Tree” describing the causes and effects of the problem qualitatively. The event also offered the opportunity for a first exchange of views on policy objectives and potential options, further discussed in the pertinent sections of this report. Through a dedicated questionnaire, stakeholders were also able to express their views on the significance of the problem, its effects and primary causes.



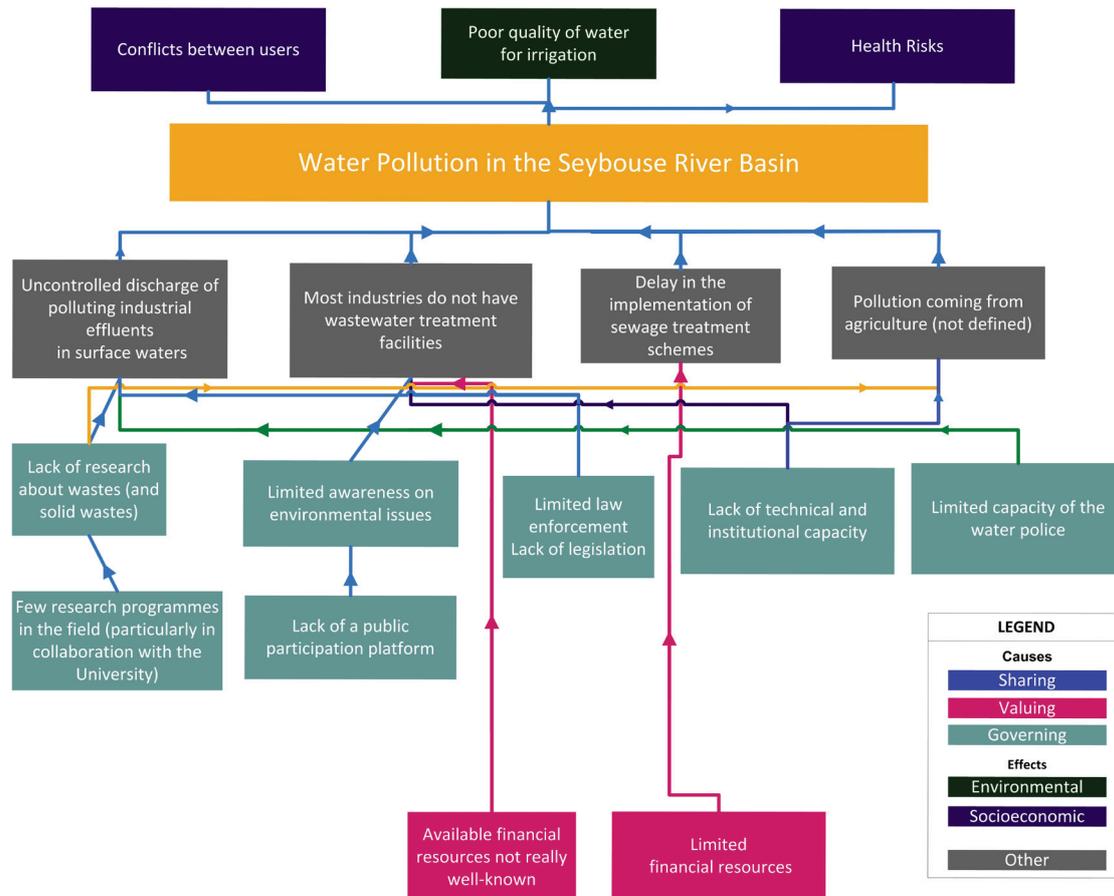
**Photos from the INECO Algeria Stakeholder Workshop on “Protecting the Seybouse waters from pollution”, Annaba, January 19<sup>th</sup> 2008**

Within the framework of the workshop, stakeholders were asked to validate a preliminary “Problem Tree”. The resulting diagram is presented in Figure 9. According to the “problem tree” analysis, currently there are significant water pollution issues associated with the discharge of both domestic and industrial effluents from the cities and industries located along the river bank. The annual effluent discharge of used oils is approximately 3 million m<sup>3</sup>. Although the pertinent legislation specifies emission limits and discharge standards, there are problems with the actual implementation of the law, as most industrial units do not have the financial possibility of developing wastewater treatment schemes. The most vulnerable areas are Meboudja, Bouchegouf and Guelma, which concentrate the largest part of industrial activities. In those areas, the contamination of groundwater is also a major concern. Furthermore, the surface run-off, originating from mountainous areas (e.g. Edough and Gelaat Bou Sbaa) and recharging the water table, conveys significant volume of polluting effluents. At present, there is risk for human health, as children often play in the vicinity of the river but also in agricultural production, as many farmers abstract water directly from the river for crop irrigation. Fauna and flora are also seriously threatened, as well as soil productivity and the overall river ecosystem.

Additional shortcomings, as identified by participants, were related to:

- Technical issues, as there is lack of knowledge on:
  - The sources of water pollution and the regular monitoring of water quality and pollution evolution. Actions undertaken by technical institutions should not be restricted to the management of specific incidents/events.
  - Pollution hotspots, as the monitoring network is not dense enough.
  - Specific characteristics of pollution sources.
- Economic and financial issues, where there is lack of knowledge on:
  - The real status of the different funds available, and especially their use for environmental purposes.
  - The actual financial support offered to industries for the installation of wastewater treatment units, also in relation to their own investing capacity.
- Law enforcement, and especially to the operation of the water police, which is still inadequately equipped.
- Lack of efforts to raise awareness among water users and especially industrialists and farmers, on practices that can lead to an increase of production but also to a de-

crease of pollution. It was pointed out that the pollution of resources can evolve to an insurmountable obstacle to production, especially in the agricultural sector.

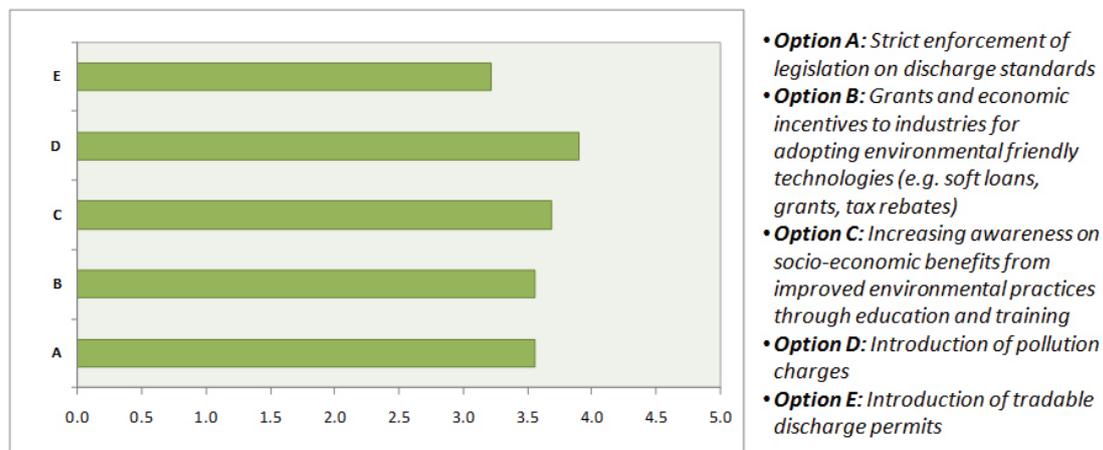


**Figure 9: Problem tree analysis of the causes and effects of water pollution in the Seybouse River Basin**

Replies to the dedicated questionnaire that was distributed and completed during the workshop were also a helpful tool in revealing the perceptions of stakeholders as to the significance of causes and effects to the problem and possible options for problem mitigation. The most significant results of the survey were the following:

- The majority of respondents perceive that water pollution is indeed the most significant water management issue faced in the basin (54.8% of replies), followed by the lack of infrastructure for sewage treatment (35.7% of replies). The uncontrolled discharge of industrial effluents is considered by far the primary cause of the problem (78.6% of replies).
- As to the underlying causes of the problem, respondents have identified deficiencies in enforcement of the pertinent legislation (76.2% of replies) and the lack of mobilization of the general public, polluters included (47.6% of replies).
- The majority of respondents agree that public participation is a prerequisite for developing sound and successful water management policies. Favoured measures to that end comprise the implementation and operation of “Advisory Committees” and the introduction of “Notice and Comment” procedures on water management plans and measures.

Five main instruments were discussed for mitigating industrial pollution and were ranked by workshop participants, using a scale ranging from 1 (least effective) to 5 (most effective). Ranking results are presented in Figure 10, below.



**Figure 10: Ranking of options for industrial pollution prevention and control in the Seybouse River Basin**

In addition to the approaches discussed, participants further suggested the following action points:

- Acceleration of processes for acquiring relevant data, taking advantage of the relevant programmes issued by the ABHCSM and the ANRH and with involvement of the Annaba University on the basis of clear forms of collaboration;
- Strengthening of awareness programmes and actions addressed to the industrial sector and farmers, and to elected local officials.
- Enhanced coordination between the different ministries and regional departments in charge of water pollution monitoring and control: Water Resources, Health, Environment, Industry and Agriculture.
- Acquisition of mobile laboratories, able to undertake regular and random measurements of water quality parameters.
- Increased efforts to implement laws on water pollution, especially those concerning the obligation of polluting industries to provide information on loads and quality of discharges, and the prohibition of discharging industrial waste in the sewerage network without appropriate treatment.
- Enhancement of knowledge on economic and financial issues, particularly with regard to the possibility of mobilizing dedicated funds from the Ministry of Water Resources and the Ministry of the Environment. Financial incentives for the development of industrial wastewater treatment could possibly be provided through inter-ministerial coordination and take the form of contracts with specific industrial sectors.
- Development of capacity building programmes for the water police, through coordination with different security bodies and examination of the possibility of establishing a central department, in charge of monitoring environmental violations.

Suggestions, comments and issues raised formed the basis for the discussion on policy objectives and potential options, described in the following sections.

## DEFINING POLICY OBJECTIVES

Following from the participatory consolidation of the “Problem Tree”, individual consultation and discussion sessions were held with all local stakeholders and actors that participated in the workshop event of 18/01/2008. These meetings were aimed at: (a) defining the key policy objectives that should be pursued for problem mitigation, and (b) collecting additional suggestions on options that could be applied to attain the defined objectives.

Firstly, the results of the previous stage (“Problem Analysis”) were used to draw a preliminary “Objective Tree”, translating the original cause-effect diagram to means-to-ends relations. This “tree” was then further elaborated to define a set of key policy objectives towards achieving the main goal of “Mitigating industrial pollution in the Seybouse River Basin”, incorporating the views of all stakeholders. The two main policy objectives defined through this process were the following:

- **Objective A:** The minimization of pollution from industrial effluents, to be achieved through (a) the offer of economic incentives/disincentives to industries for developing and operating individual wastewater treatment facilities, and (b) the enhancement of the institutional and regulatory capacity of water management authorities for monitoring compliance with the corresponding legislation on the discharge of untreated industrial effluents.
- **Objective B:** Raising awareness on environmental, societal and economic benefits from cleaner industrial production, and fostering the actual development and implementation of public participation processes.

Taking into account that a medium-term goal for the River Basin would also be to ensure the financial sustainability of the sewage treatment schemes currently under development, a **third objective** was also defined, concerning the “adequate recovery of financial costs for the developed/planned domestic wastewater collection and treatment schemes” of the Basin.

## IDENTIFICATION AND ANALYSIS OF OPTIONS

The work towards deriving policy recommendations focused on the identification of alternative (institutional and economic) options to achieve the aforementioned objectives. These suggestions, subject to evaluation, were used to develop a roadmap for strategies suitable for achieving the wider goal, i.e. the mitigation of industrial water pollution in the Seybouse River Basin. To facilitate discussions with local stakeholders, and in accordance with the objectives defined above, potential policy instruments were grouped to three (3) categories, as follows:

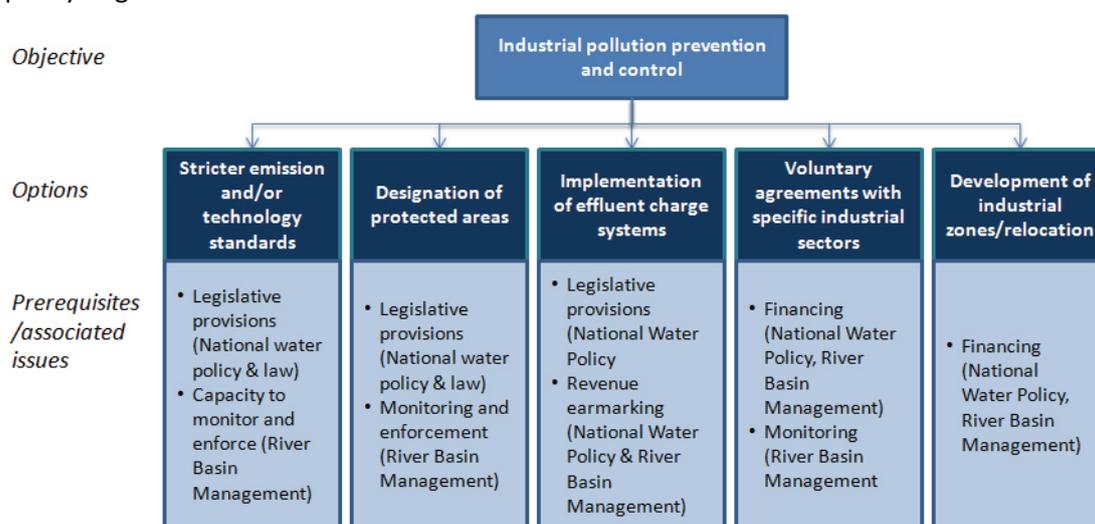
- (1) Options aimed at preventing and controlling the pollution of surface water bodies from industrial effluents;
- (2) Alternative approaches for ensuring adequate cost recovery for domestic water supply and sewerage services;
- (3) Options to enhance awareness, collaboration and joint planning for the water management issues encountered in the River Basin.

The following paragraphs present the suggested options in more detail. The analysis also outlines barriers that have inhibited the (effective) implementation of potential responses, as well as associated issues that need to be considered and evaluated to achieve sustainable

solutions to the problem at hand. Identified issues pertain to the three main functions: (a) water service provision (Operational function); (b) River Basin/Aquifer management (Organizational function); (c) National water policy and law (Constitutional function).

### MINIMIZATION OF POLLUTION FROM INDUSTRIAL EFFLUENTS

As industrial pollution is considered the key sector where policies should focus, the first set of options, presented in Figure 11, summarizes instruments aimed at industrial pollution prevention and control. Currently, industries have to obtain discharge permits and comply with specific standards concerning the quality of effluents. Furthermore, there are areas that have been designated as protected in the vicinity of vulnerable ecosystems or drinking water abstraction points. Plans and programmes are pursued for the restoration of environmentally degraded lakes, rivers (perennial or temporary) and for the prevention of future water quality degradation.



**Figure 11: Suggested options – Industrial pollution prevention and control**

Penalties and sanctions for the violation of discharge standards should be applied by the Environmental Directorates. As these authorities operate at the local level, the system is considered adequately decentralized to allow effective control of polluting industrial units and implementation of the corresponding legislative provisions of the Decree of September 2007. However, the situation is problematic, as the relevant Decree does not appear to be clear enough when it comes to implementation aspects. Furthermore, problems arise from the lack of knowledge and information: activities for data collection, effective monitoring of water quality and identification of pollution hot-spots have just been initiated.

In this regard, suggested options include:

- The introduction of technology standards for particular industrial processes, complementary to the existing discharge standards;
- The implementation of pollution charges, proportional to the amount of pollution generated;
- Instruments to further encourage the industrial sector towards the adoption of more environmentally friendly practices and cleaner production concepts, in order to avoid undermining competitiveness, and to ensure further development according to the broader economic policies and goals.

Pollution charges are in fact introducible given the current legislative framework. However, the problems directly related to their implementation concerning: (a) the delay in the elaboration of the corresponding legislative decrees and (b) the lack of knowledge on pollution loads/discharged volumes, as mentioned above. Furthermore, additional provisions need to be introduced with regard to the use of the revenue generated from these charges. It is noted that charges would be more easily accepted if revenue is earmarked and re-allocated for investments in environmental protection (locally, in the River Basin, or at national level).

Further incentives to the industrial sector can entail the wider application of voluntary schemes. Voluntary agreements concerning compliance to existing standards are already promoted by the Algerian Government, but their implementation in the Seybouse River Basin is still limited. Cited reasons include the lack of relevant information and inadequate incentives. In this regard, the initiation of a dialogue with industrial parties could promote a better understanding of the true obstacles faced, and identify those incentives that would better promote voluntary schemes.

Direct financial aid to specific industries for developing end-of-pipe systems could be provided through dedicated funds of the Ministry of Water Resources or the Ministry of the Environment. The grant can represent a share of the cost of the wastewater treatment unit, and should be provided after an in-depth assessment of environmental impacts and costs by the local administrations or agencies. Otherwise, financial and fiscal incentives could be introduced (e.g. tax rebates or reduction of water tariffs and charges).

With regard to relocation, it is notable that there have never been efforts to relocate specific industries to a designated area in order to develop a collective wastewater treatment scheme. Relocating industries and developing collective wastewater treatment schemes for specific sectors is not feasible for the moment, due to the high costs entailed and further considerations with regard to employment.

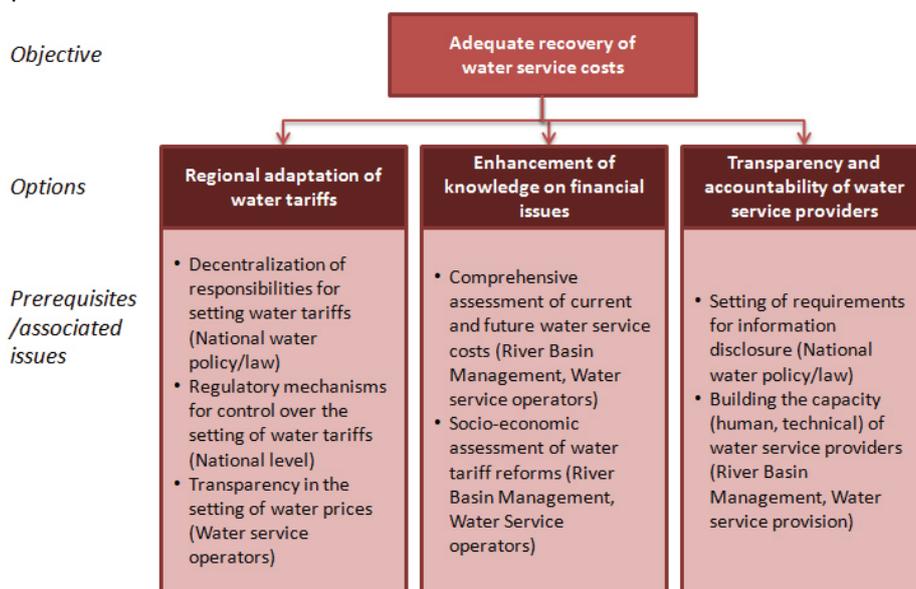
As mentioned several times throughout this report, the key problem for water pollution prevention and control is related to the lack of data, knowledge and regulatory capacity. Effective monitoring, development and maintenance of the corresponding inventories, and empowerment of local authorities to enforce legislation are all prerequisites for the implementation of enhanced policies. In this regard, the full implementation of the current system of levies, already advocated in the legislation, could assist in the generation of resources required, and the development of locally concerted action for problem mitigation.

#### **ADEQUATE RECOVERY OF WATER SERVICE COSTS**

Currently, the adequate recovery of the financial costs of water services is not an issue of concern. As there are considerable needs for infrastructure development, most new schemes are financed by the State; recovery of these costs cannot be achieved without compromising the affordability of water tariffs, especially with regard to low-income households. In this regard, the main water tariffs are designed with the following purposes: (a) achieving financial equilibrium, with State-aid, (b) ensuring social solidarity and equity, and (c) providing incentives towards water conservation, by incorporating volumetric charges.

It has however been noted that there has never been a comprehensive approach and analysis of water service costs and their recovery; furthermore, the centralization of the system provides little flexibility to water service providers. Subsidies and cross-subsidies among users and regions are not transparent and potential tariff reforms would possibly not be well

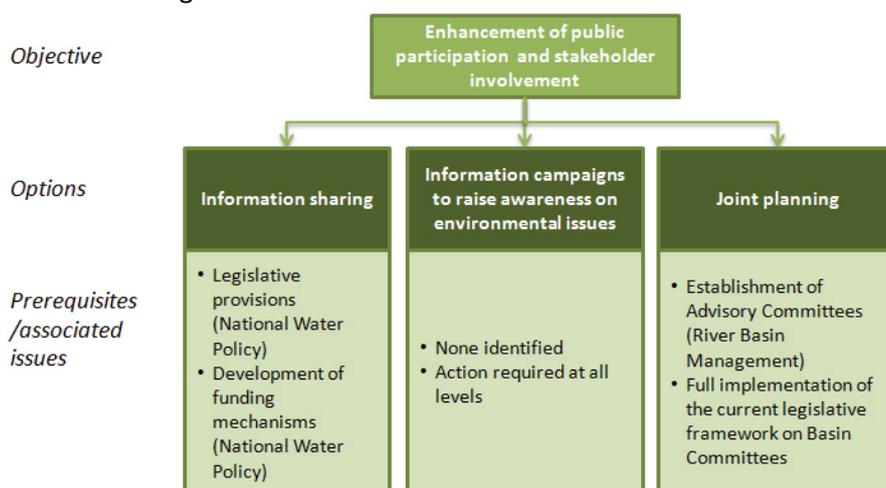
accepted by the general public as they cannot be justified. In this context, it is evident that an assessment of current and future water service costs is a major priority for the next years, in combination with an in-depth appraisal of the current tariff system and its economic and social implications at local and national levels.



**Figure 12: Suggested options – Towards the adequate recovery of water service costs**

### ENHANCING AWARENESS, COLLABORATION AND JOINT PLANNING

During the past years, there has been increased awareness of the fact that the pollution of the Seybouse River is becoming a major problem. In terms of infrastructure, this has resulted to the launch of a programme for the construction of sewage treatment plants in urban areas, in an effort to meet sanitation goals and eliminate domestic pollution. However, the approach required for the prevention or the elimination of pollution of agricultural or industrial origin is not as straightforward.



**Figure 13: Suggested options – Enhancing public participation and awareness**

In this regard, significant efforts have been undertaken by the ANPEP (National Association for the Protection of the Environment and Water Pollution Abatement) through extensive awareness campaigns targeting the general public, organization of conferences with the aim to promote innovative technologies for wastewater treatment, improved practices etc.

Along this line, initiatives undertaken by the ABHCSM, also through the framework of INECO, were aimed at:

- Fostering dialogue, by organizing workshop sessions with industries and local administrative authorities;
- Establishing a closer collaboration with the University of Annaba, to propose and undertake specific research work, adapted to the local problem.

Additional efforts are being pursued to develop the established forum by involving the different institutions dealing with hydraulic infrastructure and environmental issues in the River Basin, and reinforce the role of associations and NGOs dealing with environmental protection. Options to further strengthen these initiatives are summarized in Figure 13, and can involve the official establishment of permanent fora, Advisory Committees or public hearings, etc.

## OPTION EVALUATION

### PRIORITIZATION OF SUGGESTED INSTRUMENTS

The first step towards the evaluation of suggested responses was their prioritization by local stakeholders on the basis of a set of predefined criteria common to all the INECO Case Studies. The step was implemented from February to June 2008, and included the:

- Distribution and completion of a survey for ranking ten (10) broad categories of instruments; the survey was aimed at evaluating the feasibility and applicability of economic and institutional instruments, taking into account the local and national water management context, current conditions and priorities, and future challenges;
- Further consultation meetings and discussion sessions with key user groups and decision-makers to discuss the outcomes of the prioritisation “exercise” and elaborate on potential options.

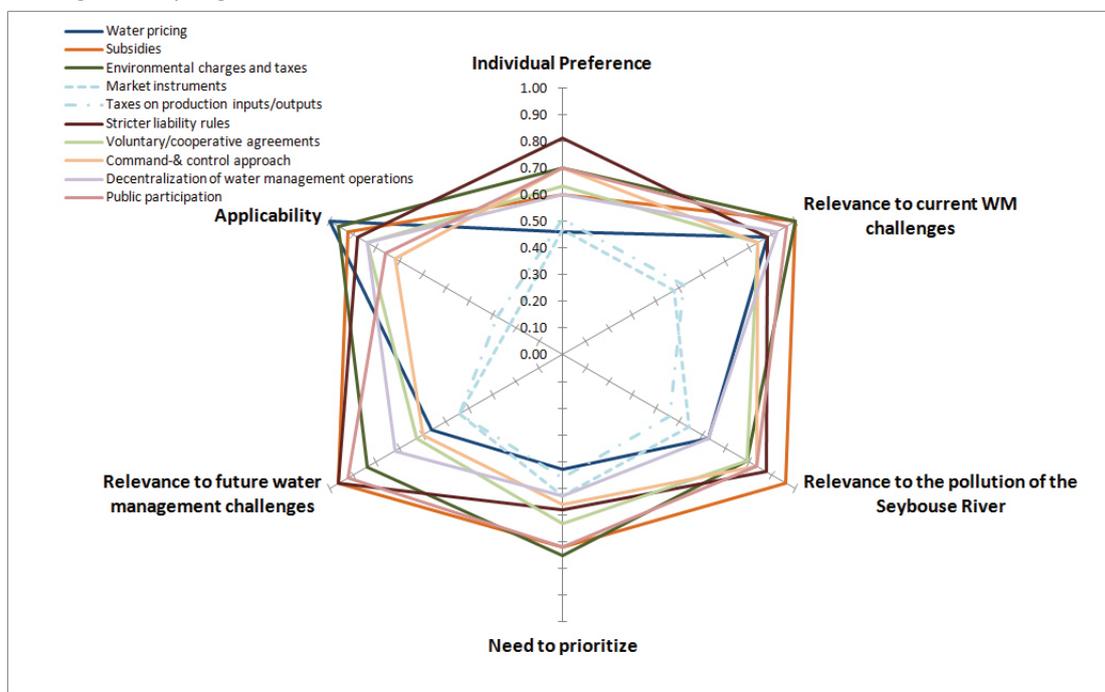
Prior to the distribution of the surveys, several consultation meetings were held and continuous contact was pursued to answer potential queries and provide expert support. The outcomes from the 27 respondents who represented local industries, NGOs, members of the academia and local decision makers are summarized in the spider chart of Figure 14.

A key outcome of responses was that answers from different stakeholder groups converged with regard to the need to change the way that industrial pollution issues are handled both by the users and by the administration. The instruments and approaches that seemed to be most relevant and applicable are public participation and increased liability of polluters. Furthermore, respondents emphasize on the need to pursue the actual implementation of environmental charges foreseen in the legislation.

With regard to the currently applied (or potentially applicable) instruments, opinions and suggestions can be summarized in the following:

- Accelerate the implementation or the rehabilitation of treatment stations for the most significant polluting industries and agglomerations that discharge directly in the Seybouse River, especially those in Guelma and Annaba;
- Encourage the actions and the initiatives undertaken by different associations and NGOs;
- Take all necessary measures to strictly apply environmental regulations.

As outlined above, water quality monitoring and enhancement of the knowledge base on water resources are prerequisites to enable the successful implementation of all initiatives, particularly with regard to the setting and collection of environmental charges and the strict enforcement of the pertinent legislation. Ways of enabling public participation and enhancing awareness, also through the establishment of water user associations, are also perceived as important means towards resource conservation and successful implementation of water management programmes.



**Figure 14: Prioritization of instruments for addressing current and future water management challenges**

### FURTHER CONSIDERATIONS TOWARDS OPTION IMPLEMENTATION

The overall process of evaluating potential policies for addressing industrial pollution in the Seybouse River Basin was complemented through a last step, aimed at mapping perceptions and sharing views on further considerations for the implementation of proposed approaches.

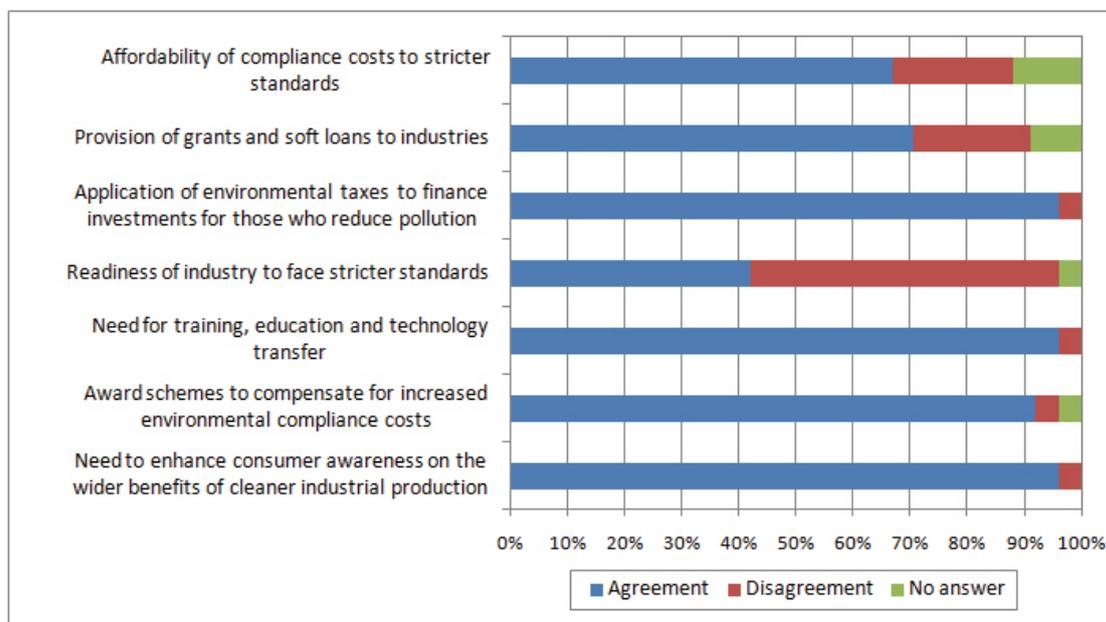
The process was articulated through individual interviews and meetings with representatives from all major institutions dealing with water management in the area (ADE, ANRH, ONA, Environmental Directions, ANPEP, DWH, DSA, ONID), Universities and Industrial Groups from different areas of the target region (Annaba, Constantine and Guelma). The outcomes of this stage are presented in the following paragraphs, which elaborate on issues relating to: (a) industrial pollution prevention and control, (b) cost recovery and cost sharing with regard to infrastructure operation, maintenance and development, (c) the overall framework for water management and water service provision, and (d) ways of enabling public participation and involvement in decision-making.

#### Instruments towards industrial pollution prevention and control

With the industrial sector being considered the main cause of water quality degradation in the Seybouse River Basin, and taking into account the current limitations in monitoring and

legislation enforcement, soft measures towards industrial pollution prevention and encouragement of cleaner production constitute an alternative, sustainable way, for addressing water pollution issues. In this regard, consideration was given on the analysis of ways through which the industrial sector could be encouraged towards environmental compliance and cleaner production practices. Responses are portrayed in Figure 15.

Although a significant percentage of respondents (68%) perceives that the industrial sector can afford compliance to tighter effluent standards, the majority also believes that subsidies, grants and other financial incentives would be helpful and could assist faster and enhanced compliance without compromising competitiveness. As discussed in the following paragraph, environmental charges and taxes are widely accepted as means of raising the revenue required to provide financial assistance to those who decide to invest in improved environmental performance and cleaner production. In spite of the consideration that compliance costs should be affordable by most industries, over 95% of stakeholders perceive that there are significant technical and managerial deficiencies, requiring dedicated capacity building programmes. Transfer of know-how and technology should be undertaken through the design and implementation of medium to long-term training programmes, with the financial support of the State. Such programmes could involve the organization of seminars, dedicated courses, workshops and exhibitions, as well as mobility grants for the exchange of staff. Additional support could be provided through bilateral partnerships and international cooperation programmes with other countries, well advanced in the field. For providing additional incentives to the industrial sector, tax reductions and rebates could be offered to industries that participate in such initiatives. Furthermore, several respondents suggested the upgrading and the establishment of (additional) public institutions (training schools and centres) offering courses to managers and decision makers on advanced technologies and water-related issues.



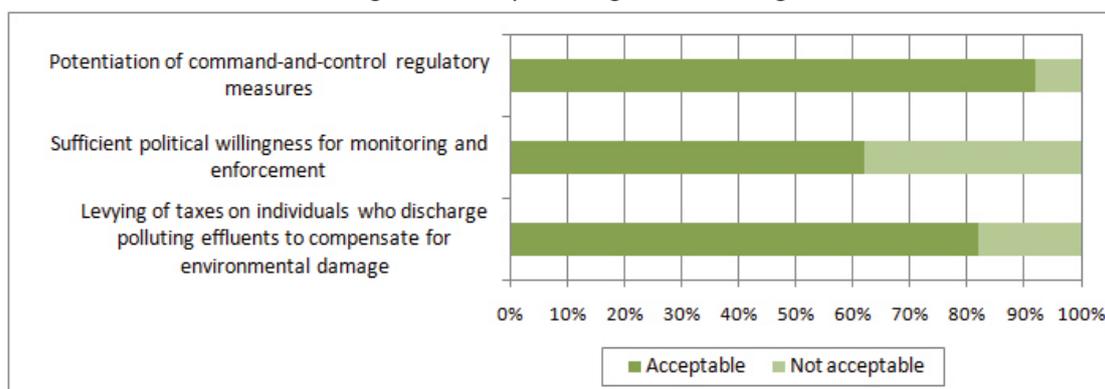
**Figure 15: Stakeholder views on approaches to industrial pollution prevention**

Ecolabelling and award schemes are also considered positively, as they would allow signalling efforts towards environmental and consumer protection to society. However, there is almost unanimous consensus that such programmes would be fully effective only if combined with intensified efforts to raise societal awareness on the corresponding benefits. Re-

spondents underline the role of mass media in promoting such initiatives, stressing also that efforts should be oriented towards the production of simple messages in local dialect in order to reach a broader audience. Wide promotion of best practices through establishment of dedicated awards, dissemination of successful projects, and extensive advertisement of benefits to consumers would provide additional incentive for the mobilization of the industrial sector. Stakeholders also point out the need for involving City Committees and Municipal Boards in the overall process, through the implementation of laws and regulations on the protection of consumers, and the promotion of the establishment of consumer associations, which could further foster awareness campaigning and represent the views of consumers and the society at large.

The effective implementation of command-and-control regulatory approaches for individual discharge into water streams or onto land is also being advocated as a priority solution for mitigating different causes contributing the pollution of the Seybouse river. Stricter enforcement of regulations was examined in light of the:

- Feasibility, applicability and effectiveness of regular control of industrial effluent discharges;
- Empowerment and political willingness of the pertinent authorities to strictly enforce legislation on discharge and technology standards;
- Compensation of environmental damage through the setting of relevant environmental taxes and charges, and ways through which charges could be defined;

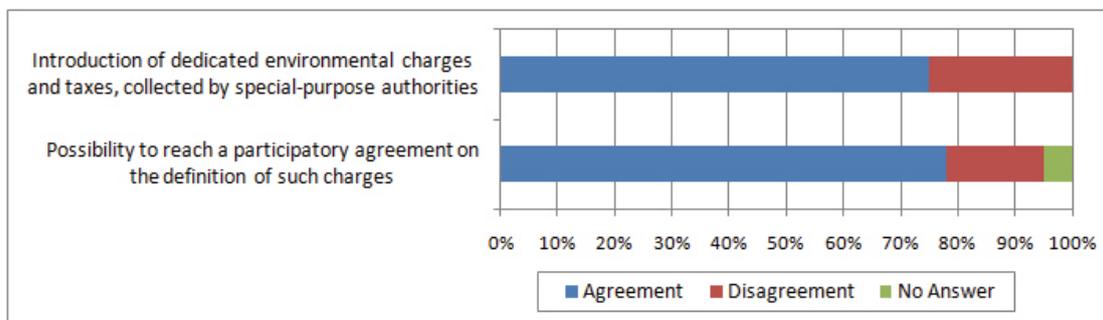


**Figure 16: Stakeholder views on alternative approaches to regulating the discharge of effluents by individual users**

While the great majority (≈92%) of stakeholders interviewed underlined the pertinence of potentiating command-and-control regulatory measures, a significant share of respondents (37.5%) perceives that the relevant authorities are not sufficiently empowered and willing to enforce existing regulations on polluters. The main cited reasons are that no concrete action has yet been undertaken despite the fact that the legislation exists, implementation problems “on the ground”, and lack of awareness among water managers and authorities given that no major crisis has emerged yet. In light of these implementation problems, respondents recommend the empowerment of institutions dealing solely with the enforcement of environmental legislation (e.g. water police).

Financial forms of compensation for environmental damage are broadly accepted, but it is also argued that effective regulation requires an action plan at the local level, involving all actors and especially the Water Police and the Police of Urban Planning and Environmental Protection. The definition of such taxes, as well as the elaboration of other pollution abate-

ment and prevention measures could also be the task of a dedicated Committee, whose members would have been selected by all water users (businesses, farmers, fishermen) and the State. Along the same lines, and as these have already been introduced in the pertinent legislation, special-purpose environmental taxes and charges are broadly accepted (Figure 17). The majority of stakeholders perceives that an agreement on the setting of more fair charges (currently a lump sum is paid by all industries, independently of the pollution generated) could easily be achieved through participatory processes.



**Figure 17: Stakeholder views on environmental tax and charge systems**

It is further underlined that there is need to inform users on the legislation and regulations in force, and to have dedicated facilities (laboratories) to analyse effluent samples and compare results to national and international discharge standards. In the case of significantly polluting industries, there should be regular monitoring to ensure compliance. The need to enhance the knowledge base and develop a national-wide database for individual discharges and abstractions is also pointed out by 87.5% of respondents.

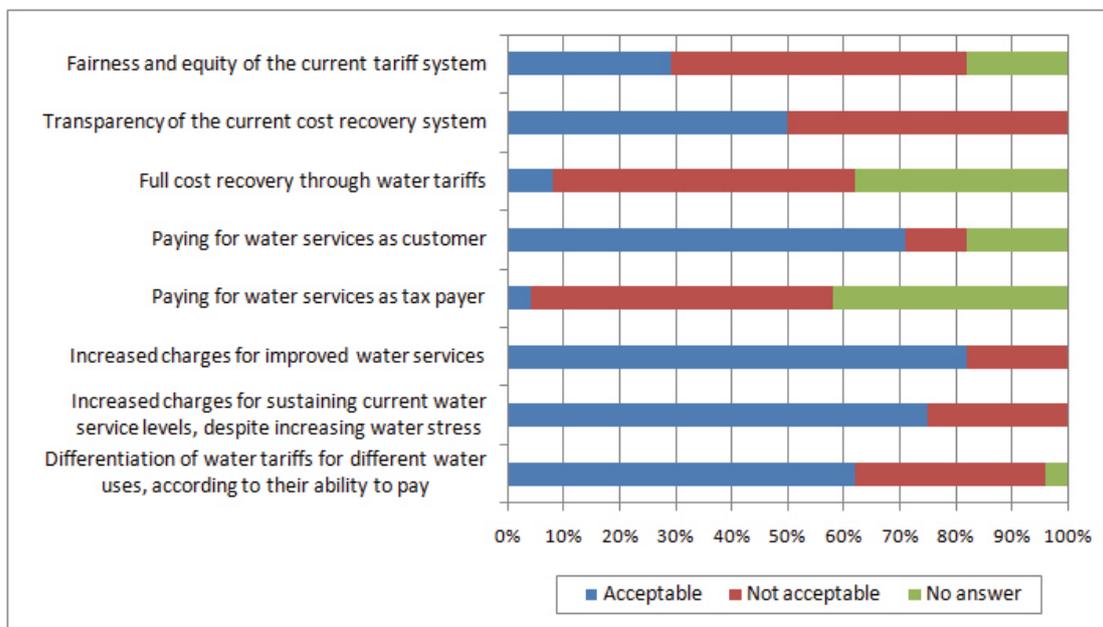
### Cost recovery and cost sharing issues

In view of the significant investment being implemented in the River Basin for the construction of sewerage networks and wastewater treatment facilities, as well as the underpinned deficiencies of the current framework for cost recovery, further consideration was given on cost recovery and cost sharing mechanisms. The questions set to the different stakeholders were aimed at mapping their opinion on:

- Ways of distributing costs among different consumer categories (households, industry, tourist sector and agriculture);
- Transparency, fairness and equity of the current tariff system, and ways through which these can be improved;
- Water pricing as means to achieve recovery of costs for water service provision and the financing of the water system;
- Willingness to accept an increase of the applied water rates, provided that this would mean an improvement in water services or a continuation of current water service levels despite increasing water stress;
- Potential differentiation of water tariffs according to the type of use, with the aim to generate cross-subsidies among different water user categories.

As portrayed in Figure 18, most respondents disagree with full cost recovery through water tariffs. It is generally supported that the costs relating to maintenance, improvement and expansion of the infrastructure base should be shared between the different public authorities (municipalities, River Basin Agency, Ministry) and the consumers, in order to maintain affordability. Sharing issues should be based on an agreement among all those concerned.

However, it is also argued that costs allocated to consumers should reflect the real cost of water supply and sanitation services provided. The allocation of costs between different water uses should be done according to their consumption and the use of the resource, also taking into account local conditions (climate, water availability etc.). In addition, the generation of cross-subsidies among different types of use (e.g. industry and agriculture vs. households) is accepted by 63% of respondents.



**Figure 18: Stakeholder views on cost recovery and cost sharing issues**

Half of respondents perceive that the current cost recovery system is not transparent enough. This group argues that water users should be provided with additional information concerning the calculation of the different charges. In order to increase transparency, especially with regard to the use of generated revenue, invoices should be more detailed. Another proposal involves the issuing of two different invoices: one relating to water supply and sewerage, and one detailing the different taxes included in the water bill, also providing additional explanations on the use of revenue generated from these taxes.

An additional problem pointed out by several respondents is related to the metering of water consumption, as it appears that there is little information on the process and that that meter reading is often unreliable. Stakeholders underline the need for regular and on-time reading of water meters (so that charges imposed are correct), for installing meters in all households, public buildings and also in irrigation water supply, and for regular inspection to ensure proper maintenance and prevent water theft.

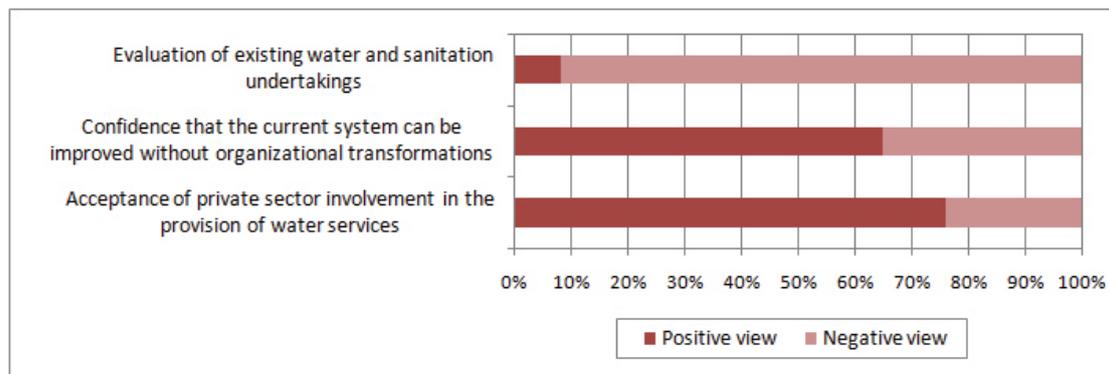
Although full cost recovery through water tariffs is not accepted, the majority of consulted stakeholders would prefer to be charged as customers of water services, rather than to pay indirectly through the general income tax. The main reasons are that this ensures higher sustainability of the system while at the same time it provides incentive towards water saving. A particular group notes that currently prices do not reflect real costs and do not correspond to the quality of services provided to customers. Respondents further argue that the use of revenue from water tariffs should be clearly indicated: there should be marked improvement of the quality of services provided (e.g. elimination of water supply interruptions, higher efficiency of operators in billing, sound management and financial transparency) and disclosure of pertinent information to citizens.

## Framework for water management and service provision

The required modernization of the water sector, especially with regard to water supply and sanitation, has been the subject of recent reforms. However, there is probably need for a more professional water management system, able to implement required technologies and offering enhanced management skills and capital provision. This is manifested with the recent cooperation established by the Algerienne des Eaux and the Office National d'Assainissement. In the above context, stakeholders were further asked to comment upon:

- The existing water and sanitation undertakings, in relation to meeting current demands and securing environmental protection;
- Margins for improvement, without considering complex, time consuming and often problematic organizational transformations;
- Potential contribution and involvement of the private sector;
- Acceptability of private sector involvement in the provision of water services.

Responses are portrayed in Figure 19.



**Figure 19: Stakeholder views concerning the framework for water management and provision of water services**

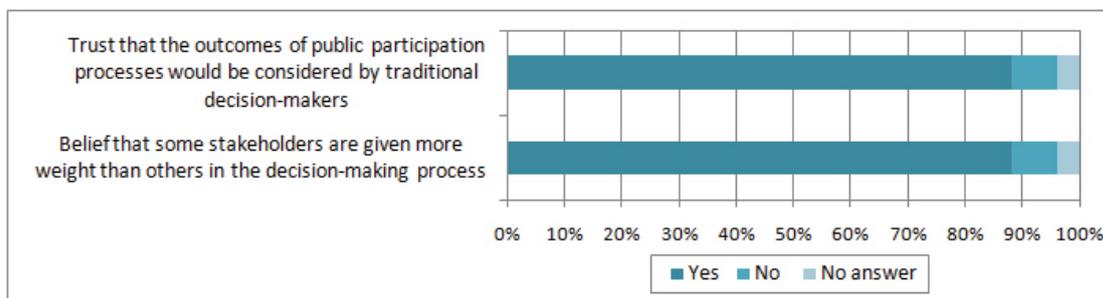
The vast majority of respondents evaluates current water supply and sanitation undertakings negatively, especially with regard to their ability to address the emerging challenges (rapid population growth, water quality degradation, etc.). Although there are views that management should remain at the State level, the involvement of the private sector is judged positively overall. Reservations are mostly based on the opinion that the Algerian private sector does not yet have the resources and capacity required to respond to such tasks. It is additionally underlined that subcontracts, concessions or other forms of public-private partnerships should be subject to regulation by the State and strict terms, especially with regard to performance, environmental compliance, setting of water tariffs and capital investment.

## Public participation and stakeholder involvement

The need to strengthen the involvement of stakeholders and water users in decision-making had been perceived as of crucial importance from the early stages of case study definition and elaboration. Potential issues considered critical for further analysis included:

- Perceptions of users on public participation and joint decision-making;
- Ways through which water users could be further involved;
- Willingness of decision-makers to consider the outcomes of participatory planning processes;

- Actual accessibility to information on water management issues of common interest;
- Impartiality and objectivity of decisions taken, as water management issues are often subject to political pressure from specific user groups.



**Figure 20: Stakeholder views on factors affecting public participation processes**

When it comes to the forms of public participation envisaged by the different stakeholder groups, opinions vary to a significant degree, ranging from enhanced awareness to more open and democratic water management. Suggestions towards the latter include:

- Enhancing the role of NGOs and consumer associations in decision-making through their representation in basin committees and/or in the decision board of water management agencies.
- Organizing open debates on water-related issues and ensuring representation of all stakeholders in decision-making.
- Providing means for control over water management decisions and operations.

A commonly underlying factor is the need to raise awareness among all levels of society, in order to enhance civic responsibility towards water use and pollution prevention.

Enhanced stakeholder involvement cannot be implemented without access to relevant information. In relation to this issue, several respondents underline significant lack of data, limited or no access to information and lack of transparency. Furthermore, it is also noted that there are cases when information becomes available very late to be useful. Although information and communication systems have been established in the area (the ABHCSM regularly publishes information on the Seybouse on its web site), respondents also point out that relevant, reliable and comprehensive information should be provided at all levels and to the general public, in other regions and on a variety of water management issues. Ideally, data collection and management should be the responsibility of one institution, and relevant information needs to be disclosed through the internet and the mass media, and effectively communicated to the general public.

## CONCLUDING REMARKS

The Case Study of the Seybouse River Basin highlights the importance of water quality degradation as a problem of equal importance to water scarcity; the deterioration of water quality, stemming from inadequate infrastructure, deficiencies in legislation enforcement, knowledge and data gaps and limitations in water sector capacity, is an essential element of water stress faced both at the river basin and at the national level. Specific objectives that could be pursued in order to enhance the conditions and mitigate problems in the area include industrial pollution reduction, agricultural pollution reduction, and enhancement of knowledge on conditions governing all water-related issues.

Participative processes undertaken for the development of the Case Study have indicated that there is general consensus on the significance and potential of certain pollution mitigation measures. Stakeholders highlight the significance of pollution impacts, and agree on the need to enhance efforts to strictly control and reduce industrial and agricultural effluents, enforcing the relevant legislation. It is broadly agreed that polluters must pay; however stakeholders are also favourable towards the introduction of pollution reduction incentives. In addition, the wider implementation of economic instruments to encourage the adoption of advanced technological options by industries and less water consuming and less polluting techniques/approaches by farmers are widely accepted. The reduction of industrial pollution is strongly advocated through the creation of pollution taxation, proportional to the environmental damage incurred, in order to promote the adoption of pollution reduction equipment by polluters, as well as the enforcement of legislation upholding the “polluter pays” principle.

Overall, measures viewed as necessary by the stakeholders comprise the empowerment of the water police for basin monitoring and legislation implementation, and the improvement and upgrading of water and sanitation services, possibly including the encouragement of private sector involvement under the overview of the State; price increases are viewed as acceptable, provided that the quality of services provided is improved. The improvement of knowledge of the cost of water, which is an important parameter in building consumer confidence, requires the undertaking of economic studies on the real price of water, implemented with full transparency, and the communication of results to the general public. This would enable the determination of appropriate cost recovery policies and the potential subsequent introduction of subsidies by the government with full knowledge of the factors at play.

In summary, the protection of the natural environment in the Seybouse River Basin requires consistent monitoring and data collection, enabling the qualitative and quantitative analysis and assessment of pollution through appropriate policies and measures for achieving the set objectives. The reduction of pollution can be effected through increasing public awareness and by persuading polluters to take action through the introduction and strict enforcement of significant pollution taxes. This would require the introduction of appropriate legislation and the reinforcement of institutions (monitoring agencies, water police) supportive to its implementation and enforcement. Awareness and public participation are considered paramount in the effort to address the problems faced; training and education as well as promoting the establishment of consumer associations are perceived as key to raising awareness on environmental matters, particularly with regard to cleaner production practices. Finally, the reinforcement and dissemination of available information on water consumption, pollution and discharges are viewed as a priority in order to exercise better management of water resources.

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### **Consulted web sites**

ABHCSM: <http://www.abhcsm.dz/banqueau/consult/data>

Algerian Ministry of Water Resources

## ANNEX

### WATER QUALITY ASSESSMENT

#### Water quality classification

Water quality for each measured parameter (BOD, COD, Dissolved O<sub>2</sub>, NH<sub>4</sub><sup>+</sup>, NO<sub>3</sub><sup>-</sup>, NO<sub>2</sub><sup>-</sup>, PO<sub>4</sub><sup>3-</sup>, Conductivity and Turbidity) is classified into 5 classes, according to the 1994 WHO classification. These are outlined in the following tables.

#### *Organic Matter*

Quality class	Unit	Excellent	Good	Average	Bad	Excessive Pollution
COD	mg/l	20	30	40	80	> 80
BOD	mg/l	3	5	8	10	> 10

#### *Dissolved oxygen*

Quality class	Unit	Excellent	Good	Average	Bad	Excessive Pollution
Dissolved O <sub>2</sub>	%	90	70	50	30	> 30

#### *Ammonia and Nitrites*

Quality class	Unit	Excellent	Good	Average	Bad	Excessive Pollution
NH <sub>4</sub> <sup>+</sup>	mg/l	0.1	0.5	2	5	> 8
NO <sub>2</sub> <sup>-</sup>	mg/l	0.03	0.1	0.5	1	> 1

#### *Nitrates*

Quality class	Unit	Excellent	Good	Average	Bad	Excessive Pollution
NO <sub>3</sub> <sup>-</sup>	mg/l	2	10	25	50	> 50

#### *Phosphates*

Quality class	Unit	Excellent	Good	Average	Bad	Excessive Pollution
PO <sub>4</sub> <sup>3-</sup>	mg/l	0.1	0.5	1	2	> 2

#### *Conductivity*

Quality class	Unit	Excellent	Good	Average	Bad	Excessive Pollution
Cond.	µS/cm	2500	3000	3500	4000	> 4000

#### *Turbidity*

Quality class	Unit	Excellent	Good	Average	Bad	Excessive Pollution
Turb.	NTU	2	35	70	105	> 105

#### Water quality measurements

The above parameters are measured in 4 monitoring points, located on the Seybouse River. This section provides details on those measurements. It should be noted that the Meboudja oued inflows to the Seybouse River, and that both rivers are very polluted.

Carte du Bassin Hydrographique Seybouse

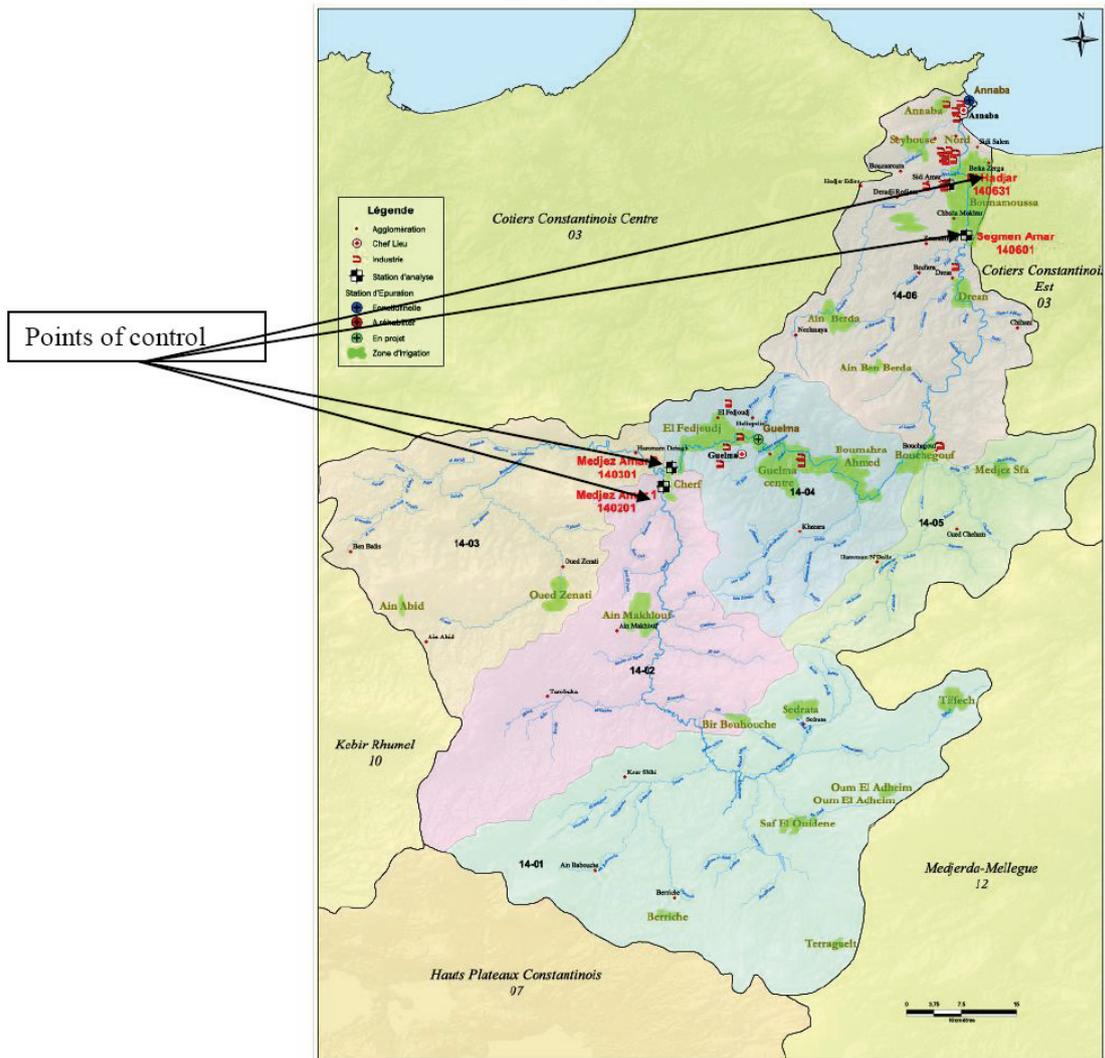


Figure 21: Points of water quality control

Medjez Amar 1 Station 140201

Water is rather polluted. Pollution originates from urban and agricultural sources.

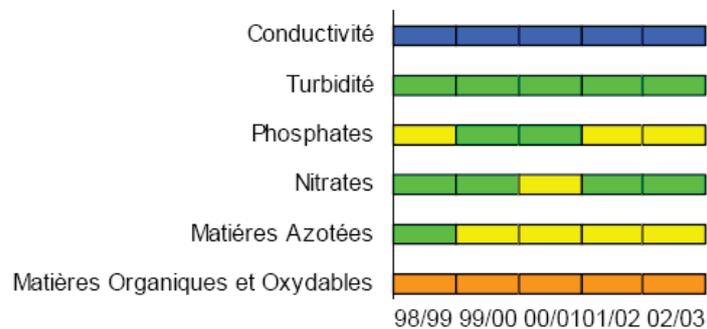
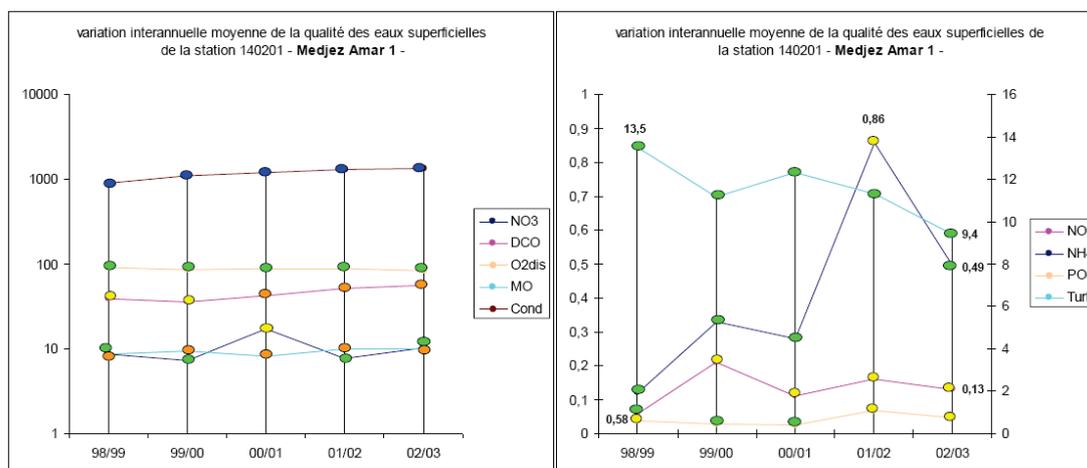


Figure 22: Water quality in Medjez Amar 1 Station 140201 (1998-2003)

**Table 7: Water quality classification and water pollution sources in the Medjez Amar 1 St. 140201**

Medjez Amar 1 St. 140201		Pollution	Overall quality	Comments	Observations Water pollution sources
Pollutants	Organic and Oxidisable matter, Nitrogen and Ammonia, Phosphoric matter	Important	Average	Good self-purification capacity and therefore adequate oxygenation	Urban Agricultural
	Phosphates	Weak	Acceptable		
	Nitrates		Good		
Dissolved Oxygen			Good		
Water pollution sources					
Agglomerations (1998 population)	Abid Mabrouk (3448)		Houari boumediene (4515)		Total (7963)
Industry			-		
Agriculture			Ain Makhlouf		



**Figure 23: Water quality measurements at the Medjez Amar 1 St. 140201 (1998-2003)**

*Medjez Amar 2 St. 140301*

Water is not significantly polluted. Pollution originates from urban and agricultural sources.

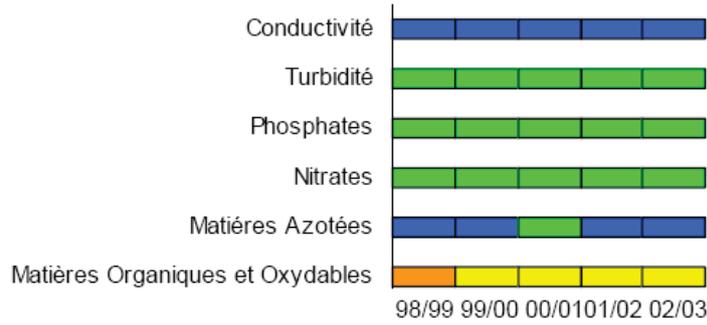


Figure 24: Water quality in Medjez Amar 2 St. 140301 (1998-2003)

Table 8: Water quality classification and water pollution sources in the Medjez Amar 2 St. 140301

Medjez Amar 2 St. 140301		Pollution	Overall quality	Observations Comments	Water pollution sources
Pollutants	Organic and Oxidisable matter, Nitrogen and Ammonia, Phosphoric matter	Weak	Adequate	Water dilution from the Bouhamdane river (oued) Good self-purification capacity and therefore adequate oxygenation	Confluence of Cherf and Bouhamdane rivers Water pollution sources: - Urban - Agricultural
	Phosphates		Good		
	Nitrates		Good		
Oxygenation			Good		
Water pollution sources					
Agglomerations (1998 population)		Hammam Debagh (10178)			
Industry		-			
Agriculture		Hourari boumediene, Medjez Amar			

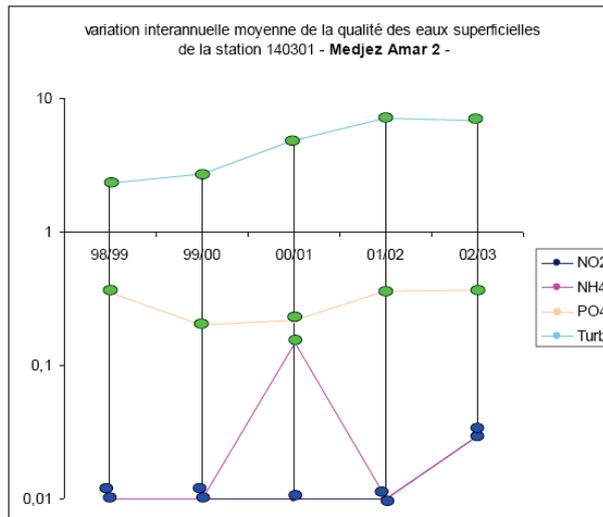


Figure 25: Water quality measurements at the Medjez Amar 2 St. 140301 (1998-2003)

Segmen Amar St. 140601

Water is much polluted. Pollution originates from urban, industrial and agricultural sources.

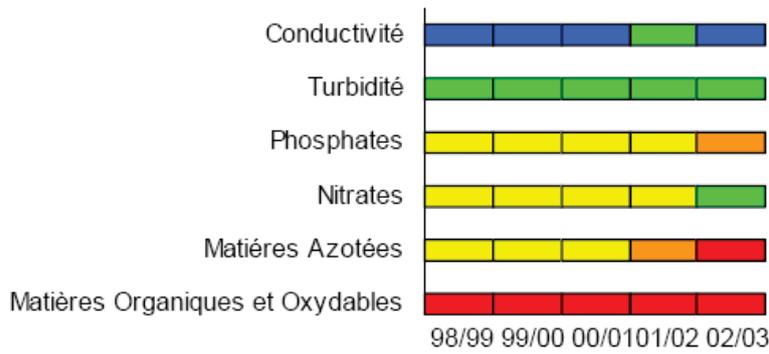


Figure 26: Water quality in Segmen Amar St. 140601 (1998-2003)

Table 9: Water quality and water pollution sources in the Segmen Amar St. 140601

Segmen Amar St. 140601		Pollution	Overall quality	Observations	Water pollution sources	
				Comments		
Pollutants	Organic and Oxidisable matter, Nitrogen and Ammonia, Phosphoric matter	Excessive	Very bad	Good self-purification capacity and therefore adequate oxygenation	<ul style="list-style-type: none"> <li>- Urban</li> <li>- Industrial</li> <li>- Agricultural</li> </ul>	
	Phosphates	Weak	Adequate			
	Nitrates		Good			
Oxygenation			Good			
Water pollution sources						
Agglomerations (1998 population)	Boucheouf (15086)	Oued Fragha (1171)	Ain Ben Berda (3686)	Chihani Bachir (7442)	Drean (17957)	Total (45342)
Industry	EPE (yeast), SACA (transf. tomatoes), LES AURES (transf. tomatoes)					
Agriculture	GPI Boucheouf, Guelma, Boumahra A. Belkheir, El Fedjoudj, GPI Bounamoussa					

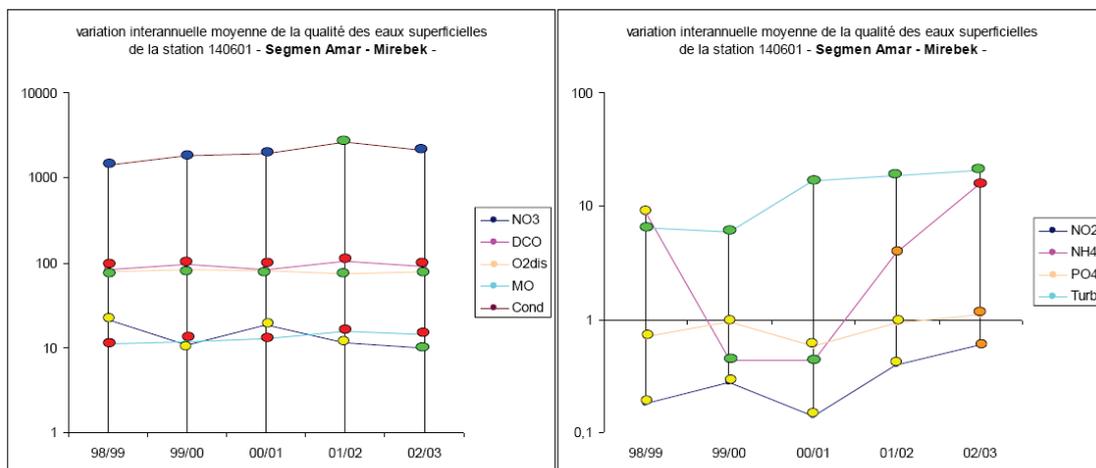


Figure 27: Water quality measurements at the Segmen Amar St. 140601 (1998-2003)

El Hadjar St. 140631

Water is much polluted. Pollution originates from urban, industrial and agricultural sources.

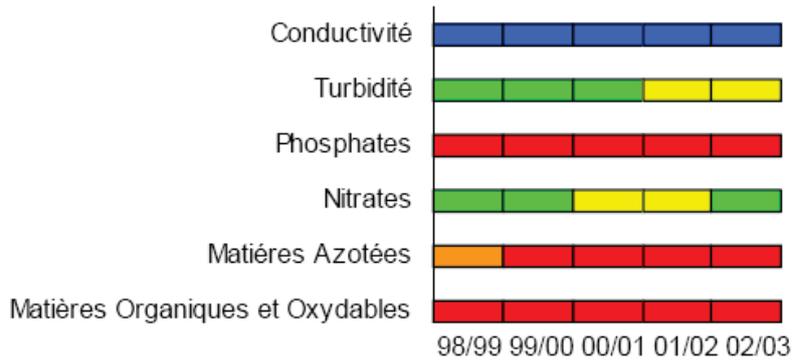


Figure 28: Water quality in El Hadjar St. 140631 (1998-2003)

Table 10: Water quality classification and water pollution sources in the El Hadjar St. 140631

El Hadjar St. 140631		Pollution	Overall quality	Observations Comments	Water Pollution Sources		
Pollutants	Organic and Oxidisable matter, Nitrogen and Ammonia, Phosphoric matter	Excessive	Very Bad	Bad oxygenation, due to the small purification capacity of the river, as compared to water pollution received	<ul style="list-style-type: none"> <li>- Urban</li> <li>- Industrial</li> <li>- Agricultural</li> </ul>		
	Phosphates	Excessive	Very Bad				
	Nitrates	Weak	Adequate				
Oxygenation			Bad				
Water pollution sources							
Agglomerations (1998 population)	El Hadjar (23777)	Sidi Amar (40706)	El Karma (1218)	El Horai-cha (3679)	Deradji Redjem (7440)	Hadjer Eddiss (18610)	Total (95430)
Industry	ZI Pt. Bouchet, ZI Sidi Amar,						
Agriculture	El Hadjar, Sidi Amar						

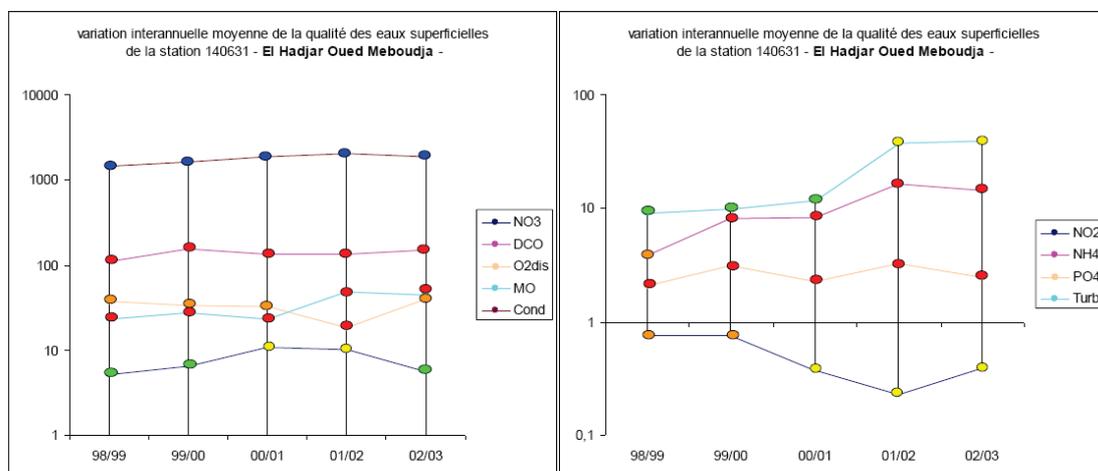


Figure 29: Water quality measurements at the El Hadjar St. 140631 (1998-2003)

### CHARACTERISTICS OF MAIN INDUSTRIES LOCATED IN THE SEYBOUSE RIVER BASIN

INDUSTRY NAME	COMMUNITY-MUNICIPALITY	WILAYA	TYPE OF ACTIVITY	CAPACITY	WATER DEMAND	REJECTED VOLUME	DISCHARGE POINT	TREATMENT	RECYCLING
TRANS CANAL EST EL HADJAR	EL HADJAR	ANNABA	UNITE DE FABRICATION DE TUYAUX EN BETON ARME	32000 ml/yr	25			YES	NO
MITTAL STEEL ENTREPRISE DE COMMERCIALISATION	EL HADJAR	ANNABA	COMMERCE DE PRODUITS SIDERURGIQUE		43		SEWERAGE NETWORK	NO	NO
SOCIETE DES TRAVAUX ET DE LA CONSTRUCTION DE ANNABA S.T.C.A	EL BOUNI	ANNABA	BATIMENTS TOUS CORPS D'ETATS	100 LOGEMENTS /yr	5		RIVER	NO	NO
REFRACTAL	EL HADJAR	ANNABA	FABRICATION ET COMMER PRODUITS REFRACTALE	1500 tonnes/an	5			NO	NO
PAPIREC	SIDI AMAR	ANNABA	RECUPERATION DU PAPIER	3000 ton/yr	1	0.8	SEWERAGE NETWORK	NO	NO
SOFAMESTE ZIANE MAHMOUD ET FILS	SIDI AMAR	ANNABA	EBENISTERIE		1	0.8	SEWERAGE NETWORK	NO	NO
SONELGAZ CENTRAL THERMIQUE DE ANNABA	ANNABA	ANNABA	PRODUCTION DE L'ENERGIE ELECTRIQUE	143000 kW	872		SEWERAGE NETWORK	NO	NO
MITTAL STEEL	SIDI AMAR	ANNABA	PRODUCTION DE L'ACIER ET DERIVEES	1400000 ton/yr	32877	3287	MEBOUDJA RIVER	NO	NO
SUCCURSALE EST SPOA	SIDI AMAR	ANNABA	VENTE EN GROS DE PEINTURE		0.6			NO	NO
MOKA ELECTROLUX	SIDI AMAR	ANNABA	MONTAGE DES APPAREILS ELECTRO-MECANIQUE	12000 pieces/yr	2	2	SEWERAGE NETWORK	NO	NO

INDUSTRY NAME	COMMUNITY-MUNICIPALITY	WILAYA	TYPE OF ACTIVITY	CAPACITY	WATER DEMAND	REJECTED VOLUME	DISCHARGE POINT	TREATMENT	RECYCLING
NAFTAL CENTRE MARINE	ANNABA	ANNABA	AVITAILLEMENT DES NAVIRES	30000 ton/month	2	1.6	SEWERAGE NETWORK	NO	NO
MAIN D'OR	EL BOUNI	ANNABA	PRODUCTION SE-MOULE	400 Qt/d	1.5	0.5	FOSSE SEPTIQUE	NO	NO
TARSI ANNABA	EL HADJAR	ANNABA	MONTAGE ET MAINTENANCE INDUSTRIELLE		5			NO	NO
EL DJORF	EL HADJAR	ANNABA	IMPORTATION DU BOIS ET DERIVES		2			NO	NO
ATH ARAB TRADING HOUSE	SIDI AMAR	ANNABA	COLLECTE DES DECHET FERREUX ET NON FERREUX					NO	NO
RAYANE PAPIER	EL BOUNI	ANNABA	TRANSFORMATION DE PAPIER		0.3		SEWERAGE NETWORK	NO	NO
STA / UMPA	SIDI AMAR	ANNABA	PRESTATION ET MAINTENANCE		37		PUBLIC NETWORK	NO	NO
FERROVIAL	EL BOUNI	ANNABA	CONSTRUCTION DE MATERIELS ET EQUIPEMENTS FERROVIAI	800WAGONS STD/AN +PF=3000 T/yr	150	30	ALLELICK RIVER	NO	NO
ENGI-ANNABA ENTREPRISE NATIONALE DES GAZ INDUSTRIELLE	EL HADJAR	ANNABA	PRODUCTION ET CONDITIONNEMENT DES GAZ INDUSTRIELS	C2H2 (120000 m3+O=570000 m3/yr	400	2.3	CANAL D'EVACUATION D'EAU USEES	YES	NO
TREFILEST SOCIETE DE TREFILAGE DE L'EST	EL HADJAR	ANNABA	TRANSFORMATION DES PRODUITS LONGS		60		LA SOCIETE ETANT DOTEE D'UN CIRCUIT FERME	NO	NO

INDUSTRY NAME	COMMUNITY-MUNICIPALITY	WILAYA	TYPE OF ACTIVITY	CAPACITY	WATER DEMAND	REJECTED VOLUME	DISCHARGE POINT	TREATMENT	RECYCLING
FCM	EL BOUNI	ANNABA	PRODUCTION DE CARREAUX MONO-COUCHE	350 m2/d	5			NO	NO
SELMA SEMOULE	EL BOUNI	ANNABA	PRODUCTION DE SEMOULE +FARINE	2500 ton/d	2		SEWERAGE NETWORK	NO	NO
C.E.C.C.O NOUBLI ET FILS	SIDI AMAR	ANNABA	FABRICATION D'EMBALLAGE CARTON COMPACT ET ONDULE	20 CAISSES / d	0.5	0.4	PUBLIC NETWORK	NO	NO
LES MOULINS SEYBOUSE	ANNABA	ANNABA	PRODUCTION-COMMERCIALISATION-TRANSFORMATION ISSUES	SE-MOULE1000QX/J+FARINE 1400QX/d	168.5		SEWERAGE NETWORK	NO	NO
CAFE SAFIA	SIDI AMAR	ANNABA	TORREFACTION ET CONDITIONNEMENT DE CAFE	200 kg/d	0.5		CANALS	NO	NO
VERRERIE BEN KHALIFA	EL BOUNI	ANNABA	PRODUCTION ET USINAGE DE VERRE CREUX	1460 ton/yr	4		SEWERAGE NETWORK	NO	NO
LAITERIE DE L'E-DOUGH	EL BOUNI	ANNABA	FABRICATION ET DISTRIBUTION DU LAIT ET SES DERIVES	150000 l/d of milk	500		SEYBOUSE RIVER	NO	NO
KHENOUS HAMANA	EL BOUNI	ANNABA	LIMONADERIE	360000 l/yr	1.1			NO	NO
ALPHA	EL BOUNI	ANNABA	PRODUCTION INDUSTRIELLE	3000 ton/yr	2			NO	NO
ENTREPRISE PUBLIQUE ECONOMIQUE	EL HADJAR	ANNABA	RECUPERATION .TRAIT +COMMERCIALI/ DECHET FERREUX	40000 ton/yr				NO	NO

INDUSTRY NAME	COMMUNITY-MUNICIPALITY	WILAYA	TYPE OF ACTIVITY	CAPACITY	WATER DEMAND	REJECTED VOLUME	DISCHARGE POINT	TREATMENT	RECYCLING
PROCIM	SIDI AMAR	ANNABA	PRODUCTION CONSTRUCTION INDUSTRIELLE ET METALLIQU	3500 ton/yr	14	13	MEBOUDJA RIVER	NO	NO
UNITED CO	EL BOUNI	ANNABA	INDUSTRIE ELECTRIQUES		3.3	3.3	SEWERAGE NETWORK	NO	NO
MIDOU	EL BOUNI	ANNABA	PATES ALIMEN-TAIRES	750 kg/h	4			NO	NO
CHOCOTEK	EL HADJAR	ANNABA	CHOCOLATERIE	2 ton/d	10	8	SEWERAGE NETWORK	NO	NO
KHEZZANE AB-DEKADER HIPPONE - NATTES	SIDI AMAR	ANNABA	TRANSFORMATION DU PLASTIQUE	2000 m/day	0.4			NO	NO
ALGAL	EL BOUNI	ANNABA	COMMERCIALISA-TION ET FABRICA-TION D'ALUMIN-IUM					NO	NO
SOCIETE DES ABATTOIRS DE L'EST UNITE CEN-VOIR ANNABA	EL BOUNI	ANNABA	AVICULTURE	520000 POUS-SINS /AN	10.91		BOUKHMIR A CANAL	NO	NO
S.A.E.I SOCIETE ALGERIENNE D'EQUIPEMENTS INDUSTRIELS	SIDI AMAR	ANNABA	FABRICATION D'EQUIPEMENTS FRIGORIFIQUES INDUSTRIEL	500 units/yr	15		SEWERAGE NETWORK	NO	NO
SILO A SUCRE SORA SUCRE GUELMA-DEPOT	ANNABA	ANNABA	DEPÖT A SUCRE	15000 tons	2	1.6	SEWERAGE NETWORK	NO	NO
SOFARM	EL HADJAR	ANNABA	FABRICATION ET COMMERCIALISA-TION ARTICLES MEDICAUX		2	1	SEPTIC TANK	NO	NO

INDUSTRY NAME	COMMUNITY-MUNICIPALITY	WILAYA	TYPE OF ACTIVITY	CAPACITY	WATER DEMAND	REJECTED VOLUME	DISCHARGE POINT	TREATMENT	RECYCLING
CHERIAK MECANIQUE DE PRECISION C.M.P	EL HADJAR	ANNABA	FABRICATION ET REPARATION DE PIECES MECANIQUE		0.1		SEWERAGE NETWORK	NO	NO
SODIPAP	SIDI AMAR	ANNABA	VENTE EN GROS PAPIER		0.5			NO	NO
FETIMI P.M.R.	EL HADJAR	ANNABA	FABRIQUE DALLES ET MONO COUCHE	105600 m2/yr	9	4	SEWERAGE NETWORK	YES	NO
A.T.F ALGERO TURQUE DU FER	EL HADJAR	ANNABA	FABRICATION CORNIERE A CHAUD	4000 to 5000 ton/month	15	7	MEBOUDJA RIVER	NO	NO
SIDEST SOCIETE INDUSTRIELLE DES DETERGENT DE L'EST	SIDI AMAR	ANNABA	INDUSTRIELLE ET COMMERCIALE	10000 ton/yr	432		SEWERAGE NETWORK	NO	NO
LOGITRAME ANNABA	SIDI AMAR	ANNABA	TRANSPORT ROUTIER(MARCHANDISE)		0.5	0.15	SEWERAGE NETWORK	NO	NO
A.L.T EST ANNABA	EL BOUNI	ANNABA	TORREFACTION ET CONDITIONNEMENT DE CAFE	1500 ton/yr	3			NO	NO
S.A.E-U.P.C EL KARMA	EL HADJAR	ANNABA	PRODUCTION POULET DE CHAIR	508000 Poulet/an	100			NO	NO
MESSAADI	EL HADJAR	ANNABA	TOLERIE	10 PORTE/JOUR	0.06	0.06	SEWERAGE NETWORK	NO	NO
BAIBA AZIZ MODELAGE MECANIQUE	EL HADJAR	ANNABA	MODELAGE MECANIQUE		1	1	SEWERAGE NETWORK	NO	NO
SELMI MOHAMED MILOUD MENUISERIE GENERAL DU BOIS	EL HADJAR	ANNABA	MENUISERIE DU BOIS	2 m3 of wood	99	0.07	SEWERAGE NETWORK	NO	NO
S.T.R.I.A	EL BOUNI	ANNABA	RETEVEMENT DES ROUTES	100 ton/d		0.2	SEPTIC TANK	NO	NO

INDUSTRY NAME	COMMUNITY-MUNICIPALITY	WILAYA	TYPE OF ACTIVITY	CAPACITY	WATER DEMAND	REJECTED VOLUME	DISCHARGE POINT	TREATMENT	RECYCLING
SCMCE ANNABA	SIDI AMAR	ANNABA	ENSACHAGE ET COMMERCIALISATION	200 ton/d	1			NO	NO
ENTREPRISE NATIONALE D'APPROVISIONNEMENT EN BOIS ET DERIVES U	SIDI AMAR	ANNABA	VENTE DE BOIS ET DERIVES ET PRODUITS SIDERURGIQUES					NO	NO
UAB ANNABA 2	EL BOUNI	ANNABA	FABRICATION +COMMERCIALISATION DES ALIMENTS BETAAIL	27000 ton/yr	17		SEWERAGE NETWORK	NO	NO
FERTIAL (ex GROUPE ASMIDAL ) SOCIETE DE FERTILISANTS -ALGERIE	ANNABA	ANNABA	AMMONIAC ET ENGRAIS PHOSPHATES	4500 ton/d	3836	24000	SEA	NO	NO
SATPAP ALIF	SIDI AMAR	ANNABA	TANSFORMATION PLASTIQUE ET PAPIER	7000 ton/yr	20	0.5	SEWERAGE NETWORK	NO	NO
DECOPLAST	EL BOUNI	ANNABA	FABRICATION DE MAITRES COLORANTS		2	0.5	SEWERAGE NETWORK	NO	NO
PLASTINATTE	SIDI AMAR	ANNABA	FABRICATION DE NATES EN POLYPROPYLENE	1500 NATTES DE 3 mm /JOUR	8	8	SEWERAGE NETWORK	NO	NO
COTA CONTRÔLE TECHNIQUE AUTOMOBILE	SIDI AMAR	ANNABA	CONTRÔLE TECHNIQUE AUTO		2		SEWERAGE NETWORK	NO	NO
ETABLISSEMENT DE TRANSPORT ANNABA ETA	SIDI AMAR	ANNABA	TRANSPORT ET MAINTENANCE			0.8	SEWERAGE NETWORK	NO	NO

INDUSTRY NAME	COMMUNITY-MUNICIPALITY	WILAYA	TYPE OF ACTIVITY	CAPACITY	WATER DEMAND	REJECTED VOLUME	DISCHARGE POINT	TREATMENT	RECYCLING
SATPAP SOCIETE DE TRANSFORMATION DE PAPIER ET DE PLASTIQUE	EL HADJAR	ANNABA	TRANSFORMATION DU PAPIER	7000 ton/yr				NO	NO
ALTRO ANTENNE DE MAINTENANCE	EL HADJAR	ANNABA	MAINTENANCE INDUSTRIELLE		11	5	SEWERAGE NETWORK	NO	NO
VITRE KHEZZANE	SIDI AMAR	ANNABA	TRANSFORMATION DU VERRE		0.95	0.8	PUBLIC SEWERAGE NETWORK	NO	NO
ORGANISATION SYSTEME INFORMATIQUE ET BUREAUTIQUE SOSIB	SIDI AMAR	ANNABA	IMPORT EXPORT MATERIEL INFORMATIQUE					NO	NO
HIPPONE EMBALLAGE	SIDI AMAR	ANNABA	TRANSFORMATION DU PAPIER ET CARTONS	10000 units/month	1	0.16	SEWERAGE NETWORK	NO	NO
SNVI - URD 801	EL - BOUNI	ANNABA	COMMERCIALISATION VEHICULES INDUSTRIELS VENTE PIECES DE RECHANGE ET RENOUVATION		1314	1051	MEDJOUBA RIVER	YES	NO
PROMECH - ANNABA SPA	EL - HADJAR	ANNABA		5311	350	350	RIVER	NO	NO
ex EMIB EPBA	ANNABA	ANNABA	PROD . COMMERCIALISATION DE BOISSON ALCOOLISES ET NON ALCOOLISES		1500	150	BOUDJENA RIVER	NO	NO

INDUSTRY NAME	COMMUNITY-MUNICIPALITY	WILAYA	TYPE OF ACTIVITY	CAPACITY	WATER DEMAND	REJECTED VOLUME	DISCHARGE POINT	TREATMENT	RECYCLING
SOCIETE INDUSTRIELLE DE PRODUITS ALIMENTAIRES	EL - BOUNI	ANNABA		3600	70000		EGOUTS COMMUNANT	NO	NO
UNITE MARBRE GUELMA ENA-MARBRE	BOUMAHRA AHMED	GUELMA	EXTRACTION ET TRANSFORMATION DU MARBRE	73000 m2/yr	1.4			YES	YES
E.C.V.E	GUELMA	GUELMA	PRODUCTION DE PORCELAINE	3000 ton/yr	240	24	INDUSTRIAL ZONE NETWORK	NO	NO
UAB BOUDAROUA	OUED FRAGHA	GUELMA	FABRICATION ALIMENT DE BETAIL	15 tonnes/heure	9			NO	NO
SPA COMPLEXE AVICOLE REPRODUCTEURS CHAIR	BOUMAHRA AHMED	GUELMA	ELEVAGE ET REPRODUCTION CHAIR+ PRODUCTION POUSSINS	10239000 OEUF+601500 POUSSIN	96			NO	NO
LES MOULINS DE MERMOURA GUELMA UNITE DE PRODUCTION GASSEM LA	BOUCHEGOUF	GUELMA	PRODUCTION ET VENTE SEMOULE	850 Qt/d			SEYBOUSE RIVER	NO	NO
ENA SUCRE GUELMA	GUELMA	GUELMA	USINE DE RAFFINAGE DU SUCRE	330 ton/d	1507	1000	AERATED LAGOONS	NO	NO
BRIQUETERIE EL RYAD	BENDJERAH	GUELMA	BRIQUE	70000 ton/yr	40		CHAABA	NO	NO
EURL / LAITERIE BENI FOUGHEL	EL FEDJOU DJ	GUELMA	LAIT ET DERIVES	10 to 20000 l/d	25	25	RIVER	NO	NO
LIMONADERIE BOUKABOU FRERES	GUELMA	GUELMA	FABRICATION BOISSONS GAZEUSES	400 cases/d	10		SEWERAGE NETWORK	NO	NO

INDUSTRY NAME	COMMUNITY-MUNICIPALITY	WILAYA	TYPE OF ACTIVITY	CAPACITY	WATER DEMAND	REJECTED VOLUME	DISCHARGE POINT	TREATMENT	RECYCLING
GROUPE SMIDE CONSTANTINE FILIALE MOULINS MERMOURA GUELMA UPC	HELIOPOLIS	GUELMA	TRITURATION BLE DUR	650 Qx/d	5		SEWERAGE NETWORK	NO	NO
FENDJEL	BELKHEIR	GUELMA	FABRICATION DE BOISSONS GAZEUSES NON ALCOLISES	60000 l/d	40	3	CHAABA	NO	NO
COMPLEXE DE PRODUCTION DE VÊTEMENT MILITAIRE	BOUCHEGOUF	GUELMA	CONFECTION		36	25	SEYBOUSE RIVER	NO	NO
BORDJIBA	EL FEDOUDJ DAIRA HELIOPOLIS	GUELMA	FABRICATION DE PARPAINGS ET HOURDIS		15		RIVER	NO	NO
UNITE DE CYCLES ET MOTOCYCLES (CYCMA)	GUELMA	GUELMA	MECANIQUE DE CONSTRUCTION	5000 products	240	30	INTERNAL CANAL	YES	NO
LES LEVURES DE L'EST	BOUCHEGOUF	GUELMA	FABRICATION DE LEVURE	15000 ton/yr	1500	1000	MELLAH RIVER	YES	NO
EL SAFIA MINOTERIE	EL FEDJOU DJ	GUELMA	TRANSFORMATION DE BLE TENDRE EN FARINE	40 ton/d	3		SEWERAGE NETWORK	NO	NO