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GUIDANCE DOCUMENT

ON SIGNIFICANT WATER MANAGEMENT ISSUES AND PROGRAMME OF MEASURES

USAID GOVERNING FOR GROWTH (G4G) IN GEORGIA

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GUIDANCE DOCUMENT

SIGNIFICANT WATER MANAGEMENT ISSUES AND PROGRAMME OF MEASURES

USAID GOVERNING FOR GROWTH (G4G) IN GEORGIA

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ACRONYMS

AWB	Artificial Water Body
BOD	Biological Oxygen Demand
CIS	WFD Common Implementation Strategy (Documents)
COD	Chemical Oxygen Demand
EU	European Union
G4G	Governing for Growth in Georgia
GD	Guidance Document
GEP	Good Ecological Potential
GES	Good Ecological Status
GIS	Geographic Information System
HMWB	Heavily Modified Water Body
HPP	Hydro Power Plant
IED	EU Industrial Emission Directive
IMPRESS	CIS Guidance for the analysis of Pressures and Impacts In accordance with the Water Framework Directive
NGO	Non-Governmental Organization
RBD	River Basin District
RBMP	River Basin Management Plan
SWMI	Significant Water Management Issues
USAID	United States Agency for International Development
WFD	Water Framework Directive
WWTP	Waste Water Treatment Plant

CONTENTS

DEFINITIONS

Artificial Water Body (AWB) - Body of surface water created by human activity e.g. a canal.

Good Ecological Potential - Is the required status of a *heavily modified* or an *artificial water body*.

Good Status - The status achieved by a surface waterbody when both its *ecological status* and its *chemical status* are at least 'Good'.

Heavily Modified Water Body (HMWB) - Body of *surface water*, which is substantially changed in character as a result of human activity.

Priority Substances - Substances identified in accordance with Article 16(2) of the Water Framework Directive.

River Basin District (RBD) - The area of land and sea, made up of one or more neighbouring river basins, together with their associated ground waters and coastal waters, as the main unit for management of river basins.

Surface Water - Means all inland waters, except ground water, and includes transitional waters and coastal waters; territorial waters are included as surface waters for the purposes of the Directive insofar as chemical status is concerned.

Water Body - A coherent sub-unit (delineated water body) in the river basin (district) to which the environmental objectives of the directive must apply. Hence, the main purpose of identifying "water bodies" is to enable the status to be accurately described and compared to environmental objectives.

EXECUTIVE SUMMARY

The Water Framework Directive (WFD) established new and improved ways of protecting and improving the water environment, with the overall objective of achieving co-ordinated and integrated water management in the river basin districts.

One of the Directive's requirements is the publication of an interim overview of the significant water management issues in each river basin district and setting out of the appropriate measures to mitigate the impact from the significant issues.

This guidance document (GD), in Part 1, describes the steps to develop the overview report on significant issues and baseline scenario. The GD concentrates on the identification of the significant issues and their environmental, socio-economic impacts and measures to address the significant issues. An inherent part of the overview report for public consultation is a baseline scenario to implement selected measures through the three planning cycles of the River Management Plans (RBMPs). In this GD, some examples for implementation measures are presented and a baseline scenario is built on the planning strategies and management objectives covering all three planning cycles.

The GD, in Part 2, describes the approach to set out the Programme of Measures to address the significant issues. The basic and supplementary measures are described along with the categories and mechanisms of potential measures to be applied. Some examples of measures for significant water management issues are presented as well.

INTRODUCTION

Significant water management issues (SWMIs) report gives a diagnosis of the basin and proposes solutions for the detected significant water issues, integrating the comments and contributions of the stakeholders. However, it is a document different and previous to the River Basin Management Plans (RBMPs) and therefore it shall not require updates other than the relevant contributions made by the stakeholders during its public consultation.

The Water Framework Directive (WFD) is a wide-ranging piece of European environmental legislation. It established a new basis for protecting and improving the water environment (both surface and ground waters) within the river basin districts. The setting out and interim overview of the SWMI and the Programme of Measures is an important statutory requirement of the WFD for all river basin districts.

The State Government (Ministry responsible for the environment), regional and local governments have a lead role under the implementation of the WFD. However, addressing the challenges related to cope with SWMI requires collective action. While the making of the RBMP requires a considerable amount of technical expertise, it also requires the knowledge and perspectives of people who use water in their everyday lives, whether as a source of drinking water for themselves, their livestock, for fishing or swimming or to support manufacturing or power generation or even just for its aesthetic appeal. Water is a fundamental aspect and RBMPs can assist the society in ensuring that there is a healthy water environment for all living the river basin district.

TO WHOM IS THIS GUIDANCE DOCUMENT ADDRESSED?

The guidance document aims at guiding experts and stakeholders in the identification of the significant water management issues and the measures to address them as a coherent, substantial part for the development of RBMPs for the river basin districts in Georgia. This guidance will help experts to conduct the activities in the field:

- Setting out the significant key issues affecting the water environment in the river basin districts;
- Definition of the strategies and management objectives to achieve the environmental objectives (prioritisation and implementation of the measures);
- Bridging policy making process and stakeholders involvement with an opportunity to contribute to the river basin planning process.

WHAT CAN BE FOUND IN THIS GUIDANCE DOCUMENT?

The content of this document is focused on:

Part 1 Significant Water Management Issues

- Basic concept of the SWMIs;
- Identification of the SWMIs expected in Georgia, including impact of climate change;
- Description of the expected SWMIs with their impacts (each SWMI is described by the environmental, social-economics impacts along with the proposal of the measures to address the significant issue);
- Baseline scenario to implement measures (Document for Public Consultations).

Part 2 Programme of Measures

- Basin concept of the Programme of Measures;
- Categorisation of selected measures;
- Selection of measures;
- Examples of measures to address the SWMIs.

PART 1 SIGNIFICANT WATER MANAGEMENT ISSUES

The overview of the significant water management issues (SWMI) is an important requirement of the WFD for river basin districts. The overview should set out the key issues affecting the water environment in the river districts and is built on the results of the WFD Article 5 reports (Characterization Report, Pressures and Impact Analysis), Environmental Objectives and Programme of Measures. This part of the WFD implementation is somehow an intermediate step in the preparation of the RBMPs by offering a diagnosis of the water related problems (SWMIs) and proposing measures to treat them (planning scenarios). The whole process is illustrated in Fig. 1.

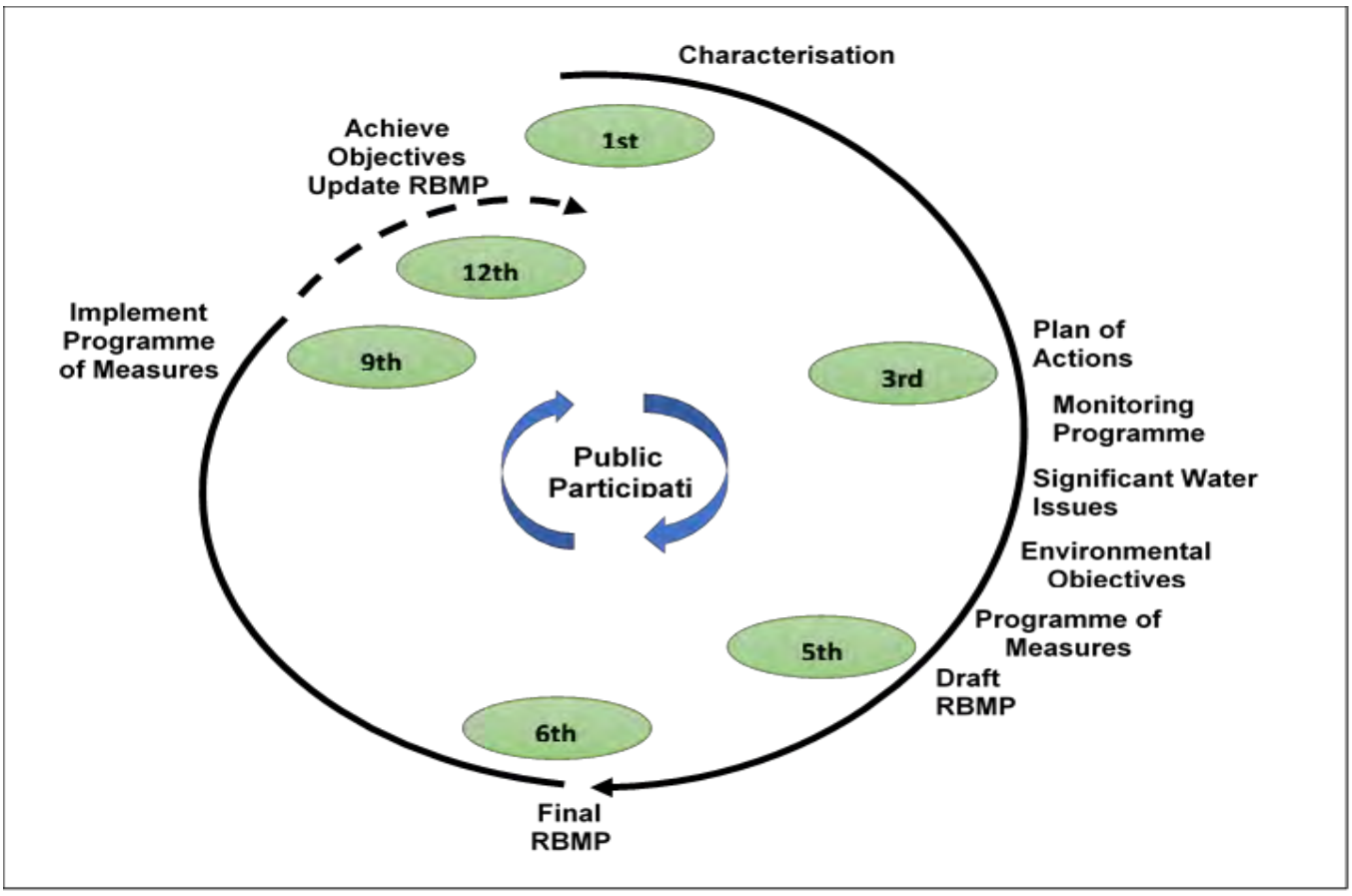

Figure 1. The river basin planning process

Once the SWMIs are identified, they will be used in the development of the planning cycle scenarios. These scenarios will be developed in two stages:

Stage 1. Characterisation the present horizon (reference situation) of the significant issues of the river basin districts;

Stage 2. Development of the planning cycles scenario (baseline scenario) to cope with the significant issues for the 1st, 2nd and 3rd planning cycle, respectively.

As part of this process that is required by the WFD, this overview must be available for public consultation. This will provide stakeholders and the general public an opportunity to contribute to the river basin planning process by bringing the local issues and measures from the river basin districts and sub-basins.

The following consultation questions may be considered:

- *Do you agree that these are the significant issues impacting the water bodies within the river basin district?*
- *Are there other significant issues at the river basin district level that have not been considered?*

- *Were all the important existing measures identified that are being used to address these significant issues?*
- *Please identify any important existing measures that have been missed.*
- *Are there additional new measures that you think could make an important contribution to addressing a significant issue?*
- *Can you identify new or existing measures which you can help deliver?*

BASIC CONCEPT OF SWMI

The significant water management issues are the pressures acting on the water environment that are considered having significant impacts on water bodies in all surface water categories and ground water, refraining them from achieving the environmental objectives of the WFD. Issues may arise from: on-going human activity (e.g. farming, industry), historic human activity (e.g. historical engineering structures, abandoned mines, contaminated sites) and a new development, (e.g. future infrastructure and land use projects) and they should be addressed during the first river basin planning cycle.

Significant issues should be identified by evaluation of:

- Extent of the adverse impact of the issues on the achievement of the WFD´s objectives for each category of water bodies in the river basin districts;
- Evidence that such impact is based on sound research results;
- Efficiency of measures that were already implemented to mitigate the impacts in the river basin districts.

SWMIs report gives a diagnosis of the basin and proposes solutions for the detected significant water issues, integrating the comments and contributions of the stakeholders. However, it is a document different and previous to the River Basin Management Plans and therefore it shall ***not require updates*** *other than the relevant contributions made by the stakeholders during its public consultation.*

The significant issues will be identified at the river basin district level. However, significant issues can differ geographically between the sub-basins and would be therefore also be presented by the sub-basin.

IDENTIFICATION OF SWMI

Identification of the SWMIs will be based on:

- Data collected for the characterisation reports (WFD, Article 5);
- The Pressures and Impact Analysis results and risk assessment;
- Consultation and discussions with stakeholders in the river basin districts.

The pressures recorded on those water bodies that have been identified as being “at risk” category and in some cases if there are uncertainties to classify that water body into ”probably at risk” in the IMPRESS Analysis will be used to identify the SWMIs.

The SWMIs will be identified separately for each water body category: rivers, lakes, reservoirs, transitional, coastal waters and ground water. Heavily modified and artificial water bodies will be included in the relevant water bodies category.

It is suitable to define the significant issues in terms of both the pressure type and the source of origin (i.e. industry sectors, agriculture activities, old burdens). For example, point source pollution from the collection and treatment of sewage, and morphology from land claim. Describing the significant issues at this level of detail will give a possibility to identify measures already implemented and estimate gaps to meet the WFD´s environmental objectives (the additional measures).

Based on the WFD principles, the whole water body will fail to comply with good status if the WFD’s objectives are not achieved, although a pressure may not impact the entire length or area of a water body. Therefore, estimating the “significance” of the pressure (a significant part of the water body affected) is essential for the identification of the SWMIs. The length or the area of water bodies impacted by each pressure will be calculated or estimated depending on the pressure for each water body.

The selection criteria to estimate which pressures can be said to be significant will be the ones used in the risk assessment part of the IMPRESS Analysis.

Another principle that will be taken into account in the process to identify issues as significant is the sensitivity of the water bodies to reflect the level of ecological damage. This principle is important mainly for the identification of SWMIs on sub-basins level (e.g. the same volume of wastewater discharged into a large river would have a different impact when being discharged into a small creek or an oligotrophic lake).

It can be expected that during the identification of the SWMIs, some of the pressures may not have been regulated or no measures to mitigate their impacts have been taken. In such cases, the necessary measures should be proposed for those significant issues.

IMPACT OF CLIMATE CHANGE

Nowadays, it is not possible to consider significant water management issues without taking climate change into account. Climate change predictions make it clear that both water quality and quantity will change in future. Less water will become available in certain areas of Georgia. Rainfall intensity and frequency is also likely to increase as a result of climate change. Flash floods, and unpredictable weather events will increase the risk of pollution and sediment loading within catchments. Sea level rise may have impacts on the integrity of coastal environments, with potentially significant impacts on coastal habitats. Increase in the intensity and severity of floods will impact on erosion rates, diffuse pollution, and cause degradation of the coastal ecosystems. All of these impacts should be taken into consideration, and measures should tend to provide flexible means of managing any potential future problems. Adapting to these changes through making land use management practices (principally agriculture and forestry) more sustainable should be an important part of SWMIs and RBMPs.

THE EXPECTED SIGNIFICANT WATER MANAGEMENT ISSUES IN GEORGIA

There are a wide range of significant water management issues affecting the water bodies of the river basin districts in Georgia. Many of these, such as point source pollution from collection and treatment of sewage activities, diffuse pollution from agriculture and morphological changes affect a number of water body categories from inland waters, coastal waters to ground water. The expected significant issues for the RBDs in Georgia are listed in Table 1. However, the detailed list would be based on the pressure and impact analysis (including risk assessment) after IMPRESS analysis.

Table 1. The expected SWMI in RBDs

Pressure type	Key sectors
Point source pollution	Collection and treatment of urban waste waters Industry Solid waste disposal Mining and quarrying
Diffuse source pollution	Agriculture (plant production and livestock) Urban development Coastal water transport
Water abstraction and flow regulation	Drinking water supplies Irrigation and livestock Energy generation (HPP)
Morphological alterations	Historical engineering Urban development Electricity generation (HPP) Floodplain and land claim
Invasive species	All sectors

Generally, the most common problems affecting water environment are pollution, abstraction and modifications to the physical habitat. However, it is also important to consider the increasing pressure from the presence of invasive alien species. Furthermore, it is known that we still do not fully understand the links between some pressures and ecological status resulting from human activity. Similar uncertainty exists in terms of attributing some pressures to sources (sectors). This uncertainty will be reduced as further monitoring is undertaken and scientific understanding improves.

What is necessary to be taken into account is geographical scale. There are a number of issues that are significant at the sub-basin level but which have not been identified as significant at the RBD level. It is important to recognize that these issues would be consulted with group of experts before they are going to be addressed by selected measures.

In the below subchapters, the pressures types and related key sectors are described. The description is concentrated on **environmental, socio-economic impacts and measures to address the significant issue**.

POINT SOURCE POLLUTION

This section describes four types of point source pollution identified as significant water management issues:

- Collection and treatment of urban waste waters;
- Industry and manufacturing;
- Solid waste disposals;
- Mining and quarrying.

COLLECTION AND TREATMENT OF URBAN WASTE WATERS

Urban waste water is a mixture of water from households (baths, sinks and washing machines, toilets) industrial and small manufactures effluents and, in many cases also with rainwater run-off from roofs, roads and other surfaced areas. The sewers (canalization) are constructed to collect wastewater and convey it to waste water treatment plants (WWTP).

There are two main types of sewer systems:

- Surface water sewers take rain run-off from roads, yards and roofs. They often discharge this without treatment to the water environment.
- Combined sewers convey urban waste waters (households and industries) and some rain run-off to WWTPs. The volume of waste water in combined sewers increases considerably during wet weather. If they become full during heavy rain, they are designed to overflow diluted screened, settled or untreated waste water in order to protect homes, properties and WWTPs from flooding.

Treatment at WWTPs is designed to remove pollutants. Some of the pollutants are broken down by bacteria to harmless constituents. However, persistent hazardous substances cannot be broken down and either pass through the WWTPs or are removed from the wastewater into the sludge left after the biological treatment. These contaminants then create problems for the reuse of the sludge.

There may be also localised environmental problems in rural areas caused by waste water from scattered houses, small hotels and manufactures which are typically treated by septic tanks or small treatment plants.

The management of surface water drainage is critical to a successful solution to the problems of both pollution and flooding. All aspects of the drainage network need to be taken into account when considering its development. Solutions to pollution (quality) problems need to be linked to flooding issues – the two cannot be addressed separately.

Environmental Impacts

Untreated or inadequately treated waste water is polluting:

- The organic matter present removes oxygen from the water killing fish and other aquatic wildlife;
- The nutrients present encourage algae to grow to bloom levels, smothering fish habitats and requiring expensive treatment of water abstracted for industrial or drinking water purposes;
- Toxic substances from industry, household chemicals and road run-off in the waste waters do not degrade and accumulate within fish and marine mammals;
- Waste water related debris (plastics, floating materials, etc) can affect the public welfare value of rivers and beaches;
- Bacteria and viruses in the waste waters can cause health problems with water contact activities such as swimming, canoeing or fishing.

Generally, it was found that pollution caused by inadequately treated waste water is the most important source of pollution for river, transitional and coastal waters.

Socio-economic Impacts

Rivers polluted with waste waters lose their value as a community asset and, in extreme cases, may represent a health hazard for the population. More housing means a higher volume of waste waters and new impermeable surfaces resulting in increased rain run-off. It is important to consider the effects on the existing network and the environment at the planning stage. Limits on the capacity of some sewer networks and/or WWTPs means it is not always possible to allow new developments to connect to the sewerage system (both collection and treatment of waste waters).

How to Address this Issue

Investment into the collection and WWTP systems is the main mechanism to address pollution caused by waste water. This investment can be delivered via a public planning process in the context of ministerial or regional government decisions. Financial means for this purpose can be collected on the scale of charges that can be afforded by customers.

Source control is the management of a pollutant at or near its source. Reducing pollution at the source reduces the costs associated with its treatment and produces environmental benefits. This is especially true for hazardous substances and nutrients. For example, not using certain substances in domestic products (e.g. removing phosphates from detergents) reduces the need for treatment to remove them from waste water and reduces their concentration in sewage sludge.

Removal of pollutants through pollution control can lead to improvements in the quality of rivers and coastal waters. In this context, it would be taken into account that standard treatment methods do not

generally remove all contaminants. As example may be present that to meet the standards set by the Bathing Water Directive (regarding bacteria and viruses), will be required to use the disinfection of waste water discharging at sites designated as bathing waters (particularly where there are significant levels of human activity). Such measure can be costly and infeasible to implement in the given planning cycle.

Table 2 summarizes those measures currently available to address point source pollution from collection and waste water treatment systems.

Table 2. Measure to address impacts from urban WWTP

Measures to address the impacts from collection and WWTPs	
Regulation (legislative tools)	• Environmental inspection controls on wastewater discharges to rivers, lakes, coastal waters, etc. • Environmental inspection controls on industrial effluent discharges to sewer system (canalization) of UWWTP. • Controls over use of polluting substances in industrial products. • Control of domestic products with regard to their impact on the environment (e.g. low phosphorus detergents).
Economics	• National charging scheme (tariffs, fees) provides incentives for industry to reduce the amount of industrial effluent discharged to sewer.
Advice	• Pollution reduction campaigns on national and municipality levels. • Best Available Practice technologies campaigns for industry.

INDUSTRY AND MANUFACTURING

The level of water pollution from industries and manufacturing is a significant issue in some parts of Georgia, despite the powerful regulatory controls. On the other hand, the industry sector has progressively taken a proactive approach by developing environmental management systems which can deliver improved environmental performance and often cost benefits. The impacts caused by direct discharges from industrial activities might be mainly associated with the ferrous metallurgy, chemicals, food and drink sectors. It would be taken into account that environmental impacts are partly a consequence of current operations and partly the result of historical operations which have a contaminated aquatic environment (e.g. sediments).

Environmental Impacts

Inadequately treated industrial effluent discharges can result in the following impacts:

- The high levels of organic matter in the discharges consume oxygen as they degrade, reducing the levels of oxygen in the receiving waters;
- The levels of dissolved metals and hazardous organic substances present can have a direct toxic effect on animals and plants;
- Metals and hazardous (persistent) organic substances can accumulate within the food chain and result in high levels of contaminants in top predators;
- Significant levels of metals and hazardous (persistent) organic substances contaminate the sediments.

Point source pollution from industries and manufacturing is a significant issue mainly on surface water bodies. However, the ground water bodies can also be impacted.

Socio-economic Impacts

The attention would be concentrated on those chemicals that are persistent and bio-accumulative. These chemicals can be transported over long distances and accumulate through the food chain. Several studies on the effects of high chemical levels in humans suggest that toxic chemicals can lead to reproductive problems, cancer and neurological disorders. These chemicals cannot be easily removed from the food chain even after their releases have ceased. Many of them may persist in the sediments.

How to Address this Issue

Industrial processes are already subject to an effective regulatory regime which has resulted in substantial environmental benefits. Therefore, the main aim will be to ensure that these tools are applied in a proportionate and risk-focused manner which will continue to achieve environmental benefits.

Measures to be address to mitigate the impacts from industry activities pressures are summarized in Table 3.

Table 3. Measure to address impacts from industries and manufacturing

Measures to address the impacts from industries and manufacturing	
Regulation (legislative tools)	• Integrated Pollution Prevention and Control (IPPC) regime regulates industrial processes to minimise pollution. • Controlled Regulations regulate discharges to the water environment. • Inspectorates (or other authorities) control the use of certain dangerous substances through marketing and use regulations. • Spatial Development Plans ensure industrial developments are located in appropriate locations.
Economics	• National charging scheme (tariffs, fees) provides incentives for industry to reduce the amount of industrial effluent discharged to recipient. • Tax exemption for industrial facilities when applying measures to bring environmental benefits.
Advice	• Environmental management systems in the industrial facilities promoted as means to improve environmental performance. • Government offers advice on using the Best Available Practices. • National Environmental Agency offers advice on minimising water pollution. • Guidance to industries on reducing the use of hazardous raw materials along with development case studies.

SOLID WASTE DISPOSAL SITES

Historically, the solid waste disposal sites were often inadequately constructed and, in many cases, had no protection layers against percolation of dangerous substances. Polluted liquid generated from the degrading waste was thus able to percolate through soil and rock, entering ground water and contaminating surface waters. On the other hand, presently more modern landfill sites are designed in accordance with the national legislation and operated under control regulations. Landfills are required to contain and manage leachates by incorporating a basal liner and leachate collection systems.

Environmental Impacts

The potentially harmful properties of landfill leachates result from the presence of:

- High levels of ammonia and suspended solids;
- Dissolved solids;
- Toxic compounds;
- Immiscible organic chemicals;
- High chemical/biochemical oxygen demand (cod/bod);
- High levels of nutrients;
- Microbiological contaminants.

Generally, point source pollution from solid waste disposal activities is mainly identified as a significant issue for ground water and transitional water bodies in many of the EU member states.

Socio-economic Impacts

Similarly, as in industrial pressures, the attention would be concentrated on those chemicals that are persistent and bio-accumulative. These chemicals can be transported over long distances and accumulate through the food chain.

How to Address this Issue

Solid waste disposal sites identified as impacting water bodies may consist of:

- Historic areas of waste disposal without any regulatory control;
- Sites operated under national regulation that are no longer accepting waste;

- Industrial solid waste disposal sites with old phases of landfilling.

The potential measures to be taken to mitigate the impacts from landfills are summarized in Table 4.

Table 4. Measures to address the impacts from solid waste disposal sites

Measures to address the impacts from solid waste disposal sites	
Regulation (legislative tools)	• National Regulations prevent new landfill sites from polluting ground water (surface water). • Measures required to address pollution at sites still operating under previous regulations. • Impacts caused by closed landfill sites no longer subject to licensing can be addressed by the contaminated land regime.
Economics	• National support scheme to provides financial support in mitigating impact from landfills on water environment (e. g. Environmental Fund).
Advice	• Actions to implement the National Waste Legislation to reduce the volume of waste going to landfill.

MINING AND QUARRYING SITES

Georgia has a long history of mining carried out on large scale. Mine are primarily associated with coal, ironstone and non-ferrous metals. There are both deep and surface mines. The waters from mines can pollute ground water and when reaching the surface water, polluted mine water discharges may cause significant changes in the chemistry and ecology of affected surface water bodies.

Environmental Impacts

The main impacts associated with mining are listed below:

- Existing ground water that has been polluted by mining activities can no longer be used for drinking water supply or for most industrial purposes (heavy metals);
- Rising iron-rich ground water can contaminate overlying or adjacent aquifers preventing their use as a source of drinking water or water for industrial processes;
- Rivers may be polluted by mine water flowing from shafts and tailings within abandoned mines and through the migration of iron-containing ground water to surface water as baseflow. These discharges can kill most animal life and affecting also its aesthetic and recreational value.

Socio-economic Impacts

Point source pollution from mining and quarrying has irreversible impact of the drinking water resources and also on the water uses for some industries. This situation can have high effect on the development in the river basin district.

How to Address this Issue

The major problem in addressing this significant issue is that the mine and/or quarry often closed many years ago and therefore there is no longer anyone directly responsible for controlling this source of pollution. The potential measures to be taken to address this issue are presented in Table 5.

Table 5. Measures to be address the impacts from mining and quarrying

Measures to be address the impacts from mining and quarrying	
Regulation (legislative tools)	• Inspectorates can impose controls on mine dewatering and its discharge from existing mines and quarries • Government can require the treatment of discharges from mines where a responsible person can be Identified • Spatial Development Plans imposed by local governments will minimise wider environmental impacts • List of abundant mines will be prepared by National Environmental Agency
Economics	• National support scheme to provides financial support in mitigating impact from mines on water environment (e. g. Environmental Fund) • Funding from state budget is required to allow to treat polluting discharges from mines and quarrying sites where no responsible person is known

DIFFUSE SOURCE POLLUTION

This section describes three types of diffuse pollution that can be identified as significant water management issues (agriculture plant and livestock production, rural urban development and sea and coastal water transport).

AGRICULTURE

Agriculture is about much more than simply producing food. Farming contributes greatly to landscapes, culture, tourism and natural heritage of Georgia. In rural areas, agriculture also employs a significant number of people.

However, the reverse side of agricultural activities is that production systems rely on the use of fertilizers and pesticides, not all of which reach their intended target and can run-off or drain into rivers and ground water resulting in a deterioration in water quality.

Diffuse pollution from agriculture is a significant issue for ground water, rivers, lakes, transitional and coastal waters.

ENVIRONMENTAL IMPACTS

Diffuse agricultural pollution can have the following types of impact:

- Losses of nutrients from fertilisers, animal manures and slurries applied to land. This can cause eutrophication and plankton will reduce light penetration and affects oxygen levels;
- Organic matter from animal manures, slurries and effluent from livestock feeds (e.g. silage) depletes oxygen levels in rivers;
- Soil erosion can have a direct physical impact in rivers and lakes and reducing light penetration in estuaries and coastal waters. It is also important in the transport of other pollutants such as pesticides, nutrients and faecal pathogens attached to soil particles;
- Livestock manures and slurries, and access to watercourses by cattle and sheep, can lead to significant losses of micro-organisms from faecal matter to bathing waters. This can affect the amenity value of the water environment and pose a risk to human health; and
- Losses of pesticides during handling, use and washdown can cause severe impacts on plants and animals in rivers and can affect the quality of drinking water.

SOCIO-ECONOMIC IMPACTS

The costs of diffuse pollution from agriculture are met by a wide range of water environment users with the most important affected sectors being water supply, recreational water use and fisheries.

HOW TO ADDRESS THIS ISSUE

Measures to control diffuse pollution are widely in place across Europe where intensification of agriculture has resulted in similar environmental problems as they can be identified in Georgia. In Table 6 the potential measures to reduce the pollution from agriculture activities (diffuse sources) are summarized.

Table 6. Measures to address the impacts from agricultural diffuse sources

Measures to address the impacts from agricultural diffuse sources	
Regulation (legislative tools)	• Nitrate Vulnerable Zone action programmes. • Targeted Regulation Controls of the diffuse sources of pollution.
Economics	• Farm subsidies system, where farmers will comply with certain environmental conditions before payment. • Rural Development Strategy supporting small farmers food production and market.
Advice	• Codes of Good Agriculture Practice and similar guidance to reduce pollution. • The initiative of non-governmental organisations and voluntaries.

URBAN DEVELOPMENT

Many studies have shown that pollution entering the surface water system comes from different sources including roads, pavements, roofs and yards. These sources may be individually minor, but collectively significant. This form of diffuse source pollution has been identified as a major adverse impact in urban streams and rivers.

Environmental Impacts

Diffuse pollution from urban areas includes the following:

- The main pollutants are toxic metals, oil and other hydrocarbons such as polyaromatic hydrocarbons (PAHs) which are associated with hydrocarbon spills and especially with the combustion of hydrocarbons. Such contamination can kill macroinvertebrates and fish;
- Herbicides used to control weeds along roadsides and pavements, and spillages of domestic pesticides kill plants in rivers.

Diffuse pollution from urban development may be identified as a significant issue on rivers and coastal water bodies.

There are other impacts of urban run-off which are not associated with pollution. These result from the rapid run-off of rain straight into drains and to rivers (the rapid overland run-off can cause river water levels to rise quickly, increasing the risk of flooding).

Socio-economic Impacts

The significant majority of the population in Georgia lives in urban areas where rivers have high amenity potential and can form the focus of urban regeneration. However, pollution from urban run-off can have a major impact on these watercourses. Furthermore, the rapid run-off from urban areas also can contribute to the flooding of properties and such circumstances can have effect on the socio-economic development.

How to Address this Issue

Development of so called sustainable urban drainage systems are a vital tool that can be used to address the issue of both the quantity and quality of run-off while providing amenity value. Such drainage systems will aim to mimic a more natural water cycle using a number of techniques including:

- Reducing the area of impermeable surfaces to allow infiltration at source;
- Using systems such as artificial ponds or wetlands to allow for some treatment and attenuation before the runoff is discharged back into the water environment.

Table 7 presents some measures that can be potentially address diffuse pollution from urban development.

Table 7. Measures to address the impacts from agricultural diffuse sources

Measures to address the impacts from agricultural diffuse sources	
Regulation (legislative tools)	• Local Government (Municipalities) will development Spatial Development Plans, where Sustainable Urban Drainage systems are included. • Regulation control enforces the requirements for sustainable urban drainage systems. • General binding rule requires that all new surface water discharges will be treated.
Economics	• Scheme of drainage charges based on the amount of impermeable area draining to sewer. • Government will provide with funds to build sustainable urban drainage systems.
Advice	• The initiative of non-governmental organizations (NGOs) and volunteers to keep water in the cities.

SEA AND COASTAL WATER TRANSPORT

Ship traffic is a part of the national transport system in Georgia and contributes to the state budget. Ports are often at the heart of their local community. They are major providers of employment within their

areas. Many also contribute to local economies through leisure activities such as yachting, sightseeing and diving.

Environmental Impacts

The main impacts caused by shipping are as follows:

- Chemical contamination resulting from the release of compounds that can be toxic or have sub-lethal effects on marine invertebrates. For example, Tributyl tin is the main anti-foulant of concern. It is a powerful endocrine disrupter;
- Oil released from ships can have a toxic or smothering effect on marine invertebrates and plants. Larger vessels such as a container ships or oil tankers take on ballast water when unloading cargo. Problem can arise where the ballast water being discharged contains invasive alien species, oils or other chemical contaminants;
- Oil pollution can result from accidents such as the grounding of vessels and from historic ship wrecks;
- Litter from vessels makes a significant contribution to the debris.

These pressures can have widespread impacts but may not always affect coastal water bodies as a whole.

Socio-economic Impacts

Adverse impacts are largely associated with recreation and tourism. Oil spills affect recreational sports such as sailing and surfing, while litter problems affect the enjoyment of beaches and impose clean-up costs on local authorities.

How to Address this Issue

Several Regulation measures were adapted to control the contamination of marine environment by the transport.

Table 8 lists some measures that can be addressed to diffuse pollution from sea and coastal water transport.

Table 8. Measures to be address the impacts from sea and coastal water transport

Measures to be address the impacts from sea and coastal water transport	
Regulation (legislative tools)	• Regulation to control using tributyl tin by vessels. • Inspectorates controls compliance with Regulation on using tributyl tin.
Advice	• Guidelines on ballast water management plan for vessels entering ports.

WATER ABSTRACTION AND FLOW REGULATION

This section describes three types of water resource pressures which have been identified as significant water management issues (drinking water supply, irrigation and livestock and energy generation).

DRINKING WATER SUPPLIES

Public water supplies are extracted from rivers, lakes, reservoirs and ground water. Water supplies have been developed over a number of years and some have faced a progressive increase in the volume of water used for domestic purposes. In addition, communities have expanded in many areas resulting in increased demand for drinking water. This long-term trend places increasing demands on water resources and consequently on the environment.

Environmental Impacts

The environmental impacts associated with water supply include:

- Low levels of water in rivers (particularly during the summer) by direct abstractions with the potential to damage the ecology of rivers and their associated wetlands;

- Low ground water levels caused by abstraction leading to the drying out of small tributaries and wetlands, and the reduction in river baseflows during periods of low rainfall;
- Variation in water levels in lakes and reservoirs leading to regular drying out of the shoreline, preventing the growth of plants and spawning of fish;
- Barriers to fish migration caused by dams;
- Interruption of flow of sediment downstream of dams depletes gravel needed by salmon and trout to spawn;
- Reduction in the ground water resource, resulting in a reduction in baseflow to surface water and wetlands.

These impacts affect ecology via the effects of changing river flows and lake levels as well as changing the morphology of rivers and lakes.

Socio-economic Impacts

Drinking water abstractions from rivers and lakes (reservoirs) tend to occur in upland catchments where there are few or no conflicting uses of the water environment. Fisheries are consequently the other key water user affected, with dams and limited compensation flows restricting fish migration and recruitment. On the other hand, there are huge benefits to society from the reliable supply of clean water with respect to public health, amenity value and industrial/commercial development.

How to Address this Issue

Table 9 lists some measures available to address abstraction for public water supply.

Table 9 Measures to address impacts from abstraction for public water supply.

Measures to address impacts from abstraction for public water supply	
Regulation (legislative tools)	• Inspectorate (regulator) controls on levels of abstraction, management of dams and efficient use of water.
Economics	• Charging incentives encourage efficient use of water by industry.
Advice	• Publicity campaigns promoting efficient water use by domestic customers. • Campaigns to support using rainwater and recycling for garden use and toilet flushing.

AGRIGULTURE: IRRIGATION AND LIVESTOCK

Abstraction of water for agriculture serves many purposes depending on the type of farming, e.g. water for crop irrigation, drinking water for livestock and washing water for dairy farms. The largest agricultural use of water is for irrigation and occurs primarily in the eastern part of Georgia.

Obviously, the water abstraction for agricultural use is mainly significant issue for rivers and lakes (reservoirs). To successfully manage this problem, it would be required to work at a catchment scale to identify appropriate quantities and timings of abstraction. There is an important economic balance to be addressed with this approach, particularly where there are multiple users within a catchment.

Environmental Impacts

Irrigation is typically required during dry weather when rivers are low. As a consequence, abstraction for irrigation changes naturally occurring low flows. In addition, the distribution of crops means that farmers frequently have to rely on ground water or on tributaries. During periods of low flows, these may not have sufficient flow to support the abstraction without causing an environmental impact. In this context, **the ecological (environmental) flow** conditions would be applied as principle to prevent water body deterioration and protect the aquatic organism sensitive on the flow regime.

Irrigation typically occurs between May and August. It has the following environmental impacts.

- Reduced summer flows occasionally lead to stranding of fish and drying out of wetlands;
- It increases the vulnerability of fish and other freshwater life to high temperatures in pools isolated by low flows;

- It exacerbates the effects of pollution with very limited dilution for discharges, resulting in low oxygen conditions;
- Small dams across rivers are sometimes constructed to assist in the abstraction of water and can, if poorly constructed, be as barrier for the migration of fish;
- The effects of agricultural abstraction often combine with the effects of diffuse pollution to seriously damage the ecology of mainly small water bodies;
- The effects of ground water abstraction can affect receptors (rivers). In these areas, irrigation abstraction from ground water can further reduce summer low flows in rivers;
- Ground water abstraction can impact on wetlands and can damage aquifers by inducing the inland intrusion of seawater (drainage areas of the transitional and coastal water bodies).

Socio-economic Impacts

Abstraction for agriculture primarily affects the population of juvenile fish, particularly in small rivers and creeks used for spawning. This in turn reduces recruitment for fisheries, which are already under pressure from a wide range of sources both in freshwater and at coastal waters.

How to Address this Issue

The network of the irrigation canals is large and the scale of irrigation after decline in 90th of the last century, has increased over the past 20 years, particularly in the east of Georgia. **This trend, together with climate change projections for drier summers along the east Georgia**, suggests the environment will be at greater risk of harm and the water resources available to farmers more vulnerable and less predictable or secure.

Table 10 summarizes those measures available that can be addressed to abstraction for irrigation.

Table 10. Measures to address impacts of abstraction for agricultural irrigation

Measures to address impacts from abstraction for agricultural irrigation	
Regulation (legislative tools)	• Inspectorates (other Authority) control on volume of water that can be abstracted and the time over which it can be abstracted (licenses, permits). • Droughts management strategy. • Regulation requires efficient use of water.
Economics	• Charging scheme to support the abstract of water during high river flow levels and storage by farmers. • State support funding for using modern and efficient irrigation technologies (e.g. as part of the Rural Development Programme) to economize the water uses.
Advice	• Training of farmers to use water in efficient way and to store water.

ENERGY PRODUCTION: HYDRO POWER PLANTS

Hydropower stations use the downhill flow of water to generate electricity. The production of hydropower is intensively used and creates major generation schemes covering substantial part of the energy balance in Georgia. There are several schemes of the hydro power plants. Some of the plants divert water across catchments to dams which hold the water until energy generation is required. Other groups of hydropower plants are using bypass to generate energy continuously.

Hydropower generation provides substantial employment in many rural communities across Georgia and the sector contributes significantly to state economy.

Environmental Impacts

Hydropower plants represent an important source of renewable energy. It is less susceptible to the weather than for example wind plants and can generate energy on demands. Hydropower will remain part of our fight against climate change.

The potential negative environmental impacts of hydropower are associated with the abstraction of water and the construction and operation of dams. If these activities are not controlled and appropriate mitigation measures incorporated, they can result in:

- Low flows in rivers, which may be virtually dry except during periods of heavy rain;
- Highly variable flows (hydropeaking) below generating stations, resulting in bare banks and unsuitable habitat for aquatic fauna and flora;
- Highly variable water levels in reservoirs leading to regular drying out of the shoreline, preventing the growth of plants and spawning of fish;
- Barriers to fish migration caused by dams and death of fish entering turbines;
- Interruption of the flow of sediment downstream of dams, which depletes gravels needed by trout to spawn;
- Compaction of silt and the loss of some habitats in some cases from steady compensation flows.

These impacts affect ecology via the effects of changing river flows and lake levels as well as changes to the morphology of rivers and lakes.

Socio-economic Impacts

Hydropower generation can affect the recreation and aesthetic value of the water environment. There is long-term potential conflict between hydropower production and fisheries sectors. On the other hand, hydropower plants can positively affect in the summer recreational rafting and canoeing, which is significant income for several small recreational businesses in the mountainous areas.

How to Address this Issue

The main mechanism for addressing the negative impacts of hydropower plants on the water environment is through the regulatory controls defined in licences (permits). The main aim of these controls will be to reconcile measures to improve the water environment with the importance of renewable energy generation in combating climate change.

The river basin management plan will designate heavily modified water bodies where restoration of the water environment to good ecological status cannot be achieved without causing a significant adverse impact on energy generation.

Georgia needs to promote new hydropower schemes due to high hydro power potential but these must not compromise important environmental sites or other sectors interests. It will be necessary to find a way to reconcile these potentially conflicting interests. The most likely interests to be affected by hydropower are nature conservation, fishing and canoeing. To give confidence to the hydropower industry, it is necessary to identify sites important for these other uses. This will ensure that hydropower development is directed towards sites where environmental and other concerns can best be mitigated, minimized or are less significant.

Table 11 lists those measures that can be addressed to flow regulation from electricity generation.

Table 11. Measures to address the impacts of flow regulation from electricity generation

Measures to be address the impacts of flow regulation from electricity generation	
Regulation (legislative tools)	• Inspectorates (other authority) imposes controls on licensed hydropower schemes. • Authority responsible for fishery sector provides advice on measures to protect fisheries. • Local government include hydropower plants into their spatial development plans and control.
Economics	• Economic support to use the environmental best practice as criterion for eligibility.
Advice	• Agreements between hydropower companies and interest groups such as for example fisheries, recreational agencies. • Map showing potential constraints on hydropower development to facilitate the targeting of development.

IMPACT ON MORPHOLOGY

This section describes four types of morphological impacts which have been identified as significant water management issues (historical engineering, urban development, energy production floodplain and land claim).

HISTORICAL ENGINEERING AND URBAN DEVELOPMENT

Although engineering has an important and ongoing role in river management, it is now recognized that some engineering interventions can significantly alter a natural character of the rivers and lead to habitat damage and in some cases even to increased flood risks.

It is needed to take into account when assessing morphological alteration on the rivers that under natural conditions, rivers will create a shape, size and character that reflect a balance between local conditions and conditions within the wider catchment. However, urban development and historical engineering activities can affect this natural balance and result in morphological damage (lead to a loss of important habitats, changes to rates of erosion or sediment deposition).

Environmental Impacts

Urban development and historical engineering activities can result in:

- The loss of floodplain wetlands and associated biodiversity from the construction of embankments;
- The loss of in-channel habitats due to increased erosion during floods affecting fish, invertebrates and aquatic plants;
- The loss of bankside vegetation, often with increased risk of bank erosion downstream and resultant loss of in-channel habitat supporting fish, invertebrates and aquatic plants;
- Structures (associated with culverts, dams and small weirs) that impede the migration of fish and other organisms and which may also affect erosion and deposition rates, and result in a loss of sediment supply downstream;
- Loss of in-channel habitats and significant changes to erosion and sediment deposition in the surrounding channel as a result of channel straightening;
- Loss of habitat for fish spawning, invertebrates and aquatic plants due to gravel removal;
- Increased inputs of fine sediments, increased risk of bank erosion, loss of bankside habitats and elevated water temperatures as a result of removal of bankside vegetation;
- Potential increase in the risk of flooding due to the construction of embankments, culverts and other engineering activities.

The permanency of engineering structures means that many of these impacts are likely to be cumulative and long lasting.

Socio-economic Impacts

The adverse economic and social impacts of poorly designed or ineffective engineering include:

Erosion. Hard engineering structures (particularly those that are misaligned) tend to deflect flow, potentially increasing the risk of erosion elsewhere.

Flooding. Poorly planned or designed engineering structures can even increase flood risk. Culverts and channel realignments can reduce the storage capacity of the river channel and increase the risk of flooding of adjacent and upstream land.

Barriers to fish migration. Fisheries are dependent on good fish recruitment. Artificial barriers, including culverts and weirs, can prevent access to spawning sites or block migrations to sea. This reduces fishery income and imposes costs on fishery managers attempting to mitigate these impacts.

Aesthetic value. An unintended consequence of river engineering has been a reduction in the recreational value of some rivers, particularly in urban settings.

Urban development of floodplains. This can place pressure on existing flood management measures. Policies are in place to ensure that new developments do not increase flood risk, but continued development on floodplains could increase the costs of maintaining existing levels of flood protection.

How to Address this Issue

Regulatory mechanisms exist that can reduce the direct impact of engineering activities. It is expected that regulations to protect the environment and to ensure that other sectors interests are not compromised. Such approach will be applied to proposals for new engineering in rivers and lakes.

Removing historic structures. Engineering pressures on freshwaters are largely in areas of urban and agricultural development. In some urban areas, rivers have been altered to such a degree that attempting to return a river to a natural condition would now be economically or technically infeasible. Despite these constraints, there are opportunities to restore rivers to a more natural condition and thus achieve substantial environmental, social and economic benefits. This type of restoration work is widespread across Europe.

Sustainable flood risk management. A common driver for river engineering, particularly in urban areas, has been flood protection. Engineering schemes to alleviate flooding are common on many rivers and, in many areas, this work has significantly reduced the risk of flooding for local communities. However, climate change and the loss of natural floodplains mean these schemes are likely to become more expensive and technically challenging. Implementation of the EU Directive on the Assessment and Management of Flood Risks will require application of new principles **("natural" flood management measures, integration of rural land use and flood management policies**) and the development of catchment flood management plans.

Table 12 lists those measures currently available to address morphological impacts from historical engineering and urban development.

Table 12. Measures to address morphological impacts from historical engineering and urban development

Measures to address morphological impacts from historical engineering and urban development	
Regulation (legislative tools)	• Controlled Regulations prevent new damage to the water environment from engineering works on rivers (including from maintenance regimes). • Planning and development control used to identify restrictions on urban development and opportunities for restoration. • Development and introduction of river restoration and remediation regulations (if do not exist). • Regulation to prevent progressive loss of flood plains. • Development of flood risk management plans under the EU Floods Directive.
Economics	• New funding framework (e.g. Environmental Fund) to enable much more restoration work.
Advice	• Government efforts to promote sustainable flood management. • Public effort to use/natural" measures in flood management.

FLOODPLAIN AND LAND CLAIM

Floodplain is the area alongside rivers. Many of such areas were converted into agricultural land. Alterations typically occur in areas where constraining or altering a river will bring economic benefits (e.g. maximising the area available for agricultural production).

Land claim is the enclosure of intertidal or sub-tidal areas within impermeable banks followed by infilling for use by agriculture, housing, port or industry. In Georgia river basin districts, the majority of land claim works are concentrated on the major estuaries and although there are also some areas of land claim on the coast.

Environmental Impacts

Physical impacts associated with land claim can include:

- Changes in the nature and extent of river bank sides vegetation and coastal features;
- Reduction of the floodplain areas;

- Substratum loss and changes to the natural size of sediment;
- Increased deposition due to changes in suspended sediment concentrations;
- Changes in longitudinal and lateral sediment transport pathways;
- Changes in currents – effects are site-specific;
- Changes in wave exposure.

These changes to the hydromorphology can affect the ecology which it supports. Changes in riverine and intertidal habitat extent and species composition can have an indirect consequence on food availability for birds and fish, and the composition, density and abundance of phytoplankton leading to reduced overall ecological productivity.

Socio-economic Impacts

Floodplain areas as agricultural areas have direct economic consequences for the local farmers. On the other hand, such alteration can increase the local flood risks. Decreased area of floodplain means also loss of wetlands and habitats and aesthetic value of the river. Intertidal areas that have undergone land claim provide the foundation for ports and harbours, industry, housing and increased agricultural productivity. This in turn provides many direct and indirect jobs and forms an important component of the national economy. It is also a case that, some areas of reclaimed land are nature conservation areas such as RAMSAR sites, or local nature reserves. These areas have an amenity value associated with them.

How to Address this Issue

Restoring the hydromorphology and habitat extent within some riverine areas and estuarine systems through managed realignment offers the potential to meet the requirements of the WFD for some water bodies. Re-establishing the ecological integrity of intertidal habitats for biodiversity gain will also be an important driver for managed realignment to mitigate the negative effects of previous land claim developments (including floodplain).

Table 13 lists those measures currently available to address the morphological impacts of floodplain and land claim.

Table 13. Measures to address the morphological impacts of floodplain and land claim

Measures to address morphological impacts from historical engineering and urban development	
Regulation (legislative tools)	• Local Government will develop controls on new areas of land claim • EIA Report will be used by local authorities
Economics	• Develop funding mechanisms to promote managed restoration
Advice	• Regulation on Biodiversity • Restoration demonstration projects by National Environmental Agency and NGOs • Develop a strategic approach to manage realignment projects • Development of Coastal Planning Guidance

INVASIVE ALIEN SPECIES

This section describes the effect of invasive alien species which can be identified as significant water management issues.

Invasive alien species are non-native organisms that successfully establish themselves in our aquatic ecosystems, resulting in damage to our natural biodiversity and creating potentially significant economic impacts. Numerous alien species have been introduced deliberately into Georgia through, for example, agriculture, forestry, horticulture and fisheries. Many other species have, however, been introduced accidentally through these and other sectors.

Environmental Impacts

Most of the alien species are not presently strongly invasive or harmful to native biodiversity. But given the appropriate environmental conditions, a minority of alien species behave invasively and can cause

declines in native biodiversity and the transformation of ecosystems. Mainly transitional waters are vulnerable on such pressure.

It is expected that no detailed inventory and assessment of the alien species was conducted in Georgia. Therefore, it would be the first task of the relevant authorities to develop a strategy for this purpose.

Socio-economic Impacts

Many invasive aquatic and riparian invasive species can have significant social and economic consequences. A number of invasive alien species also cause considerable interference with the amenity and recreational uses of water environments, e.g. interference with access for angling.

How to Address this Issue

Addressing alien species problems that prevent the achievement of good ecological status will require action within specific water bodies and consideration of potential sources of re-infestation in the surrounding area. A strategic approach will be needed to adopt due to fact that there is also a risk of re-infestation from neighbouring sites or, for example, upstream river sections. Coordinated control programmes involving a wide range of partners and stakeholders have a much greater chance of success in the long term. In this context, it will need to identify and prioritise:

- Aquatic invasive alien species in their area for monitoring;
- Preventative measures to restrict spread;
- Measures for control and possible eradication (where appropriate).

PLANNING CYCLES SCENARIO

The development process of the planning cycle scenario will consist of two stages that will cover the present horizon (reference situation) describing the current status and development of the baseline scenario (phasing work) for the planning cycles to achieve the environmental objectives. The scenario will allow estimating the effectiveness of the measures to decrease the impacts of significant issues (e.g. reduction of organic pollution, nutrients, priority substances, hydrological regime changes, morphological alterations).

STAGE 1. PRESENT HORIZON - REFRENCE SITUATION

The present horizon will be obtained by collecting and using results from the previous phases of the RBMP development process:

- Pressures and impacts analysis where significant water management issues are identified;
- Economic Analysis (water demands per sectors (municipalities, agriculture and industry);
- Environmental objectives (default and alternative objectives);
- Proposal of the Programme of Measures.

This results and outcome are needed to have an overall picture on the extent of the work to be done to achieve the environmental objectives during RBMP implementation.

STAGE 2. BASELINE SCENARIO

The WFD requires that environmental priorities, economic, and social issues be considered and taken into account when setting water management objectives. This should ensure that the WFD is implemented cost-effectively. This approach will be based on the **planning strategies** (describe the principle objectives (benefits)) and setting the **management objectives** for each of the river basins. The respective management objectives will describe the first steps towards the environmental objectives in the river basin in an explicit way. While planning strategies will cover all the RBMP cycles, the management objectives will be sub-divided among the planning cycles depending on the prioritization of measures and alternative objectives.

Some of the key points of the planning strategies of protecting and improving the water environment can be as follows:

- Safeguarding and supporting the expansion of businesses that depend on high quality water environment, such as tourism, fisheries, aquaculture and whisky production;
- Providing water for key industries and hydro power;
- Providing effective dilution for pollutants;
- Protecting drinking water supplies and avoiding increased purification treatment costs;
- Maintaining and expanding opportunities for a wide range of recreational activities;
- Contributing to the social well-being and regeneration of areas where high quality water environment is, or has the potential to be, an important community amenity;
- Protecting and enhancing wildlife, including rare and endangered species;
- Improving our ability to cope with the effects of a changing climate (e.g. More frequent droughts, floods, heat waves etc.).

The baseline scenario will be developed for the three planning cycles. In the 1st planning cycle, those management objectives with the highest priority contributing to meet the WFD´s default environmental objectives will be included. In the next two planning cycles, those management objectives and works after technical assessments (including consideration of technical infeasibility), economic assessment (to consider issues of disproportionate expense) and public consultation analysis will be included to fulfil the alternative objectives.

In text below, two examples on the planning strategy and the management objectives for the SWMIs (hydromorphological alterations and organic pollution) are presented.

EXAMPLE 1

Strategy for **hydromorphological alterations** will be the balanced management of past, ongoing and future structural changes of the riverine environment, so that the aquatic ecosystem of the river basin functions and all native species are present.

Management Objectives for Morphological Alterations:

- 30% (end of 1st cycle) and 50% (end of 2nd cycle) of anthropogenic barriers and habitat deficits do not hinder fish migration and spawning (compared with Reference Situation, 2016);
- Significant floodplains/wetlands in the river basin are protected, conserved and restored ensuring the development of self-sustaining aquatic populations, flood protection and pollution reduction in the river basin to the end of 2nd cycle;
- Future infrastructure projects are conducted in a transparent way using best environmental practices and best available techniques and impact on, or the deterioration of, good status is fully prevented, mitigated or compensated.

Management Objectives for Each Type of Hydrological Alteration:

- Impoundments: Impounded water bodies are designated as heavily modified and therefore a good ecological potential need to be achieved. Due to this fact, the management objective foresees measures at the sub-basin level to improve the hydromorphological situation in order to achieve and ensure this potential;
- Water abstractions: The management objective foresees the discharge of a minimum ecological flow, ensuring that the biological quality elements have a good ecological status or good ecological potential;
- Hydropeaking: Water bodies affected by hydropeaking are designated as heavily modified and a good ecological potential must be achieved. Therefore, the management objective foresees measures at the sub-basin level to improve the situation to achieve and ensure this potential.

EXAMPLE 2

Strategy for **organic pollution** will be no emissions of untreated waste waters into waters of the river basin districts.

Management Objectives for Organic Pollution:

- Phasing out all discharges of untreated waste waters from settlements over 10,000 population equivalents and from all major industrial and agricultural installations (facilities) to the end of the 1st planning cycle.
- Phasing out 30% discharges of untreated waste waters from settlements over 2,000 population equivalents and from all major industrial and agricultural installations (facilities) to the end of the 2nd planning cycle.
- Phasing out all discharges of untreated waste waters from settlements over 2,000 population equivalents including industries, agricultural facilities and small manufactures to the end of 3rd planning cycle.

PART 2 PROGRAMME OF MEASURES

RBMPs will include a set of management measures (along with mechanisms that can be used to carry out the measures) aimed at achieving the environmental objectives (WFD Article 4) during the first planning cycle, unless alternative objectives are proposed in the RBMP. Article 11 of the WFD sets out the type of measures that have to be included in the RBMP. These are “basic measures” and, where necessary, “supplementary measures”. The programme of measures cycle is illustrated in Fig. 2.

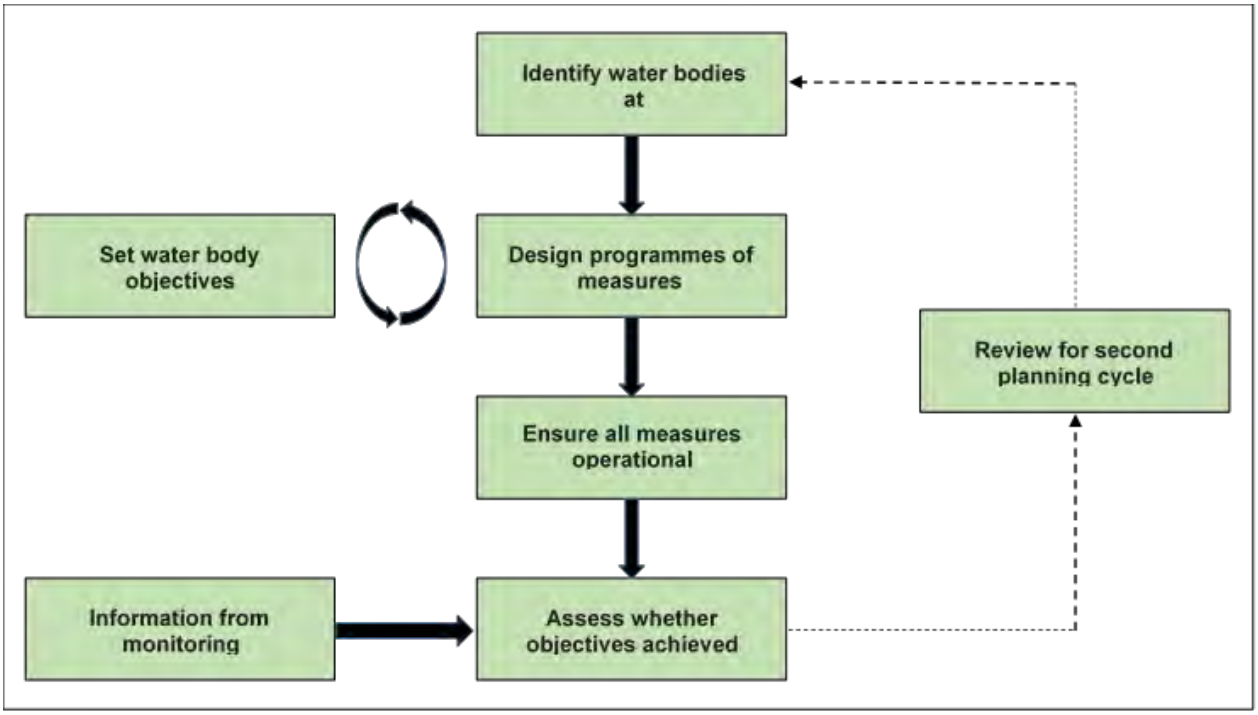

Figure 2. The programme of measures cycle

MEASURES REQUIRED BY WFD

The WFD´s Programmes of Measures for the purpose of achieving the set environmental objectives shall include:

- Basic measures;
- Supplementary measures.

BASIC MEASURES

The basic measures include those required to implement existing Community legislation for the protection of waters. They are summarized in Table 14.

Table 14. Basic measures to address significant issues to achieve WFD´s environmental objectives

Basic measure	Description
The Bathing Water Directive (2006/7/EC)	The purpose of the Bathing Waters Directive is to preserve, protect and improve the quality of the bathing waters and therefore, to protect human health. The Directive set binding standards for bathing waters.
The Habitats Directive (92/43/EEC) and Birds Directive	Community legislation concerning nature conservation comprises two Directives: the “Birds” Directive and the “Habitats” Directive, which are

Basic measure	Description
(79/409/EEC);	concerned with the protection of natural habitats, fauna and flora and the creation of a European network of protected sites. The network includes water dependent species and habitats.
The Drinking Water Directive (98/83/EC);	The Directive has set the objective is to protect the health of the consumer and to make sure the water is wholesome and clean.
The Major Accidents (Seveso) Directive (96/82/EC);	This directive concerns the control of major hazards involving dangerous substances.
The Environmental Impact Assessment Directive (85/337/EEC);	The Directive ensures that environmental consequences of projects are identified and assessed before authorisation is given. Environmental Impact Assessment (EIA) is a procedure for; the systematic examination of the likely significant effects on the environment of a proposed development; ensuring that adequate consideration is given to any such effects; and avoiding, reducing or offsetting any significant adverse effects.
The Sewage Sludge Directive (86/278/EEC);	The Sewage Sludge Directive seeks to encourage the use of sewage sludge in agriculture and to regulate its use in such a way as to prevent harmful effects on soil, vegetation, animals and man. To this end, it prohibits the use of untreated sludge on agricultural land unless it is injected or incorporated into the soil.
The Urban Waste Water Treatment Directive (91/271/EEC);	The Urban Waste Water Treatment Directive deals with the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors.
The Plant Protection Products Directive (91/414/EEC);	The Plant Protection Products Directive concerns the authorisation of plant protection product for use or placing on the market. Before an active substance can be authorised it must conform to rigid controls specified in accordance with EU legislation.
The Nitrates Directive (91/676/EEC);	The Nitrates Directive concerns the protection of waters against pollution caused by nitrates (and also phosphorus) from agricultural sources. Its objective is to reduce water pollution caused or induced by nitrates from agricultural sources and to prevent further such pollution.
The Integrated Pollution Prevention Control Directive (96/61/EC).	The objective of the IPPC Directive is to minimise pollution from various industrial sources throughout the EU.
Other basic measures	
Practical steps and measures taken to apply the principle of recovery of costs for water use and measures to promote efficient and sustainable water use	The WFD requires Member States to devise and adopt a cost recovery system to ensure that water pricing policies act as incentives towards efficient water usage so as to “contribute to the environmental objectives of the directive” and to recover “an adequate contribution” of the costs of water services from the main user groups, including industry, agriculture and households. The “polluter pays principle” must be applied.
Measures taken to protect	The WFD requires drinking water resources to be protected. Article 7 requires the identification of all ground water and surface water bodies

Basic measure	Description
drinking water sources	that are used, or may be used in the future, as a source of drinking water for 50 persons or more, or where the rate of abstraction is more than 10m³ per day.
Controls on abstraction and impoundment with an impact on the status of water	The WFD requires controls over the abstraction of fresh surface water and ground water, and impoundment of fresh surface water, including a register or registers of water abstractions and a requirement of prior authorisation for abstraction and impoundment.
Controls on point source and diffuse source discharges with an impact on the status of water	The WFD requires prior regulation for point source discharges liable to cause pollution. Controls may include prohibition on the entry of pollutants into water, prior authorisation, or registration based on general binding rules and laying down emission controls for the pollutants.
Authorisations of direct discharges to ground water	Measures to protect ground water are required by the WFD. Article 11(3)(j) prohibits the direct discharge of pollutants into ground water, but it permits prior authorization of a number of specific activities related to the reinjection of waters that have been extracted for particular purposes such as dewatering for mining or construction, exploration for oils and injection for storage of gas.
Measures to deal with priority substances	Measures are required by the Directive to eliminate pollution of surface waters by 45 priority substances and other pollutants. Measures must aim to progressively reduce pollution from priority substances and cease or phase out emissions, discharges and losses of priority hazardous substances.
Controls on physical modifications to surface waters with an impact on the status of water	The WFD requires that the physical conditions of surface water bodies are consistent with the achievement of the required ecological status or good ecological potential for bodies of water designated as artificial or heavily modified.
Controls on other activities with an impact on the status of water	The WFD also requires measures to be put in place to deal with any other significant adverse impacts on the status of water identified by risk assessment in the characterisation report (under Article 5 and Annex II). Controls for this purpose may take the form of a requirement for prior authorisation or registration based on general binding rules where such a requirement is not otherwise provided for under Community legislation. Invasive aquatic alien species are non-native plants or animals that successfully establish themselves in aquatic and fringing habitats and damage the natural flora and fauna.
Measures taken to prevent or reduce the impact of accidental pollution incidents	The WFD requires measures to prevent significant losses of pollutants from technical installations (e.g. industrial sites), and to prevent and/or to reduce the impact of accidental pollution incidents, for example, as a result of floods, including through systems to detect or give warning of such events including, in the case of accidents which could not reasonably have been foreseen, all appropriate measures to reduce the risk to aquatic ecosystems (the Seveso II Directive (96/82/EC and 2003/105/EC)).

Supplementary Measures

In addition to the above basic measures, the WFD requires the implementation of supplementary measures where necessary to achieve environmental objectives.

The WFD is not prescriptive on the type of supplementary measures that are to be used. Examples are provided such as: administrative arrangements, economic or fiscal instruments, negotiated environmental agreements, emission controls, codes of good practice, restoration of wetlands and rehabilitation projects.

The identification of supplementary measures should be transparent, proportionate and pragmatic. The most cost-effective combination of supplementary measures to achieve this goal should be identified in each case.

CATEGORISATION OF MEASURES

During the Programmes of Measures development, the answers to the following questions should be searched:

- Which sectors may be contributing to particular water environment problems and pressures?
- What measures we could use to tackle these?
- What mechanisms exist to bring about this action?
- Which existing processes may help to implement these mechanisms?
- What to consider in selecting mechanisms?
- How to assess and compare the effectiveness of measures?

Categories of Measures

The term “measures” in the WFD encompasses both on the ground actions and the policy and legislative instruments to achieve these actions. There is a long history of protecting and improving the water environment and there are many existing measures in place that are continuing to help improve the water environment. There are also many measures that are planned for reasons other than the WFD implementation. These measures fall under the “umbrella” of the WFD and it is needed to understand how they can help to meet the WFD's environmental objectives.

To help simplify the river basin management planning process, the measures will be categorized in four broad groups (see Table 15). This ensures that there is a common way of distinguishing between those measures that already exist or are foreseen by the stakeholders, and those additional measures that are going to be proposed in order to meet WFD objectives.

Detailed analysis will be necessary to know how the EU Directives (presented in Tab. 14 as basic measures) were already implemented in Georgia. The outcomes of such analysis will be addressed as measures.

Table 15. Categories of measures

MC1	Measures already happening (not driven by WFD): Actions already agreed and funded, which may help to meet the objectives of the WFD. Into this group the National environmental programs, restoration programs and local initiatives will be included.
MC2	New measures that will happen (not driven by WFD): Actions that will happen irrespective of the WFD (usually under other Directives) but which may help to meet the objectives of the WFD. This group mainly covers actions for Directives on Water Used for Human Consumption, Freshwater Fish, Urban Waste Water Treatment, Habitats, Nitrates, Bathing Waters and Shellfish Waters.
MC3	New measures that will happen – national (driven by WFD): Measures for the WFD that only require national decisions. For example, controls on chemicals, fertilizers and the formulation of other products (such as detergents), as well as

	national general binding rules and codes of practice that apply to specific activities. Measures led nationally that require targeting at the water body or catchment scale. For example, calculations of permit conditions, targeted use of uniform emission limits, targeted use of diffuse pollution measures.
MC4	New measures that will happen – local, RBD agreed (driven by WFD): New measures specifically for objectives of the WFD that require no national decisions. For example, a local partnership to create a new wetland, new rivers trusts initiatives or a local awareness/education campaign.

The measures will also differ in terms of scale. Measures can be applied at a variety of levels from a national level down to a single water body. These measures will be delivered by a wide range of organisations and initiatives in order to meet the WFD's objectives to achieve good status and to prevent deterioration in the status of water bodies. In this context, public consultations (Significant Water Management Issues) will bring more insight on the responsibilities for implementation of the measures on river basin and local levels.

Mechanisms for Measures

For carrying out the measures, proper mechanisms will be proposed. Some of them are presented in Table 16.

Table 16. Examples of mechanisms for measures

Hard Regulations												**Softer regulations**
←												→
Regulations (legislative)					**Economics (financial)**					**Advice**		
Prohibitions/Bans	General binding rules	Licenses/permits	Products authorization	Development control	Environmental management schemes	Subsidies/incentives	Spatial planning	Assurance/eco-labelling	Cooperative agreements	Memorandum of understanding	Codes of practice	Awareness raising

The Programme of Measures should be a combination of mechanisms originating from policies to management ground actions aimed at preventing deterioration of water quality and achieving at least good water status at the lowest cost. In general, it is advisable to begin by categorizing available, measurable, and constructible solutions according to general type and then by spatial qualities. In this context, prioritization of the available measures should be done by examining of the results from the characterisations of the three River Basins and develop criteria for prioritising efforts for WFD´s objectives implementation. Prioritisation criteria may include considerations of:

- Severity of problems in the water environment;
- Spatial extent;
- Pressures;
- Economic considerations;
- Political issues.

SELECTION OF MEASURES

The process of selecting measures to address the significant water management issues of the water bodies in may be subdivided into the following steps:

Step one: Current or planned **basic measures** would be identified and presented in the form as for example proposed in Table 17 as well as assessment on how far these go to meeting WFD´s environmental objectives.

Step two: If the implementation of basic measure (after the first step) do not ensure that these objectives are achieved, potential additional **supplementary measures** should be identified.

Step three: Cost-effective options for the supplementary measures (or combination of measures) will be identified in order to bring together the best tools to address an issue. The intention is to achieve maximum environmental benefits with the minimum financial costs and administrative burden. **This step will directly benefit from the economic analysis.**

Step four: The supplementary measures will be evaluated to see whether they are currently technically feasible and not disproportionately costly (by comparing the costs of the measures with the benefits and other impacts that implementing the measure will bring).

Step five: The alternative objectives will be identified and final water body objectives will be proposed. The choice of which alternative objective is set (**extended deadline or a less stringent objective**) will depend on whether the particular conditions in Article 4.4 and/or 4.5 of the WFD are met. On this matter, **an implementation schedule for the measures** should be proposed based on the stakeholders´ available financial resources and a prioritisation of the supplementary measures. This timetable will help to propose the deadlines for meeting the objectives during the river basin management plan cycles.

Table 17 Example of headings and descriptions of measures implementation

Pressures	Description of measures			Lead organisation and partners
	What will happen	Where it will happen	Date	
The pressure being managed	The action that will be taken	The location or geographical extent of the measure	This will be date when measure will be put in place	The organisation responsible for delivering measure and other organisations

Both basic and supplementary measures will be delivered by a wide range of organisations and institutions across Georgia (national level measures delivered by central institutions) and the River Basins Authorities in order to meet the WFD's objectives to achieve good status and to prevent deterioration in the status of water bodies. In text below, some of the measures are presented for expected significant water management issues in the river basin districts in Georgia.

BASIC MEASURES

This chapter will describe some basic measures that might be included in the Programme of Measures and that contribute to deal with the Significant Water Management Issues in the River Basin Districts.

Point Pollution Sources

Several types of basic measures have been defined in order to deal with this SWMI. These measures are briefly described below.

Control and Governance Measures

The control and governance measures related to urban and industrial waste water discharges have a scope of action in the whole river basin district, that is to say to all surface water bodies in the basin.

- Water discharges inventory, including monitoring and control: In order to know the pressures derived from the discharges, it is necessary to have an updated record (registry of new authorizations of waste water discharges or revision of existing ones). This measure is important to have a comprehensive overview of water discharges throughout the basin.
- Monitoring of water quality in surface water bodies: An adequate control is necessary in order to ensure the protection of surface water and the follow-up water quality. Monitoring shall include all water bodies with significant pressures. General parameters, specific pollutants and priority substances must be included.

Measures Deemed Specially for Urban Waste Water Discharges

It is expected that the EU Urban Waste Water Treatment Directive (91/271/EEC) will be transposed and implemented in the following parts:

- The analysis of the current state of the public sewerage systems in Georgia is elaborated;
- The sensitive areas are designated and agglomerations in all three categories delineated;
- Technical and investment program for the urban waste water collection and treatment developed.

These measures will take into account the outcome from the implementation of the EU UWWT Directive. That means to what extent waste water should be treated based on the sensitive areas and category of agglomerations **(appropriate treatment, secondary treatment and/or N and P removal)**. Specifically, the following measure can be expected to take with the regards of UWWTPs:

- Construction of new UWWTPs;
- Improvement of treatment in existing UWWTPs;
- Construction of waste water infrastructure (sewerage);
- Maintenance and repair of existing UWWTPs when is deemed necessary according to the competent authority;
- Revision of existing UWWTPs when is deemed necessary according to the competent authority.

Note: The technical and investment program will involve both the base investments into the water infrastructure and maintenance and operational costs. those economic data will be used ***for costing of the measures.***

Municipalities and their water and sewerage administrations, MEPA are responsible authorities on construction, improvement and revision of the UWWTPs.

Measures Deemed Specially for Industrial Waste Water Discharges

Basic measures included regarding industrial discharges are enclosed in the following typologies:

- Reconstruction of industrial effluent treatment plants.
- Construction of new wastewater treatment plants if required to adequate industrial discharges to the standards specified by the applicable legislation.

Pressures are distinguished as:

- Biodegradable wastewater,
- Wastewater from activities covered by the EU Industrial Emission Directive 2010/75/EU (IED),
- Non-biodegradable wastewater and wastewater from non-IED activities.

Construction of the WWTPs is under responsibility of the industries themselves. Measures for industries would be defined per type of pressure and per water bodies (or groups of water bodies).

Pollution Discharges/Leachates from Municipal Landfills to both Surface and Ground Water

Several types of basic measures have been defined in order to deal with this SWMI. These measures are briefly described below.

Control and Governance Measures

The control and governance measures regarding landfills discharges, whose scope of action is the whole basin.

- Water discharges inventory, including monitoring and control: In order to know the pressures derived from the discharges it is necessary to have an updated record (Registry as in case WWTPs). This measure is important to have a comprehensive overview of water discharges throughout the basin.
- Monitoring of water quality in surface water bodies: An adequate control is necessary in order to ensure the protection of surface water and the follow-up water quality. Monitoring shall include all water bodies with significant pressures. General parameters, specific pollutants and priority substances must be included.

Measures Deemed Specifically for Municipal Landfills Discharges

This type of measure will be based on the Solid Waste Management Regulations.

- Measures for the removal of unsanitary landfills that also comprise the construction of new transfer stations connected with sanitary landfills.
- Removal of unsanitary landfills and construction, operation, monitoring and control of the new sanitary landfills.

Municipalities will be responsible for the construction of new sanitary landfills and closure and sealing of the unsanitary landfills. MEPA is presently responsible for the monitoring and the control of the existing ones. Measures defined above are at district level, and they would take into consideration the administrative framework of each competent district (regional) authority (depending on the competencies in Georgia).

Diffuse Pollution from Agriculture to both Surface water and Ground water

In this part, concern will be paid to basic measures to address the diffuse sources of pollution from agricultural activities.

Control and Governance Measures

The control and governance measures will be defined which may have an effect on diffuse pollution from agriculture and livestock in the basin.

- Monitoring of water quality in surface water bodies: An adequate control will be necessary in order to ensure the protection of surface water and the follow-up water quality. Monitoring shall include all water bodies with significant pressures. General parameters, specific pollutants and priority substances must be included. This measure scope of action is the whole basin.
- Design or improvement of the ground water level monitoring network and the ground water qualitative surveillance network: The scope of this measure is the entire basin (covering all ground water bodies. A quantitative (ground water level) monitoring network will be required to assist in characterization to determine the quantitative status of ground water bodies, to support the chemical status assessment and trend analysis, and to support the design and evaluation of the Programme of Measures. The monitoring design should be based on a conceptual understanding of the ground water system and the pressures.
- Design or improvement of ground water qualitative operational networks: Operational monitoring is required only in bodies “at risk" of failing to meet WFD objectives. It is focused on assessing the identified risks to the achievement of the WFD’s objectives. The scope of this measure would be those ground water bodies that do not meet the WFD objectives in the river basin district and it is focused in monitoring and control of ground water pollutants.

Measures Deemed Specifically for Diffuse Pollution from Agriculture and Livestock

The measures will be also defined for the diffuse pollution from agriculture and livestock.

- Codes of Good Agricultural Practices for Protection of Waters against Agricultural Nitrate Pollution.
  - The main purpose of the Good Agricultural Practices is the reduction in the use of fertilizers in agriculture. This task has already been undertaken by MEPA.
  - This measure applies to all water bodies with significant pressures due to livestock or irrigation.
- Codes of Good Agricultural Practices in river basin for the reduction of nitrates. Training activities.
  - This measure consists of the required training and publishing activities that shall be undertaken for agricultural enterprises. Education and awareness campaigns for farmers.
  - This measure applies to all water bodies with significant pressures due to irrigation.
- Codes of Good Practices for Livestock in river basin. Training activities.
  - This measure consists of the required training and publishing activities that shall be undertaken for livestock enterprises. Education and awareness campaigns for farmers.
  - This measure applies to all water bodies with significant pressures due to livestock.
- Actions plans for nitrate vulnerable zones.

  This measure consist in the preparation of actions plans for nitrate vulnerable zones in river basin. MEPA is responsible for undertaking these plans.

This measure applies to all water bodies defined as nitrate vulnerable zones and are in line with the EU-Nitrate Directive (91/676/EEC).

Abstraction and other Flow Pressures for Surface Waters and Ground waters

The natural flows of most surface water bodies are affected by abstractions, discharges distribution and in some cases reservoirs and river basin transfers. As a guide for the management of the impacts of abstractions on surface and ground water bodies, we shall use the environmental flow indicators (flow values and water levels). Nowadays, environmental impacts of abstractions are controlled through the abstraction licences.

- *Measures to regulate new proposals for abstractions and impoundments to prevent deterioration of water body status.*
  - The system of abstraction licensing control will be reviewed and used to ensure that any new abstraction, water resources impoundment or flow regulation proposals do not result in deterioration of ecological status
- *Measures to promote efficient and sustainable water use.*
  - To alleviate abstraction pressures on existing resources and the water environment;
  - To conserve water uses and reduce leakages the three sectors (municipal, industrial and agricultural).
- *Measures to restore existing abstraction to sustainable levels.*
  - *A*ny reduction in abstraction rates may have to be matched by either the development of alternative supplies or more efficient water use.

Measures to Hydromorphological Pressures

In this part, measures will cover all significant morphological modifications (removal of historical -hard-engineering structures; bank reprofiling; modification of existing structures; installation of fish pass-ways, land management measures, habitat creation measures, navigation measures, development and education measures, etc.).

Measures in this group will be investigated regarding disproportionate cost in the first cycle of river basin management planning.

MEASURES ON SEDIMENTS

Measures helping to reduce the risk of problems created by sediments on national level, regional authorities (Code of Practice) and local projects are expected to be addressed.

MEASURES TO IMPACTS FROM INVASIVE ALIEN SPECIES

Invasive non-native (or "alien") species are not specifically mentioned in the WFD. However, many invasive aquatic and riparian invasive species can have significant social and economic consequences due to this fact measures to mitigate the impacts should be identified and included in the programme of measures. They can be as follows:

- Development of a programme of work to tackle existing aquatic alien species problems;
- Prevention the further spread of invasive alien species already present;
- Prevention of new introductions of invasive alien species.

THE COST EFFECTIVENESS ANALYSIS

Basic measures are implemented independently *of the status of the water body. In this case alternative group of measures are not established, consequently the cost-effectiveness analysis does not aim to determine which group of measures are better in order to attain the environmental objectives at the lowest cost.*

The cost-effectiveness is a tool designed at helping in the decision-making process **for selecting the supplementary measures** that make it technically possible to attain the environmental objectives at the lowest cost. Consequently, the cost-effectiveness analysis applies for those supplementary measures that present alternative solutions to address a certain issue. It is obvious that two alternative programs or groups of measures are designed.

Such analysis will result to a preliminary Programme of Measures that must be subjected to public consultation and detailed analysis in order to set priorities within principles of rationality and wisdom. This process will define action priorities and justifies exemptions regarding deadlines and levels as compared to the good status objective, forming the final Programme of Measures.

The following Figure 3 represents the process of designing a Programme of Measures. It also represents the review process of the effectiveness of potential measures to reach the objectives, an iterative process that leads to the Programme of Measures to be subject to the public consultation and possible exemptions.

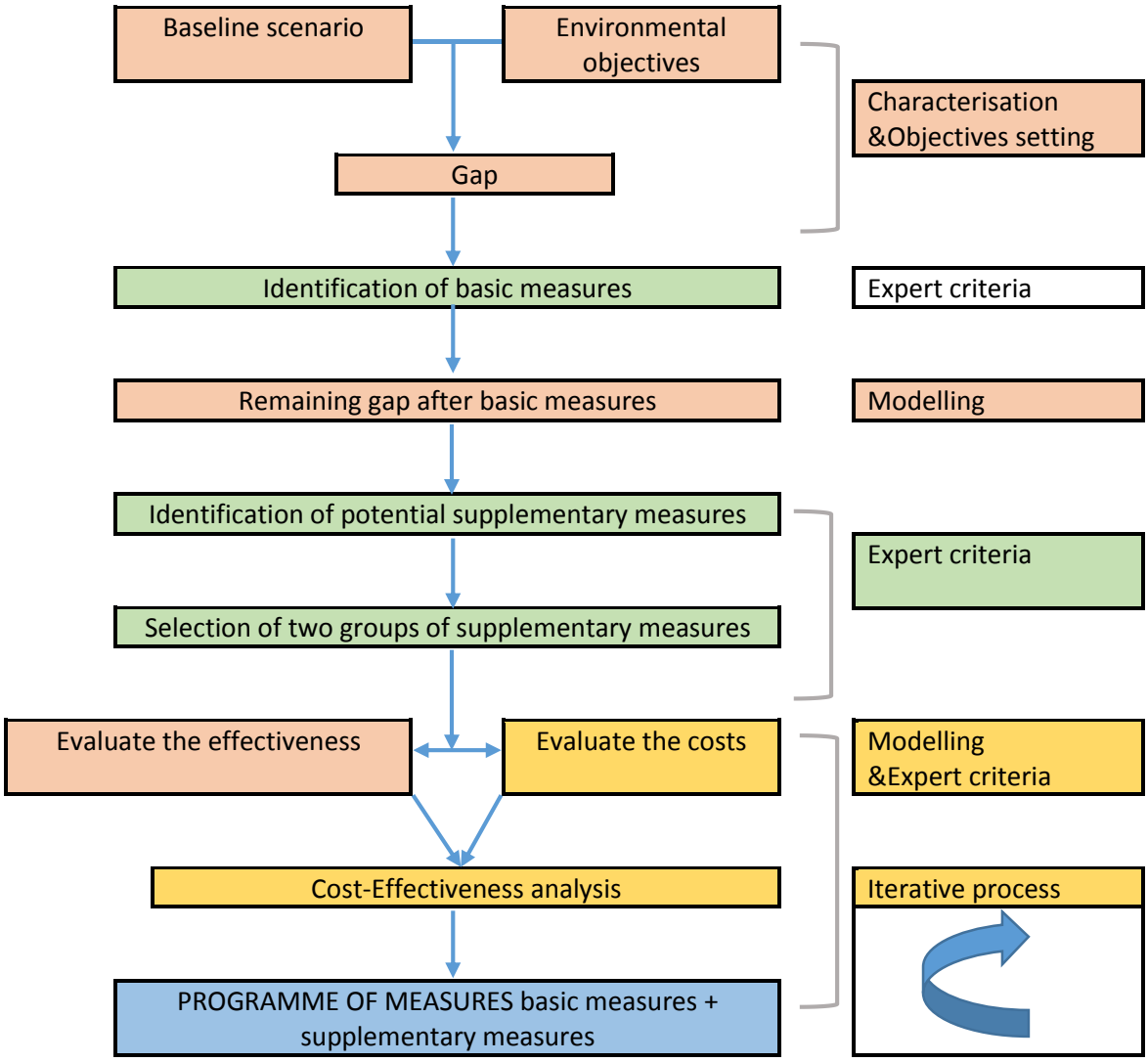

Figure 3. Cost effectiveness analysis structure

The different measures would be assessed in terms of both their cost and effectiveness in reducing pressures and impacts over the water body.

Costs can be represented in annual terms by using a time horizon (lifetime) and a discount rate. By this way, a comparable indicator (annual equivalent cost) for all type of measures can be obtained.

To assess the effectiveness, the reduction of concentration of the pollution parameters above the environmental quality standards (EQS) is evaluated. As an example, Table 18 below shows the range of parameters used for the assessment when above the environmental quality standard.

Table 18 Parameters used for effectiveness assessment

Type	Parameter	Unit	Test value
General physico-chemical and chemical parameters	pH		Annual average
	Conductivity	µS/cm	Annual average
	Oxygen concentration	mg/l	Annual average
	Biological oxygen demand	mg/l	Annual average
	Chemical oxygen demand	mg/l	Annual average
	Ammonium	mg NH4+/l	Annual average
	Nitrates	mg NO3+/l	Annual average

	Total nitrogen	mg N/l	Annual average
	Orto-Phosphates	mg o-PO4/l	Annual average
	Total phosphorus	mg P/l	Annual average
Specific pollutants	Non conformity parameters	µg/l	Annual average
Priority substances	Non conformity parameters	µg/l	Annual average
Microbiological	E. Coli	EMS/100 ml	Annual average
Biological	EQS		Annual average

As commonly water bodies are dependent from each other and so improvements in one of them leads to improvements in others, the only way to undertake the effectiveness analysis for the implementation of subsequent measures is by **using simulation models**. Models will predict and allow to understand how a combination of measures will reach the environmental objectives.

The alternative Programme of Measures with the lowest cost-effectiveness ratios for the majority of pollution parameters will be subsequently selected as the most cost-effective one.

This approach may consist of three scenarios that can be modelled for the river basin districts. However, before the implementation of basic measures the impact in each water body of the River Basin District will be assessed. In this stage, **Impact Values of pollutants** (higher than EQS) will be calculated and used as a baseline for simulation of the three scenarios below:

- **Basic Measures.** This scenario will represent the situation with the implementation of the basic measures defined in the Programme of Measures.

Most of the water bodies will show no impact after the implementation of the basic measures. However, for those showing impact (the impact values of pollutants are higher than EQS) the alternative scenario with implementation of supplement measures will be simulated by model.

- **Alternative 1 scenario.** Scenario will simulate, in addition to the basic measures, the implementation of a group of supplementary measures mostly addressed to improve the treatment in urban and industrial waste water discharges.
- **Alternative 2 scenario.** Scenario will simulate, in addition to the basic measures, the implementation of a group of supplementary measures that consider among others, the modernization of irrigation systems, riparian zone restoration measures as well as re-use of urban waste waters.

In some water bodies of the river basins, where "Floodplain forest zone restoration" measures are defined as supplementary measures because of the bad status of the floodplain forest, these measures may have a positive effect on the reduction of polluting parameters. Therefore, there will be considered in the cost-effectiveness analysis.
On the other hand, based on the model results, some water bodies reach the environmental objectives when considering the measures for the restoration of floodplain forest. Then, no additional measures need to be implemented in these water bodies and no cost-effectiveness analysis will be performed for these water bodies.

Efficiency of the supplementary measures, by water body, will be as result from the difference between the concentrations of the several pollution parameters in the scenario Basic Measures and the Alternative scenarios.
Efficiency is defined as:

$$Ef_{WB,parameter} = [Parameter_{WB,basic}] - [Parameter_{WB,alternative\ i}]/[Parameter_{WB,basic}]$$

The cost effectiveness index is as calculated as follows:

$$CEI_{WBalternative\ i} = ([\Pi^{n}_{parameter=1} * Ef_{WB,parameter}]/\text{Annual Equivalent Cost of the by alternative i by WB})*1{,}000{,}000$$

Where:

n = number of parameters with positive Impact value (higher than EQS) in the water body,

1,000,000 is a scale factor.

Important note: The number of alternative scenarios will depend on the fact, if there are needed other measures to reach the environmental objectives after basic measures are implemented.

CONCLUDING REMARKS

The development of the menu of possible measures should be consistent with the “polluter-pays” and “user-pays” principles embodied in the WFD but should not limit the identification of any measure that can possibly help achieve good water status. It is also expected that some measures might appear during the implementation of the RBMPs.

The end point will be the **Overall Programme of Measures** to mitigate the pressures to meet the WFD´s environmental objective.

FURTHER READINGS AND REFERENCES

EU Directive 2000/60/EC establishing a framework for Community action in the field of water policy (Water Framework Directive).

EU CIS Guidance Document No. 31. "Ecological flows in the implementation of the Water Framework Directive".

EU CIS Guidance document No. 24. "River Basin Management in a Changing Climate".

EU CIS Guidance document No. 11. "Planning process".

EU CIS Guidance document No. 8. "Public Participation in relation to the Water Framework Directive".

EU CIS Guidance document No. 1 "Economics and the environment The implementation challenge of the Water Framework Directive".

LIST OF FIGURES AND TABLES

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