PART III

NON-TECHNICAL SUMMARY

NON TECHNICAL SUMMARY

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INTRODUCTION

The city of Bucharest, where around 2 millions inhabitants are living, has a combined system to collect domestic, industrial and storm water. The discharge of the Bucharest untreated wastewater was considered the main source of water quality degradation in Dambovita and Arges Rivers and also as one of the major sources of pollution of the Danube River.

To remediate this situation, an ISPA Measure "Bucharest Wastewater Treatment Plant Rehabilitation Stage 1" was promoted. Within the frame of this project, the stage 1 of the Glina WWTP development and the Feasibility Study for the development stage 2 of the same plant was included, as well as the elaboration of the Cohesion Fund Application. The Cohesion Fund Application will cover also the works for rehabilitation of the Bucharest sewerage system.

The project is correlated with the Framework Scheme for Arrangement of the Dambovita Hydrographical Basin and do not affect any existing or future objectives in the area.

The Beneficiary of the Project is the Municipality of Bucharest (MoB).

The Consultant, preparing the Feasibility Study (FS), the Environmental Impact Assessment (EIA) and finally the Cohesion Fund Application (CFA) is the Joint Venture Sweco International AB, Halcrow Group Ltd and Sogreah Consultants (SHS JV). The technical definition of infiltration reduction measures has been elaborated by Apa Nova Bucharest.

The elaborator of Environmental Impact Assessment (EIA) is the former SC Enviroassist srl, (actual SC Artelia Romania srl), registered within the National Register of environmental studies elaborators at the position no.198. The registration Certificate is valid till 13.04.2015.

The Environmental Impact Assessment study (EIA) refers to the whole Glina WWTP - Stage 2 project, which means:

- Glina WWTP treatment line no 2 including sludge incinerator
- Works for the Bucharest sewerage system rehabilitation.

Practically, the EIA report is composed of two parts:

- Part I: EIA of Glina WWTP stage 2 development including sludge incineration
- Part II: EIA of the works the Bucharest sewerage system rehabilitation.

The two parts of the EIA study are strongly correlated because the works for rehabilitation of the wastewater collection network have been proposed not only to improve the functioning and durability of the sewerage system but primary in order to optimize the costs for investment and operation of the whole Glina WWTP, aiming to limit the entrance of groundwater into components of the sewerage system. By reducing the flow and dilution of wastewater sent to the Glina WWTP it results a reduction of the investment cost of plant Phase 2 and of the functioning costs of the whole plant.

PART I

SUMMARY of EIA of the Glina WWTP stage 2 including the sludge incineration

DESCRIPTION OF THE PROJECT

Location of Project

Stage 2 of the Glina WWTP and the sludge incinerator will be constructed in direct connection to the existing WWTP phase 1, which is now in function. Glina WWTP is situated south-east of the Bucharest, on the right bank of Dambovita River, inside an area of the Glina commune designated within the General Urban Plan (PUG) as industrial zone and has the following vicinities:

- north - the Dambovita River canal and the formerly proposed Bucharest Inland Harbour
- east - pastures and other agricultural land
- south - the Glina Village residential area and the landfill "Ochiul Boului" to south-west
- west - a wholesale store for consumer goods, the pilot wastewater treatment plant, the PROTAN factory, while to **north-west** - the Thermo-Electric Power Plant.

Of the total surface of 114 ha, for the Glina WWTP stage 2 a surface of around 65 ha was reserved. The surface that will be occupied by constructions or installations is around 8.5 ha while the remaining unoccupied surface will be arranged as green land.

History of the project

The design of Glina WWTP was developed based on pilot plant studies carried out in the years 1970's. The initial design envisaged a WWTP next to Glina village, composed of three treatment lines for a 7.5 m^3/s flow each, containing primary settlement and conventional activated sludge basins. The construction works started in 1985, but was interrupted many times after 1990. Finally, the WWTP Stage 1 was put into operation in the first part of the year 2011.

The actual Stage 1 of the Glina WWTP was designed to treat a 10 m^3/s flow by mechanical and biological processes, based on parameters established in the year 2005. But because the influent pollutant concentration and the conditions imposed for the discharged effluent have been changed, it was agreed that the treatment capacity of the stage 1 to be reduced and a supplementary treatment for Phosphorus removal to be introduced. As a result, the Glina WWTP Stage 1 operational parameters have been changed as follows:

- 10 m^3/s to be treat in the primary mechanical phase, but only 5 m^3/s - in the secondary biological phase, including Phosphorus removal;
- the remaining 5 m^3/s mechanically treated to be diverted through the emergency by-pass to the river;
- the hydraulic capacity of all biological process units to remain 10 m^3/s.

In March 2011, the Contractor started to treat the wastewater in both the mechanical and biological stage. The performances obtained during June 2011 have shown compliance with the discharge conditions, indicating that the biological process works as intended by the design.

Design parameters for Glina WWTP stage 2

The design flow for the Glina stage 2 is the *maximum hourly dry weather flow* - MHDWF (maximum hourly flow during the day with the maximum daily dry weather flow from a certain period of time). This flow includes the peak day factor and the peak hour factor.

The design flow, established to be 11.9 m3/s, is the result of choosing the intermediate option for infiltration reduction within the sewerage system. The considered 3.43 m^3/s infiltration will be reduced by achieving 6 of the actions proposed for the sewerage system rehabilitation. The table below gives brief information about current (2010) and expected future load and concentrations (2040) in sewage coming to Glina WWTP.

Loads and concentrations in wastewater coming to Glina WWTP (influent)

Indicators	Units	2010	2040
Total organic load (BOD_5)	kg/d	80,750	100,000
Organic load - domestic customers	%	96	98
Organic load- from industry	%	2	1
Organic load – commerce, public services	%	2	1
BOD_5, influent	mg/l	80	140
Tot-N, influent	mg/l	24.3	40.6
Tot-P, influent	mg/l	1,08	6.3
SS, influent	mg/l	165	280
COD, influent	mg/l	253	420

The wastewater treatment process will comprise:

- the primary mechanical stage (coarse and fine screens, grit chambers, grease removal and primary sedimentation) designed to treat up to 2 times the MHDWF
- the secondary biological stage, based on activated return sludge combined with chemical precipitation for Phosphorus removal.

The component installations of the water line 2 are the followings:

Mechanical stage:
- 1 septic tank
- 4 Coarse screens
- 2 Inlet pumps
- 2 Fine screens
- 3 Grit chambers
- 9 Grease removal tanks
- 4 Primary sedimentation tanks

Biological stage:
- 12 Aeration tanks (8 AS +4 ARS)
- 48 Secondary sedimentation tanks.

The design of stage 2 is oriented to solve part of deficiencies identified after putting in function the Stage 1, due to lack of needed equipment, respectively:

- Grease removal
- Flow measurement after mechanical stage
- Odour minimization measures.

The other deficiencies are or will be solved by construction remediation.

The treated effluent should comply with the Romanian standard NTPA 001 – 011, which transposes the Urban Wastewater Treatment Directive 91/271/EEC, meaning:

BOD5	25 mg/l,
COD	125 mg/l,
SS	35 mg/l,
total P	1 mg/l,
total N	10 mg/l).

The plant efficiency for water pollutants removal shall be between 70% and 90 %.

Sludge treatment will be made by thickening, anaerobic digestion, dewatering by centrifugation and finally disposed of by incineration. The new sludge line components are:

5+2 Belt thickening presses for primary sludge
2 storage tanks for surplus activated sludge (SAS buffer tanks)
5 Gravity belt thickeners of surplus biological sludge
2 Raw thickened sludge mixing tank (mixing buffer tank);
1 Digested sludge storage tank (emergency storage tanks);
5+1 Centrifuges for digested sludge dewatering;
Sludge incineration plant

The amount of sludge sent to anaerobic digestion will be 3,291 m^3/d. The digested sludge will be dewatered, from this process resulting an amount of 481 m^3/d dewatered sludge with a 67% water content (33% dry solids).

The dewatered sludge will be disposed of by incineration, process of which an ash amount of 79.6 t/day will result.

The selection of incineration as sludge disposal solution was based on the following arguments:

1). The **use as fertiliser,** meaning a recycling of N, P and organic matters content by application on agricultural lands, on derelict areas for land reclamation, or on forestry land and soil production by composting or landfill coverage is not possible for many reasons but mainly because the concentration of heavy metals in Glina sludge is to high for any such uses (EC Directive 86/278/EEC) and the improvement of the sludge quality would be possible by significant changes in the economic pattern of the area and only in long time.

2) **Landfilling** cannot be considered sustainable in the future firstly because of the limitations imposed by the Directive 1991/31 EC related to disposal of organic waste.

Secondly, as in case of land application sludge, landfilling needs measures for limiting environmental impact on groundwater and the costs of a sound handling and transport of around 481 m^3/day or 163,700 m^3/year (water content of 67%) will be very high.

Because both, the land application and landfilling have limitations and high uncertainties these options are not only undesirable, but even inapplicable in case of Glina plant.

3) The incineration quality of being able to substantially reduce the amount of residues to be disposed is of extreme importance for a very large plant as Glina WWTP. This quality outweighs all disadvantages when compared with other options.

Incineration was from the beginning more or less established as the final sludge handling option for Glina WWTP, justified by the following aspects specific to other options:

- Negative influences on the environment (spreading toxics, bad odour, noise)
- Health reasons for the citizens in Bucharest and surrounding municipalities.

The **incineration process** configuration was chosen taking into account the best available techniques (BAT) for sewage sludge incineration, which is considered to be:

- *fluidized bed technology* - because of the higher combustion efficiency and lower flue-gas volumes resulting from such system;
- *drying of the sewage sludge by using heat recovered from inside the incinerator* to the extent that additional combustion support fuel is not required for the normal operation of the installation (normal operation excludes start-up, shut-down and the occasional use of support fuels for maintaining combustion temperatures).

Comparison between BAT provisions and Glina incinerator process

BAT provisions for sludge incineration	**Glina incinerator process configuration**
Fluidized bed technology	Combustion into a fluidized bed, having high burning efficiency and generating lower flue-gas volumes
Drying of the sludge by using heat recovered from inside the incinerator	Drying of sludge by using the heat recovered from the incineration process, in order to avoid the need of additional fuels for normal operation
Occasional use of support fuels for maintaining combustion temperatures	Auxiliary burners for start–up and shut-down to maintain the needed combustion temperature
Burning temperature - 850ºC.	Burning temperature - 850ºC.
Retention time in the combustion chamber of minimum 2 seconds	Minimum 2 seconds retention time in the combustion chamber in the presence of at least 6% after the final injection of combustion air.

The sewage sludge with a moisture content of 67% will be fed into the fluidized bed furnace where it is burned at a temperature of 850ºC.

The flue gases leaving the furnace will pass over heating surfaces in which steam for the dryer is generated and the combustion air for the fluidized bed is heated. The flue gases leaving the boiler are then cleaned into a flue gas cleaning system, comprising an **electrostatic precipitator (ESP**), where heavy metals will be removed and a **bag filter**, where **activated carbon and sodium bicarbonate ($NaHCO_3$)** is injected, in order to retain mercury and organic compounds, before the flue gas is exhausted to atmosphere through the stack.

Compared to wet systems, the proposed dry removal system is less expensive, both in terms of capital cost as well as in operating cost. The dry system is also less complex since **no wastewater handling is required**.

It was assumed that 10% of the solids discharged from the system are removed as bottom ash from the furnace, whilst 68% and respectively 22% are removed in the ESP (electrostatic precipitator) and bag filter.

METHODOLOGY FOR DETERMINING ENVIRONMENTAL IMPACTS

The main environmental impacts considering the project nature could happen on water and air.

The methodology used for evaluation of the possible impacts determined by the Glina plant on the **surface water** has considered the water body, respectively the effects on the ecological potential and chemical status of the heavily modified water body downstream Glina in comparison to the environmental objectives.

The methodology used for evaluating the impact on the **air quality** was based on modeling the dispersion of the pollutants resulted from sludge incineration, taking into account the imposed air quality in Glina area.

In case of the other components of the environment the assessment was based on the effects of the measures proposed for abatement of impacts possibly related to the plant activity.

IMPACT ASSESSMENT

Impact on surface water

The water body **Dambovita upstream APA NOVA (GLINA) discharge – Confluence with ARGES River,** which is an heavily modified water body, is characterized by:

- *a moderate ecological potential*
- *other than a good chemical status.*

Reaching the environmental objectives for this water body, which are *a good ecological potential and a good chemical status*, means improvement of the actual situation that is possible only in case of finalizing the Glina WWTP. The good functioning of this plant will reduce the

water pollutants with around 118,200 kg/d as BOD; 252,000 t/d as suspended solids, 31,500 kg/d as total Nitrogen and 5,450 kg/d as total Phosphorus.

Finalising the construction of Glina WWTP will eliminate the main cause of the actual precarious situation of this water body and will lead to a substantial improvement of Dambovita water quality downstream Bucharest and, subsequently, an improvement of water quality in Arges River and reduction of pollutants brought into the Danube River.

The improvement of water quality in Dambovita River will have direct effects such as:

- increasing the capacity of auto-purification of the river water
- increasing the biologic and genetic biodiversity (as vegetation, birds, mammals)
- rincreasing the abundance of life forms in river water and on the river banks
- reduction of some nuisances (odours, floating refuse, unpleasant water colour)
- progressive reduction of groundwater pollution and prevention of its further pollution.

The above favourable effects will lead to the extension of some water and land uses by:

- development of irrigations and extension of the cultivated lands
- appearance of new industrial uses, especially small scale industries, but not only;
- new opportunities for recreation activities along the river;
- possible extension of dwelled areas.

The new or extended water and land uses will have beneficial socio-economic effects on the area expressed as:

- growth of agricultural and industrial production
- more working places and local stabilising of the rural population
- increasing of the properties value
- better life standards for inhabitants.

Impact on Groundwater

The **construction** of several elements of the WWTP stage 2 implies soil excavation (for piping and foundations) and *lowering of the groundwater level*. Lowering of groundwater table could generate disagreements to the nearby households using wells for water supply, but this negative impact will have low amplitude, will be temporary and will last not for long time.

Another form of impact on the groundwater could be generated by *accidental spillage of chemicals and fuel* used during construction. To avoid such situation these materials will be stored in closed tanks, vessels or drums placed separately inside the storehouse. The storage area will be equipped with impermeable concrete floor having channels for spillage retaining and removing in order to avoid soil and groundwater pollution.

The level of the groundwater will not be affected by the **operation** of the WWTP stage 2. *No losses of wastewater from plant installations* are possible because all technological basins will be waterproof. In order to prevent pollution of groundwater all structures will be constructed using impermeable concrete and the waterproof degree of structures will be tested and restored (if the case) before the functioning start-up.

Similarly to the construction phase, during the functioning phase the groundwater can be polluted by *spillage of chemicals, sludge or fuels*. To avoid such accidents the storage of containers containing chemicals or other materials will be organized in dedicated spaces inside buildings, having concrete floors and spillage collection channels. In case of spillage occurrence, the spilled material will be safely removed.

In conclusion, *no impact on groundwater is expected* during finalizing and operation of Glina WWTP stage II.

Impact on Soil

During the **construction** of the plant several components *the soil has to be excavated* and the resulted materials have to be removed from the area. In order to avoid any impact and assure recycling, the fertile soil will be separately deposited on the site in order to be reused for land remediation in places where such actions are needed. The ground rocks will be evacuated from the site and landfilled. Specialized companies that are managing non-hazardous waste landfills or construction waste landfills will be contracted for disposal of this material.

The soil and ground rocks could also be polluted during construction by *accidental spillage* of chemicals and fuels. Therefore chemicals will be stored in closed vessels or drums, placed separately, inside the storehouses equipped with impermeable concrete floors provided with channels for collection of spillage and contaminated rain resulting from fire-fighting operations. Fuels will be stored in dedicated underground tanks within the Fuel Supply Station that will be constructed observing measures for work safety and environmental protection.

During the **functioning phase** no excavations will normally occur. The land surface that remains unoccupied by installations/buildings will be *covered with grass* and even ornamental plants. Accidents generated by *spillage of chemicals and fuels* will be still possible and for avoiding such risks the already mentioned security measures will be taken.

The *appropriate waste management* will avoid any pollution due to them. Disposal of technological waste will be made by incineration, recycling or landfilling. Incineration will be made locally, while contracts with authorized companies will be negotiated for landfilling and recycling of domestic waste and some of the technological waste.

In conclusion, no impact on soil is expected as result of the construction and operation of stage II of Glina WWTP, if normally operated.

Impact on Air

The general impact on air during **construction phase** could be produced by emissions of dust particulates, gases/vapors and odours.

Construction of WWTP stage 2 will not generate specific odours, gases and vapors, but some combustion gases and dust emissions may occur from car traffic and excavations. From environmental point of view and considering the sensitive receptor, which is the Glina village,

traffic gases and dust emissions from construction activity are not capable to modify the general quality of the air in the area, due to the small surface occupied by constructions compared with the surface that will remain free of constructions (8.5 ha out of 65ha).

During the **functioning of WWTP stage 2** air emissions will arise from: water treatment processes happening in open air, combustion of biogas and sludge incineration. Two types of impact forms could be discussed as caused by these emissions: odours and effects on air quality.

Impact of emissions from water treatment processes
Normally, from plant components having large uncovered surfaces (i.e. aeration tanks, settlement tanks, etc.) no substantial emissions such as *CO2, CH4 and other gases* will occur. The emission of these gases especially occurs from the sludge digestion process, which takes place in completely closed digestion tanks and generated gases are collected in biogas reservoirs.

Odour emissions due to the content of H_2S and mercaptans in the wastewater could appear at the influent entrance in the WWTP and in the area of sludge thickeners. These compartments will be covered and the air will be purified before exhausting.

The disturbance of the local inhabitants will decrease compared with the situation without wastewater treatment plant. The arguments sustaining this estimation are the following:

- plant components causing strongest odours (i.e. the plant inlet) are located at the largest distances from the Glina village; these plant structures will be covered and the air will be treated before exhausting;
- odours at the plant inlet will be reduced also due to removal of materials deposited inside the sewage main collectors which are subject of fermentation causing odours;
- odour generated now by the untreated wastewater along the Dambovita River will disappear completely, the impact on the air quality being favorable for the inhabitants living downstream Glina WWTP.

In order to verify these estimations, during the first operation period of the plant stage 2, an odour monitoring study will be performed and supplementary abatement measures will be proposed if needed.

Impact of emissions from combustion of biogas in gas engines
The biogas burning in order to produce warm water and/or electricity will generate mainly CO_2 and, in minor quantities, some other gases such as NOx and SO_2, while emissions of particulates (soot and ash) will be negligible. Their contribution to the air pollution was included in the calculations of the background pollution within the dispersion study of the incinerator emissions.

In case of emergency or accidents (ex. malfunctioning of biogas burners) the combustible gases produced by anaerobic fermentation will feed a flare burning combustible gases in the open atmosphere. The flare is enough high to ensure good dispersion of burning gases.

Impact of emissions from sludge incineration

The Glina incinerator will be designed, equipped, built and operated in such a way that the emission limits, as have been set out by **IE Directive 2010/75/EU – Annex VI Part 3** will be not exceeded.

The dispersion study has concluded that a height of 30 m for the stack of Glina sludge incinerator is optimal to ensure the atmospheric dispersion of the pollutants emitted from the incineration process and to determine a low impact, not affecting the compliance with the limit/ target values/critical levels for the ambient air.

For the stack height of 30 m, in the dwelled areas with sensitive receptors to Nitrogen dioxide (NO_2), which is the most important pollutant generated by incinerator (because of the highest value of the ratio between the estimated emission and the appropriate value for air quality), there is no exceeding of the limit values, even in the case of the cumulative impact of incinerator operation and background levels, for any of the averaging periods.

For the stack height of 30 m, the maximum concentrations for the other analyzed pollutants (SO_2, PM10, PM2.5, CO, Pb, As, Cd, Ni, Hg and PAH) are well below the corresponding limit/target values for all the averaging periods in case of exclusive incinerator operation. In the same time, the limit values/ target values/ critical levels in the areas with sensitive receptors (i.e. localities situated in the area of maximum impact) will be not exceeded by the cumulative impact with the background levels generated by other emission sources.

Noise impact

The noise generated during the **construction phase** by the building activities on site and the traffic due to the transport of construction materials and waste is expected not to surpass the accepted level for industrial sites - 65 db(A). Being a temporary nuisance and taking into account the location of the new constructions within the site, it can be considered as not increasing the impact on the dwelled areas.

The traffic on roads in the surroundings of dwelled areas is a constant element of the environmental conditions and it is not expected to consistently change due to the new project construction. Traffic noise could still increase if transport (for landfilling or recycling) of dewatered sludge produced by the stage 1 will become a regular activity.

During the **operation phase,** noise generated by the traffic is not considered to become an issue for the local inhabitants, even if the number of cars transporting materials/personnel will increase, because a new access to the plant will be arranged opposite to the dwelled zone.

During the WWTP functioning period, another noise source will be the functioning of mechanical equipment, mainly blowers and large pumps. In order to reduce this noise all blowers and large pumps will be placed inside buildings and fixed on solid foundations capable to attenuate vibrations and noise. So, they will have small contribution to the noise level in the dwelled areas.

The flare burning combustible gases is of no significance as a noise source because it will be used only in case of emergency.

The described new noise sources will not generate an additional impact for the dwelled area and will not modify the existing noise levels that are comprised between the following values:

- 65-70 db(A) – along A2 highway, Bucharest ring-way and access road to Ochiul Boului landfill;
- 50-70 db(A) – inside the WWTP area
- 45-55 db(A) – in Glina and Popesti Leordeni villages, except the households situated near the main roads, where 60-65 db(A) is registered.

Impact related to the Consumption of Energy and Chemicals

Energy consumption

The construction of the WWTP stage 2 requires energy for the building activities on the site and elsewhere - for processing materials (i.e. concrete) that are used in the construction. The use of energy during the construction phase is not of major importance for the overall environmental impact of the WWTP when compared with the good effects of its activity.

No special chemicals will be used in the construction phase, except paints and ground coats. Consumption of these materials will not have a larger impact than in case of other buildings. All packaging waste resulted from such chemicals are to be correctly evacuated by the construction company, which will record on the consumed quantities.

During **operation phase** the use of energy in the form of electricity can be split in two components, respectively for the water line and for the sludge line.The electricity consumed by the *water line* is mainly for pumping and biological processes (aeration of activated sludge basins), the other plant components using comparatively small amounts of electricity. The energy consumption by the *sludge line* is mainly for sludge pumping, anaerobic digestion and sludge dewatering.

The Glina WWTP will not only consume electricity (total consumption by plant - **98,480,000 kWh)**, it will also produce energy by conversion of biogas, steam reuse and outlet turbines. By using the energy generated by **anaerobic digestion, which is estimated to be 45,980,000 kW,** the net consumption will be of only **52,500,000 kWh.**

It results that even there will be a substantial consumption of energy within the Glina WWTP, the stage 2 project is offering different possibilities to reduce it, by recovery of energy, use of heat from biogas burning, use of steam (from incinerator) and possibly power generated by outlet turbines.

Chemicals use

Chemical use and consumption is specific to the functioning phase.

Basically, the *treatment of wastewater* does not require addition of chemicals, except the tertiary step for Phosphorus removal, where Ferric chloride (13.8% Fe) is used (22,500t/year).
The *sludge treatment* needs chemicals, possibly polymers for thickening and dewatering (400t/year). Also the incineration process uses some chemicals such as sodium bicarbonate (2,200t/year) and activated carbon (60t/year) for the retention of flue gas pollutants.

An uncertainty is related to the consumption of additional fuel for the start-up of incineration process. One can not say if significant supplemental fuel is necessary for starting incineration because at this stage the sludge calorific value is not really known. It is still certain that supplemental fuel will be used only during the start up of the process.

One can say that the consumption of chemicals for wastewater treatment and sludge disposal within Glina WWTP will be not significant as types and quantities and will not impact the environment by the hazardousness of the substances.

Impact on the landscape

During the **construction phase** a temporary impact on the landscape will be observed from the dwelled area – Glina village – that is located south of the plant, on a small hill. The impact will be related to the presence of building equipment and excavations for different basins. After the completion of the construction these visual nuisances will disappear. The visual impact is not considered to be significant because of its limited duration, the relatively small surface occupied by the stage 2 constructions and installations (8.5 ha out of the total surface of 65 ha) and the relative long distance to the village households.

During **operation phase**, since stage 1 of the WWTP structures has been already built, the additional visual impact of the stage 2 components will be not very obvious. The main visual impact is related to the sludge digesters that are very visible, but these structures are mainly part of the stage 1, already constructed. Most of the new structures to be built will be similar with some of the existing ones. The maximum height of these structures will be of around 10 – 15 meters above the ground level, except the incinerator that will be a higher construction having a stack of at least 30 meters height.

When completely constructed and the remaining free land will be covered by vegetation, the plant site could appear as a well organized space. It is recommended that trees, brushes and flowers to be planted on the alley borders and other trees rows to be planted in parallel to the fence surrounding the site, in order to form a vegetal curtain to hide partially the plant components. Finally, the Glina WWTP will be an objective with no negative impact on the surrounding landscape.

Impact on biological environment

The construction of the WWTP stage 2 new structures needs that their locations to be free of vegetation. The removal of vegetation will be limited to shrubs and grass because no trees are present on the site. This action will have a small negative effect on the fauna, since species such

as rodents, lizards, rabbits, etc., living now on the site have to move away towards other locations.

After the completion of the WWTP the land unoccupied by constructions and installations will be covered by grass, while flowers and trees will be planted on the alleys border and parallel to the site fence. It is not expected that the animal species will return to the site when the completed WWTP will be in operation, but it would be possible a large number of birds (seagulls especially) to pass over the new water surfaces. Such situation, already observed during this study elaboration, is not a real negative effect.

Impact on human health

During the **construction phase** the contractor will have to elaborate and implement a Health and Safety Plan for people working on the site. The safety measures will be brought to attention of all personnel that will be obliged to respect them.

Wearing protective clothes and boots, safety helmets, protective glasses, ear plugs, etc. will reduce risks for human health, that are related to fire and explosions, asphyxiation, mechanical injuries and poisoning.

Hygiene facilities will be part of the site arrangement and will help for avoiding different diseases generated by pathogenic germs living in wastewater.

During the **operation phase** similar measures for health and safety will be imposed for plant workers. These measures will consider the potential risks specific to operation of WWTP that are not only fire and explosions, asphyxiation, mechanical injuries and poisoning, but also risks of falling in basins and underground installations. These parts will be clearly marked and only trained personnel will have access within risks places. For visitors such places will be accessible only under supervision. All measures will be included within the Safety and Health Action Plan that will be elaborated for the plant.

Supplementary to the specific measures described above, fencing, lighting, guarding and watching of the works and visitors will be provided anywhere it will be needed. During construction and operation all reasonable efforts will be taken to keep the site and works out of risks for individual persons. In such conditions the impact on human health and safety is insignificant.

Beside the above described risks for workers and visitors, it is to mention that for the inhabitants of the Glina Village, and people living downstream the plant, the risks related to the potential spread of infectious diseases will be substantially reduced, WWTP ensuring improved conditions for preserving human health.

Impact on dwellings

The impact on dwellings is expressed by the effects on groundwater deepness, air quality, noise level, land use and socio-economic aspects.

Water supply of households in the neighbouring dwellings is made now from underground resources. In the future all three villages of Glina commune will be connected to a centralized water supply and sewer system, but this action is planned to begin after ending the construction of WWTP stage 2.

During the construction of WWTP stage 2 phase, the *level of the groundwater* will be lowered due to the need of working in a dry environment. Lowering the groundwater table could generate disagreements to households still using wells. This negative form of impact is expected to have low amplitude and be temporary, lasting only a part of the construction period.

Construction of WWTP stage 2 will generate minor *dust emissions* from traffic and excavations. These emissions will not modify the general quality of the air in the area and especially in the Glina village, due to the large size of the location. During the functioning of WWTP *gaseous emissions* arising from the open air treatment processes, combustion of biogas and sludge incineration could theoretically influence the air quality, but the designed measures will avoid the possible negative effects.

Noise produced during the construction of WWTP stage 2 by the building activities and by the traffic related to the transport of construction materials and waste will not impede the life conditions in the neighboring dwellings. During the functioning period, main noise source will be the mechanical equipment (blowers and large pumps). The large surface of the site and the proposed measures for noise abatement will contribute to the reduction of any supplemental impact on dwellings due to noise, whose level inside Glina village will remain within the limits of 45-55 db(A).

The implementation of the Glina project stage 2 will have beneficial *socio-economic influences* on dwelled areas expressed by new job opportunities for local people, appearance of small scale companies, extension of the dwelled area, increasing of the properties value, all these effects leading finally to an improved life standard for the inhabitants.

Global evaluation of the project impacts

The synthesis of the described impacts forms indicates the followings:

a) most forms of the impact of the analyzed project are:
   - direct (14 of 22);
   - significant (16 of 22)
   - positive (17 of 22)
   - permanent (18 of 22).

a) only 6 forms of impact are negative;
b) almost half of the impact forms are cumulative and positive (11 of 22);
c) more than half of the impact forms will appear in medium time (12) while the other will appear in short time (10).

PROPOSED ENVIRONMENTAL MONITORING PROGRAM

Environment monitoring programs have been proposed both, for the construction and the operation periods in order to survey the impact of the Glina WWTP. Based on the monitoring results it will be possible **to control the environment quality** and, when necessary, to undertake additional measures for further reduction of negative impacts.

The monitoring data will be used also **to demonstrate the compliance with legislation** and conditions imposed by the environmental permit and authorization.

Characterization /classification of identified impact forms related to the construction and operation of Glina WWTP stage II

Identified impacts	Significance of impact		Nature of impact					Term of appearance		Duration of impact	
	Significant	Not-significant	Direct	Indirect	Pozitive	Negative	Cumulative	Short	Medium	Temporary	Permanent
Impact on surface water Improving of water quality in Dambovita river downstream Bucharest	**x**		**x**		**x**			x			**x**
Increasing the capacity of auto-purification of the river water	**x**			x	**x**		x		x		**x**
Increasing the biodiversity (vegetation, fishes, reptiles, birds, mammals);	**x**			x	**x**		x		x		**x**
Increasing the abundance of life forms in river water and on the river banks;	**x**			x	**x**		x		x		**x**
Improving the area general perception due to reduction of floating refuse and unpleasant water colour	**x**		**x**		**x**			x			**x**
Increasing of the fishing activity		x		x	**x**				x		**x**
New recreation activities along the river	**x**			x	**x**		x		x		**x**
Development of irrigations and extension of the cultivated lands	**x**			x	**x**				x	x	
Appearance of new companies, especially small scale industries, on the river banks;	**x**			x	**x**		x		x	x	
Improving of water quality in Arges River after the confluence with Dambovita	**x**		**x**		**x**		x		x		**x**
Reduction of pollutants brought into the Danube River	**x**		**x**		**x**				x		**x**

Identified impacts	Significance of impact		Nature of impact					Term of appearance		Duration of impact	
	Significant	Non-significant	Direct	Indirect	Pozitive	Negative	Cumulative	Short	Medium	Temporary	Permanent
Impact on groundwater **L**owering of level		x				x		x		x	
Impact on air Disappearance of odour generated by the untreated wastewater	**x**		**x**		**x**		x	x			**x**
Sludge incineration and biogas burning will generate CO2, NOx, SO_2 and particulates		x	**x**			x		x			**x**
Noise Noise produced by more traffic and equipment such as blowers and large pumps		x	**x**			x		x			**x**
Consumption of resources Energy and chemicals consumption	**x**		**x**			x		x			**x**
Lanscape Local appearance of new constructions, green spaces and tree curtains surrounding the site. Improvement the landscape along the river	**x**		**x**		**x**		x	x			**x**
Impact on fauna Effects on the fauna, since several species have to move away their habitat. Sea-gulls invasion.		x	**x**			x		x			**x**
Impact on human health Reducing the risks of infectious diseases for people living in the plant surroundings and downstream	**x**		**x**		**x**			x			**x**
Impact on dwellings and other objectives Possible extension of dwelled areas;		x	**x**		**x**		x		x		**x**
Increasing the properties value due to the improvement of the general perception of the area	**x**		**x**		**x**		x		x	x	
Socio-economic effects More working places; increased income for local inhabitants; improved life standards	**x**		**x**		**x**		x		x		**x**

PART II

EIA of the works the Bucharest sewerage system rehabilitation.

DESCRIPTION OF THE PROJECT

Bucharest Municipality has a combined sewerage system, collecting both rainwater and wastewater,s that extends throughout the developed area of the city and surrounding dwelling areas. The sewer network receives domestic wastewater from approximately 95 % of the Bucharest population (1,925,000 inhabitants), wastewater from neighboring communities, industrial wastewater and surface water runoff during storm events. Collected wastewater is transported south-east of Bucharest, to the Glina wastewater treatment plant (WWTP) from where, after treatment, it is discharged into the River Dambovița.

In relation to the Stage 2 of Glina WWTP development, technical solutions and works for rehabilitation of the wastewater collection network have been proposed in order to optimize the costs for investment and operation of the Glina WWTP stage 2 and the functioning of the sewerage system. These solutions and works are aimed to:

- limiting the entrance of groundwater and other undesired waters into components of the sewerage system, in order to reduce the flow and dilution of wastewater sent to the Glina WWTP,

- ensuring a good functioning and durability of the main structures bringing wastewater to Glina WWTP – the Caseta and main collectors.

The Feasibility Studies for Glina WWTP Stage 2 and studies for rehabilitation of Caseta and main Collectors, as well as the corresponding EIA reports, will serve for the elaboration of the Cohesion Fund Application.

Project location and object

The Project area will be Bucharest, while the project object is Bucharest sewerage system.

Following completion of the investments, the sewerage service will be significantly improved and more close to the target of providing a piped sewerage system to all chosen surrounding areas, by 2015. The neighbouring communities, recommended to be connected with the Bucharest system are: Glina, Popesti-Leordini, Jilava, Chiajna, Chitila, Mogosoaia, Buftea, Voluntari, Dobroesti and Pantelimon.

Without intervention, the incidence of flooding from the system is likely to increase in the future due to the expansion of the system to serve 100% of the resident population, the continued development of the Municipality and connection of sewerage systems of neighbouring communities.

The Caseta was designed to collect wastewater brought by main collectors, by crossing Bucharest from the western part (near lacul Morii) towards east, on a distance of 17.8 km, and to bring it to Glina Wastewater Treatment Plant. The Caseta trajectory is going under the Dambovita channel on 10 km, till the Vitan bridge, where it deviates and goes 3 km along the north shore (left shore), till after the Popesti overflow, where it under-crosses the river and continues the final 4 km, till Glina, along the south shore (right shore).

The existing sewage system is approximately 2,561 km in length (1,772 km collectors plus 789 km connections). Before the construction of the Caseta the wastewater was collected by mean of 2 main collectors – A0 and B0 - placed on both sides of the river Dambovita. Today there are 12 main collectors that have fragmented the old main collectors A0 and B0 in their route to the Caseta. The sewerage system operates predominately by gravity with 13 minor pumping stations serving local low-lying areas.

The identified problems related to the Caseta and main Collectors that influence the Glina WWTP design and functioning are the followings:

i) *Infiltrations*
ii) Deposition of sediments
iii) Lakes water discharge in the sewage system

Infiltrations

Significant entrance of clean water, by infiltration and clean water discharge, has been identified inside the Caseta, as a result of the following factors:

- Groundwater discharges in the Caseta from the main **drain which is not connected to the river channel (superior reach)** and due to the **non-functioning of the pumping stations** (Eroilor, Opera si Mihai Bravu)

- Infiltrations at the **intersection points** between the Caseta main drain and collectors or inspection tunnels and at **the junction points of collectors with the Caseta.** In these points the groundwater is flowing around the pipes and is penetrating the drain walls because of sealing lacking or because of pipes incorrect placement

- Infiltrations of groundwater due to **illegal or unknown connections**

- Entrance of clean water through the **non-waterproof joint points of the Caseta ceiling components** and through the **cracks in the riverbed.**

Deposition of sediments and other materials

The sediments and sludge accumulated inside the Caseta together with debris resulted from ceiling crumbling and construction materials not removed after ending the building are making difficult the water transport especially when the flow is small.

Lakes water discharge in the sewage system

The outlet of the drainage systems of lakes Titan, Tineretului and Carol are discharged directly in the sewage network and the discharged water is sent in the Caseta.

Quantitative details on the infiltrations and reduction objectives

As resulted from the ANB measurements (2009-2010) **the total amount** of infiltration and other undesired water arriving in the Caseta is **5.36 m^3/s,** out of which **infiltration flow** was found to be **4.66 m^3/s**, while the flow of **other undesired waters - 0.71 m^3/s.**

Origins of infiltration and other undesired flows and proposed reduction actions

Action No.	Origin	Nature of undesired water	Reason for reduction	Action to reduce undesired water	Flow m^3/s
1	Infiltration from water network leakage	Infiltration	To reduce infiltration	Leakage control of water supply network	0.44
2	Drainage from industries	Other undesired water	To reduce other undesired water	Disconnection from Caseta and connection to Dambovita channel	0.11
3	Drainage from lakes	Other undesired water	To reduce other undesired water	Disconnection from Caseta and connection to Dambovita channel	0.50
4	Infiltration from Dambovita river	Infiltration	Caseta structural rehabilitation	Waterproofing on 17 km, 60 m width	0.93
5	Infiltration from groundwater (part linked to high level of groundwater table)	Infiltration	To reduce infiltration	Reinstatement of subway drainage system to lower the ground water table	1.38
6	Infiltration from groundwater (part due to structural sewers conditions)	Infiltration	Network structural rehabilitation	Rehabilitation of 36 km sewers	0.10
7	Metro drainage	Other undesired water	To reduce other undesired water	Disconnection from Caseta and connection to Dambovita channel	0.09
8	Infiltration from Caseta left drain in city centre (10 km)	Infiltration	To reduce infiltration	Rehabilitation of Caseta drain	1.26
9	Infiltration from Caseta left drain downstream city centre (7 km)	Infiltration	To reduce infiltration	Rehabilitation of Caseta drain	0.27
10	Infiltration from Caseta right drain downstream city centre (7 km)	Infiltration	To reduce infiltration	Rehabilitation of Caseta drain	0.27

Action No.	Origin	Nature of undesired water	Reason for reduction	Action to reduce undesired water	Flow m^3/s
	Total, infiltration (1, 4, 5, 6, 8, 9, 10)				**4.66**
	Total, other undesired water (2,3,7)				**0.71**
	Grand total (1-10)				**5.36**

Options for reducing the infiltration and other undesired water flows

A number of 3 options have been defined for reducing the infiltration into the Caseta:

- High infiltration reduction (**HIR**) – comprising 10 actions reducing the infiltration flow with 4.02 m^3 /s of the total 5.36 m^3/s
- Intermediate infiltration reduction (**IIR**) – comprising 6 actions reducing the infiltration flow with 3.43 m^3 /s
- No infiltration reduction (**NIR**) - but only 2 structural remediation actions, which could reduce the infiltration flow with 0.86 m^3 /s of the total 5.36 m^3/s.

The options analysis has revealed that the **IIR option, which is the most advantageous** from economic and technical point of view, assures a realistic design flow for Glina WWTP stage 2, correlated with an optimal functioning of the sewerage system.

Specific data on the project

The proposed work categories have been detailed in the ANB document "Supporting report regarding works to be performed in the sewerage system of Bucharest for Glina phase 2".

Works on the MAIN DRAIN of the Caseta between Ciurel and Vitan

- *Allowing and ensuring the access to the drain by dewatering of the structures*
- *Install a drain by-pass on the collectors entering the Caseta*
- *Rehabilitation of the main drain over 10 km and its pumping stations*

Earth dams on the upper reach will be built for limiting the consecutive work sections and allowing dewatering. Access to the drain will be ensured by mean of earth ramps for the transport and handling of mechanical devices and materials.

Works assuring the sealing of the SUPERIOR REACH - Dambovita channel

- *Cleaning the bottom of the channel*
- *Repairing damages and provide a new base layer on the bottom of the channel*
- *Sealing the bottom on the sections potentially leaking*.

Works for structural rehabilitation of the CASETA

- *Rehabilitation of the Caseta* (Cleaning the bottom; cement grout injection (4 drills every 3 km); passivation of the exposed steel and application of structural concrete on the gaps found; stabilization of the pre-slabs and removal of the pre-slabs that can not be stabilized)
- *Rehabilitation of the access ways to the Caseta.*

Works for the SUBWAY DRAINAGE

- *Rehabilitation of the subway drainage on a length of 8 km* (Installing a new drain - DN 400 - at the level of -1m from the bottom of the sewage collectors; applying of a 20/40 gravel layer surrounded by a specific geo-textile)
- *Installing of 5 pumping stations.*

Rehabilitation of COLLECTORS on 35 km in the affected area

- *Rehabilitation of non-visitable collectors* (Demolition of roads and excavations; putting new collectors next to the old ones; restoring the connections and the sites)
- *Rehabilitation of visitable collectors* (Repairing of structural damages using structural concrete; repairing of cracks and facings; securing the access ways)

Works for LAKES WATER DISCHARGE in the superior reach

- *Install water tanks (500m^3) downstream of the lakes drainage system*
- *Construct pumping plants*
- *Install pipes discharging lakes water in the upper reach of river Dambovita*.

The proposed duration for execution of the planned works was declared 30 months and, as the completion of the Glina WWTP Phase 2, they will be finished at the end of year 2015, offering an improved durability of the sewerage system for the next 25 years.

IMPACT ON THE ENVIRONMENT AND ABATEMENT MEASURES

A general characteristic of this project that the most polluting emissions and nuisances will be registered during the construction phase while the operation phase will benefit of positive changes.

Impact on Surface water

During the construction phase the works are mostly impacting by:

- dams to be constructed on the upper reach to delimitate the work sectors
- upper reach sectors limited by dams that will be dewatered, the water of the channel sectors being diverted downstream the worksite by pipes
- slabs of the upper reach will be dislocated to give access to the drain or Caseta
- bypasses built for the water drained by the main drain and the subway drain to be discharged in the upper reach.

Although spectacular, these construction works will not affect the quality of the surface water because no wastewater will be discharged in the upper reach. The water used for cleaning, around 300 l/s, will be sent only into the Caseta.

During the operation phase

The planned works are influencing the river Dambovita, either by discharging drained clean water in the upper reach or by the effects on the Glina WWTP.

Effects on the water in the Dambovita upper reach on the Bucharest territory

- the flow in the upper reach will increase with around 3 m^3/s and will speed the water movement in the channel ensuring a better refreshing
- the supplemental flow will improve the quality of the upper reach water and will diminish the risks of eutrophication.

Effects on the Glina WWTP

- the Glina WWTP *efficiency in pollutants removal will increase* due to better conditions for the activated sludge development (as flow and pollutants concentration); the discharge of a *cleaner effluent* means less negative influence on the receptor;
- as a consequence an *improvement of the water quality in river Dambovita* downstream Bucharest is expected. This means an *increased capacity of auto-purification* of the river water and, subsequently, an *increased abundance of life forms;*
- improvement *of the water quality of the river Arges* is expected too, considering the contribution of river Dambovita to Arges pollution and, similarly, a reduction of pollutants sent into the Danube.

Impact on Groundwater

The construction of the Caseta and Subway line no 1 has increased the groundwater level, which rose in the Vitan zone from - 69.12m to – 60.00m. On the right bank of the river there is no draining system related to the Subway, while the drainage of the left bank is not well functioning. At present, the Caseta and the collectors nearby the Caseta are placed inside the groundwater layer and for this reason the clean water from the ground is entering in the sewerage system, by cracks and constructive defects.

Impact during construction

- *No disturbance of the geological structure* will take place during work performance.
- *No change of the groundwater quality* will be determined because no wastewater discharge will occur in the ground or soil during the works and after their ending.

Impact during operation

- As effect of the planned works, *a lowering of the groundwater level with 1-2 m*, from the actual depth of -3… -7 m, till around -5 m (that is the depth of the pumping stations on the left bank and of the Subway drain on the right bank) is expected.
- The lowering of the shallow groundwater layer will have as main effect the *reduction of clean water infiltration* inside the sewage system components.
- The subsequent effects are the *reduction of the wastewater flow* brought to the Glina Plant and *improved treatment efficiency.*

Impact determined by Waste

Impact during construction
The planned works will generate construction waste that is of 2 categories considering their adequate disposal option:

- waste that could be recycled (fragments of asphalt, concrete tiles, metallic waste),
- waste that should be disposed of by landfilling (sludge, clogging sand, debris of facings, mixed domestic waste extracted from the bottom of the superior reach).

Most part of the generated waste is inert construction materials, which impact on the environment is not dangerous and could be recycled in the benefit of the environment. But a special attention has to be offered to the clogging sand and sludge for the reason of their possible contaminants content (pollutants or pathogenic germs) and potential of generating unpleasant odour.

Regardless of the impact on the environment, all waste has to be separately collected and stored before disposal or sending to recycling. Storage places and/or recipients (for transport) have to be provided in such a way not to allow spreading and spilling. Contracting services for waste management with specialized companies will ensure the correct treatment of generated waste.

Impact during operation
No waste are expected to be generated during operation phase, except those ordinary waste resulted from periodic cleaning of the upper reach and maintenance of the pumping stations or access ways.

Impact related to Consumption of Materials and Energy

Impact during construction phase
Most part of works will use equipments whose functioning is based on consumption of fuels – diesel or gasoline (excavators, bulldozers, concrete trucks) or electricity from generators whose functioning is assured by burning liquid fuel, too). At this moment, the energy consumption could not yet be estimated, depending on many factors.

The amount of materials that will be consumed is roughly estimated to 51,000 m^2 asphalt, 95,000 m^3 concrete, 300,000 m^3 water proofing materials, 1153 tones enforcements.

As measures for reducing the impact of materials and energy consumption the following were recommended:

- using modern equipment with reduced energy consumption
- optimization of equipment functioning regime and materials consumption
- daily control of the energy/materials consumption.

Impact during operation
The *consumption of energy* during operation will be limited to the functioning of pumps that evacuate the drained water from the main drain or the subway drain. The amount of energy consumption will depend upon the number, types and capacity of pumps and the quantity of

pumped water. *Materials* consumption will be limited to those needed for maintenance and possible small remediation of the sewage network.

Impact on Soil

Impact during construction phase
The planned works will take place on sectors having a maximum length of 1 km and occupying surfaces of around 400 m^2 of the Caseta and 200 m^2 of the surrounding area. Worksites will be organized on surfaces covered by roads or occupied by the Dambovita channel and only outside the city worksites will comprise areas not covered by asphalt or concrete. It is recommended that all worksites will be fenced by reusable panels in order to limit the affected areas.

Uncovered or discovered soil surfaces could be accidentally polluted by waste especially by sludge and clogging sand extracted from the Caseta and drains. The proposed measures for waste separate collection and storage are intended to and could avoid soil pollution.

Soil accidental pollution could occur with oils or fuels from the equipment supply or repairing on the sites, if not carefully handled. It is recommended that any oil/fuel spill to be removed by using absorbent materials.

Impact during operation
No impact on soil is expected to happen during the operation phase. Accidents could happen due to the incorrect waste management during maintenance actions or by spilling of oils/fuels, but the probability of such events is very low.

Impact on Air

Impact during construction
The impact on air could be determined by the **emission of particulates and burning gases** that will result from vehicles and equipment functioning, construction of dams, excavations or sawing the upper slabs, as well as from actions for restoration of sites. Repairing of structural damaging, cracks and facings are also actions producing particulates but, because having large dimensions or being wet, these particulates settles not far from sources.

Measures as optimization of vehicles and machinery movement, wetting their trajectory inside the worksites and correct handling of powdery materials/waste could substantially reduce the emissions of **particulates** emissions in the air and the impact on the air quality. Avoiding excessive functioning of equipment using gasoline or diesel as energy source will reduce the emissions of **burned gases.**

Another form of impact on the air is **odour** that will appear from actions involving opening, dewatering and cleaning of Caseta, main drain, or access ways to them. Extraction and handling of clogging sand, sludge or construction materials left inside the Caseta, as well as wastewater generated from cleaning could generate unpleasant odours. The mechanically cleaning of the

upper reach is supposed to generate fewer odours because of the higher degree of sediments stabilization.

Reduction of the impact due to odours will be possible by:

- Separate collection and rapid evacuation of waste, sludge and clogging sand
- Immediate evacuation into the Caseta of any wastewater resulted from cleaning.

It is expected that the above measures will reduce odour impact to a supportable level for the people living in the area or passing by.

Impact during operation

No impact on the air is expected to be generated during the operational phase. An improvement of the actual situation is expected as result of the improved hydraulic functioning of the Caseta and of the increased flow and water speed in the upper reach.

Noise impact

Impact during construction

The noise generated by works on the sewage system will affect areas that are placed on the length of the Caseta and upper reach (17 km), along different collectors (35 km), as well along the Metro line no 1 (8 km).

The character of noise generated will depend on the types of works performed and types of equipment used, some works (breaking asphalt cover or concrete slab) being more noisy than others (cleaning, repairing, facing). The noisiest equipment used on the worksites will be peak hammers, pumps, electricity generators, compressors, and concrete mixer/trucks. It is expected that their noise emissions overlapped on the background noise will not exceed 70-90 dB(A), especially due to the fact that there will be not simultaneous functioning of two or many noisy equipments.

Being not continuous, the noise generated by the planned works could be compared with the noise in some industrial premises or noise generated by the maintenance works performed for utilities such as the natural gas distribution or water supply.

The receptors affected by noise are the persons living or working in the area and the passersby, pedestrians or car passengers.

The recommended fencing of the worksites using noise absorbent panels will be more efficient in combination with the placement of the noisy equipment at the lowest level inside the site, on the bottom of the upper reach or open drain, in order to be supplementary shielded. Another recommendation is to fix the equipment producing vibrations and noise on a temporary support, when this equipment will be used many times in the same location.

The above measures recommended in order to reduce the impact of noise will be capable to reduce the level of noise at least with 20% for the receptors, which are persons living or working

in the area and the passersby, pedestrians or car passengers. Supplementary, it will be very important to limit the working period during the day to the interval 9.00 -17.00.

Impact during operation
No impact due to noise is expected to be generated during the operational phase.

Impact on the Landscape

Impact during construction
Any workplace will constitute a nuisance for the landscape because of introducing disturbing elements such as fencings, dams, demolished items, machinery, wastes, etc., that are not usually present in the areas. These elements are modifying the traffic regime on the roads and the water flowing in the Dambovita upper channel, that are normal landscape components. The impact on landscape is limited in space - worksites are extended on maximum 1 km length of the Dambovita channel - and in time, the total works duration of being 30 months.

Limiting the landscape impact during the worksites life is assured by measures such as:
- Worksites have to be completely fenced with panels covered by advertising prints;
- Their surfaces have to be well organized (for example the opening of the upper reach will be made at once on only 5 m length);
- The wheels of vehicles leaving the worksites have to be washed not to soil the roads.

Impact during operation
No negative impact on the landscape due to planned works is expected to be generated during the operation phase. Instead, *positive impact* could be generated by the increased flow in the upper reach, which *will increase the water circulation speed*, respectively the water refreshing, and will *reduce the risks of eutrophication*.

Impact on Human Health

Impact during construction phase
Human health could be impacted by some of the already described nuisances (air pollution, noise, crowded traffic, etc.) for which reduction measures have been already presented. The safety of workers will be assured as required by the regulations in force.

Impact during operation
All above mentioned nuisances related to the worksites will disappear after the works ending, while the *disease risks sources* due to flooded cellars and streets flooding during heavy rains *will disappear*.

Another benefic impact is the *reduction of the risks for workers involved in survey and control of the sewerage system* that are using the access ways. The access ways to the rehabilitated pumping stations, drains and collectors will be provided with safety equipment - steps, ramps, signalization, automatic control devices and ventilation.

Impact on Dwellings and other objectives

Impact during construction phase
The impact on dwellings determined during the construction phase will consist in forms already mentioned – bottlenecks in traffic, noise, disturbed landscape, etc., for which reduction measures have been already presented. All these negative impacts are limited to the areas around the work sectors and will last no longer than 30 months, the total duration of works.

Impact during operation
No negative impacts are expected on dwellings or other objectives during operation phase. Instead, positive impacts are supposed to be registered, consisting in:

- better collection of the wastewater; improved durability of the sewerage system;
- reduction of risks of flooding roads and cellars during heavy rains;
- elimination of risks for inhabitant health;
- better functioning of the Glina wastewater treatment plant.

It is to mention that of special importance is the economic effect on the Glina WWTP that consists in reduction of the investment and operation costs reflected in the taxes to be paid.

Global evaluation of the project impacts

In order to synthesize the elements presented above one can conclude the followings:

a) most forms of the impact of the analyzed project are:

- significant (18 of 22)
- direct (17 of 22);
- positive and permanent (13 of 22).

b) only 9 forms of impact are negative;

c) the 13 positive impact forms will appear in short term and the 9 negative impact forms will be not permanent, being manifest only during the construction phase.

PROPOSED ENVIRONMENTAL MONITORING PROGRAM

The study has proposed a monitoring program to be implemented in order to survey the impact on the environment of the planned works, during their construction and the functioning of the sewerage system after its rehabilitation. Based on the monitoring results it will be possible to control the environment quality and, when necessary, to undertake additional measures for further reduction of negative impacts.

The monitoring program contains:

- parameters or impact form
- proposed measurement frequency
- proposed location of sampling points.

The monitoring data will be used also to demonstrate the compliance with legislation and conditions imposed by the environmental permit and authorization. These data will be periodically reported to the interested authorities.

Characterizing of identified impact forms related to the construction and operation of planned works

No	Identified impacts	Significance of impact		Nature of impact					Term of appearance		Duration of impact	
		Significant	Not-significant	Direct	Indirect	Pozitive	Negative	Cumulative	Short	Medium	Temporary	Permanent
	Impact on surface water											
1	Improving the quality of water in Dambovita upper reach, by mixing with clean groundwater, increasing speed circulation, reducing eutrophication risks	x		x		x			x			x
2	Improving of water quality in Dambovita river downstream Bucharest	x			x	x		x		x		x
3	Increasing the capacity of auto-purification of the river water, because of the better quality of the discharged effluent of the Glina WWTP	x			x	x		x		x		x
4	Increasing the abundance of life forms in river water	x			x	x		x		x		x
5	Improving of water quality in Arges River after the confluence with Dambovita	x			x	x		x		x		x
6	Reduction of pollutants sent to the Danube River	x			x	x		x		x		x
	Impact on groundwater											
7	Lowering the groundwater level around Caseta and main collectors	x		x		x				x		x
8	Reducing the groundwater infiltration in the sewerage system and subsequently reducing the wastewater dilution in the Caseta	x		x		x			x			x
	Impact due to waste											
9	Pollutant and pathogenic risks due to the sludge and clogging sand extracted from main drain and Caseta	x		x			x		x		x	
10	Unpleasant odours due to sludge and clogging sand extracted from drains and Caseta	x		x			x		x		x	

No	Identified impacts	Significance of impact		Nature of impact					Term of appearance		Duration of impact	
		Significant	Non-significant	Direct	Indirect	Pozitive	Negative	Cumulative	Short	Medium	Temporary	Permanent
	Impact on air											
11	Emission of particulates and burned gases from vehicles and equipment circulation		x	x		x		x	x		x	
12	Possible unpleasant odour emissions from sludge /sand extracted from main drain and Caseta		x	x		x			x		x	
	Impact on soil											
13	Discovered areas where worksites will be located		x	x		x			x		x	
14	Accidental pollution by waste or oil/fuel spills		x	x		x			x		x	
	Noise											
15	Noise produced by traffic of vehicles and functioning of equipment such as peak hammers, compressors, electricity generators, concrete trucks, large pumps	x		x		x			x		x	
	Consumption of resources											
16	Energy and construction materials consumption	x		x		x			x		x	
	Impact on human health											
17	Reducing the infectious risks due to flooded roads and cellars for people living in areas of Caseta and main collectors	x		x		x			x			x
	Landscape											
18	Appearance of worksites is a disturbing element for the local landscape	x		x		x			x		x	
	Impact on dwellings and other objectives											
19	Improved durability of the sewerage system.	x		x		x			x			x
20	Better wastewater collection, roads flooding reduction	x		x		x			x			x
21	Better functioning of the Glina WWTP	x		x		x			x			x
	Socio-economic effects											
22	Reduction of the investment and operation costs for Glina WWTP	x		x		x			x			x