Water Research Institute

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Georgia’s Environmental Outlook - GEO

GUIDELINES ON ESTABLISHMENT OF AGGLOMERATIONS IN THE PILOT RIVER BASIN

Project SAMRS/2018/VP/01/07

September 2020

Table of contents

ABBREVIATIONS

EU	*European Union*
MS	*member states*
p.e.	*population equivalent*
UWWTD	*Urban Waste Water Treatment Directive*
WWTP	*waste water treatment plant*

LIST OF FIGURES AND TABLES

1. INTRODUCTION

The production of pollution contained in waste water is connected with human activities, bio-social and economic activities. Pollution in waste water impacts not only closest surrounding of its origin. There are also threatened larger areas and also in other countries behind the borders. Improper or insufficient treatment of waste water deteriorates the ground water quality, quality of the inland water systems, and the quality of coastal water and open seas. Therefore, the approach to waste water treatment has an international character and each country is required to treat the waste water to the level that doesn't have adverse effects on quality in other countries and the seas.

The main purpose of sewage system (including waste water treatment plant) is the protection of population and environment from adverse effects from pollution that is contained in urban waste water. The process of discharge and treating of the waste water must respect principles of sustainable development, protection of environment, and application of legal and conceptual requirements of waste water management. This process has to take into account integrated approaches to protect of environment, utilisation of water resources, and complex solving of environmental and water management issues under condition of keeping balance, justice, and economic effectiveness.

This Guidelines is structured in such way that will gives overview of the legal provisions on the implementation of Directive 91/271/EEC, technical and environmental criteria to be applied for the delineation of agglomerations and subsequent waste water treatment. At the end of this document, a list of data and information is presented together with the steps to delineate the agglomerations in the pilot river basin in the Georgia (the Alazani River basin).
The important definitions which are used within this document are presented in the chapter Glossary.

1.1 Background and legal provisions

Approaches of discharging waste water are based on legislative and conceptual requirements of each country, where in detail technical and technological approaches in relevant technical standards, manuals, and recommendations are elaborated. EU MS have adopted unified policy in the field of discharge and treatment of the urban waste water. This is implemented in EU directives and regulations transposed into national legislation.

In the EU, the process of discharge and treatment is determined by the Directive 91/271/EEC on urban waste water treatment in sounding of the Commission Directive 98/15/EEC and statement of European Parliament and Council 1882/2003/EEC in agglomerations above 2 000 p.e.). Requirements of this Directive are supplemented by requirements of connecting EU directives and especially by the Directive of European Parliament and Council 2000/60/EEC which states the framework of the scope for Community measures in the field of water management (Water Framework Directive). Compliance with the requirements of these directives leads to the achievement of good environmental status of water bodies.

The sufficient treatment and discharge process of urban waste water is proving very demanding as far as finance, time, technics and technology. Particular countries often cannot realize it in short time and without financial support. The EU is increasingly aware of difficulties in this process and financially supports states before and also after EU accession. The specific conditions of sewage system and deadlines are determined in the Association Agreement and all of these are obligatory for each state. The MS are expected to establish uniform strategies and present national programmes for implementation of the Directive to the Commission.
The urban waste water is a mixture of water from domestic sources (blackwater and greywater from toilets, bathrooms and kitchen), wastewater from commercial facilities and institutions including hospitals, industrial wastewater (as food processing) and run-off rain water from roofs, roads and other surface areas. The composition of the urban waste water is presented in the figure below.

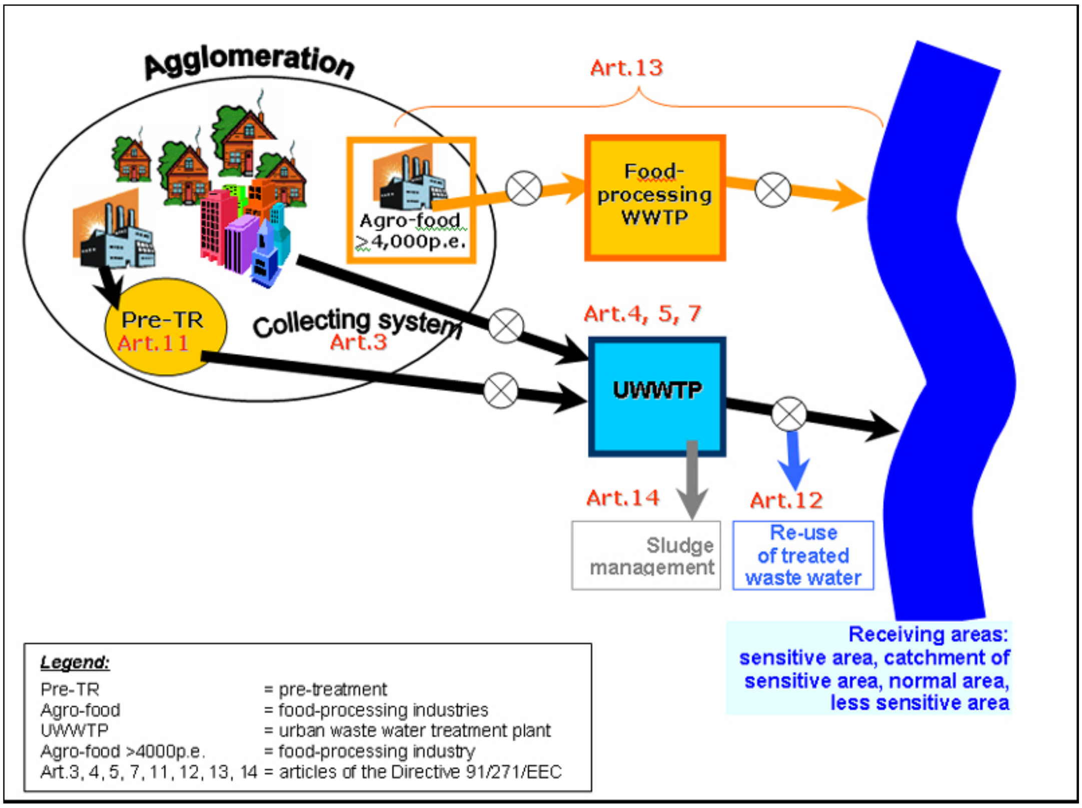


Figure 1. Composition of the urban waste water

During the preparation of national strategy for the urban waste water and sewage system of the country, legislation, environmental, technical, technological and economic aspects, which reflect local conditions such as character of built-up area, demography, urban development including industries, topology, availability of suitable recipient, climatic conditions and others should be adequately taken into account. This strategy is considered as framework for the Plan of the public sewage system development. This plan forms basis for sewage system and where the WWTP localisation and which settlements (villages) will be connected to this sewage system in the future. The process of sewage system construction will come out from stated priorities of implementation for given areas. The general principle is that the priority is given to construction, respectively completing and reconstruction of the largest sewage system and treatment plants since here the investment and operation cost per one connected inhabitant are lowest and the benefits for environmental protection are highest.

1.2 Agglomerations in Slovakia

Directive 91/271/ EEC lays down the obligation to sewage in agglomerations (an area where the population and/or economic activities are sufficiently concentrated for urban waste water to be collected and conducted to an urban waste water treatment plant or to a final discharge point) in the size category over 2 000 p.e. Designed sewage system can serve one agglomeration or even more agglomerations (examples are presented below). In Slovakia, there were proposed and approved agglomerations above 2 000 p.e., covered by the requirements of the Directive 91/271/EEC. These serve also for evaluation of fulfilment the obligations of the Slovak Republic to the European Union. Within agglomerations above 2 000 p.e. are not all settlements in Slovakia (especially smaller settlements). However settlements not all, will have to be connected to sewage system in the near or far future. Therefore these should be taken into account for collecting waste water. As it is not expected that each settlement will have its own treatment plant, the sewage system must include both settlements in agglomerations (obligation for sewage towards the EU) and also other ones (without stated deadline of connection to sewage system). Thus, the sewage system sets assumptions for connection of all settlements while the realisation will be implemented in stages according to priorities and financial possibilities. There are many combinations of sewage systems. In the simplest case, one settlement has one sewage system (or one agglomeration that concerns the obligation to the EU). Another example: several agglomerations (settlements in agglomerations that concern the obligation) and settlements (often small villages) whose connection is ecologically, technically and economically reasoned and advantage, are connected to one sewage system connected to one treatment plant. This system is implemented in several steps.

In the preparation of draft Plan of Development of Public Sewage Systems, there is evaluated each relevant area separately according to relevant criteria is evaluated and its specific character is also taken into account. Proposed sewage forms a basic framework that will be worked out in feasibility project of sewage construction and evaluated in the process of construction approval. Draft Plans serve also as a background for determination of priorities of public sewage development, determination of necessary investment cost, background for the Programme of Measures of the River Basin Management Plans, etc.

2. CRITERIA FOR DESIGNING OF SEWAGE SYSTEMS

2.1 Environmental criteria

The decisive factor of the sewage system concept of each interested area are environmental criteria and requirements for environmental protection (including health of population), and technical solution as well. The most important environmental criteria include:

- <u>Size of pollution source</u> – amount of generated load and its impact on environment, especially on surface and groundwater, number of p.e. (BOD, as 60 g of/capita/day), areas with concentrated development and scattered development – of mountain character. This criterion is one of the most important for set up concept of sewer system and WWTP.

- Requested level of recipient protection – availability of proper recipient, flow condition (especially Q_{min}), location of treatment plant, amount of treated waste water, application of emission-imission principle, increased protection of recipients that serve or are potential drinking water resources, protection of groundwater resources used for supply of inhabitants living in alluvial part of rivers, location of agglomeration, existence of Protected Water Areas, location of water bodies with poor and bad environmental status, water bodies not reaching good chemical status, areas of European importance, protection of thermal and mineral water, increased sensitivity of recipients to nutrients, transport of nutrients to downstream parts of river basins. In case of requirement for increased protection of recipient is this criterion preferably applied in plans on construction of sewer system and WWTP.
- Requested quality of treated waste water – application of relevant technology of waste water treatment, sewer, application of emission-imission principle, compliance with applicable legal requirements for waste water treatment.
- Protection of groundwater bodies – selection of sewer system, uniform or divided sewer system, surface water treatment, excluding waste water infiltration, individual ways of waste water treatment, technical solution of infiltration object, protection of groundwater bodies.

2.2 Technical criteria

During the planning of sewer systems construction all requirements of optimal function, operational stability, adequate investment intensity, operational costs, impact on recipient, etc. have to be respected. In determination of functional requirements is the whole system evaluated whether its extension or modification (for existing systems) will not cause violation of valid rules or standards related to the water body protection. Functional requirements on sewer systems have to be set in such way that the discharge of waste water should be conducted without impact on environment, risk to public health or risk to operating staff. Total cost (investment and operational) have to be taken into account as well. The impact of sewage systems on recipient must comply with requirements of entitled water bodies. Other specific requirements of those water bodies should be also accepted and fulfilled.

The function and reliability of sewage system is a prerequisite for it use under real conditions. In order to fulfil this prerequisite, several operational conditions have to be fulfilled, e.g.:

- Sewers must not get clogged during operation,
- The periodicity of flooding and overloading must comply with stated limits,
- Protection of public health and lives must be secured,
- Recipients must be protected from pollution within stated limit values,
- Sewerage pipes and sewers must not threaten existing and neighbouring constructions,
- Requested service activity and integrity must be reached,
- Waterproofness of sewerage pipes and sewers must comply with test requirements,
- Occurrence of odour and toxicity must be eliminated,

- Proper access for maintenance must be secured.

> *Note*
>
> *Although it might seem that mentioned operational conditions are well-understood, in practice may occur many problems that often lead to technical and construction problems which disable the effectiveness of sewage systems functioning. One must be aware that the sewer system (canalisation) is quite demanding investment (much more expensive that construction of a waste water treatment plant) and its proposal and technical project must be carefully prepared. Underestimating of even small details in preparation phase returns in the form of failures and accidents which can have significant ecological and other consequences.*

2.2.1 Criteria for development of agglomerations according to the UWWTD

The Directive 91/271/EC covers agglomerations ~~of~~ more than 2 000 p.e. at the same each agglomeration has to comply with all requirements defined by the Directive. The agglomeration is understood as an area where the population and/or economic activities are sufficiently concentrated for urban waste water to be collected and conducted to an urban waste water treatment plant or to a final discharge point

Criteria for delimitation agglomerations come out from the EU regulation "Terms and Definitions of the Urban Waste Water Treatment Directive 91/271/EEC" (2007). The existence of agglomeration doesn't depend on the fact whether there is a sewer network or waste water treatment plant constructed. The agglomeration is characterised by given concentration of population, services and industries for urban waste water to be collected and conducted to an WWTP or to a final discharge point. So, the agglomeration includes also areas where the sewer network was not constructed yet. In development of agglomerations also expected growth of given area must be taken into account. In case of small number of connected inhabitants and planning of sewer network and treatment plant **the agglomeration development plays** a key role.

In delineation of the agglomeration – satisfactorily concentrated area – it is necessary to proceed from case to case and take into account local conditions. The border of agglomerations can but not have to correspond to borders of administrative units (several administrative units can form one agglomeration, respectively one administrative unit can be formed by several agglomerations) – as it is presented in Fig. 2. The agglomeration can be equipped with one (relation 1:1) or several urban waste water treatment plants (relation 1:n).

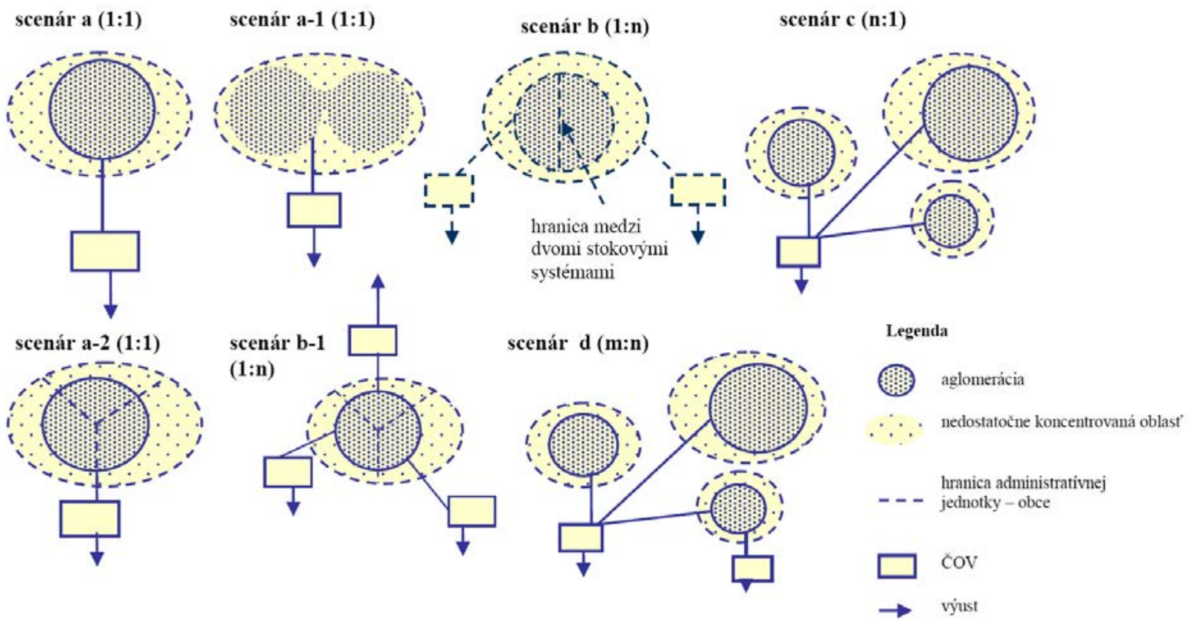


Figure 2. Possible relations between agglomerations and water treatment plants (Terms and Definitions, 2007, adjusted)

The size of agglomeration depends on overall generated load from resident inhabitants, temporary inhabitants, industries connected to urban sewer network, local facilities, service, imported waste water, and waste water origin in the agglomeration. Chosen technical solution can lead neither to decrease the density of sewer, nor to the quality of waste water treatment. In exceptional circumstances when there is no reason to construct the sewer network due to inappropriate cost, a part of agglomeration can be solved individually (cesspools, domestic WWTP). These shall achieve the same level of environmental protection as provided for urban waste water discharged into the collecting system.

Types of closed systems (cesspools) are considered as satisfactory, if they are waterproof and all accumulated water are treated on requested level according to requirements on the agglomeration in which they were produced. The size of agglomeration depends on generated load expressed in p.e., and sensitivity and type of receiving area. The Directive 91/271/EEC does not determine the distance between particular agglomerations, i.e. areas with satisfactorily concentrated urbanisation. This distance is proposed by authorities of particular MS after consultation with EU responsible bodies. Determination of this distance is based on relevant conditions of particular countries. According to available information, these distances range from 300 m to more than 1 500 m. If the distance between agglomerations is too short, it decreases requirements on sewer system (obligation of the country) and on the other hand, longer distances increase requirements on sewer system (collecting and discharging of waste water). According to existing experience, it is more appropriate to create the agglomerations at first according to principles of the Directive 91/271/EEC and specific conditions in the country in order to fulfil the obligations and then subsequently to design sewer system where the agglomerations and other settlements will be included.

If investment and especially operational cost of sewage systems during the lifetime is taken into account, it is expected that even settlements from the distance 2 kilometres will be connected to sewage system. Then the construction of sewer system can be implemented in several stages (time periods). In the first stage, the parts of sewer system for agglomeration and common parts of sewer system will be constructed, and then (according to the necessity and funding possibilities) other settlements (or built-up areas) will be connected. Technical parameters of common sections are designed for the whole sewer system which will create conditions for its extension in the future. Similar situation appears in case of the water treatment plant construction.

Note: With respect to geographic and demographic character of interested area is reasonable to connect several settlements into agglomerations with common WWTP which increases the operational stability of WWTP and quality of treated waste water.

2.3 Principles and criteria for proposal of agglomerations and sewage systems

Basic principles of sewer system include following criteria that apply in evaluation of particular interested areas:

- Lower investment cost of construction of sewage system connection (inlet pipe between settlements in comparison to construction of treatment plant for given settlement),
- Securing of common sewage system for several settlements with less total cost,
- Increase of rate of protection of important drinking water resources (both surface and ground), mineral and curing water against contamination with the help of more reliable water treatment plant situated downstream and discharge into more suitable (usually with higher volume of water) section of recipient,
- Suitability of hydrological or hydrogeological conditions for discharge of treated water,
- Preferable application of gravitation discharge of waste water (without pumping stations, if possible),
- Taking into account both completed and not completed constructions also in cases when their localisation is not very suitable for the system,
- Allowing change of present waste water handling in selected emergency cases (for example, if capacity of the waste water sanitation facility is constructed without reserve (10-20% of the current volume), there is low possibility for extension of treatment in case of increased waste water discharges (e.g. increased number of inhabitants, industrial development),
- Connection of industries to urban WWTP (individual approach),
- Accepting increased requirements on quality of treated waste water in order to reach required **environmental and chemical status of surface water bodies (at least good status).**

Basic general principles for elaboration of sewage system concept are supplemented by factors characterising particular locality (agglomeration). Factors are: character of development of settlements (villages), demography, settlement urbanism, geomorphology of recipient and topology of development – (type and character, etc. are important factors for particular localities).

Character of municipality development

Character of settlement development, density of development, type of development and slope of the area considerably influence the way of sewage system. Sewage system of given area should comply with concept of areal development of given settlements (villages). In older Urban Plans (often also in present) there is missing the issue of water management infrastructure. If the solution of sewage system of given area is proposed (projected), but is not included in Land Use Planning documentation, it is desirable in further stages of project preparation to update Land Use Plans in order to evaluate general urban solutions and impacts taken into account by sewage system concept.

Municipality demography

Generated load depends on number of inhabitants, number of houses and flat units. Creation and distribution of generated load through sewage network (or future sewer system network) is an important factor. It is also important to distribute the area to parts for permanent living and character of its development, part for facilities, leisure activities, etc. Very important factors influencing sewer system projection process include the mobility of inhabitants, how many people move out for work, services, schools, or opposite, how many people come to rural locations, settlement, weekly and seasonal changes of really living inhabitants and development trends of a village in increase or decrease of inhabitants and transfer of inhabitants into cities, or from cities to surrounding villages.

Municipality urbanism

Information on facilities in settlement like schools, shops, restaurants, institutions, etc. are of relatively steady character from the point of view of generated load. Much more dynamic changes appear in industry and service reflecting in immediate boom, or downturn. Sudden and unexpected changes can happen in the agriculture sector. Existing, or being prepared objects of industrial organized zones flexibly react to immediate demand. One must take into account this phenomenon in process sewage system preparation.

Municipality geomorphology

Factors that cannot be influenced are the altitude, slope of terrain and hydrogeological basement of the settlement. The air temperature decreases when the altitude increases which influences the technological process of waste water treatment, degree of the protection of sewer system network and water treatment plants (for example placing the WWTP), etc. The increased altitude of the settlement is connected with higher precipitations, thickness and eventually duration of snow cover, and way of road maintenance in winter. An important influence has the way of water discharge from surface runoff and from surrounding areas of the settlements.

Hydrogeological conditions of settlement (agglomeration) affects really acceptable depth of sewer gravitation networks, rate of economic viability to accept the requirement of gravitation connection of underground spaces (objects), condition of water infiltration in place of WWTP (small resources without surface recipient), and water infiltration from surface runoff (necessity for individual complex evaluation from case by case). An important factor is the groundwater table level that affect (both economic and technical~~ly~~) depth of founding sewers and sewerage objects, condition and process of infiltration.

Recipient

The existence or not existence of the proper recipient for discharge of treated waste water from given area influences the final approach to sewage system and to location of the WWTP. Ecological conditions in recipient (surface stream where treated waste water is discharged) are characterized by flows and water quality. In order to determine the quality of treated water there is necessary to take into account guaranteed flows for example Q_{355}, or ecological flow if already defined (or other limit values). After mixing surface water with treated waste water, the resulted water quality is determined according to emission–imission principle and both good environmental and chemical status should be achieved.

In determination of the WWTP altitude it is necessary to take into account data on so called high water (flood conditions), i.e. situations when water level is high, with occurrence once in 1, 2, 05, 10, 20, 50, 100 years. From these data it is then possible to derive altitude of the treatment plant and the altitude of outlet in order that the treatment plant would not be flooded, respectively propose measures oriented to protection against high water. For treatment plant placing it is necessary to have information on flooded area in case of high water and also information on the rivers (slope of the river bed, bank stability, cross section, etc.).

Topology of urban development – type and character

Spatial layout of urban development and the slope of the area predetermine proper ways of waste water discharge. For agglomerations of city type and agglomerations of country type with concentrated development is in principle predetermined centralised system of waste water discharge. Uniform sewage network (common discharge of waste water and water from surface runoff) is recommended for large urban development and only waste water sewer network is recommended to be applied in suburban parts of towns and in villages. If in small agglomerations is the discharge of surface water through trenches without problems, usually it is let in original status, or the trench system should be rehabilitated or reconstructed. Application of separated sewer system for urban waste water and water from surface runoff is usually result of technical, technological, economic and especially ecological evaluation. In case of separate parts of villages consisting of several estates of mountain character of urban development it is reasonable to consider the decentralised way of waste water discharge and its treatment. Individual waste water treatment with discharge to surface water or infiltration to ground water is applied in very sparse (scattered) urban development or in case of hamlets. In sparse settlements of line type along roads or streams, respectively groups of settlements with permanent inhabitants there is used separated discharge of waste water that is realised by gravitation sewage system with the help of pressure of vacuum system, if necessary.

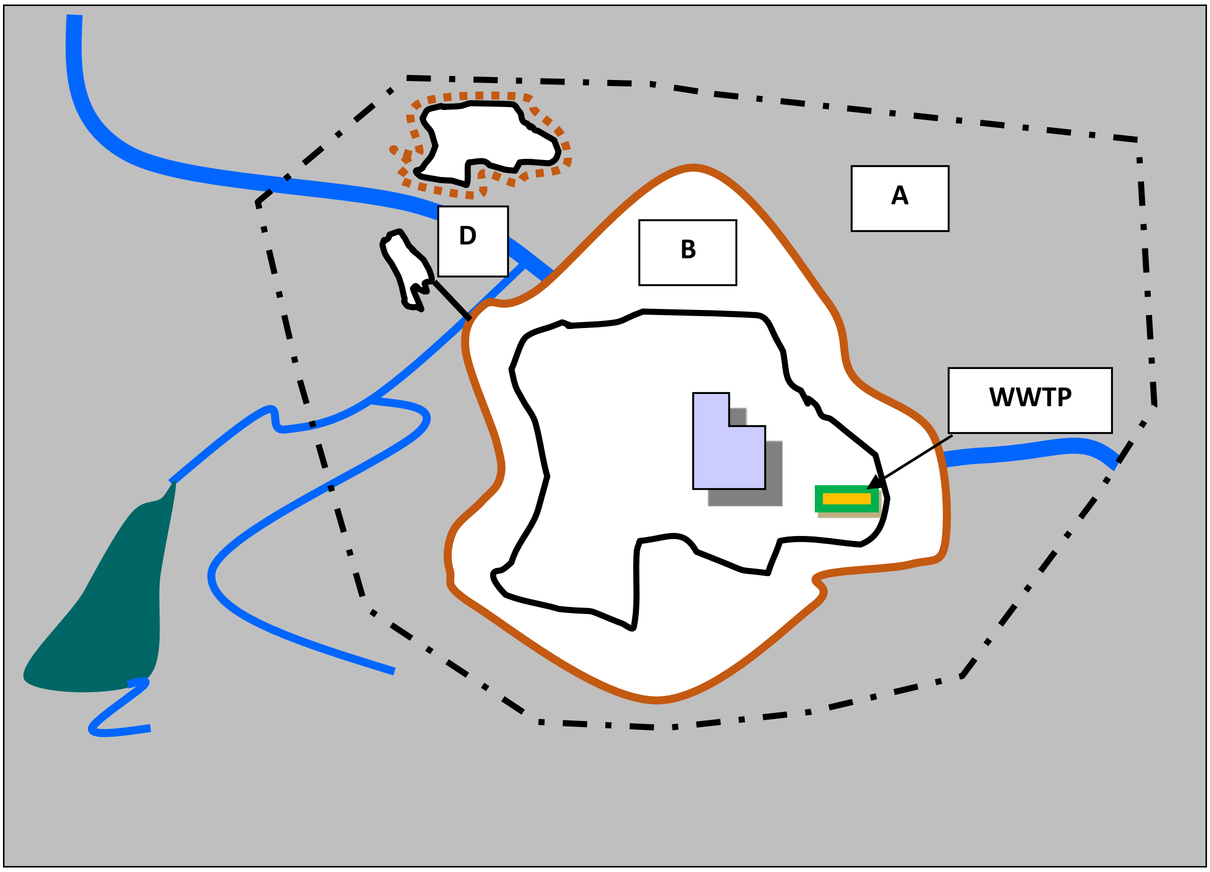
Individual approach to sewage system is applied in settlements with large public areas and large empty lots between houses. Individual approach is applied also in case of very dense urban development which is given by historic development and natural conditions. In such cases there is usually gravitation system, pressure or vacuum system or their combination used.

Problems can appear in vertical placement of urban development with respect to roads, or route of sewage system. If the slope of the terrain is very high and ground floor of buildings is below the sewer system level, usually gravitation sewer is chosen when waste water is pumped from houses to sewage system. Then gravitation sewer system can be combined with pressure or vacuum systems.

In settlements with expected larger urban development is the way of future waste water discharge determined by altitude, terrain, climate conditions as well as altitude and technical parameters of existing sewage system. In practice, there is always possible to choose an optimal way of sewage system for given locality.

Waste water treatment system from scattered urban development of mountain type with permanently living inhabitants is usually solved individually. It is possible to accumulate the waste water in sewers and then transfer it to existing waste water treatment plant (it is necessary to calculate the cost of that transfer, terrain accessibility, capacity of potential waste water treatment plant). For particular houses, respectively group of houses it is advantageous to construct home, or small waste water treatment plants which discharge treated waste water to surface stream or to ground water bodies (if it is allowed by legislation). Intensive processes of treatment (WWTP on principle of activation, biofilters, bio-discs) suit for permanently settled houses (with regular waste water production). Extensive processes of treatment (most often septic tank connected with root treatment plant (wetland), ground filter, sub-soiling, etc.) is suitable to apply for leisure and cottage type of houses where waste inflow is not regular.
Based on the requested criteria the following map of the agglomerations can be created as shown on the Fig. 3.

Figure 3. Delineation of agglomerations with existing and planned built-up areas



Legend

- *Administrative boundary of municipality*
- *Boundary of presently built-up area*
- *Boundary of agglomeration larger than 2000 PE*
- *Boundary of agglomeration lower than 2000 PE*
- *Rivers*

A – Agricultural and forest land

B – Planned to be built-up area

D – Distance of agglomeration from the nearest built-up area

WWTP – waste water treatment plant

2.4 Technical and operational criteria for waste water treatment plants

For technological and operational criteria, local requirements concentrated on the quality of treatment process are taken into account predominantly. More specifically, amount and level of pollution of incoming waste water, on one hand and requirements on recipient protection on the other hand determine requested level of waste water treatment process, composition of water treatment plant facilities and the overall technological process of WWTP. Basic criteria and requirements on WWTPs can be characterised as follows:

- Ensure the compliance with limit values for discharge of waste water to treatment plant,
- The necessity of ensuring the treatment in full range of flows during dry and wet periods (rain period),
- The safety for operating staff,
- Not overload with odour, noise, toxicity, aerosols, and foam (the need to meet relevant criteria and limit values),
- Possible future extension or rehabilitation must be taken into account,
- High reliability of operation must be secured,
- Economic advantage of total cost,
- Minimisation of produced waste and ~~its~~ possible reuse.

The requirements of the Directive 91/271/EEC on the agglomerations and sewage systems are summarized in the Tab. 1.

Table 1. Requirements of the Directive 91/271/EEC on the agglomerations and sewage system

Requirement	Sewage system	Waste water treatment
Agglomeration > 10 000 p.e.	Complete sewage system, Article 3, (1)	More strict treatment Article 5, (2)
Agglomeration > 2 000 p.e.	Complete sewage system, Article 3, (1)	Secondary or equivalent treatment in accordance of Annex I B, Article 4, (1.3)
Agglomeration < 2 000 p.e.	No specific requirements	No specific requirements, but "appropriate" treatment should be applied

2.5 Environmental and technical criteria for determination of priorities and urgency in public sewage construction

Environmental and technical criteria according to which there is possible to set priorities and urgency of sewage system construction are as follows:

- ***Size of pollution source*** **–** fulfilment of the Directive 91/271/EEC on urban waste water treatment in relation to size categories in discharge and treatment of waste water. Lower level of urgency is applied in case of sewage systems smaller than 2000 p.e.
- ***Reaching required level of waste water treatment*** **–** reaching the satisfactory waste water treatment with removal nutrients N and P is the priority. The same urgency is given to sewage systems that include sewer network where waste water treatment is not secured, and to sewage systems located in sensitive and other protected areas.
- ***Share of inhabitants connected to sewage system*** **–** the emphasis is put on development of existing sewage systems with small number of connected inhabitants. On the other hand, sewage systems with huge number of connected inhabitants are considered as less problematic.
- ***Placement of sewage system*** **–** preferably construct sewage systems in protected areas, in areas with high eutrophication potential, or in areas where can be affected drinking water for public supplying system and drinking water resources in alluvial parts of the rivers.

The Plan of Public Sewage system development prepared according to above mentioned criteria fill be the basic framework document guiding the process of preparation, planning and construction of sewer network and waste water treatment plants.

3. REQUEST TO PROVIDE BACKGROUND MATERIALS

Background materials and data for delineation of the agglomerations and the Plan of Sewage system development can be summarized as follows:

- Map of pilot river basin in the scale at least 1:20 000, eventually 1:50 000, with framework indication of urban objects, altitude of an area, river network (streams and flow direction) and protected areas;
- Basic information on streams (minimal flows, respectively Q_{355}, average annual flow, Q_{100}, and information on flooded area for localisation of the treatment plant);
- Data on number of permanent and temporary inhabitants of village, information on production of waste water from industry, service and facilities;
- Data on number of inhabitants connected to sewer network in the settlement, number of inhabitants not connected on sewer network, information on number of domestic WWTP, number of cesspools, and data of transfer the waste from cesspools to treatment plant;
- Information on expected settlement development, eventually information received from Land Use Development Plan of settlements, if exist;
- Information on sewer networks in a settlement, type of sewer network (uniform, separated, semi-separated, pressure, vacuum systems);
- Way of rain water handling (surface runoff);
- Information on waste water treatment plant, its capacity, technology of waste water treatment, location of waste water treatment plant;
- Basic information on not completed sewer networks, share of completed sewer network in settlement, share of not completed sewer network in settlement;
- Information on capacity and technology of not completed WWTP.

3.1. Steps to delineation of the agglomerations

After **transposition** of the Directive 91/271/EEC on urban waste water treatment into the legislation in Georgia (Water Act, Building Act, Spatial Development Plan etc.), it is recommended to **implement** the requirements as stepwise approach as it is proposed below:

- Characterisation and analysis of the river basin;
- Identification of the municipalities and their built-up areas (houses, service yards, adjacent fields, etc.) as defined by the legislation;
- Identification of the potentially built-up areas adjacent to the municipality based on the relevant regulations;
- Technical and economic analysis of the agglomeration (based on the principles and criteria as presented in chapter 2.3);
- Delineation of the agglomeration boundary including distance "D" without any building and constructions (it is recommended to be at least 300 m as a rule of thumb, but this distance may be lower). Agglomeration boundary has to respect the cost effectiveness.
- List of the agglomerations (for grouping into the categories) as presented in Table 1 of this Guidelines (including Map).
- Proposal of the waste water treatment system for the agglomerations with respects of criteria and principles as defined in chapter 2.3.

This Guidelines will be applied in the Alazani river basin in Georgia that was selected as pilot river basin (together with the Guidelines on the delineation of sensitive areas).

REFERENCES

Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment

GLOSSARY

Except where indicated 'the Directive 'Articles', 'Annexes' and 'Table(s)' refer to the Urban Waste Water Treatment Directive 91/271/EEC

1 population equivalent: '1 Population Equivalent' is the unit of measure employed in the Directive for assessing the polluting potential of waste water discharges. 'Population' does not refer to a population headcount of communities. It is defined in the Directive as: *'1 p.e. (population equivalent)' means the organic biodegradable load having a five-day biochemical oxygen demand (BOD5) of 60 g of oxygen per day.* This means the oxygen used, largely by bacterial organisms, in breaking down the organic matter in waste water. The use of 'equivalent' is therefore a proxy for any organic matter, not just that arising from human metabolism, that when broken down by bacterial cultures utilises dissolved oxygen. The sensitivity of water to discharges, such as if they are impacted by excess nutrients in discharges, may also need to be considered. See Article 2(6).

Agglomeration: An agglomeration is an area where population and/or economic activities are sufficiently concentrated for urban waste water to be collected and conducted to an urban waste water treatment plant or to a final discharge point.

Appropriate treatment: The term used in the Directive to refer to the waste water treatment applicable to smaller communities. "Appropriate treatment" means " treatment of urban waste water by any process and/or disposal system which after discharge allows the receiving waters to meet the relevant quality objectives and the relevant provisions of this and other Community Directives". See Articles 2(9) and 7.

Bathing Water Directive: Introduced in 1975 to help protect bathers (in identified water) from the harmful bacteria and viruses arising from sewage discharges largely. It sets microbiological and physico-chemical quality requirements for identified bathing water. A revised Bathing Water Directive was adopted in March 2006 requiring higher water quality standards than the 1975 Bathing Water Directive.

Biochemical oxygen demand (BOD): A widely used measure of polluting potential – BOD is a measure of oxygen use or 'demand' of bacteria and other organisms breaking down the biodegradable load present in waste water. BOD is the basis for deriving a community's **population equivalent**. See Article 2(6) and Annex I, Table 1.

Biodegradation: The chemical deconstruction of organic matter by largely by bacteria, fungi and other organisms. When biodegradation occurs in the water environment dissolved oxygen is utilised generally through bacterial action. If acting on significant amounts of organic matter, such as that present in untreated waste water, the process rapidly deoxygenates water and can lead to fish and invertebrate deaths.

Diffuse pollution: Pollution not arising from a specific, identifiable point. Agricultural land and brownfield sites are often cited as sources of diffuse pollution. Contrasts with **Point source pollution**.

Effluent: Generally, the treated waste water discharged from a sewage system. Effluent from treatment plants is typically sampled and analysed to ensure discharged water complies with standards set in **discharge authorisations**. Where percentage reduction standards for parameters are to be achieved, effluent is sampled in conjunction with **influent** to enable reductions to be measured.

Eutrophication: Naturally occurring eutrophication is usually the beneficial enrichment of the environment by various mechanisms such as animal and plant decay, mineral and nutrient deposition from rock weathering and soil erosion, nitrogen-fixing by bacteria or lightning. The natural state of environments with low to high nutrient levels (their trophic status) are classed as: oligotrophic (low), mesotrophic (medium), eutrophic (high). Ecosystems associated with these naturally arising trophic states can be adversely impacted by nutrient inputs from human activities. For example, small inputs of nutrients to oligotrophic ecosystems can cause more damage than larger inputs to a mesotrophic environment and so on. 'Eutrophic' describes the status of water chronically impacted by excessive nutrient inputs (for that ecosystem) from human activities. Eutrophic water may usually be populated by plant and algal species that are better able to utilise excess nutrients and that are more tolerant of poor quality water arising from eutrophication, (such as low oxygen or light levels), and so outcompete other species. See Article 5 and Annex II (A)(a).

Parameter: In the context of waste water treatment and a **discharge authorisation** a parameter is a pollutant present in waste water that should be controlled through relevant treatment, such as UV light irradiation to destroy bacterial or viral contaminants. Examples of other parameters that need to be controlled are: **BOD**, named toxic metals or nutrients or sewage litter.

Pathogen: Disease causing agent, more generally referring to viruses, bacteria and protozoa, but can include microscopic invertebrates, fungi and alga.

Point source pollution: Pollution arising from specific identifiable points, such as the end of pipes discharging waste water. Contrasts with **Diffuse pollution**.

Primary treatment: Primary treatment involves the passive and/or chemically-enhanced process of sedimentation of suspended solids not removed by preliminary treatment. The Directive sets percentage reduction figures for biochemical oxygen demand of the influent by at least 20% and a reduction in total suspended solids in the influent by at least 50% before discharge to receiving water. Discharges from agglomerations to inland and estuarine water above 2,000 p.e. and coastal discharges above 10 000 p.e. to **normal water** receive secondary treatment with more stringent **BOD** standards. Primary treatment standards are therefore generally intended to apply to discharges made to **less sensitive areas** provided comprehensive studies demonstrate a minimum of primary treatment would not adverse effects the environment. See Article 2(7).

Secondary treatment: Secondary treatment is the biological treatment of waste water. It generally involves use of bacterial cultures to break down biodegradable matter in waste water. The objective of secondary treatment is to reduce the **BOD** of waste water to avoid chronic oxygen depletion in receiving water, the immediate and most damaging effect of untreated sewage discharges to the environment. Various processes are used to achieve BOD reductions, such as: aeration of waste water with bacterial culture sludges to accelerate biodegradation of organic matter, often used for larger communities; trickle filter beds containing aggregate covered with bacterial cultures to maximise the surface area over which waste water is trickled, used for small to medium size communities. See Article 4 and Annex I, Table 1.

Sensitive area: A 'sensitive area' is a legally designated body of water. There are three criteria for their determination with the objective of (a) protecting water ecosystems from excessive nutrients; (b) protecting abstraction source water from high nitrate levels and (c) 'flagging' other directives' water that require tertiary treatment to achieve their parent directives' quality requirements. The common thread is that whatever the criterion, sensitive areas receive tertiary treatment protection from impacting discharges. See Article 5 and Annex II (A) (a), (b) and (c).

Sewer: Generally, it is network of pipes and objects to collect and deliver the waste water to the WWTP.

Sewage: The more commonly used term to refer to '*urban waste water*'. In general, this report uses the term '*waste water*'.

Sewerage: Generally, a term to describe the network, or system, of pipes, and for larger systems, also tunnels, that collect waste water; their receiving drains, manholes, pumping stations, combined sewer or emergency overflows, screening chambers and WWTP. Sewerage ends at the point of discharge of treated or untreated waste water to the environment.

Suspended solids: This is a term used to describe the matter, both organic and artificial, such as **sewage litter**, suspended in water. See **Sewage solids** also.

Tertiary treatment: Treatment provided after preliminary, primary and secondary treatment. It is provided to address a variety of polluting agents so can take a variety of forms such as ultra-violet light irradiation (UV treatment), microfiltration or chemical dosing. The Directive applies the term **more stringent treatment** (then secondary treatment) to refer to tertiary treatment. The Directive does not set (environmental) quality standards for other directives' water identified as sensitive areas – the Directive only sets emission standards.

The report was prepared by the joint team of experts and controlled by both project managers.

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