Financira Europska unija

IPA PROGRAM PREKOGRANIČNE SARADNJE BOSNA I HERCEGOVINA - CRNA GORA

WILD LANDFILLS AND IMPACT ON WATERCOURSES

WEST HERZEGOVINA COUNTY (BiH)

Project developer:

Association for Development, Environment and Culture EKO ZH

NGO Our Action

Youth DRIVE

EKO

NVO "Nasa akcija"
Radi danas za bolje sjutra.

IPA – Cross - border cooperation program BiH - Montenegro
Project **YOUth Drive** – Program for raising awareness on proper waste management and empowering legislators for taking action

Program for raising awareness on proper waste management and empowering legislators for taking action

Project developer: **Association for Development, Environment and Culture EKO ZH**
NGO Our Action

Expert team for the study: **TEHNOZAŠTITA d.o.o.** Mostar

Project manager: M.sc. Radoslav Udovičić, dig

Designers and collaborators: Assoc. prof. Ph.D Željko Rozić, dig
Jure Udovičić, dig
Selma Mrgan, dig

September, 2020.

"This publication was made with the help of the European Union. The content of this publication is the exclusive responsibility of the Association for the Development, Environment and Culture of EKO ZH and NGO Our Action, and does not necessarily represent the views of the European Union.

CONTENT

A.

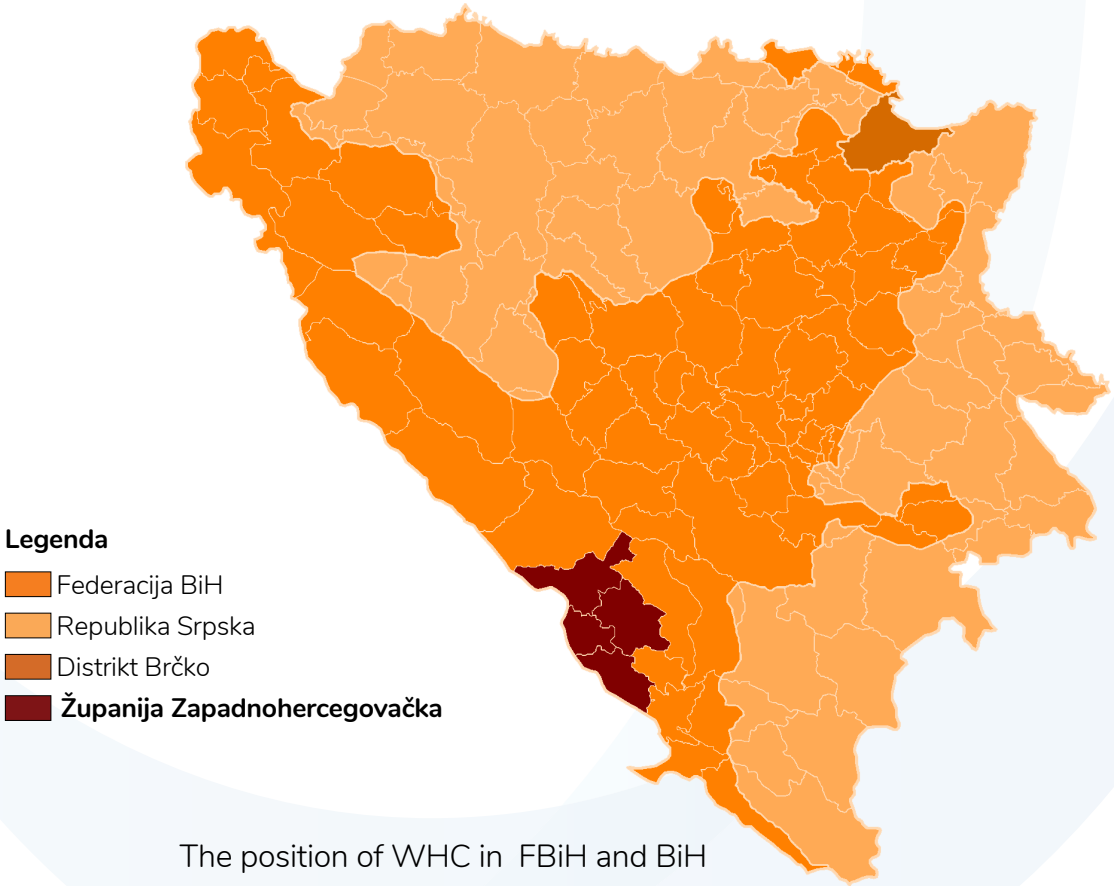
WEST HERZEGOVINA COUNTY (BIH)

1. REVIEW OF THE CURRENT SITUATION

City of Ljubuški, City of Široki Brijeg, Municipality of Posušje, Municipality of Grude

1.1. Introduction – West Herzegovina County

Based on the terms of reference and natural and created conditions and available documentation submitted by the project developer, the Association for Development, Environment and Culture EKO ZH, the requested project was made, which shows and illustrates the state of the environment in the West Herzegovina County (hereinafter WHC).. The impacts of possible pollutants - illegal landfills, and their impact on the nature of water resources were analyzed.



The position of WHC in FBiH and BiH

West Herzegovina County is one of ten counties in the Federation of Bosnia and Herzegovina. It was founded in 1996, and is located in the southwestern part of the F BiH, which borders the Republic of Croatia. It occupies 1,364 km^2 or 5.2% of the area of the Federation of Bosnia and Herzegovina, and has a population of about 94,000.

The seat of the county is the town of Široki Brijeg, and it also includes the municipalities of Grude, Posušje and the town of Ljubuški. It stretches from the northern side of the mountain Čvrsnica all the way to the border with the Republic of Croatia in the west and south, while on the east it borders the Herzegovina-Neretva County. The northern border of WHC goes to the tops of the mountains Vran and Čvrsnica; the eastern one by the top of the Čabulja mountain and the stepped terraces of the Goranačko-Bogodolska plateau, Mostarsko blato and Brotnje, the western by the slopes of the Vran mountain from Blidinjsko Lake to Studeni vril and the southern and southwestern state border with the Republic of Croatia.

1.2. Natural characteristics

1.2.1. Hydrogeological features

Although the area of the West Herzegovina County covers a distinctly karst terrain, several significant surface flows have been formed in it, the boundaries of which are difficult to determine due to high karstification. Surface runoff for the most part of this area takes place through the Neretva River Basin.

Although the Neretva is generally rich in water, some of its tributaries, especially in the higher horizons, as well as the springs that flow directly into it, regularly dry up, which in some cases lasts for most of the year.

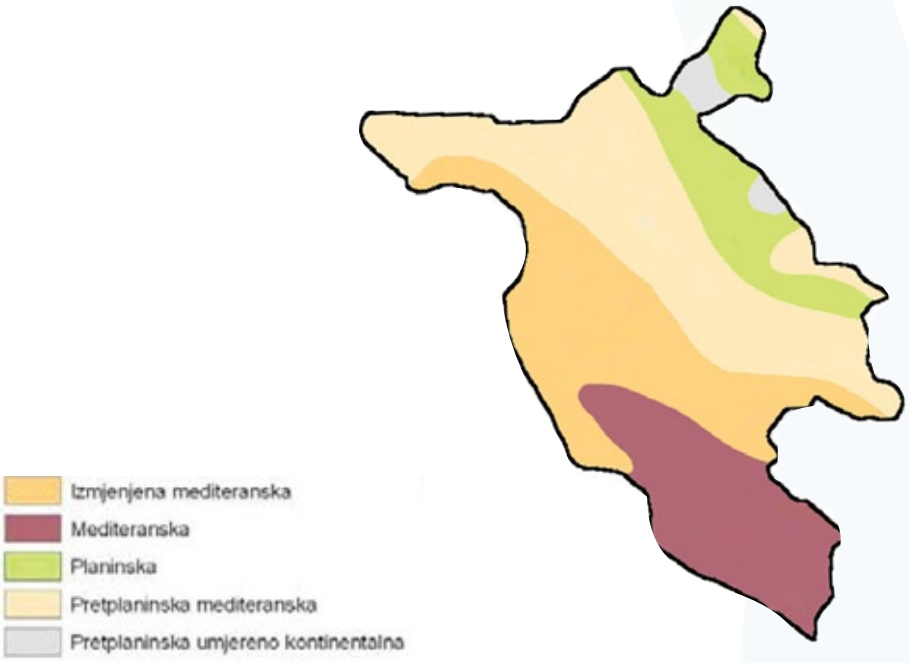
The geological structure of karst terrains and their transport and accumulation characteristics make the runoff process significantly different from runoff in non-karst terrains. This is reflected in the extremely intense vertical infiltration of water from the surface into the ground, and in the lack of a developed surface river network. There are significant areas of karst with huge rainfall during the year (even among the largest in Europe), but without a constant water flow. Even occasional currents are rare, which appear on some surfaces only after intense rainfall of up to 20 mm / h. This abundance of water is quickly infiltrated underground by an intensive fissure system and transported by underground karst conductors into karst underground aquifers. Their discharge is done through outlets that are known as one of the most important features of karst, and that is karst springs.

The occurrence of water in occasionally flooded karst fields has a significant impact on the water regime in karst. The magnitude of the impact depends on the specific situation and in some basins over one half of the annual inflow of water passes through them. The formation of branched underground streams, by which the movement of water is directed towards the common exit, is analogous to the surface river network through which water is drained towards the mouth. At the same time, completely different conditions for the movement of water in relation to surface water can be formed in the ground, so the general direction of groundwater movement can be opposite to the surface. Within this area there are smaller areas with waterproof or poorly permeable soils. These are isolated areas where fine sediments and sediments have settled.

1.2.2. Climatic characteristics

The West Herzegovina County includes two basic types of climate, Mediterranean and mountainous. There are transitional forms between these two types, and, depending on the distance from the sea and altitude, it depends on whether the influence of the Mediterranean or mountain-continental climate will prevail in one of the transitional areas.

The Mediterranean climate, which characterizes the areas of Ljubuški, Grude and Široki Brijeg, is characterized by very hot and dry summers, and mild and rainy winters, and the average annual temperature ranges from 13 ° C to 16 ° C. The warmest month is July. - has a medium temperature above 25 ° C, and the coldest January above 5 ° C. The annual amount of precipitation is significant, but with a very unfavorable distribution during the year, which is one of the basic characteristics of the Mediterranean climate.



Climate zones in WHC (source: WHC space vulnerability study)

In winter it falls over 60%, and in summer less than 40% of the total annual rainfall. Thanks to mild winters and the fact that there is not a single month with an average temperature below 5 ° C throughout the year, it is possible to grow vegetation of certain crops (grasses, cereals, winter vegetables, etc.). Summer droughts make it possible to produce in this area during the summer only with irrigation. This climate favors the production of grapes, fruits, early vegetables and flowers.

The mountain climate has all the basic characteristics of the continental climate with the difference that there are no warm summers and that the precipitation is slightly higher compared to the continental climate. he mountain climate has cold winters and cool summers. The average annual temperature ranges from 6 ° - 9 ° C. The warmest month (July) has an average temperature of 18 ° C, and the coldest (January) less than -3 °. The average annual rainfall is over 1,500 liters per m2. Maximum precipitation comes in late autumn and winter, and minimum in summer, so summer droughts are quite common here.The frost-free period is quite short and depends on altitude and position.Due to the unfavorable climate, the length of the vegetation period is quite shortened compared to the Mediterranean climate. Due to the shorter vegetation period, these areas have a smaller number of plant species, ideal conditions for the production of fodder crops, primarily artificial meadows and natural grasslands, and are destined for livestock production.

1.3. Disposal of solid and liquid waste and problems with landfills in the West Herzegovina County

In the West Herzegovina County, municipal waste is disposed of in municipal (city) landfills (list given in the tables in the following chapters - individually), which are usually unregulated and without proper control of the impact of pollution on people and the environment, and "wild" landfills. The main reasons for such a bad situation are insufficient knowledge of the problem and the possibilities by which the problem can be solved, the problem of site selection or decision on the location where the "Waste Management Center" would be built, and the provision of financial resources and organizational solutions. The key problem with the creation of illegal landfills is the lack of coverage by municipal waste collection services in the territory of cities / municipalities. It is important that we need to work on changes to the Decision on Communal Order. It is necessary to publish on the official website because citizens need to be referred to the same or the websites of utility companies in order to make all relevant information available to citizens. Having in mind the complexity of environmental issues throughout BiH, and the importance of the environment for economic development, human health and social balance, the World Bank financed the development of a basic program document - the BiH Environmental Action Plan (NEAP), which, based on the principles of sustainable development, completely creates processes for environmental protection and provides guidelines for the beginning of new practices in the overall development of BiH.

One of the 10 thematic units that is specifically addressed in the NEAP is waste management. Waste is presented as one of the priority environmental problems in BiH. It is estimated that BiH has very few landfills that, with certain shortcomings, can be included in sanitary landfills. One such landfill is the Uborak sanitary landfill near Mostar.

The current state of waste management in BiH is characterized by the fact that there is no organized waste exchange, no collection for the purpose of recycling and reuse of useful components of waste, which is a serious economic loss for the community. As waste is not sorted and separated for recycling, the total amount of waste disposed of in landfills is significantly increased, and the energy value contained in waste is not used, etc. NEAP defines goals and measures for achieving EU standards for integrated management waste. In BiH, relatively high investments are needed to reach these standards, so gradual changes are envisaged to improve the situation in waste management.

According to available data obtained from public utility companies, waste production was 215 kg /flat/year in ZZH, similar to Hercegbosna County, Bosnia-Podrinje County, Central Bosnia County (Source: 2010 State of the Environment Report, FMOIT). The total amount of non-hazardous industrial waste in the FBiH, mostly waste from thermal processes, and to a lesser extent waste from inorganic chemical processes, according to the collected data from the questionnaire and estimates (given the intensity of production activities and characteristic waste), is about 3,225.100 t/year., of which WHC accounts for only 200t/year. Electronic and electrical waste Collection and disposal of EE waste is entrusted to the operators ZEOS eko-sistem doo and Kim Tec KIM TEC ECO doo In the area of WHC ZEOS eko-sistem has signed a cooperation agreement only with Ladanušić čistoća doo Posušje.

The placed containers on the territory of WHC are presented in the following table:

Municipalities / Cities	ZEOS infrastructure
Grude	Green furniture - vertical e-waste containers
Ljubuški	Green furniture - vertical e-waste containers
Posušje	Recycling yard - authorized collector

According to the **Law on Waste Management**, and within the process of obtaining an environmental permit, all municipal and inter-municipal landfills, mostly unregulated, are required to develop Waste Management Adaptation Plans and obtain an environmental permit. The environmental permit for existing landfills is issued on the basis of the submitted Adaptation Plan, which proposes the activities of remediation of the landfill where the waste is disposed of in an inadequate manner, and the activities of adaptation of the other body of the landfill. Since the beginning of 2012, waste disposal has been banned in an unsanitary manner and all landfills that have not received environmental permits have had to be closed. So far, no municipal landfill has done this Plan. By the way, the closure of local municipal landfills and the opening of regional ones has been a legal obligation since 2003, and the deadline for the realization of that project was 2008.

1.3.1. Solid waste

First of all, it should be emphasized that not all cities / municipalities have an established system of separate waste collection and that everything ends up in municipal waste (medicines and small electronic waste). One very important problem will be solved through this project, and that is small electronic waste that people throw in the utility room in a way that 160 bins for small electronic waste will be placed in WHC. One small battery permanently pollutes 12 liters of water. Also, there are no special or completed landfills for construction waste, but construction, asbestos and solid waste is disposed of in unregulated landfills by municipalities / cities.

Data on generated quantities were estimated based on the level of service coverage According to these data, the calculated production of waste per capita on an annual basis in 2018 is in WHC 0,58 kg/capita/day or about 215 kg/capita/year.

Generated amounts of waste (t/year)	2014	2015	2016	2017	2018
Ljubuški	4924,00	4927,86	4683,32	4811,70	4993,90
Grude	2222,22	3541,67	4878,46	4456,25	4161,46
Posušje	3789,47	3854,17	3838,38	3939,39	4040,40
Široki Brijeg	7594,03	7449,28	7333,33	7933,78	7869,23
Total	**18529,73**	**19772,97**	**20733,50**	**21141,13**	**21064,99**

Waste generation per capita per day (2018)	kg/c/d	kg/c/year
Ljubuški	0,46	167
Grude	0,64	233
Posušje	0,53	195
Široki Brijeg	0,87	264
Mean value	**0,63**	**215**

For comparison, the daily generated quantities of waste in Zenica-Doboj County are 0,63 kg/c/day, Bosnian-Podrinje County 0,55; Tuzla County 0,89; Central Bosnia County 0,71 and Una-Sana County 0,81. In Croatia, it is produced per capita 393 kg/c/year, Serbia 318, BiH 325. Considering that WHC is a less industrial region, and more rural than urban (considering the population density per m2), the obtained values per capita in WHC represent real values.

Coverage of collection services was stated in the survey by public utility companies and municipalities / cities:

Coverage (%)	2014	2015	2016	2017	2018
Ljubuški	100%	100%	100%	100%	100%
Grude	90%	96%	96%	96%	96%
Posušje	95%	96%	99%	99%	99%
Široki Brijeg	67%	69%	72%	74%	78%
Mean value in WHC					**93%**

Waste from health facilities

Medical waste is waste generated in health care facilities. Data for the purpose of this study were obtained from the Ljubuški Health Center and the Široki Brijeg Health Center. Hazardous waste produced in these institutions was handed over for disposal to authorized companies for hazardous waste management, and non-hazardous to Public Utility Companies (hereinafter PUC) in the municipalities of origin. The Ordinance on Medical Waste Management ("Official Journal of FiH", No. 77/08) defines (Paragraph 5) the need to develop a Medical Waste Management Plan for each health care institution no later than 2 years after the entry into force of the Ordinance. WHC is responsible for approving the plan. None of the institutions developed the said Plan. Therefore, there is no clear record in the WHC on the amount and flow of medical waste.

Građevinski otpad

The WHC spatial plan states that it is necessary to establish an inert waste landfill. Within the development of this Plan, a couple of locations have been spatially defined:

- Municipality of Grude - locality in Tihaljina on the border between the municipalities of Grude and Ljubuški.
- City of Ljubuški - locality in the economic zone Grude Pogana Vlaka-Poljanice.

In Ljubuški, construction waste is not collected by PUCs, so it most likely ends up in illegal landfills, and there are no estimated quantities. According to the composition of waste determined in the municipality of Posušje, and the amount of waste disposed of, it is estimated that about 470 kg of construction waste per year is disposed of at the landfill. It should be noted that this amount does not show the actual value, as most of the construction waste is disposed of in illegal landfills. In the area of Široki Brijeg, construction waste is disposed of in illegal landfills. There is no estimate of the amount of this waste. Within the Spatial Plan (hereinafter SP) Široki Brijeg, several locations in various parts of the City of Široki Brijeg for inert waste are spatially defined: the industrial zone of Knešpolje, Ivanj Draga, and the area of Dužice and Buhovo. The city should make a decision at the level of the utility company to whom the concession for recycling and treatment of construction waste will be awarded.

Data on the status and disposal of construction waste in Posušje are not available, but it is assumed that it ends up in illegal landfills.

End-of-life vehicles

There is no record of the number of abandoned or obsolete vehicles in the area of WHC. At the FBiH level, a rulebook on the disposal of this type of special waste has not yet been adopted (September 2019). In any case, the locations where waste vehicles are disposed of should be identified in their municipal / city waste management plans. The company Pinocio doo Ljubuški operates on the territory of WHC, which deals with the purchase of metal materials, including waste vehicles. There is no exact data on the number of old vehicles, but numerous illegal dumps of these vehicles are evident - car waste along the roads from Široki Brijeg - Posušje - Grude - Ljubuški.

Waste tires

Most old waste tires from industry and transport are disposed of in an inadequate manner, incinerated or stored for a long time. Old waste tires are considered non-hazardous waste. There is no record of the amount of this type of waste. At the FBiH level, a rulebook on the disposal of this type of special waste has not yet been adopted (September 2019).

Waste fats and oils

There are no landfills or disposal sites for waste oils and lubricants on the territory of WHC. There are no data on the quantities of waste oils on the territory of WHC. The development strategy of the municipality of Posušje states the need for a landfill for waste oils and estimates the generation of 20,000 l / year (estimate: 6l per vehicle), which is data that is not relevant for the entire WHC. The environmental impact study of the Konjevac landfill (Posušje municipality) states the possibility of building an incinerator at the Konjevac landfill.

Unfortunately, the bad and unacceptable practice of taking oil from individuals and companies and then burning it in factory and individual furnaces also exists, leading to air pollution and extremely detrimental impact on human health.

Animal waste

The Environmental Protection Plan states that there are significant companies in the meat industry, so there is a pronounced problem of waste disposal of animal origin (whole animal carcasses or parts of carcasses, and products of animal origin that are not intended for human consumption), which are not can process (infectious waste). For the purposes of this Plan, data were obtained on the quantities of generated animal waste of the Meat Industry Rakitno (750-900 t/year) and Dušići (160 t/year). Waste from the Meat Industry Rakitno is disposed of in the pit of the old mine, which is owned by the Meat Industry Rakitno (they have an environmental permit).

In Ljubuški, there are no data on the quantities of waste of animal origin.

The company Ladanušić čistoća doo owns an animal waste incinerator (45 kg / h) and a Waste Management Permit on the territory of WHC. The incinerator does not have the capacity to accept waste on the territory of WHC.In general, there is no system for recording and reporting on the quantities of this type of waste, and therefore there is no adequate planning of solutions with unknown required capacities, locations and competencies.

City of Široki Brijeg

The existing organization of municipal waste management is based on the principle of one municipality - one operator. In the municipalities of WHC, one utility company is in charge of municipal waste management issues. Not all households are covered by waste collection, so part of the waste ends up in illegal (illegal) landfills. Waste collection services cover mainly households from urban and some accessible rural areas. Waste is mainly taken to the regional landfill "Uborak", Mostar.

Utility companies

City of Široki Brijeg	PE **"Čistoća"**	• Cleansing department
	Public institution **"Coming"**	• Maintenance of public lighting • Drainage of rainwater • Maintenance of public green areas • Maintenance and reconstruction of local and unclassified roads • Maintenance of water supply system • Problems of cemeteries
	PE **"Vodovod i kanalizacija" or "WASC"**	• Water supply • Wastewater drainage

Existing municipal landfills

Široki Brijeg	
Izbično	It was used as a city landfill from July 2000 to 2008.Located in an abandoned bauxite mine, 15 km from the city and 5 km from the river Lištica 5 km. The space is legalized. The readjustment plan has not been done The size of the landfill is 2 ha, with an estimated capacity of about 35,000 m^3. Household waste predominates. Treatment of disposed waste is mechanical, bulldozing and backfilling. The landfill is no longer active.
Mokro - Krtine	Used for over 20 years, until 1999. It is located on a natural slope where smaller bauxite deposits were previously excavated. It is now covered with earth and partially forested. It is about 2 km away from the monastery complex, and about 1.5 km from the open watercourse. It doesn't have a license. No landfill adjustment plan has been developed. There is no data on the amount and type of waste, but it is assumed that all types of waste are in this landfill.

Ivanj Draga	The landfill is in the area of Dobrkovići, 5 km away from the town and 500 m from the river Ugrovača, it was used as a wild landfill for 2 years (1998-1999), after which all waste was removed and taken to the town landfill. The land is owned by the municipality. Larger quantities of waste were again disposed of at the landfill: construction waste, slag, household waste, car waste. The landfill is 500 m long and is located next to the river Ugrovača and the road. Access is directly from the road. The waste is unloaded down the slope of the Ugrovača riverbed. This wild landfill is actively used. Waste is disposed of along the road about 500 m and an average depth of 5 m. There is household waste, car waste, slag at the landfill. The amount of waste is estimated at about 500 m^3. The landfill is 2 km away from the city and 1 km from the highway. The access road from the highway is partially arranged and secured with a ramp. The space is a former bauxite mine with a volume of 30,000 m^3. The land is largely privately owned. There is currently a small amount of waste at the site.The landfill contains household waste, car waste and bulky waste. The amount of car waste at the entrance is also significant.
Donja Britvica	Climbing from the town towards Donja Britvica, along the way, there are several landfills of unknown origin. Last year, the carcasses of several dead domestic pigs were spotted on them (location below the Tribošić)
Trn Dubrave	Landfill largely rehabilitated.

Grad Ljubuški

The company "Alba BH" doo is responsible for waste disposal, which performs organized collection and disposal of municipal waste generated in the household, catering and service activities, as well as cleaning and arranging public areas.

The method, collection and removal of waste in the city of Ljubuški is done so that waste is collected in individual bins of 120l and residential areas through containers, usually 1m³. In the entire area of the town of Ljubuški, the collection and removal of municipal waste is carried out, except for certain locations (hamlets / settlements) within populated places, which are currently not fully covered by the collection and disposal of municipal waste, as follows:

- In settlement Kašče,
- Dole and
- In settlement Greda

Utility companies

Municipality of Ljubuški	
PE **"Parkovi"** d.o.o.	• Water supply and sewerage, • Maintenance of green areas, • Wastewater treatment, • Maintenance of local and unclassified roads, • Maintenance of cemeteries, • Parking, • PE Kravica
"Alba BH" d.o.o. Mostar	• Collection and disposal of municipal waste
"Pinocio" d.o.o. Ljubuški	• Purchase of metal materials, including waste vehicles

Existing municipal landfills

Ljubuški	
Bučine 1	Former landfill located on municipal land, in a natural valley near the village Humac, about 1 km from the city. The landfill does not meet the minimum hygienic-sanitary and technical requirements, is not fenced, sanitary, supplied with water, electricity, ancillary facilities, without supervision, and is therefore accessible to all. All waste that was placed in containers was disposed of, without sorting and recycling, with only mechanical processing - compaction and covering of waste in layers by backfilling with construction and soil material. Exploration works have never been carried out on the site to determine the suitability of the site, as well as investigative works to determine the impact on groundwater and surface water. Waters that seep through the body of the landfill infiltrate underground and flow underground or above ground towards the river Trebižat. No landfill adjustment plan has been developed.
Bučine 2	Closed municipal landfill, near the settlement of Humac, used from 1996 to 2000 as a legal landfill with a temporary permit. Natural bay of 8,000 m2 with an average height of 5 m, 2 km away from the city center. Access road from the local road. Partially arranged, without prior preparation of the terrain with backfilling of waste in layers of soil material and afforestation, but it is necessary to carry out additional remediation after environmental impact research, especially on groundwater, which will indicate the scope of remediation. There is no accurate data on the amount and composition of waste. No landfill adjustment plan has been developed.
Humac	Landfill near the village Humac near the old landfill, 2 km from the city center. The access road is from the local road. Waste treatment is only mechanical. The only treatment for waste disposal is covering and compaction in layers with construction and surrounding soil material. The work is done by machine bulldozer. No investigative works were carried out on the site to determine the suitability of the location, nor any preparation of the terrain. No investigations have been carried out to determine the impact on groundwater and surface water. He doesn't have a license. No landfill adjustment plan has been developed. Waste is disposed of together, without sorting and recycling.
Matinjevac	Wild dump, along the local road, about 2.5 km from the city center. The landfill is actively used on both sides of the road, 200 m long and 7 m wide. Occasionally, this waste is cleaned and removed. He doesn't have a license. No landfill adjustment plan has been developed.
Koćuša	The landfill is actively used along the banks of the river Trebižat. Waste is disposed of along the coast in several places. Waste is disposed of from the road leading through the field. There are smaller amounts of waste in several places on the site, with the river taking away a large part of that waste. Due to the immediate pollution and pollution of the river Trebižat, which is used to irrigate the surrounding agricultural land, it is necessary to remove and clean waste in this area. He doesn't have a license. No landfill adjustment plan has been developed.

Municipality of Posušje

Organized collection and treatment of municipal waste in the Municipality of Posušje is performed in accordance with the Law on Waste Management and the Law on Municipal Economy (NN WHC, No.: 14/00, 07/03 and 08/12). Therefore, the Municipality of Posušje is in charge of organizing municipal waste management and establishing public utility companies to implement activities on waste management planning. Activities for the collection, removal and disposal of municipal waste from the area of the Municipality of Posušje are performed by the following companies: PE „Vodovod“ d.o.o. Posušje and „Ladanušić“ d.o.o. Posušje with a percentage covers the area of 100% and disposes of waste in the municipal landfill “Konjovac”. According to estimates in recent years, the average annual amount of municipal waste disposed of at the landfill was 3,600 tons, or 10 tons / day and 3,200 users (households and legal entities) from which waste is collected.

Waste in the Municipality of Posušje is collected separately at more than 100 locations in the farm and through 6 green islands with containers for paper, plastic and glass. Also, in the area of Posušje, there are containers for collecting paper and transport packaging next to each major business facility and at municipal and other public institutions. Paper and cardboard as well as other recycling materials are collected by the company Ladanušić Čistoća from Rakitno.

Municipal landfill “Konjovac” is located in LC Tribistovo above the village Sobča, from the regional road (R 419) Posušje - Rakitno is 2 km (macadam), north of the center of Posušje 6 km as the crow flies and the village Sobča is 2 km overhead lines. The landfill is located on a plot no. 3761/1 total plot area is 1,946,645 m^2.

Based on the prepared Investment-technical and environmental documentation from 2014, the municipal landfill “Konjovac” has all the conditions for expansion and construction of new areas for disposal of future quantities of waste until adequate and economically justified conditions for transition to the Regional Concept are created. disposal, ie disposal at the nearest Regional landfill. In addition to the above, there is a problem with the existence of illegal landfills that the municipality can reduce or remove and clean through cooperation with associations, schools and utilities. As for landfills, we can categorize them as construction and municipal waste.

Landfills in the municipality are mostly construction waste. Landfills with municipal waste are present in the following areas: Koljani, Vlašani, Korita (2 large tire dumps), Tribistovo, Oluja and the Blidinje area. Regarding the selective collection of waste, so far in the Municipality of Posušje there is a purchase of paper and secondary raw materials, mostly iron. It is estimated that only 5% of waste is selected in total. However, work still needs to be done on the construction of a recycling yard and the removal of illegal landfills. Also, the problem of a regional municipal landfill to which waste would be disposed of has not yet been resolved.

All of the above is explained in more detail in the strategic documents of the Municipality of Posušje, and mostly in the Local Environmental Action Plan for the period 2016-2026.(LEAP). LEAP builds on the development strategy of the Municipality of Posušje from 2014 to 2023, taking into account the priorities of the Inter-Entity Environmental Action Plan (NEAP BiH) and seeks to apply a modern approach to addressing environmental issues, ie to promote public awareness and responsibility for environmental protection and thus a healthy life.

Utility companies

Municipality of Posušje	
PE **"Vodovod"** d.o.o.	• Collection, purification and distribution of water • Collection and disposal of municipal waste
Public institution **"URBIKOM"**	• Drainage of atmospheric water-maintenance • Maintenance of cleanliness in the part related to cleaning of public areas • Maintenance of public areas • Maintenance of unclassified roads • Maintenance of public lighting • Maintenance and arrangement of other public facilities in accordance with the revenue plan and utility program adopted Municipal Council
"Ladanušić čistoća" d.o.o.	• Company founded in 2001 with its headquarters in Rakitno, Municipality of Posušje and one of the first private utility companies in BiH.

Existing municipal landfills

Posušje	
Konjovac	Municipal landfill for municipal waste, located about 10 km from the city center (8 km on the asphalt road Posušje-Rakitno and 2 km on the macadam road). It doesn't have a license. No landfill adjustment plan has been developed. The landfill does not meet the minimum technical, sanitary or legal regulations for waste disposal and it is used as a temporary necessary solution that needs to be abandoned as soon as possible. In the document Environmental Impact Assessment for the rehabilitation of the existing municipal waste landfill "Konjovac" and the construction of supporting facilities adapted to the regional concept of disposal in the municipality of Posušje, some of the proposed landfill remediation measures are: isolation of old waste, construction of a new area for municipal waste by 2018 as well as landfill degassing systems, construction of infrastructure (electricity, drinking water...), internal technological routes, and finally the closure of the entire landfill and land reclamation.

In the municipality of Posušje there is organized waste collection, ie 100% of the area is covered by organized purchase, including a private collection company for the northern part of the municipality Tribistovo - Rakitno - Blidnje - concession area - Ladanušić doo, while the rest of the municipality is in charge of public utility company PE Vodovod doo Posušje. The second dimension is the implementation, ie collection and compliance with the obligation to pay and the collection schedule, so then we can talk about about 90% of waste collection.

As for landfills, we can categorize them as construction and municipal waste.Landfills in the municipality are mostly construction waste.Landfills with municipal waste are present in the following areas: Koljani, Vlašani, Korita (2 large tire dumps), Tribistovo, Oluja and the Blidinje area.

Municipality of Grude

The general state of waste disposal has deteriorated many times over after the environmental incident in February 2003, when the city landfill Bezdan caught fire. By the way, the Bezdan landfill, which has been used for waste disposal since 1996, in many respects was not a safe solution for waste disposal. The landfill is located at an elevation higher than the city, about 400m from the center and probably in the II protection zone of the Grudsko vrilo water pumping station. Preliminary study made in 1999. pointed out the dangers of this type of waste disposal. Currently, municipal waste is taken to landfills in neighboring municipalities. The population not covered by the central waste collection incines garbage on the property or disposes of it in illegal landfills, which is the cause of a large number of illegal landfills in the Municipality of Grude.

Utility companies

Municipality of Grude	
PE **"Komunalno"** d.o.o.	• Water supply • Wastewater drainage
PI for utility services "**VRILO"**	• Maintenance of public lighting in the municipality
"**ALBA BH"** d.o.o. Mostar	• Collection and disposal of municipal waste

Existing municipal landfills

Grude	
Bezdan	City landfill, located in a natural bay and about 400 m as the crow flies from the city center and probably in the II protection zone of the Grudsko vrilo water pumping station. During the environmental incident in 2003, landfills were set on fire. It has been used for waste disposal since 1996. Due to its many features, it was not a safe solution for waste disposal. It doesn't have a license. No landfill adjustment plan has been developed.

1.3.2. Waste waters

Wastewater drainage of the Municipality of Široki Brijeg

Kanalizacijski sustav Općine Široki Brijeg slabo je razvijen. Još prije rata je izgrađen i opremljen pročistač otpadnih voda sa glavnim kolektorom, ali nije stavljen u funkciju. Postavljene instalacije i oprema su devastirani, a ponovno opremanje i stavljanje objekta u funkciju iziskuje veća novčana sredstva. Naknadno je glavnom gradskom ulicom postavljen glavni kanalizacijski odvod (Pecara-Most). Trenutno je u izgradnji uređaj za pročišćavanje otpadnih voda (5000 ES + 5000 ES).

Wastewater drainage of the Municipality of Ljubuški

The sewage system for drainage of surface and fecal waters for the town of Ljubuški was completed in 1987 and covered about 80% of the urban part of the town. For the rest of the city there are technical possibilities of connection. The sewage system is in relatively good condition, and as such can meet the requirements and needs for which it was built. The entire sewage system is connected to the main collector O = 1000 mm by which all accepted water (faecal and precipitation) is drained into the wastewater treatment plant. The project implementation of the construction of a municipal wastewater treatment plant envisages two phases of construction:

- Phase I = 5,000 EP (equivalent population)
- Phase II =10 000 EP (equivalent population)

The first phase of the construction of the municipal wastewater treatment plant was completed in 1989, when the plant was put into operation. Since the commissioning of the plant, it has recorded continuous operation until today (even in the war period it did not interrupt operation).

The plant is located south of the city center, about 350m away from the confluence with the recipient. The natural fall of the terrain enables the gravitational passage of water through the plant, which significantly reduces costs, both investment and maintenance costs.

The recipient of the plant is the river Trebižat. By the Decree of the State of Bosnia and Herzegovina on the classification of waters, the waters of the river Trebižat are classified in the II category of watercourses from the source to the mouth. The water quality is therefore suitable for swimming, water sports and fish farming. This water quality requires that the operation of the municipal wastewater treatment plant (hereinafter the Wastewater Treatment Plant - WWTP) must maintain the water quality in the river Trebižat at the level of category II.

Drainage distribution system

In 2015, 15.2 km of a new sewerage network was built (of a separate type: faecal and precipitation collector). The problem is that the new collector pipes (340m from WWTP) are connected to the old main collector pipe of mixed type. So both rainwater and fecal water come in one pipe to the device. In the rainy season, the hydraulic capacity of the device cannot receive all the water and so the fecal water together with the rainwater through the rain overflow must go to the river Trebižat. As the main organic loads in the faecal water (fats, floating substances, faeces...) are lighter, these contents float to the surface and in the rush of the water flow into the river. On the other hand, rainwater carries with it large amounts of sand which creates a problem in the device itself.The project of separation of fecal and rainwater in the immediate vicinity of WWTP Ljubuški would achieve that the plant enters fecal water (hydraulic capacity ensures this) and part of the rainwater that the device can receive, and part of the rainwater that can not enter the device would went in the rainy season

as needed to the river. The current design of the inlet part of the device could easily be adapted to the new version for separating rainwater from fecal because we already have a 1000mm diameter pipe for the by-pass inlet grille connected to the rain overflow. The sand brought by rainwater could simply be taken out from time to time in the shaft that would be provided on the rainwater pipe itself before entering the device. Seen from the technological aspect, in the period of high hydraulic inflow and low organic load (because a significant part of the organic load goes to the river) we have problems in the operation of activated sludge, which results in smaller purification effects. The project of separation of fecal and rainwater in the immediate vicinity of WWTP Ljubuški would also avoid the mentioned technological problems.

In Ljubuški, secondary wastewater treatment has been carried out since 2014. The amounts of sludge that occur are between 50-65 tons per year. The sludge is dried in the fields, and there is no solution for its permanent disposal. This is a big problem for the city and the environment.

According to the Decisions on communal activities of municipalities / cities, the owners of septic tanks are obliged to empty them, and the emptying (for a fee) is performed by the Public Utility Companies. There is no data on how much sludge is disposed of in this way per year, and where it is disposed of.

No.	Municipality/City	WWTP CAPACITY (EP)	The amount of sludge produced (kg/day)	Method of sludge disposal
1	Ljubuški	6.000	128	Temporary landfill in the circle
2	Grude	5.000	n.d.	On the territory of WHC
3	Široki Brijeg	8.000	n.d.	On the territory of WHC

Putting into operation the existing station for receiving the contents of septic tanks

During the reconstruction in 2015, a facility for receiving the contents of septic tanks was built (in order to avoid major blows to the biology of the device). However, due to insufficient financial resources, the constructed facility was not equipped with the necessary mechanical equipment. Also, appropriate construction deficiencies were noticed on the completed project, which should be repaired before the installation of the equipment itself.

Equipping and expanding the existing water laboratory

Within WWTP Ljubuški, there is also a laboratory for wastewater analysis (the attached analyzes under item no.1 were performed in our laboratory). The existing laboratory needs to be improved in terms of laboratory equipment (e.g. 24-hour effluent samples are taken manually). Also, with better equipment they could have better pollutant control throughout the area. Ljubuški is the lowest point in gravity in the West Herzegovina County and is therefore the most endangered in terms of water pollution from pollutants upstream, so it is necessary to think in the direction of expanding the possibilities of analysis in the laboratory.

Wastewater drainage of the Municipality of Posušje

The Municipality of Posušje does not have a sewerage network except for one branch of the storm sewerage in street fra Grge Martića. All households and institutions and industry dispose of

their wastewater and sewage through septic tanks, which generally do not meet the prescribed standards. The first project of the sewerage network and wastewater treatment plant for the municipality of Posušje was done in 1985. Since the plan of the municipality expanded with certain urban changes, in 1998 a conceptual design of a separate sewerage system of the urbanized part of the municipality was made. In the same year, the main project of the Posušje sewer system collector was completed. Since the main project is a purifier wastewater done more than twenty years ago, a new project with newer treatment technology needs to be done.

The necessary funds for the implementation of the project of the sewerage system of the municipality of Posušje far exceed the possibilities of the municipality. Therefore, a solution to this problem was sought from both the municipal and county levels. The result of these activities is that the sewerage system of the Municipality of Posušje entered the Medium-Term Development Strategy of Bosnia and Herzegovina, which was adopted by the Government of F BiH and the Council of Ministers of BiH and thus declared of interest to the state of BiH. This is a good basis for the sewerage system of the municipality of Posušje to apply for favorable loans from the World and European Bank for Reconstruction and Development, without which it will be very difficult to implement this expensive project. The development of the conceptual design of the sewerage network of the municipality of Posušje and water purification devices is in progress. One part of the sewerage system around the settlement of Mokri Dolac - around the Stadium has been done.

Wastewater drainage of the Municipality of Grude

The share of the municipal population that was reported for sewerage in 2007 was approximately 10%, and the length of the sewerage was approximately 10 km.

The location of the wastewater discharge is the abyss in Grudsko polje.

There was a WWTP in Grude, but it was devastated during the war and renovated after the war.

Afterwards, the device stopped working again, so now it is again in the phase of repair, additional design and upgrade.

2. IDENTIFICATION OF WILD LANDFILLS

2.1. WEST HERZEGOVINA COUNTY – WILD LANDFILLS

The Association for Development, Environment and Culture EKO ZH has been operating in the West Herzegovina County for a long time, aiming at the following important guidelines:

1. Protection of the environment and nature,
2. Development and promotion of sustainable development,
3. Encouragement and promotion of culture and cooperation,
4. Participation in creating the implementation and monitoring of public policies that affect the environment, development and culture.

In cooperation with the EKO ZH Association, through the website www.nasapriroda.com, the entire area of the West Herzegovina County was analyzed. All locations of unregulated (wild) landfills have been identified. For years, the association has been pointing out this very important problem both from the aspect of environmental protection (primarily water and air), and from the aspect of possible infection and impact on the population. In the next chapter, only the most important illustrations of individual illegal landfills are given, while the appendices give all the locations of these landfills with the exact map position (Annex 2.6).

2.2. 2.2. City of Široki Bijeg - locations of illegal dumps

2.2.1. Tabular presentation of identified landfills

No.	Landfill code	Landfill name	Coordinates	Quadraturem^2	Waste type
1	54001	Široki Brijeg	43.3718, 17.608	500	Animal, construction, Municipal waste, oil
2	54002	Široki Brijeg	43.3696, 17.4807	50	Municipal waste, animal, construction, electronic
3	54003	Široki Brijeg	43.3697, 17.4781	200	Municipal waste, construction, animal, electronic, waste oils
4	54004	Široki Brijeg	43.4174, 17.4231	100	Animal, electronic, construction, pcs
5	54005	Široki Brijeg	43.4186, 17.417	150	Construction, Municipal waste, waste oil
6	54006	Široki Brijeg	43.4164, 17.4146	120	Animal, Municipal waste
7	54007	Široki Brijeg	43.4157, 17.4133	100	Municipal, construction, waste oil
8	54008	Široki Brijeg	43.4219, 17.412	150	Municipal waste, animal, tires, oil
9	54009	Široki Brijeg	43.3974, 17.4613	40	Tires, Municipal waste
10	54010	Široki Brijeg	43.362, 17.5964	50	Construction, Municipal waste
11	54011	Široki Brijeg	43.3176, 17.6834	20	Municipal waste
12	54012	Široki Brijeg	43.3397, 17.6971	30	Mostly pvc bottles
13	54013	Široki Brijeg	43.3274, 17.6887	60	Construction, electronic, oil, tires
14	54014	Široki Brijeg	43.3266, 17.6874	20	Construction, Municipal waste
15	54015	Široki Brijeg	43.3682, 17.5128	20	Animal, Municipal waste
16	54016	Široki Brijeg	43.3637, 17.517	50	Tires, Municipal waste
17	54017	Široki Brijeg	43.3128, 17.55	120	PVC and glass bottles
18	54018	Široki Brijeg	43.3131, 17.5517	150	PVC bottles
19	54019	Široki Brijeg	43.2983, 17.5297	20	Municipal waste and construction
20	54020	Široki Brijeg	43.2983, 17.5297	20	Municipal waste and construction
21	54021	Široki Brijeg	43.3121, 17.5369	200	Municipal waste animal electronic
22	54022	Široki Brijeg	43.3182, 17.5381	20	Municipal waste
23	54023	Široki Brijeg	43.3183, 17.539	40	Municipal waste, tires, oil
24	54024	Široki Brijeg	43.3177, 17.5687	30	Municipal waste, animal
25	54025	Široki Brijeg	43.318, 17.5678	1000	Other
26	54026	Široki Brijeg	43.3401, 17.5722	60	Municipal waste, construction, electronic
27	54027	Široki Brijeg	43.4189, 17.5493	130	Municipal waste construction animal furniture
28	54028	Široki Brijeg	43.4274, 17.5302	50	Municipal waste

29	54029	Široki Brijeg	43.4238, 17.5444	200	Municipal waste construction animal electronic
30	54030	Široki Brijeg	43.4164, 17.5487	80	Municipal waste tires construction oil
31	54031	Dobrkovići	43.4164, 17.5487	1000	The utility company once dumped waste of all kinds
32	54032	Široki Brijeg	43.4123, 17.5471	400	Municipal waste animal tires electronic
33	54033	Široki Brijeg	43.3598, 17.6596	60	Municipal waste
34	54034	Široki Brijeg	43.3596, 17.6596	100	Bottles municipal waste
35	54035	Široki Brijeg	43.3995, 17.4543	30	Municipal waste PVC bottles bags
36	54036	Široki Brijeg	43.4058, 17.4399	50	Municipal waste animal tires PVC bottles bags
37	54037	Ljubotići	43.4114, 17.5169	40	Construction PVC pipes
38	54038	Široki Brijeg	43.4291, 17.4495	2	Pit hole
39	54039	Široki Brijeg	43.4273, 17.4997	500	Municipal waste animal electronic
40	54040	Široki Brijeg	43.4197, 17.413	30	Municipal waste animal electronic
41	54041	Široki Brijeg	43.4229, 17.4123	80	Municipal waste animal
42	54042	Široki Brijeg	43.3871, 17.4715	20	Municipal waste, construction
43	54043	Široki Brijeg	43.3814, 17.5243	40	Municipal waste animal
44	54044	Široki Brijeg	43.3073, 17.5545	20	Municipal waste, construction
45	54045	Široki Brijeg	43.3847, 17.4952	40	Municipal waste, furniture and construction
46	54046	Široki Brijeg	43.4178, 17.5509	50	Municipal waste construction
47	54047	Široki Brijeg	43.437, 17.5495	1000	Municipal waste
48	54048	Široki Brijeg	43.4561, 17.5647	30m3	Other
49	54049	Široki Brijeg	43.4561, 17.5647	40	Municipal waste
50	54050	Široki Brijeg	43.4467, 17.5755	60	Municipal waste
51	54051	Široki Brijeg	43.4467, 17.5755	150	Municipal waste animal
52	54052	Široki Brijeg	43.4421, 17.5739	70	Municipal waste construction
53	54053	Široki Brijeg	43.4309, 17.5807	200	Municipal waste
54	54054	Široki Brijeg	43.4290, 17.5825	120	Municipal waste
55	54055	Mostarsko Blato	43.20089, 17.40076		Municipal waste construction
56	54056	Mostarsko Blato	43.20217, 17.40218		construction
57	54057	Mostarsko Blato	43.20298, 17.39597		Municipal waste construction
58	54058	Mostarsko Blato	43.19391, 17.41201		Municipal waste construction
59	54059	Mostarsko Blato	43.19358, 17.41158		Municipal waste construction
60	54060	Mostarsko Blato	43.19082, 17.41386		Mixed
61	54061	Mostarsko Blato	43.18541, 17.42027		Mixed
62	54062	Mostarsko Blato	43.18503, 17.42089		Mixed
63	54063	Mostarsko Blato	43.18332, 17.4244		Mixed

2.2.2. Illustrative photo presentation of individual landfills with basic data

Slika 1

Slika 2

Picture 1, 2 – Landfill name: **Široki Brijeg.** Landfill code: **54039.** Coordinates: **43.4273, 17.4997** Quadrature m^2: **500.** Type of waste: **municipal waste, animal, electronic.**

Picture 3 – Landfill name: **Široki Brijeg.** Landfill code: **54047.** Coordinates: **43.437, 17.5495** Quadrature m^2: **1000.** Type of waste: **municipal waste**

Picture 4 – Landfill name: **Ljubotići.** Landfill code: **54037.** Coordinates **43.4114, 17.5169** Quadrature m^2: **40.** Type of waste: **construction and municipal waste.**

Slika 5

Picture 5 – Landfill name: **Široki Brijeg.** Landfill code: **54032.** Coordinates: **43.4123, 17.5471** Quadrature m^2: **400.** Type of waste: **municipal waste, animal, tires and electronic.**

2.3. City of Ljubuški - locations of illegal dumps

2.3.1. Tabelarni prikaz identificiranih deponija

No.	Landfill code	Landfill name	Coordinates	Quadraturem^2	Waste type
1	590029	Ljubuški		40 m^2	Municipal waste construction
2	590043	Ljubuški			
3	590001	Ljubuški-Gornja Vitina	43.242325, 17.483152	50 m^2	Municipal waste construction
4	590002	Ljubuški-Doci	43.262268, 17.460236	50 m^2	Municipal waste tires
5	590003	Ljubuški-Vitina	43.244396, 17.471405	40 m^2	Municipal waste plastic
6	590004	Ljubuški-Osoje	43.273979, 17.44573	50 m^2	Municipal waste
7	590005	Ljubuški	43.258884, 17.432737	50 m^2	Municipal waste construction and electronic
8	590006	Ljubuški	43.264565, 17.412825	50 m^2	Municipal waste construction and plastic
9	590007	Ljubuški-Banja	43.264118, 17.394114	50 m^2	Municipal waste
10	590008	Ljubuški	43.243374, 17.4253142	50 m^2	Municipal waste construction and plastic
11	590009	Ljubuški	43.241428, 17.455547	40 m^2	Plastic municipal waste electronic
12	590010	Ljubuški	43.262009, 17.45927	40 m^2	Municipal waste construction
13	590011	Ljubuški	43.278572, 17.445848	60 m^2	Municipal waste animal
14	590012	Ljubuški	43.309753, 17.434273	70 m^2	Municipal waste construction plastic
15	590013	Ljubuški	43.309479, 17.435013	50 m^2	Municipal waste
16	590014	Ljubuški	43.292709, 17.528793	40 m^2	Municipal waste plastic
17	590015	Ljubuški	43.263706, 17.515854	100 m^2	Municipal waste construction
18	590016	Ljubuški	43.267441, 17.518429	70 m^2	Municipal waste
19	590017	Ljubuški	43.182625, 17.537989	150 m^2	Municipal waste construction
20	590018	Ljubuški	43.170914, 17.587685	40 m^2	Municipal waste construction
21	590019	Ljubuški	43.199585, 17.598316	30 m^2	Tires municipal waste
22	590020	Ljubuški	43.198463, 17.599529	200 m^2	Municipal waste, animal, construction plastic
23	590021	Ljubuški	43.198009, 17.601116	100 m^2	Municipal waste construction electronic
24	590022	Ljubuški	43.197323, 17.605612	60 m^2	Municipal waste construction
25	590023	Ljubuški	43.237278, 17.558662	50 m^2	Municipal waste construction car waste
26	590024	Ljubuški	43.243896, 17.559595	40 m^2	Municipal waste animals
27	590025	Ljubuški	43.265377, 17.541014	30 m^2	Municipal waste plastic
28	590026	Ljubuški	43.270313, 17.535681	40 m^2	Municipal waste plastic

29	590027	Ljubuški	43.288715, 17.507229	70 m^2	Municipal waste construction tires
30	590028	Ljubuški	43.290382, 17.516981	80 m^2	Municipal waste construction
31	590030	Ljubuški	43.188744, 17.57835	50 m^2	Municipal waste sanitary, tires
32	590031	Ljubuški-Stubica	43.150932, 17.636156	100 m^2	Municipal waste sanitary electronic
33	590032	Ljubuški	43.151653, 17.631479	50 m^2	Municipal waste construction
34	590033	Ljubuški	43.146065, 17.616287	80 m^2	Municipal waste construction plastic
35	590034	Ljubuški	43.147167, 17.615515	80 m^2	Municipal waste sanitary plastic
36	590035	Ljubuški	43.146564, 17.618475	30 m^2	Municipal waste construction animal
37	590036	Ljubuški	43.171814, 17.607553	60 m^2	Construction
38	590037	Ljubuški	43.173237, 17.565937	50 m^2	Municipal waste construction animal
39	590038	Ljubuški	43.177742, 17.562826	40 m^2	Municipal waste construction
40	590039	Ljubuški	43.183815, 17.5567	70 m^2	Municipal waste construction tires
41	590040	Ljubuški	43.243279, 17.487917	30 m^2	Municipal waste
42	590041	Ljubuški	43.290371, 17.522099	20 m^2	Municipal waste
43	590042	Ljubuški	43.289215, 17.526293	70 m^2	Municipal waste construction

2.3.2. Illustrative photo presentation of individual landfills with basic data

Slika 1

Picture 1 - Grljevići – Landfill name: **Ljubuški**. Landfill code: **590028**. Coordinates: **43.290382, 17.516981**. Quadrature m^2: **80**. Type of waste: **municipal and construction waste.**

Slika 2

Picture 2 – Landfill name: **Ljubuški, Vojnići.** Landfill code: **590006**. Coordinates: **43.264565, 17.412825**. Quadrature m^2: **50**. Type of waste: **municipal waste, construction and plastic.**

Slika 3

Picture 3 – Landfill name: **Ljubuški, Gornja Vitina**. Landfill code: **590001**. Coordinates: **43.242325, 17.483152.** Quadrature m^2: **50**. Type of waste: **Municipal and construction waste.**

Slika 4

Picture 4 – Landfill name: **Ljubuški**. Landfill code: **590039**. Coordinates: **43.183815, 17.5567**. Quadrature m^2: **70**. Type of waste: **Municipal waste, construction and tires.**

Slika 5

Picture 5 – Landfill name: **Ljubuški**. Landfill code: **590021**. Coordinates: **43.198009, 17.601116**. Quadrature m^2: **100**. Type of waste: **municipal waste, construction and electronic.**

2.4. Municipality of Grude - locations of illegal dumps

2.4.1. Tabular presentation of identified landfills

No.	Landfill code	Landfill name	Coordinates	Quadraturem^2	Waste type
1	1	Grude	43.3976, 17.3925	120 m^2	Tires
2	370002	Grude	43.386, 17.3943	20 m^2	Municipal waste,animal
3	370003	Grude	43.3398, 17.4932	20 m^2	Municipal waste,animal, construction
4	370004	Grude	43.335621, 17.330482	80 m^2	Municipal waste
5	370005	Grude	43.3348, 17.4543	30 m^2	Municipal waste, construction
6	370006	Grude	43.3155, 17.435	20 m^2	Municipal waste,animal
7	370007	Grude	43.3104, 17.4339	30 m^2	Municipal waste
8	370008	Grude	43.3094, 17.4349	20 m^2	Municipal waste
9	370009	Grude-Drinovci	43.3308, 17.3396	20 m^2	Municipal waste
10	370010	Grude	43.3724, 17.3101	150 m^2	Municipal waste,animal, construction
11	370011	Grude	43.3978, 17.3062	50 m^2	Municipal waste, construction
12	370012	Grude	43.373, 17.4194	30 m^2	Municipal waste, construction
13	370013	Grude	43.3778, 17.4153	1000 m^2	Municipal waste, construction, animal
14	370014	Grude	43.3773, 17.4156	50 m^2	Municipal waste
15	370015	Grude	43.3769, 17.4151	20 m^2	Municipal waste
16	370016	Grude	43.3795, 17.4088	40 m^2	Municipal waste, construction
17	370017	Grude	43.3895, 17.404	30 m^2	Municipal waste, plastic
18	370018	Grude	43.3841, 17.4121	20 m^2	Municipal waste
19	370019	Grude	43.3779, 17.412	80 m^2	Old cars, iron, oils, tires, Municipal waste
20	370020	Grude	43.3812, 17.4033	20 m^2	Municipal waste
21	370021	Grude	43.3821, 17.4022	120 m^2	Municipal waste, construction, animal
22	370022	Grude	43.3862, 17.3931	140 m^2	Municipal waste construction, animals, tires
23	370023	Grude	43.3881, 17.3901	30 m^2	Municipal waste
24	370024	Grude	43.3904, 17.3874	50 m^2	Municipal waste tires
25	370025	Grude	43.3917, 17.3848	10 m^2	PVC,glass bottles
26	370026	Grude	43.3977, 17.3768	200 m^2	Construction, Municipal waste animals
27	370027	Grude	43.403, 17.3747	30 m^2	Municipal waste tires
28	370028	Grude	43.4041, 17.3726	20 m^2	Municipal waste, animals
29	370029	Grude	43.4106, 17.3672	80 m^2	construction, Municipal waste, animals
30	370030	Grude	43.332375, 17.486553	40 m^2	Municipal waste construction
31	370031	Grude	43.311104, 17.480234	30 m^2	Municipal waste
32	370032	Grude	43.315029, 17.458853	50 m^2	Municipal waste plastic, sanitary waste
33	370033	Grude	43.326019, 17.440678	30 m^2	Municipal waste tires
34	370034	Grude	43.335823, 17.454967	40 m^2	Municipal waste construction

35	370035	Grude	43.335472, 17.4307	40 m^2	Municipal waste, cars, construction
36	370036	Grude	43.350895, 17.385811	60 m^2	Municipal waste, construction
37	370037	Grude	43.358589, 17.39992	80 m^2	Municipal waste, construction, sanitary, tires
38	370038	Grude	43.357105, 17.406141	150 m^2	Municipal waste construction electronic
39	370039	Grude	43.36787, 17.413984	40 m^2	Municipal waste construction

2.4.2. Illustrative photo presentation of individual landfills with basic data

Slika 1

Picture 1 – Landfill name: **Grude**. Lanfill code: **370017**. Coordinates: **43.3895, 17.404**. Quadrature m^2: **30**. Type of waste: **municipal waste, plastic.**

Slika 2

Picture 2 - Landfill name: **Grude**. Lanfill code: **370032**. Coordinates: **43.315029, 17.458853**. Quadrature m^2: **50**. Type of waste: **municipal waste, plastic, sanitry.**

Slika 3

Picture 3 – Landfill name: **Grude**. Landfill code: **370039**. Coordinates: **43.36787, 17.413984.** Quadrature m^2: **40**. Type of waste: **municipal waste, construction.**

Slika 4

Picture 4 – Landfill name: **Grude**. Landfill code: **370038**. Coordinates: **43.357105, 17.406141.** Quadrature m^2: **150**. Type of waste: **municipal waste, construction and electric.**

Slika 5

Picture 5 - Landfill name: **Grude**. Landfill code: **370031**. Coordinates: **43.311104, 17.480234.** Quadrature m^2: **30**. Type of waste: **municipal waste.**

2.5. Municipality of Posušje - locations of illegal dumps

2.5.1. Tabular presentation of identified landfills

No.	Landfill code	Landfill name	Coordinates	Quadraturem^2	Waste type
1	70001	Posušje, grad	43.465691, 17.310537	20 m^2	Construction, old advertising rubber plastic
2	70002	Posušje, grad	43.46595, 17.310507	50 m^2	Construction waste, plastic, cans
3	70003	Posušje, grad	43.466003, 17.309816	60 m^2	Construction waste, ceramics, boards, styrofoam
4	70004	Posušje, grad	43.465752, 17.309589	15 m^2	tires, bottles, cans
5	70005	Posušje, grad	43.466282, 17.309076	20 m^2	tires, bottles, household waste
6	70006	Posušje, grad	43.553513, 17.232534	20 m^2	construction, plastic, iron
7	70007	Vinjani	43.521755, 17.272858	40 m^2	Plastic bags, household waste, glass, tires
8	70008	Vinjani	43.521469, 17.272579	60 m^2	PVC bags, cars, municipal waste
9	70009	Posušje, grad	43.525429, 17.278358	30 m^2	PVC bags, bottles, household waste,
10	70010	Posušje, grad	43.538368, 17.281767	10 m^2	PVC bags household waste, construction
11	70011	Posušje, grad	43.524342, 17.277981	20 m^2	cardboard, plastic, bottles
12	70012	Posušje, grad	43.525574, 17.2898167	150 m^2	household waste, plastic, clothes
13	70013	Vinjani	43.515003, 17.267933	100 m^2	animals, furniture, plastic
14	70014	Vinjani	43.512009, 17.268774	50 m^2	Carpets, pallets, furniture, plastic
15	70015	Vinjani	43.512489, 17.268379	20 m^2	animals, furniture, plastic
16	70016	Posušje	43.472458, 17.301626	15 m^2	plastic, construction
17	70017	Posušje	43.467537, 17.297709	80 m^2	construction, plastic, furniture
18	70018	Rastovača	43.4733412, 17.346123	20 m^2	tires, plastic, construction
19	70019	Rastovača	43.4739797, 17.3500464	150 m^2	PVC waste, municipal waste, tires, furniture
20	70020	Posušje	43.4740152, 17.3489061	40 m^2	Plastic bottles construction, furniture
21	70021	Posušje	43.4867694, 17.3686472	60 m^2	PVC waste, tires furniture
22	70022	Posušje	43.4899868, 17.3709954	200 m^2	animals, household waste, construction

23	70023	Posušje	43.5090362, 17.386459	500 m^2	Tires, cars
24	70024	Posušje	43.5273952, 17.3880325	500 m^2	Plastic, municipal waste, tires, furniture
25	70025	Sutina	43.4954347, 17.4638797	40 m^2	PVC waste, Tires, household waste
26	70026	Sutina	43.4979371, 17.4666041	200 m^2	Plastic municipal waste, furniture, construction
27	70027	Sutina	43.4989904, 17.4696136	60 m^2	PVC waste, Tires, planks and solid waste
28	70028	Rakitno	43.5343107, 17.4504576	150 m^2	municipal waste, furniture, construction
29	70029	Rakitno	43.5405741, 17.4693581	40 m^2	household waste PVC material
30	70030	Rakitno	43.5429058, 17.4687472	50 m^2	municipal waste
31	70031	Posušje	43.5493126, 17.4733351	15 m^2	Plastic, household waste, furniture
32	70032	Rakitno	43.5394296, 17.4538123	10 m^2	glass, bottles, cars
33	70033	Posušje	43.5200274, 17.3866508	15 m^2	Household waste, pipes, plastic
34	70034	Posušje	43.5212906, 17.3859591	20 m^2	Household waste, PVC, construction
35	70035	Posušje	43.5076443, 17.3832726	50 m^2	furniture, PVC bags, bottles household waste
36	70036	Posušje	43.4755368, 17.3596631	30 m^2	Construction, plastic, windows
37	70037	Posušje	43.5353403, 17.4558052	200 m^2	PVC waste, animals, furniture
38	70038	Posušje	43.4676354, 17.3189009	30 m^2	Plastic bottles, bags, mattresses
39	70039	Posušje	43.4483189, 17.3249768	10 m^2	Construction, Styrofoam, plastic
40	70040	Posušje	43.448859, 17.3265137	15 m^2	Construction, iron, sanitary waste
41	70041	Posušje	43.425038, 17.411266	30 m^2	Plastic waste, cans, bottles
42	70042	Posušje	43.4399341, 17.406003	40 m^2	Plastic, tires, municipal waste
43	70043	Posušje	43.442599, 17.4059439	50 m^2	furniture PVC waste, municipal waste
44	70044	Posušje	43.4638274, 17.3963343	60 m^2	municipal waste, furniture, plastic
45	70045	Posušje	43.4744704, 17.3950709	500 m^2	municipal waste PVC bags
46	70046	Posušje	43.464931, 17.3949214	30 m^2	Plastic, animals, sanitary waste
47	70047	Posušje	43.4738, 17.3498	50 m^2	Plastic, municipal waste

2.5.2. Illustrative photo presentation of individual landfills with basic data

Slika 1

Picture 1 – Landfill name: **Posušje**. Landfill code: **70010**. Coordinates: **43.538368, 17.281767.** Quadrature m^2: **10**. Type of waste: **household and construction waste.**

Slika 2

Picture 2 - Landfill name: **Vinjani**. Landfill code: **70013**. Coordinates: **43.515003, 17.267933**. Quadrature m^2: **100**. Type of waste: **animals household and plastic waste.**

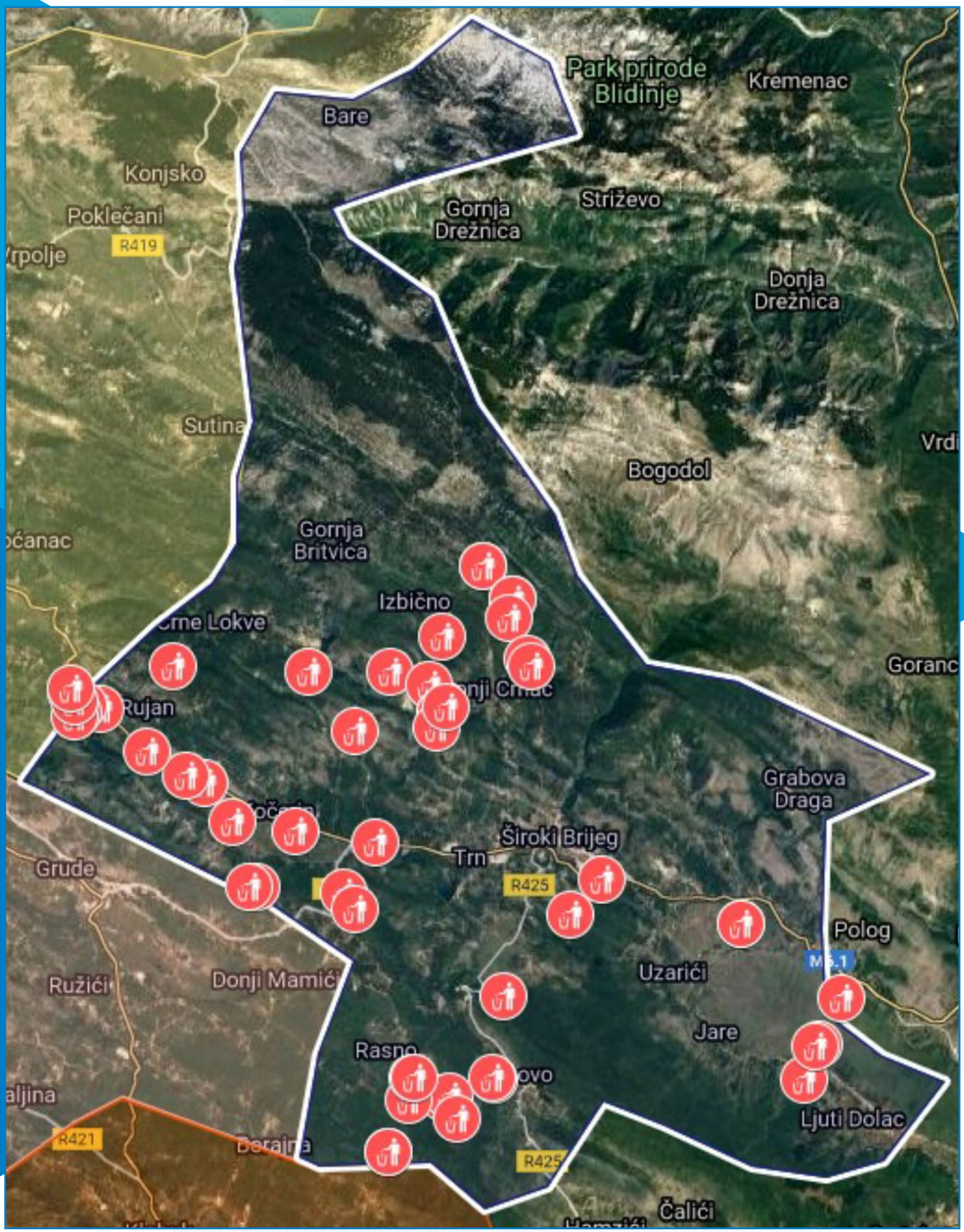
Picture 3 - Landfill name: **Posušje**. Landfill code: **70017**. Coordinates: **43.467537, 17.297709.** Quadrature m^2: **80**. Type of waste: **construction plastic and furniture waste.**

Picture 4 – Landfill name: **Posušje**. Landfill code: **70037**. Coordinates: 4**3.5353403, 17.4558052.** Quadrature m^2: **200**. Type of waste: **PVC waste, animals and furniture waste.**

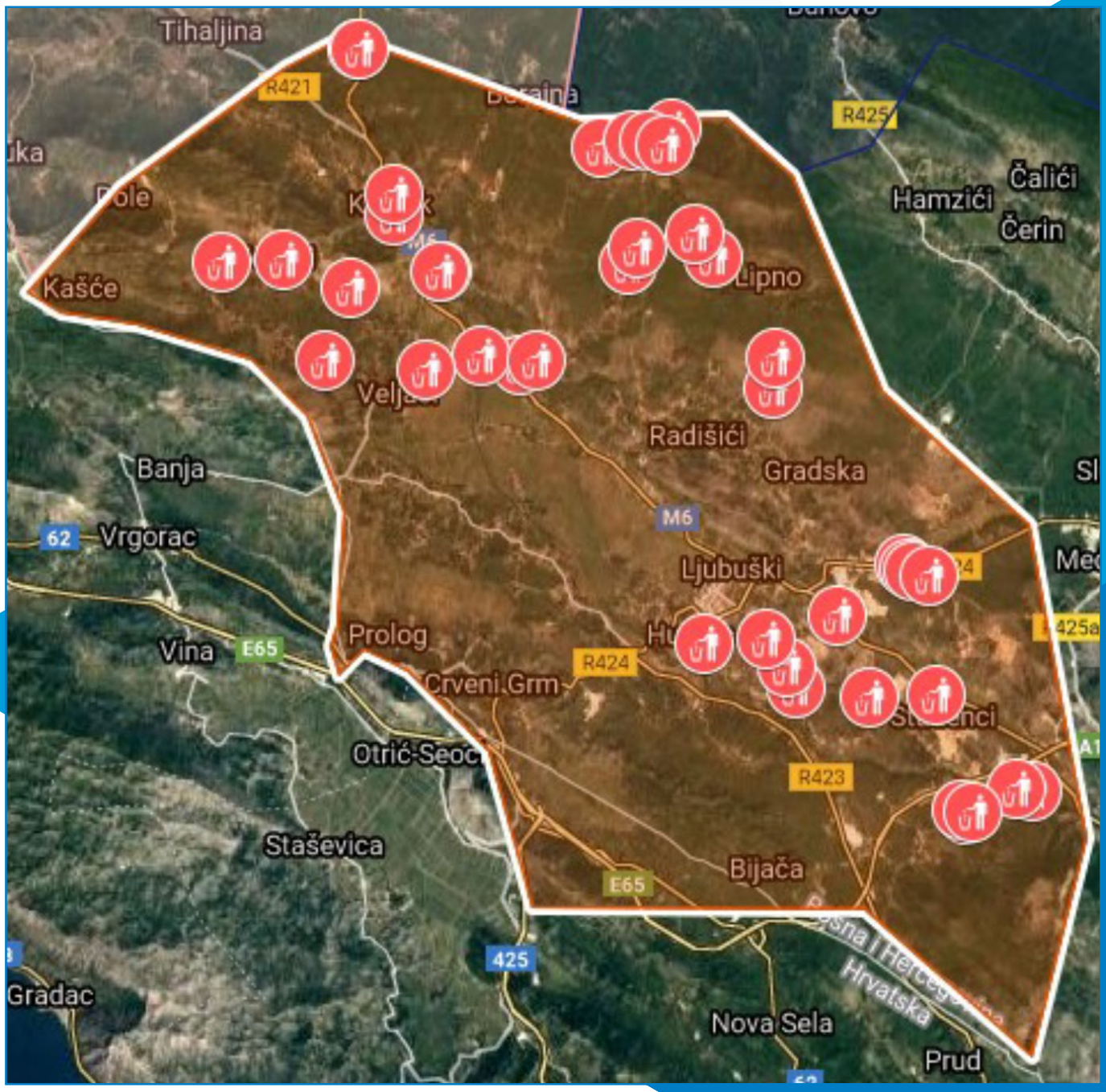
Picture 5 – Landfill name: **Posušje**. Landfill code: **70040**. Coordinates: **43.448859, 17.3265137.** Quadrature m^2: **15**. Type of waste: **construction, iron and sanitary waste.**

2.6. Annex - maps with the location of illegal landfills

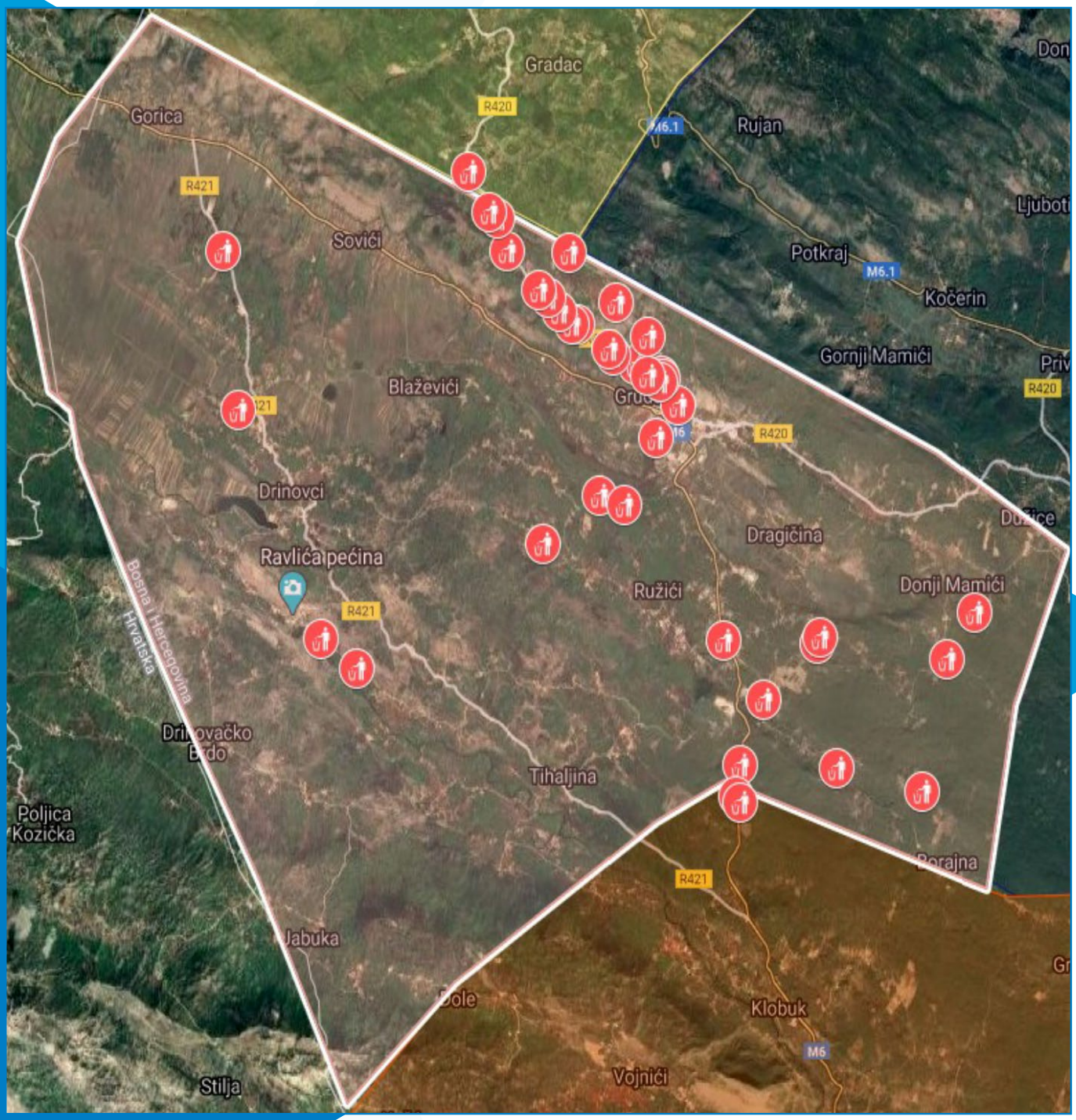
2.6.1. Overview map with locations of illegal dumps - City of Široki Brijeg



2.6.2. Overview map with locations of illegal dumps - City of Ljubuški



2.6.3. Overview map with locations of illegal dumps - Municipality of Grude



2.6.4. Overview map with locations of illegal dumps - Municipality of Posušje

3. SAMPLING AND ANALYSIS OF WATER

3.1. Water resources in the area of the West Herzegovina County

City of Široki Brijeg

Waters from the area of Široki Brijeg belong to the Neretva river basin. The main surface flows towards Mostarski Blato are: Lištica s Ugrovača, Mokašnica, Crnašnica and Žvatić.. The river Lištica belongs to a part of the surface waters of Čabulja which the torrent watercourse Brinja collects from Ladina and Dobrinja. Brinja, whose beginnings are north of Bogodol, below the elevation of Kulica (1199) flows to the west and on its way to Lištica receives the brook Ladina near Prskalo,and 2.5 kmlower the waters of Dobrinjski p. These streams buy all surface water during heavy rainfall and melting snow in the southwestern parts of the Čabulja mountain.

The surface waters received by Rakitsko polje are drained by the watercourses Točak, Jelica, Zmijinac and during heavy rainfall they form a significant occasional watercourse Ugrovača which, passing through the deeply incised Brina canyon, receives incidental torrents, and in the settlement Trn waters Kočerinsko polje. Mostarski Blato, in the center of Široki Brijeg, connects with the river Lištica.

City of Ljubuški

The Ljubuški area has large amounts of surface and groundwater. The groundwater fund is quite significant, because it is fed by an extremely large continental hinterland composed of limestone rocks. The area of Ljubuški is mainly built of limestone rocks, which form the basis in all other geological deposits in Ljubuški, and a significant amount of groundwater from this area gravitates through limestone cracks to the Neretva, all the way to the Adriatic Sea.

The largest river in the city is Trebižat. rebizat is a right tributary of the Neretva, and flows through parts of Dalmatia and central Herzegovina. The course of the river is located in a very karst area, which causes water to sink along the riverbed. The change in the watercourse (surface and underground) caused the river to have as many as six names: Ričina, Suvaja, Vrlika, Tihaljina, Mlade and Trebižat. At its entrance to the territory of the town of Ljubuški, the river has the name Tihaljina. It receives the largest spring of constant character and great abundance, the Klokun spring. In dry periods, very little water flows to Klokun through Tihaljina, and after the mouth of Klokun it regains the character of a river. Downstream from the Kavazbašina bridge (Klobuk), Tihaljina gets the name Mlade and under that name it flows through Ljubuško polje. The Mlade River receives the occasional Grabovo vrelo watercourse and the Vrioštica permanent watercourse on the left, while the Porilo-Brza Voda canal separates on the right, which drains part of the water from the Mlada River into the Rastoke and Jezera area (Republic of Croatia). After passing under the bridge on Humac, the river got its final name Trebižat.

Trebižat has only one permanent tributary Studenčica on its course. Studenčica is a permanent watercourse that originates from springs: Vrilo, Vakuf and Kajtazovina, and receives the occasional flow of the stream Lukoć coming from the Čitluk plateau. Hydrological tests in the Trebizat river basin have a long tradition. Based on many years of testing and measurements, it was found that the average annual water flow at the bridge on Humac Q sr = 39.8 m3 / sec. The town of Ljubuški is rich in strong karst springs interesting for water supply. Some of them have been captured and are used for drinking water supply, namely Klokun-Klobuk, Studena-Veljaci, Vrioštica-Vitina, Vrilo-Studenci,

Vakuf-Studenci and Kajtazovina-Studenci. The area of the Municipality has extremely large amounts of water, both groundwater and surface water. Water is of relatively good quality, which requires that in the future far more attention must be paid to the protection of water from pollution, because water is a basic human resource that must be permanently protected.

Municipality of Posušje

The basic feature of the area of the municipality of Posušje in hydrological terms is that there are no permanent surface flows, ie larger surface water flows. The river Ričina springs at 900 m above sea level in the area of Tribistovo. The Ričine watercourse descends through narrow straits into Posuško polje (580 m above sea level), where several torrents (Topola, Studeni potok) flow into it. From Posuško polje, Ričina, called Suvaja, flows into the Prološko Blato retention in Imotski polje, and from there it goes all the way to the confluence with the Neretva as Trebižat. The total length of this watercourse from Imotski to the Neretva is over 70 km.

Research has shown that in the Ričina and Topala riverbeds, and in the Posuško field, there are several abysses through which water goes underground to the lower horizons in the Imotski - Bekijsko field. Therefore, the amounts of water that drain are very small and the runoff coefficients are lower than 0.1. In addition, three reservoirs are located in the catchment area in question: Rastovača on Topala, and Tribistovo and IGM on Ričina. There are practically no water discharges from Rastovača and Tribistovo (discharges are very rare), which significantly disrupted the natural hydrological regime on the downstream sections of the watercourse, and the surface runoff, which was occasional in natural conditions, was further reduced. This is especially true for peak flows that are many times smaller after the construction of the mentioned reservoirs. There are small springs in the municipality of Posušje and they are: Žukovica, Zečica, Vrelo Jastreb and Jelica in Rakitno, and Jelinak in Tribistovo and the spring Šipak in Vučipolje. In developmental and economic terms, these resources are limited.

Municipality of Grude

As the basic feature of the area of the municipality of Grude in terms of hydrology, it is significant that there are no permanent surface flows, nor larger surface water flows.The only permanent flows are at the bottom of the Imotski-Grudsko field, among which the largest is the Vrlika river, which sinks in the immediate vicinity of Drinovac.

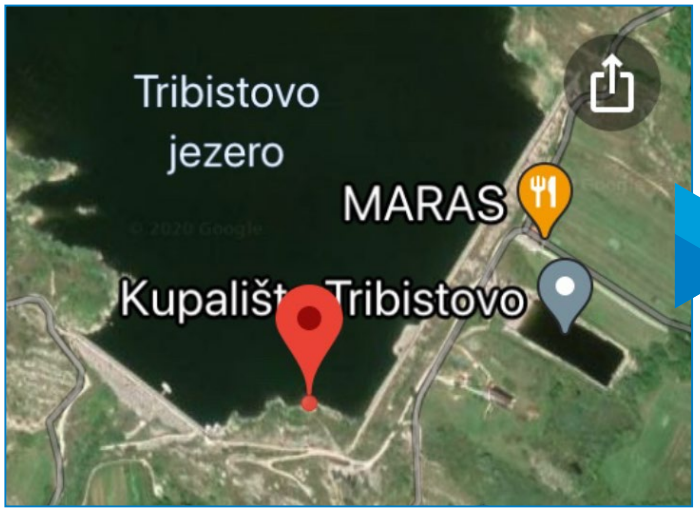
In the south, near the settlement of Peć Mlini, the river Tihaljina springs, which changes its name to Mlade downstream, and as Trebižat it flows into the Neretva. HPP Peć Mlini was built there, which is of great importance for the municipality.

In the northwestern part of Kongora there is another natural rarity of this area - Lake Krenica. The lake has a constant connection with groundwater and never dries up. The lake is about 300 m wide and about 50 m deep.

3.2. Locations of water samples taken for analysis

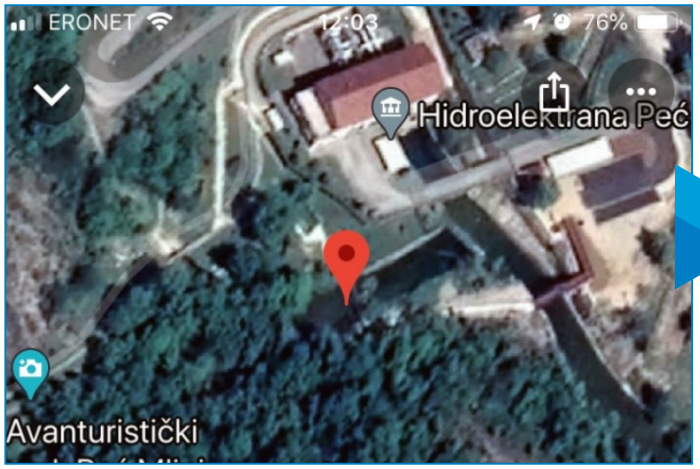
Locations for water sampling were determined and given for analysis. Water analysis was performed for laboratory testing of physicochemical parameters, laboratory testing of heavy metals, laboratory testing of polycyclic aromatic hydrocarbons (PAHs) and laboratory testing of pesticides.

3.2.1. Municipality of Posušje



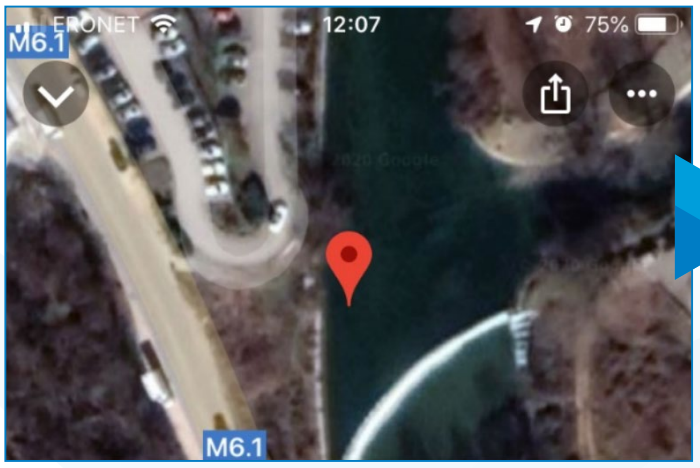
G8CW+RX Tribistovo
(43.5220759, 17.3474024)

3.2.2. Municipality of Grude



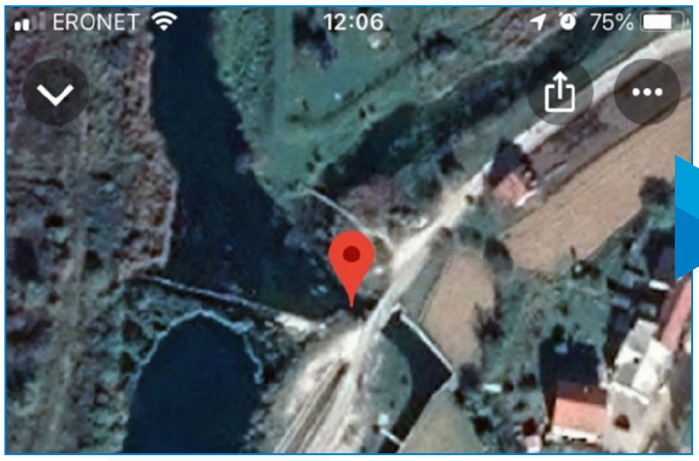
88QG+2C Drinovci
(43.3375262, 17.3260215)

3.2.3. City of Široki Brijeg



9HHR+G9 Široki Brijeg
(43.3788006, 17.5909577)

3.2.4. City of Ljubuški



7F53+3W Klobuk

(43.2576300, 17.4547565)

4. ANALYSIS OF THE RESULTS OBTAINED

4.1. Legislation

Water and water body legislation is quite complex and demanding. The area of water protection and quality is particularly sensitive. Therefore, water analysis in the context of existing legislation requires quality planning, management and constant monitoring - monitoring of surface and groundwater systems, both water quantity and quality. The following is a list of required legislation:

- **Laws**
  - Water Law ("Official journal of Federation of BiH" no. 70/06)
  - Law on Waters of the West Herzegovina County („Official journal of Federation of BiH" 12/15)

- **Decree**
  - Decree on the conditions for discharging wastewater into the environment and public sewerage systems, „Official journal of Federation of BiH" no. 26/20
  - Decree on the manner of granting the right to extract materials from watercourses, „Official journal of Federation of BiH" no. 58/15
  - Decree on the types and content of plans for protection against harmful effects of water, „Official journal of Federation of BiH" no. 26/09
  - Decree on hazardous and harmful substances in water, „Official journal of Federation of BiH" no. 43/07
  - Decree on water classification, „Official journal of SR BiH" no. 19/80
  - Decree on the categorization of watercourses, „Official journal of SR BiH" no. 42/67

- **Regulatons**
  - Ordinance amending the Ordinance on the method of determining the environmentally acceptable flow, „Official journal of Federation of BiH" no. 62/19
  - Ordinance on amendments to the Ordinance on procedures and measures in cases of accidents on waters and coastal water land, „Official journal of Federation of BiH" no. 102/18
  - Ordinance on the manner of determining the environmentally acceptable flow, „Official journal of Federation of BiH" no. 4/13
  - Ordinance on the manner of determining the conditions for determining the zones of sanitary protection and protective measures for water sources for public water supply of the population, „Official journal of Federation of BiH" no. 88/12
  - Ordinance on monitoring in areas subject to eutrophication and sensitive to nitrates, "Official journal of Federation of BiH" no. 71/09
  - Ordinance on procedures and measures in cases of accidents on waters and coastal water land, „Official journal of Federation of BiH" no. 71/09
  - Ordinance on the determination of areas susceptible to eutrophication and sensitive to nitrates, „Official journal of Federation of BiH" no. 71/09
  - Ordinance on the establishment and management of the water information system, „Official journal of Federation of BiH" no. 77/09
  - Ordinance on the correctness of drinking water, „Official journal of Federation of BiH, no: 40/10, 43/10, 30/12

Decree on hazardous and harmful substances in water, „Official journal of Federation of BiH“ br. 43/07

Article 1. The Decree on Hazardous and Harmful Substances in Waters prescribes substances and their maximum permitted concentrations by individual water classes, which are considered hazardous and harmful substances in waters in accordance with Article 121, paragraphs 2 and 3 of the Water Act.

Article 2. Dangerous and harmful substances, in terms of the provisions of this Regulation, have been determined on the basis of their toxicity, degradability, bioaccumulation, carcinogenicity and other properties of these substances.

Article 3. Dangerous substances are substances, energy and other pathogens that, by their physical, chemical and biological composition, quantity and other properties, can endanger human life and health and the survival of fauna and flora and the state of the environment. Harmful substances are substances that can cause changes in the chemical, physical and biological properties of water, as a result of which the use of water for useful purposes is limited or prevented.

Article 4. They belong to the group of dangerous substances: 1. organohalogen compounds and substances which may form such compounds in water, 2. organophosphorus compounds and substances which may form such compounds in water, 3. organotin compounds and substances which may form such compounds in water, 4. mercury and mercury compounds, 5. lead and lead compounds, 6. arsenic and arsenic compounds, 7. cadmium and cadmium compounds, 8. cyanides, 9. substances and preparations which have been shown to have carcinogenic or mutagenic properties or properties which may affect reproduction, 10. non-degradable mineral oils and hydrocarbons of petroleum origin, 11. biocides and products for plant protection, 12. radioactive substances, including radioactive waste. The group of harmful substances includes other metals, metalloids and their compounds and some inorganic compounds.

Article 5. The maximum permissible concentrations of individual hazardous substances in surface waters, by individual water classes, are determined in Table 1. Table 1 and Table 2. The maximum permissible concentrations of individual hazardous substances in surface waters.

HAZARDOUS SUBSTANCES
I GROUP: I - II SURFACE WATER CLASS µ g/l
II GROUP: III - IV SURFACE WATER CLASS µ g/l

Ordinance on the health safety of drinking water - general provisions ‘Official Journal of BiH’’, no: 40/10, 43/10, 30/12

Article 1. (1) The Ordinance on the health safety of drinking water prescribes the requirements and standards that drinking water must meet, the maximum permitted values of health safety parameters, methods of laboratory tests, and measures for monitoring the health safety of drinking water. (2) The aim of this Ordinance is to protect human health from the negative impact of any pollution of drinking water by ensuring its health.

Based on the above-mentioned legislation, water analyzes of individual surface streams, given locations and maps in the previous chapters have been performed.

4.2. City of Široki Brijeg – Test report No 10-749-1/20

TEST LABORATORY **template code OB.107**

TECHNICAL DATA ON THE SAMPLE:

Order by	TEHNOZAŠTITA D.O.O. MOSTAR (EKO ZH)
Type	SURFACE WATER
Location	Lištica, Široki Brijeg
Municipality and county	Široki Brijeg, WHC
Water area	Water area of the Adriatic Sea
Sampling performed by	Petar Aničić
Sampling performed according to methods / instructions	RU-UV 01/BAS ISO 5667:2019
Preservation of samples performed according to the method / instructions	RU-KU 01/BAS ISO 5667-3:2019
Place and date of sampling	Široki Brijeg; 08.09.2020.
Date of receipt of the sample in the laboratory	08.09.2020.
Date of examination	08.09.2020. – 13.10.2020.
Sampling report no.	049-10/20
Test order No.	086/20
Sample code / seal number	1
Analysis done in	Test laboratory Control-H d.o.o. Mostar and Water Institute Bijeljina

SAMPLE DESCRIPTION (DECLARATION):

The pattern is non-original packaging, clear, colorless without visible impurities.

LABORATORY TESTING OF PHYSICO-CHEMICAL PARAMETERS:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
PHYSICO-CHEMICAL ANALYSIS	TEMPERATURE	BAS DIN 38404-4:2010*	0C	11,25
	TOTAL ORGANIC CARBON (TOC)	BAS ISO 8245:2003	g/m3	24,18
	pH VALUE	BAS ISO 10523:2013*	/	6,92
	QUANTITY OF SULFATE	Standard methods 23th edition-4500 E:2017*	mg/l	26,3
	QUANTITY OF ORTHOPHOSPHATE	BAS EN ISO 6878:2006 (dio 4)*	mgP/l	0,295
	QUANTITY OF TOTAL PHOSPHORUS	BAS EN ISO 6878:2006 (dio 8)*	mgP/l	0,318
	QUANTITY OF CHLORIDE	BAS ISO 9297:2002*	mg/l	14,22
	AMOUNT OF DISSOLVED OXYGEN	BAS EN 25813:2000*	mgO2/l	8,78
	AMOUNT OF AMMONIA (NH3-N)	BAS ISO 7150-1:2002*	mgN/l	0,0031
	NITRATE AMOUNT (NO3-N)	BAS ISO 7890-3:2002*	mgN/l	0,3175
	QUANTITY OF TOTAL NITROGEN	Calculated from the content of nitrate, nitrite and nitrogen according to Kjaldahl *	mg/L	1,08
	CHEMICAL CONSUMPTION O_2	BAS ISO 6060:2000*	mgO2/l	< 30,0
	BIOKEMISKA POTROŠNJA O_2	BAS EN 1899-1:2002*	mgO_2/l	3,84

LABORATORY TESTING OF HEAVY METALS

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
HEAVY METAL ANALYSIS	QUANTITY OF IRON	Standard methods 3111 (B). APHA-AWWA-WEF, 2017	g/m^3	< 0,03
	QUANTITY OF ARSENE	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,50
	QUANTITY OF COPPER	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,40
	QUANTITY OF TOTAL CHROME	BAS ISO 9174:2002	mg/m^3	< 0,50
	QUANTITY OF ZINC	BAS ISO 8288:2002	g/m^3	< 0,002
	QUANTITY OF CADMIUM	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,05
	QUANTITY OF LEAD	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,10
	QUANTITY OF MERCURY	AMA 254. Advanced Mercury Analyser Operaing manual	mg/m^3	< 0,10
	QUANTITY OF NICKEL	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	1,15

LABORATORY TESTING OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHs):

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
ANALYSIS OF PAHs	QUANTITY OF ANTHRACENE	EPA 550.1:1990	mg/m^3	< 0,012
	QUANTITY OF BENZO (B) FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,007
	QUANTITY OF BENZO (K) FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,008
	QUANTITY OF BENZO (A) PYRENE	EPA 550.1:1990	mg/m^3	< 0,009
	QUANTITY OF NAFTHALENE	EPA 550.1:1990	mg/m^3	< 0,018
	AMOUNT OF FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,010

LABORATORY TESTING OF PESTICIDES:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
PESTICIDE ANALYSIS	QUANTITY OF ALDRIN	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULPHANES 1	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULPHANES 2	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULFAN SULFATE	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDRIN	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF DIURON	BAS EN ISO 11369:2002	mg/m^3	< 0,012
	AMOUNT OF ISOPROTURONE	BAS EN ISO 11369:2002	mg/m^3	< 0,011
	QUANTITY OF ALAHLOR	EPA 525.2:1995	mg/m^3	< 0,01
	QUANTITY OF ATRAZINE	EPA 525.2:1995	mg/m^3	< 0,01
	QUANTITY OF CHLORPYRIPHOSE	EPA 525.2:1995	mg/m^3	< 0,02

DATE: 13.10.2020.

OSOBA ODGOVORNA ZA LABORATORIJSKA ISPITIVANJA

KONTROL-H d.o.o. MOSTAR

4.2.1. Conclusion

The surface water sample was taken from the Bent site, which is located at the intersection of the Lištica River and the Ugrovača River, which is a sinkhole. The area that gravitates to these rivers and along those rivers is quite ecologically burdened, both with the existence of illegal landfills that can affect surface and groundwater and there are a large number of sewage discharges, and in some places there is a metal processing industry, concrete plants and bauxite mines, which can also be potential polluters of these rivers.

Based on the Decree on Hazardous and Harmful Substances in Waters, **„Official Journal of Federation of BiH“ no. 43/07 and Ordinance on the health safety of drinking water - general provisions** 'Official Journal of BiH'', no: 40/10, 43/10, 30/12. and **Decisions on categorization of watercourses (picture no. 01/14) the following can be concluded:**

Physico-chemical parameters of these surface waters based on the “Assessment of physico-chemical accompanying parameters of the ecological condition”; can be assessed as “high” noting that for example the following parameters are below the limit values for this assessment of water quality: dissolved oxygen: 8,78 mg/l, which is larger than 7,5 mg/l; nitrates: 0,317 mg/l (allowed < 0,5 mg/l), total N: 1,08 (allowed < 1,5 mg/l). The following parameters based on the “Assessment of physico-chemical accompanying environmental parameters”; can be assessed as “moderate”;, for example: Biochemical oxygen demand (BOD5): 3,84 mg/l (allowed: 2 mg/l – 'high, for larger than 3,0 mg/l – 'moderate); total P: 0,318 mg/l (allowed: 0,1 mg/l – 'high, for larger than 0,25 mg/l – 'moderate).

Regarding the analysis of surface waters related to the limit values of **PAHs, heavy metals and pesticides**, it can be concluded that the quantities of these parameters are below the detection limit of the accredited method, which means that they are present in such small quantities that they can only be detected. in the sample. Therefore, these accredited methods cannot be quantified, but the result in this case is expressed as values less than the value of the detection limit (according to legal provisions), which means that the laboratory in these cases cannot and must not express the result as a final number.

General conclusion: the water analysis, according to the conducted tests, is of extremely good quality (rated with “high” quality), except for two parameters (BOD5 and total P) - where the quality level is rated as moderate. This indicates a slight increase in organic load and water pollution (proximity to illegal landfills, sewage and septic tanks). Other parameters are within the limits of high water quality, which means that water can be used for drinking with less treatment and purification (pre-treatment and disinfection), but it is also necessary to make a micro-biological analysis of water to accurately define drinking water quality. It can be concluded according to the maximum permissible concentrations of certain hazardous substances in surface waters, these waters can be classified in I - II class of surface waters. The water from the sampling site does not contain traces of heavy metals and pesticides that could pose a threat to the environment and as such can be used for crop irrigation, possible bathing, as technical water or for other acceptable purposes.

4.3. City of Ljubuški – Test report No 10-752-1/20

TEST LABORATORY **template code OB.107**

TECHNICAL DATA ON THE SAMPLE:

Order by	TEHNOZAŠTITA D.O.O. MOSTAR (EKO ZH)
Type	SURFACE WATER
Location	Klokun, Ljubuški
Municipality and county	Ljubuški, ZHŽ/K
Water area	Water area of the Adriatic Sea
Sampling performed by	Petar Aničić
Sampling performed according to methods / instructions	RU-UV 01/BAS ISO 5667:2019
Preservation of samples performed according to the method / instructions	RU-KU 01/BAS ISO 5667-3:2019
Place and date of sampling	Klokun; 08.09.2020.
Date of receipt of the sample in the laboratory	08.09.2020.
Date of examination	08.09.2020. – 13.10.2020.
Sampling report no.	049-10/20
Test order No.	086/20
Sample code / seal number	4
Analysis done in	Test laboratory Control-H d.o.o. Mostar and Water Institute Bijeljina

SAMPLE DESCRIPTION (DECLARATION):

The sample is non-original packaging, clear, without visible impurities

LABORATORY TESTING OF PHYSICO-CHEMICAL PARAMETERS:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
FIZIKALNO-KEMIJSKA ANALIZA	TEMPERATURE	BAS DIN 38404-4:2010*	^{0}C	10,70
	TOTAL ORGANIC CARBON (TOC)	BAS ISO 8245:2003	g/m^3	42,40
	pH VALUE	BAS ISO 10523:2013*	/	7,73
	QUANTITY OF SULFATE	Standard methods 23th edition- 4500 E:2017*	mg/l	22,6
	QUANTITY OF ORTHOPHOSPHATE	BAS EN ISO 6878:2006 (part 4)*	mgP/l	0,383
	QUANTITY OF TOTAL PHOSPHORUS	BAS EN ISO 6878:2006 (part 8)*	mgP/l	0,401
	QUANTITY OF CHLORIDE	BAS ISO 9297:2002*	mg/l	12,36
	AMOUNT OF DISSOLVED OXYGEN	BAS EN 25813:2000*	mgO_2/l	8,12
	AMOUNT OF AMMONIA (NH3-N)	BAS ISO 7150-1:2002*	mgN/l	0,0017
	NITRATE AMOUNT (NO3-N)	BAS ISO 7890-3:2002*	mgN/l	0,3471
	QUANTITY OF TOTAL NITROGEN	Calculated from the content of nitrate, nitrite and nitrogen according to Kjaldahl *	mg/L	0,98
	CHEMICAL CONSUMPTION O2	BAS ISO 6060:2000*	mgO_2/l	< 30,0
	BIOCHEMICAL CONSUMPTION O2	BAS EN 1899-1:2002*	mgO_2/l	3,22

LABORATORY TESTING OF HEAVY METALS:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
HEAVY METAL ANALYSIS	QUANTITY OF IRON	Standard methods 3111 (B). APHA-AWWA-WEF, 2017	g/m^3	< 0,03
	QUANTITY OF ARSENE	Standard methods 3113 (B) APHA-AWWA-WEF, 2017	mg/m^3	12,20
	QUANTITY OF COPPER	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,40
	QUANTITY OF TOTAL CHROME	BAS ISO 9174:2002	mg/m^3	< 0,50
	QUANTITY OF ZINC	BAS ISO 8288:2002	g/m^3	< 0,002
	QUANTITY OF CADMIUM	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,05
	QUANTITY OF LEAD	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,10
	QUANTITY OF MERCURY	AMA 254. Advanced Mercury Analyser Operaing manual	mg/m^3	< 0,10
	QUANTITY OF NICKEL	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	2,44

LABORATORY TESTING OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHs):

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
ANALYSIS OF PAHs	QUANTITY OF ANTHRACENE	EPA 550.1:1990	mg/m^3	< 0,012
	QUANTITY OF BENZO (B) FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,007
	QUANTITY OF BENZO (K) FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,008
	QUANTITY OF BENZO (A) PYRENE	EPA 550.1:1990	mg/m^3	< 0,009
	QUANTITY OF NAFTHALENE	EPA 550.1:1990	mg/m^3	< 0,018
	AMOUNT OF FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,010

LABORATORY TESTING OF PESTICIDES:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
PESTICIDE ANALYSIS	QUANTITY OF ALDRIN	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULPHANES 1	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULPHANES 2	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULFAN SULFATE	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDRIN	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF DIURON	BAS EN ISO 11369:2002	mg/m^3	< 0,012
	AMOUNT OF ISOPROTURONE	BAS EN ISO 11369:2002	mg/m^3	< 0,011
	QUANTITY OF ALAHLOR	EPA 525.2:1995	mg/m^3	< 0,01
	QUANTITY OF ATRAZINE	EPA 525.2:1995	mg/m^3	< 0,01
	QUANTITY OF CHLORPYRIPHOSE	EPA 525.2:1995	mg/m^3	< 0,02

DATE: 13.10.2020.

OSOBA ODGOVORNA ZA LABORATORIJSKA ISPITIVANJA

4.3.1. Conclusion

A surface water sample was taken from the Klobuk site, located on the Tihaljina River. The area that gravitates towards this river (sampling location) is quite ecologically burdened, both by the existence of illegal landfills that can affect surface and groundwater and by the large number of sewage outlets and permeable septic tanks, which can also be potential pollutants.

Based on the **Decree on Hazardous and Harmful Substances in Waters, „Official Journal of Federation of BiH" no. 43/07 and Ordinance on the health safety of drinking water - general provisions** 'Official Journal of BiH'', no: 40/10, 43/10, 30/12. and **Decisions on categorization of watercourses (picture no. 01/14) the following can be concluded:**

Physico-chemical parameters of these surface waters based on the "Assessment of physico-chemical accompanying parameters of the ecological condition"; can be assessed as "high" noting that for example the following parameters are below the limit values for this assessment of water quality: dissolved oxygen: 8,12 mg/l, which is larger than 7,5 mg/l; nitrates: 0,34 mg/l (allowed < 0,5 mg/l), total N: 0,98 (allowed < 1,5 mg/l). The following parameters based on the "Assessment of physico-chemical accompanying environmental parameters"; can be assessed as "moderate";for example: Biochemical oxygen demand (BPK5): 3,22 mg/l (allowed: 2 mg/l – 'high, for larger than 3,0 mg/l – 'moderate); total P: 0,401 mg/l (allowed: 0,1 mg/l – 'high, for larger than 0,25 mg/l – 'moderate).

Regarding the analysis of surface waters related to the limit values of **PAHs, heavy metals and pesticides**, it can be concluded that the quantities of these parameters are below the detection limit of the accredited method, which means that they are present in such small quantities that they can only be detected. in the sample. Therefore, these accredited methods cannot be quantified, but the result in this case is expressed as values less than the value of the detection limit (according to legal provisions), which means that the laboratory in these cases cannot and must not express the result as a final number.

General conclusion: the water analysis, according to the conducted tests, is of extremely good quality (rated with "high" quality), except for two parameters (BOD5 and total P) - where the quality level is rated as moderate. This indicates a slight increase in organic load and water pollution (proximity to illegal landfills, sewage and septic tanks). Other parameters are within the limits of high water quality, which means that water can be used for drinking with less treatment and purification (pre-treatment and disinfection), but it is also necessary to make a micro-biological analysis of water to accurately define drinking water quality. It can be concluded according to the maximum permissible concentrations of certain hazardous substances in surface waters, these waters can be classified in I - II class of surface waters. The water from the sampling site does not contain traces of heavy metals and pesticides that could pose a threat to the environment and as such can be used for crop irrigation, possible bathing, as technical water or for other acceptable purposes.

4.4. Municipality of Posušje – Quality control report no. 10-750-1/20

TEST LABORATORY **template code OB.107**

TECHNICAL DATA ON THE SAMPLE:

Order by	TEHNOZAŠTITA D.O.O. MOSTAR (EKO ZH)
Type	SURFACE WATER
Location	Tribistovo, Posušje
Municipality and county	Posušje, ZHŽ/K
Water area	Water area of the Adriatic Sea
Sampling performed by	Petar Aničić
Sampling performed according to methods / instructions	RU-UV 01/BAS ISO 5667:2019
Preservation of samples performed according to the method / instructions	RU-KU 01/BAS ISO 5667-3:2019
Place and date of sampling	Tribistovo; 08.09.2020.
Date of receipt of the sample in the laboratory	08.09.2020.
Date of examination	08.09.2020. – 13.10.2020.
Sampling report no.	049-10/20
Test order No.	086/20
Sample code / seal number	2
Analysis done in	Test laboratory Control-H d.o.o. Mostar and Water Institute Bijeljina

SAMPLE DESCRIPTION (DECLARATION):

The sample is non-original packaging, clear, without visible impurities

LABORATORY TESTING OF PHYSICO-CHEMICAL PARAMETERS:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
PHYSICO-CHEMICAL ANALYSIS	TEMPERATURE	BAS DIN 38404-4:2010*	^{0}C	12,30
	TOTAL ORGANIC CARBON (TOC)	BAS ISO 8245:2003	g/m^3	27,70
	pH VALUE	BAS ISO 10523:2013*	/	6,88
	QUANTITY OF SULFATE	Standard methods 23th edition- 4500 E:2017*	mg/l	25,2
	QUANTITY OF ORTHOPHOSPHATE	BAS EN ISO 6878:2006 (part 4)*	mgP/l	0,312
	QUANTITY OF TOTAL PHOSPHORUS	BAS EN ISO 6878:2006 (part 8)*	mgP/l	0,304
	QUANTITY OF CHLORIDE	BAS ISO 9297:2002*	mg/l	13,18
	AMOUNT OF DISSOLVED OXYGEN	BAS EN 25813:2000*	mgO_2/l	8,22
	AMOUNT OF AMMONIA (NH3-N)	BAS ISO 7150-1:2002*	mgN/l	0,0041
	NITRATE AMOUNT (NO3-N)	BAS ISO 7890-3:2002*	mgN/l	0,3914
	QUANTITY OF TOTAL NITROGEN	Calculated from the content of nitrate, nitrite and nitrogen according to Kjaldahl*	mg/L	1,12
	CHEMICAL CONSUMPTION O2	BAS ISO 6060:2000*	mgO_2/l	< 30,0
	BIOCHEMICAL CONSUMPTION O2	BAS EN 1899-1:2002*	mgO_2/l	3,44

LABORATORY TESTING OF HEAVY METALS:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
HEAVY METAL ANALYSIS	QUANTITY OF IRON	Standard methods 3111 (B). APHA-AWWA-WEF, 2017	g/m^3	0,121
	QUANTITY OF ARSENE	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,50
	QUANTITY OF COPPER	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	1,43
	QUANTITY OF TOTAL CHROME	BAS ISO 9174:2002	mg/m^3	< 0,50
	QUANTITY OF ZINC	BAS ISO 8288:2002	g/m^3	< 0,002
	QUANTITY OF CADMIUM	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,05
	QUANTITY OF LEAD	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,10
	QUANTITY OF MERCURY	AMA 254. Advanced Mercury Analyser Operaing manual	mg/m^3	< 0,10
	QUANTITY OF NICKEL	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,50

LABORATORY TESTING OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHs):

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
ANALYSIS OF PAHs	QUANTITY OF ANTHRACENE	EPA 550.1:1990	mg/m^3	< 0,012
	QUANTITY OF BENZO (B) FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,007
	QUANTITY OF BENZO (K) FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,008
	QUANTITY OF BENZO (A) PYRENE	EPA 550.1:1990	mg/m^3	< 0,009
	QUANTITY OF NAFTHALENE	EPA 550.1:1990	mg/m^3	< 0,018
	AMOUNT OF FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,010

LABORATORY TESTING OF PESTICIDES:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
PESTICIDE ANALYSIS	QUANTITY OF ALDRIN	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULPHANES 1	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULPHANES 2	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULFAN SULFATE	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDRIN	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF DIURON	BAS EN ISO 11369:2002	mg/m^3	< 0,012
	AMOUNT OF ISOPROTURONE	BAS EN ISO 11369:2002	mg/m^3	< 0,011
	QUANTITY OF ALAHLOR	EPA 525.2:1995	mg/m^3	< 0,01
	QUANTITY OF ATRAZINE	EPA 525.2:1995	mg/m^3	< 0,01
	QUANTITY OF CHLORPYRIPHOSE	EPA 525.2:1995	mg/m^3	< 0,02

DATE: 13.10.2020.

OSOBA ODGOVORNA ZA LABORATORIJSKA ISPITIVANJA

CONTROL-H d.o.o. MOSTAR

4.4.1. Conclusion

The surface water sample was taken from the Tribistovo location, Tribistovo reservoir. The area that gravitates towards this accumulation (sampling site) is quite ecologically burdened, both by the existence of illegal landfills that can affect surface and groundwater and by the number of sewage discharges and water-permeable septic tanks, which can also be potential contaminants of these water

Based on the **Decree on Hazardous and Harmful Substances in Waters, „Official Journal of Federation of BiH" no. 43/07 and Ordinance on the health safety of drinking water - general provisions** 'Official Journal of BiH'', no: 40/10, 43/10, 30/12. and **Decisions on categorization of watercourses (picture no. 01/14) the following can be concluded:**

Physico-chemical parameters of these surface waters based on the "Assessment of physi-co-chemical accompanying parameters of the ecological condition"; can be assessed as "high" not-ing that for example the following parameters are below the limit values for this assessment of water quality: dissolved oxygen: 8,22 mg/l, which is larger than 7,5 mg/l; nitrates: 0,391 mg/l (allowed < 0,5 mg/l), total N: 1,12 (allowed < 1,5 mg/l). The following parameters based on the "Assessment of physico-chemical accompanying environmental parameters"; can be assessed as "moderate";for example: Biochemical oxygen demand (BPK5): 3,44 mg/l (allowed: 2 mg/l – 'high, for larger than 3,0 mg/l – 'moderate); total P: 0,304 mg/l (allowed: 0,1 mg/l – 'high, for larger than 0,25 mg/l – 'moderate).

Regarding the analysis of surface waters related to the limit values of **PAHs, heavy metals and pesticides**, it can be concluded that the quantities of these parameters are below the detection limit of the accredited method, which means that they are present in such small quantities that they can only be detected. in the sample. Therefore, these accredited methods cannot be quantified, but the result in this case is expressed as values less than the value of the detection limit (according to legal provisions), which means that the laboratory in these cases cannot and must not express the result as a final number.

General conclusion: the water analysis, according to the conducted tests, is of extremely good quality (rated with "high" quality), except for two parameters (BOD5 and total P) - where the quality level is rated as moderate. This indicates a slight increase in organic load and water pollution (proximity to illegal landfills, sewage and septic tanks). Other parameters are with-in the limits of high water quality, which means that water can be used for drinking with less treatment and purification (pre-treatment and disinfection), but it is also necessary to make a micro-biological analysis of water to accurately define drinking water quality. It can be conclud-ed according to the maximum permissible concentrations of certain hazardous substances in surface waters, these waters can be classified in I - II class of surface waters. The water from the sampling site does not contain traces of heavy metals and pesticides that could pose a threat to the environment and as such can be used for crop irrigation, possible bathing, as tech-nical water or for other acceptable purposes.

4.5. Municipality of Grude – Quality control report no. 10-751-1/20

TEST LABORATORY **template code OB.107**

TECHNICAL DATA ON THE SAMPLE:

Order by	TEHNOZAŠTITA D.O.O. MOSTAR (EKO ZH)
Type	SURFACE WATER
Location	Peć Mlini, Grude
Municipality and county	Grude, ZHŽ/K
Water area	Water area of the Adriatic Sea
Sampling performed by	Petar Aničić
Sampling performed according to methods / instructions	RU-UV 01/BAS ISO 5667:2019
Preservation of samples performed according to the method / instructions	RU-KU 01/BAS ISO 5667-3:2019
Place and date of sampling	Peć Mllini; 08.09.2020.
Date of receipt of the sample in the laboratory	08.09.2020.
Date of examination	08.09.2020. – 13.10.2020.
Sampling report no.	049-10/20
Test order No.	086/20
Sample code / seal number	3
Analysis done in	Test laboratory Control-H d.o.o. Mostar and Water Institute Bijeljina

SAMPLE DESCRIPTION (DECLARATION):

The sample is non-original packaging, clear, without visible impurities.

LABORATORY TESTING OF PHYSICO-CHEMICAL PARAMETERS:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
PHYSICO-CHEMICAL ANALYSIS	TEMPERATURE	BAS DIN 38404-4:2010*	^{0}C	9,47
	TOTAL ORGANIC CARBON (TOC)	BAS ISO 8245:2003	g/m^3	33,67
	pH VALUE	BAS ISO 10523:2013*	/	7,51
	QUANTITY OF SULFATE	Standard methods 23th edition- 4500 E:2017*	mg/l	20,5
	QUANTITY OF ORTHOPHOSPHATE	BAS EN ISO 6878:2006 (part 4)*	mgP/l	0,344
	QUANTITY OF TOTAL PHOSPHORUS	BAS EN ISO 6878:2006 (part 8)*	mgP/l	0,398
	QUANTITY OF CHLORIDE	BAS ISO 9297:2002*	mg/l	12,18
	AMOUNT OF DISSOLVED OXYGEN	BAS EN 25813:2000*	mgO_2/l	8,53
	AMOUNT OF AMMONIA (NH3-N)	BAS ISO 7150-1:2002*	mgN/l	0,0039
	NITRATE AMOUNT (NO3-N)	BAS ISO 7890-3:2002*	mgN/l	0,3841
	QUANTITY OF TOTAL NITROGEN	Calculated from the content of nitrate, nitrite and nitrogen according to Kjaldahl *	mg/L	0,98
	CHEMICAL CONSUMPTION O2	BAS ISO 6060:2000*	mgO_2/l	< 30,0
	BIOCHEMICAL CONSUMPTION O2	BAS EN 1899-1:2002*	mgO_2/l	3,18

LABORATORY TESTING OF HEAVY METALS:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
HEAVY METAL ANALYSIS	QUANTITY OF IRON	Standard methods 3111 (B). APHA-AWWA-WEF, 2017	g/m^3	< 0,03
	QUANTITY OF ARSENE	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,50
	QUANTITY OF COPPER	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,40
	QUANTITY OF TOTAL CHROME	BAS ISO 9174:2002	mg/m^3	< 0,50
	QUANTITY OF ZINC	BAS ISO 8288:2002	g/m^3	< 0,002
	QUANTITY OF CADMIUM	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,05
	QUANTITY OF LEAD	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,10
	QUANTITY OF MERCURY	AMA 254. Advanced Mercury Analyser Operaing manual	mg/m^3	< 0,10
	QUANTITY OF NICKEL	Standard methods 3113 (B). APHA-AWWA-WEF, 2017	mg/m^3	< 0,50

LABORATORY TESTING OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHs):

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
ANALYSIS OF PAHs	QUANTITY OF ANTHRACENE	EPA 550.1:1990	mg/m^3	< 0,012
	QUANTITY OF BENZO (B) FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,007
	QUANTITY OF BENZO (K) FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,008
	QUANTITY OF BENZO (A) PYRENE	EPA 550.1:1990	mg/m^3	< 0,009
	QUANTITY OF NAFTHALENE	EPA 550.1:1990	mg/m^3	< 0,018
	AMOUNT OF FLUORANTENE	EPA 550.1:1990	mg/m^3	< 0,010

LABORATORY TESTING OF PESTICIDES:

TYPE OF ANALYSIS	TESTED PARAMETER	METHOD	UNIT	RESULT
PESTICIDE ANALYSIS	QUANTITY OF ALDRIN	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULPHANES 1	EPA 508.1:1994	mg/m^3	< 0,0
	QUANTITY OF ENDOSULPHANES 2	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDOSULFAN SULFATE	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF ENDRIN	EPA 508.1:1994	mg/m^3	< 0,01
	QUANTITY OF DIURON	BAS EN ISO 11369:2002	mg/m^3	< 0,012
	AMOUNT OF ISOPROTURONE	BAS EN ISO 11369:2002	mg/m^3	< 0,011
	QUANTITY OF ALAHLOR	EPA 525.2:1995	mg/m^3	< 0,01
	QUANTITY OF ATRAZINE	EPA 525.2:1995	mg/m^3	< 0,01
	QUANTITY OF CHLORPYRIPHOSE	EPA 525.2:1995	mg/m^3	< 0,02

DATE: 13.10. 2020.

OSOBA ODGOVORNA ZA LABORATORIJSKA ISPITIVANJA

4.5.1. Conclusion

A sample of surface water was taken from the Drinovci site, near the Peć Mlini hydroelectric power plant - an accumulation on the Matica River. The area that gravitates towards this accumulation - Imotski - Bekijsko polje (sampling location) is quite ecologically burdened, both by the existence of illegal landfills that can affect surface and groundwater and by the number of sewage outlets and watertight septic tanks, which can also be potential pollutants. of these waters.

Based on the Decree on Hazardous and Harmful Substances in Waters, „**Official Journal of Federation of BiH" no. 43/07 and Ordinance on the health safety of drinking water - general provisions** 'Official Journal of BiH'', no: 40/10, 43/10, 30/12. and **Decisions on categorization of watercourses (picture no. 01/14) the following can be concluded:**

Physico-chemical parameters of these surface waters based on the "Assessment of physico-chemical accompanying parameters of the ecological condition"; can be assessed as "high" noting that for example the following parameters are below the limit values for this assessment of water quality: dissolved oxygen: 8,53 mg/l, which is larger than 7,5 mg/l; nitrates: 0,384 mg/l (allowed < 0,5 mg/l), total N: 0,98 (allowed < 1,5 mg/l). The following parameters based on the "Assessment of physico-chemical accompanying environmental parameters"; can be assessed as "moderate";for example: Biochemical oxygen demand (BPK5): 3,18 mg/l (allowed: 2 mg/l – 'high, for larger than 3,0 mg/l – 'moderate); total P: 0,398 mg/l (allowed: 0,1 mg/l – 'high, for larger than 0,25 mg/l – 'moderate).

Regarding the analysis of surface waters related to the limit values of **PAHs, heavy metals and pesticides**, it can be concluded that the quantities of these parameters are below the detection limit of the accredited method, which means that they are present in such small quantities that they can only be detected. in the sample. Therefore, these accredited methods cannot be quantified, but the result in this case is expressed as values less than the value of the detection limit (according to legal provisions), which means that the laboratory in these cases cannot and must not express the result as a final number.

General conclusion: the water analysis, according to the conducted tests, is of extremely good quality (rated with "high" quality), except for two parameters (BOD5 and total P) - where the quality level is rated as moderate. This indicates a slight increase in organic load and water pollution (proximity to illegal landfills, sewage and septic tanks). Other parameters are within the limits of high water quality, which means that water can be used for drinking with less treatment and purification (pre-treatment and disinfection), but it is also necessary to make a micro-biological analysis of water to accurately define drinking water quality. It can be concluded according to the maximum permissible concentrations of certain hazardous substances in surface waters, these waters can be classified in I - II class of surface waters. The water from the sampling site does not contain traces of heavy metals and pesticides that could pose a threat to the environment and as such can be used for crop irrigation, possible bathing, as technical water or for other acceptable purposes.

5. CONCLUSION - Guidelines and recommendations

5.1. Summary of results obtained

Based on the analysis, the general condition of surface water quality is slightly better compared to the pre-war period, solely because large industrial plants have stopped working or are working with smaller capacities. Surface waters, according to their significance for water management, are classified into Category I waters and II waters. The waters of the 1st category in the area of WHC are: watercourses Matica (Vrljika), TM-T (Tihaljina, Mlada, Trebižat) and Lištica (downstream from Široki Brijeg), and Blidinjsko Lake. All remaining waters are II. categories. Watercourses, in terms of quality, belong to two categories (creditworthiness classes), namely:

a. I. category, represented by waters which, in their natural state or after disinfection, may be used for drinking and for the needs of the food industry, the rearing of noble species of fish,
b. II. category, which consists of waters suitable for bathing and recreation, breeding of less noble species of fish, and waters that after purification can be used for drinking and food industry needs,
c. Waters of III. categories are those that after purification can be used in industry, and as natural waters can be used for irrigation.

Preservation of good water quality and prevention of additional pollution of water resources can be controlled through:

- Point pollution from municipal wastewater discharge (faecal water)
- Diffuse (diffuse) pollution of watercourses and groundwater:
  - Agriculture (pesticides and other protective means)
  - Forestry
  - Mining
  - Construction
- Leachate pollution from public and illegal landfills;
- Pollution from industrial wastewater.

5.2. Wastewater - status and recommendations

In addition to illegal landfills and solid waste management, a major problem for environmental protection, ie water resources, is wastewater drainage. Insufficient construction of the sewerage system and appropriate infrastructure, damage and deterioration of the existing infrastructure in the sector of drainage and wastewater treatment, as well as insufficient maintenance of infrastructure, lead to the possibility of increasing surface and groundwater pollution and thus deteriorating drinking water quality. Only the town of Ljubuški has a wastewater treatment plant, other municipalities are still in the design and construction phase of such plants.

The following is an analysis of the issues related to wastewater in the West Herzegovina County.

5.2.1. City of Široki Brijeg

A significant problem in the town of Široki Brijeg for many years is the lack of a sewerage network, but septic tanks have already been used for this purpose. Before the war, a wastewater treatment plant with a main collector was built and equipped, but it was not put into operation. The installed installations and equipment have been devastated, so re-equipping and putting the facility into operation requires significant funds. Investments in the construction of the sewerage system in the near future will certainly be among the priorities in the construction of communal infrastructure of the City of Široki Brijeg.

In the meantime, the main sewer drain (Pecara-Most) was installed on the main city street. The feasibility study of the project for water and wastewater in Široki Brijeg (2008) anticipates the needs of water and wastewater until 2035 and establishes long-term infrastructural conditions to meet these needs. As Široki Brijeg does not have a water purifier, the new sewerage system of Široki Brijeg is designed as a distribution system. The project plans 5 collector zones (A, B, C, D and E), with a total length of 61,339 m. Faecal wastewater is drained to a central treatment plant with a capacity of 10,000 ES, which is planned downstream from the city and at the lowest point of the system, so that the drainage is done by natural fall. Rainwater is discharged to the recipients (river Lištica and river Ugrovača), with prior treatment through grease traps. The project envisages the construction of the remaining parts of collectors A and B, collector C, and priority parts of collectors D and E. In September 2013, works on the construction of sewer collector "B" of the first phase of the project "Water Supply and Sanitation in FBiH" were technically received. In addition to the installation of sewage collectors, water pipes, as well as telecommunications and electrical installations were replaced. Project documentation for collector "B" - II. phase and for the unbuilt part of collector "A" and collector "C". Works are underway in Lise, on Gedža!s side, and on the Right Bank. A wastewater treatment plant is under construction.

5.2.2. City of Ljubuški

In the town of Ljubuški, the wastewater drainage system was built in 1987, it is of a mixed character and covers 80% of the urban part, and according to the study of communal economy of the West Herzegovina County (2011) it was used by 287 economic users and 747 households. The length of the main collectors is approximately 8 km, and the total length of the drainage system is approximately 12 km. The main collectors are made mainly of concrete pipes which are in relatively poor condition, partly due to wear and tear, and partly due to the aggressive action of sewage waste on them. Part of the collector is made of PVC or PE pipes. With the main collector Ø1.000 mm, all wastewater is drained to the central wastewater treatment plant (CUPOV) "Matinjevac", southwest of the center of Ljubuški, about 350 m away from the confluence in the recipient, or the river Trebižat.

At the time of design, the construction of the plant is planned in 2 phases; in the first phase of construction, a capacity of 5,000 ES was envisaged (1989), since when the plant has been operating continuously. The treatment consists of: mechanical treatment (removal of large waste of organic and mineral origin with a grate and removal of sand, slag and ash by sandblasting) and biological treatment (process with activated sludge, nitrification process, secondary deposition, chlorination as needed, sludge line - aerobic digestion, stabilization tank, arid fields).

In the second phase, a capacity of 10,000 ES is envisaged. The main disadvantage of the system is precisely the fact that the system is of a mixed type, so that the device is unnecessarily burdened by rainwater. The Ministry of Economy recently provided 180,000 KM for the reconstruction and extension of the UPOV in Ljubuški. In the rest of the Municipality there is no organized system of drainage and wastewater disposal. Household wastewater is mainly disposed of in septic tanks, ie by pumping them and transporting the collected waste to a wastewater treatment plant, which is a biological type of treatment. Septic tanks are most often improperly constructed and are rarely emptied (1-2 times a

year or even less frequently).For wastewater from the economic sector, it is not known whether and how it is treated before it is released into the environment.

The project conceptual design of sewage and rainwater drainage of the town of Ljubuški (2012) defines the long-term concept of the municipal sewerage system, which divides the municipality into 10 drainage areas - agglomeration, 9 agglomerations in the border areas of the municipality and one central agglomeration

„Matinjevac“. Border agglomerations are envisaged with a separate sewer system; sewage network, treatment device and discharge into the recipient. The systems were envisaged as incomplete distribution systems, ie only closed systems for faecal wastewater would be built, and precipitation would be handled in the same way as today. According to the project, a total of 36,780 ES is foreseen in the planning period (2035), of which 30,600 ES should be covered by public sewerage systems (agglomerations), and for the remaining 6,180 ES it is planned to be connected to individual impermeable septic tanks, whose the total contents would be driven to CUPOV “Matinjevac”. 88 The central agglomeration "Matinjevac" includes the town of Ljubuški, Mostarska vrata, Pregrađe, Humac and part of the settlement Hrašljani. In addition to the central part, it is planned to connect 4 more branches of individual sections of the sewerage network (according to the preliminary design).

In the area of the town of Ljubuški, there is the only wastewater treatment plant on the river T-MT, ie on the move of the municipalities: Grude, Ljubuški and Čapljina. This purifier has been operating continuously since the 1980s. The method of wastewater treatment for CUPOV “Matinjevac” is, as before - biologically active sludge, which is determined by the main project of reconstruction of the existing wastewater treatment plant in the town of Ljubuški. Therefore, in September 2013, Ljubuški, together with AVPJM from Mostar and FMPVŠ, started the reconstruction of the wastewater treatment plant, because the treatment results were low, as well as the construction of the eastern branch of the sewerage system and project documentation for the western branch towards Proboj. It is a well-known fact that long-term bacteriological findings have shown that bathing standards on the TMT River are not met, both downstream and upstream of wastewater treatment plants. Which treatment methods will be applied to the other 9 smaller devices will depend on the actual conditions in the field (securing the location, the recipient into which the treated wastewater is discharged, wastewater quantities and other factors), at the time of their construction decision. Sludge treatment will be performed on the device “Matinjevac” from the entire municipality - from smaller devices and septic tanks.

With the implementation of the reconstruction of wastewater treatment plants and the construction of part of the sewerage system, the water quality in Trebižat, the entire Neretva and Adriatic basins has significantly improved, which will contribute to a better life for the Municipality, with better conditions for tourism and agriculture. The construction of a complete sewerage system will not only ensure the required water quality of the Trebižat stream, but will also prevent further introduction of polluted water into the groundThe greatest impact from the construction of the system is expected to improve the quality of groundwater flowing to the Studenčica springs, especially to the captured Vakuf spring, as well as to the Mlinica spring in Studenci. This sewage system will not have an impact on the groundwater of the Kajtazovina spring and the springs downstream of it, since all the pollution that comes to these springs and springs comes from the direction of Medjugorje and Čitluk. Therefore, it is necessary to cooperate with the Municipality of Čitluk in the implementation of measures for the preservation of groundwater from these springs. The construction of the sewerage system of the Municipality of Ljubuški will also have positive effects on the protection of groundwater from the Prud spring in the Republic of Croatia, but also on the preservation of the natural phenomenon - the Kravica waterfall.

The drainage of the motorway and ancillary facilities in Corridor Vc was solved by semi-open and closed systems, respectively. A number of facilities have been designed that are in the function of drainage - facilities for receiving rainwater from areas outside the highway pavement and their drainage to the recipient, then facilities for receiving, draining and purifying water from pavement

surfaces of the highway, and facilities for receiving and disposing of waste water from accompanying road facilities. The entire system is planned in accordance with the risk zones for groundwater, given the route of the highway in the Municipality of Ljubuški is located in the so-called zones of moderate and high risk in terms of groundwater quality.

5.2.3. Municipality of Posušje

The municipal center of Posušje does not have a sewerage network, except for one branch of the storm sewerage in the street fra Grge Martića. Today, Posušje has just over 6,000 inhabitants. It is estimated that the upper limit of the population in the urban area of the city is 10,000 around 2030. All households, institutions and industry dispose of their waste and fecal water in absorbent wells or impermeable septic tanks. This mode of disposition was possible only when water consumption was low. The municipal decision on wastewater drainage in the area of the municipality of Posušje somewhat legally regulates this communal activity („OJ", No: 1/11). The decision on the appearance, method of cleaning and maintenance of septic tanks was published in the same number of journal.

During the reconstruction of some streets, shorter sections of fecal canals were built, which are armored and currently serve as septic tanks, part of the main street in front of the department store and from the Music School to the Municipality building, as well as shorter sections in side streets gravitating to Mokri Dolac natural depression in the central part.

The existing rainfall canals are, from concrete pipes along the main street from the department store to the culvert on the road Posušje-Mostar and the street from the hotel to the culvert in Mokri Dolac.

The first project of the sewerage network and wastewater treatment plant for Posušje was done in the mid-1980s. Since the city expanded with certain urban changes, the conceptual design of a separate (separate) sewerage system of the urbanized part of Posušje (1998) was made, as well as the main project of the collector of the sewerage system Posušje.

- The following conditions were taken into account when choosing the collector route:
- that all consumers are connected to the sewerage system;
- to fully enable the gravity drainage system;
- to ensure the smooth operation of the entire system during operation, especially the main wastewater collector K1, which was achieved by respecting the conditions of minimum and maximum speeds in the main collector and the minimum and maximum allowable falls;
- that all wastewater be brought by the shortest possible route to the already determined location of the future treatment plant, whose main project was done more than 20 years ago, so it is logical to create a new project with newer treatment technology.

Topographic conditions conditioned the division of the system into 2 subsystems: western and eastern, which are connected in front of the location of the future treatment plant. The western system collects about 75% of all wastewater in Posušje and most of the wastewater of the current center. The main collector of the eastern subsystem K2 starts at the church, collects water from the gravitating part of the city, turns east and partly follows the northern bypass, and is further laid southeast, outside the city roads following natural drainage routes to the intersection on the road Posušje - Mostar. Here, the collector changes direction to the west along the southern city bypass, collects water from the new settlement of Carski Gaj and connects to the western collector directly in front of the location of the treatment plant. The total length of the sewage system collector is approx. 22.100 m, of which collector K1 2,047 m, and collector K2 4,028 m.

The secondary collectors of the network are placed in such a way as to follow the existing and planned city streets and, respecting the natural decline of the terrain, take the water to the main col-

lector by the shortest route.

The stormwater sewerage system consists of a network of closed canals through which rainwater is collected from urban areas and a network of open canals laid at the lowest points of the terrain, which are regulated gutters and into which storm sewers are discharged. Rainwater collector of the western subsystem KK1 is provided by the same route as the main wastewater collector and drains next to the city center and the area of Mokri Dolac and populated areas Jukića Doci and Meljakuša. The outlet of this collector KK1 is directly next to the location of the treatment plant in the Topalu stream. Secondary collectors of the western rainwater system monitor the existing city roads, and partly the planned roads in the future settlement of Jukića Doci. The total length of the collector of the western subsystem is approximately 12,530 m, of which the main collector KK1 is 2,055 m long. The stormwater drainage system of the eastern part of the city is designed partly as a network of closed collectors which drain the future urbanized area of the northern part of the urban area and the new settlement Carski Dol, and partly as a network of open canals and regulated gutters into which closed collectors flow. rainwater.

Open canals are partly peripheral canals (along the road Posušje-Rakitno), which have the task of accepting and draining water that reaches the urban area from outside the urban area. The open channel KK2, which collects rainwater from the eastern subsystem, brings water to the Brina River, a tributary of the Topala River, about 750 m east of the inflow of rainwater collector from the western subsystem. The total length of the closed pipe collectors of the eastern subsystem is approx. 5,140 m, and the total length of open channels of this subsystem is approx.6.700 m. The main open stormwater channel of the eastern subsystem KK2 is 4,195 m long. Before the inflow of the stormwater collector, retention basins were designed to receive the “first rain”.

The necessary funds for the implementation of the sewerage system project of the Municipality of Posušje far exceed the possibilities of the Municipality. The result of these activities is that it entered the medium-term development strategy of Bosnia and Herzegovina, which was adopted by the Council of Ministers of BiH and thus declared of interest to the state of BiH. This is a good basis for this project to be eligible for favorable World and European Bank for Reconstruction and Development loans, without which it will be very difficult to implement this expensive project. In November 2016, an expert meeting “Financing of infrastructure projects from EU funds in BiH” was held in Posušje, in order to start with more concrete activities in the field of water conservation and environmental protection both at the local level and at the level of Herzegovina and the Adriatic basin. It was pointed out that every rain in Posušje is a potential ecological threat to the Adriatic Sea - everything that washes off the streets ends up in manholes; motor oils, fuel, even feces due to illegal connections. All this flows underground into Trebižat, and then along the Neretva into the Adriatic Sea.

5.2.4. Municipality of Grude

In the municipality of Grude, drainage and wastewater treatment is organized only in the narrower urban part of Grude. The Decision on drainage and wastewater treatment was passed („OJ“, No: 1/00). The sewerage network and the purifier are managed by PE “Komunalno”. According to official data, 4,400 inhabitants live in the center of Grude, of which about 1,500 are connected to the sewerage network. The length of the sewerage network is 9.6 km. There are a large number of illegal connections that are sometimes connected to the stormwater sewer system. In the rural part of the municipality, the entire wastewater disposal system (in the part of fecal water), as well as in other municipalities of WHC, is based on the construction of septic tanks.

A 2,500 ES wastewater treatment plant was built at the Bili Brig site. According to the technological project, this purifier was supposed to be biological-chemical. For unknown reasons, the construction of the chemical part of the treatment plant was never completed, so it now works as a basis for biological water treatment technology. However, this part of the technology does not perform its

function to the end due to the fact that wastewater from Grude brewery is connected to the sewage system, which themselves have a load of 10,000 ES, which greatly exceeds the designed load of the treatment plant. Due to the high hydraulic load, it is assumed that the total amount of water discharged of 553 m³ / d does not meet the prescribed requirements of the Ordinance on limit values for hazardous and harmful substances for water that are discharged into the natural receiver after treatment from the public sewerage system.

The main recipient of treated wastewater is expected to be the abyss in Grudsko polje, but (due to poor construction of the drain from the treatment plant to the abyss) the recipient is actually the eastern part of the IBP, which was flooded for part of the year.

The device was repaired after the war, in 1996 and put into operation in part, but very briefly. Reconstruction, upgrading and re-design of wastewater treatment plants is in progress. One part of the mechanical wastewater treatment has already been done.

The Development Strategy of the Municipality of Grude outlines plans for the construction of the second phase of the treatment plant and the expansion of the sewerage network for wastewater drainage for the settlement of Pešija. In the rural part of the Municipality, the entire wastewater disposal system (in the part of fecal water), as well as in other municipalities of WHC, is based on the construction of septic tanks.

5.2.5. Objectives, measures and recommendations for reducing surface and groundwater pollution

In order to preserve good water quality (surface and groundwater bodies) it is necessary to: Reduce the burden of pollution from urban / sanitary wastewater, by implementing measures:

- Increasing the level of population coverage by sewage systems (up to 70% of the population) and construction of appropriate water treatment plants: settlements with 2,000-10,000 ES; settlements with 10,000-15,000 ES; settlements over 15,000 ES;
- Construction of watertight septic tanks and control of pollution from them.

Reduction of emissions of harmful and toxic substances produced by individual industrial pollutants through the establishment of a system of permitted emissions and the principle of “polluter pays”, by implementing measures:

- Establish a database of pollutants
- Improve inspections of industrial pollutants;
- Improve multisectoral cooperation in WHC through the issuance of water acts and environmental permits.

Construction of a system for collection, drainage and treatment of wastewater for settlements with up to 2,000 inhabitants, by implementing the measure:

- Development of guidelines, definition of standards and construction of sewage systems and wastewater treatment plants for about 25% of the population living in settlements with up to 2,000 inhabitants.

Establishment of protected areas in accordance with the Law on Waters of FBiH, implementation of the measure:

- Establishment, technically and administratively, of a zone for sanitary protection of drinking springs of public and local water supply systems with a capacity exceeding 10 m3 / day, in accordance with the adopted decisions on protection of springs.

5.3. Wild landfills - guidelines and recommendations

Prevention measures

The most adequate principle in terms of waste management is waste prevention. For this purpose, it is necessary to conduct a public awareness campaign, encourage the reduction of the use of plastic bags, encourage the reduction of the use of packaging (more packaging and more bags), smart shopping that will not lead to food waste, avoid buying disposable plastic products (straws, plates, cups) etc. Campaigns can be run by WHC through NGOs and other organizations, and / or companies involved in production, distribution and sales. Additionally, companies in the manufacturing sector can work to improve the packaging and technical aspects of their products to reduce waste production. The key problem of illegal landfills is the lack of coverage by municipal waste collection services in the territory of cities / municipalities.

Waste treatment measures

The current practice in WHC is waste collection and disposal, with a very low level of waste selection by private companies (especially paper, less plastic). The capacities of companies engaged in collection (including selective collection) and recycling can be expanded with an adequate system established in WHC. The chapters below list the measures that should lead to the establishment of the system and increase the level of selection and recycling, and reuse of waste. In order to implement these measures, it was estimated that at the level of WHC it is necessary (according to the Environmental Protection Plan of the West Herzegovina County for the period from 2017 to 2027.):

- 20,000 bins for municipal waste
- 20,000 bins for paper
- 20,000 composters
- 2,000 containers for municipal waste
- 2,000 containers for packaging waste
- 200 Igloos for glass
- 5 x 3-axle bins
- 5 x 2-axle bins
- 5 duplex bins for packaging waste
- 4 tractors with trailers
- 16 roll containers 36 m^3 for waste transport

Separate waste collection

There is no selective collection of waste at the source on the territory of WHC. The goal of separate collection is to reduce the amount of waste for disposal and use of waste for new purposes. The establishment of missing infrastructure (bins and containers for waste selection) should be subsidized by the operator.

Waste selection at source

The concept is based on the separation of dry fractions of usable waste from the wet fraction. The dry fraction means packaging waste, ie glass, paper, cardboard, plastic and metal packaging. All other mixed waste is a wet fraction. Paper collection should be done through 120 L bins placed near individual and residential buildings, and the frequency of collection should be determined by collectors (utilities and private companies covering certain regions, based on the quantities collected). It is necessary to place Igloo 3m3 bins next to shopping centers for collecting glass and plastic.

Collection costs would be covered exclusively through a subsidy from authorized operators. Operators (who have charged for this service) have to pay paper collectors because the selling price of glass is not enough to cover the cost of collection. Before installing Igloo, do an analysis of the amount of glass, and postpone the establishment of the needle until the construction of a landfill for inlet waste where the glass could be disposed of in the absence of a market for purchase. Collection of dry packaging waste should be done through the so-called yellow bags. Collection costs should be covered through a subsidy from authorized operators. Operators have to pay dry packaging collectors because the selling price of mixed packaging is not enough to cover collection costs. Sorting of dry packaging waste only makes sense at the regional level (this waste in the EU is largely processed into RDF).

Green islands

Green islands are used for selective temporary disposal of large quantities of waste (2100 l). Green islands can be set up in collective housing areas in urban areas of municipalities / cities. It is necessary for municipalities / cities to determine the locations of these islands, and to ensure the installation of a base, fence and information board. Containers should be closed, clearly marked as containers for dry fraction (glass, paper, cardboard, plastic and metal packaging) and containers for residual mixed waste. The number of islands that need to be set up will vary depending on the number of inhabitants and the available space, but the practice should be to set them up according to the principle of 1 island per 100 inhabitants.

Recycling yards

Recycling yards have already been considered by various studies in the municipalities / cities of WHC. It is necessary to approach the construction of these recycling yards. It is recommended that recycling yards be built for every 1500 inhabitants (Republic of Croatia), but in WHC this recommendation is not applicable due to the low level of development of the waste management system, and the lack of funds.This plan envisages the construction of the RY in Grude and Široki Brijeg during the period of validity of this Plan, with the proviso that it is necessary to build the RY in phases (with capacity expansion). It is necessary to plan the construction of RY in Ljubuški (within the PS) and Posušje (if it is assessed as cost-effective; adequate sizing, based on the analyzed needs and capacities in the municipalities is necessary). Recycling yards should be minimally provided for separate collection of: bulky waste, metal, EE waste and hazardous components of municipal waste (batteries, medicines and other types of waste as needed), textiles and construction waste for individuals. In order to further plan the establishment of a separate collection system, it is proposed to prepare a Study on the composition of waste and a plan for the phased establishment of a separate collection system. Draft Waste Management Plan of the West Herzegovina County 2020-2030.

Transfer stations

The Spatial Plan of Ljubuški states that the Transfer Station in the area of the Municipality of Ljubuški will be located on the site of the former landfill in Bučine, and the waste will be transported further to the Uborak landfill until the RWMC for WHC is built. Transshipment, selection and recycling of waste at the TS site will greatly reduce transportation costs, and the amount of waste that will be disposed of at the regional landfill. After the selection of waste, it is necessary to hand over the waste for further reuse or recycling. Therefore, it is necessary to strengthen the existing capacities for waste recycling in the area of WHC, and to establish contacts with other regions, in order to hand over waste (if there are no capacities in WHC). It is necessary for the Government of WHC to encourage communication and improve cooperation with operators, as well as the sector dealing with selective waste collection and recycling in WHC.

Ultimate waste disposal

Regionalne deponije Praksa dosadašnjeg odlaganja otpada je bilo odlaganje na Regionalnu deponiju u Mostaru. Izgradnja regionalne deponije na teritoriji ŽZH nikada nije ekonomski opravdana. Postoji mogućnost odlaganja otpada na regionalnu deponiju Livno (koja još nije u funkciji), mada su troškovi transporta do ove deponije značajno veliki. Opredeljenje ŽZH je nastavak odlaganja otpada na Regionalnu deponiju Mostar, uz obvezivanje smanjivanja količina za odlaganje intezivnom izgradnjom sistema za odvojeno sakupljanje otpada i reciklažu, kao i ponovnu upotrebu.

Municipal / city landfills and remediation measures

Municipal / city landfills have been closed, but have not been fully rehabilitated, in order to minimize the impact of the landfill on the environment and the population. Technological study of the rehabilitation of the Konjevac landfill and the Study of the impact of the rehabilitation was done for Posušje. Other municipalities / cities should prepare Environmental and Population Risk Studies of existing landfills, and in accordance with the results, prepare a Rehabilitation Plan. It is necessary to envisage in the Plans the necessary funds for the implementation of rehabilitation and sources of savings. If possible, plan to set up a mobile crusher and use construction waste to cover and remediate the landfill. It is necessary for WHC to keep records of illegal landfills (data obtained from municipalities / cities) and co-finance their removal.

5.3.1. Possible protection measures and proposal of guidelines for reduction of water resources pollution

Within this project “Wild landfills and impact on natural watercourses” for the areas of West Herzegovina County (BiH) and Boka Kotorska (Montenegro), ie for municipalities / cities belonging to this area, after the analysis of illegal dumps and watercourse analysis, the following can be concluded:

Local unregulated and illegal landfills were identified and positioned, ie recorded, including all data on them that were recorded directly on the site. The analysis of the results obtained during the implementation of this project revealed the existence of a large number of illegal landfills in local communities, which can be attributed to low public awareness of the negative impact of waste disposal on illegal landfills, but also a number of local unregulated landfills that need to be rehabilitated. in accordance with European guidelines and recommendations

Pursuant to the Law on Environmental Protection and Water Protection, and on the basis of the adopted Environmental Protection Strategy of the Federation of BiH, an integral part of which is the Waste Management Strategy of the Federation of BiH (OJ of Federation BiH No. 4/12)which provides that an integrated waste management system follows the regional concept. which are grouped into regions, for which county waste management plans are then drawn up. According to the Law on Waste Management) (OJ of Federation BiH No 33/03, 72/09) as an implementing document of the Waste Management Strategy, the Federal Waste Management Plan (FWMP) has been developed, which envisages remediation and closure of municipal landfills. The principles presented in the Federal Waste Management Strategy define the basic platform of the waste management concept, which is based on the hierarchy of waste treatment procedures and which are an integral part of the integrated waste management system. The legislation in Montenegro is similar.

Therefore, the following measures can be singled out as basic measures for local unregulated landfills:

- Rehabilitation and closure of local unregulated landfills with the creation of conditions for the transition to an integrated waste management system that follows the regional concept,

- Removal of illegal landfills and waste material from areas that have a negative impact on surface and groundwater in accordance with defined priorities,
- Removal of waste from the site,
- Removal of waste to the disposal site,
- Landscaping, the so-called “Tightening of the terrain” (leveling and filling a layer of humus 20 cm thick), Deratization and disinsection of the site,
- Setting up a sign prohibiting waste disposal,
- Development of regional sanitary landfills for the area of Western Herzegovina (BiH) and the area of Boka Kotorska (Montenegro).
- Some of the landfills are located in private facilities, often of unknown owner, and their cleaning cannot be performed without the consent of the owner. Therefore, the removal must be carried out on the order of the appropriate municipal inspection.
- Inspections also need to be strengthened.
- Increase penalties for illegal waste disposal.

5.4. Summary

Wild dumps are a constant - everyday occurrence. As a rule, they occur along local less frequent roads. One of the main goals of this project is to define a proposal for a plan to solve the problem of registered landfills whose existence causes pollution of water resources in the analyzed area. In the next step, it is necessary to make an analysis of groundwater, and look at and analyze the state of groundwater quality in the context of environmental pollution (landfills and other). Wild landfills are mostly unclassified municipal and construction waste.

In order to achieve strategic goals in environmental protection, it is necessary to:

- Preserve biodiversity
- Improve the quality of life
- Protect water
- Reduce all forms of air pollution
- Preserve natural and historical landscapes
- It is necessary to rationally manage waste, which includes the following:

1. URGENTLY stop the creation of new landfills (tighten the existing legislation, introduce communal wardens - inspectors)
2. Place signs prohibiting waste disposal at all locations,
3. In all municipalities / cities to form landfills of inert and hazardous (asbestos - salonite) construction waste,
4. Rehabilitate existing landfills in one of the acceptable ways:

• **Relocation of unregulated landfills**

Disposal of unregulated landfills is a procedure recommended in situations when they are located near larger landfills that have a large enough capacity to receive the amount of waste of a particular unregulated landfill and when there are opportunities to safely transport waste from one location to another. Of course, this step should be decided only in situations when a certain unregulated landfill has a relatively small amount of waste, ie when it is not rational to perform its complete remediation. A larger regulated landfill can be considered a local or regional landfill, but for several reasons it is recommended that it be a local sanitary landfill.

• Partial remediation of unregulated landfills

If it is still not possible to relocate a certain unregulated landfill in the manner described above, it is recommended to consider the possibility of partial remediation. The basic condition for the application of this solution, in addition to certain financial resources that are necessary, is a sufficient distance of groundwater from the landfill body so that the problem of further pollution of the surrounding water does not remain unresolved. If a detailed analysis of the terrain shows that the groundwater is far enough away, a partial remediation of the landfill can be approached, which implies its closure or regulation in a way that minimizes its negative and potentially negative impact on the environment.

• **Complete remediation of unregulated landfills**

In order to complete the remediation of the landfill, it is necessary to perform detailed investigative works:

topographic measurements, groundwater contact testing and necessary geotechnical research. After the research, it is necessary to develop a remediation project that would include the study of all data obtained, present a specific remediation solution derived from the characteristics and features of the terrain and all norms and standards to solve this type of problem and detail the necessary environmental measures. **As practice has shown, that soon after cleaning the waste reappears, in order to protect the regulated site, we suggest installing video surveillance on the rehabilitated landfills.**

5. Start educating the population with an emphasis on the harmfulness of inadequate waste disposal in water supplies and the need for selective waste collection - special emphasis on primary selection during waste collection.

   Example: Campaigns and education in primary and secondary schools, information sessions. 192 educational information sessions in schools organized in 7 participating communities, 24 sessions in each participating community. The education covered approximately 4500 students. Removal of 10 illegal landfills, and placing signs (boards) with the message and clearly marked “No waste disposal”;,through actions that will take place. Educating the elderly through information and promotional campaigns through online tools (instagram, fb, google, youtube). Setting up 320 bins for electronic waste, and disposing of them throughout the year, as an example of what can be done after those one year. Implementation of uniquely designed mass eco-actions (TBD. i.e. guerrilla illegal cleaning of landfills, public performance) 4 environmental events (3 days), two in each country with 50 participants.

6. In all municipalities - cities to form recycling yards and organize the purchase of secondary raw materials with an emphasis on packaging hazardous waste. Involve existing operators in all activities: DUGA, ALBA (packaging waste), ZEOS (electronic waste), LADANUŠIĆ ČISTOĆA (municipal waste, recycling) MVVM (medical waste) and PUC and organize waste management in one of the acceptable ways that has been proven in use.

7. Transport the unusable part of the waste to the regional landfill.

8. Application of examples of good practice - as a possible solution for the disposal of certain types of waste in WHC:

   - Rehabilitation of waste from Health Centers (medical waste) as we have in Mostar for the hospital - medical waste incinerator;
   - (NOT) disposal of oils and motor oils as one of the important environmental problems, which are not taken anywhere and released into the environment without control, car mechanic work, etc. A good example is the disposal of restaurant oils, as we have a number of positive practices in the EU, where these oils are used to make ecological fuel;
   - Mention the problem of car tire disposal. There is a plant that produces small granules from old tires that can be reused in industry

   Mention the problem of plastic bags in stores, and that the regulation on the payment of fees for plastic bags in the FBiH has shown as an example of good practice. In connection with the same, we have the EU Directive on the prohibition of the use of plastic plates, bags, cups, forks in order to reduce plastic pollution, and this is now signed by BiH - Directive (EU) 2019/904 of the European Parliament and the Council of 5 June 2019 on reducing the environmental impact of certain plastic products.

Based on previously conducted analyzes, it is necessary to propose an action plan to address the problem of pollution. The analysis of identified and recorded landfills in the field revealed that there are landfills near rivers, near springs, and even in water protection zones. Therefore, it is important to define the parameters for determining the priorities for landfill remediation, according to the criteria where the priority for remediation will be those landfills that most endanger the waters on which human health depends. It is proposed to group all landfills into 4 groups: high priority, priority, medium priority and other, based on the sanitary protection zone, proximity to watercourses, hydrogeological base, etc. This would provide a hierarchical strategic plan for remediation of illegal landfills and solving environmental problems. by phases - priorities and current needs.

If this is how waste management is organized, we will have small amounts of unusable waste, we will preserve a healthy environment and ensure cheap, economical and rational disposal of solid waste.

LITERATURE

1. Draft Waste Management Plan of the West Herzegovina County for the period 2020-2030 REGIONAL CENTER FOR ENVIRONMENTAL PROTECTION FOR CENTRAL AND EASTERN EUROPE OFFICE FOR BOSNIA AND HERZEGOVINA REC BIH, 2018
2. Spatial plan - spatial basis of the West Herzegovina County, Urban Techniques, Zagreb 2011.
3. LOCAL ECOLOGICAL ACTION PLAN (LEAP) OF POSUŠJE MUNICIPALITY FOR THE PERIOD 2016-2026, 2016
4. Strategic plan for the development of ecotourism for the area along the river Trebižat for the period 2014 - 2018, 2014.
5. Feasibility study of the project for water and wastewater in Posušje, 2008.
6. DEVELOPMENT STRATEGY OF POSUŠJE MUNICIPALITY 2014 -2023, 2014
7. https://nasapriroda.com/ilegalne-deponije-u-zzh/
8. Attachments: water analysis reports (Republika Srpska: Bijeljina, WATER INSTITUTE).

LIST OF ABBREVIATIONS

EKO ZH	- Association for Development, Environment and Culture of the West Herzegovina County
F BiH	- Federation of Bosnia and Herzegovina
WHC	- West Herzegovina County
NEAP	- National Environmental Action Plan
BIH	- Bosnia and Herzegovina
EU	- European Union
HBC	- Hercegbosna County
PC	- Posavina County
FMOET	- Federal Ministry of Environment and Tourism
EE	- Electrical - electronic waste
ZEOS	- Operator of waste electrical and electronic equipment management system in Bosnia and Herzegovina
KIM TEC ECO	- Operator of waste electrical and electronic equipment management system in Bosnia and Herzegovina.
OJ WHC	- Official Journal of West Herzegovina County
PE	- Public enterprises
LLC	- limited liability company
MI	- meat industry
LC	- Local community
LEAP	- Local environmental action plan
PI	- Public institution
ES	- Population equivalent
WTP	- Wastewater treatment plant
PVC	- Poly (vinyl chloride)
HE	- Hydro electric plant
IGM	- Construction material production company
BAS DIN, BAS ISO, BAS EN ISO, APHA-AWWA -WEF, EPA	- Methods and standards for laboratory testing
PAHs	- Polycyclic aromatic hydrocarbons
TMT	- Rivers Tihaljina, Mlada, Trebižat
WWTP	- Central wastewater treatment plant
ASWA	- Adriatic Sea Water Agency
FMAWF	- Federal Ministry of Agriculture, Water Management and Forestry
RH	- Republic of Croatia
Vc	- Corridor Vc
NGO	- Non-governmental organization
UNEP	- (United Nations Environment Programme)
RY	- Recycling yards
RWMC	- Regional Waste Management Center
FWMP	- Federal Waste Management Plan
PUC	- Public utility company

NOTES

Date .....

NOTES

Date .....

NOTES

Date .....