Illegal dumps mapping and risk assessment

City of Bor andBoychinovtsi Municipality

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1 Introduction

This Report is elaborated as the part of the project - Field laboratories for examination of the quality of water and soils within the Interreg-IPA CBC Bulgaria-Serbia Programme.

The overall objective of the project is to stimulate the balanced and sustainable development of the Boichinovci-Bor region through implementation of joint measures for nature protection in the programme area. The Specifics objectives of the project are focused on: 1. Measures for waste management and 2. Monitoring the condition of water and soil in the local ecosystems, polluted by the illegal landfills.

Activities: 1. Mapping of the polluted areas and identification of critical spots for cleaning; 2. Improvement the technical capacity of the partners through purchase of equipment for waste management and laboratory for sample testing; 3. Cleaning of the identified spots; 4. Elaboration of comparative legal analysis and elaboration of study on local and EU best green practices in the field of waste disaster management; 5. Conduction of awareness joint forum – round table.

Expected results: 1. Map of the polluted areas and identification of critical spots for cleaning; 2. Delivered equipments for waste management (Bor) and laboratory for sample testing (Boichinovci); 3. Cleaned identified spots in Bor and Boichinovci; 4. Elaborated comparative legal analysis and study on local and EU best green practices in the field of waste disaster management; 5. Conducted of awareness joint forum – round table with 20 participants.

The main purpose of this Report is to present:

1. Developed map of polluted areas of the cross-border region of City of Bor (Serbia). Map will be developed by:
    - existing data that City of Bor already poses about existing pollution presenting danger for the area,
    - site visits to additionally asses the risks that these sites can have on environment and human health.

The structure of the Report is:

Chapter 2 – General information about city of Bor
Chapter 3 – General information about Boychinovtsi Municipality
Chapter 4 – Methodology that was altered and applied for illegal dumpsites
Chapter 5 – Shows the results of applied methodology and relevant maps
Chapter 6 – Main conclusions
Annex – Questionnaire for illegal dumpsite

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2 City of Bor

2.1 General information

Bor is a regional administrative and mining centre located 250 km south-east of Belgrade, with over a century of copper and gold mining history. The area also supports forestry and agriculture.

The municipality of Bor covers an area of 856 km^2, and it borders with municipalities: Zajecar, Negotin, Majdanpek, Zagubica, Despotovac and Boljevac. The general data is presented in the following table (Table 1).

Table 1. General data[1]

City	Area, km^2	Number of settlements	Population on 30th June 2018		Cadastre municipalities	Registered local communities	Local offices
			total	on 1 km^2			
Bor	*856*	*14*	*45266*	*53*	*19*	*26*	*12*

2.2 Geology

In terms of geology, the area of city of Bor is located in Timok magmatic region and the most common is agglomerate of breccia, andesite and dacite -ωK_2^3 (Figure 1).

[1] Statistical office of Republic of Serbia, Municipalities and Regions in Serbia, 2019

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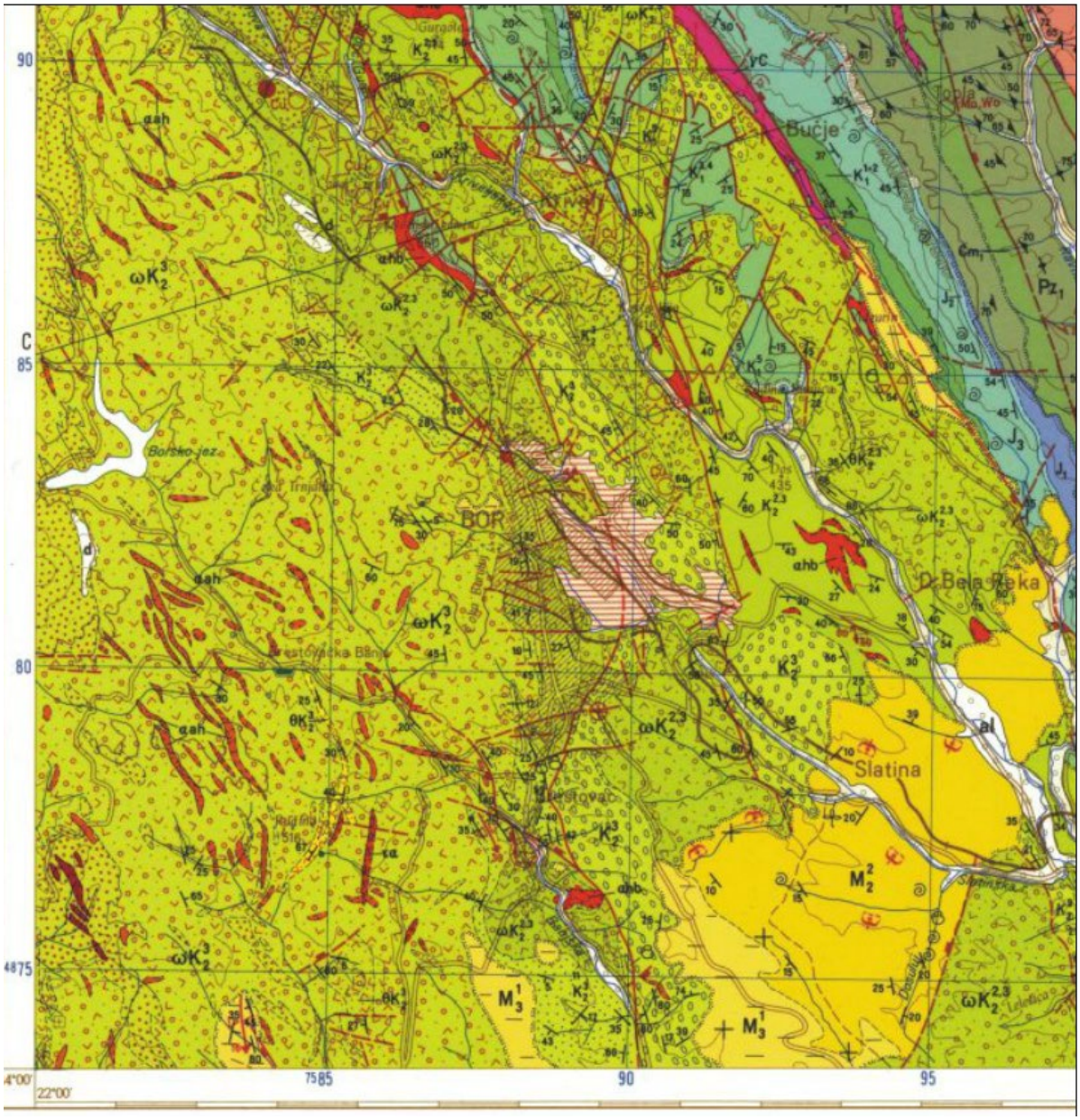

Figure 1. Geological map of Serbia – Bor[2]

2.3 Hydrogeology

The two main aquifer systems concerning groundwater reserves and potential for potable water supply are karst aquifer in Mesozoic carbonate rocks and alluvial aquifer. In terms of mineral waters and geothermal potential the fissured aquifers in volcanic rocks and artesian Neogene aquifers, although both with smaller extensions than latter two, are of major importance (Figure 2).[3]

[2] http://geoliss.mre.gov.rs/OGK/RasterSrbija/OGKWebOrig/listovi.php?karta=Bor

[3] Zoran Stevanović, Veselin Dragišić, GEOLOGY AND HYDROGEOLOGY OF CARPATHIAN BALKANIDES OF SERBIA – AN OVERVIEW, PROCEEDINGS OF 4TH CONFERENCE OF THE IAH CEG, Danube Gorge, Donji Milanovac, Serbia 2019

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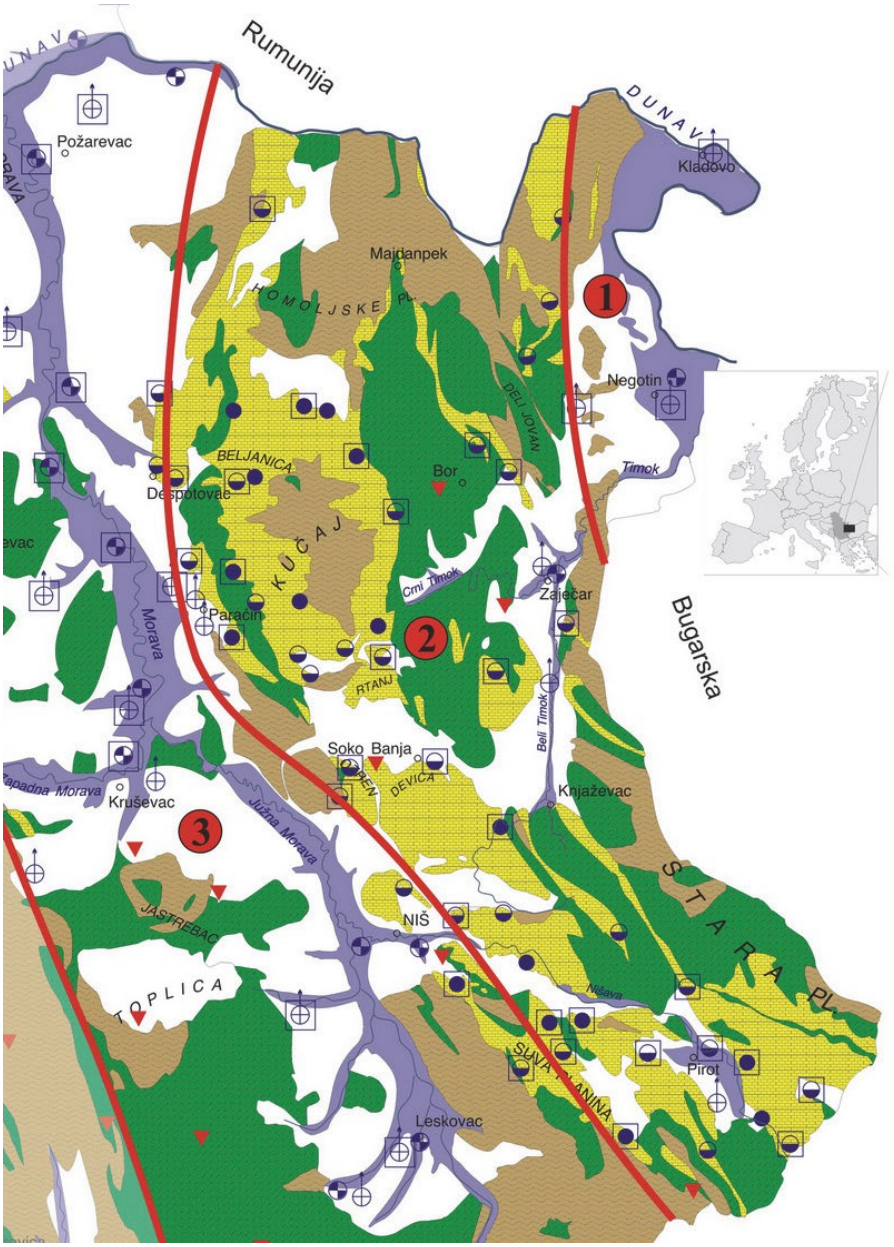

Figure 2. Hydrogeological sketch map of eastern Serbia and main groundwater sources
(based on Hydrogeological digital map of Serbia, Stevanovic & Jemcov 1996, reprinted from Stevanović et al. 2011).
Legend: 1. Dacian basin, 2. Carpathian-Balkanides, 3. Serbian-Macedonian massif;
Yellow – Karst aquifer, Green – Fissured aquifer, White – Neogene basins' sediments, Blue –Alluvial aquifer;
Blue dots – springs and wells, if squared – utilized for potable water supply

Two main aquifers are present in the region of Bor: Karst and Fissured aquifer.

Karst ground waters are regularly low mineralised, odourless and tasteless. Occasional in periods of heavy rain, short-lasting (rarely longer than 2-3 days) turbidities of gravity springs' waters make one of the major problems in regard of their usage.

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Fissure aquifer in andesite rocks is the best reservoir of thermal and mineral waters in Serbian Carpathians (Dragišić, 1981). Fissure aquifer of volcanogenic-sedimentary complex of Timok tectonic zone (Fig.2) contains several important thermal and thermomineral occurrences with the water temperature ranging from 30-40ºC (Brestovačka spa, Gamzigradska spa, Sokobanja, Nikoličevo, Šarbanovac).[3]

2.4 Population

There are 45266 inhabitants in City of Bor that live in 14 settlements, out of which 49% is male and 51% is female. The number of inhabitants is declining as it can be seen in the following table.

Table 2. The number of inhabitants 2011-2018[1]

City	2011	2012	2013	2014	2015	2016	2017	2018
Bor	48682	48294	47911	47444	46924	46379	45834	45266

The vital data for City of Bor is presented in the following table.

Table 3. Vital data for City of Bor[1]

City	New-borns		Deaths		Natural increase	
	number	Per 1000 inhabitants	number	Per 1000 inhabitants	number	Per 1000 inhabitants
Bor	*355*	*7,8*	*734*	*16,2*	*-379*	*27,3*

According to Census 2011, there were 34160 inhabitants in Bor (urban settlement) and 14455 inhabitants in 13 rural settlements: Brestovac (2690), Bucje (579), Gornjane (930), Donja Bela Reka (741), Zlot (3.299), Krivelj (1052), Luka (537), Metovnica (1111), Ostrelj (586), Slatina (890), Tanda (319), Topla (97), and Sarbanovac (1624).

2.5 Waste management practice

The waste management system in Bor is based on waste collecting, transporting, and landfilling. In this regard, city of Bor is no different than other municipalities in Serbia, where landfilling is still the predominant method.

The number of users that are provided with waste collection services on the territory of Bor Municipality is 35,298 inhabitants, which, compared to the total population of 48,615, represents the municipality's coverage of collection services of 72.61%. The waste is collected from the area of the town of Bor, and 8 surrounding settlements, Sarbanovac, Zlot, Brestovac, Metovnica, Ostrelj, Slatina, D.B. Rijeka and Veliki Krivelj, while other settlements of the municipality are excluded from the collection system. The number of residential houses covered is 1,490, the number of businesses, shops and outlets is 728, and the number of apartments in buildings is 11,390[4].

42 containers of 5m^3, 1043 containers of 1.1 m^3, about 1400 bins of 120 l, and 100 bins of 50 l are used for waste collection in Bor. PUC owns one rotary-tipper, one skid steer, four dump trucks and three skid steers with thrust plate[4].

Table 4. Waste management data in Bor[4]

[4] Draft- Regional waste management plan for the city of Zajecar and municipalities Boljevac, Bor, Kladovo, Majdanpek, Negotin, and Knjazevac, FTN, 2018

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Measured t/week	Totally collected t/year	Generated kg/cap/day	Generated kg/cap/year	Totally generated for all municipality t/year	Number of users	Percentage of population included in waste collection services
162.34	8464.61	0.66	239.80	11658.08	35298	72,61%

The dominant waste stream in Bor is biodegradable waste – 51,73%. The other waste streams that are present in a larger percentage is paper, cardboard, and plastic bags (Figure 3).

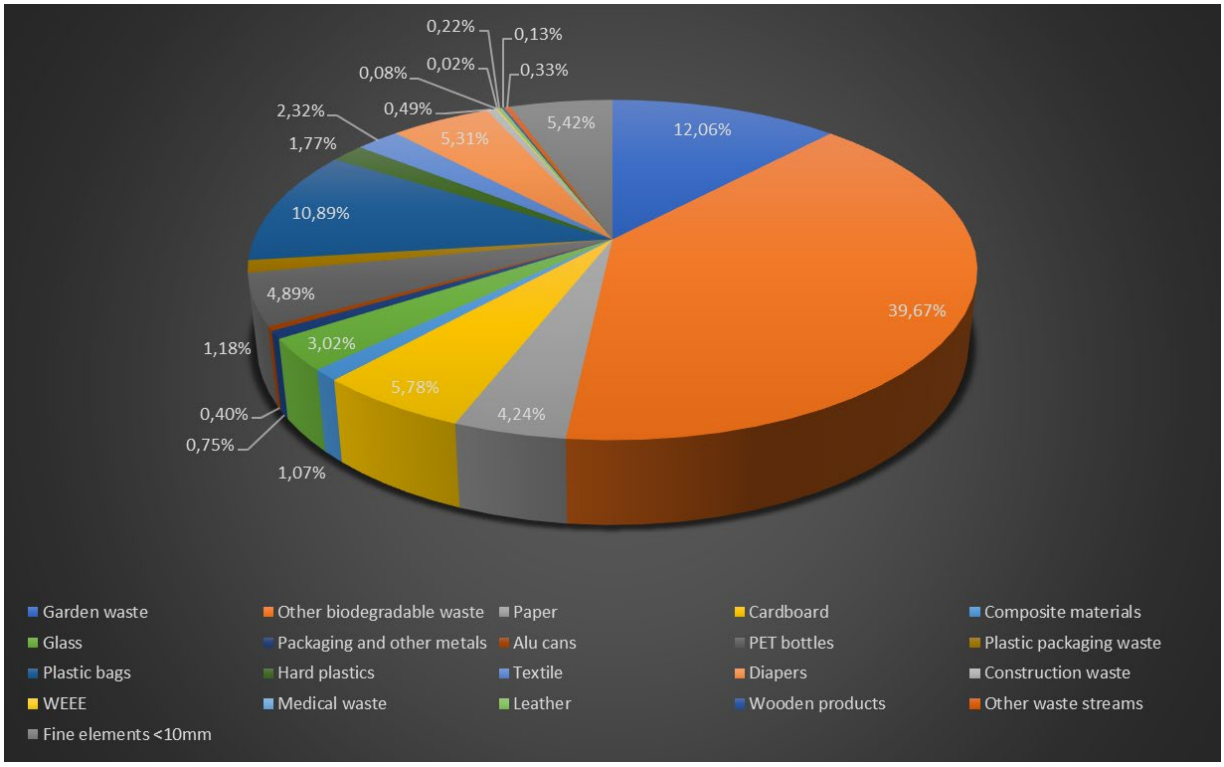

Figure 3. Waste composition in Bor[4]

2.6 Illegal dumpsites

The competent authority of the city of Bor has compiled a list of illegal landfills in all local communities in the city, including urban and rural, and established a database, which contains a description of locations, their number and other useful data. The revision of the database was made in March 2020 in cooperation with public utility company JKP "3. Oktobar" and representatives of local communities.

54 illegal dumpsites were recorded in 2019, 17 urban and 37 rural, which is 9 less than in 2018, when 63 were registered. There were 72 illegal dumpsites in 2017. This shows the decline in the number of dumpsites from year to year, which indicates that the measures taken are good and effective. This is affected by the increasing coverage of the waste collection service, as well as a more activities on raising the awareness of the population.

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Figure 4. Illegal dumpsite in Bor

The complete list of the illegal dumpsites and the relevant information are presented in the chapter 5.1 in tables: Table 11 and Table 12.

2.7 Contaminated locations

In the city of Bor, mining of copper ore and smelting of copper concentrate are the major activities and they have adverse effects on the environment. That is reported in the various documents when looking into air quality and soil contamination. In 2019, the soil was sampled and analysed on 8 locations (Table 5). The major pollutants can be related to the industrial activity.

Table 5. Soils sampling and analysis in Bor[5]

No.	Mark	Coordinate	Comment
1.	BSP	N 44°04’34.91“ E 22°05’59.36“	Elevated concentrations of lead, zinc, cadmium, copper, and arsenic.
2.	BREZ	N 44°05’52.85“ E 22°05’29.66“	Elevated concentrations of nickel, zinc, copper, and arsenic.
3.	KRI	N 44°07’47.17“ E 22°05’48.90“	Elevated concentrations of copper.
4.	SAR	N 43°57’41.80“ E 22°04’30.13“	Elevated concentrations of copper.

[5] Institute Mol, Report on analysis I 674/19, 2019,

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5.	SLA	N 44°02’25.19“ E 22°09’43.48“	Elevated concentrations of lead, zinc, copper, and arsenic.
6.	OST	N 44°04’50.80“ E 22°08’58.28“	Elevated concentrations of copper.
7.	MET	N 43°59’47.46“ E 22°07’29.94“	Elevated concentrations of copper.
8.	BREST	N 44°02’12.45“ E 22°05’42.84“	Elevated concentrations of copper.

The locations are presented on the following figure.

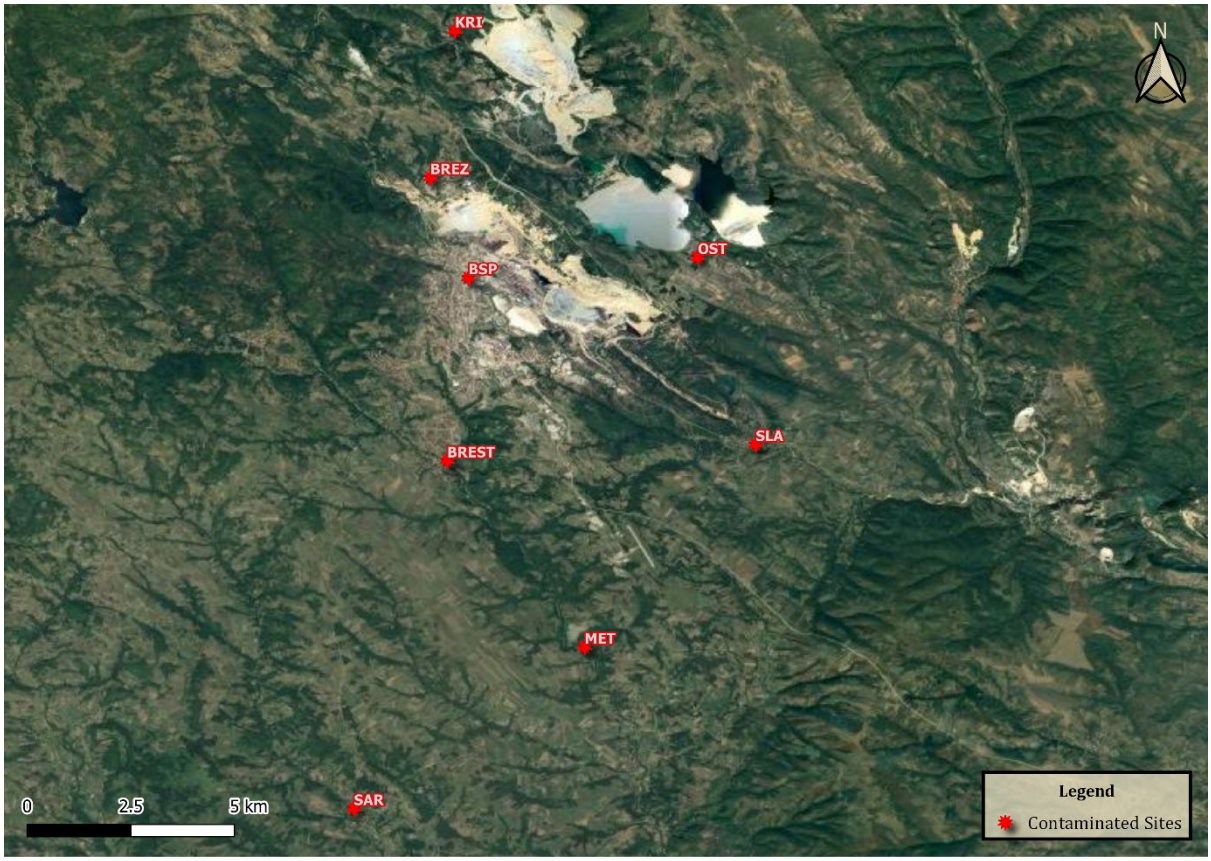

Figure 5. Maps of contaminated sites

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3 Boychinovtsi Municipality

3.1 General information

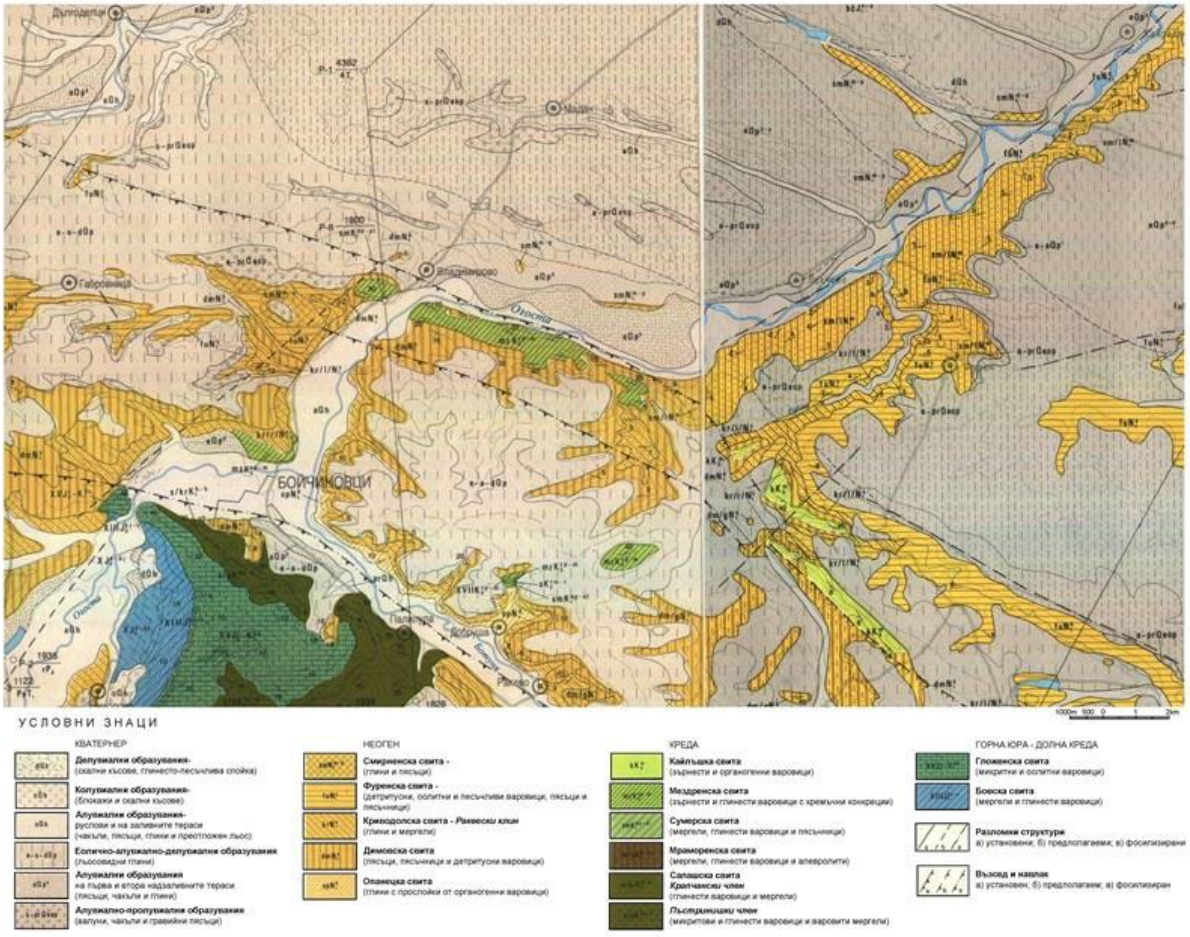
Boychinovtsi Municipality is a municipality in Montana Province, North-western Bulgaria, located in the transition between the Danubian Plain and the area of the so-called Fore-Balkan. It is named after its administrative centre – the town of Boychinovtsi[6].

The municipality embraces a territory of 307.32 km^2 with a population of 9,137 inhabitants, as of February 2011[7].

Ogosta river, a right tributary of the Danube, flows through the area from southwest to northeast.

3.2 Geology

The stratigraphic division of the geological base, on the territory of the Republic of Bulgaria in 1 : 100000, for the region of Boychinovtsi municipality, is presented on the following figure.



[6] https://en.wikipedia.org/wiki/Boychinovtsi_Municipality
[7] Bulgarian National Statistical Institute, Census 2011

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Figure 6. Geological map of the region of Boychinovtsi municipality[8]

3.3 Waste management practice

Waste collection is carried out on the territory of the whole municipality through a contract with a collection company adequately equipped. Municipal waste is collected, transported and disposed of at the Regional Municipal Landfill, Montana.

Due to the limited constructions in recent years and the economic conditions, large amounts of construction and demolition waste are not generated on the territory of the municipality, and the generated quantities are disposed of on landfill. Now there are no sites for construction waste and the municipality does not have installations for treatment and disposal of construction waste.

The hazardous waste on the territory of the municipality has been properly collected and sealed in adequate containers. There is currently no risk of contamination.

In 2007 the municipality took actions for cleaning and closing of the unregulated landfills and the landfill for municipal waste in the town of Boychinovtsi. The landfill was reclaimed and closed in 2010 in accordance with the legal requirements[8].

3.4 Illegal dumpsites

According to the submitted data, there are two illegal dumpsites in Boychinovtsi Municipality:

1. Dumpsite near Town of Boychinovci
2. Dumpsite near village Lehchevo

[8] ЗАДАНИЕза определяне на обхвата и съдържанието на Доклад за Екологичната оценка на проект на ОБЩ УСТРОЙСТВЕН ПЛАН НА ОБЩИНА БОЙЧИНОВЦИ, 2018.

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Figure 7. Dumpsite near Town of Boychinovci

Figure 8. Dumpsite near village Lehchevo

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4 Methodology

Illegal waste dumping is one of the main pollutions causing land degradation. Continuous dumping of waste material may increase heavy metal concentration in soil, which may have harmful effects on soils, crops and human health[9].

Mapping pollutants usually involves in-the-field sampling and laboratory analysis of collected samples followed by interpolation of the point results to delineate spatial distribution maps; however, such approaches are time and energy consuming[9].

The base for the risk assessment is the Code of Practice - Environmental Risk Assessment for Unregulated Waste Disposal Sites, developed by Environmental Protection Agency, Ireland.

Risk assessment considers the likelihood of occurrence and the consequences of the occurrence of an event. It represents a systematic means of determining and evaluating the nature, effect and extent of exposure a vulnerable receptor may experience in relation to a particular hazard[10].

The risk assessment methodology is a structured aid for decision-making ensuring the sites that present the highest risk to human health and environment are cleared in the latter of phase of the project.

The methodology was developed to meet the objectives of the project to assess the risk by using the available data. The key issues that were considered for the assessment are:

A. waste footprint – the area that is covered by waste
B. receptors – any human housing or settlement and/or wells in the vicinity
C. public water supply – sanitary zones for water supply or public water supply
D. surface water bodies – closeness of the surface water bodies.

The overall risk is scored by addition of these parameters (Table 6, Table 7, Table 8, and):
RISK SCORE = A x (B1+ B2 + C + D)

Table 6: A = Waste footprint

Waste type	Waste footprint (m^2)		
	≤ 100 m^2	**> 100 ≤ 300 m^2**	**≥ 300 m^2**
C&D	0,1	0,2	0,5
Municipal	1	2	4
Industrial	1	2	4

Table 7: B= Receptors – Human presence/Wells

Parameters	B1: Human presence	B2: Wells
On or within 50 m of the waste body	3	5
Greater than 50 m but less than 250 m of the waste body	2	3

[9] Tzu-How Chu, Meng-Lung Lin, Yi-Shiang Shiu, Risk assessment mapping of waste dumping through a GIS-based certainty factor model combining remotely sensed spectral unmixing model with spatial analysis
[10] Environmental Protection Agency, CODE OF PRACTICE, Environmental Risk Assessment for Unregulated Waste Disposal Sites

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Greater than 250 m but less than 1 km of the waste body	1	1
Greater than 1 km of the waste body	0	0

Table 8: C= Public water supply

Within 100 m of site boundary	**5**
Greater than 100 m but less than 300 m	3
Greater than 300 m but less than 1 km	1
Greater than 1 km	0

Table 9: D=Surface water bodies

Within 50 m of site boundary	**3**
Greater than 50 m but less than 250 m	2
Greater than 250 m but less than 1 km	1
Greater than 1 km	1*

* - See assumptions

Table 10: Risk Classification

Risk Classification	**Range of Risk Scores**
Highest Risk	Greater than or equal to 70% of maximum score (≥50)
Moderate Risk	Between 40-70% of maximum score (28-50)
Lowest Risk	Less than or equal to 40% of maximum score (≤28)

Limitations
This methodology is intended to provide general guidance in terms of risk assessment of unregulated sites. The guidance assumes a certain level of technical expertise, judgement, and experience. The results are estimated based on provided data and desk analysis.

Assumptions:

- the waste that is present on the illegal dumps is mostly municipal waste;
- the public water supply is provided for the urban settlements, and there are no wells;
- the rural settlements are getting water from the wells, and there is no public water supply network;
- the human presence is estimated from google maps, measuring the distance between the provided coordinates and the nearest houses;
- in terms of geology, it is assumed that it is mostly karst environment.

The methodology also included determined soil contamination of the specific sites in the city of Bor. The illegal dumps that are within 300 m or between 300 m and 1000 m have enlarged A criterium by 4 or 2 depending on the distance.

The same methodology was applied for Boychinovtsi Municipality. The area and the quantity was estimated from the google maps according to provided coordinates. As it was seen on the submitted photos the waste is mainly packaging waste and some construction waste. As it is

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mainly mixed waste it was assumed that is a municipal waste (the risk of the sites with municipal waste is higher than ones with construction waste).

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5 Risk Assessment and mapping

5.1 City of Bor

The results of the assessment are presented in the tables below. The scores per criterium are presented as well as the final score.

Table 11: Risk assessment for urban area - Bor

No	Location	N (lat)	S (long)	Estimated quantity (t) 2019	Estimated area (m^2) 2019	A	B1	B2	C	D	SCORE
1.	Metalurg - potok (creek)	44.0513	22.0944	3	500	4	2	0	5	1	32,00
2.	B. polje - Sokobanjska	44.0642	22.0561	0,5	4	1	3	0	5	1	9,00
3.	B. polje - Hilandarska	44.0619	22.0551	0,5	8	1	3	0	5	1	9,00
4.	B. polje - Vranjska	44.0647	22.0571	1	10	1	3	0	5	1	9,00
5.	B. polje – Desanka Maksimović	44.0619	22.0616	0,5	7	1	3	3	1	1	8,00
6.	B. Polje - Milutina Bojića	44.0631	22.0515	1	8	1	3	3	1	1	8,00
7.	B. Polje - Raskrsnica kod kontejnera (Cross-road next to containers)	44.0996	22.0524	0,5	7	1	0	0	0	1	1,00
8.	Bor 2 - Vladimira Nazora br.30	44.0581	22.0848	1	12	1	3	0	5	1	9,00
9.	Bor 2 - Okretnica (turning point)	44.0618	22.0816	0,5	15	1	2	3	1	1	7,00
10.	Bor 2 - Branka Čopića	44.0589	22.0884	0,3	4	1	3	1	5	1	10,00
11.	Brezonik - Alu Luka	44.1279	22.0975	0,5	7	1	3	5	0	1	45,00
12.	Brezonik - Kod kasarne (at military barracks)	44.0963	22.0939	2	25	1	3	5	0	1	45,00

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No	Location	N (lat)	S (long)	Estimated quantity (t) 2019	Estimated area (m^2) 2019	A	B1	B2	C	D	SCORE
13.	Brezonik - V.J.Ž.	44.0888	22.0921	8	300	4	3	5	1	1	40,00
14.	Sloga - Petra Kočića	44.0604	22.1114	1	15	1	3	0	5	1	9,00
15.	Sever - Vojske Jugoslavije 32 i 34	44.0899	22.0907	5	100	2	3	5	1	1	40,00
16.	Sever - Dositeja Obradovića	44.0851	22.0932	2	10	1,00	3	5	1	1	10,00
17.	S. Selište - Dimitrije Tucovića 31 (POTOK/CREEK)	44.0779	22.0938	5	30	1	3	0	5	1	27,00

The locations are presented on the following figure.

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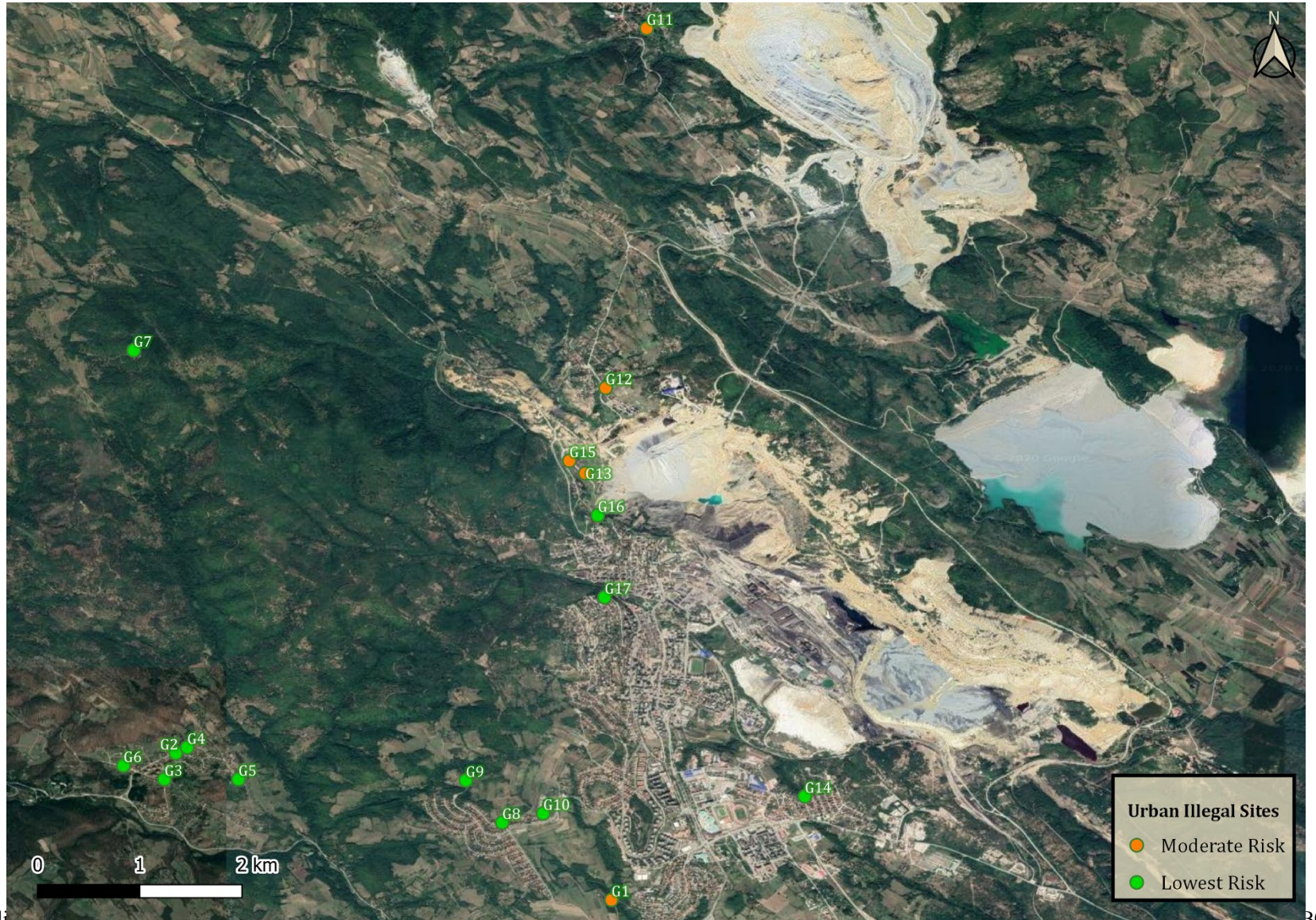

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Figure 9. Map of urban illegal sites in Bor

Table 12: Risk assessment for rural area - Bor

No	Location	N (lat)	S (long)	Estimated quantity (t)	Estimated area (m^2)	A	B1	B2	C	D	SCORE
1.	Brestovac - Na izlasku prema Metovnici (exit road to Metovnica)	44.0321	22.0994	10	250	2	4	3	0	1	16,00
2.	Brestovac - Pored trafoa kod Đokića (next to substation at Djokic)	44.0342	22.0974	1	8	1	5	5	0	1	11,00
3.	Brestovac - Stari put za Šarbanovac (old road for Sarbanovac)	44.0261	22.0962	5	300	4	2	3	0	1	24,00
4.?	Brestovac - Pored trafoa kod Đokića(Ponavlja se) - (next to substation at Djokic)- this one is repeated	44.0406	22.0977								
5.	Brestovac - Okretnica jezero - Turning point the lake	44.1031	22.0046	1	10	1	2	3	0	2	7,00
6.	Brestovac - Telekom kućica jezero - Telecom station Lake	44.0899	21.9993	1	4	1	3	5	0	2	10,00
7.	Brestovac - Pirotsko naselje (Pirot settlement)	44.071	22.0317	1	15	1	3	5	0	3	11,00
8.	Bučje - Kod groblja (at cemetery)	44.1387	22.1451	2	40	1	2	3	0	1	6,00
9.	Bučje - Valja Bučje	44.1154	22.1674	1	15	1	1	1	0	1	3,00
10.	Donja Bela Reka - Kod mosta na ušću (at the bridge on confluence)	44.0727	22.2078	12	400	4	3	5	0	1	36,00
11.	Gornjane - Ispod groblja (close to cemetery)	44.2423	22.0697	5	120	2	2	3	0	1	12,00
12.	Krivelj - Krivina kod kopa Krivelj (bend at open pit Krivelj)	44.1141	22.1032	4	80	1	2	3	0	1	6,00

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No	Location	N (lat)	S (long)	Estimated quantity (t)	Estimated area (m^2)	A	B1	B2	C	D	SCORE
13.	Krivelj - Stari Banovinski put (old Banovinski road)	44.1262	22.1003	4	35	3	2	3	0	1	18,00
14.	Luka - Staro vašarište (old fairgrounds)	44.1722	22.1851	2	40	1	2	3	0	1	6,00
15.	Metovnica - Suva reka - ulaz u selo (entrence in the village)	43,9818	22,165	2	30	1	2	3	0	1	6,00
16.	Metovnica - Kod železničke stanice (most) - Bridge at the railway station	43.9381	22.1516	10	400	4	3	5	0	3	44,00
17.	Metovnica - Kod Kopilovića - At Kopilovic	43.9766	22.1338	7	150	2	2	3	0	2	14,00
18.	Metovnica - Ispod Nikolića (kod Timoka) (Close to Timok- at Nikolic)	43.9424	22.1509	2	40	1	2	3	0	1	6,00
19.	Metovnica - Izlaz (ulaz) iz sela - exit/entrence in village	43.9639	22.1359	5	100	2	2	3	0	2	14,00
20.	Oštrelj - Valja Mira u reku (in river)	44.0703	22.1758	10	220	2	3	5	0	1	18,00
21.	Oštrelj - Valja Mare Dan.Janošević	44.0638	22.1771	1	10	1	1	1	0	1	3,00
22.	Oštrelj - Kod groblja (at cemetery)	44.0659	22.1701	1	15	1	2	3	0	1	6,00
23.	Oštrelj - Ogašu Mira	44.0684	22.1664	1	8	1	2	3	0	1	6,00
24.	Slatina - Izlaz kod mosta (exit at the bridge)	44.036	22.1745	1	10	1	2	3	0	3	8,00
25.	Slatina - Tovilište	44.0311	22.1811	5	20	1	2	3	0	3	8,00

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No	Location	N (lat)	S (long)	Estimated quantity (t)	Estimated area (m²)	A	B1	B2	C	D	SCORE
26.	Slatina - Preko puta planira donji put kod Oštrelja (road at Ostrelj)	44.0635	22.1395	3	50	1	1	1	0	1	3,00
27.	Šarbanovac - Groblje (cemetary)	43.9557	22.0878	3	70	1	2	3	0	1	6,00
28.	Šarbanovac - Baba Jona	43.9178	22.1231	10	50	1	2	3	0	2	7,00
29.	Šarbanovac - Andrejić	43.9509	22.0811	3	70	1	3	5	0	1	9,00
30.	Šarbanovac - Nestorov potok - raskrsnica (crossroad)	43.9717	22.0455	10	50	1	1	1	0	1	3,00
31.	Tanda - Centar most	44.2289	22.1471	0	4	1	3	5	0	1	9,00
32.	Zlot - Dubrava 1	43.9975	21.9895	7	50	1	2	3	0	1	6,00
33.	Zlot - Dubrava 2	43.998	21.9888	5	40	1	2	3	0	1	6,00
34.	Zlot - Početak ul. Đure Jakšića	44.0079	21.9869	1	10	1	3	5	0	3	11,00
35.	Zlot - Iznad vašarišta duž puta (above fairground along road)	44.0008	21.9957	10	120	2	1	1	0	3	10,00
36.	Zlot - Manastirište	44.0194	21.9758	8	50	1	2	3	0	1	6,00
37.	Zlot - Vašar pored OFK Zlot (beside OFK Zlot)	44.0033	21.9928	3	252	2	3	5	0	2	20,00

The map of rural illegal dumpsites is presented on the following figure (Figure 9), while the map of all locations on one map is Figure 10.

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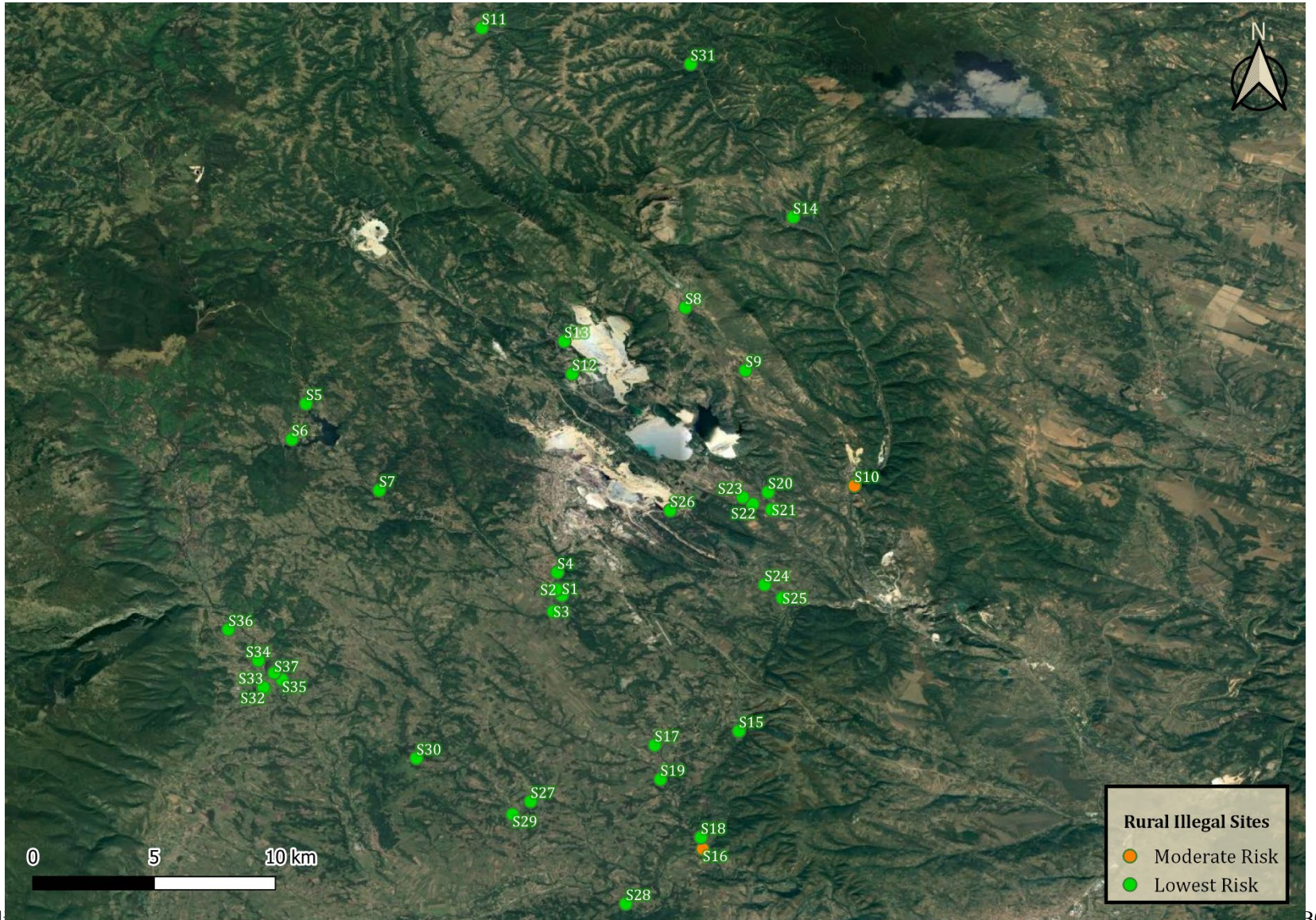

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Figure 10. Map of rural illegal dumpsites in Bor

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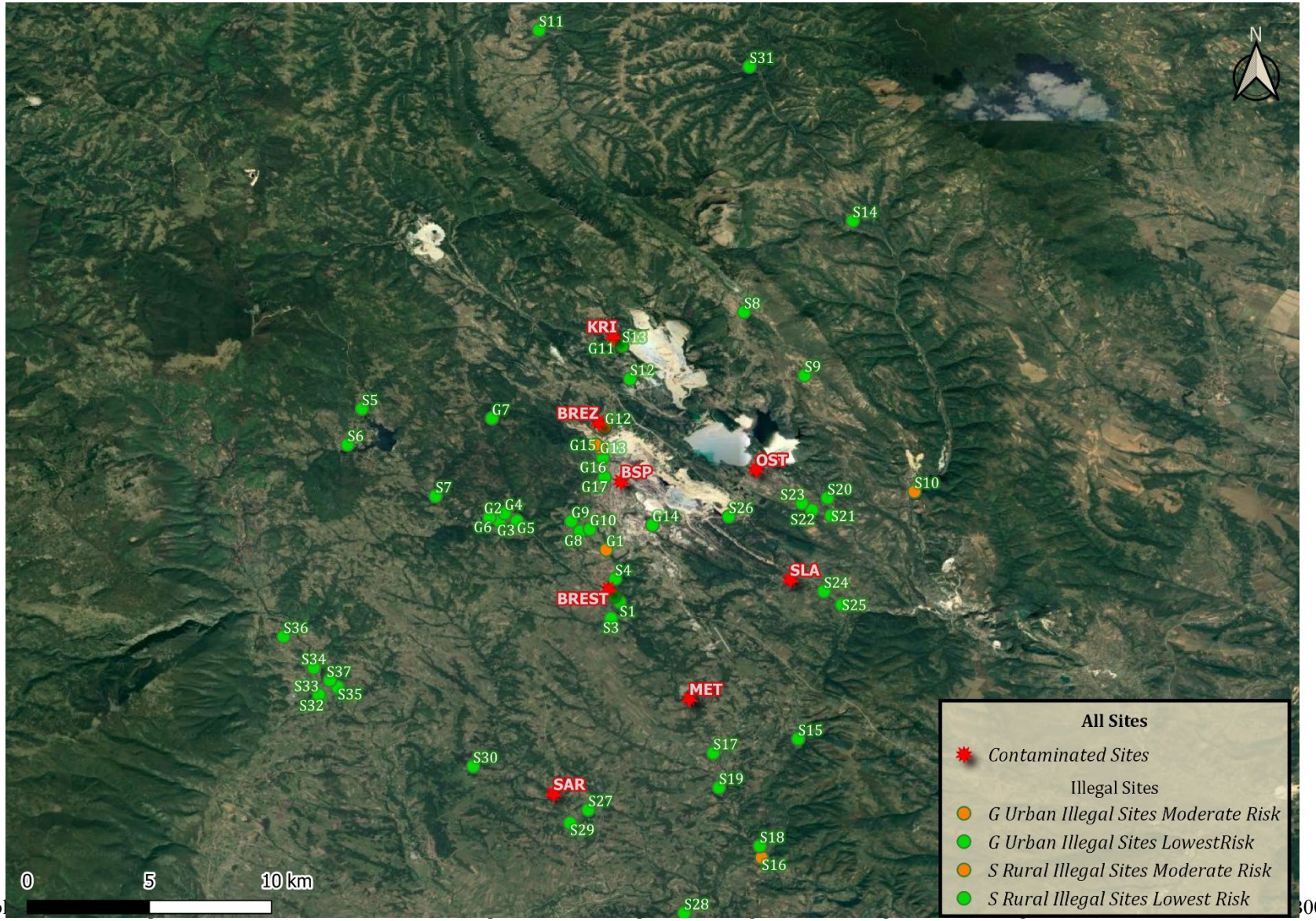

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Figure 11. Map of all locations in Bor

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5.2 Boychinovtsi Municipality

Table 13. Risk Assessment - Boychinovtsi Municipality

No	Location	N (lat)	S (long)	Estimated quantity (t)	Estimated area (m^2)	A	B1	B2	C	D	SCORE
1.	Near Town of Boychinovci	43.480623	23.329316	10	1500	4	2	3	1	2	32,00
2.	Near village Lehchevo	43.523814	23.538176	1	124	2	1	1	1	2	10,00

These two locations are presented on the following figure.

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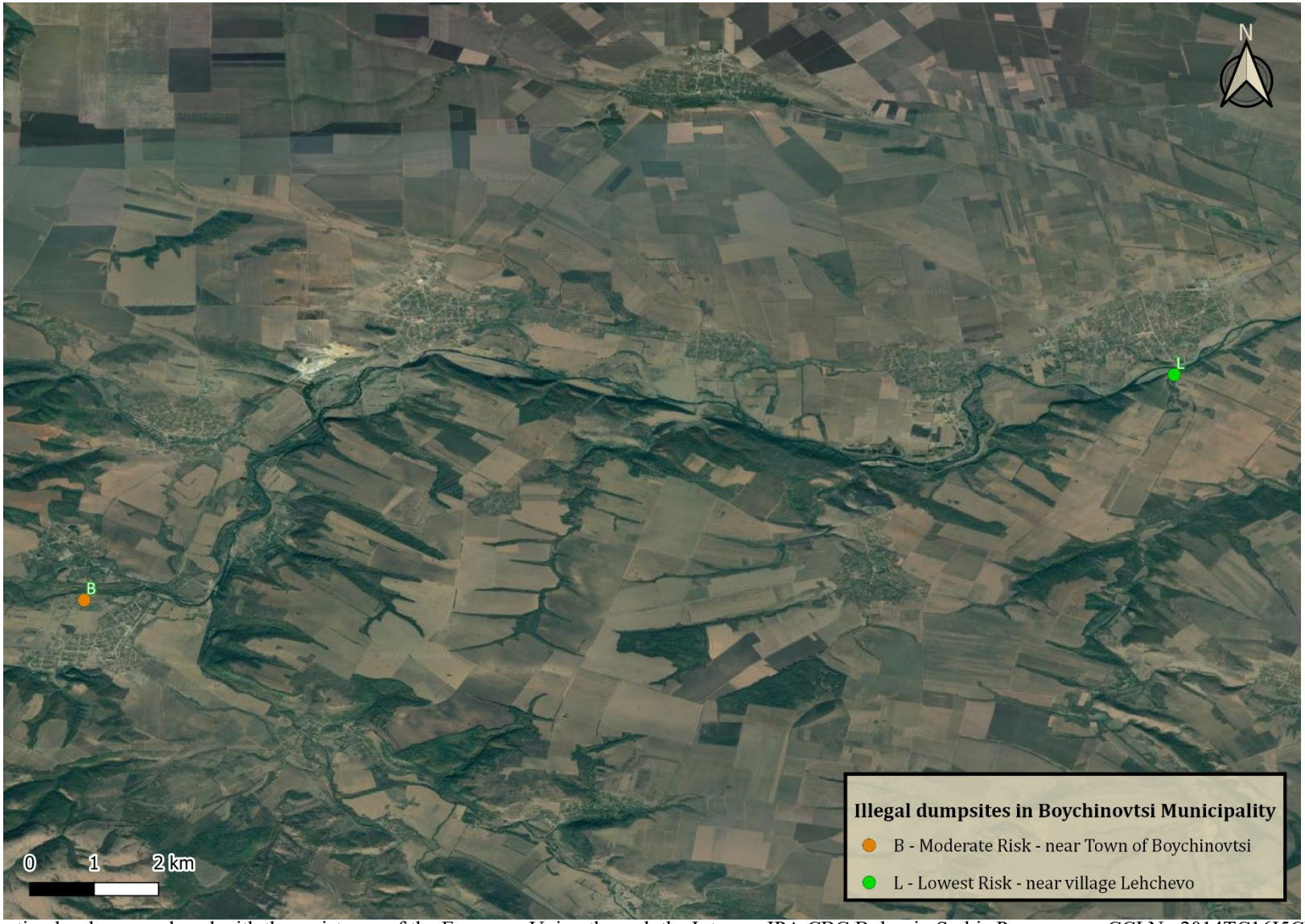

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Figure 12. Illegal dumpsites in Boychinovtsi Municipality

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6 Conclusion and recommendations

A typical open dumpsite consists of waste from many sources, waste types and compositions. The waste deposited is also not covered or compacted and in most cases in these open dumpsites, waste remains susceptible to open burning.

The most important impacts of open dumps on the environment and to public health and safety are those relative to proximity to waterways, geological/hydrogeological conditions, climatic conditions, long-term contamination due to leachate or landfill gas migration, and of course the greenhouse effect via emissions of carbon dioxide and methane, including open burning of waste releasing smoke, particulates, and gaseous contaminants into the atmosphere.

Burning directly releases toxic POPs into the atmosphere around dumpsites and, with wind carrying these, into the environment at long distances from their origin. Fauna, plants or vegetation can be impacted directly from these contaminants and often-dead vegetation and animals are associated with the zone of impact from direct contamination by waste or leachate, the migration of gases, or as a result of burning or smoke[11].

The dumpsites need to be managed properly to eliminate the risk they pose to human health and environment.

According to applied methodology for risk assessment of the dumpsites present in the city of Bor and Boychinovci Municipality the dumpsites that are of higher risk are:

- *Bor:*
  - G11. Brezonik - Alu Luka
  - G12. Brezonik - Kod kasarne (at military barracks)
  - S16. Metovnica - Kod železničke stanice (most) - Bridge at the railway station
  - G13. Brezonik - V.J.Ž.
  - G15. Sever - Vojske Jugoslavije 32 i 34
  - S10. Donja Bela Reka - Kod mosta na ušću (at the bridge on confluence)
  - G1. Metalurg - potok (creek)
- *Boychinovci:*
  - B. Near Town of Boychinovci

However, it is obvious that the city of Bor and the Boychinovci Municipality are putting a lot of efforts in removal of illegal dumpsites and improving waste management practice. The number of illegal dumpsites in Bor is evidently smaller from year to year.

The first steps are sanitation of illegal dumpsites but also inclusion of the all settlements in organised waste collection.

6.1 Recommendation for sanitation of illegal dumpsites

A number of illegal dumpsites has been identified in rural and in urban area.

[11] ISWA, A Roadmap for closing Waste Dumpsites The World’s most Polluted Places, https://www.iswa.org/fileadmin/galleries/About%20ISWA/ISWA_Roadmap_Report.pdf

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There are three ways to do the sanitation of illegal dumpsites:

1. Complete removal and transfer of waste to a landfill. This can be done for small dumpsites and that are close to a municipal landfill.
2. Partial sanitation of dumpsites. If the local geology and hydrogeology conditions are such, the waste on the dumpsite can be compacted and then covered by impermeable layer. The layer shall be covered by soil and some native species shall be sawn.
3. Complete sanitation of dumpsites. In the case of permeable geological structures and high-water table the dumpsite shall be encapsulated by firstly placing impermeable layers, then placing and compacting waste. The waste heap shall be then closed and covered. If the waste is mainly municipal, it can be expected that the “area” is active for several years. The system for leachate gas collection shall be installed as well if it is judged that the generation will be high.

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Annex – Questionnaire

Location		
Address		
GPS coordinates	N:	E:
Characteristics		
Covered area (in m²)		
Dominant type of waste/waste stream	Municipal waste	
	Industrial waste	
	Construction & Demolition waste	
Closeness of industrial pollution	Greater than 300 m but less than 1 km	
	Greater than 1 km	
Short description of local geology (type and permeability)		
Short description of local hydrogeology (type of aquifer)		
Sensitive receptors		
Human presence	On or within 50 m of the waste body	
	Greater than 50 m but less than 250 m of the waste body	
	Greater than 250 m but less than 1 km of the waste body	
	Greater than 1 km of the waste body	
Public water supply	Within 100 m of site boundary	
	Greater than 100 m but less than 300 m	
	Greater than 300 m but less than 1 km	
	Greater than 1 km	
Surface water bodies	Within 50 m of site boundary	
	Greater than 50 m but less than 250 m	
	Greater than 250 m but less than 1 km	
	Greater than 1 km	
Notes (any additional comments, information available for the site):		

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