



Environmental Protection of International River Basins Project (Contract No 2011/279-666)

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**Investigation of illegal discharges of waste water in
Carpathian National Nature Park as a major pressure on
the ecological status of the Upper Prut pilot river basin in
the territory of Ukraine**

**'Investigation of the extent and impact of untreated
waste water (particularly from the tourism industry) in
the Carpathian National Nature Park, that lies in the
Upper Prut pilot basin'**

Deliverable 2

DRAFT Report

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Abbreviations and Acronyms

BOD	biochemical oxygen demand
BUWR	River basin management authority
Ca	calcium
Cd	Cadmium
CIS	Common Implementation Strategy (for WFD)
Cl	Chloride
CNNP	Carpathian National Nature Park
DO	dissolved oxygen
DWPA	drinking water protected areas
EC	Electric conductivity
EPIRB	Environmental Protection of International River Basins
EU	European Union
HCO₃	hydro-carbonate
Hg	Mercury
ISO	International Standardisation Organisation
IWRM	Integrated Water Resources Management
M	total mineralisation
MAC	maximum allowable concentration
MENR	Ministry of Ecology and Natural Resources
m³, m²	cubic meter, square meter
mg-eq/l	milligram-equivalent per litre = [(mg/l) / eq weight]
mg/l	milligrams per litre
Na	Sodium
NGO	Nongovernment organisation
NH₄	Ammonium
NO₂	Nitrite
NO₃	Nitrate
PoM	Programme of Measures
PRB	Prut River Basin
SAWR	State Agency for Water Resource of Ukraine
SO₄	Sulphate
WB	Water Body
WFD	Water Framework Directive
WWTP	Waste water treatment plant



Introduction

The present report has been prepared by Consulting and methodological centre 'CEUME LTD' within the signed contract for Implementation of selected measures from the programme for pilot projects in the scope of EU funded project 'Environmental Protection of International River Basins' (EPIRB).

The EPIRB project targets the improvement of water quality in the trans-boundary river basins of the wider Black Sea region and Belarus. It supports the move towards modern management tools and compliance of the EU Water Framework Directive (WFD) by building capacities learning-by-doing, and through the development and implementation of River Basin Management Plans for selected pilot river basins according to the requirements of WFD.

EPIRB project has undertaken both groundwater and surface water Field Surveys in Upper Prut River Basin in 2013 and 2014. The results has enable the project establish 'reference conditions' for the various water body types and determine 'good ecological status' (WFD 2000/60/EC) of the water bodies within the Natural Parks. A major pressure that has been identified is tourism, where resorts near/in the Natural Parks are discharging waste water and solid wastes into the River Prut, clogging of river channels and worsening of the waters ecological status. In order to maintain the Prut's good ecological status more attention to control and policing of these discharges is required by the regulatory authority.

The object of the assignment is to investigate the impact of waste water as a major pressure on the ecological status (especially illegal discharges of the non-treated waste water in protected areas) in the Upper Prut River basin in the territory of Ukraine and to identify a detailed programme of measures to address the problem and to include it in the RBMP. This assignment will contribute to the implementation of EPIRB project Activity 2.6 – 'Implementation of selected measures'.

The major steps and deliverables of this investigation:

- design and reporting of a detailed investigation of the extent and impact of untreated waste water, particularly from the tourism industry, in the Carpathian National Nature Park, lying in the Upper Prut pilot basin;
- preparation of **'Waste water treatment and control strategy for the Upper Prut and Carpathian National Nature Park'**.

Carpathian National Nature Park (CNNP) was created according to the decree #376 of Council of Ministers of USSR on 03.06.1980 on the area of 50 495



hectares. The park is situated in the north-eastern slopes of Ukrainian Carpathians and covers territory within absolute altitudes of 400 (Dora village) – 2061 (Hoverla mountain) to the north of drainage divide of Chornohora's ridge and to Yaremche town, then along the Prut River and western tributaries of Chorny Cheremosh River. The length of the national park is 55 km from northwest to southeast and 20 km from west to east.

The park was created for the purpose of preservation, restoration and efficient use of natural complexes and objects of Chornohora and Gorgany that have special environmental, recreational, historical, cultural, scientific, educational and aesthetic value.

Rivers and streams are the habitat of brown trout that is one of representatives of salmon fishes. It ascends through the mountain streams up to thousands of meters above sea level. Mountain rivers are the habitat of fishes like common minnow, stone loach, common bullhead, common nase, European chub, spined loach, Carpathian barbel and Danube barbel.

There are ten species of amphibians. Five species belong to the Salamanders' order and advanced salamanders' suborder: common newt, northern crested newt, Carpathian newt, alpine newt and fire salamander. Anura order is represented by four species: yellow-bellied toad, common toad, European tree frog and European common frog.

The territory of park contains about 1000 protected rivers and streams, 85 natural sources of groundwater and two natural lakes of glacial origin: Maricheika lake (area of 0,7 hectares, the depth does not exceed 2,0 m) and Nesamovyte lake (area of 0,3 hectares, depth does not exceed 0,8 m).

Two territories within the CNNP were submitted on their inclusion in the list of Wetlands of International Importance to the Ramsar Convention Secretariat:

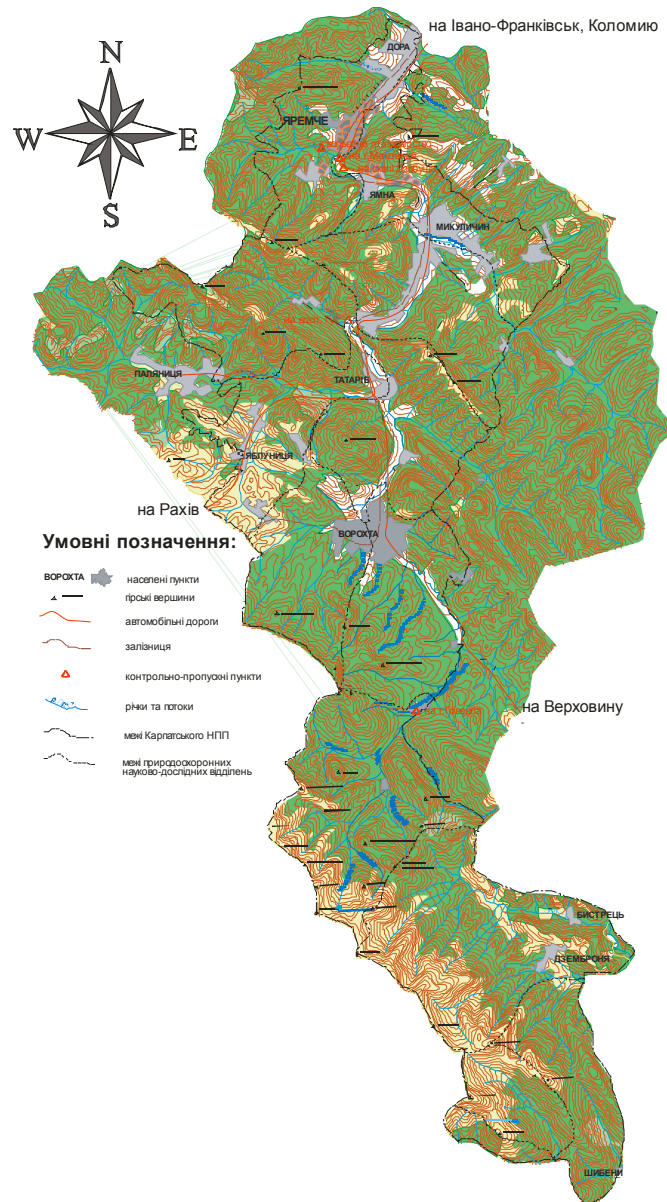
1) The riverhead of Prut (administrative location: Ivano-Frankivsk region, Yaremche town council, Vorokhta village, geographic location: north – 48°12'N 24°32'E, east – 48°9'N 24°37'E, south – 48°7'N 24°33'E, west – 48°9'N 24°30'E; minimum altitude above sea level is 900 m, maximum altitude above sea level is 2061 m, the total area of wetland is 4935,44 hectares.

2) The riverhead of Pogorilets (administrative location: Ivano-Frankivsk region, Verkhovyna district, Zelene village; geographic location: north – 48°04'N 24°38'E, east – 48°02'N 24°38'E, south – 47°59'N 24°41'E, west – 48°04'N 24°37'E; minimum altitude above sea level is 900 m, maximum altitude above sea level is 2061 m, the total area of wetland is 1624,55 hectares.

Beneficiary and recipients of Pilot project results:



Beneficiary: Ministry of Ecology and Natural Resources of Ukraine (MENR).
Recipients: Administration of the Carpathian National Nature Park (Ministry of Ecology and Natural Resources), Prut River Basin authority (State Water Agency of Ukraine), local authorities, local communities, local business (tourism (green tourism), recreation etc.), NGOs.



Picture 1. Map of Carpathian National Nature Park



Main outputs of investigation

1. During the field survey were selected 27 potentially contaminated sites, where samples for analysis of physical and chemical indicators were drawn. There were illegal discharges of waste water, pipes, sites downstream of illegal discharges, streams flowing through the territories of the villages with dense buildings and landfill waste.
2. Results of Pilot Project field survey complete the database of EPIRB JFS (2013 - 2015) and become the basis for the development of institutional, legal and technical measures against the negative environmental impact of these water bodies. These measures will be included in the Prut River Basin Management Plan.
3. Tourist resorts within the Carpathian Park develop spontaneously. There are no statistics of the number of local entities there. Almost all resorts' owners are not registered as private legal entities and do not legal receive permission for tourism business. As a result, the owners do not get permission for special water use, including discharge of treated waste water into the rivers.
4. The study showed that small tourist resorts have no wastewater treatment systems. Some small resorts are collecting waste water in special tanks and then transported by special cars. In most cases, wastewater is discharged untreated into water bodies of the Prut River during the rain period or at night to hide the waste discharges.
5. The Ukrainian Government decided to suspend all inspections in order to protect the business in Crisis times. This also affected the control of compliance with environmental legislation. In the same time, the Ukrainian State Ecological Inspectorate is not monitoring illegal wastewater discharges last 4 years and even excluded this task from own Regulation.
6. In most cases, the local tourist business is not covered by official statistics, no control by the tax authorities, no supervision of the environmental inspection and sanitary epidemiological service. Report on form "2TP-vodgosp" (state statistical reporting for the use and allocation of water) includes only 18 entities, representing about 20% of all big hotel facilities (excluding small tourist resorts).
7. The largest excess of nitrite ions are defined in the 11 sites. It seems contamination by domestic sewage (toilets flushing), as nitrites are formed by the biochemical oxidation of ammonia. Other problem is a lack of treatment of domestic sewage in resorts located on the surveyed areas of CNNP. These results are confirmed by biochemical oxygen demand indicators.



8. There are 11 Prut water bodies under the risk failure to reach a water body "good" status (by EPIRB assessment methodology), through excess of phosphates, pH, ammonia nitrogen, oxygen content. Next Pilot project deliverable report (#3) will include appropriate measures for these water bodies (mostly in Prut river basin and Prutetz Chemigivskiy river).

9. A final report of this pilot study will be presented to the beneficiaries and local authorities for comments. After discussion and consideration of comments, the final report will be sent to MENR, CNNP Administration, local authorities in Prut river basin and put on the EPIRB website. Link to the final report will be posted up on the MENR website and Dniester-Prut River Basin Authority web-site.

10. MENR will prepare a request to all local authorities concerning the facts of water pollution in the Carpathian National Nature Park by illegal waste water discharges.

11. The deliverable N 3 of this investigations will be consist '**Waste water treatment and control strategy for the Upper Prut and Carpathian National Nature Park**'. Will be prepared a detailed analysis of the options for municipal waste water treatment, including modern and inexpensive available treatment techniques for camp sites and small resorts. The current regulatory regime should also undertake a review of the current and means of its improvement and efficiency. The proposed strategy of wastewater treatment will be based on the main principles of treatment, depending on the composition of the wastewater and financial ability of local communities. In accordance with the European principles the water purification systems anyhow should include mechanical treatment (clarification), chemical system (more expensive but it uses different reagents for transformation of water contaminants into the soluble compounds and their subsequent deposition on the bottom of the aeration tanks or septic tanks) and biological system for wastewater treatment from contamination (using microorganisms).

12. This Strategy will be present on local stakeholder meeting for discussing and then give to the MENR for statement. The measures of this Strategy will be put in Prut River Basin Management Plan.



1. Design and reporting of a detailed investigation of the extent and impact of untreated waste water (particularly from the tourism industry) in the Carpathian National Nature Park, that lies in the Upper Prut pilot basin

1.1. Investigation of the extent and impact of untreated waste water (particularly from the tourism industry) in the Carpathian National Nature Park, that lies in the Upper Prut pilot basin

The potential threat to the environment can be caused by excessive escalation (overload) of recreational objects. It can lead to the worsening of the ecological status of Prut water bodies as a result of exceeding the standards of ultimate load.

Waste Water Treatment plants are the significant point sources of multi spectrum pollutants, including organic matter, nutrients (particularly, nitrogen and phosphorus) and different chemical pollutants, taking into account that most of mini hotels and ski-resorts discharge their non-treated or low treated wastewaters to the small Upper Prut river tributaries. The indicators for discharges of (untreated) waste water include: BOD₅ (biochemical oxygen demand over five days); COD (chemical oxygen demand; preferably dichromate method, other permanganate); NH₄⁺ (total ammonium); NO₂⁻ (nitrite); NO₃⁺ (nitrate); PO₄ (orthophosphate). It will be provided in-situ measurements of electric conductivity, pH, dissolved oxygen and water temperature. Low concentration of Oxygen can identify wastewater discharges, as colour and smell can also be indicative.

In framework of the first stage of investigation was organized a wide field survey in Carpathian National Nature Park (see map below, picture 3) and contributing basin, which potentially is under pressure from human activities (recreation areas, camp sites, holiday homes, restaurants) and for which no information about pressures, first of all about unlicensed waste water discharges.

The survey was undertaken by accredited laboratory (Annex 1, official Accreditation of the laboratory) of Ivano-Frankivsk regional authority for water management of State Water Agency of Ukraine (Ivano-Frankivsk city, 50 km from Yaremche) and included physical-chemical parameters at the selected points.



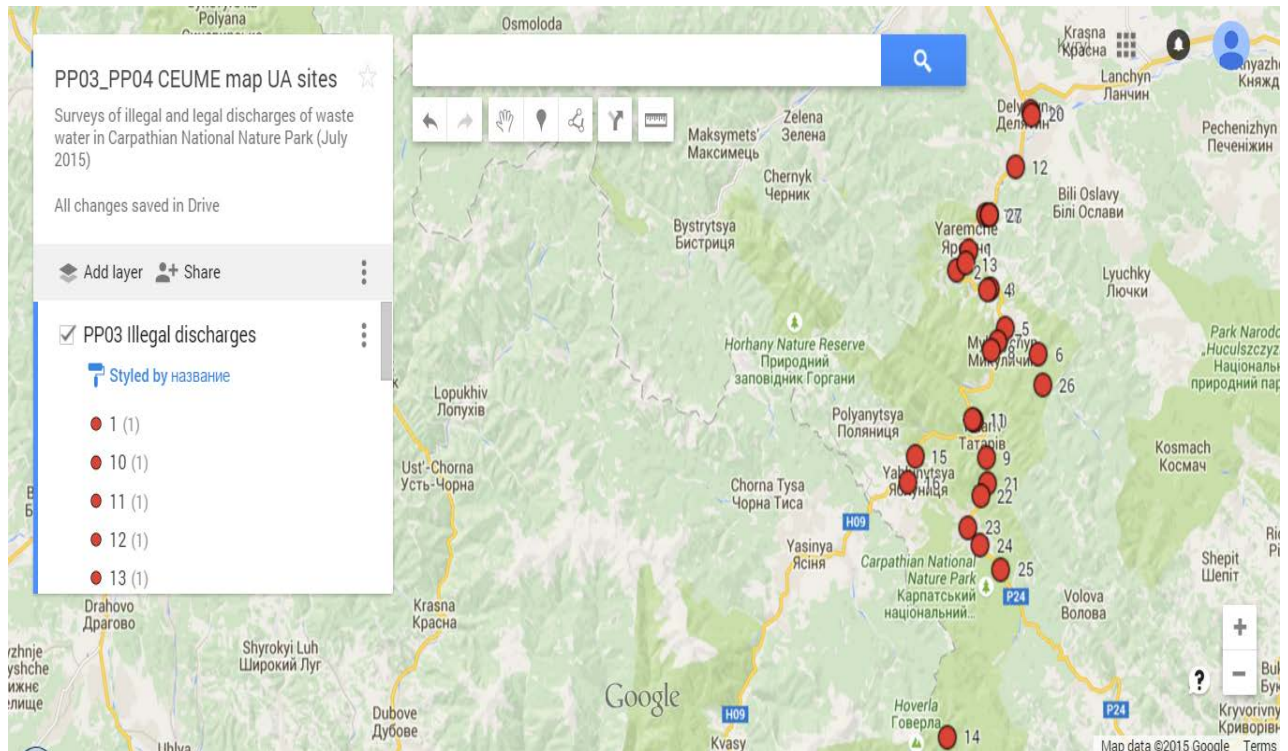
Picture 2. Hydrochemistry laboratory of Ivano-Frankivsk regional authority for water management

Laboratory conducts monitoring of the surface water under the programme for the environmental monitoring as regards the implementation of control of surface water quality by the State Agency for Water Resource of Ukraine. According to the Programme of hydrogeological and reclamation works the measurement of samples of ground, drainage and surface waters and soils on inter-farm reference drainage systems is carried out by the Laboratory.

It is certified to carry out the measurements in sphere of the state metrological supervision – accreditation certificate #199 issued February 20, 2012, valid until April 11, 2016 and it determines 31 quality indicators of surface water, 21 quality indicators of ground water and 23 indicators of composition and physical-chemical parameters of soils (Annex I).

Fieldresearch was carried out in July involving the representatives of the Carpathian National Nature Park, specialists of housing and communal services of local authorities, members of local governments, activists of ecological NGOs.

Previously the aforementioned representatives compiled the list of objects of economic activity within the park that are the potentially dangerous contaminants of water bodies and that do not have licenses for wastewater discharges. Also, this list included objects that report about equipping the treatment facilities, but according to the information from local residents, continue to dump the untreated wastewaters into the tributaries of the Prut River and directly into the Prut River, mostly at night.



Picture 3. Points of sampling on the territory of Carpathian NNP

Source: PP03 Illegal discharges, Google map

https://www.google.com/maps/d/edit?mid=zD3WWW_Xw2UE.kLA1iBgNcg2c&usp=sharing (for opening the map, please, click on this link)

It is necessary to note the serious difficulties in communication with the responsible officials who saw direct or indirect risk to themselves in carrying out of such research, and who either refused to help or asked not to mention their names. The matter is that in most cases the owners of entities, particularly large ones, are the persons who have directly close relationships with the government officials or "big business" in Ivano-Frankivsk region and Kyiv.

Official controls on discharges of such entities are not conducted, considering the fact that local authorities have not registered all entities that provide the tourist and hotel services. Moreover, at the present time (2013) there is the moratorium on carrying out any ecological inspections of business activities in order to "facilitate" business development in Ukraine.

In general, samples were selected for analysis of physical-chemical parameters of 27 potentially contaminated sites (Table 1). Sampling sites were refined in place. They were either directly the exit points of the wastewater pipes or the sections of rivers in the immediate proximity to such facilities. Also, samples were taken in small rivers (the tributaries of the Prut River) flowing through the territories of villages with dense housing along the banks and where there are no centralised wastewater treatment plants and the illegal waste dumps are taking place.



Table 1. Sampling points of field survey

<i>N</i>	<i>River, Site description, Number of site according EPIRB delineation</i>	<i>Altitude above sea level</i>	<i>Coordinates</i>	<i>Comments</i>
1	Chornogirchik river, Yaremche	490	48°27'13.5"N 24°33'41,7"E	Unauthorized discharges from households (tracked pipes with the wastewaters)
2	Prut, Yaremche, near "souvenir market"	506	48°26'29.4"N 24°32'50.6"E	A lot of garbage from market on river side
3	Prut, Mykulychyn village, near "Garda hotel"	555	48°25'51.4"N 24°35'14.0"E	Contaminated water (visually – the increased turbidity, surfactants)
4	Prut, Mykulychyn village, near hotel "Zatyn" Dzherelo, Babchukiv	548	48°25'47.6"N 24°34'59.2"E	According to information, there are no wastewater treatment plants in the presence of the water tower
5	Prutets Chemygivskii river, Mykulychyn village, near hotel "Zori Karpat"	586	48°24'25.9"N 24°36'14.9"E	Waste waters are directed to the treatment plants of Yaremche City, but there is information that the additional discharges of waste waters



N	River, Site description, Number of site according EPIRB delineation	Altitude above sea level	Coordinates	Comments
				without the treatment are possible.
6	Prutets Chemygivskii river, Mykulychyn village, near resort "Barwysche", resort Skelya"	638	48°23'30.8"N 24°38'36.3"E	According to information, there are no treatment facilities and it is an intensive recreation place
7	"Nameless brook" tributary of Prut river, Mykulychyn village, near "Yaremy Bonoka"	589	48°23'58.5"N 24°35'42.9"E	According to information, there are no treatment facilities, the discharge is carried out into a small stream
8	"Nameless brook" tributary of Prut river, Mykulychyn village, near "Millenium" hotel	619	48°23'38.7"N 24°35'15.1"E	A small stream with visually very contaminated waste water that flowed directly from the territory of hotel
9	Pihy river, tributary of Prut river Tatariv village	695	48°19'51.6"N 24°34'55.7"E	River is in the started condition, according to information the wastewater discharges from the village are carried out into the river,



N	River, Site description, Number of site according EPIRB delineation	Altitude above sea level	Coordinates	Comments
				water is visually polluted, it has an unpleasant odor
10	Sanitary sewer (old) (illegal discharges Shevchenko St. near Prut river in Tatariv village	664	48°21'10"N 24°34'06.3"E	Illegal discharges into old destroyed sanitary sewer
11	Prut river in Tatariv village	660	48°21'13.7"N 24°33'59.2"E	Place of potential influence from destroyed sanitary sewer
12	Peremyiska river, Delyatyn village	435	48°30'11.8"N 24°36'58.6"E	Unauthorised discharges of wastewater from the households of the village
13	Prut river Yaremche, "Krasna sadyba" resor	505	48°26'45,8"N 24°33'28,1"E	According to the information there are no treatment facilities
14	Prut, Upper reaches	1239	48, 16389 N 24, 53680 E	Impact of the Zaroslyak camping site, souvenir market, spontaneous resting place before the road to Mount Hoverla



N	River, Site description, Number of site according EPIRB delineation	Altitude above sea level	Coordinates	Comments
15	Prutetz Yablunetskiy river, Yablunytsia village	783	48°19'53,4"N 24°29'54,3"E	Woodworking enterprise, the banks of river are covered with the waste wood
16	Prutetz Yablunetskiy river, Yablunytsia village, near village Council opposite to church	809	48°18'58,5"N 24°29'24"E	Unauthorised discharges of wastewater from the households
17	Kamianka river, Dora village	472	48°28'29"N 24°34'54"E	Unauthorised discharges of wastewater from the households
18	Boyarski brook, Dora village	460	48°28'27,2"N 24°35'10"E	Unauthorised discharges of wastewater from the households
19	Syrylivka river, downstream of Deliatyn village	428	N48,535642 E24,633855	According to the information the river is extremely polluted
20	Liubyzhnianka downstream of Syrylivka river	427	48°32'01"N 24°38'07"E	The impact of the Syrylivka river, the nursing home without the treatment facilities is located upstream
21	Prut river, downstream of Vorochta village	739	48°18'55,5"N 24°35'01,6"E	The impact of households and rest homes, treatment facilities are



N	River, Site description, Number of site according EPIRB delineation	Altitude above sea level	Coordinates	Comments
				absent
22	Prut river, downstream of destroyed old WWTP of Vorochta village	745	48°18'29,4"N 24°34'32,6"E	
23	Prut river, Vorokhta village, near "Ukraine" resort	740	48°17'22,5"N 24°33'39,2"E	Waste water discharge pipe
24	Gnylytsa stream, Vorokhta village, near Timber factory	755	48°16'44,6"N 24°34'27,9"E	Discharges from the woodworking factory and households
25	Prut river upstream of Vorokhta	780	48°15'52,9"N 24°35'57,9"E	Near the old waste disposal
26	Prutetz Chemygivskii, Mykulychin village	18	48,37377 24,64785	A lot of garbage on the both sides of river, place of car washing
27	Kamianka river, mouth, Prut river Site N	27	48,47465 24,58331	Discharges from the households and rest homes

Trash dump occur all over the park, where the tourists have rest and the population lives. Disposition of garbage is organised very seldom, even from the special containers for its collection. These dumps are sources of water pollution including the bacterial pollution (picture 4).

Picture 4. Illegal garbage dumping place



1.3. Analyses of hydrochemistry results

Table 2 (please see below) presents the results of hydrochemical research that is identified by laboratory. Analysis of parameters according to the requirements of Ukrainian environmental legislation shows that not all of the picked water samples meet the standards of SRLI (safe reference level of impact) for water of fishery ponds.



Table 2. Hydrochemistry parameters of sampling sites

N	River, Site description	Oxygen (mg/dm ³)	pH	EC	T, C ^o	BOD ₅	COD	Amm-onium salt, mg/dm ³	Amm-onium nitrog-en, mg/dm ³	Nitrite ion, mg/dm ³	Nitrate ion, mg/dm ³	Phosp-hate ion, mg/dm ³
	Joint list of MAC and potentially safe levels of impacts of hazardous substances for fish breeding waters	6,0	6,5-8,5			3,0	25,0	0,5	2,0	0,08	40,0	
1	Chornogirchik river, Yaremche	8,6	8,01	361	18,2	2,2	9	0,14	0,11	0,041	1,90	0,1
2	Prut, Yaremche, near "Souvenir market"	8,64	8,42	223	21,2	2,25	9	0,075	0,058	0,22	0,67	0,28
3	Prut, Mykulychyn village, near "Garda hotel"	8,2	8,51	226	23,3	0,50	10	0,078	0,061	0,21	0,74	0,28
4	Prut, Mykulychyn village, near hotel "Zatyn", "Dzherelo", Babchukiv	9,27	8,43	228	23,6	2,57	8	0,059	0,046	0,20	0,79	0,22



N	River, Site description	Oxygen (mg/dm ³)	pH	EC	T, C ^o	BOD ₅	COD	Amm-onium salt, mg/dm ³	Amm-onium nitrogen, mg/dm ³	Nitrite ion, mg/dm ³	Nitrate ion, mg/dm ³	Phosp-hate ion, mg/dm ³
5	Prutets Chemygivskii river, Mykulychyn village, near hotel "Zori Karpat"	8,79	8,23	222	22,8	0,38	11	0,042	0,033	0,18	1,0	0,23
6	Prutets Chemygivskii river, Mykulychyn village, near resort "Barwysche", resort Skelya"	8,2	8,03	210	20,5	0,73	20,0	0,053	0,041	0,17	1,0	0,21
7	"Nameless brook" tributary of Prut river, Mykulychyn village, near "Yaremy Bonoka"	7,33	7,30	225	22,5	3,77	12,0	0,15	0,12	0,51	1,5	0,1
8	"Nameless brook" tributary of Prut river, Mykulychyn village, near "Millenium" hotel	0,0	7,13	433	21,7	-	67,0	7,0	5,4	0,41	0,93	2,2



N	River, Site description	Oxygen (mg/dm ³)	pH	EC	T, C ^o	BOD ₅	COD	Amm-onium salt, mg/dm ³	Amm-onium nitrogen, mg/dm ³	Nitrite ion, mg/dm ³	Nitrate ion, mg/dm ³	Phosp hate ion, mg/dm ³
9	Pihy river, tributary of Prut river Tatariv village	9,14	7,99	188	20,9	2,75	8,00	0,086	0,067	0,18	0,85	0,023
10	Sanitary sewer (old) (illegal discharges Shevchenko St., near Prut river in Tatariv village)	1,73	6,43	236	18,1	1,73	40,0	0,9	0,7	0,25	7,3	0,2
11	Prut river in Tatariv village	8,74	8,82	213	25,1	2,49	7,00	0,096	0,075	0,25	0,58	0,024
12	Peremyiska river, Delyatyn village	11,7	8,48	303	23	2,97	12,0	0,16	0,12	0,01	1,0	0,026
13	Prut river Yaremche, "Krasna sadyba" resort	9,51	8,50	220	24,3	3,05	13,0	0,14	0,11	0,017	1,0	0,034
14	Prut, Upper reaches	11,0	7,6	270	14,0		1,60	-	0,20	-	1,50	0,32
15	Prutetz Yablunetskiy river, Yablunytsia village	8,43	8,50	367	26,5	2,39	13,0	0,17	0,13	0,031	0,76	0,052



N	River, Site description	Oxygen (mg/dm ³)	pH	EC	T, C ^o	BOD ₅	COD	Amm-onium salt, mg/dm ³	Amm-onium nitrogen, mg/dm ³	Nitrite ion, mg/dm ³	Nitrate ion, mg/dm ³	Phosphat e ion, mg/dm ³
16	Prutetz Yablunetskiy river, Yablunytsia village, near village Council opposite to church	9,42	8,30	362	24,7	3,59	15,0	0,15	0,12	0,028	0,67	0,054
17	Kamianka river, Dora village	8,75	8,13	313	23,2	3,01	14,0	0,078	0,061	0,015	2,8	0,038
18	Boyarski brook, Dora village	9,05	8,09	345	22,6	2,90	13,0	0,04	0,031	0,006	2,4	0,028
19	Srylivka river, downstream of Deliatyn village	6,75	8,32	999	26,3	3,50	110	0,13	0,1	0,012	0,71	0,026
20	Liubyzhnianka downstream of Srylivka river	7,23	8,13	177	25	4,94	23,0	0,088	0,019	0,014	0,77	0,034
21	Prut river, downstream of Vorochta village	9,32	8,53	223	19,3	4,32	6,00	0,11	0,086	0,012	1,4	0,041
22	Prut river, downstream of destroyed old WWTP of	9,82	8,60	225	18,7	3,55	6,50	0,12	0,094	0,012	1,3	0,045



N	River, Site description	Oxygen (mg/dm ³)	pH	EC	T, C ^o	BOD ₅	COD	Amm-onium salt, mg/dm ³	Amm-onium nitrogen, mg/dm ³	Nitrite ion, mg/dm ³	Nitrate ion, mg/dm ³	Phosp hate ion, mg/dm ³
	Vorochta village											
23	Prut river, Vorokhta village, near "Ukraine" resort	9,96	8,10	212	18,3	3,56	6,00	0,09	0,07	0,01	1,5	0,041
24	Gnylytsa stream, Vorokhta village, near Timber factory	8,74	7,34	430	18,2	3,98	13,0	0,39	0,3	0,33	7,2	0,25
25	Prut river upstream of Vorokhta	8,43	7,53	248	20,9	1,97	7,00	0,13	0,1	0,018	1,5	0,06
26	Prutetz Chemygivskii, Mykulychin village	10,64	6,16	236	15,7		2,40		0,01		0,88	0,08
27	Kamianka river, mouth, Prut river	10,85	7,2	323	17,8	6,69	1,92	-	0,01	-	0,44	0,01



The largest exceedance for 11 samples was marked for nitrite ions. This indicates the contamination of sites where samples were taken with the waste water (washed out from toilets) because nitrites are formed as a result of the biochemical oxidation of ammonia. Such exceedance at the sections of water bodies where the waste waters of the vacation hotels are discharged means that they have no system for the domestic wastewater treatment at all.

These conclusions also confirm the indicators of the biochemical oxygen demand in five days. They are especially high for the small streams that flow from the vacation hotels and sections of the Prut River and its tributaries just following their placement.

The most impressive pollution is found near the hotel Millennium in the Mykulychyn village that is situated at the Prut's tributary – the Prutets Chemigivskyi River (picture 5). The hotel is designed for 60 people and has a swimming pool and sauna. Its territory is a source of the unconcealed water stream that has no oxygen at all. The exceedance of the chemical oxygen demand in it is more than 2 times, ammonia nitrogen – 2,7 times, ammonium salt – 15 times, nitrite ions – 5 times.

Picture 5. Polluted small brook near 'Millennium' hotel, village Mykulychin

Given that other recreational institutions illegally discharge the wastewater directly into the water bodies, it's not hard to guess about the composition of their pollution. It was not always possible to catch such pollution in the rivers with the mountainous hydrological regime that facilitates the rapid purification of water by mixing and oxygenation. But even the appearance of the river sections downstream the possible discharges left no doubt that these places are constantly fed with water with a high content of biogenic substances which are not inherent to their natural status (picture 6).

Picture 6. Place of permanent illegal waste water discharge, Prut, village Tatariv

It is impossible to leave without attention the part of the Prut River in the Tatariv village. The ruined water collector that is situated directly in the meadow on the left bank of the river near the Shevchenko Street is a source of water with an extremely unpleasant specific smell of sewage. During the Soviet times the wastewater treatment facilities of the Tatariv village were located there. Among others they were receiving the waste waters from the



tuberculosis dispensary. Currently the wastewater treatment facilities have been eliminated, but the network of tumbledown collectors remains (picture 7). Somehow a certain amount of waste water still gets to this old place and is washed off directly into the Prut River. It is proved by the picked samples. Oxygen is 1,73 instead of 6,0 according to norms, ammonium salt exceeds almost twice, nitrite – more than three times.

Picture 7. Destroyed sewage collector in right side of Prut, village Tatariv



2. Risk assessment for physical-chemical elements of water bodies of Prut river basin in territory of Carpathian National Nature Park according to WFD

As defined by the WFD the general physical-chemical elements have to be included into analysis of pressures and impacts that may put water body at risk of falling environmental objectives and they are used together with biological elements to determine a high and good water status of WBs (table 3). The general physical-chemical parameters according to the definition of the WFD are for rivers:

1. Thermal conditions
2. Oxygenation conditions
3. Salinity
4. Acidification status
5. Nutrient conditions

For risk assessment based on selected water quality parameter/indicator a threshold value related to this water quality indicator was used.

Risk criteria are applied by comparing existing information with the threshold values for a certain indicator. If the threshold is exceeded, it is assumed that the water body is at risk of failing environmental objectives related to general physical-chemical parameters at the given location.

Table 3. Risk criteria for in-stream water quality indicators

River Size	Oxygen [% sat]*	BOD** (ATH inhibition)	NH ₄ **	NH ₄ ***	PO ₄ ***	pH	Delta T***
Small	75	5	0,4	0,15	0,2	6,5-8,5	< 2
Medium	70	6	0,6	0,2	0,3		< 2
Large	60	7	0,8	0,3	0,4		< 3

The use of methodology (that is proposed by the EPIRB project) for assessing the risk of failure to reach a “good” state of the water body by the physical and chemical indicators for the carried out research shows the following. As well as according the Ukrainian standards, 11 water bodies in the case of the research are at risk on such indicators as phosphates, pH, ammonia nitrogen, oxygen content. Unfortunately, this directly concerns the water bodies of the Prut river and Prutets-Chemygivskyi, its major tributary,



whose catchment area is located entirely within the Carpathian NNP (table 4).

Table 4. Risk analysis on physical-chemical elements of water bodies of Prut river basin in territory of Carpathian National Nature Park

N	River, Site description	River Size	Oxygen (mg/l)	pH	BOD ₅	NH ₄	PO ₄
		Small	>4	6,5-8,5	>5	0,15	0,2
		Medium	>5		>6	0,2	0,3
		Large	>6		>7	0,3	0,4
1	Chornogirchik river, Yaremche	Small	8,60	8,01	2,20	0,11	0,10
2	Prut, Yaremche, near "Souvenir market"	Medium	8,64	8,42	2,25	0,058	0,28
3	Prut, Mykulychyn village, near "Garda hotel"	Medium	8,20	8,51	0,50	0,061	0,28
4	Prut, Mykulychyn village, near hotel "Zatyn", "Dzherelo", Babchukiv	Medium	9,27	8,43	2,57	0,046	0,22
5	Prutets Chemygivskii river, Mykulychyn village, near hotel "Zori Karpat"	Small	8,79	8,23	0,38	0,033	0,23
6	Prutets Chemygivskii river, Mykulychyn village, near resort "Barwysche", resort	Small	8,20	8,03	0,73	0,041	0,21



N	River, Site description	River Size	Oxygen (mg/l)	pH	BOD ₅	NH ₄	PO ₄
	Skelya"						
7	"Nameless brook" tributary of Prut river, Mykulychyn village, near "Yaremy Bonoka"	Small	7,33	7,30	3,77	0,12	0,10
8	"Nameless brook" tributary of Prut river, Mykulychyn village, near "Millenium" hotel	Small	0,00	7,13	0,00	5,40	2,20
9	Pihy river, tributary of Prut river Tatariv village	Small	9,14	7,99	2,75	0,067	0,023
10	Sanitary sewer (old) (illegal discharges Shevchenko St., near Prut river in Tatariv village	Small	1,73	6,43	0,00	0,70	0,20
11	Prut river in Tatariv village	Medium	8,74	8,82	2,49	0,075	0,024
12	Peremyiska river, Delyatyn village	Small	11,7	8,48	2,97	0,12	0,026
13	Prut river Yaremche, "Krasna sadyba"	Medium	9,51	8,50	3,05	0,11	0,034



N	River, Site description	River Size	Oxygen (mg/l)	pH	BOD ₅	NH ₄	PO ₄
	resort						
14	Prut, Upper reaches	Small		7,6		0,20	0,20
15	Prutetz Yablunetskiy river, Yablunytsia village	Small	8,43	8,50	2,39	0,13	0,052
16	Prutetz Yablunetskiy river, Yablunytsia village, near village Council opposite to church	Small	9,42	8,30	3,59	0,12	0,054
17	Kamianka river, Dora village	Small	8,75	8,13	3,01	0,061	0,038
18	Boyarski brook, Dora village	Small	9,05	8,09	2,90	0,031	0,028
19	Syrylivka river, downstream of Deliatyn village	Small	6,75	8,32	6,50	0,10	0,026
20	Liubyzhnianka downstream of Syrylivka river	Small	7,23	8,13	5,00	0,019	0,034
21	Prut river, downstream of Vorochta village	Medium	9,32	8,53	4,32	0,086	0,041
22	Prut river, downstream of destroyed old WWTP of	Medium	9,82	8,60	3,55	0,094	0,045



N	River, Site description	River Size	Oxygen (mg/l)	pH	BOD ₅	NH ₄	PO ₄
	Vorochta village						
23	Prut river, Vorokhta village, near "Ukraine" resort	Medium	9,96	8,10	3,56	0,07	0,041
24	Gnylytsa stream, Vorokhta village, near Timber factory	Small	8,74	7,34	3,98	0,30	0,25
25	Prut river upstream of Vorokhta	Medium	8,43	7,53	1,97	0,10	0,06
26	Prutetz Chemygivskii, Mykulychin village	Small	10,64	6,60		0,01	0,08
27	Kamianka river, mouth, Prut river	Small	10,85	7,20	6,69	0,01	0,01

Red color – marked for RWB “at risk”, green – marks for WB “not at risk”

Taking into account that the period in which the research was carried out was very dry in terms of the hydrological regime, as well as throughout Ukraine this year, we can talk about the representativeness of the results for their further use in assessing the impact of anthropogenic pressure on these water bodies.

The largest number of the recreation facilities is located exactly on the banks of Prut river water bodies, given the fresh mountain air, beautiful landscapes and picturesque rivers.

According to the local ecologists, the load on the water bodies of the park is growing. Number of tourists this year has increased much owing to the loss by Ukraine the Crimean and partly the Azov recreational areas. If climate changes that have so significantly affected the weather in Ukraine this year



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will continue to be kept in the Carpathians, the water and ecological status of rivers will become much worse. The largest number of the recreation facilities is situated exactly on the banks of these water bodies, given the fresh mountain air, beautiful landscapes and picturesque rivers.



3. Analysis of current situation of illegal discharges of waste water in CNNP area

The EU Water Framework Directive (WFD) requires the development of Programme of measures for improving water quality for each basin, as well as the development of the register of special protected areas as a result. The WFD term 'protected areas' is much more inclusive than the traditional notion of national parks, reserves, etc. This register must contain:

- areas designated for the abstraction of drinking water for human consumption;
- areas designated for the protection of economically significant aquatic species;
 - bodies of water designated as recreational areas and bathing areas;
 - nutrient-sensitive areas, including nitrate vulnerable zones with high demand for protection of water and soil from agricultural pollution (under Nitrates Directive 91/676/EEC), and areas with special requirements for municipal waste water treatment (under the Directive 91/271/EEC concerning urban waste water treatment (UWWTD));
- areas designated for the protection of habitats or species where the maintenance or improvement of the status of water is an important factor in their protection.

Tourism in the Carpathian region (especially in the Ivano-Frankivsk region) is developing rapidly. The tourist flow increases every year, hotel and recreational infrastructure is being built up and cultural actions are being organised. Despite the obvious positive effect on the regional economy the intensive development of tourism brings with it a number of threats.

The mountain landscape is particularly vulnerable to various forms of the economic impact. Its ecosystem is restored heavily and slow. Therefore it is very important to provide such planning of the infrastructure elements of the tourism industry which would coordinate the development of industry and the preservation of environment. This is especially the acute issue in the Ukrainian Carpathians, because the good ecological status is one of the recreational resources of the region.

The growth of the tourism industry is followed by a direct impact on natural landscapes. Degradation, depletion and radical change of the landscape elements is a result of intensive building of accommodation facilities, roads and airports, as well as of the use of land resources as a building material for creation of housing infrastructure. The destruction of large forest massifs during the construction of tourism infrastructure in mountainous regions of Ukraine is an actual ecological problem. For example, the tourist complex "Bukovel" is constantly expanding, now it is occupying about 822 hectares of land with total length of ski trails about 53 km.



Life-support systems of tourist complexes require significant amount of the energy and water resources. The intensive use of water resources and their contamination are the result of functioning of the tourism infrastructure. For instance, the average water consumption in the city of Antalya (Turkey) on a daily basis is 250 litres per day, while in the tourist areas of Antalya the average daily consumption reaches 600 litres. Similar generalised calculations show that tourists in the Ivano-Frankivsk region may additionally use from 100 000 to 450 000 m³ of water per day during the peak tourist seasons. The problem of withdrawal of wastewater from the small hotels and rural estates remains because the vast majority of tourist destinations have no centralized sewage system (picture 8). Research of quantitative and qualitative changes of the underground hydrosphere and surface waters remains relevant in the context of ecological safety of tourist destinations.

Picture 8. Illegal waste water pipe, Bukovel resort

Table 5. The norms of recreational load on natural systems of the Carpathian region

Natural systems	The norms of recreational load, PPL/km	
	Summer	Winter
Low-lying	80-120	30-50
Undulating land	100-150	40 - 35
Mountainous (incl. Carpathian National Park)	110-200	60-160

These figures are maximal and give an overview of the EU ecological norms of recreational load on various natural systems.

The territory of Carpathian National Park is a place of operation for about 50 hotels (40-50 persons each), 48 recreational facilities (3000 beds), about 550 estates for green tourism (9000 tourists), as well as for a series of environmental, scientific, informative and ecological tourism routes of total length of 400 km, including 47 hiking routes, 6 ski routes, 3 water routes; 9 recreational zones and 9 recreational places. The total capacity of some recreational centres (including Bukovel and Yaremche) is close to optimal. Therefore the strict compliance with the optimal recreational load on natural ecosystems is a necessary condition for further development of recreational areas.



Municipal and domestic wastewaters in settlements without the sanitation services or with the partial provision with them are accumulated in the decentralised systems: septic tanks or cesspools. A significant part of annually produced wastewater is discharged into the septic tanks or removed in other uncontrolled manner leading thus to the nitrate and bacterial contamination of the well water and surface water bodies. Detailed data on this significant component of the total volume of wastewater is absent not only in the scale of the region, but also throughout Ukraine.

Research of access to the safe drinking water and sanitation services on the territory of Yaremche City Council (where the CNNP is located) indicates that the focus on these issues is given to the centralised water supply and disposal, although this service covers only 11% of the population. Decentralised sources of drinking water and sewage systems even are not registered. There is no relevant service for the proper maintenance of the individual water supply and wastewater systems. Individual owners equip, service and exploit the local water pipes, wells, septic tanks etc. on their own. Local governments almost have no information on the private wastewater treatment plants, the volume and composition of wastewater, the discharge locations etc. 2TP-Vodgosp Report (the state statistical reporting on the use and disposal of water) delivers only 18 entities, representing about 20% of all hotel facilities (excluding the small tourist estates).

Two target programs at improvement of the water supply and disposal and the protection of water resources have been developed, but the key problem is their insufficient funding.

Urban residents have advantages in possibilities of connection to the centralised sources of water supply and disposal. Residents of rural areas do not have such opportunity. The obtained data shows that there is a progress in the financing of program activities of the studied field. At the same time, the lack of data on the vulnerable target groups does not allow to objectively assess the levels of ensuring that everyone has access to the quality services. Policy in the water supply and disposal, as well as in the access to the sanitation services should take into account the interests of marginalised groups (disabled, homeless, displaced persons etc.) and reduction of geographic inequalities (rural population compared to the urban).

Concerning the development of the tourism industry the main focus should be given to the informational work on the necessity of installation of local treatment facilities with owners of the small tourism businesses and catering facilities in the areas without the water disposal systems. According to new



legislation the local authority is deprived the powers to influence the individual owners during the commissioning of object and the monitoring of functioning of existing facilities, to control it and to bring the owners to responsibility for violations of environmental laws. Resolutions of the village/town councils are not the effective mechanism for addressing these problems. The lack of proper control over the subsoil use and the issuance of permits for the special water use lead to the unsanctioned discharges of waste waters into rivers and building in the coastal protection strips contrary to the current water legislation. Problem of the bacterial and (rarely) physical and chemical contamination of the drinking water sources is a result.

According to results of the independent survey, the centralised water supply and disposal are economically available to the population of Yaremche area (less than 4% of family income). Termination of servicing for the debts does not exist. The costs of self-reliant installation of the sources of water supply and the sewage systems are significant for the rural residents. The problem is also the lack of plans for the safe public water supply during the abundant and dry years. Thus, the study period covers the so-called "dry" years and freshet-flood periods. The disappearance of the drinking water in private wells during the dry periods of year is a concern. The population is devoid of any support from the state on this issue. One of the measures can be the organised delivery of the imported water for individual neighbourhoods where problem is the most acute.

There is no centralised water supply and disposal of the administrative centres in Mykulychyn, Tatariv, Yablunytsya and Polyanytsya villages. There are separate local sewage systems, which are connected to some households, but there is no exact information about them. Treatment of the discharged return waters in the settlements is partially solved by the construction of biological treatment plants.

As of 01.01.2015, 95 hotels and recreational centres, 580 green tourism estates operate at the territory of Yaremche City Council. It was visited by 890 thousands of people in 2013 and by 934 thousands of people in 2014. The tourist sphere creates additional stress on the water resources in region. The dynamics of tourists is shown in Picture 9.

However the information on availability of permits for the special water use, volumes of wastewater discharges and method of their treatment/purification, as well as the information on the 2TP-Vodgosp reporting form in the local governments is absent.



Picture 9. The dynamics of tourists on the territory of Yaremche City Council (2010-2014 years)

The cost of the one disposal of content of cesspool by the sewage cleaning machine (3,8 m³) for individuals and legal entities is 345 UAH in Yaremche City, 550 UAH in Mykulychyn village, 735 UAH in Tatariv village, 1040 UAH in Polyanytsya and Yablunytsya villages, 450 UAH in Vorokhta town. Analyzing the results of the independent survey, we can say that the economic accessibility of the centralised water supply and disposal is acceptable (1-4% of total revenues).

In 2014 EU funded project "Ivano-Frankivsk region - the land for tourism", which is implemented by the Department of International Cooperation, European integration and the development of tourism infrastructure of the Ivano-Frankivsk Regional State Administration, provided sociological research. Various aspects of the tourism business in the region were studied. The most negative impression of the interviewed tourists were a contamination of the Carpathian forests and lack of public toilets.

