E721
Vol. 2

Amendment to Environmental Assessment of the Constructed Treatment Wetlands in Saranda

Influence of new discharge point to Cuka Chanel on the wells in neighboring village

TABLE OF CONTENTS

1. Preamble

The public consultation process related to the new discharge waters of the Saranda CTW engendered the following concerns:

- As Ksamili settlement and some other smaller settlements get water supply from the wells near Cuka canal, WB wants to know which could be the long term or any impact of the new CTW discharge at Cuka canal;
- How is the situation of groundwater/aquifer layers in relation with the influence of this new discharge to Cuka canal;
- Is it expected to have infiltration in the aquifer due to the new solution at Cuka canal?

2. Background

Currently the wastewater collected in the Saranda town is lifted by a pumping station, located near the former Butrinti Hotel, up-to the Bistriça river (Cuka Canal), with an out-fall located close to the existing bridge on the river (Cuka Bridge n. 1 - **see photo 1**).

The Saranda CTW final design includes the following solution for the future effluent discharging:

- **Pumped Out-fall into Bistriça river**: the effluent will be discharged in the Cuka canal by a pumping station, with the new proposed out-fall located 1,75 km upstream the existing sewage out-fall (**see photo 2**). The new sewage out-fall is located at 2,5 Km up-steam from the sea out-fall;
- **Emergency Gravity out-fall in the Butrinti Lake**: Emergency CTW out-fall by gravity into an existing open drainage discharging, via an existing hydrovore, in the Butrinti lake and then to the sea (**see photo 3**). The emergency out-fall will be used **only** in case of effluent pumping station failure

In the following general layout the existing and future situation is shown as above detailed.

Photo 1: Existing outfall on Cuka bridge n.1

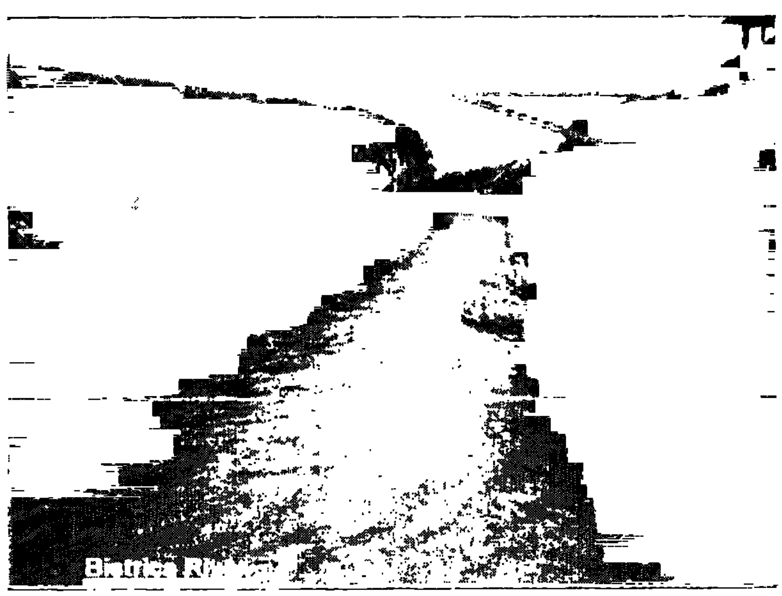


Photo 2: Future outfall on Cuka bridge n.2

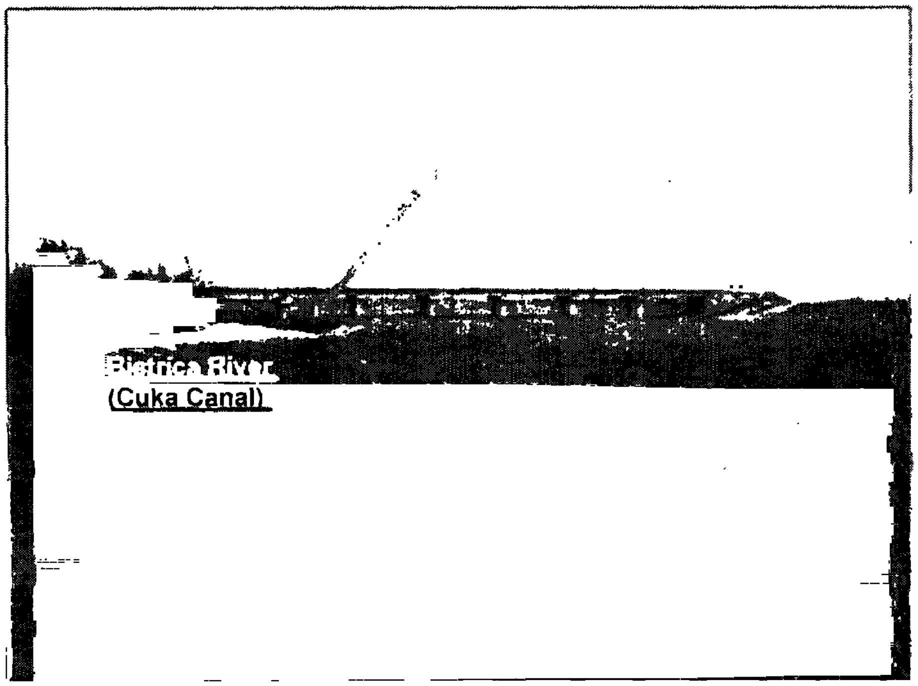
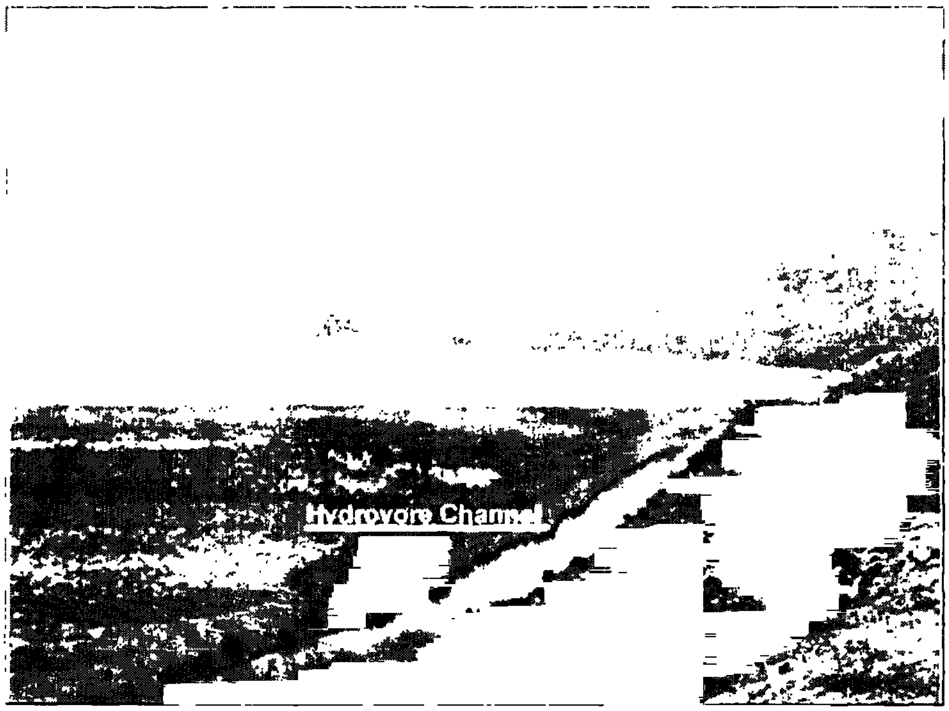
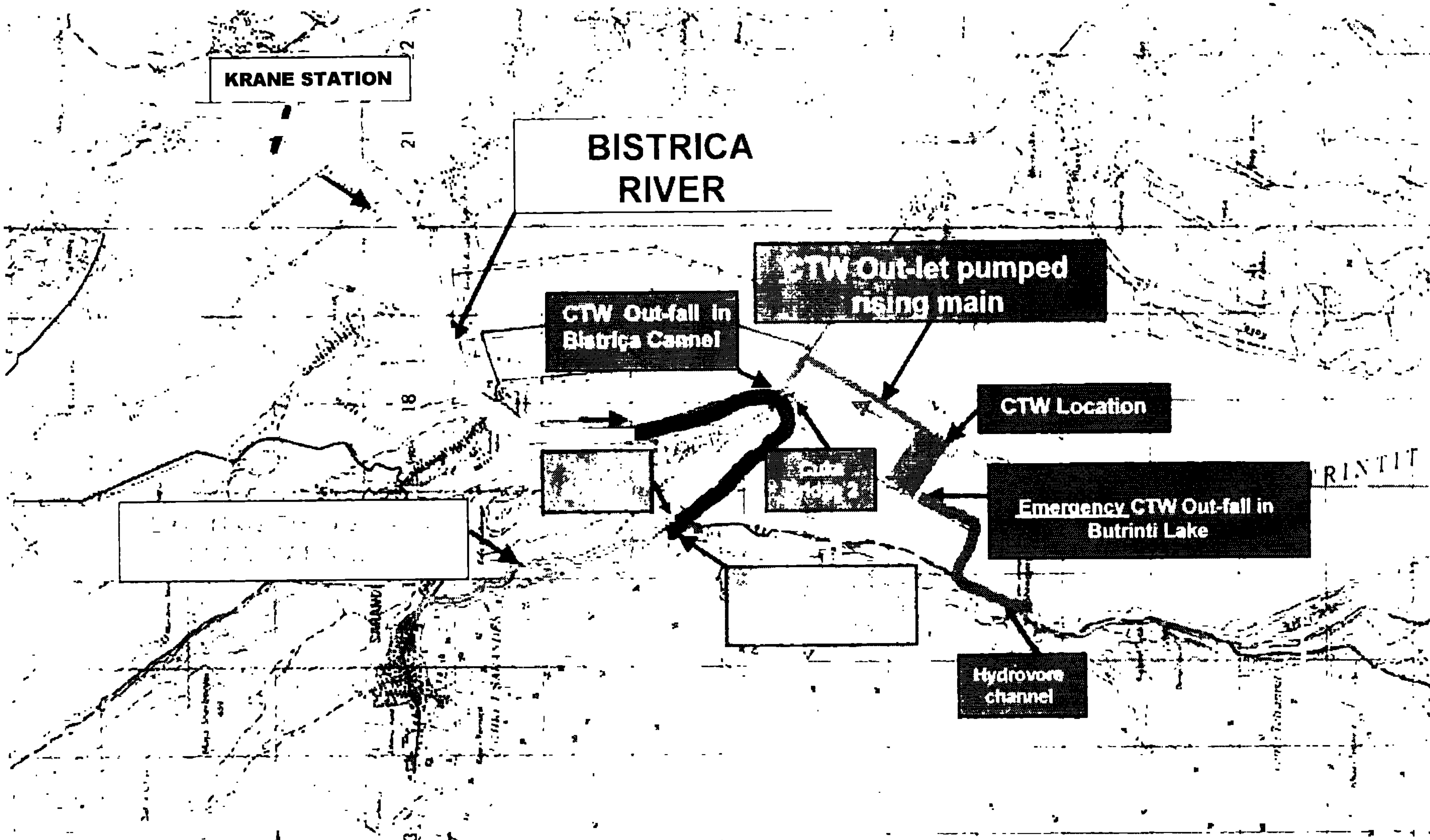


Photo 3: Emergency out-fall by gravity via existing hydrovore in the Butrinti lake



General Layout: Existing and future situation



3. Hydraulic and water quality characteristic of the Bistriça river (Cuka canal)

During Project preparation (May, 2002) water quality sampling and hydrometric measure has been preformed in the Cuka canal. The results can be summarized as follow:

- **Flow measurement:** Q=15.2 m^3/s; (width=25 m; average depth=0.90 m).
- **Water quality analysis:** Tab. 3.1 summarized water quality analysis sampled close the Cuka canal mouth.

Tab. 3.1-Cuka Canal water quality analysis (May, 2002)

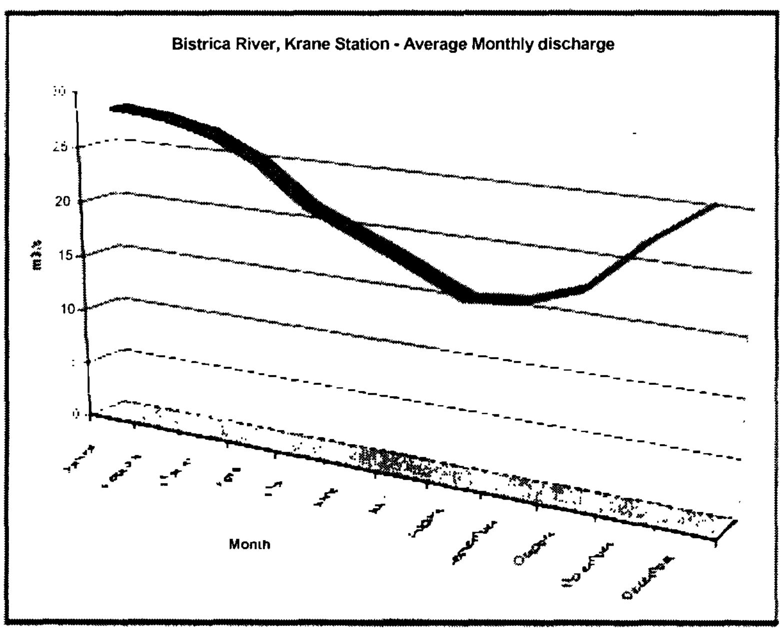
Parameter	Conc. (mg/l)
BOD_5	4.20
Total N	1.02
Total P	0.60
SS	0.25

The above flow measurement has been confirmed by the more comprehensive hydrologic study carried out on the Albanian water resources.[1] In the following Table 3.2 and graph 3.1 the average monthly discharges of the Bistriça river measured at the Krane Station are shown.

Table 3.2- Bistriça river average monthly discharge, Krane Station

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Discharge m3/s	28.5	28.1	27.1	25	21.6	19.7	17.7	15.6	16.1	17.7	22	25.4

Graph 3.1- Bistrica river average monthly discharge, Krane Station



[1] Les ressources en eau de l'albanie", A. Selenica Institut d'Hydrométéorologie Tirana, M. Morell, Institut de Recherche pour Développement Montpellier, 2000

Moreover the calculated probability of exceeding for the Bistrica river discharges are shown in the following table 3.3:

Table 3.3-Krane Station, probability of exceeding for the Bistrica river discharges

Probability of exceeding	75%	90%	95%
Discharge m^3/s	13.8	11.6	10.5

4. CTW expected effluent water quality

In Tab. 4.1 the expected effluent water quality of the Saranda WWTP is shown. The Treatment Performance or Removal Efficiency (RE%) of the WWTP is a ratio of the outgoing concentration versus the ingoing concentration of wastewater substances.

Tab. 4.1-Saranda WWTP Inlet/outlet Removal Efficiency (RE%)

	In-let flow composition (mg/l)	Out-let flow composition (mg/l)	RE (%)
BOD_5	200	29.5	85
Total N	50	33.6	33
Total P	20	16.3	19
SS	400	14.8	96

The expected Fecal Coliform Removal Efficiency (by considering preliminary treatment, Oxidation pond and Wetland) is expected to be ranging between 92÷97% as shown in the next Table 4.2 (hydraulic retention time about 12 days):

Tab. 4.2-Saranda WWTP FC Removal Efficiency

Process	% Removal
Screens	10-20
Grit Chamber	10-25
Wetland	90-95
WWTP plant	92-97

Assuming a Fecal Coliform in-let concentration of $1*10^7$ MPN/100 ml (typical urban wastewater concentration), the FC effluent concentration will be $3*10^5$ MPN/100 ml.

5. Wastewater effect of residual wastewater on the Cuka canal fresh water

Pollutant & Nutrient
By considering an Cuka canal flow discharge of 10.5 m^3/s (lowest expected flow, 95% probability of exceeding), the dilution rate, between the receptor flow discharge and the average WWTP effluent flow-rate (85 l/s), result **120 times** (10,500/85=123).

Fecal
According the Final Design calculation, the expected increasing on the FC receptor concentration due to the WWTP outfall diluted results in 2,500 MPN/100 ml.
By considering the expected insignificant concentration of the pathogen bacteria in the plant out fall, it is possible to discharge directly the treated water into the Bistriça river, without any relevant health risk constrains.

Nevertheless a treated wastewater disinfections unit has been included for he Saranda plant. Before the plant out fall the waste-residual-water will disinfected by a water chlorination

system, including an hypo chlorite dosing pump, residual chlorine meter and de-chlorination unit.
Assuming that the removal efficiency of the chlorination unit will be 99.99% the Fecal Coliform effluent concentration is shown in the following table 5.2:

Tab. 5.2- (MPN/100ml)effluent concentration after chlorination process

	In-let Chlorination flow concentration (MPN/100ml)	Effluent concentration (MPN/100ml)	Increasing of FC on the Cuka fresh water (MPN/100ml)
Fecal Coliform	$3*10^5$	30	0.24

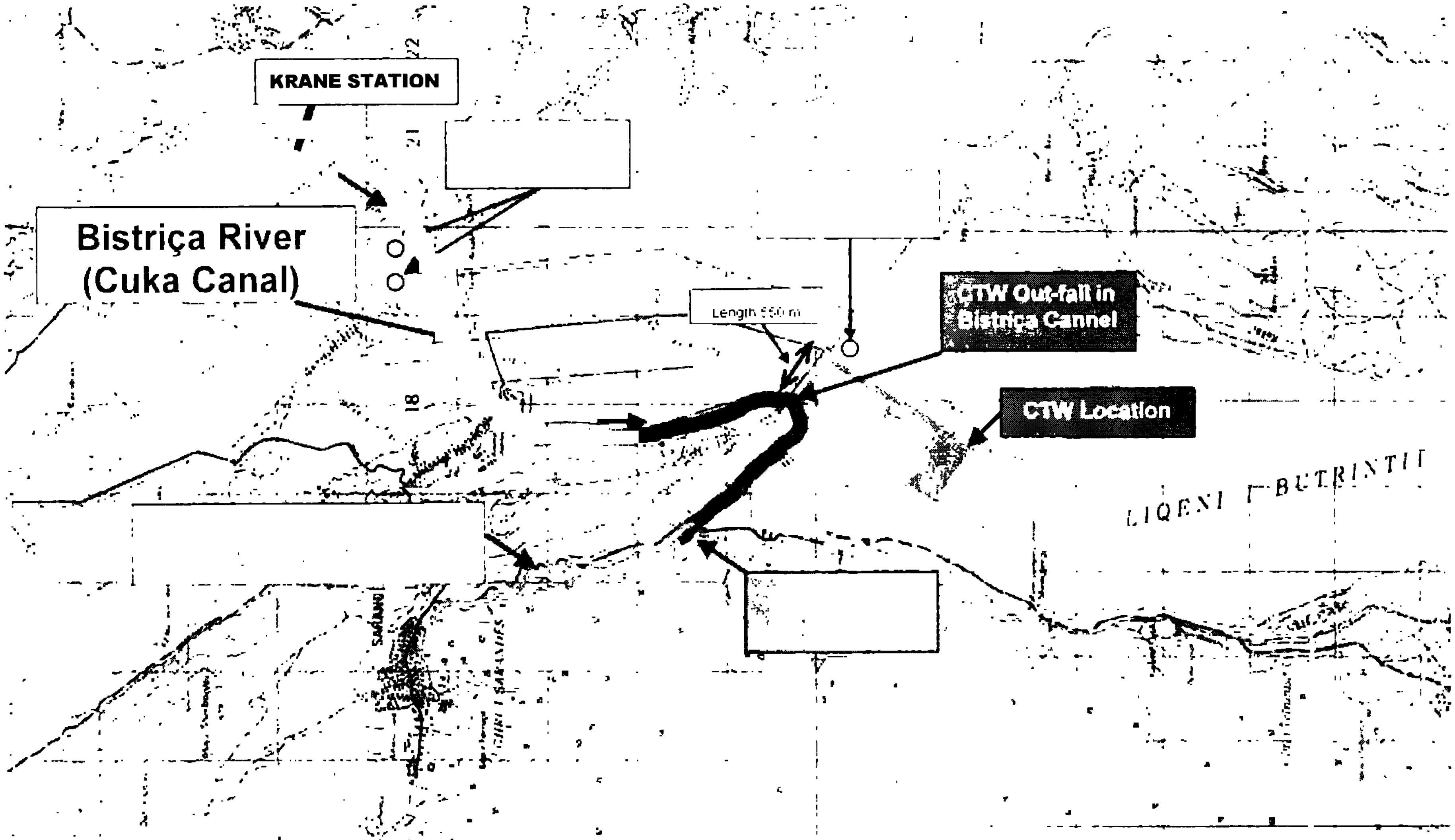
It's necessary to note that at present the raw sewage is discharged directly to the Cuka Canal without any treatment so that the future discharge of the WWTP out-fall will increase the fresh water quality of the Cuka Canal.

6. Wastewater effect of treated wastewater on the existing wells in the Cuka area

In the Saranda area can be distinguished two main aquifers: *limestone karst aquifer* and *gravelly porous aquifer.*
The Saranda limestone mountain strip represents a karst aquifer, which due to the intensive fissuring and karstification has a distinctly high permeability. The intensive infiltrated precipitation in the limestone formations is short way discharged into the Ionian Sea without forming important springs.
Mainly Quaternary fluvial deposits, which maximal thickness is about 250 m (in the southern sector of the plain), fill up the Vurgu Plain. These deposits consist of alternated gravely and clayey layers. The transmissibility of the gravely layers is generally high to very high, particularly in the northern sector of the Vurgu Plain where it is about 8000 m^2/d. The yield of the wells varies from 10-20 l/s up to more then 100 l/s. Two wells total capacity 150 l/s located about 4-km northeast to Saranda, near Vrioni village, are used for the city water supply.
In the figure in next page the location of existing main wells in the Saranda area are shown: Saranda wells and Cuka wells.
The Saranda water supply wells are situated about 5 km north to CTW location, or 3 Km north to the CTW out-fall into Bistriça canal. The water supply wells are situated up-stream, so it is excluded any possibility for groundwater to be effected by the residual wastewater discharged into the Cuka canal.
The Cuka water supply wells are located about 2 km north to the CTW location, and at 550 m up-stream from the CTW discharging point into Bistriça canal. As above, due the up-stream position of the wells, no influence on groundwater/aquifer layers is expected. In addition, it is necessary to consider that the Cuka well gravel aquifer is well protect by an impermeably clayey layer of about 25-30 m.
As shown on the map the CTW residual treated wastewater will be discharged at 2.5 Km upstream of the Bistriça out-fall in open sea.
As per previous chapter the residual pathogen bacteria concentration discharged in Bistriça are in a insignificant level, with an expected increasing of Fecal Coliform concentration on the Cuka fresh water less than 0.24 (MPN/100ml).
Moreover, it is necessary to consider that the related pollutant "retention time" on the fresh water of Bistriça river (before to reach the open sea) is very low (river stretch of 2500 m, and stream average velocity of 3 m/s: 2500/3=0,23 h), not reasonable enough to effect any aquifer layers.

According above, **no impact is expected** on groundwater/aquifer layers in relation with the influence of the proposed new discharge of waste-residual-water on the Cuka canal.

Well position in the Cuka Village area



7. Wastewater effect on Butrinti lake during Emergency condition

In case of CTW out-fall pumping station failure, due lack of power supply or fault of the electro-mechanical devices, the waste-residual-water will be discharged by gravity into an existing open drainage channel, via an existing hydrovore, in the Butrinti lake and then to the sea.
The existing open drain has a total length of 2.0 km, between the WWTP location and the Butrinti Lake, and has a discharge between 2.0 m^3/s and 5.0 m^3/s. By considering the above receptor flow discharge and the high dilution rate (2000÷5000 / 85 l/s = **25÷60 times**), also in this case the pollutant concentration becomes insignificant once in Butrinti lake inflow.

It's noted that the receptor channel is effective as a suspended solid trap, and therefore, a trap for sediment-bound nutrients and pesticides: nutrients that bind the suspended solids include mainly phosphorous and ammonium. According as above it's expected that along the 2.0 km drain channel a large amount of phosphorous could be deposited before to reach the Butrinti Lake and then adsorbed by biological and chemical process in the trapped materials.

According the Final Design calculation the expected surplus FC receptor concentration due to the dilution results 12,000÷5,000 MPN/100 ml. The above marginal FC concentrations become insignificant in the final receptor of Butrinti Lake, also by considering that the pathogen survival time in fresh water (20°-30°) is between 10-30 days.

Next table 6.1 and 6.2 show the bacterial analysis made on Butrinti lake water and shellfish samples.[2]

Table 6.1: Bacterial analysis of Butrinti water samples

No	Sample	Harvesting Area	Sampling on	Fecal Coli/100 ml	E.Coli/100 ml
1	Sea Water	Butrinti Lake	10.04.02	0	0
2	Sea Water	Butrinti Lake	10.04.02	9	2
3	Sea Water	Butrinti Lake	10.04.02	2	2
4	Sea Water	Butrinti Lake	10.04.02	9	4

Table 6.2: Bacterial analysis in Butrinti shellfish samples

No	Sample	Harvesting Area	Sampling on	Fecal Coli/100g	E.Coli/100g
1	Mytillis	Butrinti Lake	10 04.02	900	<200
2	Mytillis	Butrinti Lake	10 04 02	200	200
3	Mytillis	Butrinti Lake	10.04.02	900	200
4	Mytillis	Butrinti Lake	10.04.02	900	<200

By considering the dilution ratio (25÷60 times), the WWTP effluent pollutants and nutrients and Coliform contribution on the final concentration (expressed in mg/l) of the receptor becomes as shown in the following Tables 6.3 and 6.4.

Tab.6.3-Pollutants and Nutrients concentration in the receptor canal

Parameter	Receptor Flow Discharge (Min flow 2.0 m^3/s)	Receptor Flow Discharge (Max flow 5.0 m^3/s)
BOD_5 (mg/l)	1.25	0.50
Total N (as Nitrate) (mg/l)	1.43	0.57
Total P (mg/l)	0.69	0.28
SS (mg/l)	0.63	0.25

[2] Dr. Kapllan Sulaj -Department of Food Toxicology , Institute of Veterinary-Tirana Albania

Tab.6.4- Fecal Coliform Concentration in the receptor canal

Parameter	Receptor Flow Discharge (Min flow 2.0 m^3/s)	Receptor Flow Discharge (Max flow 5.0 m^3/s)
Fecal Coli (MPN/100ml) without chlorination	12,000	5,000
Fecal Coliform (MPN/100 ml) with chlorination	1.2	0.5

By assuming a main "stream" of width 100 m, length 5 km and depth 4 m (Volume = 100x5000x4 = 2,000,000 m^3) from Butrinti in-let to mussel cultivation area, the average surplus nutrients and Coliform concentration (expressed in mg/l) due to the WWTP discharge has been evaluated as shown in the following table 6.5, considering that the dilution ratio is $1/10^6$:

Tab.6.5- Maximum Nutrients and Fecal Coliform Concentration in the Mussel culture zones

Parameter	Maximum surplus concentration
BOD_5 (mg/l)	1.25×10^{-6}
Total N (as Nitrate) (mg/l)	1.43×10^{-6}
Total P (mg/l)	0.69×10^{-6}
SS (mg/l)	0.63×10^{-6}
Fecal Coliform (MPN/100 ml) without chlorination process	0.12
Fecal Coliform (MPN/100 ml) with chlorination process	1.2×10^{-6}

8. Conclusions

The above calculations doesn't reveal any negative impact or influence on the groundwater/aquifer and on any existing facilities interesting the water supply of the settlements in the both foreseen solutions analyzed.

In detail to reply to the questions arose during the Public Consultation Process:

1. *As Ksamili settlement and some other smaller settlements get water supply from the wells near Cuka canal, WB wants to know which could be the long term or any impact of the new CTW discharge at Cuka canal:* **No impact is expected.**
2. *How is the situation of groundwater/aquifer layers in relation with the influence of this new discharge to Cuka canal.* **No influence on groundwater/aquifer layers is expected.**
3. *Is it expected to have infiltration in the aquifer due to the new solution at Cuka canal?* **No infiltration in the aquifer is expected.**

Also to responds to the WB question about influence of new discharge point to Cuka Chanel on the wells in neighboring village based on above calculation and arguments the conclusion is:

- *The Saranda water supply wells are situated about 5 km north to CTW location, or 3 Km north to the CTW out-fall into Bistriça canal. The water supply wells are situated up-stream, so it is excluded any possibility for groundwater to be effected by the residual wastewater discharged into the Cuka canal.*
- *The Cuka water supply wells are located about 2 km north to the CTW location, and at 550 m up-stream from the CTW discharging point into Bistriça canal. As above, due the up-stream position of the wells, no influence on groundwater/aquifer layers is expected. In addition, it is necessary to consider that the Cuka well gravel aquifer is well protect by an impermeably clayey layer of about 25-30 m.*