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LIST OF ANNEXES

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Annex 1

(Extracts in Translation)

The Hungarian "White Book"

WHITE BOOK - CONTENTS

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Particular manuscrips of this edition contain different opinions which were not authorized with every co-author. The opinion of all co-authors is from one viewpoint coincident: administration on the G/N Project was a serious error and it is a national interest to give it over into the hands of experts.

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Introduction

The discussions on the G/N Project last already some 15 years, decisions, positions of Academy, sessions of "ad hoc commissions were taken one after another, "independent" experts and foreign "professors" explained their positions, "environmentalists" have given the tone, international counsels are preparing the case in the Hague.

The realization of the G/N Project has got into the period of power change and changed into a Trojan horse of power change and government. It confirmed its destiny. The measures against the G/N Project were based on imprudent opinions as in the past, so in present political system.

It is deplorable that no politician could be found in our country who would have expressed clearly after the power change that the utilization of artificial and without expert documents inflaming opinions against the G/N Project helped or prepared the necessary change of power and system.

The basic element determined in world on modern environment that the environment is mostly economized with such a production of electric energy which uses naturally renewable supplies and energy sources could not be used.

The political decisions - from ignorance or intended disinformation - were taken with stressing historical lies (Stalinist ideas, catastrophes etc.). The decisions were taken only after deformed and ignorant unreal arguments of "environmentalists", forgetting international development and political interests.

We know from history that every period had its small, but very loud groups representing only own interests which frightened the public with faulty "catastrophes" and obstructed development of sciences and society. Something similar was the last century fight against railway and against construction of Lánchíd (Chain bridge in Budapest). Since that time, the Danube bridges are admired by the whole Europe. Similarly, there was an opposition against the Danube regulation and Tisa-Kõrösvology which is now counted as the second gain of homeland. Regulation realized after ideas of István Szécsényi and according to designs of Pál Vásárhely, eliminated catastrophic floods on the territory of almost half of country and eliminated also swamps spreading malaria. It supported economic development of the whole land with construction of foundations in road and railway net, other constructions and foundation of base of still not existing Nagyalföld (Big Hungarian Plain) with two millions hectares of arable land of high value.

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Unreal "environmentalists" of our period attacked also this case. They stimulated statements which influenced often artful and not founded demands for environment of authorities. These authorities then pass over frontiers of capacity with such unreal demands. Such an ignorant interest is the greatest enemy of environment because it is not able to classify tasks and possibilities according to order of urgency.

Some mass media dishonoured also Hungarian water engineers. Such a hunt - to a big surprise of foreign experts - reached a level, in some press articles, something similar as the pursue of witches in the Middle-Ages was as far as ignorance and style crudity is concerned. For. ex. an article "On the bottom or through" - 7.3.1994 in Népszabadság, Varga. It is pity, but no Könyves Kálmán was found, who would have courage to say: "De strigis quae non sunt, nulla questio fiat" /On witches which don't exist, no word should be said!/.

Some facts and data:

Mass-media have almost never given possibility to real experts to say their opinion. From articles, published from 1..1992 to 7.4.1993 were only 16, i.e. 3% published from real experts or they were results of their consultations. 12 newspapers refused to publish the opening speech of the President of the Hungarian Republic at the General Assembly of the Hungarian hydrological society in 1990. Is it possible to find a country calling itself democratic to do the same?

The events which have happened in the ten years long history of the G/N Project, then statements and declarations published in mass-media have become already historical facts. This edition puts opinions against reality, it discovers further moral and expert contradictions, respectively relations of singular measures. The principle is: the participants of the discussions on the G/N Project should be judged by their activities, statements and facts. Therefore a number of Hungarian experts living in Hungary and abroad considered for important and inevitable to publish this edition because, in their opinion, it is impossible that due to one-sided information, the experts, feeling responsibility for nation and damage increasing from irresponsibility, be silent. Voltaire said: it is obligation to silence defamation. The public has a constitutional right to know the reality.

To support the project has become in Hungary the defence of penal activities. In every such case, there must be a factual evidence of penal activity (corpus delicti). In the case G/N, the only waterworks could be such an evidence. The opponents of the waterworks would like just to demolish it, i.e. they want to avoid to be detected (unveiled), because the examination of operation could confirm that the waterwork is not corpus delicti, but corpus innocentiae, even the confirmation of a good work. The supporters of the system don't fear at all reality and facts.

This edition tries to follow events, to discover motives of decisions, to submit their consequences, to look in special and scientific preparation of decisions, to look for an answer on classical question whose interest it was and whose interest it is now that we are here, that we look for a truth at the ICJ.

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The contributions in this edition are not unconditionally uniformly edited. There are some deviations in numbers with regard to utilisation of different sources, there are deviations in economic calculations, in cost estimations with regard to different price levels and methods of calculations. There are no coordinated positions in many partially questions, nor in evaluation of motives. Naturally, the style and tone of individual contributions is not coordinated, nor uniform.

The content of contributions is common in the fact that decisions taken since spring 1989 were lacking expert and scientific reasons. They qualified the problem of the G/N Project as everyday's political problem, they did not count with any consequences of decisions. Information of the public was done exclusively with voice of "environmentalists", interested in maintaining the hysteria around the G/N Project. All this has directed to the fact that the public could not know all expert and scientific positions and standpoints about the G/N Project, international practice and facts, it had not the opportunity to evaluate economic, ecologic and political consequences of decisions.

The future men taking decisions should think over the opinion of the former government plenipotentiary of the G/N Project who knows well this artificially inflamated hysteria and opinions and who stated: "the activists know well how effectively prevent something, to demolish something, but they are very dangerous in situations demanding responsible decisions" (Népszabadság 4.5.1994)

The aim of this edition is to try in the last minute to persuade the respective responsible authorities that "expert arguments" mentioned against the G/N Project are not sustainable. It is proved that there happened serious expert and ethic defects in administration of the G/n Project since May 1989. With regard to the fact that every party, old or new, stresses the importance of expertness (expertise), thus - if statements were sincere - we can hope that the expert opinion and sober reality will be applied instead of ignorance.

We know that it is not easy to step before the misled public who was informed that the G/N Project was a Stalinist gigantomania which construction was a catastrophe for environment and it was thus presented as a symbol of former political system. It is difficult for a politician to state that there were authorities in this case which took decisions and were advised by bad advisors who qualified themselves as "independent experts". Some of these scientists were involved in science far distant from the given problem.

Nor the speakers /informants of the public/ are in a good position, because they should now present and inform about such expert positions which were kept silent instead of dramatic statements about a "moon country", "supplies of drinking water for 5 millions citizens", "danger of earthquake", "compensation of water for Szigetköz" and other problems.

It should not be forgotten that time and solid science will express standpoints to our activities. History has always swept down all defamation and ignorant decisions forced out by a power authorities.

WHITE BOOK, page 1 (the end of the book)

Final ideas

The actual history of the G/N Project is the sad consequence of activities of dilettante "experts" and desk-officers. The following facts can be marginally outlined from the results.

The deliberate by-pass of real experts of this thematic group, the lack of expert competence of the most influencing persons unfavourable to the G/N Project, speakers and desk-officers. It is pity that they stood also at he head of Hungarian Academy of Sciences (honour to some exceptions). May the former President of the Academy (Szentágothay) speak instead of us:

"At the end of 1983, the Presidency of Academy in an unambiguous resolution proposed to cancel the G/N Project." Question: From where this position goes out when some years lasting research and examinations of commissions opposed this position? Answer: From opinions of those who supported the eocene programme, who argued against the project as follows: "The G/N Project is an obstacle of eocene program and contributes to disrupt a good tuned coal mine".

The then President of the Academy did not realize that the resistance against the G/N Project hide egoistic branch (eocene programme) and not at all national interests.

The target "ad hoc" commissions have arisen one after another and the whole water management branch was excluded. A quite new "scientific" notion was formed in our country, when a lawyer makes statements to the economic questions, a doctor to legal questions, a marxist sociologist or a desk-officers of foreign affairs to the technical questions, i.e. everybody makes statements to that part which does not belong to his profession.

Neither press, nor mass-media were behind this competition of mis-leading campaign. They asked everybody to express their opinion in the case of waterwork, except real experts. For ex. a wandering American chemist (Lipták) was entitled a professor,

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to put emphasis what he says against the G/N Project (he is not a professor). For follower of our well-known professor

(Mosonyi), they name the second German laboratory engineer as the professor-head of a chair who makes statements against the water work (Dr.Bernhardt) to increase significance of what he said. The mentioned doctor is neither professor, nor the head of a chair. The real is only his name! This is a press ethics of 1989!

At the same time, if someone has expressed positive statements to the project, they kept it secret that neither mistakes , nor misleading persons arise. Our well-know academician of the Academy (Dr.Vajda), the head of technical dept. told vainly in 1989 that "the actual decision on suspension...is much more motivated politically than with experts support, that "the suspension will cost much more than completion" etc. (En.pol.1989/9). Those who took decisions, were not interested in opinions of experts, scientists, power engineers, electroengineers, but only in opinions of journalists and the father of theories about paper tiger.

This method led to the fact that many persons could only hardly distinguish the aims of these groups which did not need an ecological waterwork, south motor-way, lágymány bridge, motorway MO, EXPO, entreprise to accumulator processing, burning sites of dangerous elements, i.e. those infrastructure structures which proved to be positive in the whole world.

All these elements, as well as individual decisions of persons were faulty if they thought that the consequence of their errors could be only a Hungarian internal matter. They did not take into account that their decisions had such physical-technical-economic legitimacy which were valid all around the world and these could not be subordinated to personal, nor political caprice.

At international evaluation of government activities in connection with waterwork, the international rules of science and not national, ignorant green principles will be decisive.

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It would be good not to forget it.

Those who have taken decisions in the past, did not take into account a following instruction of Arthur Hailey "High

Voltage" which concerns the ecodictatorship:

"What they cannot reach with a sober mind, arguments, they put obstacles to it by postponing and lies arousing an impression of legitimacy". "They don't bother about the facts,...they only walk their way,... and at last they destroy all of us." " The most we can do, is to inform the public,....that our interests are undermined by devious union of minorities fanatics and political climbers!"

If of all their expert promises, only a half would be realized, those who will take decisions in future, will no more entitled by the citation of A.Hailey, even if it concerns them as well.

The laws of physics will never be subordinated to everyday's politics.

Extracts:

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2.2. Ecological aspects of the G/N Project

/..../

The State council for environment and nature protection (OKTT) determined in 1982 to elaborate the study on "Impacts o of the G/n project on environment. This great work was elaborated by using documents and 96 studies of 17 institutions under coordination of Water management and design institution. Thus, the G/N project on the Danube became the first big investment in Hungary which was evaluated by the complex study on impacts on environment.

This study has been criticized positively and negatively several times since 1985. It is natural in the case of each new task. But it is unusual and unnatural that the opposers of the investment did not take into account the existence of this study. In the same manner, they ignored, in 1989, the elaborated opinion of independent experts (Environment Evaluation of the G/N River Barrage System - Bechtel Environmental, USA, San Francisco) which in detail evaluated the awaited impacts of the project on environment and it evaluated also the Hungarian study.

Naturally, with dependence of new viewpoints of national and foreign experts evaluations, it was necessary to adapt the original G/N Project. Some parts had to be reevaluated and redone, but at synthetising the results, there was no such problem which would demand the change of basic solution or its rejection. On the basis of test effects, their results and awaited impacts, the reevaluation and adaptation of the 1977 Treaty began. It happened at the beginning with the Slovaks. The characteristics of this extended and extraordinary work will be described on some examples, as well as our steps for finding a solution till the suspension of works.

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1. It is necessary to elaborate the changes for groundwater balance at Szigetköz! It is necessary to look for such solution which will not only compensate the awaited damages ensuing from

the project, but it will be oriented at amelioration of the actual situation!

The solutions of 1970 tried to compensate the awaited increase of groundwaters at the reservoir, but it considered also for acceptable consequence the decrease of groundwaters in the great part of Szigetköz. The planned measures for compensation of this situation (irrigation, common water supply, forest plantation etc.) demanded a position and thus, after a rich discussion VIZITERV elaborated in 1981 the study No. T-1-12-1 on the "Regulation of groundwaters in Szigetköz". Five variants of solution were tested and the best variant was elaborated by the Technical University in Budapest with regard to results of tests of that time and technical project was elaborated by the Directory of the North-Danube Water Management office which was best informed about this territory. We know now that later suspension of the project and construction works and also unilateral Slovak step, known as C-Variant, worsened significantly the compensation effects on the Hungarian side.

2. It is necessary to decide the proportion of peak operation on the basis of joint optimalization of hydrologic, ecologic, energy and navigation viewpoints.

On the basis of remarks and results of the Hungarian Academy of Sciences and of the State council for environment and nature protection, the Council of Ministers formulated the taks for optimalization of peak operation. First of all, we had to determine if some of mentioned opinions was not an obstacle to give up the peak operation. The study, elaborated in 1986, did not find any such factor and thus, the Economic Council took into account, with its resolution No. 10066/1986, the possibility of peak operation. The research plan of the Council for scientific politics determined for the period 1986-89 the elaboration of the complex hydrodynamic Danube model. The Budapest technical university (BME), VITUKI and VIZITERV participated in the elaboration of this model. The works were realized jointly with the Slovak partneres up to the termination of international working relations. (....)

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4. It is necessary to clear the possible consequences of the operation rules on existing waterworks and possible impact of the G/N Project on potential water bases!

It was necessary to count with impacts on quantity and quality of water at reservoir banks (equipments for water pumping). The realized hydraulic-seepage and statistical tests demonstrated that the capacity of wells can be decreased by mud sedimenting on the bottom of the reservoir, but much greater role is played by elevated water level of groundwaters on the capacity of wells.

The quality of waters near reservoirs banks could be ameliorated permanently by receding seepage of nitrates, but temporary negative impacts from flooded territory and mud sedimenting could be awaited. To avoid this situation, we planned modifications of inundation territory and we supposed to do also the maintenance dredging.

The calculations realized for wells in the section below Nagymaros supplying water to Dunakanyar and Budapest did not demonstrate any change in quantity and quality which had to arise after putting the G/N project into operation. Nevertheless we elaborated a study on enrichment of groundwaters if a negative situation had arise.

The section between new embankments around reservoirs and irrigation canals would have given an ideal possibility to localize there new waterworks constructions. The conditions of water balance on concrete sites, their state and possible impacts were examined in five studies till the suspension of all works.

According to research of VITUKI, all fears of endangering the big water supply in gravel deposits at Szigetköz, have been unjustified.

5. It is necessary to study the possible impact of dam waters on karst waters

One of the working commissions of the Hungarian Academy has pointed out the possible relation of the Danube and karst waters.

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Even if in 1990 this programme had to stopped, all data collected up to that time and knowledge prove that the planned dams should have no significant impact on karst waters or mine waters.

6. With aim to stabilize the actual situation and to reveal possible changes, it is necessary to build up a monitoring system of the G/N Project area

One important statement of the study about impacts on environment was the fact that awaited evolution of ecological impact can be only hardly evaluated. Thus the need of the monitoring system arose. It was succeeded in 1986-89 to realize this monitoring system with significant intellectual and material costs. Besides monitoring of traditional meteorological and hydrological data, the monitoring of agriculture, forestry, ecologic and seismologic impacts began, too. The data were systematically processed by computers and stored in databases up to 1991. Then the system was transferred to the supervision of respective Inspection for environment. Its character and system conditions changed basically.

(....)

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(....)

2.3.2. My relations to the G/N Project in the years 1971 - 1985

The basic condition of the development of energy system was the evaluation and comparison of existing possibilities of development and construction of energy works. One of the possibilities of energy works was to build in 840 MW capable to produce 3,6 TWh into the G/N Project. The preparatory material was elaborated in 1972.

The economic evaluation was determined substantially by investment costs for construction of an energy structure and the price of fuel, i.e. the own costs of the electric power plant for energy production. The characteristic specific costs were concluded for the realization in 1972 as follows:

- investment costs for construction of thermal power plant based on brown coal	5 600 Ft/kW
- Investment costs for nuclear power plant	9 027 Ft/kW
- Investment costs of hydroel. plant/G/N	14 800 Ft/kW
- Price of imported Soviet oil	19,8 Ft/GJ
- Price of imported oil from other countries	33,4 Ft/GJ
- Price of imported electric energy	40,9 fill/kWh

The substance of calculations is following: what ratio of investment costs for hydroelectric power plant is possible, at which the costs for one unity of produced electrical energy would not overcome the costs for the unity of electrical energy produced by other alternative electric power plant. The fact will be taken into account that no fuel is used in the hydroelectric plant.

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According to the calculations, the possible ratio of investment costs for hydroelectric power plant within the framework of the G/N Project was only 70% as compared to electric plant operating on heating oils imported from Soviet Union, 80% as compared to nuclear power plant and 90% as compared to plants with imported oils.

According to the calculations of 1972, the production of electrical energy in the G/N Water System was economically

effective neither if compared to thermal electric plant ingesting oil products from the Soviet Union, nor if compared to nuclear power plant, nor if compared to imported electrical energy. The import of oil from other countries was not necessary at that time.
The other branches of that time, for ex. navigation transport, agriculture had not at disposal any national-economical evaluating analysis of effects. The Danube Commission submitted already at that time its recommendations for reference numbers of navigation transport, agriculture could already at that time analyze the decrease of groundwaters at Szigetköz. The Czechoslovak side determined for these branches already at that time substantially higher ratios of costs. The production of electric energy was impeded with 40% proportion from investment costs and thus, they have got the technicians on the side to support the G/N Project. The Czechoslovaks have considered it as a prognosis and it was clear that they intended to develop Bratislava with regard to navigation. Nobody could understand at that time why agriculture accepted 20% of costs for the G/N Project, today it is quite clear that the Czechoslovak side wanted, with regard to the deepening of the Danube river bed, to ameliorate the water management and economy of Žitný ostrov.
The reluctant position of the technicians on energy to the G/N Project ensued also from the fact that nothing was yet invested.

2.3.3. First attemp to cancel the Treaty
Nevertheless the concluded Treaty, the former Government was forced by this big investment and successively those economic difficulties have arisen which indicated political and economic bankrupcy of the System on the so-called "socialistic" systematic field. Therefore consideration and evaluation went on and was intensified in 1980. At that time, the economics of the country was burdened by two other energy investments due to the directives of the Party which was obsessed with development. One investment was the nuclear power plant in Paks and the second was the eocenic programme.

The calculations of economic effectiveness, which were done in the years 1978 - 81, demonstrated that all investments on the G/N Project are not returnable with the only electrical energy. The possible proportion on investment costs from the point of view of effectiveness ranged between 54,2% and 90%. These admissible investment costs were dependent on the alternative solution with which it was compared, at which stage of construction were the plants and how prices of respective fuels developed on the world market.

The original data from the study of 1972 were substantially changed and measuring investment costs were as follows:

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- thermal power plant based on fossil fuel/investment costs	12 000 Ft/kW
- Investment costs for nuclear power plant	36 000 Ft/kW
- Investment costs of hydroel. plant/G/N	59 200 Ft/kW
- Price of imported Soviet oil	140 Ft/GJ
- Price of imported electric energy	52 fill/kWh

Measuring investment costs increased during 9 years 2,4 - 4 times.

The changes occured also in individual sorts of fuels. Thermal plants operating on liquid fuels were excluded from comparison. It was the consequence of oil crisis. According to calculations of 1981, the electric energy produced by the G/N Project would have covered the investment costs of the G/N Project only with 75,2% if compared with thermal plant operating with brown coal and only 61,1% if compared to the nuclear power plant.

Great investments with high measuring investment costs and long period of construction, such energy structures - and the G/N Project was one of them - are burdened with the fact that measuring investment costs are 2-3 times higher that those of fossil or nuclear electrical plants. The management considers such structure for "insupportable rubbed in chip " even if in such a case the work will be paid out after having been put into operation, but it won't serve any more the interests of those who are at power at the time of taking decision.

The energy calculations of technicians did not take, naturally, into account the effects ensuing from the complex utilization of the structure (navigation, water management, anti-flood protection). Thus the first steps of the Hungarian government for the cancellation of the Treaty began and they hoped that the problems envisaged by the environment protectors which were politically motivated, would increase in such a measure that they would become a sufficient reason for beginning the discussions. At that time, there were still no investments. Material on the construction site represented 2% of the total investment.

The government of that time lost the certitude of taking decisions. One of the reasons was also the ambiguity of the 1983 report of the Academy. This report stated that the possible damages on environment could be solved with some interventions and recommended only the postponement of the construction. The second reason was the the pressure of the Czechoslovak side for continuation of the construction. The third reason was the Austrian advantageous offer which would in Shilling finance the construction and payment had been demanded by electrical energy. This offer was advantageous for the government which had financial problems, and it was in convertible money.

Due to these facts, the Hungarian side decided to postpone and later to continue the construction. The works began in 1983. The Czechoslovak side began works with whole energy because it did not believe the intentions of the Hungarian side. The Austrians utilized their technical equipment and good experience from constructions of waterworks and they realized all their tasks in a three times shorter period than scheduled. On the

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pressure of the Austrians, we addressed the Czechoslovak side to speed up the construction.

2.3.4. Second attempt to cancel the Treaty

In 1988, new calculations on economic effectivness of the G/N Project were elaborated. The drop-out of 1,8 TWh of electrical energy from 60% completed system had to be substituted with gaz turbines. The electrical energy produced on gaz turbines was already more expensive at that time than the production of electrical energy envisaged by the G/N Project. Nor these calculations contain other effects: navigation, water management, anti-flood protection which were not yet expressed in numbers, but it was already sure that they bring effects.

With aim to stress the problems of environment, different movements have arisen and their leaders and especially speakers officiated as experts in mass-media. Their arguments, supported also by above-mentioned calculations, was first of all excess of construction. (They argued also with communist gigantomania, nevertheless this project seems to be a dwarf in comparision to similar works in the USA). They could not understand that in the meantime, during 1983 -88, came to such investment changes which smashed to pieces the arguments based on this information.

Ensuing from the given situation, in 1988, further investment for completion of the project was so unimportant that the electrical energy produced by the project could have paid back all measures and necessary investments for the protection of environment and about which the protectors could only dream.

The real reevaluation of the new situation could have led to a new position of Mr. Havel and Dubček who were against the work already at the beginning of construction. This reevaluation could not have been done by Hungarians leaders filled with incompetent advisers' opinions.

2.3.5. The actual situation

The Hungarian position to the G/N Project is a big fault. By such extensive investition, one-sided solution of opinion differences is not admissible. I sent my opinions to respective person and I expessed my positionn in an article which can be hardly published. Time has confirmed all what I have declared.

According to the report of the Accounting Court which was discussed in 1992 also in the Parliament, the works which had be to done on the G/N Project by the Hungarian side, 71% were already completed. On the Slovak side, the step Gabčíkovo is

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already operating. On the joint Project, 80% of investments were already realized. According to the Accounting Court report, the value of realized investments at the construction site is 38,4 billions Ft., 14,6 billions Ft has to be completed. This value is not greater than the costs for gaz turbines which have to substitute electrical energy from the hydroelectric power plant and which demand still costs for necessary fuel. The investement which is necessary to complete the project would be returnable only with electrical energy produced by the project.

On the basis of this report and the concept of energy politics which were approved by the Parliament, I elaborated an economic evaluation of the G/N Project with respective calculations of damages and benefits. It can be stated that if demolition instead of completion has to be done, it would cost 187-295 billions Ft more if we want to substitute all what the project had to bring.

From the viewpoint of navigation, the Danube states as Germany, Austria, former Yugoslavia, Roumania and now Slovakia have done everything what the Danube Commission awaited from them. Now, the Hungarian diplomacy would come into a difficult situation in the Danube Commission if we want to determine which ships have to be used on the international navigation route.

It is certain that the Hungarian economy needs 1,8 billions kWh which would be produced by the hydroelectric power plant without any fuel polluting environment. We are already informed about two gaz turbines in construction, the operation of which would be dependent on import of fuel. The increase of demands of energy consumption about 1% is confirmed also by the report of the Minister of Finances.

It is obviously irresponsible that some protectors of environment ignore all resolutions of the World Conference of U.N. (Brasil 1992) about the Environment and its development. This Conference discussed the development of renewable sources of energy, fight against air pollution, protection of sources and supplies of drinking water in quality and quantity. It stated that the quantity of exhalations causing "glasshouse effect is increasing therefore the change of climate of the world can be awaited. Thus, the agricultural territories would be shifted more to north and actual rich agricultural territories would be changed into desert."

Therefore one cannot understand that the actual Hungarian government which is one of the rich agricultural country, is fighting against hydroelectrical energy, is against the utilization of renewable source of energy. It protests against reservoirs which are the only way how to stock water and to use it at times of droughts (see Tiszántúl and valley of Kőrös which are examples of this fact).

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2.3.6.

2.3.6. Consequences

I formed my opiniom on the G/N Project by comparing numbers and calculations. Thus, I was against the G/N Project from 1972 to 1985 (almost 15 years) from the point of view of energetics. The data, which we had at disposal at that time showed that the construction was inadvantageous for us. Now the situation changed and the results of calculations show that it is necessary to construct the G/N Project, because the demolition of already competed works would mean the costs of 20000,-Ft for every inhabitant of Hungary, including every toddler.

The wise politicians and scientists cannot accept sentimental positions. Everything has its price. The safeguarding calculations give value also to human life. All prescriptions for planes, regulation of road traffic etc. are based on this fact. It is impossible to accept such decisions which are forced by members of some lobby groups in interest of their owm egocentricity.

I see the only way from this impasse that the government would adopt as soon as possible all those laws for environment protection which will concern everybody and every impact on environment and which will affect everybody who will pollute air, water or territory. Then the state can give concessions for navigation and water management and will utilize renewable energy favourable to environment. Those who will utilize it and who live in this area will evaluate advantages and disadvantages and not some ecodicators. The state will take only the proportion in the form of tax of produced effect from the work.

January 30, 1994 Dr. Koncz

(....)

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3. Chronology of the G/N Project

The organic part of Szechenyi concept was also the regulation and utilization of the Danube. The first ideas and plans on energy and navigation utilization of the Danube on the Hungarian section of the Danube arose still during the Austrian-Hungarian monarchy. Therefore the statement that the G/N Project should be a "Stalinist vision" is a witty malice and such statements are irresponsible.

Let's have a look on the facts. There are documents, intentions and plans from the period of Austrian-Hungarian monarchy and from the period between both world wars in 3.1. The part 3.2. refers to the most important documents since 1950 relating to decisions, investment intentions on the construction and operation of the G/N Project till the signature of the Treaty. The part 3.3. refers to datas since the beginning of the construction till nowadays.

3.1. The plans concerning utilization of water energy and water transport in the period of Austrian-Hungarian Monarchy and between two World Wars.

1887-1903 - Viczian-Ede elaborates the work on hydroenergetic potential of the country. His work was worldwide considered for a pioneer work and counted many followers. /Magyarország vízerôi, Budapest, 1905/

1911 - Buss and Schmidthauer elaborated in his work "Water works in connection with navigation and irrigation canal between Bratislava and Gyôr" a proposal for the construction of a three-step water work with utilization of the Mosoni Danube /Légrádi Budapest, 1911/.

1917 - Fischer-Reinau submit projects entitled "The Danube as a water route and as a source of energy" including section between Bratislava and Palkovičovo (Deutsche Bauzeitung, 1917)

1917 - At the conference on the Danube in Budapest, an association Rhine-Main-Danube was established. Its aim is utilization of the Danube and development of European water transport. The base of this watercourse should be the Danube.

1935 - Géza Bornemissza, Minister of Hungarian Royal Industry submits the work entitled "Energy reserves of Hungary" to the Parliament on November 14, 1935, which contains also the utilization of section between Veĺký Žitný Ostrov and Szigetköz and Nagymaros for energy purposes.

1942 - Prof.Mosoni begins to plan the first concept of the hydroelectric plant Nagymaros.

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3.2. Preparation of investment task of the system of waterworks up to signing the Treaty between Hungary and Czechoslovakia

1950 - Prof. Emil Mosoni submits at the session of the Hungarian Academy the proposal for elaboration of the projects of a joint system of waterworks on the Danube with Czechoslovakia.

1950 - At the celebration of 125 anniversary of the Hungarian Academy of Sciences, Dr. László Heller, a power engineer stressed the importance of works concerning the utilization of domestic hydroenergy potential, with regard to economize home sources of fossile fuels.

1952 - The Council of Ministers approved with its resolution the commencement of preparation works for investment construction of the Nagymaros work. Research and scientific works begin.

1954 - The Hungarian Academy organizes a public presentation of the projects to the public.

1958 - Joint Hungarian-Czechoslovak design works on the realization and evaluation of the comprehensive utilization began.

1963 - OMBF, in its report, takes standpoint to all projects elaborated up to this time

1963 - Interstate agreement between Hungary and Czechoslovákia on common elaboration of investment programme.

1964 - 68 - A joint governmental investment programme is being agreed, the research and exploration work is being done.

1968 - 69 - Examination of new alternatives, completion of joint investment programme.

1972 - Agreement on the joint actualization of the programme of investment construction and further examination in the field of engineering geology and hydrogeology.

1975 - An actualized investment program was elaborated.

1975 - 77 Governmental discussion and agreement of the joint investment programme, elaboration of interstate treaty.

1977 - The Prime Ministers of both states sign the interstate Treaty for a Joint construction of the G/N Project. The Treaty was ratified and legal validity was then published in the Hungarian Code of laws in 1978.

1978 - The Water Management Council of the Academy discussed the situation of scientific works connected with the system of waterworks, they appreciated already completed work and submitted recommendations for expansion of monitoring.

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3.3. From the beginning of construction up to nowadays.

1978 - The Czechoslovak side began construction near Gabčíkovo and the Hungarian side the work on Dunakiliti weir.

1979 - The Hungarian side begins preparatory works on the Nagymaros water work.

1981 - The Hungarian Academy sets up a council for reevaluation of the waterwork on agriculture and environment. Recommendations were included in the projects.

1981 - The Hungarian side, recalling economic difficulties, proposes modification of the construction schedule.

1982 - The Academy establishes another council for reevaluation of questions concerning the G/N Project.

1983 - The Secretariat general of the Hungarian Academy of Sciences in cooperation with operative group elaborated the document entitled "Prognosis of awaited ecological impacts of the G/N project in case of its completion."

1983 - The State Council for protection of nature and environment examines in its material of secretary general of the Academy with eventual impacts on nature if the waterwork would be realized. The Council proposes elaboration of examination on environment.

1983 - Presidency of the Hungarian Academy of Sciences elaborates an internal position to realization of the system of waterworks.

1983 - An interdisciplinary commission of the Presidency deals with the Danube. On the basis of statements of the President of Academy and President of OMFB, a joint position entitled "Perspective comprehension of the Danube utilization".

1983 - The Prime Ministers of both states agree the new schedule of the realization of investment task. The agreement is ratified by the Parliament and legal wording was published in the Code of Laws. The Hungarian side continues works on the construction site near Dunakiliti and the discussions on Austrian participation on the water work Nagymaros began.

1985 - The comprehensive study about impact of the G/N Project on environment was elaborated. The study was discussed on closed round table discussion at the presence of the President of Academy and other experts. The results of this conference were included in the projects.

1986 - A treaty is signed in May, Austria takes over the work on the Nagymaros step and at the same time an agreement is signed on the supplies of electrical energy between both states and on the construction of long-distance electrical line.

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October 1988 - The Hungarian Parliament adopts with majority of votes the decision on the realization of the G/N Project.

February 1989 - As proposed by the Hungarian side, the agreement on acceleration of works of the G/N Project is signed.

March 1989 - The Prime Minister of the Hungarian Government rejects information circulating abroad on suspension of works on the Nagymaros step

May 1989 - The Hungarian Government, a day before the term on signature, terminates the governmental agreement on protection of water quality of the Danube as well as monitoring of its quality and demands on increased protection of nature and environment.

May 1989 - The Hungarian Government adopts a new resolution on temporary suspension of the Nagymaros construction. The cause is "ecological emergency situation"

June 1989 - The Hungarian Government suspends also works at Dunakiliti weir.

October 1989 - The Hungarian Parliament adopts unilateral decision on complete termination of the construction of the Nagymaros step. At time of preparation of this resolution the Hungarian Parliament gets no information on position of experts circles on consequences of this decision.

September 1990 - The Czechoslovak Minister for Environment submits to the Hungarian Parliament the proposals of 7 variants, including the C Variant to the Hungarian side. The Hungarian Government takes no position to these proposals

November 1990 - The Hungarian and Austrian side concluded the agreement on compensation of damages caused by the suspension of works. The compensation will be 2,65 billions Shillings.

April 1991 - The Hungarian parliament adopts the resolution that the government plenipotentiary for the G/N Project discusses the cancellation of the Treaty with the Slovaks and restoration of construction site.

April 1991 - Discussions of governmental delegations in Budapest. The Hungarian side demands the cancellation of the 1977 Treaty. It would discuss no other variant. The Slovak side proposes the organizaton of bilateral discussions of real experts on this subject. No agreement was reached.

July 1991 - Negotiations of governmental delegations in Bratislava. The Slovak side proposes that with aim to guarantee the expert and objective discussion, the experts of the EC should be invited. The Hungarian side is prepared to discuss only the cancellation of the Treaty. It agreed with bilateral talks only under condition that the Slovak side stops the preparation works on the VAriant C.

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July 1991 - The Slovak side approves the construction of the G/N Project within its own borders and putting the hydroelectric power plant in Gabčíkovo into operation by relaization of the project according to "temporary" Variant C.

July 1991 - The Government of the Czech and Slovak Federal Republic approves also the construction of the G/N Project according to the Variant C.

November 1991 - The Slovak side begins the construction of the Project according to Variant C with presence of foreign suppliers.

December 1991 - Intergovernmental negotiations in Budapest finished unsuccessfully.

December 1991 - The Czechoslovak side proposes the establishment of joint expert commission and states that it would accept the decision of the commission. The Hungarian government protests against construction and does not react to the Czechoslovak proposal.

May 1992 - The Hungarian Parliament adopts the resolution to suspend unilaterally the Treaty of 1977.

October 1992 - Slovakia puts the variant C into operation.

1993 - The Hungarian and Slovak Governments address the International Court of Justice in the Hague and sign the Special Agreement.

1994 - Slovakia begins the definite completion of the Variant C. Hungary begins the demolition of the construction site in Nagymaros

(....)

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Documents and opinions on the G/N Project
Budapest 1994

(....)

In our opinion, the moral obligation of the direction of the Hungarian Academy of Sciences was at least in this period to use in the case of the G/N Project the activities of really initiative and most universal experts Commission for Water Management Sciences and those commissions which were competent for special and expert questions.

It is really deplorable that not only the highest water management authorities but also the Academy did not accept or did not sufficiently explain, mainly from the political reasons, and they even hid those recommendations before the public which were formulated by the Commission for the Water Management Sciences according their best knowledge.

Further activities of the Commission for Water Management Sciences will be discussed in Chapter 4.3.1.

4.2. Position of the Presidium of Academy in 1983

The direction of the Academy began to act only five years later, in the mid of 1982, on the demand of the Scientific and Political Commission and it asked one "operative group" to work out a position and then at the end of 1983, on the demand of the secretary of the Central Committee of the Hungarian People's Party, it demanded the Presidium to elaborate its position. (The material of the ad hoc commissions, working for the Presidium, referred to the fact that they demanded the Academy only in 1982). The final position was elaborated by one ad hoc Commission of the Presidium, but they did not ask the Commission for Water Management Sciences and other scientific commissions for help, and they totally kept secret the text of the position. The text was given to the members of the Academy and to the scientific commissions only in spring of 1989 as a part of the material "Positions of the authorities of the Hungarian Academy of Sciences" with designation "Only for official use", "Not for publication". The substance of the position would have been correct if Czechoslovakia had not been constructing intensively the Gabčíkovo part of the Project very intensively on the basis of the International Treaty since six years. The substance of the position: it demanded to accomplish research to solve unclear questions, the appropriate systems of wastewater treatement should be constructed before putting the reservoir Dunakiliti-Hrušov into operation, the potential and agriculture as well as forest management should be utilized for development, the possibilities of territorial development could be utilized for tourism. Further it is necessary to fight against the worsening of biological state of respective river sections, it is necessary to guarantee the character of living(streaming) water, to form the operational navigational way, the economic evaluation has to be done in conformity with tendencies of world economy. The government has to take into account not only foreign and internal political reasons, but also technical, economic and ecological scientific questions. On the basis of this information, the Presidium of the Hungarian Academy of Sciences considers as justified a considerable delay of investment, application of justified objective changes and especially its suspension".

4.3. Discussions in Academy in 1985

The President of the Academy T. Berend has summoned two closed round table conferences for discussing the ecologically directed proposal of Karoly Perczel and co, and ecological study of VIZITERV. A secretary of the Commission for Water Management Sciences was invited as expert to these conferences (its contribution - see the following article). This was the first (and for next four years the last one) forum on Gabčíkovo (at that period, it was still officially Gabčíkovo, not Bős) where a representative of the Commission for Water Management Sciences was invited.

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4.3.1. Ottó Haszpra: Contribution to the ecological study of impacts of the G/N Project. Orally and in written form submitted at the round table conference on 24.6.1985, chaired by the President of the Academy. (Extracts)

I. Commission of the Academy for Water Management Sciences during 10 years

It seems now that the Hungarian Academy of Sciences begins to be preoccupied with such an expanded project as the G/N Project is, which is going to have impact on the whole respective country with its operation. Its construction demands an expanded and multilateral research work almost at the last moment and it is only on the basis of an impulse of a man who is considered as a total layman. As the secretary of the Commission of the Hungarian Academy of Sciences for Water Management Sciences since 1970, I would like to summarize the facts of the last ten years related to this project.

The last wave for the construction of the G/N Project began in 1974. Our Commission for Water Management Sciences followed with great attention the respective research and two years later, in 1976, it adopted the resolution for evaluation of researches. The detailed information, elaborated on the basis of material from various institutions and reflecting the situation by the end of 1977, was discussed by the Commission on February 27, 1978. Even if I was a speaker and I was also responsible in the first years 1963-67 and l headed a lot of researches on the G/N Project and since 1975 I coordinated the research, and since 1976 also as the Deputy Director of VITUKI for science with aim to homogeneous evaluation of complex questions, I demanded two co-speakers and two experts to submit an expert reference on special subjects. The resolution of the Commission agreed with research which was already done, is being done and is planned, and it considered for necessary that "more complex research of possible ecological impact and prevention of damages of the water quality in the system and around it". The Commission demanded the dept.of Academy for technical sciences that "Aide-mémoire of the session with proposal of resolution be sent in official way to the State Water Management Office in interest to utilize it for further research."

I would like to mention in this connection that the Commission agreed with the three-dimensional research of groundwater in Szigetköz which would lead to efficient solution of groundwater regulation....

On the demand of the Director of the State Water Management Office (OVH), the Commission established still in 1978 ad hoc commission in the presence of experts for elaboration of the study "Impact of the G/N Project on Hungarian water management research and accompanying development of technical sciences." This material was presented in April 1977 by the Director of the State Water Management Office, István Gergely, at the session of the dept. for technical sciences.

With regard to importance of this question, the Commission for Water Management Sciences discussed, in April 1980, the subject "Local impact of the Dunakiliti part of the Project on groundwater"... and in conformity with report it stated that

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"with regard to constructions of ten, even hundred years life, the colmatation and process of forming demands the more precise research than in the past with considering the possible technical measures.."

In 1982, the Commission for Water Management Sciences considered it necessary to reevaluate the researches concerning the G/N Project. Therefore in December 1982, it discussed once more the research done during 1978 - 82, in addition also from that point of view if the proposals of the Commission from 1978 were included in the research. At the same session, it discussed the study of OMFB (State Commission for technical development) on complex utilization of the Danube, because the G/N Project should be considered as a part of it.

The session, with participation of external experts, stated that the proposals of the Commission had been fundamentally fulfilled and the Commission agreed with proposal of further research. The Commission stated that "it considered for necessary to complete research in some fields, but none of the problems could throw a doubt on the reasons of the G/N Project or some which would prove the reason for suspension of the construction."

Among concrete statements, "the Commission considers for necessary the explication of the problem of ice at Dunakiliti, on one hand in interest to determine the ice impact on the construction of the weir, on the other hand in interest to stop the possibility of creation of riverine ice fields. - It is necessary to clear the measure of eventual impact of chemical and biological aspects on colmatation.... - Independently from the art of divided canal, it is necessary to go on with suspended research of groundwater changes in Szigetköz, by considering the important impact of actual and planned net of internal water ways. - The Commission approves further exploration of hydrological and ecological impacts of the G/N Project and more detailed and precise elaboration of the proposals to eliminate damage, as well as for elaboration of territorial development. The economy of the G/N Project itself must be expressed in numbers, but in future, it must be considered as an organical part of the complex utilization of the Danube. It should be considered not as a case of one economic branch, or some branches, but as a part of the whole economy.

As the complex utilization of the Danube was initiated on several levels (Scientific-political commission, Secretariat General of the Hungarian Academy of Sciences, President of the Academy and the director of the State Water Management Office), it is necessary to elaborate a coordinated evaluation. And for this purpose, an interdisciplinary, scientific and internationally complex approach is needed, as well as taking into account the technical, political and economic background. It is necessary to support greater publicity to reject the repeated misleading criticism. - The materials being elaborated at this time must be submitted to the Commission."

The Commission established at the same session a sub-commission to summary expression in numbers of questions of energetic economy.

In May 1983, the Commission for Water Management Sciences discussed the II. chapter of the study of the State Commission for Technical Development - "Perspective complex utilization of the Danube."

Among the positions of the Commission, the following ones are concerned with the G/N Project:

"The systems of groundwater regulation designed with respective hydraulic and investment reserves, with possibility of flexible regulation and expansion after the first construction, will guarantee optimal conditions in concerned areas (especially in Szigetkõz), if agriculture demands it. Some corresponding exploration and research is still needed for better and more precise design of seepage net and its maintenance."

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The decrease of amplitude of the Gabčíkovo peak waves by dividing canal is effective especially for navigation. It is necessary to study also further impacts (situation of wastewaters in Gyõr, groundwater level in Szigetkõz etc.)".

"Parameters (width, depth) of the abandoned river bed of the Danube will be almost unchanged (or relatively little changed), if the permanent water discharge from planned 50...200 m3/s would be increased on 500 m3/s, the impact on the groundwater would be of no importance..."

"Gabčíkovo and Nagymaros are related in an organic way. The peak operation in Gabčíkovo is not possible without Nagymaros. Even Nagymaros itself is very important, no other projects (flood protection, transport) could be realized without this hydroelectric power plant, therefore it is necessary to be constructed."

"The planned location of the waterwork Nagymaros is optimal... If it had been located higher, the rocky alluvium would form an obstacle for ship transport due to the river bed lowering and water level decrease in lower section, respectively it would have been necessary to remove a big quantity of rocks."

"The dimensions of navigation locks in Nagymaros should be diminished. Thus, the ships coming in, difficult due to the river bench, would be ameliorated. Neither in Nagymaros, nor in Gabčíkovo, the navigation lock wider than 24 metres is needed... Even navigation locks constructed up to this time on the Austrian section of the Danube are only 24 m wide."

"Unsystematic dredging of the river bed at the place of future canal in Nagymaros has reached already such a state that due to the waterwork in Nagymaros, only corrections with positive impact can take place. Finally, after regulation dredging, the clearer water coming from upside can only ameliorate the state of water basis in Budapest. Naturally, embankment wells, galleries and their completion will be further needed as it was up to now. If the waterwork Adony or another one will be constructed, then it will be necessary to examine its impact, but its impact would be independent of Nagymaros."

"Nevertheless the utilization of the Danube will be, waters of collection area must be biologically treated. The treatment must be solved still before putting the reservoir Dunakiliti-Hrušov into operation."

Some shorter statements:

"As far as water quality is concerned, as technical solutions are demanded, the Commission for Water Management Sciences is most competent."

"Long-distance transport should not be led through Nagymaros, because it disturbs the recreational area."

"Desulphurization of the hydroelectric power plants which is absolutely necessary, will increase the relative economy of the utilization of water energy ."

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"Different branches should be prepared for use of advantages ensuing from the complex utilization, they should be prepared to eliminate the negative points (development of navigation, adaptation of structure and organization of agriculture, wastewater treatment etc...")

"The water quality is not a biological question, but it is a biological-technical question."

It may be stated from the abovementionned that the Hungarian

Academy of Sciences - at least through mediation of the Commission for Water Management Sciences - has regularly since 1976 discussed, from the own initiative, the complex problems concerning the G/N Project. In submitting problems, criticisms and proposals, it discussed very concretely all those substantial questions which were raised by private comments or commissions of the Academy established in last years (as for ex. Interdisciplinary commission for solution of problems).

It is especially pity that the activities of the Commission and - during 35 years also the whole G/N Project - were not given a wide publicity and due to it outer - and in my opinion well-minded, but not sufficiently well-founded - criticisms caused wider tumult than it reserved, even that it came to such sharp criticism.

It is also deplorable that the Commission of the President of Academy has never, since its establishment, consulted the Commission for Water Management Sciences, and thus it had to walk alone on the same difficult road on which has been walking seven years before the Commission for Water Management Sciences.

I think that in the period of information boom it should be a warning example which problems can be caused not only by the lack of information, but its explicit concealment, or on the other hand not to get acquainted with information and the consequences of such a step can come over in certain question on national and foreign policy.

(It is interesting that the Commission for Water Management Sciences has never been officially informed about the establishment of commissions of the President of Academy. This interesting matter only completes that State Water Management Office (OVH) who was the organizer of interdepartmental commission, also completely forgot, as the Academy, the Commission for water management sciences.)

Therefore I recommend that the questions on the G/N Project would be met openly, I recommend to publish scientific and publicity statements which reflect and explain the reality, I recommend an appropriate information of experts and laymen, inhabitants interested in the question.

I demand that the Commission of Academy for the G/N Project asks the Commission of water management sciences to nominate its representative into the Preparatory Commission. The Commission of water management sciences will participate with pleasure in preparatory works of the Academy Commission and with its 10 years long experience and good experiences of cooperators will be useful for the Preparatory Commission.

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II. Standpoint to the Report elaborated by Károly Perczel and com. and to their proposal "Real adaptation of the Contractual G/N Project"
(Extracts)

(This contribution was presented by Otto Haszpra at the round table conference organized four days later).

It is pity that some text formulations are often confusing, critical statmenets and proposals are proclamatory, they don't contain arguments, therefore it is difficult to understand it and to react on it. I would like to mention only comments to those parts with which I have a personal experience.

Comments to the "Report".

The G/N Project is a complex system, therefore it is serving several aims. It means that it will solve the problem of ship transport (navigation) without regard to the fact if someone considers it as the main or secondary aim.

If we are already discussing the order of importance, the last decade demonstrated clearly that the importance of energy and reproduction of energetical supplies was quickly growing. Therefore the G/N Project is more and more needed from the viewpoint of energy. It is understandable that the realization of it cannot be accompanied by vast ecological and hydrological damages, it should rather be advantageous also from this viewpoint. The planning/designing pays a lot of attention to these problems in last months - and it is supported mainly by research.

Comments to the "Proposal"

p.1 - Wastewater must be - even according to the Project - led into the Danube after they have been treated. Peak operation is, in my opinion, favourable, because it causes a more intensive water flow than the regular operation....

p.4 - To demanded depth necessary for ship transport, the respective water level and **not** the discharge is necessary.

p.6-7 - The possibility of groundwater rehabilitation, even its regulation on the Hungarian side - especially in Szigetkőz - was confirmed by detailed three-dimensional researches. (Now they are being made precise). It is not possible in the section of some hundred meters in the inundation area of the Danube, research of other possibilities of water compensation is being done.

In the opinion and after exploration of many experts, the water regime of agricultural layer of the disputable territory does not need the direct contact with groundwater. The seepage canals can serve, therefore, as simple irrigation canals. The eventual change of forest in the considered area and in limited extent is not a cause and reason for substantial change of the actual G/N Project. The solid environmental protection demands a solid nature, but not absolutely that one which arose after river regulation in the last century. The situation was before also natural and solid, but quite other.

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p.8 - The old river bed can be washed any time when it will be necessary.

p.8-9 - As it is not the mining water extraction, the total amount of water layer of Szigetkőz and Žitný ostrov is not interesting. The regular water draining from this layer will be replaced by water seeping from the Danube (water reservoir) and from the system of seepage canals - in possible expansions.

p.10 - The reservoir Hrušov-Dunakiliti will not be a reservoir with stagnant water, not even in such a case if water would not be discharged through the hydroelectric power plant, because completion is accompanied with longitudinal flow as it is by continuous operation. The peak operation causes 5-6 times greater velocity, as opposite to continuous operation, at times of low water levels and this flow washes away all suspended load which would only float at continuous operation....

p.20 - Even water with low quantity of suspended load cannot take more suspended load than a natural water, because later, it cannot form greater sandbanks than natural water. Sandbanks don't endanger the G/N Project.

p.22 - In my opinion, the Nagymaros part of the Project will not disturb the aesthetics of the country, I think it will ameliorate it. It is uncomprehending why six different water levels (even if they would exist as small lakes) should disturb the aesthetics of the country. In my opinion, a series of mountain ponds with different water levels can be beautiful if surroundings are not neglected.

p. 26 - Recalling Belgrade (p.16), it concerns only the water level decrease in wells caused by Iron Gate, and not the deterioration of water quality. This manifestation, "so-called ageing process of wells" has been known already many years in our country and it is a growing problem even if the G/N Project would have never existed. During my visit in Rhine region last year, I was informed that the alluvial material thrown in the river bed is determined to increase the lowering water level **not** with aim to stop the groundwater water level decrease, but to guarantee the ship navigation over the sill of lower water of navigation locks.

x x x

Basically, I agree with the Evaluation of the director of OVH (State Water Management Office) and the statement of gov. plenipotentiary, as well as with opinions (VIZITERV, OVIBER, VITUKI), which I got later additionally.

I agree also with p.1 of "Introduction into the discussion" of János Szabó.

Basically, I agree also with putting the G/N Project into operation after the problem of wastewater treatment would be solved. It would be better to determine that with construction of the G/N Project, the wastewater treatment should be totally solved. In my opinion - it is not totally expert opinion - the peak operation rather ameliorates the water quality than it deteriorates it.

The prolongation of construction would lower the investment concentration on one hand, but the absolute volume - as it is at every investment - would be higher. An intensive planning, designing and research has been performed since 35 years, what is already a great shame.

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But it must be respected that water management - not at all or in a small part due to own guilt - provided almost no open information, during those 35 years, to the public and thus, instead of regular utilization, respectively rejection of small external criticism, it meets, in last moment, amateur and passionate criticism. It may be said in favour of these amateur criticisms that a needed special and expert attention is paid, in last years, to the demands of environment protection, which were not systematically respected in the past

Thus as the Commission for Water Management Sciences stated already in 1983 that further research is needed, the research is really necessary, but it is not an obstacle to realize the Project according to the original plan. It is also my opinion.

III. Standpoint to the study of VIZITERV "Study of ecological impacts of the G/N Project and summary to this study

I can express only those comments which are based on my experience.

Summary.

p.1 - As I mentioned in detail form already in I. part, the Academy of Sciences began to be preoccupied with scientific research of the G/N Project not only in 1981, but within the activities of the Commission for Water Management Sciences already in 1976 and it submitted in 1978 the same what was submitted in 1981-82 by the commissions of the President.

p.2 - Interdepartmental commission has never asked the Commission for Water Management Sciences for cooperation, although this commission was regularly informed about this question. An accidental invitation of some members of the Commission is not the same as the representation of the Commission...

p. 8-11 - Statements on water quality is, in my opinion, sufficient with a remark that the wastewater treatment is not only appropriate, but it is necessary to solve it along with the G/N Project. This is strictly related to big sources of pollution. Canalization and wastewater treatment of smaller villages can be solved later.

p. 14-15 - I agree basically with dilution of Győr wastewaters during the peak operation and their washing away into the next peak operation center, but I don't see any guarantees that in time of water level decrease, the suspended load would not sink and set on banks. Therefore from this viewpoint, the biological wastewater treatment is necessary....

On Study of ecological impacts

p.34 - If we take for basis average values, the discharge of Dunakiliti seepage canal does not reach 45-50m3/s, not even 40m3/s even in such a case if seepage with elevated level is used. But if the real average seepage factor will significantly deviate from the basic data, the seepage discharge may be

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significantly higher or lower. Therefore it is quite right that the seepage system is designed with such a high adaptability.

I propose to build in the Dunakiliti weir an electroblock with capacity 50m3/s as it was mentioned in the first projects. It would be indeed necessary to discharge only 20-25m3/s at the beginning with regard to the seepage and with aim that also in the upper section of the old river bed would be 50m3/s guaranteed, but later, the discharge should be higher because it stays unused from the viewpoint of energy due to colmatation of the river bed over the waterwork.

p.35 - I cannot understand fears from washing of the old river bed with surface water.

p.42 - Oil catching above the Dunakiliti weir is, due to the low velocity, possible with permanent floating walls.

p.63 - I am not informed that we would have at our disposal the results of finished or sufficient research to stop the riverine ice fields in winter time from the Dunakiliti reservoir. If not, the research must be done, because sliding of both ice fields to the middle can shut the free passage and thus ice can form an ice barrier causing a flood.

p.65 - In the list of literature the basic study of VITUKI of 1980 is missing (Exploration of efficiency of seepage canal of the Dunakiliti/Hrušov reservoir), which solved the groundwater regulation in Szigetköz, even if other seven studies connected to this one are mentioned on p.66.

To "Introduction into the discussion of Academician János Szabó

p.2 - I don't consider for founded to omit the peak operation, neither from the water quality, nor from the energy production. Wastewater treatment of Győr waters is necessary, independently from the fact if the peak operation will be or will not be realized. And it is not clear why one GWH of energy during regular operation should need more oil than its production with peak operation.

I don't see a reason to guarantee the permanent ship navigation on the old river bed. If needed, with opening of weir, it is possible to fill the old river bed up to navigation depth...

p.5 - I am personally very glad that the groundwater problem in Szigetköz, which some years ago provoked major reservation, and agricultural situation is considered in the Introduction for corresponding one.

It would be good if we could boast with only one fragment of wastewater treatment on the right side of the Danube as it is with water on the left side of the river. But we must first construct something before we demand more from our neighbour on the left side.

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p. 6 - To reservations against the change of water quality from the hydraulic viewpoint, I would like to mention only that the water in Dunakiliti reservoir will stay there max. some days and therefore it cannot be considered as stagnant water. Regardless of it, there are significantly higher velocities at the peak operation than it is by regular operation.

p.7 - It is possible that energy production of the G/N System in peak operation will represent only 1,2% in the year 2000, but it will guarantee 7% of peak operation what is not unimportant.

p.9 - If some weeks or some months waiting of ships is not considered as damage, then the ship transport will really gain nothing with the G/N System. But I really doubt that it is true.

Debiting the anti-flood budget with costs of anti-flood constructions is quite right.

The result of concealing the information is the fact that the groundwater problem arises once more in 1981, even if a solution existed already in 1980.

I agree with other parts of Introduction or for some of them I am not competent.

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4.3.2. Position of the Academy in the year 1985

The ad hoc commission of the Hungarian Academy of Sciences elaborated a standpoint from both round-table conferences which were sent by the President of the Academy together with Aide-mémoires from conferences to the Secretary of the Hungarian People's Party. It confirmed the position of the Academy of 1983, but it stated also that diametrically opposite opinions existed in many questions. Necessary research is mentioned in detail, but there is no information that some questions (for. ex. if the peak operation is admissible or not, or - horribile dictu - in which measure and under which conditions it is admissible) could be cleared in natural way and unambiguously on the basis how nature reacts. In connection with Perczel's proposal they state, that "an open clash of opinions is considered as useful, even if lacks are being found in the report." It is pity that after this wise statement, further secretiveness went on.

4.4. Positions of the Academy in 1989

The government - under pressure of some not yet distinct environment protectionists and their leaders - has asked the Academy for its position to support their decision taken from the innerpolitical reasons to suspend the construction of Nagymaros with the authority of the Academy. The direction of Academy has agreed at last not to construct the Nagymaros part of the Project - without regard to the fact that it was a part of International Treaty.

As nobody with normal mind could suppose at that time that it would be possible to stop the construction of Gabčíkovo-Dunakiliti, which was already by 90% completed at that time, some objective statements entered into discussion in connection with this construction. Among working groups of the ad hoc commission, preparing the position of the Academy, the group of water ecology (even if the water management construction was not represented) stated basically that in case if Nagymaros would not be constructed, the operation of the complex Gabčíkovo-Dunakiliti would be acceptable without peak operation. Some statements follow:

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"....Even if the final report of the UNDP/WHO/OVH "Model regions of regulation of water quality in Hungary" named in detail the possible and most substantial problems of water quality in connection with the G/N Project construction, no complex exploration of these problems has been realized up to these days which could serve as a basis for taking decisions.

...But the non-realization of the Nagymaros part without peak operation leads to quite another situation than the original one had to be. In case of such a decision, the very detailed and complex revision would be necessary which would reveal all connections and it would last some years.

....

The working group of ground ecology of ad hoc commission - also without water management construction - examines in its detailed report the consequences of the G/N Project realization in the whole extent, then in connection with the realization of the Project without Nagymaros - considering the construction of Gabčíkovo-Dunakiliti for obvious and also in connection with Nagymaros, it considers for appropriate only moratorium and not the suspension or demolition - and ends with two following paragraphs (which are also a criticism of the own ecology prognosis):

"If the G/N Project would be realized only partially (without Nagymaros part), without peak operation, then the secondary negative ecology impacts would be eliminated not only around Nagymaros, but they will be lowered also in upper section. But even at moment, the regulation system of groundwaters would be useful, as well as the construction of structures to prevent the deterioration of groundwater quality. This is not an alternative of effectiveness, but the basic ecologic supposition to put the G/N Project into operation.

To reliable prognosis of the above-mentioned ecologic impacts of the G/N Project, the results of monitoring during the period of 3-5 years after putting the Gabčíkovo part into operation are needed. It is absolutely necessary to construct and to operate the complex monitoring which should be more extensive than that of nowadays. But it will be possible in such a case that moratorium on Nagymaros could be guaranteed for that period.

Budapest, 15.6.1989"

The position submitted on June 20, on the plenary session of ad hoc commission, contains the verbatim report of the above-mentioned statements.

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It is necessary to state that the President of the Academy Iván T.Berend in its TV interview in which he supported the moratorium on Nagymaros - not to endanger his reputation of an economists - answered that with regard to the fact that the work Gabčíkovo-Kiliti was almost completed, its suspension cannot be discussed.

Another opinion of the president of another Academy should be mentioned in this place. It was heard on the Vienna Congress ICOLD (International commission of big weirs). The opening speech - it was published also in written form - was lectured by the President of the Austrian Academy of Sciences, the professor Otto Hittmair. This lecture was concerned in a very complex way with a balanced interaction between the utilization of water energy and environment, between man and nature. Some ideas: The utilization of water energy is clean and ecologically advantageous production of energy in comparison to multilateral, global and local impact of thermal power plants on environment and health. The correct ecological impact should serve to vital relation between environment and economy. The ecological dogmatism, the deny of all changes, damages this vital balance. The real aim of this ideological dogmatism is to awake prejudices and obstacles against every rational planning, to render impossible the development of fulfilment of human requirements, even in areas of hunger - activities against establishment of water reservoirs - also minimally fulfilment of living needs. This is in contradiction to human solidarity etc. (Perhaps, Otto Hittmair defended with these ideas its reputation of natural scientist).

In front of the building, some young men distributed leaflets of some fabricated organization ICALD (International cooperation against big weirs) and spread a linen, which - as a ideal way of life - represented a South-American Indian fishing fishes in primeval forest with title "Let rivers flow." Even the reporter of the Hungarian TV, sent for the Hungarian money, supported the small number of that non-Hungarian organization distributing leaflets, but he was not interested in the opening speech and speech of the President of Austrian Academy. (Later, Hungarian TV broadcast nothing about the Congress of ICOLD with 2000 participants, but there was a detailed report on the meeting of "ICALD" with 10 participants.

4.5.1990 Letters to the new government

Even if the mass-media fought against the G/N Project, it was possible to hope for a new, objective examination of that question on the basis of sober expression of the minister for environment of the new government in an interview.

The President of the Commission for water management sciences who was at the same time the head of national institution of highest degree for training of water construction, the former Institute of water management and water construction at the Technical University, wrote the letters, in the case of the G/N Project, of the same wording to the Prime Minister, Minister for Environment and Minister of Transport, as well as to the President of Academy. He states at the beginning: "After fall of political storm, it is now time to set up, if it is possible, a good and founded decision on the G/N Project which will take into account the present and future interests of the country." Further - on the basis of discussion in the Commission for water management sciences - he summarized the history of the

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question and demonstrated that the last ad hoc commission of the Academy had avoided in substantial questions (for ex. if Nagymaros had to be constructed or not) the decisions and left it to the President of the Academy. The President of the Academy and his close circle - under influence of members of Presidency who were not enough qualified but formed the expert opinion with regard to political situation - took position that the Nagymaros could not be constructed and so it came out to public and parliament as the expert-scientific position on the Academy. The government, referring to this fact, suspended temporarily the construction at Nagymaros, later on the whole G/N Project and promised that it would order research - especially to make prognosis of possible ecological impacts and then it would decide on the basis of these examinations about the future destiny of the whole Project.

Further he writes:

"...now, it is no more question of beginning and expansion of research necessary for the project, but much more the determination of operation possibilities - in case of Dunakiliti and Gabčíkovo of almost completed structures. Taking into account especially high degree of uncertainty of ecological prognoses and high degree of responsibility of research workers in the case that they would recommend putting the work into operation after five considered years of research and then a year later, a catastrophic ecological situation of water quality would eventually arise, thus the psychological base of objective prognosis is very week. In my opinion, much better and more economic and only reliable solution is an immediate test operation of the complex Dunakiliti-Gabčíkovo and evaluation of really existing situation, because in this case, the research workers are not overburdened with psychological load, but they can measure and evaluate only the real state and they can determine and declare with responsibility if the operation can go on....

...If the test operation of the part Dunakiliti-Gabčíkovo will be determined to be advantageous, respectively it would be positive with acceptable height of costs, then it would be possible to construct and put into operation also the Nagymaros. (Majority of experts confirms that the main cause of eventual unfavourable ecological impacts would be the water reservoir Dunakiliti, the impact of Nagymaros would be smaller).... The working area thus should be dismantled, respectively the original river bed should be restored only in such a case if the testing operation Dunakiliti-Gabčíkovo would prove that the operation of the system would be irreversible damaging."

Then, he pointed out on 70-ties years of swollen branch of the Danube in Ráckev. In comparison to this branch, the conditions of operation of the Dunakiliti reservoir would be more favourable. Then he pointed out at environment protectors, at political interactions, at mass-media and consequences of it:

"In my opinion, the well-minded protectors - along internal remarks of water management experts - raised justified or unjustified, but at any case legitimate questions... These questions were classified by the political opposition of that time - without appropriate expert control - into the arsenal of means of political fight for human and collective rights, for raising democracy (this process is not yet finished). It can be understood, that after taking over the power, it is difficult to give up "expert" and political position supported during many years without threatening its confidence and therefore the old

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and new political and expert representatives fear to come back to such projects which are connected with the former regime. It must be acknowledged (and it should be explained to the public) that putting the G/N project into operation or its suspension is not a political and ideological question, but a very practical, pragmatic, technical, economic question which has to be and should be solved in favour of country, with the least possible burden of tax-payers, with most useful utilization of the system and with the least damage to environment. And it is not impossible, if before beginning the construction, the most favourable was to back to the original situation, now due to considerable state of construction, the most favourable state would be the test operation of the system."

"....The mass-media gave room only for attacks (without controlling if they are founded), while the experts opinions supporting even in small measure the G/N Project were not published. Not to speak about the anti-democratic character of this method, the result of which was not only the unilateral influence of public opinion against the G/N Project, but as well discredit of the water management profession itself which stops the growth of experts. (The typical example is that TV reporting Delta broadcast in these days a half-an-hour programme how the "experts" elaborated in "Wallingford laboratory" the protection of dying banks of England not in discrepancy with natural laws, but with their utilization. But they did not mention that "the experts" were hydrotechnicians and there is a laboratory of water constructions in Wallingford")

He ends his letter:

"... I wrote these lines on the basis of discussion which took place during the session of the Commission for water management sciences on 14.6.1990 and on the basis of the Commission's agreement. It could be still a lot written in connection with water management and ecological tasks affecting all areas of life (to mention only an unfavourable state of waste waters and wastes in the country) which demand a principal change of aspect and measures (even money!). But now the G/N Project represents a crisis. The right solution would stabilize the position of water management and environment protection of the country and would avoid further extreme and unconsidered steps.

Dear Mr.President! Dear ministers!

There were statements from the highest places, even from the Minister for Environment (actually the most competent and temporary government plenipotentiary) which demonstrate in the questions of the G/N Project a deliberate and unprejudiced intention for reevaluation of the situation. I hope that I succeed with this letter to strengthen and realize these intentions.

I can assure you in the name of the Commission for water management sciences as well as in my name, at the same time as representatives of several institutions, that we are going to develop activities for the benefit of the country in the sphere of water management and protection of environment. We will be at disposal to the Government and Academy collectively, individually as the members of commissions established in future."

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The President of the Commission for water management sent on June 22, 1990 another letter to the same addresses in which he submitted a concrete proposal of the text of government declaration:

"The Government considers that decision of the former government for correct which states that the definitive destiny of the System of the G/N Project can be decided only on the bàsis of further examinations and research. It states at the same time that still no decision was adopted as far as the beginning of this research is concerned. It is therefore necessary that in connection with this research, with utilization of proposals of respective institutions and protection and other special organizations and after hearing well-known foreign experts, a special government commission, in which the best representatives of technical and natural sciences - including ecology should participate, should adopt the decision.

The research should be aimed at terrain measurements, theoretical studies, laboratory and other tests. Due to uncertain prognosis, especially in the sphere of ecology, to the fact that a part of the System is almost completed and therefore after minimum of work, it is suitable for test operation, it is possible to verify all original and really recommended conditions on the System itself, i.e. in the undoubtful way. During test operation, detailed research of ecological factors, especially in connection with water quality of the reservoir Dunakiliti, in the Gabčíkovo operation canal and in the Danube in the section under Dunakiliti, with operation influenced by the groundwater, with impact on regulation and appropriation system of groundwaters, with development of groundwater level and quality, with reaction of flora and fauna in the area of reservoir, respectively with moving of flora and fauna into the similar inundation territory which will not be flooded, with changes of climate of wider environs. Along to this research, those examinations will be continued or will be finished (for ex. seismologic prognosis), which can be done independently from the test operation. The Hungarian and Czechoslovak side will realize research on their territories, respectively, with participation of experts of other side and they let independent foreign and national expert and social protection organizations to look in the research results and to express their judgment.

As all experts agreed that conservation, respectively amelioration of the water quality of the Danube would be necessary also in such a case if the System of the G/N would not be put into operation, and the Hungarian and Czechoslovak side would conclude such an agreement on necessary construction, respectively spreading of wastewater treatment systems which would contain also the guarantee of construction and effective operation of necessary structures. This agreement must be open, prepared to include results from ongoing research.

The mentioned measures serve practically and exclusively to the protection of environment, for conservation of natural values and these having not only local, but also global importance and impact, the Hungarian government will address the European Communities, the governments of the U.S.A. and other developed countries which react on ecological questions that they cover costs according to their possibilities and declared intentions."

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The President of the Commission for water management sciences in his third letter of July 11, 1990, which he sent also, besides to the above-mentioned addressees, to the Minister without Portfolio charged with administration of affairs concerning the G/N System, and as consequence of worsening of economic situation, he analyses the consequences of the suspension of the G/N Project in 5 points:

1. As consequence of definitive suspension, the compensation will be higher than the costs for completion. If the sum for completion represents in reality 57 billions, then the sum for definitive suspension will be 70 billions.

2. The modernization and maintenance of navigation route on the Danube without the G/N Project gulps down permanently billions and at the end, it will be necessary to construct any system of waterworks.

3. The only way how to avoid the Slovak right for compensation is a common decision based on real knowledge from

the joint test operation.

4. The Austrians will not give up, from mere sentiment, their right for compensation of 3 billions ATS which legally belongs to them for construction of Nagymaros working area.

5. Germany obviously counted with the System G/N already under construction, when it definitively decided to complete the System Main-Rhine-Danube. Therefore Hungary cannot break its contract obligation without having results from test operation.

6. We quote word-for-word this conclusive point:

"The Hungarian government has to decide today. Either:

a. without responsible scientific research (the most competent and convincing evidence of which is the test operation), it rejects further construction and operation of the G/N System and then, the country will be burdened with non-realized benefit, the obligation of unconditioned payment of compensation, as well as the end of our reputation of a responsible partner (what will influence on our future also from other viewpoint), or

b. will perform necessary scientific research and on the basis of the only competent and convincing method, which is test operation, - and nevertheless the results of this test operation are - it will lead the country out of this case without moral detriment. If namely the definitive decision would be to complete the construction, then we don't need to pay compensation to the Slovaks, even the Austrians can accept that the construction was only suspended and it could be agreed that for postponement, neither the Austrian side nor the Slovak side would demand compensation and the effects of the functioning system would be successively realized. And if the decision supported by the scientific research would be the definitive termination, the obligations toward Austria and Slovakia would be admittedly actual, the benefit would lost, but our moral image, even commercial (and political) will be untouched, our moral capital will be undisturbed.

(At this point I must refer to the mass-media information which referring to the government circles, has reservation against limitation of supplies of Soviet oil - these are caused

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by very bad economic situation - insisting that international treaties cannot be unilaterally cancelled. Naturally, it is not possible. But how it is possible to nullify the Hungarian-Czechoslovak treaty or Hungarian-Austrian treaty and not to do any step for really scientific and only justified evidence of "ecologically emergency situation"...)"

The letter ends as follows:

"It cannot be said either from the above-mentioned and from my former letters, or from my activities that I fanatically support the G/N Project. Mentioning my opinions and proposals and taking into account the actual situation, I would like to contribute to such a solution which would minimize ecological, economic, (national and international) political and ethic damages and which would not fend off benefit - through construction of navigation route of European level, the production of energy not polluting environment etc. To the benefit of the country and the nation.

One note to my first letter (page 21) - on ruining a good name of the profession of water construction. According to my last information which was listened at the session of our faculty, only three of new listeners of construction engineering have expressed their will to continue the studies in the field of water construction."

The mentioned three letters were answered by two - not factual answers. The President of the Hungarian Academy of Sciences Domokos Kosáry wrote on July 17,1990:

"I have got your letters of June 20, 22 and July 11. I would like to inform you that the Hungarian Academy of Sciences intends to study the G/N Project only on the demand of the government. If demanded, your proposals will be handed over to those members who will be participate in research."

The Minister for Environment answered on July 26, 1990:

"I thank you for your valuable information and proposals concerning the G/N Project with intention to help us.

Dear Mr.Professor, you are surely informed that Mr. György Kiss Sámsondi was nominated as government plenipotentiary for the

Danube system of waterworks.

As the government plenipotentiary, respectively his secretariat is responsible for all operative activities, I sent them the copies of your letters."

4.6. Activity of the commission of experts of government plenipotentiary

In the meantime, the function period of the President Otto Haszpra was over, he wrote to the government plenipotentiary on January 28, 1991 as a private person. We quote:

"....Even in the past, the probability grew and as consequence of the last decision of the Slovak government, it became almost sure that the Slovak side would construct on the Slovak section of the Danube, approximately near Čunovo, that dam

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or underwater weir which would divert the Danube waters on the Slovak inundation territory and there - damming the left-side of the river bed - a reservoir of 45 km2 would arise which would supply the Gabčíkovo part of the Project. The system will guarantee the diversion of navigation route into the operational canal and the operation of the Gabčíkovo hydroelectric power plant would be according to the original plans...."

"...because in this case, the Hungarian side would not get any electrical energy, the Slovak side would get 1,5 - 2 multiple more energy than it would have got in the case of originally planned system. The possibility of utilization and interest in the Slovak reservoir of 45 km2 extent is practically the same than it was planned originally for the common Hungarian-Slovak reservoir of 60km2, but the benefit will go only to the Slovak side..."

"....from the viewpoint of groundwaters of Szigetköz - especially as consequence of the lack of an agreement - damaging consequences may be supposed which could be removed only with high costs.

According to the original projects, it would be possible to regulate the groundwaters of Szigetköz with such a system of seepage canals which would be supplied by the seepage canal on the Hungarian side of the reservoir Dunakiliti-Hrušov and intake structure at Dunakiliti."

"....Restauration, respectively regulation of the groundwater level would demand, as consequence of mentioned increase of endangered territory - according to my estimation (estimation took into account 50 m3/s as basis for supposed discharge of the old Danube) - circa one and half multiple of seepage as compared to the original project and gravitation possibility of this (i.e. that the water "alone" would flow into the seepage system) becomes totally extinct on the Hungarian territory. Then to restore the groundwater level on the territory between the Danube and Rábca, there are only two possibilities:

1. To construct on the right side of the Danube section of the Slovak territory straightaway over the weir a gravitational intake structure of minimally 100 m3/s output with a canal leading to the Hungarian territory (The Slovaks had realized it in smaller measure with aim to supply water into the Mosoni Danube) there with a system of sedimentation reservoirs with ability to clean the whole amount of water into a limpid state and to expand seepage canals there where some were already constructed or planned.

The capacity 100m3/s provides solution only on the Hungarian protected side of the Danube anti-flood dam. If the aim is to preserve woods, respectively natural environment of the Hungarian inundation territory, the capacity of the system should increase over 200 m3/s.

2. The solution, realized fully on the Hungarian side, would be the construction of a pumping station near Rajka with capacity ca 100, respectively more than 200 m3/s (with demanded output ca 15, resp. 30 mW) with above-mentioned sedimentation reservoirs with a seepage system. I note with regard to the costs of operation of the system that it must be in operation not only in vegetation period, but also during majority part of winter period due to ecological reasons.

It is evident that both "solutions" are from the economic point of view a big debit for the country and from the political point of view it is humiliating for the Hungarian side.

As it is highly probable that the ecological conditions of the Slovak reservoir are acceptable, respectively they can become acceptable, the scientific humiliation is possible in the same measure. (I can remember statements of some hydrobiologists that the putting the waterwork Kiskôr into operation according to the "I.stage" will cause that the water of Szolnok will become undrinkable. They insist nowadays on the preservation of the I.stage.)

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...The chief political leaders and statesmen sit in their owm traps because without scientific support, they believed in a conclusion ensuing from a disputable truth and they engaged themselves for it.

The construction of the G/N Project reached a certain stage, when in the ratio 1:1 a test control of the most ecologically critical part of the System (Gabčíkovo-Dunakiliti) would have been possible also without any wrong conclusions and with relatively low costs (damming of the Danube). Those who sit in their own trap are threatened unfortunately with a total fiasco with international publicity because the unilateral operation of the Gabčíkovo system could show to be highly probably as successful. It could be moderated only if we contribute to the test operation. But if influencing politics and influencing science cannot see this fact then we must address the highest forum, i.e. the sane mind.

I wish you, dear government plenipotentiary, that you are successful in your responsible activities for the benefits of our country. I hope, and I believe that a repeated study of my letters will help you in these activities."

The government plenipotentiary has answered after two months as follows:

Dear Professor!

Thank you four your letter of January 28, 1991, as well as for previous letters written with effort to help us. I must inform you that your repeated proposal for test operation is in contradiction with the Programme of national revival, therefore we could not accept it. All other your statements will be discussed once more within the framework of research of impacts with aim to prepare the decision.

The statements you mention in your last letter in connection with Czechoslovak temporary solution will be taken into account by preparing the planned meeting on government level and I hope to cooperate with you in future.

Budapest, 20.3.1991

Dr. György Kiss Sámsondi

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The government plenipotentiary hold his promise and demanded Otto Haszpra in March 1991 to participate in the work of the commission of experts organized by AGROBER. Its task was to evaluate in numbers the impact of different new variants of the G/n Project. Otto Haszpra added a text of 12 pages to tables because "as consequence of notions which can be explained in different ways, the numbers in tables alone provide no effective information....The substance is therefore formed by the text." He writes for example on energy: "The energy produced by the G/N System is a clean energy, the hydroelectric power plant pollutes neither air nor water in contradiction to thermal power plants. We'll produce the electric energy for the Austrians in polluting thermal power plants to the detriment of own health and health of our children." His summarized opinion was as follows: "The only rational solution is Variant A-2 (only Gabčíkovo). The test operation Gabčíkovo-Dunakiliti would not further culminate the Slovak-Hungarian relations and it would lead with highest probability not to an ecologically damaging and for economy loosing solution, but to an useful one. The test operation Gabčíkovo-Dunakiliti would not mean unilateral scientific, moral and political humiliation for either of both sides and in case of unfavourable results, both sides could conclude an agreement on suspension of the Project. In favourable case, the Nagymaros part of the project could be constructed with a respective scientific support. At any case. the science would win in both cases.

Budapest, 5.4.1991"

But after sending written positions, the evaluation activity was "suspended" immediately. Telex of 9.4.1991:

"The government plenipotentiary for the Danube waterwork suspended all works connected with research of impacts of the G/N system. The tasks will be made precise only after discussions on the governmental level which will take place on April 22. I ask you therefore to suspend all activities you perform on the basis of your appointment.

Ferenc Fehér, engineer, AGROBER"

But no tasks were sent after this telex.

4.7. Position of one ad hoc commission of the Academy and its response

Going back to the Academy, the new ad hoc commission began to be concerned with the question of the G/N Project. But no representative of the Commission for water management sciences was included in this commission, nevertheless it was before promised by the president of the Academy Iván T.Berend.

As it became clear later, this ad hoc commission was concerned exclusively with listing arguments against the G/N Project. It was done totally secretly and therefore nobody could discuss these arguments, neither the public, nor the external experts until the magazine Élet és Tudomány (ET - Life and Science) surprisingly published then on 20.9.1991 under title "Position".

The whole text of the position of ad hoc commission is to be found in chapter 4.7.2. with experts report and evaluation of the Commission for water management sciences.

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4.7.1. One characteristic discussion in mass-media.

Otto Haszpra reacted immediately as private person on the mentioned position. ET - after edition - published it at the beginning of November in its 44 number (in column "Dear ET"). The reaction of the ad hoc commission was published in the 46. number of November 15 and it became clear from it that the president of this ad hoc commission was Gábor Vida. The answer was no more published by ET, but we quote all three articles and the reader can do a conclusion himself.

ÉT, 1.11.1991 (44.number)

"Dear ÉT!

It seems that the Position of the ad hoc commission of the Academy to ecological risks of the Gabčíkovo waterwork, which was published in 38. number of your magazine, was not submitted to respective expert criticism.

Already the first principle of the Position is wrong: the dynamic balance of the Danube and neighbouring water systems was not altered during tens of thousands of years, but it changed substantially in the past and this centuries due to regulation of the river, flood-protection and regulation of surface waters. At Szigetköz and Žitný ostrov - even according to the map published in ÉT on page 1198 - the floods flooded territory of 5000 km2 for many weeks and months 200 years ago (sometimes it happened more times in a year). It happens nowadays only rarely on smaller territories and for short period (For comparison, I note that the Dunakiliti reservoir would flood 60 km2 of the former inundation area!). As cause of the said human activities, the whole biosphere of the region has changed if we consider "half-wild" nature or its new culture which is able to support and preserve inhabitants.

Other three "principles" of the Position analyses the following: research must be done carefully (2), the lack of knowledge limits exact conclusions (3), models of short period span can lead to wrong conclusions (4).

The lack of knowledge follows from the lack of necessary wisdom. We can deduce well-founded conclusions for the conditions of the mid-Danube from data and facts which were collected during several generations. It is generally known that the swelling structure of... Tas controls water on a wide area of Ráckevei (Soroksári) branch of the Danube and 70-years results of observations and monitoring of ecological and hydrological impacts of this swelling are at disposal. In the swelling part of this Danube branch, on the area of 12 km2, self-purification capability has arisen which has mastered industrial, agricultural and other pollution, which is irresponsibly high and which must be lowered at any case. In the lower section of the most swelling section, tourists can find every year a refreshing area and water

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of good quality. Six smaller sections of this Danube branch were already declared for protected natural areas. The process of declaration of other areas for protected is being in progress, because the new and preserved botanical, zoological, hydrological values during the last 70-years demand a legal protection.

We can consider the Soroksár Danube branch for "half-operational test". Many conditions in the Dunakiliti reservoir are more favourable and therefore we can await there still better conditions that in the Danube branch.

The swollen area Gabčíkovo-Dunakiliti and its surrounding would show surely good hydrological and ecological results during some years long operation. A part of the region could be declared for internationally protected area. Along to this and other positive sides (for ex. hydroelectric power plant is not damaging health), it cannot be understood why "restoration" of the area is demanded which would cost some billions.

Even if I mentioned every "principle" and shortly commented the positive impact of swelling, the extent of letter does not allow a detailed criticism.

Dr.Otto Haszpra

ÉT 15.11.1991 (46 No.)

"Dear ÉT!

Otto Haszpra wanted in his contribution (ÉT, No.44) to substitute "respective expert criticism" of the Position (ÉT, No.38), because according to his opinion, it lacked up to now. He satisfied himself with rebuting principles, because thus, he puts doubt on the whole Position. I would like to refer to "respective expert criticism" of Otto Hászpra.

According to Position "Actual dynamic balance of the Danube and neighbouring water systems has arisen after the last ice period. It was not substantially altered in the last 10.000 years". Really, today - as it was during last 10.000 years - the river at Szigetköz flows over the cone of own sedimentations; it retains water supplies, conserves quantity and quality of drinking water. The regulation has admittedly changed the original state of the river during last 100 years, but the statement of the author of criticism that "the biosphere of the whole region has changed" is not substantiated, and it is not precise. Not precise, because he thinks on biotope or on local fauna and flora instead of biosphere (Only Earth has biosphere, no narrow region can have it). Not substantiated, because by lack of research material, no summary opinion can be formed on this question.

The author qualifies further three "principles" and criticises their authors "for lack of necessary wisdom". Without

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regard to the criticism, I want to state that Otto Haszpra does not want to remember (or he does not remember) at that ad hoc commission of the Academy which, in June 1989, elaborated the position to the G/N System for the government. We both were members of that commission, and now principles, which are put into doubt, are word for work citation of principles of that commission. (Besides principles, I think it is important to say that estimation of ecological impacts is possible only with general (respective knowledge) and local (research) experience. It is nonsense to discuss ecological questions if common language and minimum experience in this area of extraordinary complicated science is lacking.)

Otto Haszpra has got wrong conclusions at "mentioning positive impacts of backwater" and as model, he mentioned the situation of Soroksár branch of the Danube. Even the Soroksár branch of the Danube demonstrates in a best way which unfavourable impacts of backwater area can be on the supplies of drinking water which can be reached with bank filtration. There are many wells in both sections of island banks of Szentendre and Csepel along big branch of the Danube. On Soroksár branch of the Danube, a short section at Szigetszentmiklósi was tried to be utilized. Swamp decomposing due to lack of oxygen, sedimenting in backwater area has such consequence that wells fight from the beginning "with chronic problems of quantity and quality of water!" The content of manganese and ammonia cations increase in them, expensive technical interventions are needed for their decrease. A supplementary amelioration of groundwater is for ex. necessary.

At this side of the Csepel island, it was given up to utilize the territory for further collection of water due to bad experience at Szigetszentmiklosi. At supposed impacts of Dunakiliti backwater - from the viewpoint of not yet explored organical and anorganical toxic elements - the Soroksár branch of the Danube is just a model region.

Going back to the first principle, what substantial interventions into the Danube are meant really, nevertheless the interventions of the last 100 years were, on the whole section of the Danube in Hungary the possibility of erection of bank wells was preserved - with exception of Soroksar branch, because backwater, as "substantial" intervention" has eliminated this possibility.

Academician Gabor Vida, president of ad hoc commission of Hungarian Academy of Sciences for coordination of research of joint Hungarian-Slovak section of the Danube"

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Script for ÉT (not published):

"Dear ÉT!

Gábor Vida, answering my letter (No.44) in No.46 to the Position of ad hoc commission, has not deduced meritory conclusions in connection with remarks to the first principle.

The first principle anticipates as if it could have been possible to restore the situation 10.000 years ago by dismantling the Dunakiliti and Gabčíkovo ferroconcrete structures, by suspending their equipments, by carrying away earthworks in the area of operational canal of 20 km2 and filling the river bed, i.e. further damaging of already regenerating nature, further planting. Practically it would mean restoration of the situation 15 years ago, but even this restoration would cost both countries some tens of billions of forints and crowns. (Costs for restoration of Nagymaros of circa 1 km2, not demanding dismantling of ferroconcrete structures, are supposed about 4-5 billions of forints). The state, as it was 10.000 years ago (even only 200 years ago) - which according to the Position was not altered - could have been reached only by dismantling and eliminating all antiflood dykes, the structures of river regulation, systems for diverting surface waters and thus to reach regular flooding of inundation territory of Szigetkôz and Žitný ostrov, permanent change of river beds and islands, serious damages on civil buildings, industrial and agricultural structures, equipments, products and in transport, domestication of already forgotten malaria and the result would be a substantial worsening of living conditions for inhabitants of that region (i.e. not totally damned living beings of the biosphere). This would be, even mildly expressed, a substantial change, if the national press calls the Gabčíkovo part of the Project affecting only some percentage of the 5000 km2 territory (and which would let the Danube flow over "its own cone of sediments" and would conserve also water supplies for drinking water) as ecological catastrophe, even if "reliable prognosis" is lacking (see later) for this small section, even for water quality.

I don't know till today the final text of the position of ad hoc commission of 1989, but I agree that many ideas of the 1991 Position were discussed also in 1989. But the substance of my criticised letter is already some years lasting - and self-financing - test operation of the Gabčíkovo part of the Project and just this was recommended by that 6-member ecological working group, the member of which was also Gabor Vida. They stated in the last conclusive paragraph of their position of 15.6.1989, submitted to ad hoc commission: "For reliable prognosis of above-mentioned ecological impacts of the G/N Project, the monitoring results of 3-5 years after putting Gabčíkovo part into operation are necessary" (Proposal of position of ad hoc commission has taken over word for work this phrare of Vida's working group. (See also 4.4). I agree naturally with that rational Vida's opinion.

I considered the Soroksár branch of the Danube in my letter as half-operational test. Gabor Vida's information agrees with this statement that "model region of supposed impacts of the Dunakiliti backwater .... is just the Soroksár branch of the

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Danube." Naturally, the positive and negative impacts should be studied without prejudice.

Therefore I would like to note - I hope uselessly - that Szentmiklós wells are to be found in the upper, very polluted and devastated, less swollen section of the Danube (widths to 100m, depths circa 2 m), 7 km higher from the place where the swollen area of 12 km2 (widths 200-550 m, depths 3-8m) which I am mentioning, begins containing circa 92% of the total water volume of this Danube branch. I mention also that even if water soaking the sediments could have reached wells, situated 500 m from bank, in first months, the water quality began to deteriorate only after some years operation when recreational riverine establishments were not canalized and thus caused soaking of commune wastewaters into soil between the Danube branch and wells. At that time, water works were obliged to begin swelling of groundwaters with water of the Danube branch and on the basis of positive results, the expansion is being planned. (All this does not mean naturally that sediments did not play a role in deterioration of water quality, "local experience" of manganese increase in individual wells of not backwater area is also worth mentioning).

The exploration which can be realized in this Danube branch, could contribute to prognosis of Dunakiliti, even if it is truth that the totally reliable results can be awaited only from exploration 1:1 in Dunakiliti.

Swamp was drained only in some local cases during 70 years in the Soroksár branch of the Danube. Such lack of preservation (maintenance) can be admitted neither her, nor in Dunakiliti. Only untouched virgin forest regenerates itself, the functional forest must be maintained. The same is valid for water reservoir. The Commission of the Academy for water management sciences has been urging since 1976 from own initiative not only exploration in connection with the G/N Project, but also to plan limitation of damages. The last mentioned can be solved only in such a case if hydrologists and ecologists will work together and they will have a scientific dialogue without prejudice, because only a free, open a direct exchange of opinions is appropriate for total revealing of truth and a way to form basis for decisions in benefit of the country.

Otto Haszpra"

It is still worth mentioning that on the basis of oral demand, Professor Gábor Karádi, chief of a Faculty of Milwaukee University - Wisconsin reacted also on the Position of ad hoc commission, but his letter was never published, nor any explanation was given. We cite from another letter of Gábor Karadi in another place, here we quote only the final paragraph:

"I don't doubt any minute the well-mind of ad hoc commission of the Academy. But no information substitutes any well-mind."

(...) .

Annex 2

(Translation)

The State Planning office
No. 001 263/55

TOP SECRET
Copy No.30

To the Politburo
of the Central Committee of the Communist Party of Czechoslovakia

Ref. : The report and proposals for solution of disputed questions between the Czechoslovak and Hungarian side concerning the construction of the Project of Water works on the Danube with regard to the negotiations in the Central Committee of the Communist party of the Soviet Union.

<u>Report of comrade Vošahlík on the discussions at the Central Committee of the Soviet Communist Party concerning the water works on the Danube</u>

On October 25, comrade Malenkov invited me and received me in the presence of comrade Koval, his vice deputy Pavlenkov and another representative of the Ministry of power stations of the Soviet Union and informed me:

He studied in detail the Czechoslovak project of the construction of water works on the Czechoslovak section of the Danube and the Central Committee of the Soviet Communist party discussed this problem as well. He stressed that the construction of water works on the Danube was not only a technical issue, but it was mainly a political issue, because it concerned the neighbouring Hungary and other Danubian countries and because it was connected with the navigation on the Danube. He stressed that the Soviet side was of the opinion that Czechoslovakia had first to seek an agreement about the construction of water works on the Danube with Hungary through bilateral negotiations. These discussions should be held on a high political level. After achieving an agreement with Hungary, the question should be submitted to other Danubian states. It should be considered how to initiate these discussions further in the Danube Commission. He explained that the question of the construction of waterworks on the Czechoslovak section of the Danube had to be solved within a comprehensive solution of utilization of the Danube for energy purposes. He mentioned in this connection the difficulties which had the Soviet side at constructing water works on the Siberian rivers, in particular on the river Angara, just for the reason that the problem of the utilization of the river for energy purposes was not solved complexly. In this stage of preparation of the project, the Soviet side is not in a position to formulate his advisory opinion, what does not mean the rejection. It is important to set up a precise proceeding of solution of problems in this moment. He stressed at the end that the Danube countries would have certainly eminent interest in the solution of the Danube utilization and that Czechoslovakia, which disposes of experts and specialized organizations, could have a leading role. The Soviet Union would gladly participate in discussions and its experts and social organizations would contribute to the construction of water works. He mentioned also that there were voices to be heard on Hungarian side that the Danube water work should to be constructed on the Hungarian territory regardless to the fact that this solution would be much more expensive that the project on the Czechoslovak territory. In conclusion comrade Malenkov stated that from the technical and expert point of view, the solution of the Danube water work elaborated by our side was very good. Comrade Koval reiterated that it was important to start first bilateral talks between Czechoslovakia and Hungary and only after achieving an agreement, the (Soviet) Office for economic relations with popular democratic countries could be involved.

Annex 3

CZECH NOTE VERBALE OF MARCH 3, 1993

(Translation)

The Ministry of Foreign Affairs of the Czech Republic presents its compliments to the Ministry of Foreign Affairs of the Slovak Republic and has the honour to inform that on February 23, 1993, the Parliament of Deputies of the Czech Republic has approved that the Czech Republic would not succeed to the Treaty between the Czechoslovak Socialist Republic and the Hungarian People's Republic concerning the construction and operation of the Water System of Locks Gabčíkovo-Nagymaros of 16.9.1977 and all related documents.

The Czech Republic will not apply for any property claims related to the common investment ensuing from the Treaty and thus all assets and liabilities concerning the realization of obligations according to the Treaty relate thus to the Slovak Republic.

The Ministry of Foreign Affairs of the Czech Republic avails itself of this opportunity to renew to the Ministry of Foreign Affairs of the Slovak Republic the assurance of its highest consideration.

Prague, March 3, 1993

The Ministry of
Foreign Affairs
of the Slovak Republic
B r a t i s l a v a

Annex 4

(Extracts in translation)

<u>Magyar Hírlap</u>, 14 February 1989

<u>Magyar Nemzet</u>, 22 March 1989

<u>Vasárnapi Hírek</u>, 26 March 1989

(Translation)

Magyar Hírlap, 14. 02.1989
Vice-Prime-Minister Hrivnák on Gabčíkovo-Nagymaros

Czechoslovakia will gain energy in addition by acceleration of construction of hydroelectric power plant

(MTI) - On the basis of an agreement with Hungary, Czechoslovakia will gain energy in addition by acceleration of construction of hydroelectric power plant and the air pollution will decrease at the same time. This has been stressed by the first Czechoslovak Vice-Prime-Minister Pavel Hrivnák in his interview for Rudé právo.

In his yesterday's interview Hrivnák said that the water work Gabčíkovo-Nagymaros would gain in Gabčíkovo 800 000 kWh and in Nagymaros 1 500 000 kWh electrical energy in addition. He referred to the fact that if this quantity of electrical energy would not be produced by thermal power plant, the air pollution would be decreased in Czechoslovakia with sulphur by 23 000 tonnes. He recalled that in connection with acceleration of construction, electrical structures in Gabčíkovo would be operating every three months as opposed to originally planned five months and in Nagymaros once in two months.

The Vice-Prime-Minister stressed that the water work had an immense international importance because it has improved navigation conditions on the worst section of the Danube. After finishing the Rhine-Main-Danube canal in 1992, this improvement will bring advantages not only for Czechoslovakia, Hungary and the Danube countries, but also for further countries. Hrivnák noted also that no investments were needed for accelerated construction of the work.

(Translation)

Magyar Nemzet, 22.3.1989

Acceleration of the construction is considered by Prague as extraordinary important - stressed the Czechoslovak Minister of Foreign Affairs

MTI - Praha: The Czechoslovak foreign policy results from the realities of international relations and in spite of some negative phenomena, it endeavours a creative dialogue with countries of the world - declared the Czechoslovak Minister of Foreign Affairs, Jaromír Johanes in his parliamentary speech.

The chief of the Prague diplomacy stressed in his speech especially the process of disarmament.

The Czechoslovak Minister of Foreign Affairs was concerned in detail with the results of successive Vienna meeting and concerning the final document he stressed that Prague would wish a cooperation with West-European countries in the field of economy, science and technics. In connection with human rights. Minister Johanes said that the countries which have signed this document, should lead a serious and objective dialogue on these issues. They should stop groundless accusations and interference into internal issues. The Czechoslovak Minister of Foreign Affairs formulated his position that obligations following from the Helsinki process were valid in the same measure for East as well as for West. The western partners should take it into account. (....)

Johanes informed that strengthening of relations with socialist countries, especially with Soviet Union. had a key importance for Czechoslovak foreign policy.

He said that relations between Czechoslovakia and Hungary are developing intensively. Prague considers the agreement, according to which the construction of the G/N Project would accelerated and the term shortened by 15 months, for very important.

(....)

(Translation)

Vasárnapi Hírek, 26.3.1989

Information is true, but quite opposite

A position was adopted in Nagymaros with interest of accelerated and immediate realization of investments.

We brought an information in the last number of our journal on the session of the municipal council of the Hungarian socialist People's Party in Vác. The report stated that the representative of the parent organization of the Party proposed to organize activity for suspension of the G/N Project.

In compliance with a well-known wit we could now say that the information is true, but quite opposite. But let's put wits aside. We must inform our readers that the secretary of the parent organization of the Party in Nagymaros called on for organization of activity against the suspension of the G/N Project.

How could be published a contradictory, in this case misleading information? The fault had not happened in our office, but the reporter of the Hungarian press office brought a wrong interpreted material. Naturally, we had not checked it also for the reason that we trusted the Hungarian press office for its work which is characterized by exactness and credibility.

Further, we comply with justice and demand of the municipal council of the Hungarian socialist People's party in Vác and we inform about the speech of incriminated speaker, the secretary of the Party in Nagymaros, Tibor Ádám. In conformity with the resolution of the session of the parent organization on 13. March, the secretary has informed that a contradictory situation has been formed concerning the construction of the water step. The Vice-Minister Péter Medgyessy signed in February of this year with his Czechoslovak colleague an agreement, according to which the first machines of the Gabčíkovo water work would be put into operation without any changes on June 1, 1990 and further seven aggregates after three months and not after five months as it was planned. It means by 14 months earlier. But on the session of the Parliament on 9. March, the Prime Minister Miklós Németh, reacting to the interpellations of the deputies, took a compromising position. In his opinion, the government does not reject new discussions on the construction, moreover, it is prepared to examine the possibility of plebiscite. It means that up to that time, such works could be only completed, which would not cause irreversible changes.

"We don't understand - says the secretary of the Party - how it is possible that within a month, the government concludes an agreement with his partner about acceleration of the construction on one hand and on the other hand, it accepts and obligation on suspension of the construction."

Thus, Tibor Ádám informed about the resolution of the partner organization of the Party in Nagymaros, according to it "they will inform the Government that they will initiate the state campaign for supporting the completion of investments of the water step. They reserve the right for utilization of such manners and means which they consider for important. This right has never been rejected even by the opponent of the water work.

Annex 5

(Translation)

THE GOVERNMENT OF THE SLOVAK SOCIALIST REPUBLIC

No.: 323/1976

R E S O L U T I O N

of the Government of the Slovak Socialist Republic

of February 4, 1976, Number 36

concerning the implementation of the resolution of the Government of ČSSR No.12/1976 on signing of the Treaty between ČSSR and the Hungarian People's Republic on the construction and operation of the G/N Project.

The G o v e r n m e n t

A. t a k e s n o t e

of the resolution of the Government of ČSSR No.12/1976 on signing of the Treaty between ČSSR and the Hungarian People's Republic on the construction and operation of the G/N Project,

B. r e q u e s t s

the Minister for Forest and Water Management

1. to submit to the Government, in cooperation with the Minister of Foreign Affairs of ČSSR, the Treaty between ČSSR and the Hungarian People's Republic on the construction and operation of the G/N Project, after its signature, with proposal of measures for its implementation,

2. to prepare and submit to the Government the draft principles of the Statute of the Czechoslovak government plenipotentiary in the system of political-economic management of ČSSR, by June 30, 1976,

3. to submit to the Government the draft principles of the Agreement on the Joint Statute regulating the activities of the Government plenipotentiaries according to the art. 3, para 4 of the Treaty mentioned under 1), by October 31, 1976.

To be executed by: the Minister for Forest and Water Management.

Annex 6

(Translation)

THE GOVERNMENT OF THE SLOVAK SOCIALIST REPUBLIC

No.: 2712/1977

R E S O L U T I O N

of the Government of the Slovak Socialist Republic
of October 26, 1977, Number 362

concerning the proposal for approval of the Treaty between ČSSR and the Hungarian People's Republic on the construction and operation of the G/N Project

The G o v e r n m e n t

A. t a k e s n o t e

of the report of the Minister for Forest and Water Management on the signature of the Treaty between the Czechoslovak Socialist Republic and the Hungarian People's Republic on construction and operation of the G/N Project,

B. r e q u e s t s

the Vice-President of the Government J.Hanus, Vice-President of the Government and Chairman of the Slovak Planning Commission, Minister of Construction and Technology, Minister for Forest and Water Management, Minister of the Interior, Minister of Finances, Minister of Agriculture and Alimentation, Minister of Commerce, Minister of Culture, the President of the Slovak Academy of Sciences, the Director of the Slovak Geological Office, the President of the Slovak Office of Geodesy and Cartography, the Chairman of West-Slovakia National Committee and the Mayor of Bratislava,

to assure the implementation of tasks, within their competence, following from the Treaty between Czechoslovak Socialist Republic and the Hungarian People's Republic on construction and operation of the G/N Project,

C. e n t i t l e s
the Prime Minister

1. to submit the Treaty between Czechoslovak Socialist Republic and the Hungarian People's Republic on construction and operation of the G/N Project to the Slovak National Council,
2. to submit, together with the Minister of Foreign Affairs of ČSSR, the said Treaty to the Government of the ČSSR for approval.

To be executed by:

the Vice-President of the Government J.Hanus, Vice-President of the Government and Chairman of the Slovak Planning Commission, Minister of Construction and Technology, Minister for Forest and Water Management, Minister of the Interior, Minister of Finances, Minister of Agriculture and Alimentation, Minister of Commerce, Minister of Culture, the President of the Slovak Academy of Sciences, the Director of the Slovak Geological Office, the President of the Slovak Office of Geodesy and Cartography, the Chairman of West-Slovakia National Committee and the Mayor of Bratislava.

Annex 7

(Translation)

SLOVAK NATIONAL COUNCIL

Number: 2251/1977

35

R E S O L U T I O N
OF THE SLOVAK NATIONAL COUNCIL
of 19th December 1977

concerning the Treaty between ČSSR and the Hungarian People's Republic on the construction and operation of the G/N Project signed in Budapest on 16th September 1977, submitted to the Slovak National Council by the proposal of the Government

The S l o v a k N a t i o n a l C o u n c i l

A. s t a t e s

that the Treaty between ČSSR and the Hungarian People's Republic on the construction and operation of the G/N Project signed in Budapest on 16th September 1977 comprehensively regulates the issues concerning the construction and operation of water works on the Danube and represents an important and multilateral contribution to the economy of both socialist countries.

The Project on the Danube, in compliance with the Directive of the 15th session of the Communist Party of Czechoslovakia for economic and social development of ČSSR in the years 1976-1980 and with basic objectives, will significantly contribute to further economic development of the Slovak socialist Republic as well as to unified Czechoslovak economy and growth of its effectiveness. The comprehensive multiple solution will guarantee utilization of energetical reserves, flood protection of South Slovakia, solid conditions for further development of adjacent territory, especially agriculture and development of international navigation,

B. a p p r e c i a t e s

international and national importance of the Project on the Danube, fully supports the signature of the Treaty which is a demonstration of efforts of intense involvement of the Czechoslovak economy into international division of work according to the Comprehensive program of the Socialist economic integration of the COMECON member states.

President of the SNC

Annex 8

Speech delivered to the Hungarian Parliament on 6 October 1988 by Mr. Gyula Horn

National Assembly!
Please excuse me if I trouble your attention. But more principal international reservations of political orientation occurred which affected our foreign relations and international activities and I would like to speak about it.

At the beginning, allow me some words on one specific factor. Many have already mentioned that political elements concerning the G/N almost predominated. Please allow me to say something in this connection. On August 3 with a letter of 14 issues, we expressed our position to the proposal of the Ministry for Environment and Water management which was discussed before by the Government. In this letter, we examined all issues and questions, which were partly incorporated into the proposal, and partly were discussed within preliminary work of the Government. For example, the question of frontiers, respectively question of frontier modification, preservation of navigation on the Danube, necessary water quantity of the old Danube etc.

We spoke also about the fact that we demanded still much more data about impact of total construction costs etc. I would like to stress that the Ministry of Foreign Affairs did all that in the spirit which has been characteristic for the new style of the Government that we examined principally all issues of such a high importance.

I don't know how could it happen that our proposal has been for some weeks in the programme of the radio Free Europe and the BBC where parts of the letter were read. It was later the subject of the Danube Circle, respectively the subject of the groups of environment protectors. I am not satisfied with this. But I think that there is no Government, nor the Ministry where interior activities would not take place , some sort of harmonization and they give their position only after they formulate it. It did not happen and I would like to add that after it, nobody has asked what destiny happened to our proposals and remark.

In the same manner, the letter of the Ministry for Environment and Water Management of August 26 has never been published, in which the Ministry reacts on our remarks. I consider it for important because I am an engaged follower of openness and publicity, but I think, that principal demands for ethics and correctness must be held in maximum measure in the same manner as in other fields of politics. That is all around the discussions to this issue.

The next issue. I appreciate the effort of the Academy and its position to this issue. Dear Zoltán Király, there is no mention in this position that the Government alters the text of the Treaty, but there is a mention to suspend it, to postpone it etc.

In this connection, I would like to stress the following issue. With regard to the position of the Academy, many are of the opinion that a lot is possible or is needed to be eliminated with suspension of such a treaty, but there is one fundamental argument which can be claimed and according to which the reason of suspension may be the fact that the circumstances have principally changed.

What's the problem? The problem is that from the viewpoint of international law, it is possible principally in two cases:
First. Those basic conditions which served as a principal foundation for the Treaty signature, have changed.
Second. If the proportion of obligations which have still to be fulfilled, principally changes.

But the Hungarian side cannot present these obligations in connection with the Treaty. But what we consider for substantial is the fact that basic conditions did not change, but only examination, evaluation of one side concerning the conditions. Because it does not need to influence or disturb another side from the standpoint of international politics and much more from legal position. And this is very important position because the other side must not take into account if our position changed.

Thus, it may happen by right in such a case if we suspend the construction, the other side will blame us for breaking the Treaty. Wide consequences exist which substance may be formulated in such a way that the break of the treaty may put doubt on the credibility of the Hungarian Government and I would still add that from the viewpoint of foreign policy, it would importantly weaken international legal situation of the country. We are committed with serious international interests to their compliance.

I would like to note that our experts examined the records of the last 40 years from this position if such an important international bilateral or multilateral treaty has ever been suspended in this way. We have found no such example in the history of the last 40 years.

What follows from it? If we do it, the Hungarian People's Republic would form such a precedence in international relations that its damaging consequences could be extremely great/big.

And as far as bilateral consequences are concerned. They may be two. Don't think only on the fact that in connection with already invested means, the Austrians and mainly the Czechoslovaks may demand compensation, but at the same time, they may demand from the Hungarian state all estimated compensation concerning lost gain. And this amount may be some billions. It would mean a big load.

Thus summarizing - I would like to stress once more that from the international political viewpoint that these relations are concerned two neighbouring countries with which we have excellent contacts. It must be taken into account by taking decisions.

Please, accept the information of the Government. Thank you.

Annex 9

List of recently completed sewage treatment plants on the Slovak side of the joint Slovak-Hungarian Danube section (including tributaries of the Danube)

Part A: Construction being begun in 1986:

1.	VK Bratislava - left bank	finished	04/95
2.	Chem.industry Bratislava (now Istrochem)	"	1987
3.	VK Dunajská Streda	"	1993
4.	Sugar house Dunajská Streda	"	1993
5.	VK Považská Bystrica	"	1989
6.	VK Liptovský Mikuláš	"	1989
7.	VK Prievidza	"	1992
8.	Koželužne Bošany	"	1991
9.	Kovosmalt Filakovo	"	1990
10.	Velký Krtíš	"	1990

Part B: Constructions being begun between 1986 - 90

1.	VK Bratislava-Petržalka	finished	12/93
2.	VK šamorin	"	1994
3.	VK Sered	"	1994
4.	VK Žilina	"	1992
5.	Slovakofarma Hlohovec	"	1992
6.	Sugar house Trnava	"	1993
7.	VK Banská Bystrica	"	1993
8.	VK Levice	"	1992
9.	Petrochema Dubová	"	1991

There were some other wastewater treatment plants finished and put into operation in the years 1989 - 1994.

The Danube:

1. Hamuliakovo-Kalinkovo (also for villages Rovinka and Dunajská Lužná) (microbiological treatment plant)
2. Velký Meder
3. Šenkvice
4. Limbach
5. Kafiléria Senec
6. Dolný Štál
7. Zlaté Klasy
8. VK Kolárovo

The river Hron :

1. Brezno - Pálenica
2. Brezno - city
3. Zvolen
4. Kremnica - Horná Ves
5. Nová Baňa
6. Hriňová
7. žarnovica
8. Dolná Lehota

The river Váh:

1. VK Demänovská Dolina
2. VK Liptovská Teplá
3. Celpap Ružomberok
4. VK Trstená-Tvrdošín, Nižná
5. Dolný Kubín
6. OFZ, Široká
7. VK Dolný Kubín
8. VK Sučany
9. VK Martin-Vrútky
10. VK Turček
11. VK Turèianske Teplice
12. Tepláreň Martin
13. Sučany
14. Chemicelulóza Žilina
15. ZVL Diamon Rajec
16. VK Rajec
17. VK Bytča
18. Slovamyl, a.s. Boleráz
19. VK Lehota pod Vtáč
20. Plastika Nitra
21. Sugar House Šurany

The river Ipel :

1. Velký
2. Krupina, 2 pcs
3. Málinec
4. Lovinobaňa
5. Dudince, 2 pcs
6. Mines Štiavnice, 2 pcs
7. Pôtor
8. Ipelské Predmestie
9. Slovenské Ďarmoty
10. Sklárne Málinec
11. Filakovo-Novona
12. Bučina Vinica
13. Lučenec 2 pcs

14. ZŤS Krupina
15. Veľké Zlievce
16. Plachtince
17. Litava
18. Hintianske Moravce
19. Turany
20. Mýtna

Annex 10

"Position Paper" handed to the Hungarian Ambassador in Prague by the Czechoslovak Minister of Foreign Affairs on 15 May 1989

(Translation)

P o s i t i o n

of the Government of the Czechoslovak Socialist Republic on the decision of the Government of the Hungarian People's Republic relating to continued work on the construction of the Gabčíkovo-Nagymaros system of locks

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The Government of the Czechoslovak Socialist Republic has been informed of the decision of the Government of the Hungarian People's Republic of May 13, 1989 to suspend immediately for a period of two months work on the Nagymaros part of the joint Czechoslovak-Hungarian system of locks on the Danube constructed on the basis of the Treaty between the Czechoslovak Socialist Republic and the Hungarian People's Republic on the construction and operation of the Gabčíkovo-Nagymaros system of locks signed on September 16, 1977.

This unilateral step taken by the Government of the Hungarian People's Republic practically means the suspension of the implementation of the Treaty and puts the whole intention in jeopardy. Throughout the course of construction of the system of locks the Czechoslovak side has resolutely proceeded from the Treaty and the contractual documents related to it, while closely cooperating with the Hungarian side. Furthermore, a protocol was signed on February 6, 1989 on the initiative of the Hungarian side on the basis of which the term of completion of the construction is to be shortened by fifteen months.

All circumstances on which the Government of the Hungarian People's Republic based its decision have been jointly examined before the signing of the Treaty, i.e. before the starting of the construction, and further specified during its course. The decision of the Government of the Hungarian People's Republic was made without any discussions with the Czechoslovak side, This step infringed the provision of the Treaty concerning the solution of points at issue. The Czechoslovak side considers this act as unjustified and groundless both from the matter-of-fact and international legal point of view. The Government of the Czechoslovak Socialist Republic therefore insists on the carrying on and completion of the construction of the Gabčíkovo-Nagymaros system of locks in accordance with the valid contractual documents.

The unilateral suspension of work will cause considerable damage and the Czechoslovak side reserves itself the right to enumerate and to subsequently claim its compensation in conformity with the Treaty. The same applies to much serious damage which could be caused by marring the construction of the whole system of locks.

The Government of the Czechoslovak Socialist Republic is prepared to open talks with the Government of the Hungarian People's Republic with the aim to find common grounds for the successful completion of the Gabčíkovo-Nagymaros system of locks.

Annex 11

(Translation)

Rudé Právo

16 May 1989

RUDÉ PRÁVO, 16. May 1989

POSITION OF THE GOVERNMENT OF ČSSR TO TEMPORARY SUSPENSION OF THE NAGYMAROS CONSTRUCTION

The Government of ČSSR is prepared to open negotiations with the Government of Hungary with aim to find a common way to complete the G/N Project - Full working tempo in Gabčíkovo

Praha/Bratislava - The Minister of Foreign Affairs of ČSSR Jaromír J o h a n e s received in Černínsky palace in Praha on monday the Ambassador of the Hungarian People's Republic, Miklós Barity and informed him with the position of the Government of ČSSR to the decision of the Government of Hungary of 13.5.1989 to suspend immediately for the period of two months the construction of Nagymaros of the joint G/N Project on the Danube which is constructed on the basis of the Treaty between ČSSR and HPR concerning the construction and operation of the G/N Project of 16.9.1977.

This unilateral step of the Government of HPR means practically that the realization of the Treaty was suspended and it represents a threat of the whole plan. The Czechoslovak side, during the construction of the G/N Project, proceeds thoroughly from the Treaty and all relating documents and cooperates intensively with the Hungarian side. Moreover, on the basis of Hungarian initiative, a protocol was signed on 6.2.1989 which speeded up the construction by 15 months.

All reasons with which the Hungarian side supports its decision, were jointly examined before signing the Treaty, i.e. before starting the construction and have been precised during construction. The decision of the Government of HPR was executed without any discussion with the Czechoslovak side. Thus the procedure of solving disputable issues as set up by the Treaty was not followed. The Czechoslovak side considers this act for unjustified which has neither objective foundation nor it is founded by international law. Therefore the Government of ČSSR insists on continuation and completion of the G/n Project according to valid Treaty and documents.

The unilateral suspension causes significant damages and the Czechoslovak side reserves the right to evaluate and apply for compensation according to the Treaty. The same is valid about much greater damage which would arise by destruction of the whole construction.

The Government of ČSSR is prepared to open negotiations with the Government of the HPR with aim to find a common way for effective completion of the G/N Project.

x x x

The Presidency of the Government of the Slovak Socialist Republic discussed also on its extraordinary session on May 15 the situation which has arisen as consequence of the decision of the Government of the HPR.

The Presidency of the Government of the Slovak Socialist Republic expressed a surprise about such a serious decision of the Government of the HPR for the reason that the construction of the G/N Project is a joint Czechoslovak-Hungarian work supported by the interstate Treaty. The investment and design works lasted more than 20 years. The organizations of Hungarian and Czechoslovak designers with participation of scientific workers of both states by utilization of international consultations participated actively in the work.

Especially the construction of the Nagymaros step was carefully studied from the side of the Hungarian investor with the Soviet, Austrian, French and other experts from abroad. We are still much more surprised with this step of the Government of the HPR as the signature of the Agreement between ČSSR and HPR to speed up the construction was initiated just from the Hungarian side.

The Presidency of the Government of the Slovak Socialist Republic asks the construction and supply organizations guaranteeing the Czechoslovak section of the construction of the Gabčíkovo step to go on in fulfilment of tasks in such a way that the first turbine be put into operation by July 1, 1990 in accordance with valid schedule of the construction.

(....)

Annex 12

(Translation)

Magyar Hírlap

9 October 1991

(interview with Mrs Adrianne Hájossy)

Mágyar Hírlap, October 9, 1991

New waves around the G/N Project

Only postponement in the dept. of Government plenipotentiary

The Nagymaros part of the Project was stopped by the Government of Miklós Németh on May 13, 1989. For solution of new problems, the Government Plenipotentiary was nominated.
The task of the first Government Plenipotentiary, László Udvari, belonged the establishment of the Secretariat, what happened only at the beginning of 90-ties and the head of the Secretariat was nominated György Szántó. After the change of political order, the office of the Government Plenipotentiary was preserved with the same tasks and authority. With the resolution of the Government of July 1990, György Sámsondi Kiss was nominated in the office of the Government Plenipotentiary. The second point of this resolution orders to reevaluate the tasks of the Government Plenipotentiary, its authority, activities, as the evaluation of the Project construction changed in the new order. According to the governmental programme, the waterwork as a whole is not demanded and will not be realized. Sámsondi Kiss had to organize the negotiations between both states in this sense, or to prepare some rehabilitation works. (The decision on the new statute of the Government Plenipotentiary has never been realized.) This short review was given by Ms. Adriane Hajóssy who is the counsellor of the parliamentary council for environment and who worked some months in the office of the government plenipotentiary. As she has seen the "works" done in the office, she left it voluntarily at the end of July.

The Austrians abandoned the construction of Nagymaros in autumn 1990 and the concluded treaty had to be dissolved. It meant, from the beginning, a very unpleasant condition for Hungary, because the Austrian civil and legal order had to be taken into account. According to it, Hungary had to pay compensation for lost profit, therefore the registration of real performed works had to be set up. But it did not happen. In autumn 1990, the accounting was done on the basis of invoices and documents from Austria. In the opinion of environmental defenders, the registration was not done due to the role played by György Szántó - he did nothing.

Q. - The responsibility had to be borne by the new gov. plenipotentiary, Mr. György Kiss. Have you ever met him?

A. - I met him already in July 1990 and I realized from this meeting that he was a very kind and friendly man who knew almost nothing about the problems of waterwork. He alone confirmed that before his nomination he never payed attention to the problem of the G/N Project. As the construction engineer, he has no specialization for waterworks and the discussed questions were distant to him, but he committed himself to fulfil the governmental programme and he set up for goal to cancel the construction of the project. I was very surprised, how a man with very week knowledge, can take over such an office which demands activity and immediate decisions. In summer 1990, the Prime Minister demanded the council of environment of the Hungarian Parliament to take over the social control/check role in the project. The members of the council have tried to help the gov. plenipotentiary since that time. I am convinced that the question of the Project would have been in a much more worse state than it is now.

Q. - How the cooperation was coordinated?

A. - I am sorry to say, but G.Sámsondi Kiss does not yet know whom to charge, what is a task and what is not, who wants to realize the governmental programme and who not. The original patience against the inability of the gov. plenipotentiary has been evaporated /diminished/, especially at the moment when at the meeting of the council of environment did not adopt the report on activities of gov. plenipotentiary and no adequate change occurred since that time - when in Sept. 91, the deputy for MDF Károly Jávor gave an interpellation on disputable questions to the minister, in which competence belonged the gov. plenipotentiary, Q.- Can you support these serious statements?

A. - In 1990, the office of the gov. plenipotentiary could have been reproached with postponing activity. For ex. - the summary material of some pages of the so-called controlling commission has been prepared during more than a half of a year - it was a task of the head of the office of gov. plenipotentiary, G.Szántó - therefore the government could resolve the realization of actual tasks concerning the G/N Project. The former government substantiated the suspension of works that the "ecologically emergency situation" had arisen and that irreversible processes in nature could begin. The termination of the interstate 1977 Treaty - without the fact that Hungary could be violate the Treaty - would be possible only if "ecologically emergency situation" could have been confirmed through some years lasting researches. The government plenipotentiary, although he was already urged before by deputies and experts assigned to control the project, concluded only in December 1990 a treaty with ad hoc council of Hungarian Academy of Sciences, even the Prime Minister asked before the Academy to continue the research.

In December 90, the head of the office of government plenipotentiary, G.Szántó, was revoked. This was the cause that I accepted the task of counsellor of the gov. plenipotentiary as the second working task. But after the nomination of Elemér Gilyén for the new head of the office, the situation worsened once more.

In his person, another ignorant man of the project, besides the uninformed gov. plenipotentiary, took decisions. They were advised by many "experts interested in the construction" - which were practically in the same positions as before the change of order and they forced and financed such works which did not solve the problems, but - in better case - they postponed them.

Q. - What do you mean concretely?

A. - The resolution of 1990 charged in one of basic points to evaluate within the six months the so-called "Variants" proposed by Czechoslovak side, even if it could be properly solved only with a series of researches during several years. I proposed to the gov. plenipotentiary that with regard to lacking basic researches and also with application of former international experts opinions - he should inform the government about the real necessity of time and that he should ask for the change of date. In the opposite, he took advice of the head of the office and asked Agrober to evaluate within two months the Variants which were not submitted officially by Czechoslovakia. Even if the experts protested against it, the work was concluded with the result that the so-called variant "D" - i. e. permanent operation of the Gabčíkovo part of the project should be the most advantageous.

As the Czechoslovak side - just before the April intergovernmental negotiation - could judge this activity in a way that we plan to put into operation the Gabčíkovo hydropower plant instead of them, the ministers, superior to the gov. plenipotentiary, stopped all further work of Agrober.

The Parliament, in April 1991, confirmed in his resolution that the project is not necessary it ordered the restoration with regard to ecological points of view. The resolution orders to stop immediately the works on the project to stop further squander of common money.

The proposal to realize this resolution is the task of the gov. plenipotentiary, but this proposal is not definite up to now - as the Ministry of Fiances does not agree with it - it means that the investment is not concluded. Neither does it matter that the so-called programme "Kupa" (Kupa is the Minister of Finances) it is also the governmental decision - set up June 30 for the date of financial conclusion.

In my opinion, even if it is a common social agreement, the gov. plenipotentiary and his Secretariat does not work in the sense not to realize the project and the Danube be in the original river bed.

Z.O.

Annex 13

(Extracts in translation)

Magyar Hírlap, 18 May 1992

Magyar Nemzet, 8 October 1992 (interview with Ferenc Mádl)

Magyar Hírlap, 18.5.1992

Prague has invited the Hungarian ambassador

(MTI)

The Czechoslovak Vice-Minister of Foreign Affairs, Zdenko Pírek invited the Hungarian Ambassador, György Varga to its office in Prague on Saturday in the afternoon and submitted him a detailed official information on the position of the Czechoslovak Government session of Thursday about Gabčíkovo. Furthermore, an element of "expressis verbis" that the Czechoslovak side would be prepared, under specific conditions, to negotiate the suspension of the Variant "C" was lacking in the information, as stated later György Varga.

On Saturday, ČTK (Czechoslovak press agency) issued the statement of Mr. Pírek, in which the representative of the Ministry of Foreign Affairs stated that if the meeting would take place in Vienna on Monday, the Czechoslovak side would be prepared to discuss all questions. The directives of the Prag Government would make possible to the Czechoslovak delegation to reach a reliable result. (The head of the Czechoslovak delegation was Zdenko Pírek alone). The ultimatum connected with any preliminary condition would only complicate the situation which was already difficult enough - noted the Czechoslovak Vice-Minister of Foreign Affairs.

In Sunday communiqué, Balász László, the government speaker stressed with regard to the meeting Varga-Pírek: the Hungarian Government - according to an older resolution demanding the standpoint of the Parliament - is also prepared to participate in such a meeting which would stop all unilateral steps not contained in the 1977 Treaty and start the activities of trilateral committee.

A Hungarian government expert which does not want to be named, supposes that the method of the Czechoslovak government which demands guarantees that the Hungarian side adopts any conclusions of trilateral commission and only after it, it is prepared to stop all works on the Variant "C", is nothing new. He stated that the same had been already proposed by the Slovak Prime Minister Ján Carnogurský on April 1, at the meeting with the Minister without portfolio, Ferenc Mádl in Slovakia. Ferenc Mádl informed, in his declaration, that it was not possible to accept legal obligations to any results which were not yet known.

But some time ago, Hungary had accepted the decision that the recommendations of trilateral analysis would be taken into account in the Hungarian-Slovak government decision. The Hungarian Government stressed several times that the trilateral negotiations should be started with a moratorium on the Variant "C". The Czechoslovak side had rejected several times this demand. Therefore it is unintelligible how a Czechoslovak-Hungarian meeting in Vienna in presence of the EC could take place if the neighbouring country has no will to stop works on the Variant "C"and diversion of the Danube without preliminary conditions. If the Czechoslovak declaration has to be taken seriously, the neighbouring country accepts such steps only under condition that Hungary accepts some obligations concerning their side in advance. But the Hungarian side - as actual statements prove it - is not prepared to sign such a bianco bill of exchange.

Austria will not participate in the Hungarian-Czechoslovak-EC negotiations, but it proposed service - as Saturday's "Die Presse" wrote. Die Presse informs about the Monday's meeting in Vienna as about a fact, Kurier informs about it only as about a possibility and notes that there is only a promise from Prag to stop all works on the VAriant "C" and thus, the Hungarian condition would be fulfilled. If the Slovak side demonstrates also a good will, then it would be possible that the discussions will take place in Vienna on Monday - informs Kurier.

Die Presse analyses, in its Budapest's and Prag's commentary, the case of Gabčíkovo in detail. "Budapest believes that its effort brought results". "Prag indicates a preparation for a compromise and comforts Slovakia - those are sub-titles of two articles. The Budapest's article reminds the history of the Treaty and notes that completion of the Nagymaros hydroelectric plant is unacceptable for Hungary. It is true that in "causa Androsch" the passions calmed down because even if nobody believed that his intentions were in conformity with environment (as it claims the Austrian manager), it is known where the real "opponents" are - in Bratislava.

(Translation)

Magyar Nemzet, 8.10.1992

Interview with <u>Ferenc Mádl</u>, international lawyer and Hungarian Minister without Portfolio on anticipated steps <u>of Hungarian government concerning Gabčíkovo hydroproject</u>

(.....)

Question: Magyar Nemzet published on September 23, the documentary report according to which in November 1991, a trilateral expert commission (György Hábel, István Molnár and Károly Perczel) signalled the start of construction of Variant C, but its report was put aside, respectively it went on with difficulty. How could it happen?

Answer: Many have read that report, many newspapers quoted from it. It is often asserted that a part of experts working for government did not discover the danger of the Variant C, they informed too late about the construction. Thus they did not lead the government into the situation in which it could prevent it. First of all, I don't consider it ethical if something similar is asserted without consulting respective persons. Indeed there were only selected quotations. As far as the substantive part of the problem is concerned, when the Hungarian Government learned about the Variant, it understood immediately what was happening and it even became the most important clash between two governments. It is indifferent, with regard to the case, who and in which shall of real construction voiced the idea of paper tiger or something similar. The Hungarian government was conscious from the very beginning, what was being prepared and it undertook all steps - similarly as to the Parliament - to prevent it. It went so far as to cancel the Treaty. There would be a long list of Notes sent to the Czechoslovak side in this matter and I negotiated with them several times during the years 1991 - 1992. If only we had some outlooks to alter the events! Miklós Király, an enthusiast specialist of the Danube, Adrienne Hajóssy, one of the oldest supporter of the Danube protection, similarly as Károly Perczel, György Hábel and István Molnár - I discussed with the last two and I was surprised by what they said. According to their words, they submitted a report on the commencement of the Variant C already in last November. I don't know where they submitted it, I've got it only in April 1992.

Q: They submitted it to the government plenipotentiary György Sámsondi Kiss.

A: I know that he entrusted them with it. It drew somewhere a tie tight, but definitively neither by Miklós Király, Adrienne Hajóssy, nor in my office. I know that, in the meantime, György Hábel and István Molnár sent it to the Foreign Committee of the Parliament, to the ecological committee, and as it was clear later, even to the Prime Minister and to other addresses. It came to me only in April 1992.

In december, the Czechoslovak government adopted a resolution, which entrusted different organizations with the construction of the Variant C. At that period, the problem became really serious, because it was only "signalled" up to that time. We did not suppose that it would be really realized, because it cost a lot of money and brings the same dangers as the original project and it violates the state frontiers. Still before the commencement of construction, Hungary protested with all diplomatic means because it could have serious impacts on relations between both countries. We reacted already in December to the said resolution of the Czechoslovak federal government and we stressed that the consequence could be the cancellation of the Treaty. We asked already at that time to suspend the Variant C and we asked for a common realization of trilateral examination of expected impacts of construction. It is essential that already at the time the Hungarian government undertook all diplomatic and political steps. In my opinion, the statement that the government did not know what was being prepared, is unfortunately a misleading information.

Q: According to this information, the government did such steps about which the public was not informed. But it seems now, that it did not act quite decisively.

A: The public was continuously informed, the newspapers published the exchange of correspondence between Prime Ministers, letters concerning of Gabčíkovo. When the construction really began - bushes were removed, deviation were marked etc - the experts, including colleagues, were meeting on the spot. I alone visited the whole construction site already earlier, in the summer 1991, to see what was happening. When, the works began in December, I returned back several times. There were János Vargha, some deputiés from the dept. of environment, engineers-specialists, my close colleagues, Adrienne Hajóssy and Miklós Király. Their opinion at that time was: it is almost sure that it would be the Variant C. My colleagues came back often to this place and later, they came with a news, that the works seriously began. It was at the end of January, February 1992. They said that they Czechoslovakia worked seriously.It is true that in the period of visits of György Hábel, István Molnár and Karoly Perczel at that place. They were sure of construction on the basis of their own information and designs. There was still another group of experts, which thought that nothing sure and definite could be concluded.

(....)

Q.: There was an opinion published in Magyar Nemzet that a a coordinating organization to coordinate - Hungarian steps remark of translator should be established, because the Variant C speeds to its end.

A.: We were reprehended that we abolished the office of the Government plenipotentiary for the G/N project at the end of December. It was necessary also for that reason that Hungary wanted to underline that it did not want the hydroelectric power plant to be constructed. But the cooperation of involved - remark of translator Hungarian Ministers was preserved because it was ordered by the resolution of the Council of Ministers. The resolution determined the tasks of the heads of three involved Ministries - Ministry of Foreign

Affairs, of Environment and Transport - and the fourth that's me. The said group has a consultation every week. Even if everybody of us has its own tasks connected with the G/N Project, the coordination is always necessary. It is important to know: this group exists and works more intensively. For international legal and political expert activities in connection with Gabčíkovo, a special group for Gabčíkovo was established in my secretariat, which will prepare also materials for the International Court of Justice in the Hague. Thus, there is coordination among central authorities and I don't think that the abolishment of the office of Government plenipotentiary for the G/N Project was a wrong step.

Q: In the last days, the press and some government authorities expressed the possibility of a compromise concerning the construction of the Variant C. What is your opinion?

A: It can be reproached to nobody, neither to government authorities, that they look for a way out, a solution from a danger. According to such a compromise, without a hydroelectric power plant, the Danube would have stayed in its own bed, the dyke would have been elevated in such a way that water could flow into the by-pass canal, but enough water would have been left in the old Danube. "The work" would serve only to navigation. Nobody has described this with technical reliability, and the Czechoslovak side always wanted and wants the hydroproject at any price. But the hydroelectric power plant cannot function without reservoir and therefore it is difficult to find a compromise.

Q: Could we agree with the diversion of the Danube ?

A: The resolution of the National Council excludes it. When the former Czechoslovak Federal Minister for Environment Jozef Vavroušek proposed a similar version, its own government rejected it. The idea of compromise has spread among the Hungarian public, but nobody can propose a hydroelectric power plant without a reservoir containing ecologic danger, because such a solution does not exist. The basic question is that the Danube is a border river and it cannot be unilaterally diverted on the Slovak territory. Everybody must understand: if a hydroelectric power plant exists, there must be a reservoir and then the Danube must be diverted. In any case Hungary cannot agree with such a solution, because otherwise ir would be the afflicted subject in the ecologic catastrophe.

Now, we have no other way - nor the Czechoslovak side has it - than the forum of the International Court of Justice in the Hague, respectively the negotiations on ecological questions within proposed trilateral commission. The International expert forum will can correctly state the real situation, the directions for a way-out which will be rational and acceptable.

(József Botlik).

(Translation)

Ministry of Foreign Affairs
of Hungarian Republic
365-127/1992 Budapest, September 16,1992

N o t e v e r b a l e

The Ministry of Foreign Affairs of the Republic of Hungary presents its compliments to the Embassy of the Czech and Slovak Federal Republic in Budapest and has the honour to convey that pursuant to the Resolution of the Government of the Republic of Hungary on the cancellation of the Interstate Treaty concerning the construction and operation of the G/N Project of 1977 logically the activities of the government plenipotentiary for the G/N Project were abolished.

Courtesy.

Round stamp

Embassy of the Czech and Slovak
Federal Republic

B u d a p e s t

Annex 15

Comments prepared by OVIBER on the Ecologia report of March 1989, 29 March 1989

In the draft report of the American scientists, engineers and planners invited by INFORT general policy recommendations and specific merasures against environmental damages are suggested.

Since the final report will be an important issue, the draft needs several corrections in order to contain factual statements and to exclude misunderstandings or misinterpretations. The draft suggests several actions which have been already completely or partly executed, an up-dating of the draft corresponding to the recent status is also necessary.

In the comments an attempt is made to follow the order of the report.

Chapter I. Par. 2.

The correct depth of the headrace canal is 5-15 m varying along the length, its width varies from 250 to 650 m. The third Barrage at Nagymaros is 125 km downstream from Gabcikovo. The Dunakiliti Barrage will not be operated to meet peak demand. It serves mainly to flood release into the original river bed.

Chapter I. Par. 5.

o a monitoring system exists and water quality data are collected since 25 years. This monitoring system is under further development.

o a complete 3-dimensional modeling system can be a final goal, recently mostly 2-dimensional models are available, which are sufficiently describing the phenomena. Models for pollutants are under improvement in various complexity.

o within the framework of the monitoring system a Geographic Information System was developed at VIZITERV which facilitates spatial and timely evaluations.

o the responsible authority for the investment is Ministry for Environment and Water Management. Independent supervising bodies have been created by the Parliament (an adhoc committee) and by the Council of the Ministers (a so-called "public" committee composed by several representatives of the independent environmentalists).

Thus, the major recommendations of American experts have been already implemented, independently from the draft report. This fact supports the actions taken by the Hungarian authorities before, and shows now similarly reactions can be made.

Chapter II. Par. 1.

The fourth main benefit of the project that it creates general development for the connected areas (infrastructure, recreation, irrigation etc).

Par. 2.

The length of the diversion canal is 25 km, but the improved navigational waterway from Bratislava to Nagymaros extends to 160 km, where the minimum depth of 3,5 m is ensured.

Par. 3.

In the first five years of operation no power is exported to Austria. Only 80 percent of 1200 GWh export energy serves for balancing the Austrian construction, 20 percent export paid by cash.
It should be noted that share of the system in the peak energy generation will be about 25 percent.

Par. 4.

The correct date of the flood are 1954. and 1965.

Par. 7.

The improved navigation also may help to exploit the existing capacities.

Par. 10.

Tourism is, regretfully, not a major industry in Hungary, particulary not at the reach affected by the dams. The ideas on the strategic points are highly appreciated and will be utilized. The economic benefits captured by tourist services are really established by the Project.

Chapter III. Par. 1.

The potential demage of the aquifers of the Little Hungarian Plain is prevented by the preventive measures, particularly by the groundwater control system based on the interception-drainage network designed on the basis of model and field experiments. The water supply of the villages alongside the river between Rajka and Nagymaros will not be demaged according to the detailed investigations and designes of the present and potential bankfiltered rescurces.

Forestry experts concur in the opinion that the risk of any change in the stands and productivity of the flood-plain forests area is virtually nil, except for a narrow riparian belt. The bankfiltered wells of the Budapest Water Works are located downstream of the Nagymaros Barrage. Proper measures are taken to protect them against degradation of the river bed, however previous dredging for building materaial of other puposes might cause some quality and quantity problems. The water supply of Budapest is almost independent from the barrage system. Archeological explorations have been promoted by the investment. Excavations are currently under way. Archeological work will be concluded at the sites before starting impoundment.

Recommendation 1. The suggested committees have already.been established (see comment to chapter I. Par. 5. point 4.).

Recommendation 2. Such an information is planned as a joint product with the International Institute for Applied System Analysis (IIASA) in Laxenburg.

- The advanced monitoring system will be soon fully operational, the reference data have been collected in a computerized data base.

- The integrated modeling system will be used for the operation of the Barrage System. Several components have been developed.

  Though some scientists, including V. Romanenko - having bad experiences from Soriet rivers - believes that large dams on flatland rivers are demaging, several environmentalist gave priority for hydro-power against nuçlear and thermal energy production, since it is a renewing energy source which does not produce contaminants. It is evident that simulation models are useful tools for the environmentally sound and economical operation of hydro power schemes.

- The computerized Geographic Information System is already in operation at the VIZITERV and is the sound basis for further utilization of the system.

The designers and operators are ready to study any other "users friendly" system and if it is better they have now it for the management program.

Recommendation 3.

The water quality conditions were investigated on the field and by numerical models. Waste water of Bratislava is treated and release to the Little-Danube, not directly to the main Danube. According our estimation the total amount of wastes is by one magnitude less, but the part considered "pure" is by one magnitude more, as it is mentioned. Waste water treatment plants are under construction, (both on Hungarian and Csechoslovakian side.) In the Old Danube after the diversion there are no effluents.

Czechoslovak government confirmed that they are constructing sewage treatment plants. High level officials negotiated the acceleration of the construction of the sewage treatment plants. Hungarian government is firm to implement sewage treatment program, as it was decided by the Parliament.

By the way the present quality of the Danube - identified I. or II. class - poses no serious threat to municipal water supply.

The Parliament also decided that environmental protection has first priority before water management and energy production. Thus, rapid draw-down of the reservoir in a case of water pollution (including algel bloom) should be practiced, when it is necessary.

According to estimations the groundwater resources of the Little Hungarian Plain can not economically used for the water supply of Budapest which is based on bank-filtered layers of the Danube and direct surface water intake downstream of Nagymaros. Concerns on contamination of the aquifers due to the dam system is not supported by the studies. On the other hand water quality of the Little Hungarian Plain is endangered by the sewage of the villages (without conalization), waste material and the fertilizers. The Dunakiliti reservoir, according to Austrian experiences, will be washed out by floods frequently, so siltation will be not so serious problem. In avarage 1-2 cm/year.

There is great difference between the conditions at Budapest and at Belgrad. In Belgrad the water level is influenced by the backwater of the Iron Gate Dam, and Budapest is downstream from the barrages. However, according to the studies of the Belgrad Technical University (prof.Boreli) the effect of the Dams is secondary for the water supply problems of Belgrad.

Separated models for groundwater and river water pollution are sufficient which have been developed or are under development. The aquifers along the right bank of the Danube are separated, so separate systems can be considered (Little Hungarian Plain, Komárom, Nyergesújfalu, Dunaalmás, Pilismarót, Esztergom).

Studies on the behaviour of bank filtered water are under way; dredging on the stretch near to Budapest, under Nagymaros will not be made anymore, since degradation of the channel took place already due to dredging for building industry. No further dredging is foreseen.

Recommendation 4.

To understand the situation of the protection of the ecosystem of the Old-Danube it is necessary to be informed about the interception-drainage network along the Old-Danube.

The diversion canal is only 25 km, and not 100 km, as it is stated, so it does not reach down to Komárom.

The increased ground water level at the Dunakiliti reservoir and the predicted 5-6 m depletion of the groundwater table downstream of the Dunakiliti barrage could occur when no preventive measures are made. The groundwater regulation will be solved by an intersepting canal system along the reservoir and an elevated water level on the side arms along the Old-Danube. The efficiency of this system was demonstrated by VITUKI and the Technical University of Budapest. Several papers are available (e.g. in Vízügyi Közlemények 1983/4.).

The ideas related to riverine forest, oxbow lakes and side channels are against any existing experience. The reconsideration of this statement is necessary.

The riverine forest are artificial ones, planted just in this century, so they are not natural wealth of the landscape. The small dams among and across the oxbows and side channels serve to keep the water level in these side arms elevated in order to decrease groundwater depletion and to protect forest.

Suggestions to operate water release through Old-Danube are appreciated.

The refeshment of the water in the wetlands at the Csechioslovakian side are solved.

The demanded areas for GNB projects and innundation are 70 % in Csechoslovakia and 30 % in Hungary.

The groudwater flow in the Little Hungarian Plain has no connection with the area north of the Hanségi-canal.

Recommendation 5.

Most of the archeological monuments have been detected during the project preparations. Most of the historical monuments and relics have been transferred to the museums.

The Nagymaros dam was a subject of two national concourses and of detailed landscape architectural planning in collaboration with the Chair for Landscape Management of the University of Horticulture and an acceptable solution was ellaborated.

The relocation of the Nagymaros dam was investigated 4 years ago and no acceptable alternative was found. Due to the advance of the construction the relocation can not be realistic. The removal of the Nagymaros dam from the system may completely change the concept. Due to international agreements and contracts between Hungary and Czechosklovakia, and Austria, respectively, it is almost impossible, but certainly uneconomical to eliminate this dam.

The establishment of national park with the aim in the text, as a compensation does not suit to the recent terminology what is considered "national park" in Hungary. The compensation is given in the form of the bridge, the improvement of tourism, infrastructure and recreation facilities. We agree that the removal of the recreation dwellings on the surrounding hillsides may promote the landscape beauty, however among the recent Hungarian economical-social system it would cause almost an uprising, and legal backgroung can not be found for such actions.

Recommendation 6.

The coordinated development is an important and inevitable activity which will be executed, mostly through the region-wide planning of the county and local councils.

The suggested baseline assessment have been carried out in a considerable manner, and is under way within the monitoring program (e.g. as reference value). It is planned that the effects will be evaluated within the frame of the monitoring and the experiences can be used at the design of other dams.

The existing GIS datebase will, really, be a sound background for such evaluations and demonstrations.

Recommendation 7.

Certain legislation in connection with impact on environment can be found also in Hungary. Our Environmental Low was issued in 1976. It is foreseen that a new law on Protection of the Environment will soon be necassary. We fully agree that such a review process should be codified. In this regard full respect to the already existing legislation of other countries may be given, including National Environmental Policy Act of the USA.

The criticism on the former public information policy is justified, in general. However, in the case of the Danube Dam system, several attempts have been made to inform publics, particularly along the affected reach, which are forgotten by the opponents. It schould also be noted that government ordered a ban for about three years to publicize any information, including professional ones in connection with the Danube Dams. This policy changed, and nowadays sufficient information is available, the journalism is regretfully mostly one-sided.

Conclusions

The criticism on the process in previous period may be justified, but one should bear in mind, that

- the preparations of the system started in 1952 when political, social, economical conditions were fully different, and environmental protection was almost unknown;

- the decision making process was rather slow, and sometimes it did not follow the proper ways;

- the engineers considered several environmental harms, as "side-effects", which can be mitigated or reduced by the planned works or through the operational rules to be established;

- studies and design consider the environmental protection seriously;

- quite a lot of suggested actions has been made recently and supports the justification of these actions.

Among the three possible mitigation actions in response to concerns the sewage treatment will be solved, the change in the originally planned operation is under serious consideration in the development of the operational rules which will give top priority to environment. Relocation and abandonment of the Nagymaros Barrage can not be realistic according to water and energy experts due to their political and economical consequences.

We agree that a proper policy response is recommended. The report after corrections and amendments may considerably help to inform both national and international public.

For the finalization of the draft report we suggest to study available professional literature and enclose some documents for that purpose.

Since our comments are concentrated for certain focal points we offer oral consultation during the formulation of the final report.

Budapest, 29. March 1989.

Annex 16

The Bechtel report: list of references, prior environmental impact reports and assessments

Appendix 1

REFERENCES

VIZITERV, Consulting Company for Water Engineering, July 1989. Informatory Documents[a] for the Gabcikovo/Bös-Nagymaros River Barrage System.

1. Summary Description, compiled by Dr. Endre Zsilak, Chief Project Engineer.

2. Standard Specifications, Regulations and Orders on Environmental Protection.

3. Engineering Geology. Compiled by: Dr. Jeno Mantuano, Chief Project Engineer.

4. Hydrological Conditions of the Danube and its Tributary Streams.

4.1 Surface Water Regime. Prepared by Ferenc Papp, Chief Project Engineer.

4.2 Subsurface Water Regime. Prepared by Dr. Jeno Mantuano.

4.3 Sediment Regime of the Danube Stretch Affected by the Gabcikovo-Nagymaros Hydroelectric Development Project.

4.4 Comprehensive Report "Exploration of the Ice Regime over the Danube Reach Influenced by the Bös-Nagymaros River Dam Project."

4.5 Quality of Surface Waters, Prepared by: Mrs. Eva Bartalis-Tevan, Biologist, Technical Advisor; Dr. Szabolcs Tyahun, Biologist; Dr. Pal Varga, Chemical Engineer; and Mr. Nandor Varday, Chemical Engineer.

4.6 Subsurface Water Quality, Prepared by: Ferenc Herzog, Chief Project Engineer.

5. Biological Conditions.

5.1 The Flora, Vegetation, Fish Fauna, and Biological Monitoring of the Gabcikovo/Bös-Nagymaros River Barrage System, Experts: Dr. T. Simon, Doctor of Biological Sciences and Dr. C. Lang, Candidate in Biological Sciences.

(a) Please refer to pages A1-4 through A1-35 for contents of these Informatory Documents.

5.2 Plant Nutrient Supply in the Danube River and its Hydrobiological Features, Experts: Dr. T. Kiss Keve, Candidate for Biological Sciences, MTA-OBKI, Hungarian Danube Research Station; Mrs. E. Tevan-Bartalis, Biologist, Technical Consultant, EDU-KÖVIZIG; Dr. Sz. Tyahun, Biologist, KOV-KÖVIZIG; Dr. P. Varga, Chemical Engineer, Head of Department, KOV-KÖVIZIG; Dr. N Varday, Chemical Engineer, Head Section EDU-KÖVIZIG.

6. Agricultural and Silvicultural Land Use, Compiled by Consulting Company for Water Engineering.

7. Archaeological and Monuments Assets and Annex, Compiled by: VIZITERV with participation of experts.

8. Aesthetic Quality and Character of Landscape, Produced by: VIZITERV based upon experts.

9. Recreation - Tourism, Compiled by: VIZITERV based upon the expert's report.

10. Social and Economic Aspects, Prepared by Ferenc Kollar, Chief Engineer of the River Barrage Project.

11. Evaluation of Conditions and Effects. Compiled by: Dr. D. Orloci, Civil Engineer, Senior Research Fellow.

12. The Monitoring Network 1.

12.1 The Monitoring Network Operative in 1988, Compiled by: Dr. Jeno Mantuano, Chief Project Engineer.

12.2 Comprehensive Report on Observations up to 1985. Szigetköz

12.2.1 Comprehensive Report

12.2.2 Legend to Table 1 - Table 42

12.2.3 Legend to Figures 1-27 and Maps 1-4

12.3 Comprehensive Report on Observations up to 1985. Section Downstream of Gönyü.

12.3.1 Legend to Table 1 - Table 22

12.2.2 Legend to Figures 1-16 and Maps 1-3

Power Engineering Influences of Introducing An Environment Protecting Operation Pattern on the Operation of the Bös-Nagymaros River Barrage System. Research Report. Budapest Technical University, Department of Water Management, 1989.

The Monitoring System of the Bös (Gabcikovo)-Nagymaros River Barrage System. Conception of Evaluation.

A Kisaalföld: Duna-szaKasz és a Kajesolodo mellékvizek halai és halaszato. 1987. Kalman Jancso anl Janos Toth authors. Translated from A Kisaalföld Duna-szaKasz Ökologiaja.

Table 2

ENVIRONMENTAL ASSESSMENTS AND IMPACT STUDIES

Client/Project	Location	Description*
Bay Area Rapid Transit Authority	California	Combined EIR/EIS for prepared BART extension to Antioch, California
Pacific Gas & Electric Co.	California	Applicant's EIR for a hot-oil pipeline from Richmond to Antioch
San Bernardino Water District	California	ER for an integrated pipeline system
San Francisco International Airport	California	EIR noise impact evaluation
Producers Gas Company/ Eldorado Interstate Gas Pipeline	California, Arizona	Applicant's ER for FERC License Application and Project EIR/EIS for 381-mile natural gas pipeline
COE Sacramento District Beryllium Propellant Facility	California	EA and environmental permitting
Cities Services Oil and Gas Corporation San Miguel Project	California	Environmental impact analysis, including environmental monitoring plans, assessment of potential environmental impacts, complete CEQA/NEPA-compliance documentation including permit documents
State of Idaho Department of Highways	Idaho	Draft EIR for bridge and highway relocation
Delaware Bay Oil Transport Committee	Delaware	EA for alternative methods of oil transportation in estuarine waters
Lawrence Livermore National Laboratory	California	EA for AULIS and GBFEL
Union Oil/Oil Shale Project	Colorado	EA and baseline surveys

* EIR/EIS - Environmental Impact Report/Environmental Impact Statement
ER - Environmental Report
EA - Environmental Assessment

Table 2 (Cont'd)

Client/Project	Location	Description
California State Water Resources Control Board	California	State EIR for a new water quality management plan for northern California
Mississippi Power & Light	Mississippi	ER for a nuclear power generating station
Boston Edison Co.	Massachusetts	ER for a nuclear power generating station
City of Seattle	Washington	State EIS for a solid waste recycling and ammonia recovery facility
Cleveland Cliffs Iron Co.	Ohio	Applicant's EIR for a coal-fired power plant
Western Municipal Water District	California	State EIR for a wastewater treatment and reclamation facility
Lakehead Pipeline Co.	New York	EIA for a petroleum pipeline from New York to Quebec, Canada
Sandia National Laboratories	New Mexico	Federal EIS for a waste isolation pilot plant
American River Falls	California	Federal EIS for road relocation
Public Utility District No. 2 of Grant County	Washington	State EIS/FERC Exhibit W for a hydroelectric facility
City of Anaheim	California	State EIR for an electrical substation
Bonneville Power Administration	Oregon	EA of energy conservation measures
Puget Sound Power and Light Company	Washington	ER and design for a nuclear power plant
Windfarms, Ltd.	Hawaii	State EIS for a wind energy project and a transmission line
Los Alamos National Laboratory	U.S.	EA and socioeconomic assessments for hot dry rock geothermal systems

Table 2 (Cont'd)

Client/Project	Location	Description
Florida Power & Light/Martin Coal Units 3 & 4	Florida	EIR, subcontract management, licensing, and permitting
Electric Power Research Institute (EPRI)/Battery Energy Storage Systems	Florida	EA, site selection, safety assessment
City of Richmond	California	EIR on the Port of Richmond
Shoshone-Bannock Tribes/ Bonneville Power Administration	Idaho	EA for proposed fishery enhancement of Yankee Fork River
South Bay Dischargers Authority	California	Federal (EPA) EIS and state EIR for major regional wastewater disposal pipeline
Hughes/USAF Systems Command	U. S.	Environmental studies of SDI sites
Boeing/USA Strategic Defense Command	New Mexico	Environmental studies for FEL-ITUE
Shoshone-Bannock Tribes/ Bonneville Power Administration	Idaho	EA for proposed fishery enhancement of Yankee Fork River
DOE Albuquerque, NM Waste Isolation Pilot Plant	New Mexico	Preparation and presentation of EIS
Snohomish County Public Utility District No. 1	Washington	State EIS/FERC Exhibit W for a hydroelectric facility and drinking water supply system
U.S. Army Toxic and Haz. Materials Agency/Adv. Chem Demil. Systems Dev. Project	Utah	EA, regulatory analysis and permitting
Interprovincial Pipeline Co.	Canada	EIA for a trans-Canada oil pipeline
Long Island Lighting Co.	New York	EIS (Corps of Engineers) for a coal-fired power plant in New York

Table 2 (Cont'd)

Client/Project	Location	Description
Pacific Gas & Electric Company/Richmond to Antioch Pipeline Project	California	Prepared applicant's ER, assisted in siting studies, wetland crossings and mitigation, regulatory review, applicant support at public hearings.
Southern Pacific Pipe Lines, Inc./Antioch Pipeline Relocation Project	California	Prepared applicant's EA, baseline investigations, stream crossings, siting considerations, mitigation planning.
Shell Oil Company/Shell Ventura Crude Oil Pipeline	California	Environmental health and safety analysis, spill potential impact evaluation, preparation of environmental spill control and containment measures.
Confidential/Central CA, Transmission Line Study	California	Route selection, environmental analysis and permitting review.
Southern Pacific Pipe Lines, Inc./Norwalk to Industry Pipeline	California	Prepared applicant's Environmental Assessment and environmental forms to accompany permit applications, route selection, water crossings and mitigation measures coordinated with lead agency, permitting agencies and state clearinghouse.
Southern Pacific Pipe Lines, Inc./Brentwood to Fresno Pipeline	California	Prepared applicant's Environmental Assessment and environmental forms to accompany permit applications, route selection, water crossings and mitigation measures coordinated with lead agency, permitting agencies and state clearinghouse.
San Diego Pipeline Co./ San Diego Pipeline Expansion	California	Prepared applicant's EA, agency meetings, wetland crossings, route selection and mitigation plannings.

Table 2 (Cont'd)

Client/Project	Location	Description
Four Corners Pipeline Co.	California	Environmental support, permitting, route selection and management of subcontractors for Southern California Pipeline System. Prepared Permit Acquisition Plan.
Southern Pacific Pipe Lines, Inc./Richmond to Concord Pipeline Project	California	Prepared applicant's EA.
Cities Service/San Miguel OCS Platform, Pipeline and Oil Processing Facility	California	Site selection, environmental assessment, permit acquisition plan, public participation program, and air quality modeling.
Chevron Corp./Rangely CO_2 and PO_4 Slurry Pipeline Projects	Utah, Colo., Wyoming	Environmental permitting, contract support, threatened and endangered species field survey management, cultural resources survey management, development of construction/ operations plan.
Nevada Power Company/ Allen-Warner Valley Energy System	Utah, Nevada	Prepared applicant's EIA, route selection, baseline studies management, endangered species, mitigation planning, permit and regulatory reviews, public hearings support.
Consortium of Energy Companies/St. Lawrence Crude Oil Pipeline	Quebec, Can. New York	Route selection, selected and monitored baseline contractors, prepared applicant's environmental report, performed permit and regulatory reviews, mitigation planning.
Southern Pacific Pipe Lines, Inc., Pleasant Valley Coal Slurry Pipeline System	Utah, Nevada	Definition of environment issues, regulatory and permit investigation, siting considerations, baseline investigations, impact evaluation.

Table 2 (Cont'd)

Client/Project	Location	Description
Alyeska Pipeline Services Co./Trans Alaska Pipeline Project	Alaska	Construction monitoring, streams and wetlands crossings, water quality, erosion control, restoration, wildlife, oil spill clear-up, camp, monitoring, liquid and solid waste disposal, air quality, environmental training, prepared SPCC Plans.
Pacific Gas Transmission Co./Western Leg Prebuild Project	Idaho, Washington, Oregon	Prepared applicant's mitigation programs, wetlands protection, stream/floodplain crossings, erosion control, visual and cultural resources, pollution control, restoration, environmental training, construction monitoring, prepared quality control procedures, QC training.
Energy Transportation Systems Inc./Coal Pipeline Project	Wyoming, Nebraska, Kansas, Oklahoma Arkansas, Louisiana	Prepared applicant's preliminary ER, water quality, stream and wetlands crossings, endangered species, regulatory review and permitting, prepared PSD & NPDES applications.
Interprovincial Pipeline Limited/Montreal-Sarnia Crude Oil Pipeline Project	Ontario, Quebec	Prepared applicant's EA, siting, baseline studies, stream and wetlands crossings, mitigation planning, permit acquisition, construction monitoring, restoration, program development and implementation.
Lakehead Pipeline Company, Inc./Lakehead Pipeline Project	Wisconsin	Prepared applicant's EIR, conducted field baseline investigation, proposed mitigation plans, performed permit investigation, meteorological analyses, air and water quality.

ENVIRONMENTAL EXPERIENCE - HYDROELECTRIC PROJECTS

PROJECT TYPE: Hydroelectric facility and associated pipeline

PROJECT: Sultan River Project

LOCATION: Everett, Washington

CLIENT: Public Utility District No. 1 of Snohomish County

PROJECT DESCRIPTION:

The Sultan River Project is a multi-purpose water resource development located approximately 25 miles east of Everett, Washington. The project supplies both municipal and industrial water as well as hydroelectric power.

Public Utility District No. 1 of Snohomish County contracted with Bechtel to perform feasibility studies of its proposed project and to prepare an application for an amended license to be submitted to the Federal Energy Regulatory Commission (FERC). The work included geologic exploration to determine foundation adequacy and tunneling conditions; project formulation and equipment selection; environmental assessment of the entire project; operation studies to determine optimum project benefits; and evaluation of all project costs.

The Sultan River Project design recommended by Bechtel consisted of the following:

- Raising the existing Culmback Dam approximately 60 feet by construction of a zoned earth and rockfill embankment on top of the existing dam

- Constructing a 4-mile, 14-foot diameter, partly-lined tunnel, and a 4-mile, 10-foot diameter, buried steel pipeline to convey water from the reservoir behind Culmback Dam to a new powerhouse

- Constructing a powerhouse with two Pelton units, each rated at 47.5 MW at a net head of 1,000 feet, and two Francis units, each rated at 8.5 MW at a net head of 700 feet (total installed capacity of 112 MW)

- Providing an additional pipeline to convey water by gravity from the powerhouse to Lake Chaplain to maintain a firm water supply to the City of Everett. The 8.5 MW Francis units mentioned above generate power through the differential head available in the water transfer system

- Making provision for the introduction of water back into the Sultan River above the powerhouse to maintain spawning and rearing of anadromous fish within the Sultan River

This design arrangement significantly reduced project costs as compared with earlier proposals and also made the project more environmentally acceptable. It greatly facilitated gaining the necessary agency approvals before the FERC license amendment application could be submitted.

Following acceptance of the recommended plan by the owner, Bechtel provided final project design, procurement assistance, and construction management services. The Sultan River Project won the 1984 Environmental Excellence Award given by the Washington State Department of Ecology "because the utility's construction methods were consistent with maintaining the water quality and public health, and because the project enhances the fish and wildlife resource of the area."

PROJECT TYPE: Expansion of existing hydroelectric facility

PROJECT: Meldahl Project

LOCATION: Vanceburg, Kentucky

CLIENT: City of Vanceburg

PROJECT DESCRIPTION:

The Meldahl Project is a proposed 90 MW hydroelectric project on the Ohio River at the Captain Anthony Meldahl Locks and Dam on River Mile 463. The Meldahl hydroelectric project will be a run-of-the-river facility. The powerhouse will replace a portion of an existing concrete gravity weir. A new 5-mile transmission line and switching station are also part of the project. Bechtel was responsible for preparing the Federal Energy Regulatory Commission's (FERC) relicense application for permit to construct a major project on an existing dam.

This work included preliminary engineering design and an Exhibit E environmental report. The license application is currently being reviewed by FERC. Major environmental issues associated with the project include impacts on downstream dissolved oxygen levels, fish entrainment and impingement and impacts to fishing opportunities. Engineering design modifications were made to minimize environmental issues and respond to concerns of governmental agencies.

PROJECT TYPE: Combined dam and powerhouse

PROJECT: Cowlitz Falls Project

LOCATION: Chehalis, Washington

CLIENT: Public Utility District No. 1 of Lewis County

PROJECT DESCRIPTION:

The Cowlitz Falls Project is a proposed 70 MW hydroelectric project to be constructed starting in mid-1989 on the Cowlitz River in the state of Washington. The project incorporates a run-of-the-river reservoir designed to minimize environmental effects and upstream flooding potential while serving the power needs of Lewis County.

Bechtel is performing engineering; procurement; construction management; and environmental, permitting, and licensing services on the project. Bechtel's environmental specialists are responsible for preparation and agency reviews of 12 detailed mitigation plans required by articles of the project's FERC license. These plans, supported by specific modeling studies and field investigations, were filed with FERC. A wide range of environmental issues were addressed in the FERC plans, including bald eagle protection, groundwater seepage, sediment accumulation, erosion control, cultural resources, debris removal, and wildlife habitat compensation. Bechtel is also responsible for managing the implementation of these mitigation programs, using several technical consultants for determining new transmission line routes and implementing a comprehensive field and data analysis program. Work also involves bald eagle and eagle perch surveys, a large-scale groundwater drilling and monitoring effort, erosion and slope stability studies and design, wildlife habitat improvements, and development of the project's recreational facilities. In addition, a visual impact analysis and videotape presentation were submitted. These were required by FERC to address proposed changes in the location of the project dam and associated switchyard.

Bechtel permitting specialists have been responsible for identification and acquisition of all federal, state, and local permits and approvals necessary to construct and operate the Cowlitz Falls Project. A detailed permit acquisition program and schedule were developed for the project. Applications for all permits are being prepared and filed in consultation with the appropriate agencies and through close coordination with project engineering and construction staff.

Bechtel environmental and permitting specialists are also responsible for environmental assessment and document preparation as well as for field permitting services for a 17-mile transmission line project, necessary to serve the Cowlitz Falls Project. Portions of the line will be upgrades of an existing line. Specific activities include preparation of an EA/EIS, a wetlands determination, archaeological clearances, permit acquisition, and agency consultation.

PROJECT TYPE: Dam and powerhouse

PROJECT: American Falls Project

LOCATION: Idaho

CLIENT: Idaho Power Company

PROJECT DESCRIPTION:

The American Falls Dam on the Snake River in southeastern Idaho was originally constructed by the Bureau of Reclamation in the mid-1920s as a major feature of the Minidola Project. Idaho Power Company also utilized the American Falls site to operate a 27.5 MW hydroelectric plant. The dam was a concrete gravity structure, with 1-mile earthfill embankments at each end. Because of reactive aggregate in the concrete, the safety of the dam was questioned, and the Bureau of Reclamation restricted the amount of water that could be stored in the reservoir to about two-thirds of its total capacity. This reduced the amount of water available for irrigation and the power that could be produced.

Idaho Power asked Bechtel to develop preliminary engineering plans and cost estimates for (1) rehabilitating or (2) replacing the dam so as to provide adequate safety for full reservoir conditions and loadings, including those imposed by reservoir icing and modern earthquake criteria. Both plans were also to include provision for a powerhouse utilizing the head between the reservoir and the river level.

Based on Bechtel's cost comparison and other factors, Idaho Power opted for the dam replacement plan. Bechtel was authorized to proceed with the necessary field investigation and preliminary design of the dam and powerhouse to support more reliable cost estimates and provide exhibits for the application for a license to construct the powerhouse.

The replacement plan consisted of:

- A left embankment section that incorporated the original earth embankment and a major portion of the original gravity dam
- A short zoned earthfill section connecting the left embankment to the new concrete gravity dam
- A new concrete gravity section, 577 feet long, containing low-level outlets, spillway, and powerhouse intake gates
- A right embankment section constructed of zoned earthfill, which connected the new gravity dam to the original right abutment

Those portions of the original dam that inhibited satisfactory performance of the new dam were removed, while the remaining portions were either left in place or encompassed in the new structure.

Concurrently, Idaho Power Company authorized Bechtel to design a new powerhouse to be constructed at the same time as the replacement dam. The powerhouse is located about 300 feet downstream from the dam, adjacent to the spillway stilling basin. Three 18-foot-diameter penstocks convey the water from the reservoir to three generating units in the powerhouse for a total plant rating of 92 MW.

ENVIRONMENTAL EXPERIENCE - HYDROELECTRIC PROJECTS (Cont'd)

PROJECT TYPE: Hydroelectric facility

PROJECT: Whiskeytown Project

LOCATION: Redding, California

CLIENT: City of Redding

PROJECT DESCRIPTION:

Bechtel reviewed and updated feasibility studies and cost estimates for this 3.25 MW facility to be located at an existing Bureau of Reclamation dam on Whiskeytown Lake in northern California. Bechtel also prepared the FERC license application for the project, including Exhibit E environmental reports. This application was submitted to FERC in 1982. No adverse environmental impacts resulting from the project were identified.

PROJECT TYPE: Expansion of and modifications to two existing hydroelectric facilities

PROJECT: Hauser Lake and Ryan Project

LOCATION: Butte, Montana

CLIENT: Montana Power Company

PROJECT DESCRIPTION:

These projects involved the addition of new powerhouses at two existing sites, plus necessary modifications to existing dams. Feasibility studies have recently been completed verifying optimum installed capacities: 25 MW at Hauser Lake, and 40 MW at Ryan. An application to amend the existing FERC license for the Ryan Project was submitted in 1982, and the amended license was received in May 1984.

PROJECT TYPE: Expansion of existing facility

PROJECT: Lake Redding Project

LOCATION: Redding, California

CLIENT: City of Redding

PROJECT DESCRIPTION:

The proposed project consisted of the reconstruction of an existing dam across the Sacramento River, at a site just downstream from the existing structure, plus provision of a new 3-unit powerhouse at the right abutment. The new powerhouse is designed to develop 15 MW at the normal operating head of 13.5 feet, using bulb-type turbines. Bechtel reviewed and modified earlier feasibility-level designs by others, and updated cost estimates. Bechtel also prepared the FERC license application which was submitted in February 1982. A potential adverse effect of the project was determined for anadromous fish migration. Several studies were prepared as part of the Exhibit E environmental report under the FERC license application to further characterize fisheries habitat and assess potential project impacts on fishery resources.

PROJECT TYPE: Expansion of existing hydroelectric facility

PROJECT: Slab Creek Project

LOCATION: Sacramento, California

CLIENT: Sacramento Municipal Utility District

PROJECT DESCRIPTION:

The project involved a "mini hydro" addition to the fish water release outlet of the Slab Creek Dam, a 232-foot high arch dam originally designed by Bechtel in 1965 as part of the Upper American River Project. The addition includes a turbine/generator unit, together with necessary appurtenances and modifications to the outlet works. Bechtel prepared engineering studies and data to support the FERC license application, and assisted the District with responses to queries from the various interested state and Federal agencies. Subsequently, Bechtel completed final project design, prepared procurement and construction contract documents, and assisted in project startup. The unit commenced commercial operation in October 1982.

<u>PROJECT TYPE:</u> Multipurpose water resource facility

<u>PROJECT:</u> New Don Pedro

<u>LOCATION:</u> Central California

<u>CLIENT:</u> Cooperative

<u>PROJECT DESCRIPTION:</u>

The project, on the Tuolumne River in central California, is a cooperative, multipurpose project for irrigation, power, flood control, and municipal water supply. The Turlock and Modesto Irrigation Districts, the City and County of San Francisco, and the U.S. Corps of Engineers joined together to build a 585-foot high, earth and rockfill dam to create a 2.03-million acre-foot reservoir and develop 155 MW of hydroelectric power. The new structure supplants and inundates the existing 284-foot high Don Pedro Dam.

Bechtel responsibilities included consultation, evaluation of site foundation exploration, investigation and tests of construction materials, and an extensive preliminary design and cost estimate. Bechtel also prepared and presented data required for Federal Power Commission hearings, and was responsible for final design, plans and specifications, and construction management.

<u>PROJECT TYPE:</u> Hydroelectric facility

<u>PROJECT:</u> South Fork American River Development Project

<u>LOCATION:</u> California

<u>CLIENT:</u> El Dorado County Water Agency

<u>PROJECT DESCRIPTION:</u>

Engineering studies for the further development of the hydroelectric potential of the South Fork American River have been conducted periodically since the 1900s. In 1975, the El Dorado County Water Agency (ECWA) filed an application with the Federal Power Commission for a preliminary permit for the development of the South Fork American River (SOFAR) Project.

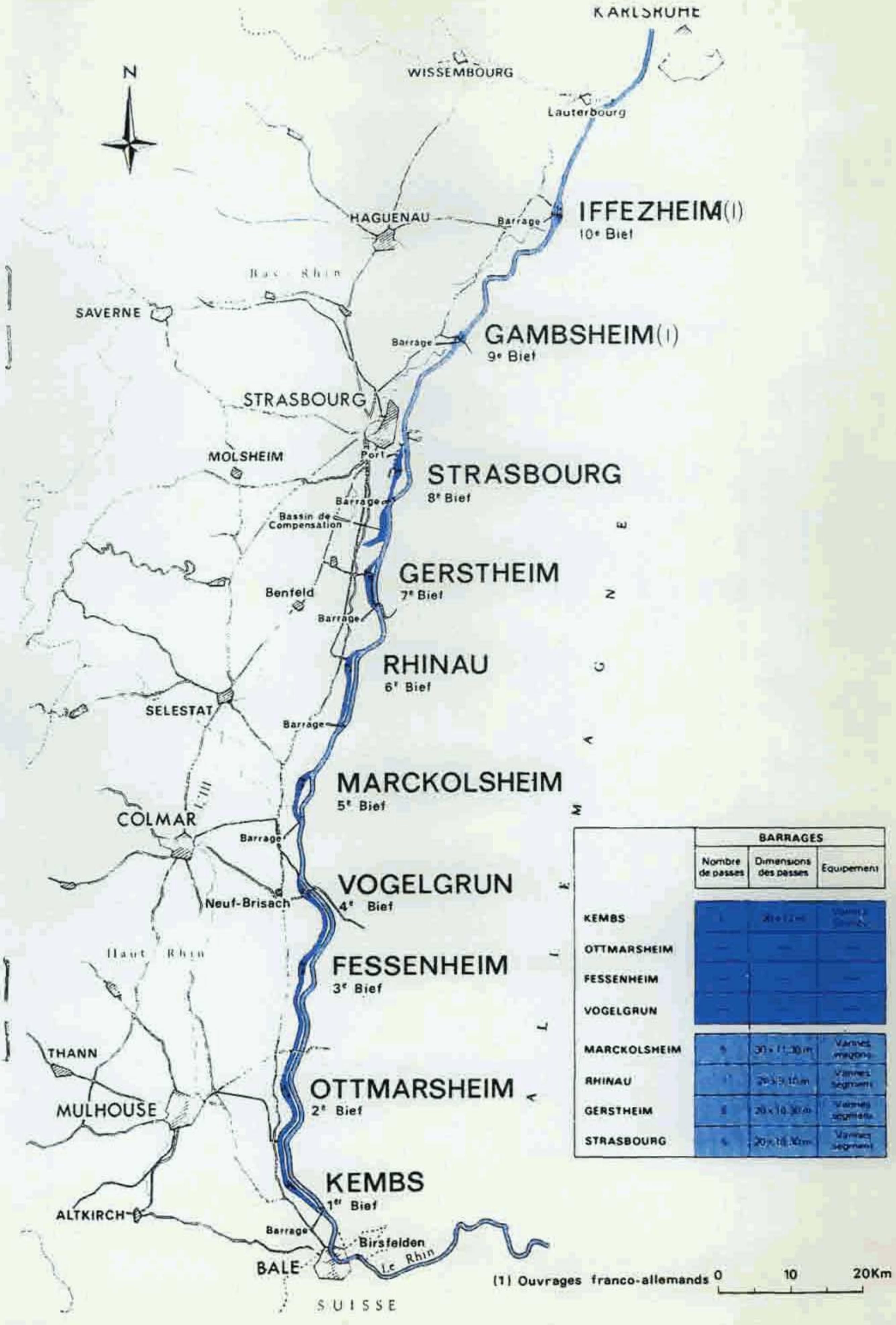
In January 1978, ECWA contracted with Bechtel for engineering services to perform studies of the project and prepare a license application to the Federal Energy Regulatory Commission (FERC). Prior to submitting the FERC license application, engineering studies were required to further refine the existing project plan and to establish project feasibility. These studies were based on previously developed plants and on new geologic and hydrologic investigations performed by other consultants.

ENVIRONMENTAL EXPERIENCE - HYDROELECTRIC PROJECTS (Cont'd)

Bechtel performed a comprehensive review of the project plan and alternatives to it. Modifications and improvements to the alignment of conduits and the layout of dams resulted in substantial cost reductions, and improved the project capability to a total of 180 MW at five power plants. Bechtel completed its feasibility report in October 1978, and assisted in preparation of the FERC license application which was submitted in July 1979.

Annex 17

French and Franco-German canal schemes on the River Rhine



	BARRAGES		
	Nombre de passes	Dimensions des passes	Equipement
KEMBS	[illegible]	[illegible]	[illegible]
OTTMARSHEIM	—	—	—
FESSENHEIM	—	—	—
VOGELGRUN	—	—	—
MARCKOLSHEIM	[illegible]	30 × 11,30 m	Vannes wagons
RHINAU	[illegible]	[illegible]	Vannes segment
GERSTHEIM	[illegible]	20 × 10,30 m	Vannes segment
STRASBOURG	[illegible]	[illegible]	Vannes segment

Annex 18

New Scientist, 16 July 1994

(Extract)

Rising water drowns opposition to Slovakia's dam

Fred Pearce, Budapest

WHEN Slovakia diverted the River Danube 20 months ago there was an international chorus of protest about its likely ecological impact. Now embarrassed chiefs at the World Wide Fund for Nature (WWF), the organisation that led the protests, are admitting that the project, at Gabcikovo on the Hungarian border, may be good for the environment after all.

The organisation's director-general, Claud Martin, has halted WWF's campaign against the diversion, after receiving detailed scientific refutation of the claim that the dam is causing an ecological catastrophe. His European director, Magnus Sylven, last month apologised to Slovakian scientists, saying "how embarrassed I personally feel about WWF's past involvement" in the campaign against the dam.

The project seems to be having the opposite effect to that claimed by the WWF as recently as last month. It is reviving an almost desiccated wetland and recharging underground water supplies.

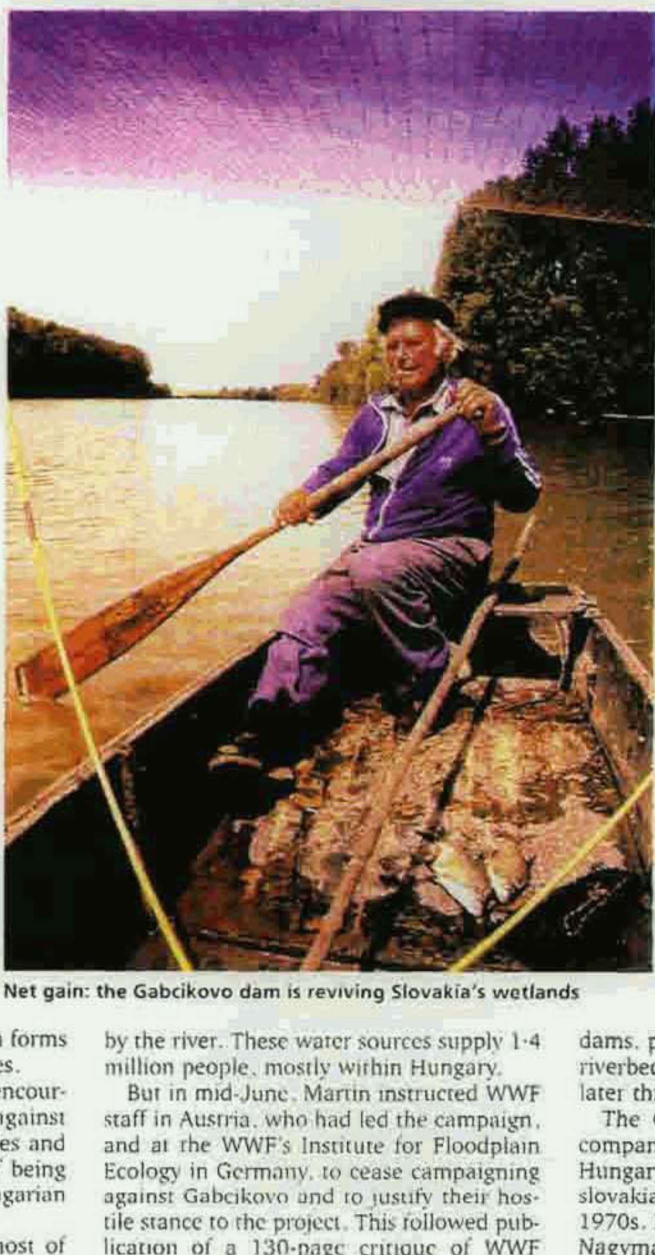
The about-turn by WWF, the world's largest and most influential environmental group, could help to resolve the long dispute between Slovakia and Hungary over the diversion of the river, which forms the border between the two countries.

The WWF has for several years encouraged an international clamour against the scheme. But Slovakian authorities and scientists have accused the WWF of being politically motivated in backing Hungarian opposition to the diversion.

The Gabcikovo scheme diverts most of the flow of the Danube into a raised canal 40 kilometres long built entirely within Slovakia. The canal contains a hydroelectric dam at Gabcikovo, which now provides Slovakia with 10 per cent of its electricity.

Gabcikovo was originally part of a larger joint hydroelectric scheme agreed between the two countries in a treaty signed in 1977. Hungary abandoned its half of the scheme in 1989, during the political turmoil that preceded the end of communist rule, and formally withdrew from the treaty months before the Gabcikovo dam was completed in 1992.

The Hungarian government claimed, with support from the WWF and others, that Gabcikovo would dry out a large forested wetland beside this stretch of the Danube and either empty or pollute important underground water sources fed by the river. These water sources supply 1·4 million people, mostly within Hungary.


Paul Massey/Frank Spooner

Net gain: the Gabcikovo dam is reviving Slovakia's wetlands

But in mid-June, Martin instructed WWF staff in Austria, who had led the campaign, and at the WWF's Institute for Floodplain Ecology in Germany, to cease campaigning against Gabcikovo and to justify their hostile stance to the project. This followed publication of a 130-page critique of WWF statements on the project by Igor Mucha, a leading Slovakian hydrologist.

"We've not taken a firm position yet," Martin told *New Scientist* this week. "I've sent Mucha's report to our specialists. Until they complete their analysis, we have no grounds to continue the campaign."

Sylven went further in a letter to Mucha. In it, he praised the analysis and promised that "there will be no further involvement from WWF unless a formal request is received from the Slovak side, which, of course, we do not expect".

Last year, the organisation won wide publicity for a claim that industrial chemicals had seeped from the canal into wells within five weeks of the dam closing. But the pollution—which Mucha says occurred too soon after the diversion to be linked—has not recurred.

Meanwhile, the Slovakians have altered the project in order to quell environmental fears. Since May 1993, they have regularly fed part of the diverted water back into the wetland, reviving branches of the Danube that have been largely dry for 30 years.

According to Miroslav Liska, a spokesman for VV Bratislava, the state-owned firm that designed the project, the flood plain has been drying out for 30 years. "This was due to dams built in Austria which changed the hydrology of the Danube, causing it to erode its river bed," he says. "The river water only rose high enough to enter the old arms of the river for less than a month each year, during the highest floods."

Far from destroying the wetland, says Liska, "our scheme has revived it, by finding an efficient way to get water into the branches. The Hungarian part of the wetland could improve just as ours has, but they refuse to join the project."

Instead, the Hungarians are about to embark on an expensive attempt to revive their wetlands using the depleted waters of the old River Danube. According to Gyorgy Tatar, a Hungarian Foreign Ministry official responsible for the Danube dams, pumps are being installed in the old riverbed and will probably begin pumping later this month.

The Gabcikovo dam, and an intended companion downstream at Nagymaros in Hungary, were planned jointly by Czechoslovakian and Hungarian engineers in the 1970s. In Hungary, hostility to the dams at Nagymaros and Gabcikovo grew in the 1980s and became the focus for opposition to the communist government.

The two countries have taken their dispute to the International Court of Justice in The Hague. Slovakia claims that Hungary acted illegally in reneging on the 1977 treaty. Hungary says its action was justified by concern about the ecological impact of the scheme, and that Slovakia acted illegally when it diverted the Danube unilaterally. But recent changes in government in the two countries, and the failure of environmentalists' fears to materialise, may ease the way to a settlement of the dispute.

Few outsiders believe that the Nagymaros dam, whose foundations currently blight the Danube Bend, one of Hungary's outstanding beauty spots, will ever be completed. ■

Annex 19

New Scientist, 17 September 1994

(Extract)

Dam truths on the Danube

Condemned as an ecological disaster in the making, plans to dam the Danube were among the most controversial in Europe. But, as Fred Pearce reports, environmentalists may be forced to eat their words

ENVIRONMENTALISTS forecast an ecological catastrophe two years ago when Slovak engineers diverted the River Danube down a new 35-kilometre ship canal to a hydroelectric dam. One of Europe's last flooded forests would dry out, said critics, and wells would empty and become fetid with pollution. Neighbouring Hungarians claimed the diversion was illegal and that their waters had been "stolen" and a million people could lose their drinking water.

Yet, the ecological disaster hasn't happened. The forest is still flooded, the trees healthier than for years, and the wells mostly clean and full. The Slovak engineers are claiming the canal is an ecological boon, returning the forest on their side of the border to a state of wetness not seen for 30 years. "We have separated the navigational and commercial function of the river from its ecological function," says Miroslav Liska, a senior engineer on the Slovak project. "This gives us a unique opportunity to develop this section of the river in its natural form."

As the Slovak wetland blooms, the environmental case against the canal and dam at Gabcikovo seems to be wilting. The World Wide Fund for Nature, once the project's most outspoken green opponent, has abandoned its campaign (This Week, 16 July). Meanwhile, with the Hungarian side of the wetland drying out fast for want of a few minor engineering works, the new prime minister in Budapest, Gyoula Horn, wants a summit to resolve the dispute.

The Danube is Central Europe's largest river. It rises in the Black Forest of Germany and flows east through the Austrian Alps, and across the Central European plain through Slovakia, Hungary, former Yugoslavia and Romania into the Black Sea. As it joins the plain, the river slows and deposits gravel and silt carried from the Alps. Over thousands of years, it has created an inland delta stretching east from Bratislava, either side of the Slovak-Hungarian border. Across the delta, the river has fed a wetland of river branches, pools and backwaters that sustain a large flooded forest. The delta is also Central Europe's largest underground reservoir of water, with a capacity of up to 20 cubic kilometres.

But the delta is also an inconvenience. The river's shallow channel makes it difficult for river traffic to pass for large parts of the year. So, in the 1960s, the governments of Hungary and Czechoslovakia drew up a plan to bypass the wetland with a raised ship canal. This would form part of a grand plan, now largely complete, to link the Danube and Rhine river systems so that ships could pass from the North Sea to the Black Sea.

In 1977, the two countries signed a treaty to build the

Waterworks: bypassing the wetland with a raised ship canal, with locks at Gabcikovo, allows ships to pass from the North Sea to the Black Sea. The port of Bratislava has already seen an increase in business

navigable canal and, at the same time, to raise two hydroelectric dams: the Gabcikovo dam in Slovakia, and the Nagymaros dam on the picturesque Danube Bend near Budapest. As the project gathered momentum, however, scientists on both sides of the border expressed fears about the environmental consequences. In Hungary particularly, where the project was inextricably linked to unpopular Communist rule, biologists worried that the dams would damage both the treasured scenery of the Danube Bend and the underground water reserves on which more than a million Hungarians depend.

The Danube Circle, a group of scientists and political activists formed in Budapest to fight the Nagymaros dam, became a major political force. It brought tens of thousands of people onto the streets in 1988, in the first great protest that brought down Communist rule. Janos Vargha, founder of the Danube Circle, told me in 1989, the year the Communists fell: "For us, the energy and water lobbies represent the Stalinist structure. Water projects here are paramilitary, centralised, undemocratic and monolithic."

'Though built to improve navigation and provide power, Gabcikovo gave engineers the chance to right much of the damage'

Since the revolution, the Hungarian parliament has halted all work at Nagymaros (where the dam foundations currently lie abandoned), and opposed any involvement in completing its upstream companion at Gabcikovo and the associated canal, which lay partly on Hungarian territory. In Bratislava, however, the canal and dam at Gabcikovo came to symbolise Slovak nationalism and, when the Hungarians refused to cooperate, the Slovaks took matters into their own hands. They moved the site of the canal's diversion 10 kilometres upstream, from Dunakiliti to Cunovo, where the river runs entirely through Slovakian territory, and then spent the equivalent of $200 million building new diversion works.

In September 1992, the Hungarians formally abandoned the 1977 treaty on environmental grounds. They demanded that the Slovaks join them in a new environmental assessment of the project before any more work was done. The Slovaks were not impressed. A month later, nine weeks before their country gained its formal independence from the Czech Republic, Slovak engineers diverted the Danube along the new high-level canal that they had built between Cunovo and Gabcikovo.

Amid a welter of hostile propaganda, in which the international press largely sided with Hungary, both countries agreed to take their dispute to the International Court at The Hague, which begins hearings next year. The Court will have to rule not on the heavy political symbolism behind the dispute, but on the science and law. Was Hungary justified in reneging on the 1977 treaty? Was Slovakia justified in taking matters into its own hands and unilaterally diverting an international river?

Liska, who works for VV Bratislava, the Slovak state hydroelectric company that designed the canal and dam at Gabcikovo, believes there is only one possible answer. For several years he has spoken at international meetings and briefed journalists about how the diversion would benefit the environment. Few listened. Now, he says, he can demonstrate the truth of his campaign.

I drove with him along the old foresters' roads of the Slovak half of the Danube wetland, between the canal and the old river bed. The poplar, larch and willow forest appears, as he promised, to be in good health, with running water everywhere. In early July, several of the roads were part-submerged.

Three years ago, when the canal lay complete but empty, I interviewed people living in the three wetland villages, Vojka, Dobrohost and Bodiky. Their sliver of land between the canal and the river, 25 kilometres long and a kilometre wide, was all but cut off from the rest of the country. The vast canal, capable of carrying more than 5000 cubic metres of water a second, was in places 700 metres wide and rose sometimes to 16 metres above the surrounding land. Sitting on an earth embankment, the canal passed houses at roof height. The villagers were frightened. On the empty inside of the canal, they had daubed giant slogans such as, "Stop the water monster"

Today, the water-filled canal remains a dreadful eyesore, bludgeoned across a flat landscape. It has annexed 40 square kilometres of farmland. Around it, a further 60 square kilometres, half of it wetland forest, are wasteland—cleared by bulldozers to make way for the reservoir that the diversion works at Dunakiliti were expected to impound—or flooded by its replacement behind the new works at Cunovo. Meanwhile, less than 10 per cent of the original flow of the old Danube remains—a dribble inside the channel of a mighty river, which has caused "huge damage to all water organisms" in the old river, says one Slovak biologist.

Yet the wetland itself is thriving and there is peace in the villages. The mayor of Vojka village, Ladislav Nagy, told me as he waited to take the ferry across the canal: "I took part in meetings that opposed the project," he says. "But people know now that there is no danger. The river branches are full of water and we have a new road, a clinic and sewers."

So what has happened to the wetland? Before the canal was built, the wetland was dying a far from natural death. The old Danube was eroding its bed so deeply that it only rarely had enough water to flood the wetland. Since 1993, however, Slovak engineers have remedied this to a remarkable extent by diverting a small part of the flow of the "new" Danube in the canal back into the wetland.

The Danube, which until 40 years ago did a great deal of depositing material in the inland delta but very little erosion, suddenly ceased depositing material and increased its ability to erode the bed. The erosion has been so intense that the level of the river bed has sunk by up to 2·5 metres over 30 years. There were three main reasons for this change.

Past mistakes

First, dredging of the river by the Slovaks in the 1970s and 1980s around Bratislava increased erosion of the river bed downstream. The dredging was carried out in a misguided attempt to save the old part of the town from flooding, to improve access to the town's port and to provide materials for construction work, including the Gabcikovo project itself. Secondly, works aimed at straightening and narrowing the river channel to improve navigation, also increased flow rates—and a faster river erodes more.

Thirdly, the construction of dams upstream in Austria, beginning in 1957, held back an estimated 600 000 cubic metres of gravel a year that was once carried down to the delta and deposited there. This both halted the deposition downstream and made the river, now carrying much less material from the mountains, better able to erode and pick up debris from its bed and banks.

The erosion progressively cut the Danube off from its wetland. In 1960, according to Mucha, 20 per cent of the Danube's flow was entering the branches on the wetland. By 1990, river water was reaching most branches on only 17 to 20 days each year, during major floods. Even the two main outer channels of the Danube received water for only about 80 days a year. As a result, over 30 years, fish stocks diminished, the native wild carp came close to extinction and the water table fell fast within the flooded forest, which lost a tenth of its trees.

Flooded forest: enough water for fishing, for those living on the right side of the border

Though built to improve navigation and provide hydroelectric power, the Gabcikovo scheme gave Slovak engineers the chance to right much of the damage, says Liska. It provided a new way to deliver water to the wetland. Since May 1993, Slovak engineers have routinely diverted up to 10 per cent of the flow of the canal onto the wetland near Dobrohost. On the wetland, they have built raised banks and culverts to control the flow of water across it—a highly artificial, but highly effective, way of keeping the territory flooded.

"We have all the tools necessary for water management here," says Liska. The wetland usually receives between 30 and 50 cubic metres of water a second from the raised canal. It may not seem much but delivering water from a raised canal is more efficient: to achieve the same degree of saturation delivering water from the old, lower, river bed would require a flow of 4000 cubic metres a second.

'We have always said that if there were ecological problems with Gabcikovo, we would find engineering solutions to them. And we have been proved right'

Engineers and scientists are still experimenting with the wetland watering system, says Liska. It can supply much more water if necessary: the capacity of the channel linking the canal and wetland is 234 cubic metres per second. This volume, combined with temporary blocking of culverts, would flood three-quarters of the wetland, though such flooding is probably necessary only twice a year, to saturate soils and leave behind a smear of silt, he says.

Water battle

Recharging the wetland and creating the reservoir at Cunovo will replenish underground water reserves, too. In the Slovak half of the wetland, the water table near Bratislava has risen by 3 metres, and 50 kilometres downstream it is still 50 centimetres higher than before. Recharging the groundwaters occurs at an average rate of 18 cubic metres a second, up by 40 per cent, and enough to supply 5 million people.

The next, and critical, step is to bring the waters of the wetland and old Danube together, in particular so that fish can swim into the still waters of the wetland to spawn. Slovak engineers plan to build small weirs across the old river bed to hold up the flow of the river, raising its level to that previously seen during average flows. But the Hungarians have refused to allow the Slovaks to tamper with the river where it is jointly owned. They claim it would destroy the old river for ever.

J. Vincent

Before and after: river branches that used to be empty for up to 11 months of the year are now permanently filled with water

Until the legal dispute is resolved in The Hague, the Hungarians have demanded that more water be put into the old Danube river. The European Union has tried to create an interim agreement. But the Slovaks object to the EU's schemes, because they would drastically reduce the power generated by Gabcikovo, which now provides 1700 gigawatt-hours of electricity per year—10 per cent of Slovak output. "Releasing water into the old river bed, as the Hungarians demand, is a waste of water," says Liska.

Gyorgy Tatar, Hungary's chief commissioner for dams, scoffs at the Slovak story of environmental recovery and warns of damage to come. "The Slovaks will show you that there is plenty of water. But that is the surface," he says. Below ground there is hydrological chaos. "Near the project, the groundwater is higher than it should be. The trees are standing in water and will drown. Further away, the water level sinks and the vegetation is suffering. Our experts say that, maybe in five years, maybe in three years, but for sure they will die as well."

On water quality, Tatar again had dire warnings. "Our scientists estimate that in maybe 10, maybe 15 years, the underground water reserves of Hungarians will deteriorate for sure. The main reason is the dirty water standing in the reservoir, which infiltrates into the underground reservoir."

Liska has a three-point answer for Tatar. First, the river is less polluted than a decade ago. Secondly, pollution will not penetrate underground to the gravel layers from which drinking water is taken, because of intervening layers of mud. And third, the water from the reservoir will, if anything, flush out nitrates and other agricultural chemicals in the surface layers, which might one day be fit enough to irrigate farms.

Mucha says that there was some deterioration in groundwater quality near the reservoir in the early stages of filling, especially on the Hungarian side. But "in general, groundwater quality is unchanged or in some places . . . improving". These are early days, however, for assessing any long-term consequences for underground water quality. However, the Hungarians believe any risk is too great. "Contamination will be irreversible," says Tatar. "The Slovaks say that if something happens, they will take steps. But this is not an environmental way of thinking." Liska admits that this is the pragmatic approach he and his compatriots have chosen. "We have always said that if there were ecological problems with the Gabcikovo scheme, we would find engineering solutions to them," he says. "And we have been proved right. You can call this a fix-it philosophy. Environmentalists oppose it. But it is not irresponsible. We know problems can be solved."

The essence of the Hungarian case in the International Court will be that with the rise of ecological concerns and the fall of the Iron Curtain, the 1977 treaty should have been suspended and the dam construction put on hold. But, claim the Slovaks, the status quo was not an option. "The Hungarians say we should have waited while research was done," says Liska. "But meanwhile the wetland would have died."

An important contribution to the debate has come from Juraj Holcik, a biologist at the Slovak Academy of Sciences in Bratislava. Holcik was the only scientist recommended to me by all sides: Greens, Slovaks and Hungarians.

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Unilateral diversion: **the Slovak diversion of water from the old Danube to the new 35-kilometre canal is reviving Slovakia's wetlands**

P. Brenkus

Three years ago, he had told me that Gabcikovo was a "megalomaniac scheme". But his outlook seems more hopeful in a recent review, published by the East European Environmental Research Institute in Budapest, a body run by Vargha, the founder of the Danube Circle.

Though he is being cautious, he nonetheless concluded that "conditions in the inland delta similar to those prior, although artificially created, could probably be obtained". But this, he says, depends "solely on the dynamic interaction between the main channel and the waters of the inland delta [being] successfully simulated, with the preservation of the natural seasonal fluctuations of flow." The task, he adds, "is to eliminate all negative impacts and to optimise the whole system as much as possible. A lot of this has already happened."

Knock-on effects

The problem for the Hungarians today is that many of their complaints about Gabcikovo are the result of their own decisions. Thus, parts of the Hungarian wetland are drying out. But this is because they refuse to use the works at Dunakiliti to revive it. Instead in April, the Hungarian parliament voted to begin pumping water out of the old river bed into its side of the wetland. This, Tatar admits ruefully, is "very expensive", costing more than £7 million a year.

Something has to give. And the governments are delicately exploring common ground. In Hungary, elections in May replaced right-wing nationalists with a coalition dominated by former reforming Communists. Prime Minister Horn says he wants a settlement and, according to Tatar, "the coalition approaches the dispute more flexibly". A breakthrough could come after elections for a new parliament in Slovakia this month.

But the room for manoeuvre is small. The Slovaks are adamant that the half-completed Nagymaros dam must be finished. If complete, they say, power output at Gabcikovo could be raised by about 50 per cent, without the risk of greater surges of water downstream flooding Budapest. But Tatar says: "It is very difficult for me to imagine us building the Nagymaros dam now. I don't think any political power here could take the risk of doing it. If, in the extreme case, the Court said we had to build, we would probably rather pay compensation." And that could well be the final outcome.

On one thing, however, Liska, Hungary and the Greens agree. Once you start to engineer a river, there is a knock-on effect. A dam upstream causes problems downstream that engineers will resolve with another dam, and then another. "Regulation on one part of a river pushes the problem downstream and so once regulation starts, it must be completed," says Liska. Thus, the Austrian dams required Gabcikovo. Gabcikovo requires Nagymaros, and so on.

He predicts that with Gabcikovo complete, the river bed will erode around Nagymaros, making navigation there increasingly difficult, until there is a dam. Ultimately, he agrees, there is no alternative to continuing to build, until the Danube is turned into a series of steps all the way to the sea. As a dam-builder, Liska is happy with that idea. Along the way, they will generate hydroelectric power, improve navigation—and protect or improve the environment where they can, he says.

But environmentalists see only a very expensive disaster along this route. Elsewhere in the world, they have often been proved right. But maybe at Gabcikovo, the engineers will at last show that concrete and asphalt can, if properly used, have positive consequences for the environment. What both sides agree is that you have to go forward or back. Standing still may be the worst option of all. □

Annex 20

(Translation)

Effect of the System of the G/N Project on Subsurface Water supplies of the Kisalföld Area and the Influence of Respective Cascades, I. Nagy, Inžinierske Stavby, Vol. 42, 1994, No. 1

EFFECT OF THE SYSTEM OF THE HYDROPOWER PROJECTS GABČÍKOVO-NAGYMAROS ON SUBSURFACE WATER SUPPLIES OF THE KISALFOLD AREA AND THE INFLUENCE OF RESPECTIVE CASCADES

Imre Nagy

The article is focused on actual problems concerning drinking water supply in the area of Szigetköz and Kisalföld in Hungary. Present state of groundwater stores and the influence of the Danube discharge have been analyzed. Essential factors involved in the operation of the riverpower project Gabčíkovo-Nagymaros are summarized.

Recently the inland unprofessional press presents more and more frequently statements presented as scientific ones asserting, that in case of putting the hydropower projects on the upper Danube into operation the adequate drinking water supply would be jeopardized for 45 % of the population. Watermanagement organizations /bodies/, supplying currently already 92 % of population with drinking water /9,6 mil. inhabitants/, daily water consumption being about 4 mil.m3/, accept with lack of sympathy these incomprehensible and scientifically unauthorized false statements. They would not even answer them if some social corporations and circles would not take them as serious, and would not be come concerned about the future of the country.

The mentioned value 45 % assumes on the Danube river reach about 30 km long a drinking water capacity of about 1,8 mil.m3, however the actual maximum utilizable water supply, infiltrating through river banks, is about 300 000 m3 per day. From this amount about 100 000 m3 per day is used on the 30 km long reach. Thus, the assertion is exaggerated - multiplied by the order of 18 /21/.

It is therefore inevitable to summarize the facts involved in the operation of river power projects, as well as data about the actual conditions of drinking water supplies at Szigetkoz, and Kisalfold, and about the interaction of the Danube waters and groundwaters, as well as the facts involved in the virtual problems of drinking water supply. We would like to focus attention on solution of actual tasks instead of fictional and delusive issues /12/.

Fortunately, the region of the upper Danube is one of the most thoroughly investigated territories. Since 1951 a field and laboratory research and mathematical model studies have been carried out here, being often basis of references in international professional literature, so that the foreign experts would be able to decide easily about their professional opinion.

PRINCIPLES OF DISCHARGE ALLOCATION BETWEEN THE OLD DANUBE and THE HEADWATER CANAL

It is well known in the professional circles that the System of the Hydropower Projects Gabčíkovo-Nagymaros /GNP/ was designed as to provide:

a/ the passage of the anticipated /assumed/ long-term largest flood discharge, to contribute by the by-pass canal, having a role of a lateral branch, with a capacity of more than 5 000 $m^3.s^{-1}$, to flood protection increasing in the adjacent area,

b/ daily regulation of medium and lower discharges by means of temporary water retention in the reservoir Dunakiliti, in accordance with ecologic, powerproduction, and navigation requirements,

c/ to attain optimum regulation of operation with regard to technical-ecological requirements and taking into consideration the natural discharge regime at negligibly changed continuous, so called dynamic /wave/ operation.

International conference held in Boston in 1984 /4/, which dealt with the issues of the dynamic regulation of hydroelectric power projects operation, had determined the principles of optimum operation. The substance of the principles is to subordinate the power production to initial and limiting requirements of the environment.

In our case following is to be provided: ecological balance of the Dunakiliti reservoir and of the old Danube channel, optimum conditions of groundwater levels at Szigetkoz, and safety of withdrawals of bank infiltration waters concerning their chemical-biological quality and quantity.

Mosonyi,E. expressed exactly the principles to be kept at dynamic /flexible/ operation of river power projects with low stream gradient /13/. On this basis Kollár,F. /8/ outlined the aspects of a purposeful operation of the GNP. Later, Nagy,I. and Rátky,I. /16/ executed a mathematical simulation of ten variants of mathematical-energetic production models in such a way, that the power production was restricted by ecological limiting conditions. Thus also conditions for determination of principles of the optimum technical-ecological dependence were created /Nagy,I.17/. The Commission for Watermanagement Sciences of the Hungarian Academy of Sciences adopted its approach to this topic /12/ and Mosony,E. elaborated in his study /14/ technical and economic aspects of small hydroelectric power plants.

Basic elements of the optimum mathematical modelling /simulation/ of a system of operation for the area concerned /with regard to ecology and quantity/ at lower than average discharges without ice cover, are as follows:

1. A new and successfully applied model of continuous discharge, based on the principle of the linear cascade system, affording daily information on expected inflow discharges and utilizable working volume of the upper reservoir.

2. Models characterizing the ecological conditions and giving review on water quality over the whole used section. By means of these models according to data from the monitoring system on water quality and ecology /depending upon the waste water loading and discharges/ the limiting /guaranteed/ hydraulic conditions /water stage, discharge, minimum and maximum velocity/ are determined, safeguarding the required environmental quality.

3. The Central operation control of hydroelectric power plants obtains continuous information on the number of operationable aggregates, on reached output, on transmission outputs at different voltage, on requirements of the Hungarian and Slovak energetic control systems.

4. The energetic partial model determines on the basis of limiting ecological, quantitative, and navigation conditions the daily chart /diagram/ of feasible electric operation. According to these data the electric control system adapts its requirements from the quantitative and time aspects. The model confirms backwardly the requirements, and the final operation stage occurs as the results of an iteration process.

5. A hydrodynamic partial model enables to forecast changes in water stages, velocities and withdrawal of water for the whole reach from Bratislava to Budapest with respect to navigation, recreation and sport.

6. According to continuous signals of the monitoring system on actual water quality conditions control computations are carried out in the course of the day concerning the required hydraulic state, and in case of need /on the basis of comparison with the electric distribution systems/ the diagram of water power utilization is to be modified.

7. Phenomena like groundwater level, ecologic characteristic of the river channel and river banks, etc. /observed by the monitoring systems/, are evaluated in dependence upon the character and extent of changes seasonally or annually, and it is inevitable to apply the modification also in water quality and ecological models.

It is in the interest of a continuous functional operation of the mentioned system of models to establish a joint Hungarian-Slovak monitoring system, as well as a common control centre.

RELATIONSHIP BETWEEN THE GROUNDWATER AND THE WATER COURSE

Since at the beginning of the construction a detailed method of operation had not been elaborated yet a Study of environmental protection was worked out in 1985. /8/ This study, assuming the concept of the "peak wave", tried to estimate one possiblitiy of the relationship between the water course and groundwaters, and concluded that under assumed operation stages the adjacent area is on certain places supplied with the Danube water with an amount of 0,4 to 0,8 m3.s-1.km-1. As far as this exaggerated estimation is concerned Erdélyi.M. /1/ remarked, that if this value is true, then water supplying from the Danube may be extended almost over the whole Kisalfold. Then, the water quality could be endangered by damming up over 10 to 15 hours, representing about 20 % during the year. Assumed extent of sedimentation in the reservoir was, however, determined only by means of judgement, since formation of the final system of flowing in the reservoir and providing the minimum required velocity of transfer of harmful substances can be solved only on the basis of results of testing operation.

Honti,G. /5/, Ubell, K. /24//25/, and Major,P. /11/ presented variants of possible relationships between groundwataer and the Danube. According to their opinion the most important flow from the Danube may probably occur in the section from the Hainburg mountain chain to the filling structure at Rajka. The northern part of the Gyor valley and Hanság may be supplied by an amount of water 70 000 m3/day.

However, this Danube section occurs already upstream of Bratislava /out of the reach of the Dunakiliti reservoir/, thus the impact of G/N Project is out of question.

The effect of the reservoir is already evidenced on the territory between the Danube and Leitha however the maximum amount of infiltrated water is here only 2 000 to 11 000 m3. km -1 per day /24/. Presumably this is due to the circumstance, that in spite of very thick gravel layers in some places of the subsoil only the upper layer /max.10m/ takes part in the intensive flowing. The gravel layer gets thinner toward the margins of the valley and in some places is closed by an impermeable layer.

Professional estimation of the relationship water course - - groundwater can be based only on data resulting from local measurements, which have been started in 1951 in the reach Rajka-Nagybajcs in eight observation profiles provided with 87 observation probes recording groundwater levels/5/. Joint research activity of VITUKI and Water Research Institute Bratislava /VÚVH/ were extended over the whole Kisalfold /24/, observations being performed in 141 probes /Fig.1/. On the basis of water balance, taking into consideration the effect of precipitation, infiltration and evaporation, following systems of groundwater regime may be identified:

1. There is an alluvial cone on the upper reach in rkm 1 810 to 1850, i.e. groundwaters are supplied here also at low

discharges in the range of about 8 to 10 km. The effect of precipitation is of no importance here and the groundwater level in the distance of abut 200 to 300 m corresponds with the Danube water level.

2. On the more remote territory from the Danube the gorundwater fluctuation during respective flood waves does not follow the water level changes in the Danube, only the effect of recurring flood waves can be observed here. Groundwater level increases on these territories, in winter period after snow melting, and in summer period due to precipitation, in both cases /almost over the whole year/ independently upon the water level in the Danube.

3. Southward from the Leitha and Mosoni Branch of the Danube the transition zone occurs, where the effect of precipitation and the Danube water takes place.

4. In the southern part of the Danube alluvial cone /at Hanság and in the considerable part of RábakozP the groundwater is supplied mostly from precipitation.

5. In the lower reach /e.g.rkm 1 767, area of Komárno/ the extent of a direct influence of the river represents only several hundred meter /Fig.2/. Indirect effect of the Danube was identified only to a distance of about 1 050 to 1 150 m.
Further on the water level alteration in the river does not influence the groundwater regime.

6. Karst waters, as important drinking water source, are to be considered at a bank section about 500 m long, where the interconnection of karstic formations with free water table of the Danube may occur /Dorog-Tokod/. However, since the present level of the majority of karst waters is everywhere above the level of the average water table in the Danube, this condition would not be changed even in case of the damming-up.

With regard to groundwater hydraulics and in accordance with above described knowledge it is evident, that at continuous or wave operation the water cascades have no influence on the present natural state. Controversy was evoked concerning the impact of daily regulation on the old river channel at peak load regime, caused chiefly by the originally considered low discharge in the old Danube - 50m3.s-1, later increased to 300 m3.s-1. Though, the computations concerning the system of groundwater recharging did not confirm these apprehensions. /2/.

The Slovak party has also considered in the new approach as more favourable and real to pass through the Dunakiliti weir a discharge of 400 to 500 m3.s-1, which from the technical and ecological viewpoint, at moderate wave operation, approaches to the optimum. Groundwater regime at Szigetkoz /as compared with the state before damming-up/ would be more favourable, more balanced and in fact the original, or even better interconnection between the Danube and groundwaters will take place. Due to elimination of the effect of culmination waves the original daily working volume in the Dunakiliti reservoir would not be required, so that by additional technical interventions it would be possible by means of guiding structures to crate such conditions in the reservoir, which would provide maintaining of flow velocities and maintain sedimentation below the probable critical value of 0,3 m.s-1.

With regard to the water quality I considered as essential to include in the assumed new interstate agreement the condition, and obligation, that the Slovak party would provide biological treatment of discharged wastewaters, amounting to about 1,5 mil. m3 per day.

UTILIZABLE WATER SUPPLIES

In contrast to exaggerated water amounts, mentioned in the introduction, Ubell,K./24/ states on the basis of data from 141 observation probes, that maximum amount of infiltrating water is only on the territory between the Danube and Leitha, as well as southward of the Leitha, its limiting extreme value being
Q = 2 000 to 11 000 m3.km-1 per day.

This standpoint is confirmed also by measurements and computations /9/, according to which in case of gallery waters the exploitable discharge is 6 600 to 12 500 m3.km-1 per day.

The probable cause of the big difference may be assumed in the fact, that in the first case the circumstance was not considered, that the velocity of groundwater flow decreases abruptly with the depth. Field measurements using radioisotopes executed in the profile rkm 1 548 of the Danube revealed, that velocity decreasing occurs already in the depth of 4 m below the surface and in the depth of 12 to 15 m the flow velocity is 4 to

5-times lower than it could be expected according to physical characteristics of the subsoil /25/. In the upper sandy earth layer the filtration coefficient k=2,1.10-2cm.s-1, and below this layer, in the depth of 12 to 15 m in the gravel sand k=0,75 cm. s-1. In spite of that, at respective measurements lower flow velocities were recorded. Besides it may be stated, that the more intense the water level fluctuations are, the less is the participation of lower laying layers in water transfer.

In addition, it is generally well known, that in case of gravel and sand sediments it is necessary, as to prevent colmation and adsorption, and to provide slow infiltration and adequate treatment, to meet in water resources with bank filtration the prescribed seepage velocity V max = 0,25 m3.m-2 per day, which creates hydrological limits for water exploitation.

The thesis about drinking water supply for 45 % of population of Hungary from the influenced reach of the Danube, presented in the introduction, would mean to provide drinking water supply from the area of Kisalfold for the population of the districts Gyor-Sopron, Komárno, Vas, Zala, Veszprém, Pest, Fejér and Budapest.

In contrast to this these, according to the State general watermanagement plan of 1984, the water stores on the territory between Rajka-Nagybajcs amounts to a maximum of 750 000 m3/day, while 50 to 80 % of exploited discharges originate from water courses, another part is recharged from groundwaters and from water bearing layers of boundary territories /10/. If karst water cooler than 35 C, and water from aquifers are considered, then the potential exploitablitiy of domestic subsurface waters is 15 mil.m3/day. With regard to the stores of aquifers over the country /6,36 mil.m3/day/, the participation of the Kisalfold amounts only to 12% /0,72 mil.m3/day.

Thus it is evident, that the predicate about the alleged shortage of drinking water, jeopardizing 45% of population is unjustified with regard to water stores and proportion of population. These assertments, besides of incorrect influencing of the public opinion are dangerous also with regard to the circumstance, that foreign experts, acquainted with the situation, may be entitled to doubt about the competence and intentions of the reputed Hungarian experts. This predicate is namely wrong, even if the original peak operation would have been considered.

REAL ISSUES INVOLVED IN DOMESTIC DRINKING WATER SUPPLY

Layman slogans, threatening with water shortage in case of G/N Project construction, may simultaneously evoke in the public an illusion, that suspension of the construction will solve our problems with drinking water supply. However the reality is completely different and in the interest of protection of the rudimentary rights of the inhabitants on safe drinking water we cannot admit the diversion of attention from virtual concerns in the connection with water supply.

The Watermanagement Scientific Commission of the Hungarian Academy of Sciences organized a meeting on June 10th 1992 /18/ with invited experts and studied and investigated the state of water supply, and focused attention on several problems:

1. In 3 092 settlements of the country with 10,4 mil. inhabitants 92% /9,6 mil/ consume currently good quality drinking water. The country has at disposal stored of good quality drinking water amounting to 8 - 15 mil.m3/day. From this store is connected on realized capacity of wells 5 mil. m3/day, i.e. theoretically a capacity of 3 mil.m3/day remains for the future development.

From districts chiefly Baranya, Borsod-Abauj-Zemplén, Nógrád, i.e. northern and southern regions, can be considered as backward ones concerning water supply, whole water supply of the districts Komárno and Vas from the area of the GNP is above the national average.

2. Drinking water resources are seriously endangered by so called "scissors" of public engineering structures, i.e. insufficient extent of wastewater treatment and inadequate sewerage. Combined sewer system is provided only for 51 % of inhabitants. The disproportion surpasses 40% and the situation is still more unfavourable if we take into account that only about one fifth of consumed water is treated in biological treatment plants. The self-governing Act No. LXV/1990 again gives priority to water supplying i.e. causes a furhter opening of the "scissors". Although it may be theoretically assumed that also

phosphorus and nitrogen are removed in biological treatment, it will represent a cost increase by about 30 to 40%.

3. Due to the circumstance, that 48% of our water resources are not provided with external protection zones, and only 6% have hydrogeological protection zones, 1 200 water resources are directly threatened by pollution. Thus, it may be expected, that in the near future it will be necessary to close because of pollution about 140 water resources /chiefly in Alfold/, that means loss of capacity of about 300 000 m3 of water per day.

4. According to the research initiated by the Ministry of Environment of Hungary acid rains crate ever increasing threat for water supply. Areal sulphur load amounts to about 40 kg.ha-1 per year and on acid forest soils /area of Mátra/ the permitted load is only 5 kg.ha-1/year. Synthetic fertilizers contribute to soil loading with nitrogen amounting to 10 to 20 kg.ha-1 per year. The load of about 7 kg.ha-1 per year from the atmosphere must be also considered. It is well known, that due to acid load increased releasing very harmful heavy metals takes place, crating unfathomable consequences for human health. According to the present concepts of development of electric power production /along with the dubious programme of nuclear power plant development/, construction of coal power plants /increased sulphur load/ or power plants with gas turbines /increased nitrogen load/ is considered, causing significant increasing of So and Nix content in the atmosphere.

5. According to the estimation of the General Board of Water Management contraction of the scissors of public services /sewerage, wastewater tratmet/ to an acceptable degree would require 520 bil.Ft, and additional 220 bil.Ft would require population water supply/providing and moderate development/. However the Government could grant in 1992 only 17 bil.Ft.

In accord with presently enforced regulations water supply and sewerage must be provided by self-administrations. In western countries charges for public structures amount to 1% of the income of inhabitants. In our country it is 6 to 8%. It is doubtful, whether the population will be able to bear ever increasing costs.

6. The programme of arsenic removal does not proceed.

480 000 inhabitants /100 settlements/ are involved. Nitrogen

pollution is very high especially in Alfold and on the territory between the Danube and Tisza river, where about 2 mil.of inhabitants are potentially jeopardized.

Academician Mosonyi,E. quotes in the literature /15/ a Chinese proverb that "real thirst cannot be quenched by water of fata morgana". In our case, with regard to the whole country "the water of fata morgana" is the water supply of Kisalfold. Though locally very important, it cannot solve water supply problems of the central, southern, northern and chiefly eastern part of the country.

CONCLUSION

To refer, in the case of G/N Project operation according to the original design, to the assumed and anticipated drinking water shortage as evoked "ecological emergency state" is a professional dilettantism, or lack of knowledge. It is a consequence of misunderstanding of facts and realities, which besides moral and economical damages and considerable international, professional and prestige losses represent a danger of diverting attention from actual and topical problems of water supply for the population, of wastewater treatment and vital problems of the environment. The time has come, when without emotions, on the basis of analysis of professional-scientific facts and real social and economic interests the goals are to be settled and together with our Slovak partners the optimum solution presented.

LITERATÚRA

[1] Erdélyi, M.: A Kisalföld hidrogeológiája a vízlépcsők megépítése előtt es után. Földrajzi Értesitő, č. 1-4, Budapest 1990.

[2] Haszpra, O.: A Szigetközi vízpótlás elektromos analóg kismintakísérlete. [Výskumná správa BME]. 1986.

[3] Honti, G.: A Szigetköz talajvíz viszonyainak vizsgálata. In: Ročenka VITUKI, 1954.

[4] International Conference on „Dynamics Benefits of Hydroelectric Power Stations". Boston 1984.

[5] Sixteenth Congress on Large Dams, San Francisco. 1988.

[6] Karádi, G.: A Duna-elterelés („c" változat) hidraulikai lehetőségeinek áttekintése. BME VVI, Budapest 1989.

[7] Kozák, M.: A Dunai vizierömü rendszer tározóinak és csatornáinak nem stacioner áramlási vizsgálata. BME CSAD. 1966.

[8] Környezeti Hatástanulmány. [GNV-17.85–M–3]. Budapest. 1985.

[9] Léczfalvy, S.: Vízművek telepítése, VGI Msz.587. Budapest 1988.

[10] Liebe, P. – Böcker, T. – Erdélyi, M. – Altnöder, S.: Az ország talaj-és rétegvizkészlete. [Štátny vodohospodársky rámcový plán]. Budapest 1984.

[11] Major, P.: A Szigetköz talajvíz helyzete. Vizügyi Közlemények, č. 4, Budapest 1983.

[12] Magyar Tudományos Akadémia Vizgazdálkodástudományi Bizottság. Állásfoglalás a bősi vízlépcső okológiai-környezeti kockazatairól. Budapest 1991.

[13] Mosonyi, E.: A kisesésü vizerő-hasznosítás helyzete, Vizügyi Közlemények, č. 2, Budapest 1989.

[14] Mosonyi, E.: Kis-vizierömüvek müszaki és gazdasági kérdései. Vizügyi Közlemények, č. 1, Budapest 1991.

[15] Mosonyi, E.: Vásárhelyi Pál, Széchenyi István vizgazdálkodási terveinek megvalósítója, Vizügyi Közlemények, č. 3-4, 1991.

[16] Nagy, I. – Rátky, I.: A BNV optimális müszaki-ökológiai üzemszabályozása. [Výskumná správa BME]. Vizgazdálkodási és Vizépitési Intézet. Budapest 1989.

[17] Nagy, L.: Hol tart a folyócsatornázás ökológiai megalapozása? Hidrológiai Közlöny, č. 3, 1991.

[18] Németh, M.: A közmüolló helyzete, várható intézkedések a megszüntetés érdekében. Előterjesztés az MTA Vizgazdálkodástudományi Bizottság vitaülésen, Budapest 1992.

[19] Öllős, G.: Ipari víztisztítás. Müszaki kiadó. Budapest 1990.

[20] Orlóczy, I.: Széchenyi programtervezői munkálkodása és a vizgazdálkodás tervezése, Vizügyi Közlemények, č. 3-4, 1991.

[21] Országos Vizgazdálkodási Keretterv. Budapest 1984.

[22] Vágás, I.: Széchenyi szerepe a Tisza szabályozásában, Vizügyi Közlemények, č. 3-4, 1991.

[23] Varga, P. – Ábrahám, M. – Simor, J.: A magyar Dunaszakasz vizminősége, Vizügyi Közlemények, č. 4, 1989.

[24] Ubell, K.. A Kisalföld déli, Magyarország területére eső részének talajvíz viszonyai, Hidrológiai Közlöny, č. 3, 1959.

[25] Ubell, K.: A folyó és talajvíz összefüggés a Duna mentén, Hidrológiai Közlöny č. 5, 1964.

[26] Zsuffa, I.: A vizgazdálkodás Széchenyi korában és ma, Vizügyi Közlemények, č. 3-4, 1991.

[27] Benetin, J. – Šoltész, A.: Metóda prognózovania vodného režimu pôd v prinečnom pásme. Vodohosp. čas. 38, 1990, č. 6.

[28] Hálek, V. – Mišút, O. – Lindtner, J.: Regulácia hladín podzemnej vody v inundovanej oblasti starého koryta v nadväznosti na upravený režim Dunaja, ramenných sústav a priesakových kanálov. [Záverečná správa ČÚ]. Bratislava, VÚVH 1988.

[29] Szolgay, J.: Zmeny vybraných charakteristík hydrologického režimu opusteného koryta Dunaja vplyvom plánovanej prevádzky VD Gabčíkovo, Vodohosp. čas. 38, č. 2, 1990.

[30] Šoltész, A.: Analýza, prognóza a regulovanie vodného režimu pôd v inundačnom území Dunaja. ÚHH SAV. Bratislava 1989.

Annex 21

Geological Map Series, Hungarian Geological Institute, concerning the hydrology of Szigetköz

(Extract)

C. HYDROGEOLOGICAL VARIANTS

The quadrangle includes the central part of the Győr Basin incorporating the most important ground-water reservoir in Hungary. To our present knowledge the total thickness of the Quaternary complex built up mainly of pervious beds exceeds even 700 m, hence its water resources are apparently more significant than previously assumed.

This region can be referred to as the most accurately studied area in Hungary from the angle of hydrogeology. In the early 1950's eight series of ground-water observation wells were completed along the Danube between Rajka and Győr for preliminary studies concerning the Gabčikovo–Nagymaros Water Dam Project and observed permanently up to the present day by VITUKI (Water Management and Research Institute) and by the Regional Water Management Offices.

Resumption of the construction of the dam in the 1980's prompted again to launch wide-ranging studies in Szigetköz. The observation well network has been reasonably supplemented. In the frame of the Little Hungarian Plain Project, beside drilling shallow boreholes, additional ground-water observation wells have also been established for complementing the existing network. Some of them have been incorporated into the GNV observation system with permanent recording. Furthermore, for the examination of the relationship between ground-water and deep aquifers 2 check-well plants with 3 screened intervals each have been set up (Figs. 3, 4) also with continuous recording.

The data assemblage used for the revelation of hydrogeological conditions of the quadrangle includes the following items:

– 213, 10-m-deep shallow mapping boreholes arranged in a 2.5x2.5 km network;

– 45, mainly 40-m-deep survey boreholes, 31 of which have been converted into ground-water observation wells.

Additional data were provided by the ground-water observation network of VITUKI; by drillings of FTV (Company for Geodesy and Soil Mechanics) deepened in the frame of the cadastral survey of gravels in the Upper Danube valley, and by engineering-geophysical soundings.

Map sheet 6: Hydrostatic level of the ground-water table below the surface
(Compiled by L. Csaba and I. Zsámbok, 1986)

Shallow boreholes representing the main source of information for the compilation of this map were carried out in 1983, the majority of them was completed in the second quarter of the year (Fig. 14).

Upon a 30-year-long recording of water level in numerous observation wells of this area, it can be said that ground-water tables in the period of our surveying were very close to, or exceeded merely by 20–40 cm the multiannual mean level, consequently no correction was needed when plotting the map.

Ground-water levels are clearly distinguishable in the different morphological-geological land units. The Danube makes its course through the most elevated sequence of the alluvial fan in a so-called hanging channel. This condition determines profoundly the ground-water setting of the area, especially its level in Szigetköz. Since, apart from the 1–5-m-thick overburden the alluvial fan comprises only coarse-grained deposits, it is the Danube that permanently refills the reservoir of ground-water percolating toward the Moson-Danube. It comes rather rarely for that the low water level of the Danube prompts its recharge by ground-water. This situation is not directly affected by the distribution of precipitation. The influence of the Danube exerted on more distant areas is illustrated in 2 hydrogeological profiles (Figs. 8, 12).

These figures give evidence that the ground-water flow is directed from the Öreg-Danube toward the Moson-Danube. Propagation of the Danube's floods in the ground-water is well traceable. E. g. the well situated 4.5 km from the river was reached in 10 days by the flood wave. A twofold effect of keeping back waters through the underground and of eventual percolation, respectively, can be observed. The hydrostatic level of ground-water table in Szigetköz ranges between 1–5 m below the surface, consequently, at high water stages it is situated invariably in the overburden while by low water it occasionally subsides into the gravel body.

The Moson Lowland is basically an alluvial fan extending from the Parndorf Plateau (Austria) and descending gradually to Hanság with ground-water level situated at depths between 3–7 m in the gravel body, below the overburden. The influence of the Moson-Danube and the precipitation are of equal importance. The inclination of the surface and the pervious nature of the subsoil promote the influence of the Danube on ground-water conditions, nonetheless the greater the distance from the major channel is the more significant the effect of precipitation becomes. Recordings of an observation well (V–2958) featuring this land unit are illustrated in Fig. 13.

Hanság is the deepest area of the Little Hungarian Plain. Ground-water stored in its thick silty-clayey-peaty overburden is occasionally connected with that of the underlying Quaternary gravel. The ground-water table is situated at a shallow level, between 0–3 m and it is controlled by a network of artificial canals extending all over the area.

The effect of meteorological factors is hardly perceptible. The water regime of the area is represented by time series of ground-water level data recorded in well V–2964 (Fig. 13).

Seepage conditions of the ground-water in the Little Hungarian Plain are illustrated in Fig. 7. Ground-waters flowing from NW, from the Danube and from SE, from Rábaköz, are tapped along the Rábca river and percolate toward Győr. This figure and maps representing extreme hydrogeological conditions (Figs. 5, 6) have been prepared in VITUKI upon a 30-year-long-time series of recordings. This area was previously referred to as a white spot in the national observation network for deep aquifers, therefore, in order to study the relationship between ground-water and deep aquifers, we established two check-well plants with 3 screened intervals each in Halászi and in Tárnokréti.

Their recording started in 1987–1988. Related generalizing lithological sections and the screened intervals are demonstrated in Figs. 3, 4. Curves of the ground-water level recorded by automatically operated instruments clearly show the immediate impact of the Danube not only on pressure conditions of deep layers (350–360 m) in the Halászi (A–1) check-well plant situated close to the river, but on pressure changes occurring in deep beds (170–175 m) of the more distant Tárnokréti (Trt–1) plant as well (Figs. 10, 11). It bears witness to the significant role of lateral recharge even in deep aquifers.

Hydrochemistry

Principal indicators of water quality show that ground-waters of the quadrangle basically possess favourable characteristics. Concerning total dissolved solids content in Szigetköz, values of 1000 mg/l and less prevail. This area bears the best-quality ground-water all over Hungary featured by 20–25 German degree of hardness, 120 mg/l sulphate ions content and zero or irrelevant nitrate content. The Moson-Danube represents simultaneously a boundary of ground-water quality with waters slightly richer in mineral constituents but still of good quality in the Moson Lowland. Their dissolved solids content ranges between 1000–2000 mg/l coupled with a total hardness of 35 German degree, rarely exceeding 50. A conspicuous rise in sulphate content occurs all over the Moson Lowland. Hanság constitutes an individual unit concerning ground-water quality with low values according to all mineral constituents. In its S margin, along the line of the Rábca–Hanság Canal a deterioration of ground-water quality can be experienced.

Because of the limited number of data available, the relationship between the ground-water and deep aquifers has barely been studied so far. The variation with depth of the water quality is illustrated in Table 2.

Map sheet 7: Map of near-surface and deep aquifers

(Compiled by Gy. Erhardt, 1990)

Morphologically the area of the quadrangle is shared by Szigetköz, the Moson Lowland and a part of Hanság. In general terms it is a distinctively lowland terrain incorporating a significant part of the depression of the Little Hungarian Plain.

Hydrogeologically, Quaternary deposits are of particular importance. For the preparation of this map hydrochemical data of wells as well as related information on water budget have been taken into account. With regard to drinking water exploratory drillings, those having the most profound influence on general features have been demonstrated (Table 4).

Description of the aquiferous complexes

Quaternary complex: Drillings conducted in the area give evidence that apart from their uniform surficial extent, they have also been deposited in considerable thickness in the depression showing up as an asymmetrical half-basin in the map sheet area. In the Moson Lowland and in Hanság its thickness ranges between 50–300 m but in the contact zone between Csallóköz and Szigetköz it can attain as much as 500–700 m. This fact highlights its utmost hydrogeological significance ranking it high among the drinking-water-bearing complexes in Hungary.

Essentially all wells of the area for drinking water and irrigation purposes tap this complex, restricting the exploitation of shallow, porous aquiferous Upper Pannonian complexes to the W peripheries overlain by a thin cover of Quaternary sediments. Ground-waters of high yield and good quality can already be located near the surface, therefore the majority of the wells screen porous beds between 40–80 m. The resulting low costs are obviously favourable for drillers but, at the same time, it is disadvantageous from the viewpoint of the more precise hydrogeological reconnaissance of deep aquifers.

Apart from creating this porous complex of high permeability, the Danube is also providing recharge to this aquifer offering excellent chances for securing water from medium depths.

Some specific recordings confirmed assumptions concerning the existence of communication between the Danube and the mighty reserves of ground-water stored in Quaternary deposits, made on a theoretical basis. An example is given in Fig. 10 demonstrating the correlation between the water level records of deep aquifers in observation well Halászi (Arak) A–1 and the simultaneous fluctuation of level of the Danube.

Given the lithology and the conditions of recharge in this area any human interference threatens to upset the delicate equilibrium of nature, since the invaluably precious ground-water resource is extremely liable to pollution.

The immense sedimentary complex filling up the depression shows great facial diversity, for it embraces a broad range of clastic sediments. It is built up of gravel and sandbeds alternating along the profile with fairly important silty and clayey horizons. Ground-water, both phreatic and deeper-situated, along with artesian waters are equally stored by Quaternary deposits. Upon recordings in observation wells the ground-water flow is directed from NW toward SE corresponding to the conditions of recharge. Ground-water flowing in this complex is drained by the valley of the Rába and, further toward NE, by that of the Moson-Danube river.

Pannonian complex: This sequence is the immediate base of Quaternary deposits. Considering cold water recovery it is of a comparatively subordinate importance, however the geothermal energy potential of this widely extended deep aquiferous complex ranks itself high in the order of the natural resources of the nation.

The thickness of Upper Pannonian sequences is around 2000 m at Győr, upon drilling data it attains 2500 m around Bősárkány, but passing toward NW, in the vicinity of the state border it drops back to 1000 m. Porous beds of clays, silts, sands, sandstones and claymarls of diverse facies contain artesian-water-bearing sequences of medium and low transmissibility.

Lower Pannonian deposits occur all over the area but there are no precise data available concerning their thickness. They are at least 900 m thick around Lipót, and about 1200 m thick at Lébény and Bősárkány. They are thinning gradually herefrom toward NW displaying values of 600 m and 100 m in boreholes of Mosonmagyaróvár and Rajka, respectively.

The hydrogeological properties of this complex are determined by the predominance of impermeable layers. It is obvious that this sequence of claymarls, clays, silts, clayey sands and sandstones cannot be utilized for drinking water purposes, nevertheless, along with the lower section of the Upper Pannonian member ("thermal-water-bearing complex") it serves as a basis for local thermal-water exploration and recovery.

To our present knowledge the only thermal-water well exploiting simultaneously the Lower and Upper Pannonian aquifers in the quadrangle operates at Lébény.

Deposits older than Lower Pannonian: As for the Tertiary deposits underlying the Pannonian complex, regarding hydrogeology, there are no data available for a proper interpretation.

In the greater part of the NW sector of the quadrangle the Sopron crystalline schists constitute the basement of Tertiary deposits. Apart from some fissured tectonic zones they show unanimously aquiclude features.

Annex 22

REPUBLIQUE SLOVAQUE
MINISTRE DES EAUX ET DES FORETS

Amenagement hydraulique
GABCIKOVO - NAGYMAROS

Rapport d'opinion sur certains aspects
du projet affectant la mise en exploitation
de la centrale GABCIKOVO

RAPPORT SYNTHESE

HYDRO-QUEBEC INTERNATIONAL
Décembre 1990

TABLE DES MATIERES

1.0 INTRODUCTION

La réalisation du complexe hydraulique de Gabcikovo-Nagymaros sur le fleuve Danube fait suite à une entente intervenue en 1977 entre les gouvernements de Tchéco-Slovaquie et de Hongrie. Ce complexe à buts multiples vise à produire l'énergie hydroélectrique, à améliorer la navigation et à fournir une protection accrue aux inondations. Il comporte deux aménagements: Gabcikovo avec une centrale de pointe de 720 MW située en territoire slovaque, 45 km à l'aval de Bratislava, et Nagymaros, une centrale au fil de l'eau de 160 MW située à 120 km plus à l'aval, près de 30 km au nord de Budapest.

Les travaux de construction ont débuté en 1978. L'échéancier prévoit la mise en service de la première turbine de la centrale Gabcikovo pour 1990 et l'achèvement du complexe pour 1994.

En 1989, le gouvernement hongrois a remis en question la pertinence du projet et a décidé de suspendre les travaux sur son territoire. A la suite de cette décision, la Tchéco-Slovaquie s'est vu contrainte de ralentir les travaux en dépit du fait que près de 95% du projet Gabcikovo est réalisé et que plus de 20 milliards de courones tchéco-slovaques ont été investis. Et récemment, l'opinion publique en Tchéco-Slovaquie a soulevé certaines questions concernant l'exploitation de cette centrale.

Pour apporter une réponse aux problèmes les plus urgents, le Ministère des Eaux et des Forêts de la République Slovaque a demandé à Hydro-Québec International (HQI) d'évaluer certains aspects du projet d'aménagement hydroélectrique de Gabcikovo. Le mandat confié consistait à produire une opinion sur :

- la contamination de la nappe phréatique;
- la méthodologie de prévisions de la variation du niveau de la nappe;
- la sécurité des infrastructures de retenue;
- les études environnementales existantes.

La présente étude d'opinion évalue globalement les études relatives aux quatre sujets cités. En particulier, elle traite de la conception des ouvrages et des méthodologies employées lors des différentes phases d'étude du projet. De plus, elle porte un jugement sur l'ensemble des études consultées pour s'assurer qu'elles respectent les règles de l'art et les standards internationaux. Dans le cas où des problèmes ont été identifiés, elle présente des propositions de solutions.

Une délégation d'experts d'Hydro-Québec International a séjourné du 8 octobre au 7 novembre 1990 en Tchéco-Slovaquie. Elle a eu l'occasion de rencontrer les spécialistes slovaques qui ont travaillé au projet et de visiter les sites et les ouvrages s'y rapportant.

Le chapitre 1 décrit sommairement les activités des experts d'Hydro-Québec International en Tchéco-Slovaquie. Le chapitre 2 fait état de la situation à partir des observations des experts d'Hydro-Québec International sur place et de leurs commentaires. Enfin, le chapitre 3 recommande un certain nombre de solutions aux problèmes identifiés.

2.0 ACTIVITES DES EXPERTS D'HYDRO-QUEBEC INTERNATIONAL EN TCHÉCO-SLOVAQUIE

Pour pouvoir réaliser la présente étude d'opinion, les experts d'Hydro-Québec International ont participé à une séance de présentation du projet et ont visité le complexe Gabcikovo ainsi que l'aménagement de Nagymaros en Hongrie. De plus, ils ont rencontré les spécialistes slovaques concernés.

Plus précisément, les séances de présentation du projet d'aménagement hydroélectrique de Gabcikovo se sont tenues dans les locaux d'Hydroconsult, à Bratislava, les 15 et 16 octobre 1990. Au cours de ces séances, les spécialistes slovaques rattachés à différentes institutions techniques ont présenté l'essentiel du projet.

Les spécialistes slovaques ont présenté aux experts d'Hydro-Québec International des études dans les disciplines suivantes : géologie, géotechnique, hydrologie, hydrogéologie, hydrogéo-chimie, conception des ouvrages de retenue et environnement.

Les 17 et 18 octobre 1990, la délégation d'Hydro-Québec International a visité le complexe Gabcikovo. Elle était accompagnée des spécialistes et des concepteurs slovaques. Cette visite sur le terrain a permis de voir chaque ouvrage de génie civil du projet. Elle a été aussi l'occasion de discussions sur le contenu des nombreuses études et recherches réalisées dans le cadre de ce projet (géologie, hydrogéologie, conception, environnement, etc.). Les experts d'Hydro-Québec International ont visité les ouvrages et les sites suivants :

- le réservoir Hrusov;
- les digues de la rive gauche et de la rive droite du réservoir Hrusov (seulement sur le territoire de la Tchéco-Slovaquie);
- la zone du développement touristique sur la rive droite du réservoir Hrusov;
- le canal d'amenée et la digue sur la rive gauche;
- la digue et les ouvrages sur la rive droite du canal d'amenée;
- l'emplacement envisagé de la fermeture du Danube entre la Tchéco-Slovaquie et la Hongrie;
- la zone d'inondation entre le Danube et le canal d'amenée;
- la centrale Gabcikovo et les écluses;
- le canal de fuite.

Le 22 octobre 1990, la délégation a pu visiter le site de l'aménagement de Nagymaros en Hongrie, la rive droite du Danube jusqu'à Dunakiliti et l'ouvrage de contrôle de Dunakiliti.

Enfin, les experts d'Hydro-Québec International ont rencontré plus de quarante spécialistes slovaques qui ont travaillé, à titres divers, au projet d'aménagement Gabcikovo. Ces spécialistes proviennent de seize organismes différents (bureaux d'études, institut de recherches, université, etc.). La liste détaillée des personnes rencontrées et les noms des organismes qu'ils représentent sont annexés au rapport général. Dans chaque spécialité et domaine d'intérêt, les experts d'Hydro-Québec International ont eu des discussions approfondies avec les spécialistes slovaques concernés. Ils ont également effectué une revue sommaire des documents soumis afin de vérifier les points d'intérêt notés lors des discussions. De plus, ils ont visité le bureau d'ingénieurs-conseils de Viziterv à Budapest et l'École Polytechnique supérieure à Brno, pour voir le système de monitoring mis au point pour le projet.

3.0 ETAT DE LA SITUATION

Le présent chapitre résume les observations et les commentaires des experts d'Hydro-Québec International concernant :

- la prévision des variations et de la contamination de la nappe phréatique;
- la sécurité des infrastructures de retenue;
- les études environnementales existantes.

3.1 Prévision de la variation et de la contamination de la nappe phréatique

Deux aspects de l'hydrogéologie ont fait l'objet d'une vérification technique. Ce sont, d'une part, la méthodologie de prévision des impacts du projet sur les niveaux de la nappe souterraine et, d'autre part, la méthodologie de prévision des variations de la qualité de l'eau souterraine.

Dans le cadre de cette évaluation technique, les experts d'Hydro-Québec International ont eu à prendre connaissance des conditions naturelles pour pouvoir étudier les méthodes de prévision élaborées par les slovaques. Cela était nécessaire en raison de l'importance du lien entre ces conditions et le choix des méthodes le plus approprié.

Soulignons que dans le caadre de cette étude d'opinion les experts d'Hydro-Québec International ont légèrement dépassé leur mandat pour évaluer de façon préliminaire et qualitative les impacts appréhendés sur la qualité de l'eau.

3.1.1 Conditions naturelles

Le projet Gabcikovo est situé dans la plaine du Danube où des dépôts d'alluvions relativement grossières sont très abondants. Les alluvions forment un important aquifère de la région de Zitny Ostrov. Cet aquifère est alimenté en grande partie par l'infiltration d'eau provenant du lit du Danube. Une moindre portion de l'alimentation de l'aquifère provient de l'infiltration des eaux de précipitation et de l'eau des cours d'eau secondaires.

C'est un aquifère libre et continu (i.e. aucune couche imperméable d'importance ne le sépare en compartiments) où l'eau s'écoule d'ouest en est, de Bratislava vers Komarno. Cet aquifère fournit actuellement l'eau de consommation à la population de la région et satisfait les besoins agro-industriels. Environ 7 $m3/^{s}$ est actuellement extrait de cet aquifère et on estime que son potentiel est de près de 18 $m3/^{s}$.

Notons que la qualité de l'eau souterraine varie régionalement et localement selon plusieurs modes différents résultant des activités humaines ou des variations naturelles. L'activité agricole est une source majeure de contamination sur l'ensemble de Zitny Ostrov où on observe la présence de nitrates à des teneurs élevées dans la partie supérieure de l'aquifère jusqu'à des profondeurs de l'ordre de 40 m. La ville de Bratislava et certaines industries provoquent des contaminations locales de la nappe et les variations naturelles du sous-sol entrainent des problèmes d'exploitation à certains endroits en particulier avec les teneurs de Fe et Mn. Toutefois, pour l'ensemble des centres de captage l'eau est de bonne qualité.

La qualité de l'eau du Danube est relativement bonne avec une faible teneur de substances contaminantes en solution. On trouve une charge de contaminants (métaux lourds essentiellement) dans des sédiments. Cependant, cette charge de contaminants n'est pas élevée par rapport aux critères habituels.

3.1.2 Impacts prévus sur les niveaux de la nappe et mesures correctrices

Des études sur modèle analogique ont permis d'évaluer l'impact futur de la mise en eau du réservoir de Hrusov. Ces études démontrent de façon acceptable que les niveaux de la nappe seront rehaussés dans le nord-ouest de la plaine Zitny Ostrov (près du réservoir). Des mesures d'atténuation (canaux de drainage et puits de décharge) sont prévues pour limiter le rehaussement dans cette région. Ce sont là des mesures flexibles et efficaces en autant que le monitoring est bien fait.

Une fois la nappe rehaussée, on prévoit que le débit exploitable de l'aquifère sera sensiblement augmenté. C'est pourquoi un important projet de captage est à l'étude à Dobrohost.

Pour la région en aval de Dunakiliti, deux types d'impacts sont prévus. En effet, près du lit actuel du fleuve, le niveau de la nappe sera rabattu de façon significative avec des impacts appréhendés sur la végétation. Afin de maintenir la nappe près de son niveau initial, on propose de déverser l'eau dans les bras abandonnés et d'y faire des inondations périodiques. Ces mesures d'atténuation ont fait l'objet d'études récentes avec des simulations locales sur modèles mathématiques (ordinateurs) combinées à des essais de colmatage en chantier. Les études relatives à ce volet du projet démontrent le fondement des mesures d'atténuation proposées. Cependant, ces mesures devront être raffinées lors de la mise en service en raison des paramètres qui ne peuvent être définis avec certitude (e.g. le taux de colmatage effectif et les propriétés hydrauliques locales du sous-sol des terrains concernés).

Enfin, à l'aval du canal de fuite, on a construit des coupures étanches sous les digues pour tenir compte des impacts d'exploitation de la centrale Nagymaros. Ces coupures étanches bloquent effectivement la sortie de l'eau souterraine vers les rivières et le Danube. Afin de parer au rehaussement indésirable de la nappe dans ces régions, des puits de pompage sont prévus. Ils permettront de transférer l'eau de la nappe vers les cours d'eau en maintenant des niveaux acceptables.

3.1.3 Impacts prévus sur la qualité des eaux souterraines et mesures correctrices

Hydro-Québec International a été informé qu'il y a des craintes concernant l'impact du projet sur la qualité de l'eau souterraine dans la plaine de Zitny Ostrov. Ces craintes ont trait à trois éléments distincts: en premier lieu, on appréhende que les métaux lourds présents dans les sédiments qui seront déposés au fond du réservoir soient mobilisés et ne viennent à contaminer l'eau de l'aquifère. En second lieu, des craintes similaires sont formulées au sujet de la matière organique (hydrocarbures divers en provenance des activités industrielles en amont) avec en plus des craintes au sujet d'accumulations hypothétiques d'hydrocarbures au fond du futur réservoir. En dernier lieu, on craint que l'équilibre physico-chimique de l'eau de l'aquifère ne soit modifié de sorte que le fer et le manganèse présents dans les alluvions seront mis en solution, diminuant ainsi la qualité de l'eau.

Jusqu'à ce jour, peu de travaux visant à prévoir l'impact sur la qualité de l'eau ont été réalisés. Récemment, une commission spéciale s'est penchée sur la question et a préparé un document définissant les problèmes potentiels et les enjeux. Un projet d'étude avec éventuellement une aide internationale est présentement en voie de démarrage. Il comporte un ambitieux projet de simulation mathématique de l'écoulement dans l'aquifère. Ce modèle vise également à reproduire tous les processus de dispersion et toutes les réactions physico-chimiques qui gouvernent la qualité de l'eau. C'est là un projet de recherche ambitieux et valable. Cependant, Hydro-Québec International considère que l'élaboration d'un tel modèle est très complexe et que sa mise en application se fera dans un avenir trop lointain pour servir les décisions que le gouvernement envisage de prendre à court terme concernant l'avenir du projet.

Etant donné l'état d'avancement du projet et l'importance des inquiétudes formulées, Hydro-Québec International a revu les données disponibles en vue de formuler une opinion qualitative des impacts potentiels du projet sur la qualité de l'eau souterraine de Zitny Ostrov. En fonction des considérations suivantes: qualité de l'eau du Danube, qualité de l'eau potable qui alimente la ville de Bratislava, qualité de l'eau actuelle de la plaine Zitny Ostrov et mesures de corrections proposées pour éviter le colmatage complet du réservoir, les craintes formulées nous semblent peu fondées et les risques du projet paraissent limités.

3.1.4 Monitoring

Afin de pouvoir suivre les effets du projet sur la nappe, un imposant système de monitoring a été mis en place. Ce système comprend près de 1000 puits d'observation où les niveaux de la nappe sont enregistrés périodiquement. De plus, une vingtaine de puits d'observation ont été mis en place le long du projet pour permettre le suivi de la qualité de l'eau. Dans son ensemble, le dispositif mis en place est adéquat et même impressionnant. Nous décelons quelques lacunes au niveau des contrôles de la qualité de la nappe à proximité du réservoir, de la piézométrie profonde et du mode de gestion des données. Ces lacunes, cependant, peuvent être facilement corrigées dans le cadre du projet.

Une observation se dégage de l'ensemble des entrevues et des documents consultés qui peut avoir un impact sur la qualité des travaux: les techniciens et les travaux dont nous avons pris connaissance font généralement la preuve d'une compétence et d'un souci du détail élevés. Cependant, nous percevons un manque de communication entre les divers organismes impliqués de même qu'une subdivision poussée des tâches. Un tel état, si notre perception est juste, présente le risque d'une lenteur de réaction inacceptable en cas de phénomène négatif. Par exemple, les données de niveau d'eau et de qualité doivent être relevées par un organisme (IGHP) et compilées par un autre (SHMU); SHMU produit ensuite des sommaires annuels de données et ne produit d'autres rapports que sur réception d'une demande explicite d'un organisme payeur. Dans ce cas, on risque de ne constater des tendances néfastes qu'après un an au minimum.

3.2 Sécurité des infrastructures de retenue

La consultation des documents disponibles permet à Hydro-Québec International de constater que la façon dont ont été menées les différentes phases de conception et de construction des ouvrages de retenue correspond aux normes généralement appliquées à ce type d'ouvrages. La conception tient compte des conditions difficiles du site. On peut dire aussi qu'à l'état actuel, le projet Gabcikovo offre déjà une protection accrue contre les crues.

3.2.1 Travaux de reconnaissance

Les moyens de reconnaissance et d'essais utilisés lors des différentes campagnes de reconnaissances géologique et géotechnique correspondent aux moyens disponibles à l'époque de leur mise en oeuvre et sont adaptés aux conditions de terrain rencontrées. Ainsi, un maillage de reconnaissance relativement serré a été utilisé pour les couches variables de surface et des forages de gros diamètre et des essais de perméabilité ont été effectués pour reconnaitre les caractéristiques des fondations. Des essais de pénétration ont été réalisés, ce qui constitue un excellent outil de reconnaissance. Les résultats obtenus, cependant, sont partiellement insatisfaisants étant donné que leur interprétation a posé certaines difficultés. Par ailleurs, l'analyse des problèmes d'érosion interne survenus dans le passé et l'exécution d'essais de comportement est susceptible d'éclairer le développement de ces phénomènes.

3.2.2 Analyse de la conception des ouvrages

Lors de la conception des ouvrages, les phénomènes d'érosion interne ont été constamment pris en considération pour dimensionner les dispositifs d'étanchéité et de drainage et pour localiser les tranchées de réalimentation. Le traitement des fondations a été adapté de façon à s'assurer que les déformations soient compatibles avec le type d'étanchéité retenu. Les risques sismiques ont été évalués suivant une approche adéquate, même si actuellement la réévaluation des accélérations sismiques maximales pourrait remettre en question l'approche conservatrice adoptée lors de la définition des densités en place. Les dispositifs d'auscultaton prévus sont conçus en appliquant des solutions relativement économiques pour le contrôle des écoulements du bassin Hrusov et en choisissant des matériaux artificiels (tels les géosynthétiques ou le béton bitumineux) qui sont en général de faible épaisseur et donc vulnérables aux défauts d'exécution.

Les élévations de crête choisies pour les digues sont déterminées par les niveaux de crue. Elles permettent d'assurer une protection sensiblement équivalente à celle permise par le dimensionnement des ouvrages hydrauliques. Par ailleurs, elles correspondent aux standards généralement admis par les évacuateurs de crue. Il y a lieu de ne jamais perdre de vue le gain de sécurité ainsi acquis et de s'assurer que ce gain ne sera pas réduit par les mesures d'atténuation envisagées dans le lit existant du Danube.

3.2.3 Analyse des méthodes de construction

La construction, lorsqu'elle ne faisait pas appel à des techniques courantes, a fait l'objet d'essais préalables et de comparaisons avec d'autres techniques utilisées ailleurs dans le monde. Les méthodologies de mise en place des matériaux artificiels étaient élaborées de façon à limiter des défauts d'exécution éventuels. Le contrôle de qualité visait toujours à s'adapter à la nature des matériaux et à faire les calibrations ou corrections nécessaires.

3.2.4 Monitoring

L'auscultation prévue fournit le degré de sécurité requis par la conception grâce au remplissage contrôlé et à la possibilité de vidange totale du réservoir.

En effet, les moyens nécessaires pour faire le suivi du comportement des ouvrages sont prévus. Ils visent à pallier, aux défauts éventuels. Des équipes expérimentées sont disponibles pour les mettre en oeuvre dans des conditions qui ne devraient pas poser de problèmes majeurs.

3.3 Études environnementales existantes

La conception du projet Gabcikovo-Nagymaros remonte à plus d'une vingtaine d'années. Il va de soi qu'à cette époque l'intégration des préoccupations environnementales revêtaient moins d'importance qu'actuellement et ce partout dans le monde.

Des études environnementales ont été entreprises parallèlement à la construction des ouvrages du complexe, soit vers 1975. La solution technique étant déjà choisie, ces études ne portaient donc pas sur une comparaison de variantes, mais plutôt sur l'optimisation du projet retenu. En ce sens, les études réalisées à cette époque étaient comparables à celles qui furent effectuées en Amérique du Nord.

De façon générale, les principaux enjeux environnementaux considérés dans ces études ont trait surtout à la qualité et à la variation du niveau de la nappe phréatique, compte tenu des besoins en agriculture, en exploitation forestière, en industrie et en approvisionnement en eau potable. Pour ces aspects, les données de base semblent nombreuses et font l'objet de plusieurs analyses. Il convient toutefois de mentionner que ces éléments ont été étudiés presqu'exclusivement en rapport avec leur exploitation économique.

Quant à l'évaluation des impacts du projet, elle ne respecte pas un cadre méthodologique précis. En effet, les différents rapports de synthèse consultés ne sont pas explicites ni en ce qui concerne les sources d'impacts ni en ce qui a trait aux impacts eux-mêmes.

Les mesures proposées pour atténuer les impacts relèvent plus d'un objetif de mise en valeur du milieu que de l'atténuation ou la correction des impacts appréhendés. Certaines d'entre elles visent notamment la résolution de problèmes liés à l'aménagmeent du territoire, alors que d'autres identifient des études complémentaires ou encore demeurent très générales.

4. CONCLUSION ET RECOMMANDATIONS

Le Ministère des Eaux et des Forêts de la République Slovaque a soulevé un certain nombre de questions concernant la mise en service éventuelle de l'aménagement hydroélectrique Gabcikovo.

Mandaté par le Ministère pour réaliser une étude d'opinion sur le sujet, Hydro-Québec International a analysé la situation en visitant le site d'aménagement, en rencontrant les spécialistes slovaques et en consultant les documents techniques soumis. Conformément à son mandat, Hydro-Québec International a analysé les sujets suivants:

- la prévision de la variation et de la contamination de la nappe phréatique;
- la sécurité des infrastructures de retenue;
- les études environnementales existantes.

A la suite de cette visite et à l'analyse des documents soumis, Hydro-Québec International constate que :

- la compilation et la construction des ouvrages de retenue ont été faites selon les règles de l'art et les standards internationaux prévalant alors;
- les impacts prévisibles du projet sur les eaux souterraines devraient être tolérables et contrôlables;

- la connaissance du milieu devrait permettre une évaluation adéquate des impacts du projets sur l'environnement

Cependant, comme il existe certaines lacunes dans les études déjà effectuées par rapport à la pratique courante et que les délais de réalisation du projet peuvent occasionner des risques supplémentaires, et afin de rendre le projet plus sécuritaire et acceptable du point de vue de son impact sur l'environnement, Hydro-Québec International recommande un certain nombre de mesures dans chacun des domaines d'études identifiés dans le mandat.

4.1 Prévision de la variation et de la contamination de la nappe phréatique

En ce qui a trait à la variation et la qualité de la nappe, Hydro-Québec International recommande d'entreprendre les études et investigations suivantes:

- réaliser un programme d'investigation pour définir plus en détail les caractéristiques (propriétés hydrauliques et géochimiques des sols et de l'eau) du fond du futur réservoir Hrusov;

- additionner, au réseau de monitoring, des puits profonds et des points de contrôle de qualité en bordure du réservoir

- additionner au projet d'étude de colmatage, un volet de caractérisation géochimique sur les sédiments et l'eau utilisée dans les essais;

- compiler les données géochimiques disponibles par toutes les sources et les résultats des essais de colmatage décrits ci-haut;

- étudier des cas analogues réalisés dans le passé, ce qui pourra aider à prévoir l'impact futur du projet (e.g. Vah en Tchéco-Slovaquie, Danube en Autriche, Rhin et Rhône en France, etc);

- développer un modèle mathématique pour simuler divers processus géochimiques et hydrauliques, en utilisant des modèles existants et en deux dimensions (en sections et en plan). Ces simulations ne viseront pas à prévoir les changements à venir, mais plutôt à circonscrire le genre de changement qui pourrait survenir (meilleur cas et pire cas).

4.2 La sécurité des infrastructures de retenue

En matière de sécurité des infrastructures de retenue, Hydro-Québec International a noté le besoin d'apporter un certain nombre de correctifs. Ces derniers visent à s'assurer que les documents de synthèse en cours de préparation par le concepteur, dans le cadre de la surveillance de la mise en eau des ouvrages, répondent aux points que Hydro-Québec International considère les plus importants. Ils sont particulièrement requis compte tenu que le projet a été retardé.

Dans ce contexte, Hydro-Québec International formule les recommandations suivantes:
- revoir l'analyse des possibilités de liquéfaction sous l'effet de secousses sismiques dans le cadre d'une mise à jour du dossier de sécurité;

- faire la synthèse des caractéristiques des fondations et les confronter aux ouvrages construits afin d'optimiser l'interprétation des données d'auscultation lors de la mise en eau, lors de l'exécution des travaux de réparation ou lors d'un entretien éventuel.

Les délais encourus par le projet sont préoccupants du point de vue de la sécurité des ouvrages dans la mesure où le maintien prolongé hors de l'eau des tapis étanches en amont peut entraîner leur dégradation de façon importante. Dans ces circonstances, une mise en eau minimale anticipée du canal d'amenée devrait être fortement considérée. De plus, les incertitudes créées par l'arrêt du projet ne constituent pas un contexte favorable pour l'effort de concertation nécessaire entre les différents intervenants lors de la préparation des opérations de mise en eau.

4.3 Études environnementales existantes

Pour bien répondre aux préoccupations concernant l'environnement pour le projet Gabcikovo, Hydro-Québec International recommande une mise à jour des études existantes, une évaluation systématique des impacts, une validation des mesures d'atténuation et de la mise en valeur proposée pour le territoire à l'étude ainsi qu'un programme de suivi environnemental suite à la mise en service de la centrale. Plus précisément, il est recommandé de :

a) **Données de base**

- mettre à jour les données de base pour tous les éléments environnementaux humains et naturels, compte tenu du temps écoulé entre la réalisation des études initiales au début de la construction, et l'éventuelle mise en service des ouvrages;

- effectuer un inventaire faunique pour la région du détournement.

b) **Evaluation des impacts**

- Développer une approche globale et intégrée de tout le territoire touché par le projet;

- effectuer un examen environnemental comparatif, selon une méthodologie internationalement reconnue des variantes retenues suite aux recommandations des groupes de travail sur les sept scénarios d'aménagement actuellement envisagés;

- reprendre, sur la base des données récentes et de façon systématique, l'évaluation des impacts, en tenant compte de leur durée, leur intensité et leur portée;

- tenir compte des valeurs sociales concernant entre autres la conservation de la nature, la récréation extensive et l'aspect visuel;

- évaluer les effets de la gestion de pointe envisagée et faire une comparaison entre la gestion de pointe et au fil de l'eau;

- faire de l'information publique avant la mise en service des ouvrages. L'évaluation comparative des variantes, tant sur les plans technique qu'économique et3environnemental pourrait être soumise lors de c3s séances d'information ou de consultation.

consultation.

c) **Validation des mesures proposées et de la mise en valeur proposée**

- réviser les mesures proposées à la lumière de l'importance des impacts identifiés et intégrer les préoccupations environnementales pour l'ensemble des aménagements;

- élaborer un mode de gestion précis des niveaux et des débits pour le secteur de l'ancien lit du Danube et des méandres, qui intègre les différentes utilisations de cette zone et revoir les mesures proposées de façon à harmoniser les concepts de conservation du milieu naturel et de récréaction extensive;

- réviser les aménagements proposés à des fins récréo-touristiques dans le secteur des villages isolés par le canal de dérivation et revoir les propositions d'aménagement récréatif intensif à la tête du réservoir Hrusov;

- revoir le concept et la planification des mesures de mise en valeur planifiées pour le canal de dérivation et pour les villages adjacents en rive gauche.

d) **Suivi environnemental**

- élaborer de façon précise un plan intégré de surveillance des travaux qui restent à effectuer ainsi qu'un programme de suivi environnemental en vue de valider l'évaluation des impacts et de faire les corrections qui s'imposent de façon immédiate.

- élaborer un mode de suivi environnemental supplémentaire et intégré à celui de la nappe phréatique qui tient compte des aspects phytosociologiques et fauniques de la zone de méandres, en relation avec les nouveaux concepts d'aménagement;

- efffectuer un suivi rigoureux de l'utilisation du secteur des méandres par les visiteurs suite à la mise en place des aménagements récréatifs dans la zone des méandres, de façon à prendre immédiatement les mesures qui s'imposent pour la sauvegarde du milieu naturel et de sa productivité.

Annex 23

Purpose Study,
Impact of Waterworks on Soil and Agriculture
S. Rehák, A. Heldi, J. Alena, J. Takáč, 1994

Purpose study

Impact of water work on soil and agriculture

Problems of impact of water work Gabčíkovo on soil and agricultural production create large space for polemics, negative and also positive evaluation. Generally, due to accumulation of waters is the impact of water work evaluating as positive on putting into practice appropriate technical solutions. For the subject of dispute on water work is typical especially searching for negatives and exaggeration, respectively prognosing only negative impacts on soil and agriculture including theories of catastrophical impacts.

The solution of problems of impact of water work on soil and agriculture had been elaborated even before signing of agreement in 1977 and then it was in detail worked out and in the present also technically brought into being on Slovak side.

This purpose study offers a brief overview on soil characteristics of Žitný ostrov and on impact of groundwater level on agricultural production. It evaluates the influence of water work on moisture security of agricultural plants and evaluates the support of capillary inflow from water tables to moisture need of plants.

Due to the same genesis of soil development on the both sides of Danube the information in this study are valid also for Malý Žitný ostrov (Szigetköz) i.e. on Hungarian side.

Characteristics of soils of Žitný ostrov

The origin and development of soils is influenced by soil creating factors as following:

- mother minerals
- relief and geomorphological processes
- climate
- plants and animals
- groundwater and flood water
- time
- human activity

The soil creating factors affect completely, their affects are interconnected and they affect very seriously the soil fertility. Soils are divided to types according to grain size distribution determined especially by mother mineral. Based on morphogenetic characters depended from the character of soil creating processes by which soil has been risen we distinguish soil types and subtypes.

The Research Institute of Irrigation Bratislava made in years from 1990 to 1994 a large hydropedological research of soils of Žitný ostrov.

The research was directed especially to:

- mapping of gravel bed which is important from the point of view of capillary support of soils by groundwater
- evaluation of grain size distribution of soil cover
- stating the hydropedological properties of soils
- evaluating of selected chemical characteristics of soils.

Within the framework of research there had been evaluated more than 2100 soil and hydropedological profiles from which there were 900 from field research proper from period 1991 - 1993. There were made granularity analysis on 200 places. There were made field measurements and laboratory evaluations of retention, transport and selected chemical characteristics of soil profile on 80 control points uniformly distributed all over the area of Žitný ostrov.

According to the research, 66 % of soils of Žitný ostrov belong to the category of middle heavy soils (sandy loam soils and loam soils). 23 % of soils belong to category of heavy soils (clay loam soils). Light soils (sand and loamy sand soils) cover less than 5 % and very heavy soils (clays) less than 6 % area.

The interference between the cover layer and gravels is deeper than 3 m on 46 % of area, in the depth from 2 to 3 m on 16 % of area, in the depth from 1 to 2 m on 21 % of area and in the depth under 1 m on 17 % of area. The biggest share have chernozems (45 %), fluvi-gleyics (34 %) and fluvisols (21 %). The chernozems are represented by the subtypes calcaro-haplic chernozem and haplic Phaeozem. From the fluvi-gleyics are most often fluvi-calcaric Phaeozem and fluvi-mollic Gleysol.

All the mentioned subtypes belong to the category of very fertile soils with deep quality humus horizon. The chernozems had been created mostly on loesses and similar substrates in the warm climate period at the most warm and most dry parts of Danubian Lowland as the soils of high grass steppes and forest steppes. The middle heavy chernozem contains approximately 3 % of high quality humus. The haplic phaeozem is the subtype which has regularly supported by supplement moisture from capillary elevation of groundwater. The chernozems are more often in the western part of Žitný ostrov.

The fluvi-mollic gleysols had been created on places where the water table was for a long time on level 1 m and fluvi calcaric phaeozems had been created on calcite bedrock continuously fluctuated between 1 and 2 m. Fluvi-gleyics are mostly in the eastern part of Žitný ostrov. Their top horizon contains 3 - 5 % of humus with similar quality as chernozem humus. The eutric fluvisols are occuring mostly near water flows on aluvial-fluvial sediments. The big fluctuation of ground water level is characteristic of them in conformity with hydropedological regime of river. They were often flooded in the past similarly as fluvi gleyics (before the water flows regulation).

The impact of groundwater level on agricultural production

The impact of ground water level on growth of cropping plants shows up especially by the share of ground water on creating of water and air regime of soils but also on chemical, biological and gleization processes which are effectual for soil fertility. Ground water strongly impacts on moisture regime of soils when the range of capillary elevated water reach the active soil layer and the capillary elevation of water runs to active soil layer at intensive water consumption for evapotranspiration. Then we talk on share of ground water on evapotranspiration covering and on irrigation effect of ground water. Because of that it is positive for growth and development of plants.

When the water table is very high, so that excess of water comes to soil top the active soil layer is wet. On the other hand when water table is too deep, capillary elevation is decreased or interrupted.

The useable amount of capillary elevated water to active soil layer depends not only on the depth of water table but also from capillary qualities of soil and its moisture state. Capillary qualities of soil depends mostly on grain size distribution especially on contents of clay parts. The structure of soil and morphogenetic horizon has an important role. The expression of moisture regime of soils, water pumping of plants in time with ground water regime by analytical and mathematical functions is difficult. Then it is necessary to make calculations for short time periods (cycles) for which is supposed constant capillary inflow of water to the active soil layer. The span of intervals (cycles) is possible to choose in such way that process of capillary filling of soil water in each cycle under conditions of regulated water regime conform to stationary flow and it would be possible to determine with help of average values of hydrophysical characteristics i.e. moisture state of soil, ground water level, retention and transport characteristics of soil and intensity of evapotranspiration for each considered cycle. For the objective evaluation of share of groundwater on covering of moisture need of agricultural plants it is necessary to make hydropedological investigation aimed at determination of retention and transport qualities of soils of considered area.

Orientation values of heights over water table with different intensity of capillary elevation

Table 1

Soil	Maximal capillary inflow $mm.d^{-1}$			
	5,0	2,5	1,0	0,5
	Height over water table			
Sand	0,35-0,70	0,40-0,75	0,45-0,85	0,50-0,90
Loamy sand	0,70-0,90	0,75-1,00	0,85-1,05	0,90-1,10
Sand loam	0,90-1,05	1,00-1,15	1,05-1,25	1,15-1,40
Loam	0,70-1,00	0,80-1,10	0,95-1,15	1,00-1,25
Clay loam	0,50-0,80	0,60-0,90	0,70-1,00	0,75-1,10

We know three characteristic depths of water table from the point of view of influence on growth and yield of plants.

a) <u>Depth (A)</u> when the soil is so much waterlogged that it is not possible to grow there the considered plant or it is not possible to reach good yield of it. This depth is approximately the same as the height of saturated capillary zone over the water table (mostly from 0,10 to 0,40 m according to the type of soil and growed plant).

b) <u>Depth (B)</u> when the biggest yield are reached in average and permanently. It is the optimal depth of water table when the soil water consumed on evapotranspiration is maximally supported by capillary elevation of ground water and the positive water and air regime in the active soil layer is keeping. The soil profile has enough capacity for cathing the rainfalls and there is no danger of salinization.

c) <u>Depth (C)</u> when the ground water has no more impact on moisture, air and salt regime in root zone of soil. It is determined as sum of the height of active capillary zone limited on top border by the moisture of wilting point (from the watering branch of retention curve of soil) and the thickness of active soil layer.

Orientation values of characteristic depths of water table (A, B, C in m) for grass

Table 2

Soil	Characteristic depths of water table in m					
	Waterlogging		Optimal ground water level (B)		Without influence (C)	
	Range	Middle value	Range	Middle value	Range	Middle value
Sand	0,10-0,25	0,15	0,45-0,80	0,60	1,00-1,60	1,30
Loamy sand	0,25-0,30	0,27	0,80-1,00	0,90	1,60-2,00	1,80
Sandy loam	0,30-0,35	0,32	1,00-1,15	1,07	2,00-2,30	2,15
Loam	0,35-0,40	0,37	0,80-1,10	0,97	2,30-2,50	2,40
Clay loam	0,40-4,45	0,42	0,70-1,00	0,85	2,50-2,80	2,65

Orientation values of characteristic depths of water table (A, B, C in m) for cereals

Table 3

Soil	Characteristic depths of water table in m					
	Waterlogging		Optimal ground water level (B)		Without influence (C)	
	Range	Middle value	Range	Middle value	Range	Middle value
Sand	0,20-0,35	0,27	0,55-0,85	0,70	1,10-1,70	1,40
Loamy sand	0,35-0,40	0,37	0,85-1,05	0,95	1,70-2,10	1,90
Sandy loam	0,40-0,45	0,42	1,00-1,20	1,10	2,10-2,40	2,25
Loam	0,50-0,55	0,52	0,70-1,20	0,95	2,60-2,90	2,75
Clay loam	0,40-0,50	0,47	0,80-1,20	1,00	2,40-2,60	2,50

Orientation values of characteristic depths of water table (A, B, C in m) for root-crops

Table 4

Soil	Characteristic depths of water table in m					
	Waterlogging		Optimal ground water level (B)		Without influence (C)	
	Range	Middle value	Range	Middle value	Range	Middle value
Sand	0,25-0,45	0,35	0,60-0,90	0,75	1,20-1,80	1,50
Loamy sand	0,30-0,45	0,37	0,80-1,10	0,95	1,80-2,20	2,00
Sandy loam	0,40-0,50	0,45	1,00-1,40	1,25	2,20-2,50	2,35
Loam	0,45-0,55	0,50	0,90-1,30	1,10	2,50-2,70	2,60
Clay loam	0,50-0,60	0,65	0,80-1,30	1,05	2,70-3,00	2,85

Evaluation of influence of water work system on moisture security of agricultural plants

The development of agriculture which is under hydroclimatic conditions of considered area dependent on irrigation forced more and more water management principles. The network of channel has been built for protection against infiltrating waters and watering of the area. This network has been step by step improved and arranged. Today it has about 2 500 km of channels under management of Danube River Basin (formerly under management of State Amelioration Authority). The specific feature of the last period from the sixties is the fact that because of global climate changes the task is not only to quickly drainage the area but also the rational use of the water. For that purpose the effort was made to bilateral regulation of supplying soil profile with the water through channels. But it had been shown that in some hydro climatic situations is such use of channels unsufficient from the point of view of security of needed moisture in soil. Agricultural crops suffered by lack of moisture in the case of long dry periods and lower rate of flow in Danube. Even the expensive pumping of Danube water into the channels did not help and irrigations were necessary for security of yield. These facts were reason of irrigation development which was characteristic for fifties and sixties but on the other hand the demand of satisfactory irrigation water resources arised which supported the need of complex water managenet solution of the area by water work system. The system of protective (seepage) channels together with pumping stations is in the case of water work system Gabčíkovo-Nagymaros more adapted to needs of regulation of ground water level in near area where were originally expected more points of view of regulation of water table both on Hungarian and Slovak side.

In the present the level of ground water in upper part of Žitný ostrov rised when "the C-variant" was put in praxis and this also impacts on enlarging the useable supplies of ground water approximately by 7 $m^3.s^{-1}$. The decrease in aside area of Danube is possible to compensate by designed barrages in original riverbed. If we consider the development of water tables on the base of existing today prognosis on impact of water work system we find that it will be possible to put in praxis drainage and back water function of channel network on majority of area and to control the ground water level by this activity. The matter is especially such arrangement of its position that it will be possible to secure partial capillary inflow to root zone of soil profile and the needed moisture will be filled by irrigation. The needed irrigation water will be possible to batch from objects of water work system by gravity way. The system channel network with necessary control will enable to distribute the water with small losses.

About 25,0 $m^3.s^{-1}$ of irrigation water is beeing secured in length 1 811 - 1 842 rkm of Danube (for maximal taking in July) from seepage channels.

Evaluation of development trends of moisture regime of soils from the point of view of regime changes of ground water level

According to the prognosis of water table development in the area of Žitný ostrov after starting of performance of water work (elaborated by working people of Prof. Mucha in 1992) and according to our consideration of its influence on development of exploitation of irrigation in this area it is possible to say that the situation will not get worse anyway and the support of water for plants will be increased by capillary inflow from ground water level.

There was a trend of decrease by 0,5 - 1 m of ground water level in comparance of average ground water levels in 1960 and 1990 in majority of the area. According to prognosis, in the worst case when the bottom of check has low permeability, the average ground water levels in majority of the area will elevate by 0,5 - 1 m. So that it is possible to say that the similar or higher ground water level as in sixties will be reached. Since the ground water level in majority of the area where were no irrigation being built was 1,0 - 2,0 m under terrain level is the suppose of increase of support of moisture from water table very actual. The question, if the ground water level could reach top covering bodies which are 2 - 3 m thin, is very important.

The problems of impact of elevatin of ground water level on agricultural production are in the present in the stage of consideration, especially impact on production of cereals and friut crops. Preliminary results of the year 1993 indicate positive impact of ground water level on plant production.

Evaluation of support of capillary inflow from the water table for moisture needs of plants

Prognosed changes of ground water level will have positive impact on support of capillary inflow for the balance of the moisture needs of plants. When reached ground water level 1,0 - 2,0 m under terrain level (in average 1,5 m) in middle heavy soils more than 2,0 m deep which are on 62 % of Žitný ostrov area, the support of balanced capillary inflow to root zone in average 2 mm/day will reach.

Due to these new facts it is necessary to consider again the total need of irrigation water in this area. From the preliminary results of the balance of covering of moisture need of plants by irrigation in average 1 600 m^3/ha is possible to suppose the decrease of this amount by even 40 %. This will also cause the decrease of need to apply the sprinkling irrigation by 40 million m^3 per year. That means also the save of operating costs of irrigation water use.

The positive economical contributions will be reached also in those areas without irrigation.

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Annex 24

(Without appendices)

GABČÍKOVO - WWF

the Pros and Cons

Elaborated by Prof. Igor Mucha

Bratislava, April 1994

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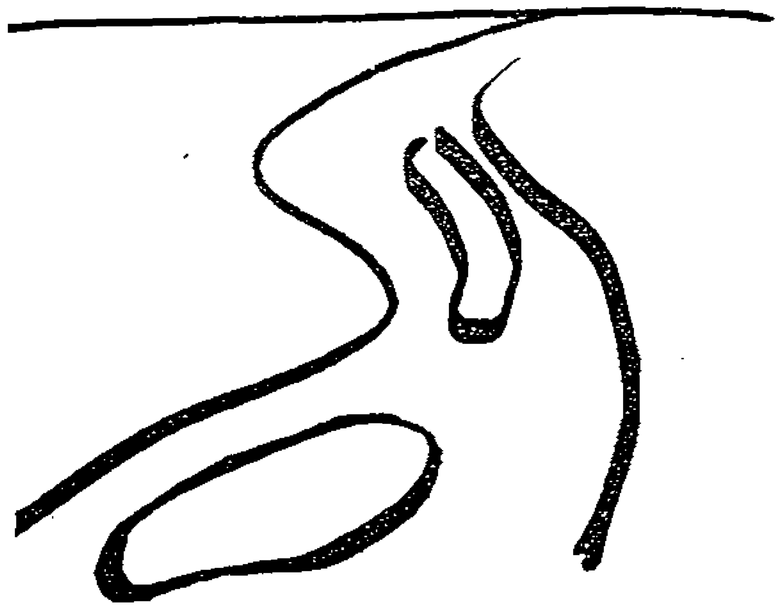
WWF (World Wide Fund for Nature)
published a pamphlet with the following obverse page:



A NEW SOLUTION FOR THE DANUBE

WWF Statement

on the EC Mission Reports of the
„Working Group of Monitoring
and Management Experts"
and on the Overall Situation
of the Gabcikovo Hydrodam Project

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Vienna/Rastatt, December 13 1993 (final version 31 January 1994)

WWF

PREFACE

In the following text we would like to provide the reader with a review of the basic characteristics of the Gabcikovo surrounding area, to explain the work of the European Union (EC or EU) experts and to oppose the WWF Statement on the cause Gabcikovo.

1. INTRODUCTION

The importance of the Danube, the necessity of its regulation and development was already recognized in ancient times. The Romans excavated a canal to bypass the dangerous rapids in the Iron Gate section on the Lower Danube. Emperor Tiberius ordered the building of regulated banks and a towpath to facilitate the upstream passage of barges. Queen Mary, wife of Bela IV. who ruled from 1235 to 1270, had a new straight bed excavated for the Danube between Bratislava and Gönyü to protect her Mosoni estates from the floods on the river. Since 1886 until 1896 there was realized regulation of the Danube because of navigation from the rkm 1880 (Devin) to 1747 (Radvan nad Dunajom, downstream from Almasfüzitö). Regulation was done to fulfill navigation conditions by the mean water level. This was the first large regulation on the Danube. There was used 3.6 mil. m^3 of stone for fortification of banks and dredged 8 mil. m^3 of gravel. At the beginning of this century, the regulations continued to fulfill navigation conditions during low water levels. This was done by:

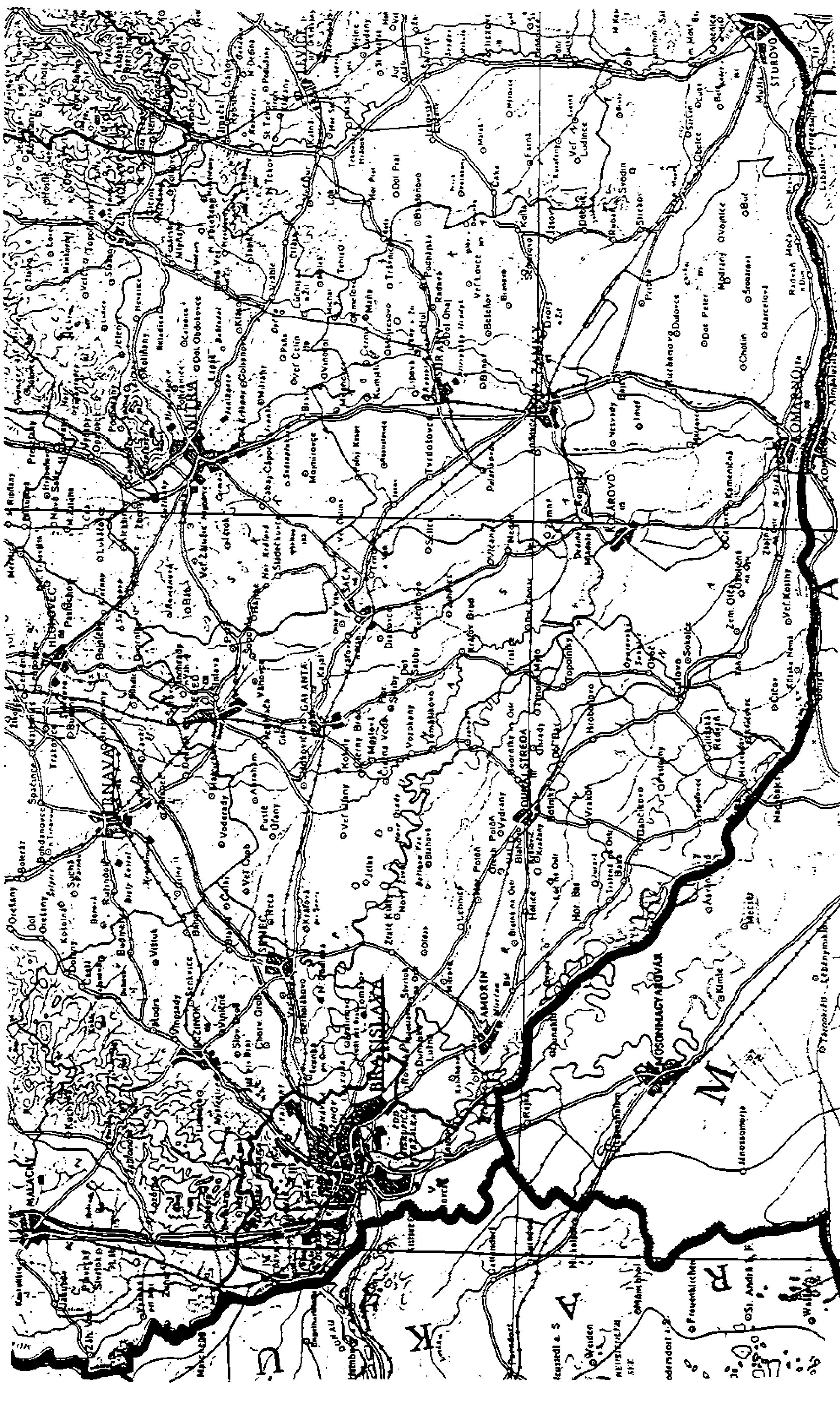
- closing of the river branches, cutting off and bundling of river branches into one main straightened and heavily fortified channel,
- regulation dikes (groynes) across the Danube to concentrate the water flow in the navigation canal,
- dredging of moving sand banks and fords in the Danube.

These measures had not fulfilled the aim to improve the navigation.

The lowlands on the both Danube sides were regularly flooded in the far past. Floods devastated last time large parts of Hungarian Szigetköz area in 1954 and Zitny ostrov area in 1965. The first dam on the river Danube, the Kachlet Dam, inaugurated in 1927, was followed by about 29 similar projects upwards from Bratislava. Construction of any river dam entails changes in the environment. Any interference is associated with changes, both adverse and beneficial. In particular, the various and sometimes delicate equilibrium or conditions, that have been developed over many decades, aimed at water resource exploitation and surface down flow control, have been significantly modified by the human activities and by the Danube upstream hydropower schemes. Recently the area has been changed by the new hydropower scheme Gabcikovo.

Characteristic of the Area

Danubian Lowland between Bratislava and Komarno (Fig. 1.1) is geologically formed by the Central Depression of the Danube Basin. The Central Depression is filled with Quaternary, Rumanian, Dacian, Pontian and Pannonian sediments [14]. The Quaternary and Rumanian sediments represented by gravel and sands are of interest. The deeper horizons are



BRATISLAVA
NITRA
TRNAVA
HLOHOVEC
SEREĎ
GALANTA
ŠAĽA
SENEC
PEZINOK
MALACKY
ŠAMORÍN
KOLÁROVO
KOMÁRNO
ŠTUROVO
ŠURANY
NOVÉ ZÁMKY
MOSONMAGYARÓVÁR
DUNAJ. STREDA
SPIEŠ

represented by clays, sandy clays, fine sands, sandstone, all of relatively very low permeability.

The depression originated in the Pannonian era and developed up to the end of Pliocene. It was a subsidence by bending, partly compensated by subsidence along faults. The depression has a dish - like brachysynclinal structure without respect to the pre-Pannonian basement. In the north side, the depression is bordered by the Carpathians Mountains and in the south it ends southwards from Danube in the Mosoni - Danube area. At this border the Danubian sediments change into less permeable sediments of rivers Lajta, Rabca and Raba. The thickness of the complex of interest, Quaternary - Rumanian era river Danube sediments, ranges from 5 to more than 450 m.

The Danube is a dynamic river with its considerable natural water flow and high water level fluctuation. On Bratislava gauge station, the minimal, average and maximal measured flow rates are 570, 2025 and 10254 m^3/s with the amplitude of water level fluctuation more than 8 meters. The river bed consists mainly of extreme permeable gravel and coarse sand. The hydraulic gradient slope downstream from Bratislava ranges from 0.03 to 0.04 % and downstream from Gabcikovo from 0.01 to 0.03 %. This gradient and the high flow rate determine the coarse composition of the grain size characteristics for the river bottom sediments, which are nearly without particular organic matter.

The river Danube creates an intercontinental delta downstream from Bratislava, passing granite threshold connecting the Alps and the Carpathians, which means, that the river is flowing on its own sediments and is lying above the surrounding area. This is the reason, why the river Danube recharges the aquifer during the whole year. In the past, ground water level was near under the surface and the Danube was divided into numerous meanders and river branches (Fig. 1.2). Compare historical maps.

The main characteristics of the area can be summarized as follows:
- a low lying, gently sloping plain area;
- weak surface layer formed by fine humid materials and soils, with variable thickness from tens of centimeters up to three meters;
- thick alluvial aquifer (the river Danube gravel deposits) with thickness from 5 m up to over 300 m, with great variability of particle size distribution and extremely high hydraulic conductivity (between 0.01 and 0.0001 m/s) intercalated by fine lenticular sands and meander deposits;
- continental climate of Central - European type, with well differentiated meteorological seasons; rainfall ranges from 500 to 700 mm/year; temperature from -15 up to over 30° C;
- river conditions of Alpine - continental type, affecting the aquifer through direct recharge;
- wide river meanders with dynamic water regime with changing water levels and with regular flooding;
- unique and valuable fauna and flora resources;
- ground water is affected quantitatively and qualitatively by the Danube water;
- in the upstream part of the area, the river Danube water infiltrates into the aquifer throughout the whole year.

Main resources of the territory are:
- intensive and diverse agriculture, using irrigation in the upper part and drainage in the lower part of the area;
- intensive floodplain forestry;

Fig. 1.2: Map of Bratislava (Preszburg) with the Danube branches (from 1712)

- water supply works of large capacity;
- spread livestock breeding;
- industrial activities, mainly in the field of food and wood processing, important chemical and petrochemical complexes;
- extreme large ground water resources which are in danger of agricultural and industrial pollution and degradation;
- riverside woods, vegetation and fishery;
- tourism;
- large water power potential;
- international ship water way and harbor;
- natural and ecological resources.

1.1. GEOLOGICAL CONDITIONS

The survey of geological conditions was performed since the half of the 18th century. Results of the survey and research are presented mainly in the geological maps issued in the 1:200000 scale, the sheets of Bratislava - Vienna, Nove Zamky - Calovo, Nitra and in various geological monographs. New knowledge was obtained during the survey for the construction of Gabcikovo - Nagymaros hydropower station scheme, by the survey of geothermal waters and geothermal energy, within the ground water resources research, protection and exploitation, etc. At least 30 deep wells and geothermal wells were drilled which verified younger parts of sediment content of Danubian Lowland depression (Quaternary, Rumanian, Dacian age). Apart from this, a lot of shallower wells, but deeper than 100 m, were drilled during the hydrogeological and engineering geological survey. We would like to quote Hungarian hydrological magazine Hidrologiai Közlönyi 3/1990 in which is stated, that to find out geological structure in Hungarian part of area of interest was drilled 400000 regular meters of drill work.

Evidence of joined comprehensive elaborate of investigation results is in the report: "Joined Agreed Project, Comprehensive documentation - basis engineering geological research, part 0-7-1.1" elaborated in year 1978 both in Slovak and Hungarian language and it is owned by both sides.

A systematic investigation of Quaternary sediments of the Danubian Lowland has been performed at the Geological Institute of Dionyz Stur in Bratislava. A summary is presented e.g. in the "Explanation of the geological map of the SE part of the Danubian Lowland 1:50000 scale" [18]. A number of geological works performed during the engineering geological and hydrogeological survey for the Gabcikovo - Nagymaros scheme contributed to the special engineering and ground water purposes. Since 1989, a program "Danube Region Environmental Geology - DANREG" is performed. Results of this program will give a complex knowledge of geological - environmental situation of the region. The final report is supposed to be elaborated in 1995. Since 1992, the PHARE Project "Danubian Lowland - Ground Water Model" [2, 3] is performed. Also this project will be completed in 1995.

In Pannonian, the sea (the Caspian brackish lake) covered the area to the NW up to Vienna gate over the Vienna basin. Throughout the Pannonian vertical movements repeated several times, causing local regressions and transgressions and synsedimentary activity of faults is apparent. The Danube, as a major river with many tributaries, originated in the age of upper Pliocene - Rumanian and it was following the regressing sea. This is related to the tectonic movements, mostly the rising of Alps and Carpathians. The last orogeneous phase, between Pliocene and Pleistocene, is particularly important. Following the regressing sea, a river network in the end of the upper Pliocene begins to form in the bottom and middle part of the Danubian Lowland [13]. The fresh water flowing lakes had originated, in which bed load and suspended load began to sediment, brought by the Danube and its tributaries. Sedimentary material originated from the rising Alps and Carpathians. Originally, the ancient Danube was entering the Danubian Lowland through the Kärnten gate, later it penetrated the Lower Carpathians mountain range by Devin, at the place, where a transverse faults pass, in between which a small depression called Devin gate was created.

In the end of the upper Pliocene, the Danube made its way to the Great Hungarian Flat between Nagymaros and Visegrad. In the central and lower part of the Danubian Lowland, a lacustrine - fluvial conditions of sedimentation were being created with littoral sedimentation of coarse - grained sediments as well, and sublittoral sedimentation of fine - grained sands and mud, which is dependent on the flow velocity in lakes. At the beginning, this occurs as a result of the Pannonian sea regression by a gradual transformation to brackish or even fresh - water conditions in the bordering parts, and later, in relation with rising of the Hungarian Central Mountains, to a lake - fresh water conditions. As an evidence of this, the alluvial terraces above the Danube by Esztergom may be mentioned. A relative subsidence of the Danubian Lowland continues in Quaternary as well, but since Mindelian age, without lacustrine - fluvial conditions, because the Danube was quick enough with filling up of the subsiding area with gravel - sand fluvial sediments, even an alluvial cone was created, rising over the surrounding surface.

The Rumanian sediments themselves (upper Pliocene) respond to the sediments of the ancient Danube, which settled into the lacustrine environment. They are called, in the work [15], the "Gabcikovo sands". Parallel with them, further to the east, the "Kolarovo formation" is found, which settled in a more peaceful conditions with sediments transported from the Carpathian's area. Sedimentation of "Gabcikovo sands" in a lacustrine conditions is proved [15] by the grain - size difference in comparison to the Danubian gravel - the fluvial Danubian gravel is very coarse - grained, 10 - 17 cm, the gravel of the "Gabcikovo sands" is fine grained to a middle grain size. Besides of this, the Danubian gravel is usually colored by limonite, proving the presence of oxidizing conditions, but the color of "Gabcikovo sands" and fine gravel ranges from gray to green - gray without this limonite coating, which proves presence of anoxic conditions of a calm lacustrine sedimentation. There is an apparent discordance between the lacustrine sedimentation of "Gabcikovo sands" and the Danubian gravel [15], and an intensive erosion of previous sediments after the regression of lakes. Certainly, in the Danubian Lowland, there exist river alluvial sediments of the Danube and its tributaries, mostly of the Vah and Nitra rivers, and river sediments settled in a lacustrine conditions as sediments of rivers' deltas. Besides of these, there are the sediments of littoral and sublittoral zone, and this all is influenced by the gradient of surface and its changes within the relative subsidence of the depression center, and by the petrographic consistence of rocks, from where the fluvial material was transported. All these influences are finally shown up in the hydraulic conductivity and grain - size specific surface of the complex in relation to position and depth.

In the area of interest on the west side, there is a lacustrine sedimentation of "Gabcikovo sands" and gravel in Rumanian, which was settled mostly by the ancient Danube and the Carpathians ancient streams, and simultaneously, on the eastern side, there exist a lacustrine sedimentation of "Kolarovo formation", settled by the Carpathians ancient streams (Vah, Nitra). To these sediments, the fluvial - lacustrine Danubian sediments are deposited discordantly in the Gabcikovo depression, and a shallow - lacustrine or river lacustrine sedimentation of the "Kolarovo formation" continues on the east side until the Mindelian period. The commencement of Mindelian was simultaneously followed by uplifting and subsiding tectonic processes. In the western part, a river sedimentation of a massive alluvial cone begins to prevail, and in the east, the Danube is shifted to north and east and begins to flow to the Hungarian flat through the area, as it is known nowadays.

The border between the Danubian fluvial - lacustrine and lacustrine sediments and the lacustrine sediments of "Kolarovo formation" passes from Sala via Calovo to Cicov. This border is very approximate because the individual kinds of sedimentation were mutually alternating and overlapping. We remind, that in the Danubian sedimentation area, the lacustrine sediments called the "Gabcikovo sands" settling approximately until the upper Mindelian, continue into a shallow lacustrine and river - lacustrine sedimentation of "Kolarovo formation". The shallow lacustrine and fluvial - lacustrine sedimentation continues, in fact, in the lower Vah stream area until nowadays while, in the Zitny ostrov area, a typical river sedimentation of the Danubian gravel continues creating alluvial cone, the so called continental delta.

1.2. HYDROLOGY AND GROUND WATER

Long-term hydrological development of the Danube region in the past was influenced mainly by river regulations, straightening of bed, closing or raising the entrance threshold of meanders. River regulation works, exploitation of sand and gravel, construction of river dams upstream from Vienna altered the bed-load balance. The bed-load transport via Bratislava was diminished and the river bed erosion increased. Investigation showed the substantial deepening of the river bed and the trend to further erosion of the river bottom. This caused a long-term lowering of water level in the Danube which resulted also in long-term lowering of ground water levels not only in the riverside areas, but on the whole area under consideration.

The Danube inundation riverine area (floodplain area - Fig. 1.3 - part of inundation saved in pre-dam conditions, in Austria it is called "Au"), contains a floodplain vegetation, especially forests, which have been largely influenced by deepening of river bed and thus lowering the ground water table and extremely influenced by unnatural closing of entrance thresholds of meanders and river branches (Fig. 1.4). It is noticeable that vegetation is suffered from shortage of water and the character of forest have been changed. The inundation wood vegetation as well as the riparian and aquatic plant families are affected and threaten to lose their typical "Au" character changing continuously from oxidizing to reducing conditions of "polders" with stagnating water or without water. The result consists in unnatural sediments of reduction conditions in closed river branches (Fig. 1.5). River banks have been fortified and the contact with the river branches have been destroyed. The Danube is more or less straighten artificial canal, self-cleaning ability of river is reduced. Inundation is not washed out, organic sediments arise and large parts of ground water are degraded (e.g. locality Dobrohost, where waterworks of capacity of 10 m^3/s was previously proposed and now abandoned because of large contents of nitrite and ammonium salts). This process would continue if the hydrological conditions of the Danube were not changed.

Ground water of a large part of the Danubian sedimentation area is of oxidizing conditions and of a high quality. Save yield was estimated at 20 m^3/s and approximately about 4 m^3/s

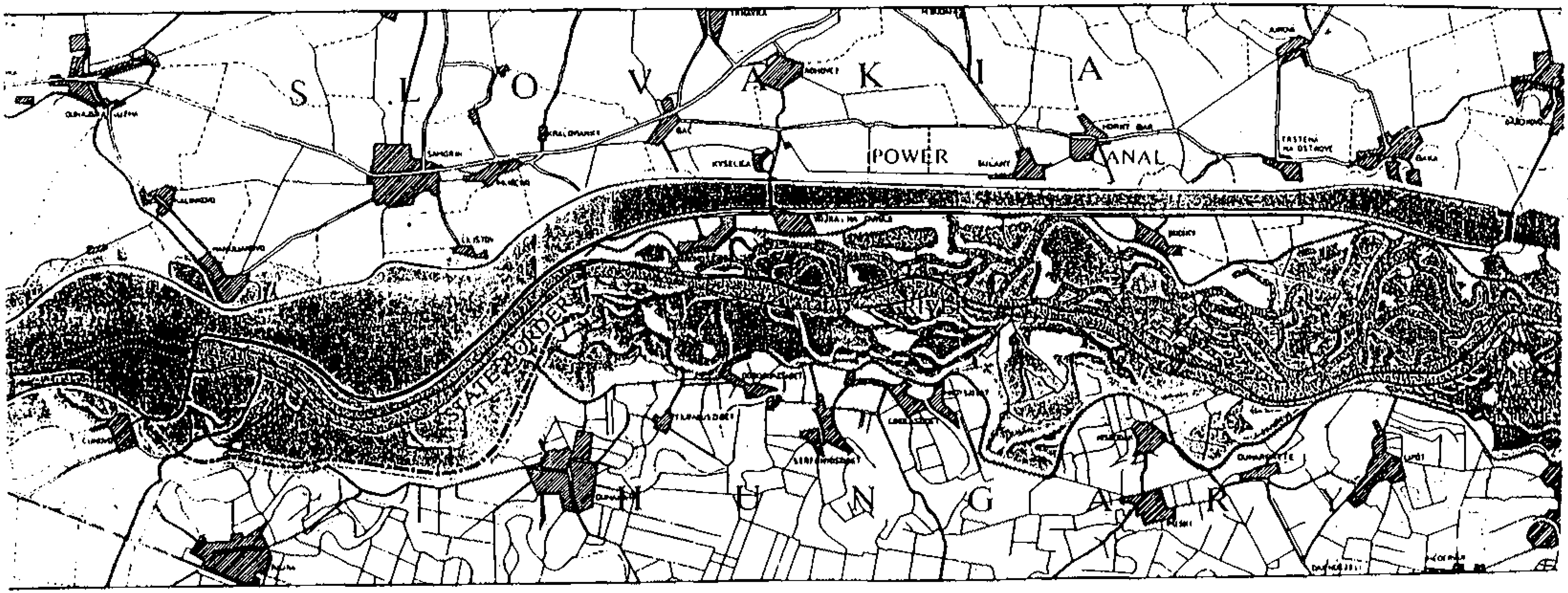


Fig. 1.3: Meanders and riverside woods

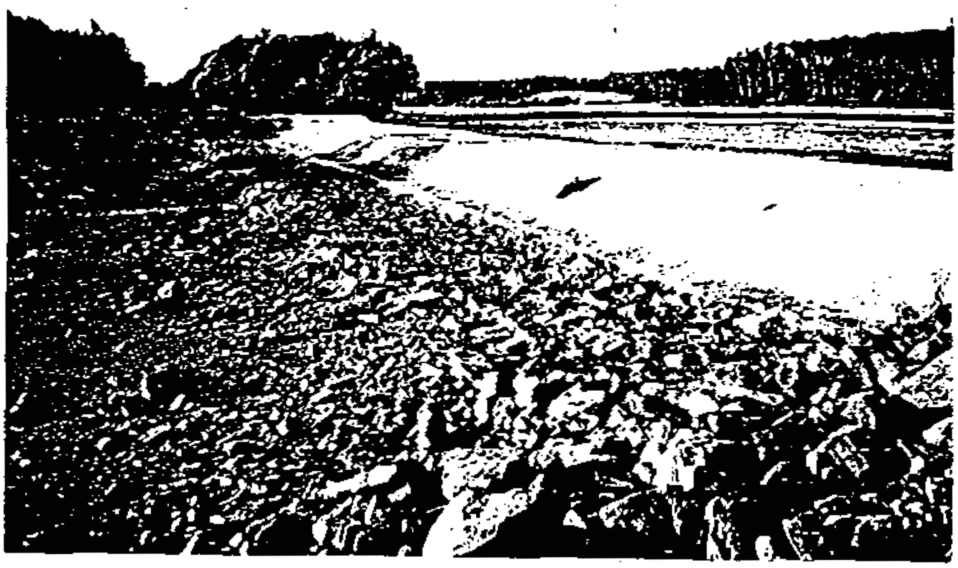


Fig. 1.4: Closure of river branch in Hungary

Fig. 1.5: Sediments in river branches with previously stagnant water

of this ground water is used for water supply directly without treatment (only chlorinating of water is used).

Decreasing of ground water level influenced the agriculture in the past. Not to lose the crops, irrigation was introduced. Introduction of irrigation means larger contamination of ground water, need of larger quantity of fertilizers and other agrochemical products. Under irrigation conditions the possibility of direct ground water contamination is much larger.

Agricultural activities are leading to contamination and degradation of ground water. The main problems are nitrate and pesticides, leaching of organic matter into aquifer, changing an oxidation state to reduction one, pollution by fuel, oil, etc., concentration of manure, sewage and other wastes and improper tillage and irrigation practices.

1.2.1. Regime of Discharge and Water Level in the Danube

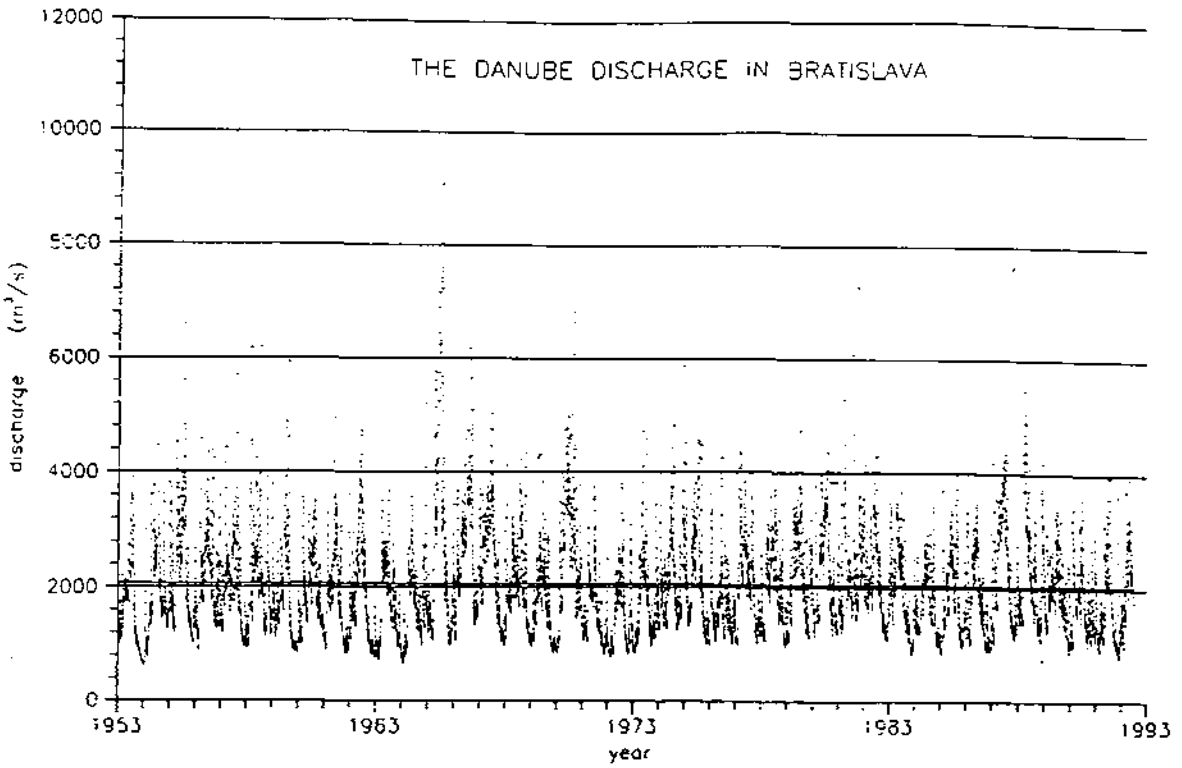
Regime of discharge and water level in the Danube is represented by discharge and water level fluctuation at gauging stations. The Danube discharge in Bratislava and Komarno in the period of 1953 - 1993 is presented in Fig. 1.6. The water level in the Danube measured in Bratislava, Gabcikovo, Medvedov and Komarno is presented in Figs. 1.7, 1.8. From the first view it is evident, that the discharge is more or less stable and water level is continuously decreasing. To express better the long-term development of discharge and water levels, the linear regression line is plotted. Equation of the linear regression is of the form

$$h = a * ((y - 1953) * 365.25 + d + c) + b \qquad (1)$$

where y is year,
d - number of day in the year,
a, b, c - parameters of eq. (1).

Table 1.1: Parameters for calculation of discharge and water levels using eq. (1)

Station	rkm	item	a	b	c
Bratislava	1868.7	disch.	-0.00175812	2099.86	19357
Bratislava	1868.7	level	-0.000119725	134.68	19357
Rusovce	1855.9	level	-0.000100193	128.013	1827
Gabcikovo	1819.6	level	-0.0000185326	115.213	1824
Medvedov	1805.4	level	-0.0000960211	112.638	9495
Klizska Nema	1792.4	level	-0.000104016	110.316	9495
Zlatna na Ostrove	1779.2	level	-0.0000891445	108.808	12782
Komarno	1767.1	disch.	-0.00681133	2406.99	12782
Komarno	1767.1	level	-0.0000571844	107.436	12782



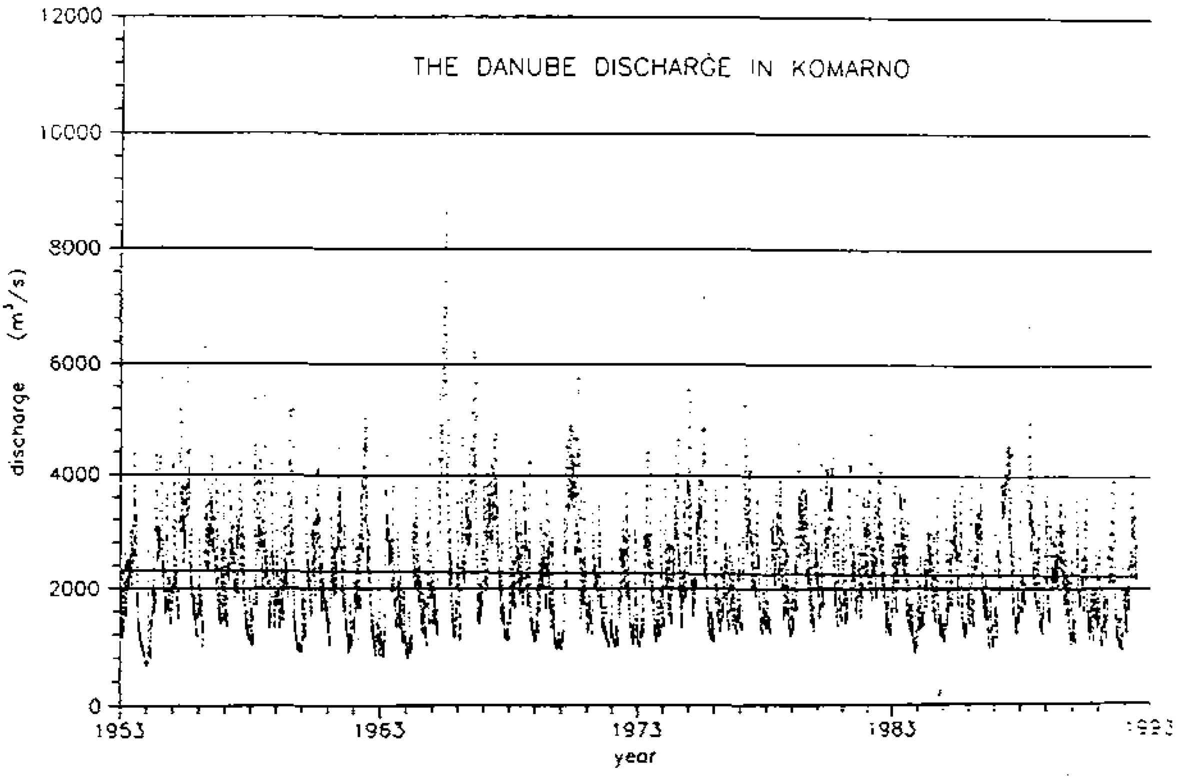
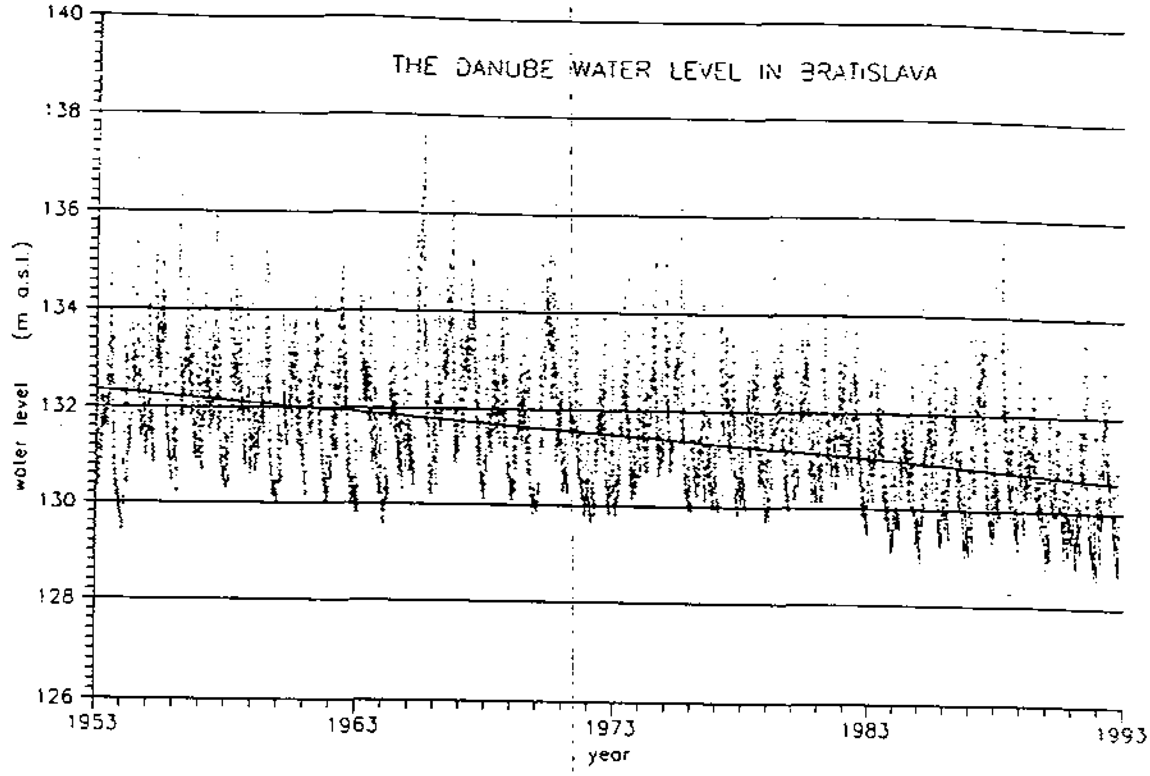


Fig. 1.6: The Danube discharge in Bratislava and Komarno



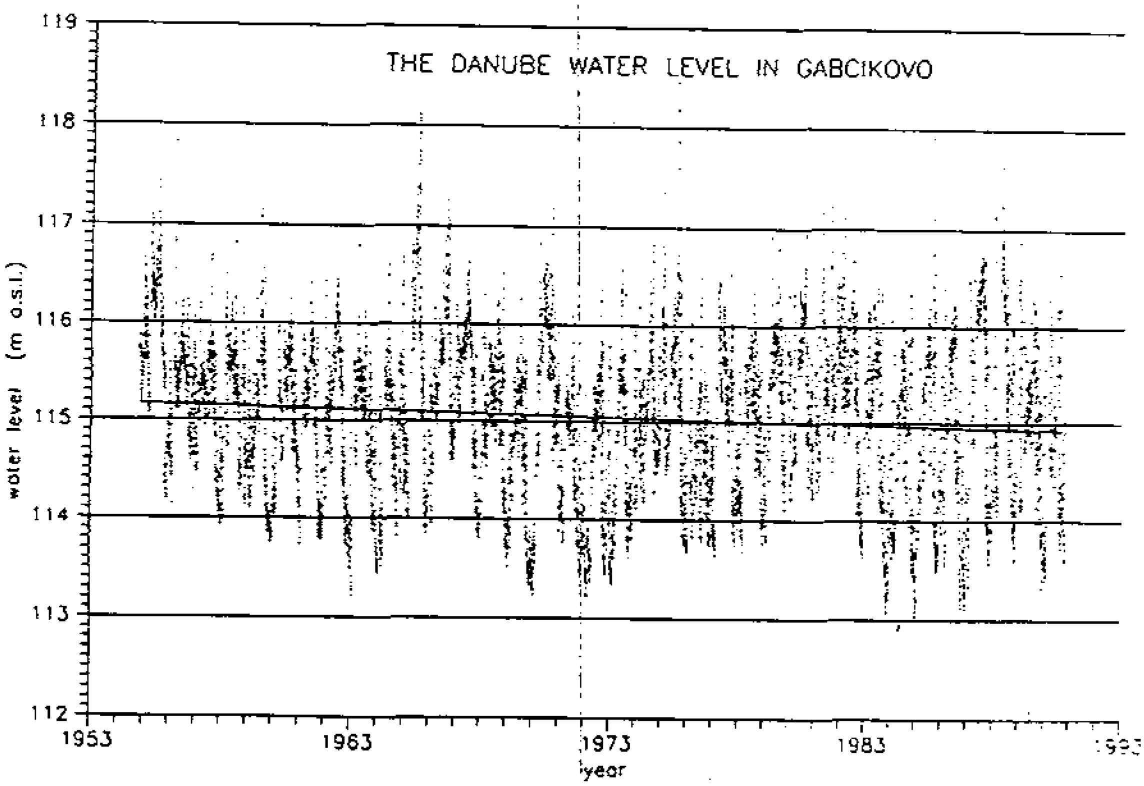
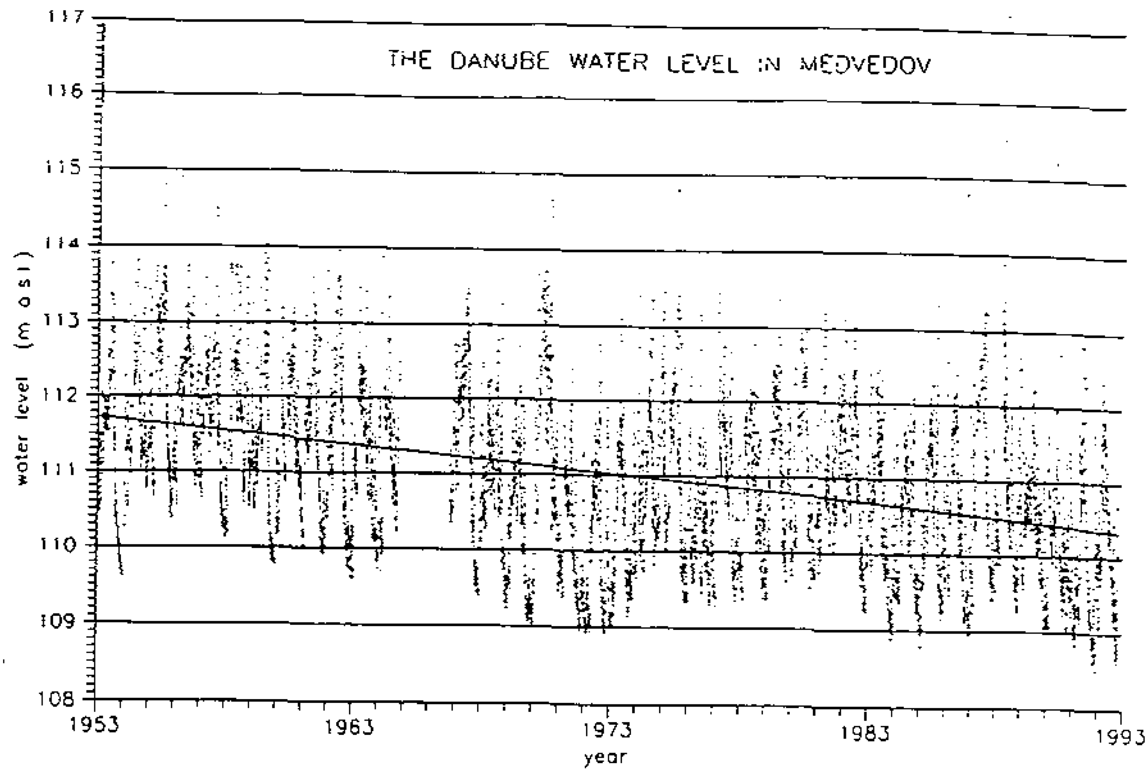


Fig. 1.7: The Danube water level in Bratislava and Gabcikovo



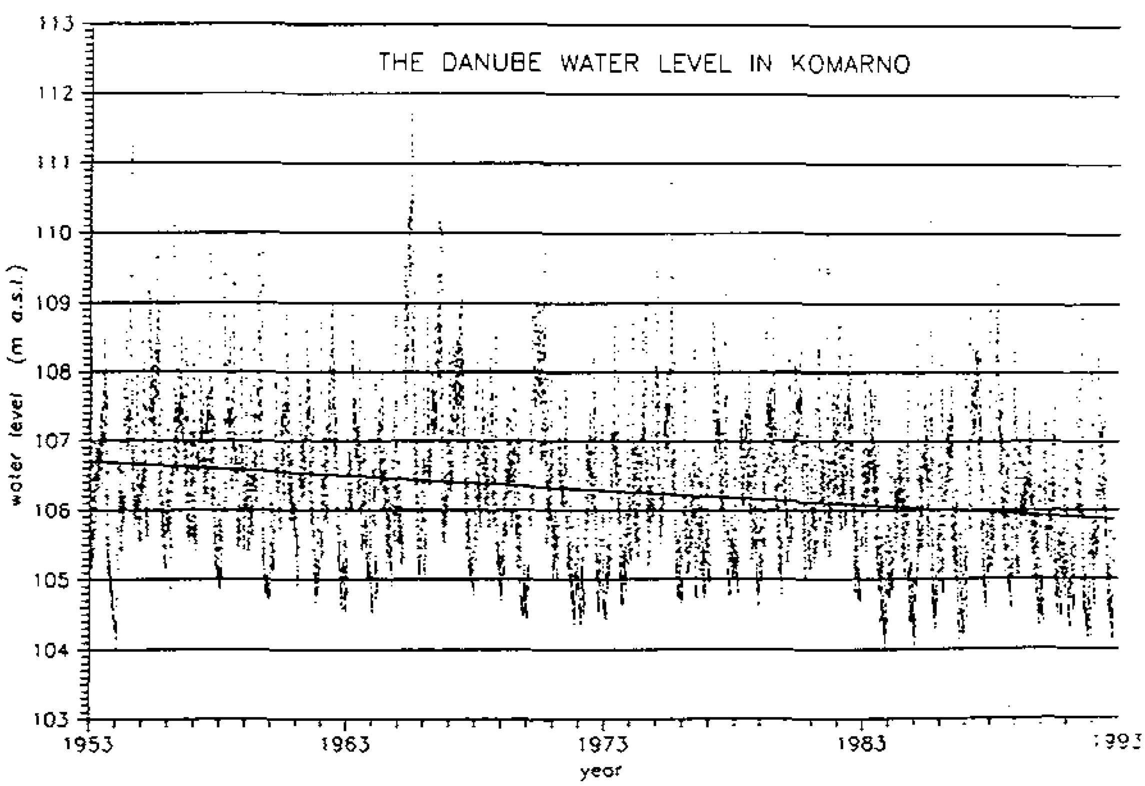


Fig. 1.8: The Danube water level in Medvedov and Komarno

Discharge and water levels, calculated by eq. (1) are considered for referential ones. Reference water levels for the years of 1963 and 1993 and their differences are given in the Table 1.2.

Table 1.2: Computed reference values of discharge and water levels for various gauging stations .

Station	rkm	item	1.1.1963	1.1.1993	difference
Bratislava	1868.7	discharge	2059,40	2040.14	19.26
Bratislava	1868.7	level	131.93	130.61	1.32
Rusovce	1855.9	level	127.47	126.37	1.10
Gabcikovo	1819.6	level	115.11	114.91	0.20
Medvedov	1805.4	level	111.37	110.32	1.05
Klizska Nema	1792.4	level	108.95	107.81	1.14
Zlatna na Ostrove	1779.2	level	107.35	106.37	0.98
Komarno	1767.1	discharge	2295.04	2220.41	74.63
Komarno	1767.1	level	106.50	105.87	0.63

Decreasing of the discharge is very small and therefore the drop in the water level is due to deepening of the river bed.

Decrease of the water level in the Danube is one of the factors yielding to decrease of ground water level, decrease of infiltration rate and it is changing the ground water flow.

Decrease of water level in the Danube together with closure of river branches, because of navigation, was the main long-term negative factor upon the riverside forests and vegetation.

1.2.2. Ground Water Level Regime

The ground water level regime is manifested by its fluctuation, usually measured in regular intervals in hydrogeological wells (wells, piezometers). There is a basic network for observing ground water level fluctuation on the territory of the Danubian Lowland, where the Slovak Hydrometeorological Institute (SHMU) performs continuously or weekly measurements (Fig. 1.9). Similarly, the water stages and discharges on the Danube, Little Danube (Maly Dunaj), Vah, and in chosen canals are processed.

Examples of ground water level fluctuations are presented in following figures. The SHMU well No. 685, situated close to the Danube river channel within the floodplain area, is shown in Fig. 1.10. The ground water level fluctuates in direct dependence upon the Danube river fluctuation. Water level fluctuation in the SHMU well No. 612, occurring in the lower part of the Danubian Lowland, can be seen in Fig. 1.10. Water level rising during the flood in 1965 is clearly visible. The typical example of changes of different effects is presented in Fig. 1.11. There is shown the ground water level fluctuation in some observation wells situated in various distances from the Danube and the fluctuation of the Danube water level.

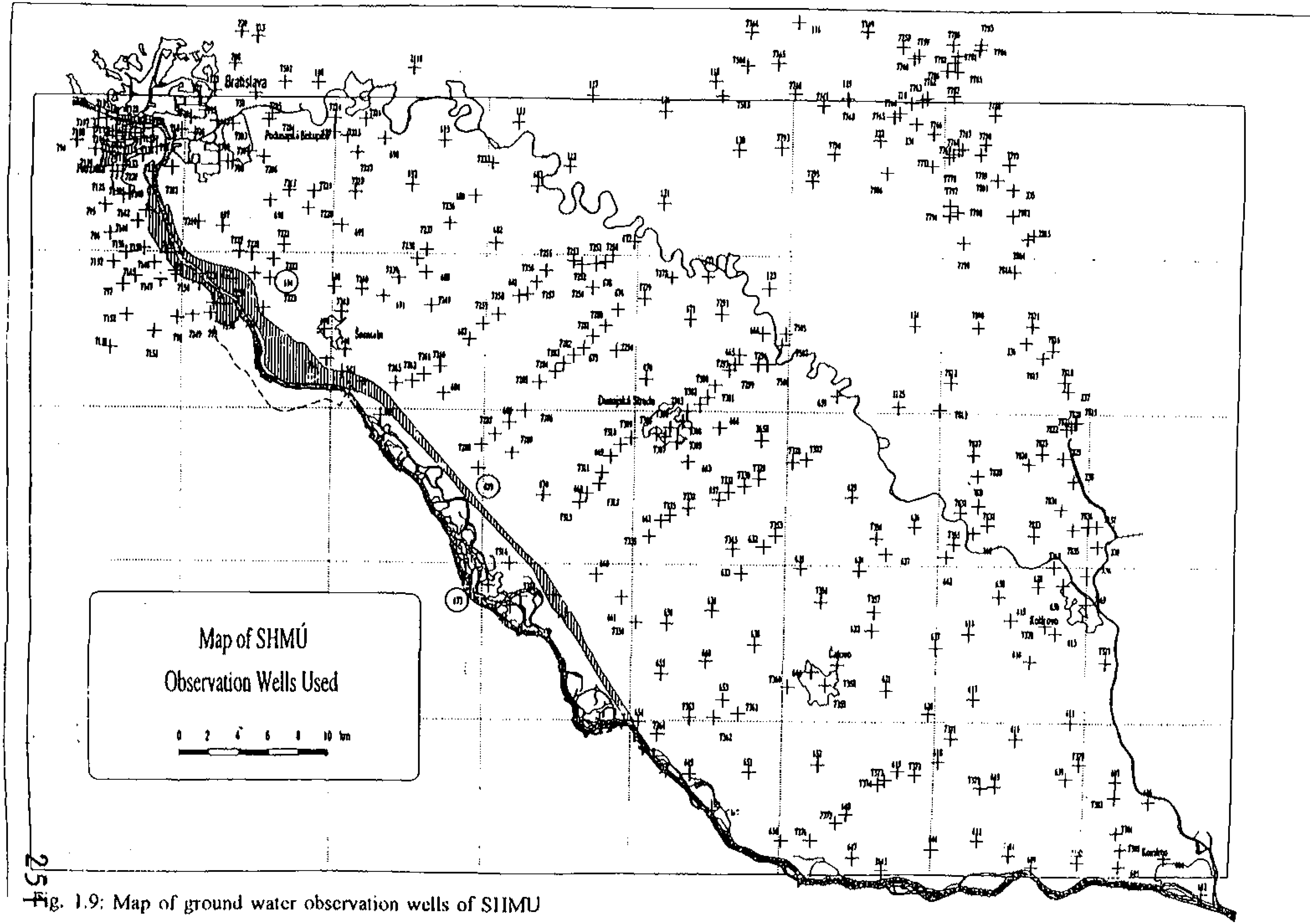


Fig. 1.9: Map of ground water observation wells of SHMU

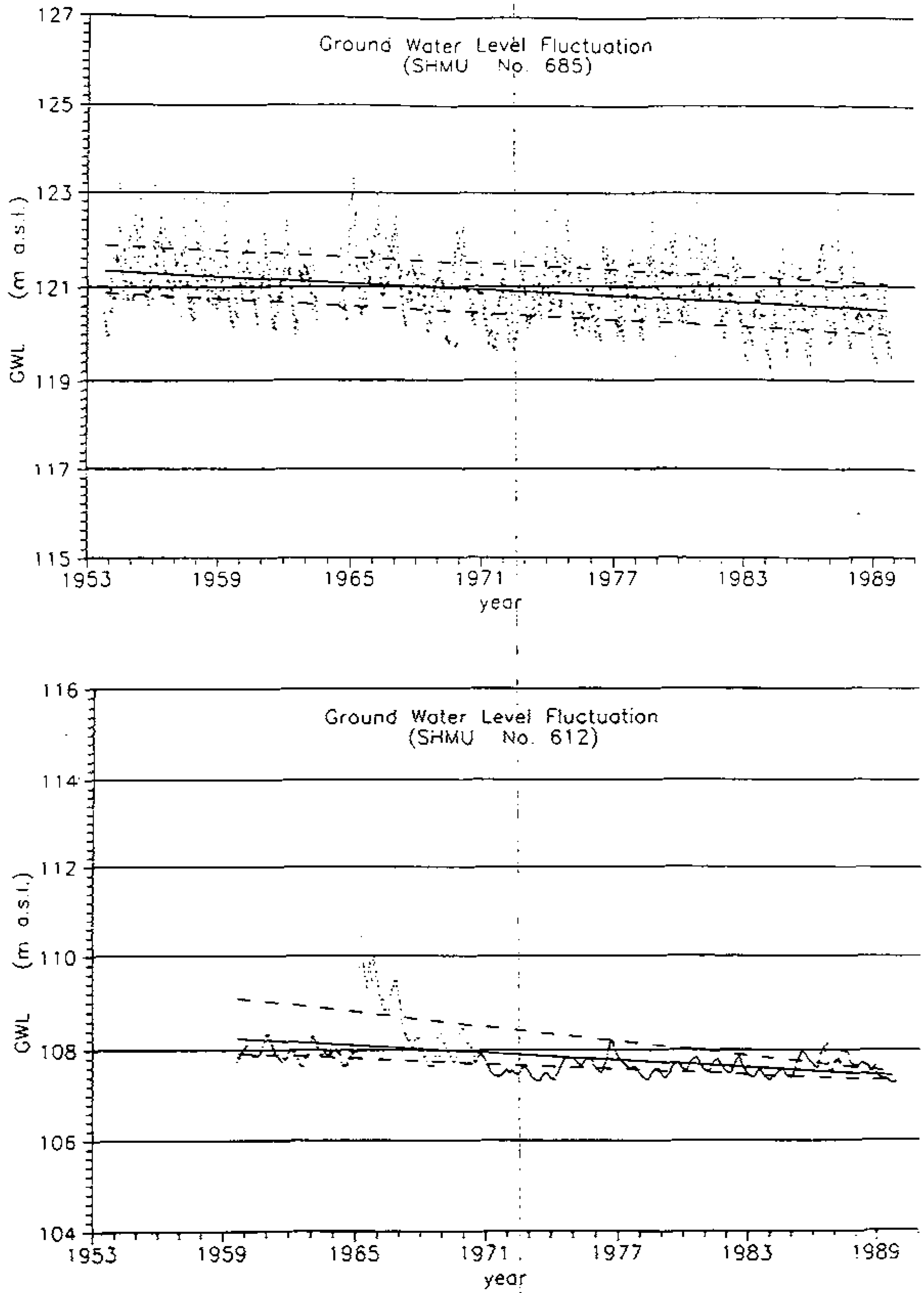


Fig. 1.10: Ground water level fluctuation in the SHMU wells No. 685 and 612

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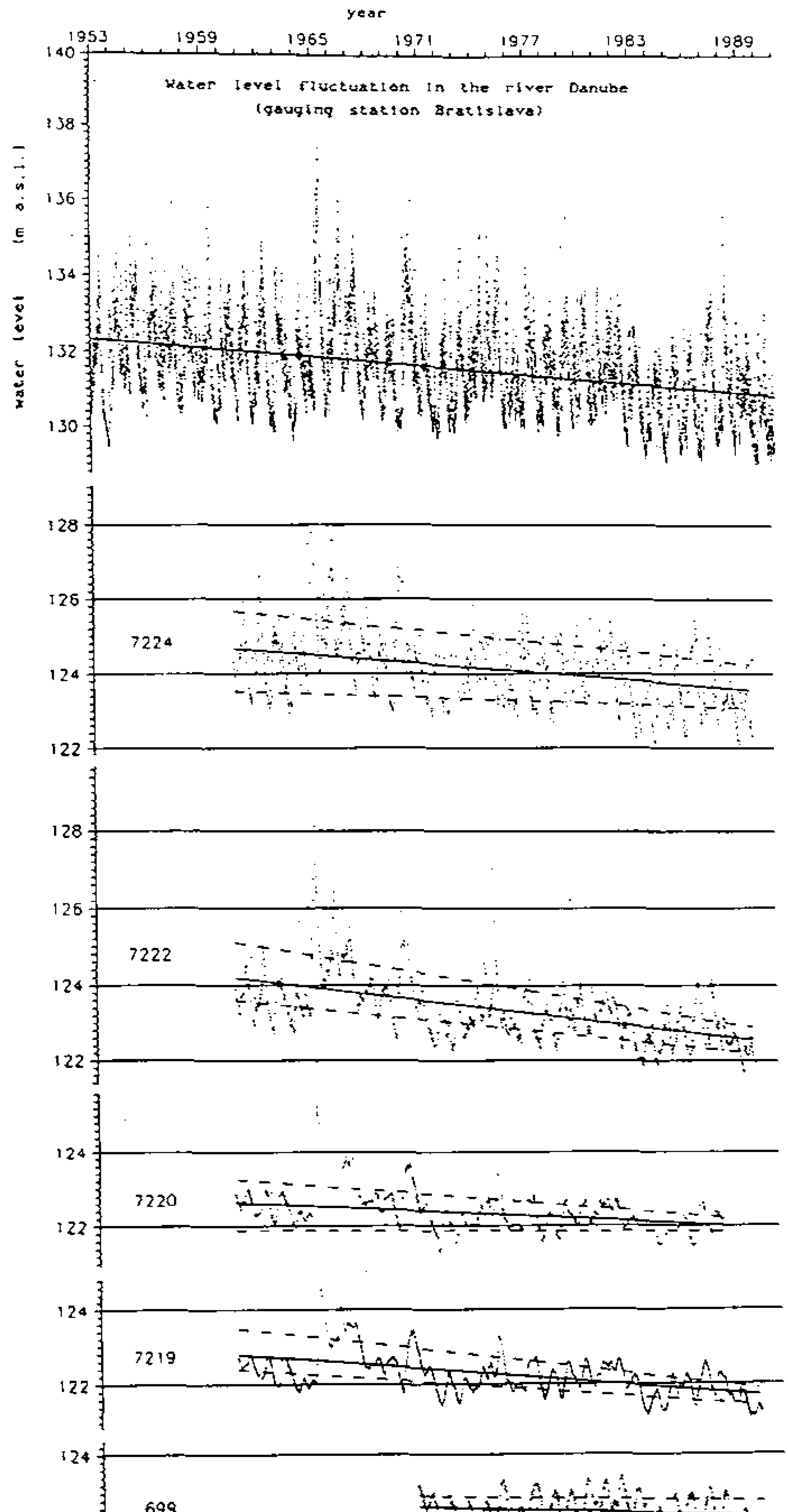


Fig. 1.11: Water level fluctuation in the Danube and ground water level fluctuation in the SHMU wells across the area

It can be seen in the region close to the Danube (SHMU well No. 7224) that the ground water level fluctuation corresponds with the water level fluctuation in the Danube. In a large distance (SHMU well No. 699), the fluctuation is strictly dependent upon the season of the year and the relationship between precipitation, snow melting, and evaporation. There exists a transition zone in which the effects of the Danube or precipitation/evaporation are more or less influencing ground water level fluctuation.

In Figs. 1.10, 1.11 it is shown the linear regression line, representing the drop of average water level in dependence upon time in a long-term period. Above and below this line there are lines (dashed) representing the linear regression of points, situated above and below the average line. The range between the upper and lower dashed line represents the average ground water level fluctuation. Such expression of observed values confirms a gradual ground water level decreasing on a large part of the territory and at the same time, it shows the changes in amplitude of ground water level fluctuation within a long-term period. It is evident, that there are many circumstances influencing the ground water regime and that the application of the linear regression is not an ideal method for the evaluation of the changes in regime of ground waters in time. Such data processing was aimed only at the documentation of the long-term trend of changes of the ground water level fluctuation regime.

The average ground water level, represented by the linear regression line for a concrete time (date), is considered as a reference water level, from which the water level changes within a long-term period may be deduced. The values of the water levels in the SHMU wells (Fig. 1.9) for the years 1960 and 1990 were used for drawing up the maps of ground water level contours (Fig. 1.12), the map of difference lines (Fig. 1.13) and the map of ground water depths below the surface (Fig. 1.13). We also draw the attention to the influence of the second water source near Podunajske Biskupice and to the effect of the hydraulic protection well system surrounding refinery Slovnaft (Fig. 1.12) and to the substantial decrease of ground water level downstream of Bratislava (Fig. 1.13).

A considerable decrease of ground water level is evident in the upper part of the Danubian Lowland downstream of Bratislava during the last 30 years. For comparison, a map of ground water level contours at low water stage in 1954 is shown (Fig. 1.14), [12].

1.2.3. Ground Water Level Fluctuation Regime

The annual sums of weekly ground water level differences were computed (since the measurements have been performed weekly). The map of the summary annual amplitudes of ground water level fluctuation is shown in Fig. 1.15. The thick line in Fig. 1.15 is an approximate distance from the Danube where the water level fluctuation in the Danube influences ground water level fluctuation. Behind this boundary, ground water level fluctuation is caused by infiltration - evaporation relationship.

1.2.4. Influence of Ground Water Regime Changes

1.2.4.1. Influence of Ground Water Level Changes upon Agriculture

The hydrological and ecological regime in the area is subjected to a long-term trend of river bed erosion and decreasing of ground water levels.

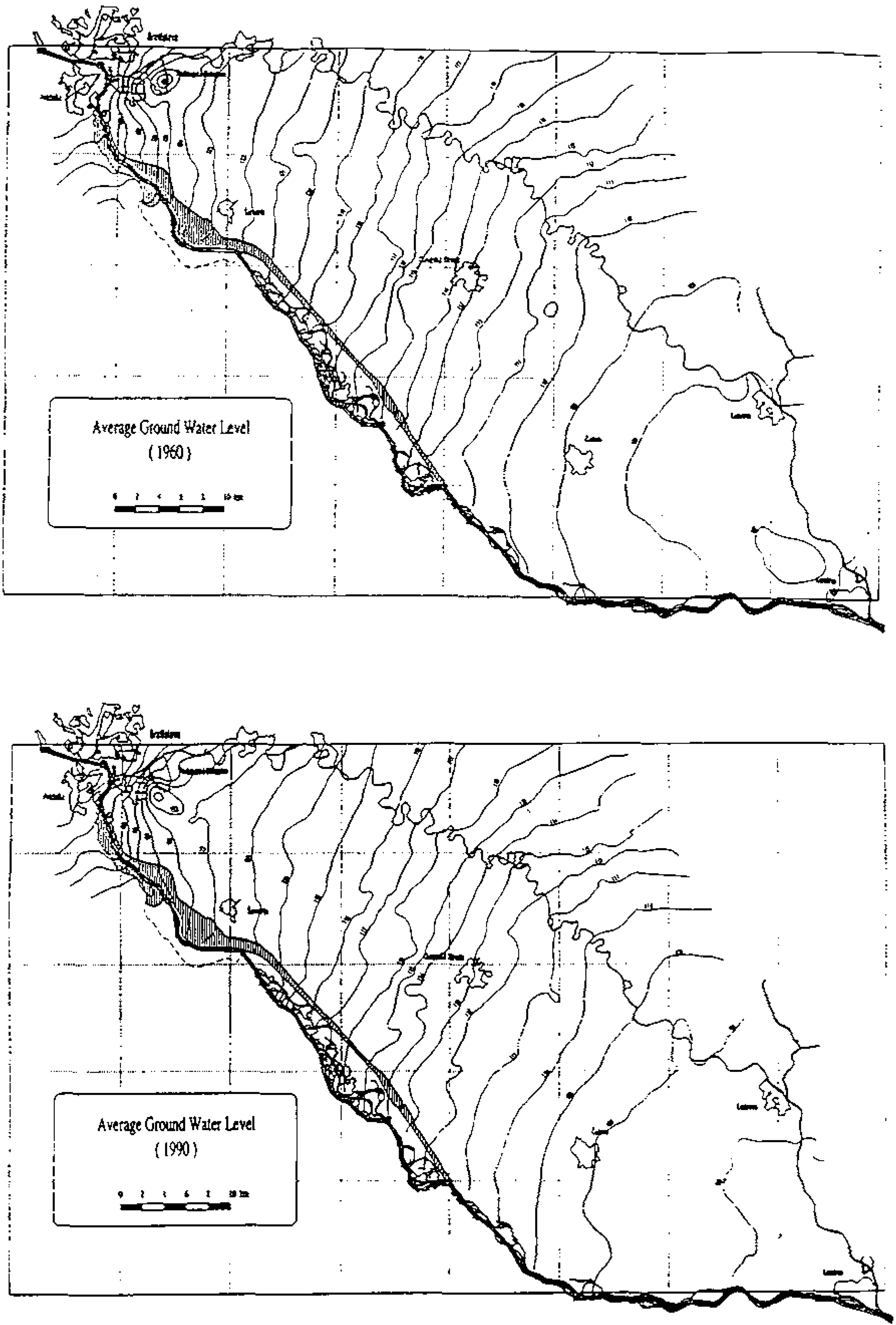
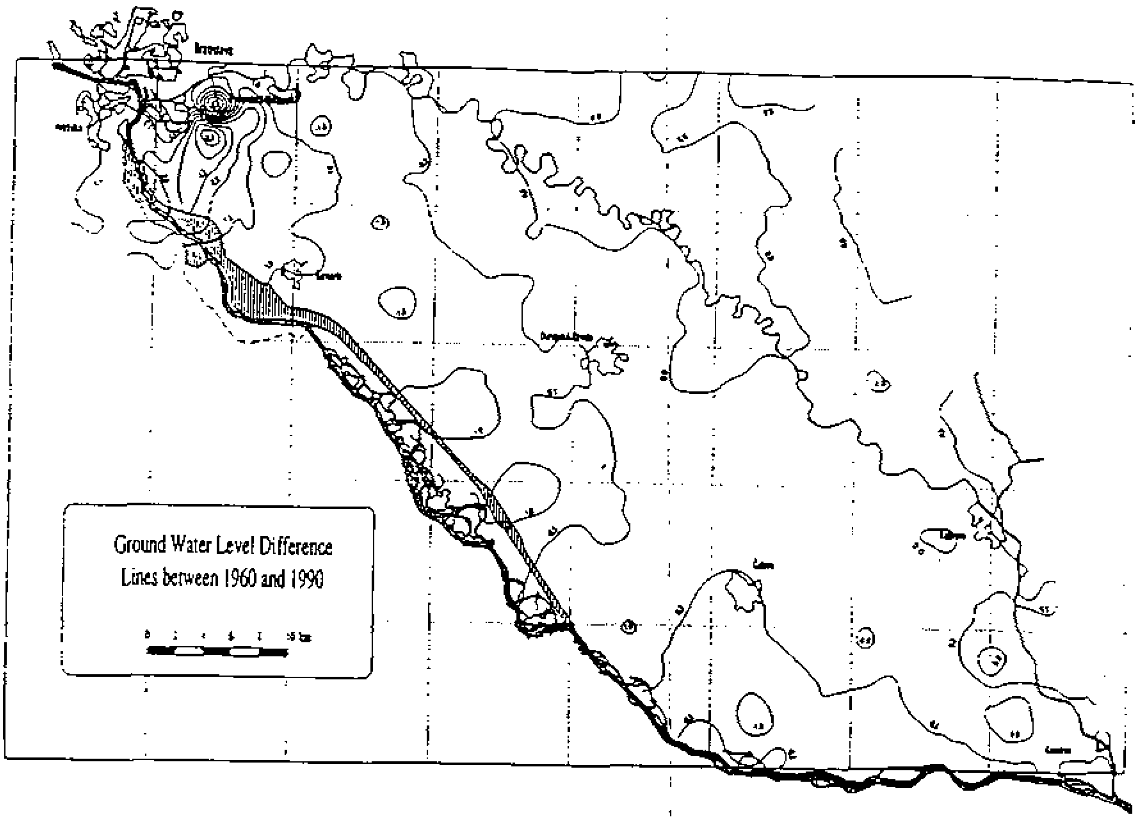


Fig. 1.12: Ground water level contour lines in 1960 and 1990



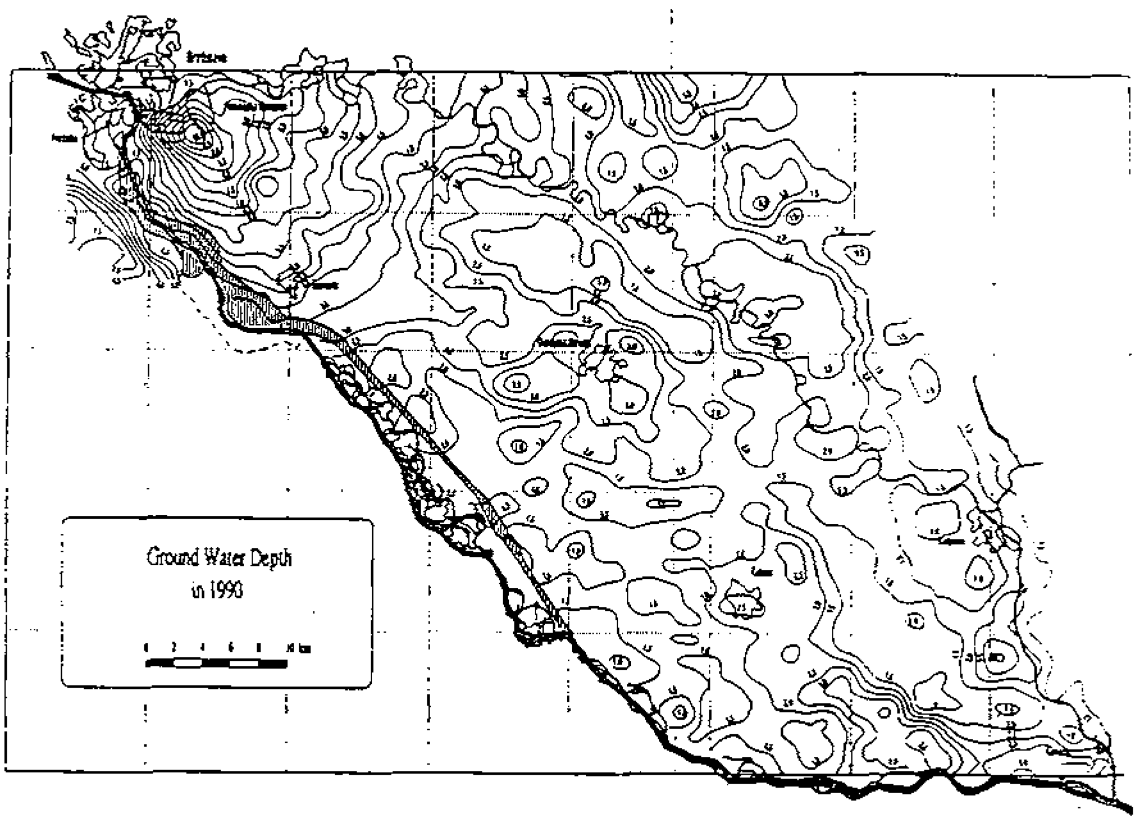


Fig. 1.13: Ground water level difference lines between 1960 and 1990 and ground water level depth in 1990

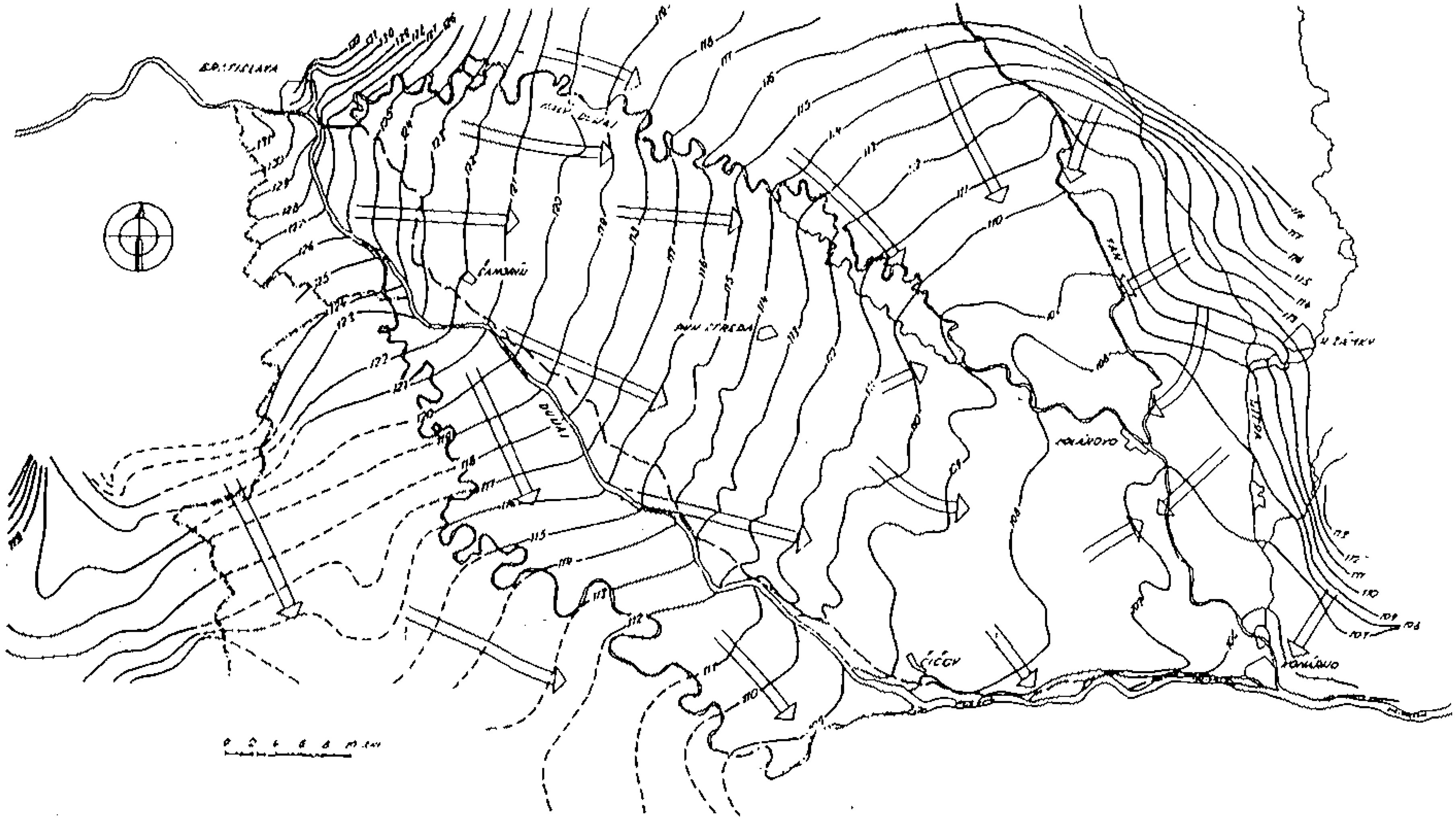


Fig. 1.14: Ground water level lines in SW part of the Danubian Lowland - low water stage, January 6, 1954 [12]

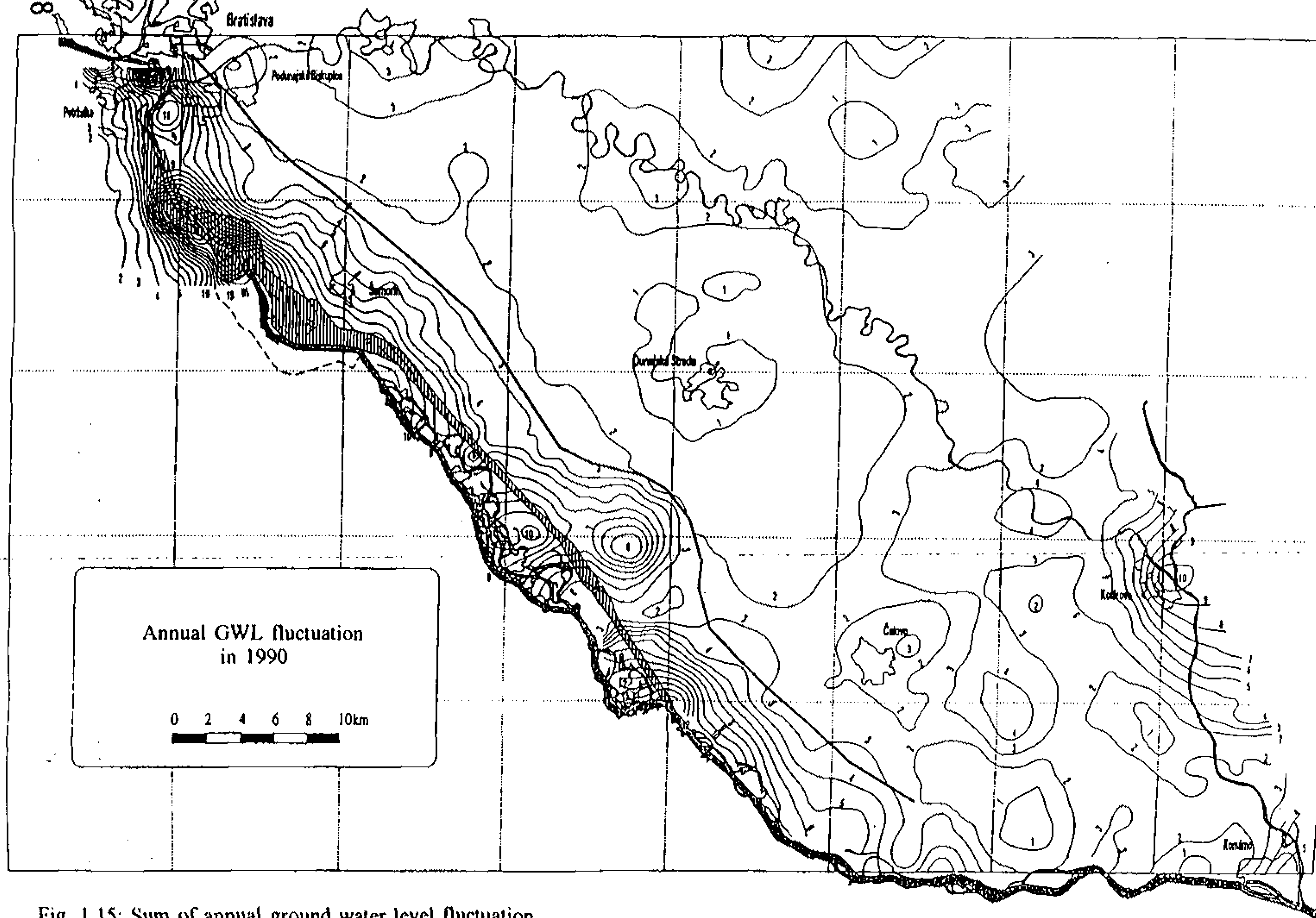


Fig. 1.15: Sum of annual ground water level fluctuation

The annual rainfall (500 - 700 mm) is much smaller than the need of water supply to the vegetation, especially during the summer season. This extra water supply was possible in the past throughout the area by vertically upwards flow in the capillary zone from the ground water table to the root zone. The necessary conditions for this are that the ground water table is not too deep and that no gravel layer is located over the ground water table. The pre-dam conditions are characterized by measured ground water level equipotential lines (Figs. 1.12 - 1.14).

However, due to the decrease in ground water levels during the past few decades, especially after the second world war, it has been necessary to make artificial irrigation for the agriculture. Thus, on the Slovak side, a comprehensive network of surface water canals has been developed for irrigation purposes. However, artificial irrigation has its disadvantages as compared to the natural situation because the downwards water flux causes a considerable leakage of nitrates, organic components, pesticides and other chemicals into the ground water.

1.2.4.2. Influence of Ground Water Level Decrease in Inundation upon Forestry

In the past, the measures taken for the navigation, constrained the possibilities for the development of the Danube and the floodplain area. The pre-dam trend with lowering of the Danube water level, endikements, cutting off the side branches upstream and fortification of the main channel has stressed the biotic communities substantially during the last decades. As a result of past ground water decrease (typical example is the SHMU well No. 673 situated at the village Bodiky, Fig. 1.16), some area of soft alluvial forests have been turned into hard alluvial forests. The latter were often cultivated with poplar and white willow. Furthermore, it is estimated that large part of the originally forest is not alluvial forest any longer. In addition, forestry has replaced many natural forests by plantation, where introduced cultivars of poplar have been used. Due to anthropogene effects, the dynamics and structure of alluvial forest were considerably disturbed and made the invasion of Solidago, Aster and Impatiens species possible.

Percentage of discharge in the Danube and its river branches, before cutting off and closing the river branches, is shown in the Table 1.3. The first number in the table is discharge in the main stream of the Danube, the number in brackets is the discharge throughout the river branches. It can be seen that e.g. from rkm 1833 to 1816, in the area of Gabcikovo, the discharge in the river branches was before the closing the river branches approximately 20 % of discharge in the Danube in Bratislava, also by low discharges. In the opposite, a short time before damming of the Danube the flow in some river arms started by discharge in Bratislava from 2500 - 3500 m^3/s. The flow in almost all river branches occurred when the discharge in the Danube was over 3500 - 4500 m^3/s. The main difference between the conditions in late 1950's and pre-dam conditions is, that in the far past the main river branches were supplied with water all the time but in pre-dam conditions less than 78 days in a year.

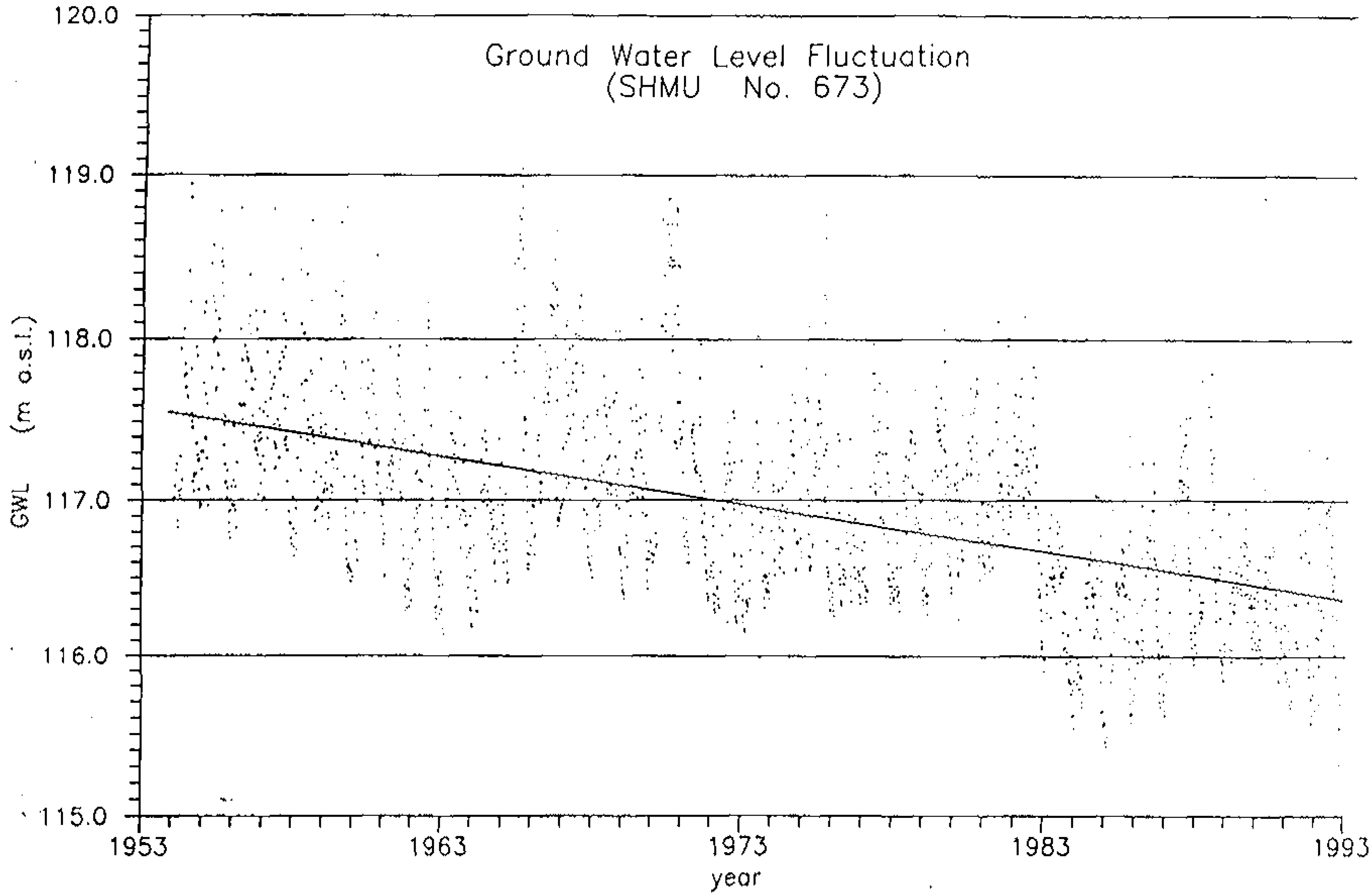


Fig. 1.16: Ground water level fluctuation in the SHMU well No. 673

Table 1.3: Percentage of discharge in the Danube and her river branches (Dub, Duba, Szolgay in [10])

		17.1.1961	21.9.1960	20.-22.6.1961	16.-17.5.1955
		Discharge in Bratislava (m^3/s)			
		1005	1958	2998	4002
	rkm	(%)			
Hrusov	1842.40	99 (1)	97 (3)	83 (17)	68 (32)
Sulany	1833.10	76 (24)	74 (26)	62 (38)	65 (35)
Baka	1825.00	88 (12)	96 (4)	78 (22)	67 (33)
Gabcikovo	1821.07	65 (35)	82 (18)	66 (34)	51 (49)
Istragov	1816.85	84 (16)	84 (16)	76 (24)	64 (36)
Palkovicovo	1810.40	99 (1)	85 (15)	68 (32)	63 (37)
Medvedov	1806.00	99 (1)	99 (1)	89 (11)	92 (8)
Klucovce	1802.37	99 (1)	99 (1)	90 (10)	99 (1)

1.2.4.3. Influence of Ground Water Level Decrease upon Water Resources

The city of Bratislava is supplied with water from the wells situated near the Danube at various places. Some of them are in the position where thickness of the gravel and sand sediments is very low. Pospisil and Kucera [17] estimated deep erosion of river bed in various places at the Danube (Table 1.4).

Table 1.4: Erosion of the Danube river bed (1964 - 1990)

Locality	rkm	decrease (m)	thickness of aquifer (m)
Sihot	1875	1.18	10 - 17
Pecensky les	1871	0.77	8 - 14
Bratislava - limnigraph	1868	0.45	8 - 15
Rusovce - Ostrovne Lucky	1856	0.41	15 - 45
Cunovo	1855	0.95	45 - 100

At locality Pecensky les, Pospisil [16] estimated the decrease of ground water inflow towards the system of wells of 30 - 40 % between the years 1973 - 1991. At the locality Rusovce -

Ostrovne Lucky, Pospisil and Kucera [17] estimated the shift of watershed divide towards Cunovo further from the Danube.

1.2.4.4. Influence of River Bed Erosion

The ground water level decreasing can be also studied with respect to geological conditions downstream of Bratislava. Fig. 1.7 shows that the Danube bed erosion is progressing. The basic problem creates the subsidence of the Danube bottom with respect to the geological interface between the gravel of the Danube sediment deposits and sub-surface sands of the Neogene age. Problems caused by erosion are well visible in Fig. 1.17, where the geological profile, worked out by the enterprise IGHP, is demonstrated in the site of planned subway under the Danube.

Thus the progressing process of the Danube bed erosion has not only a negative impact on present ground water level decreasing, on decreasing of the infiltrating amount into the Danubian Lowland region, but also on the possibility of a substantial erosion acceleration downward from the granite threshold upstream from the Bratislava castle, in places from the Old Bridge down to the winter harbor in Bratislava. It is emphasized, that the most significant factor of erosion is the water flow velocity and by influencing this velocity it is possible to directly influence the erosion and sedimentation processes.

Similar problems are known and described by Austrian water researchers Kresser [6], Zottl [8] and Prazan [7] and the cuttings from their articles are enclosed (see Appendix).

There is the imminent danger of the Danube river cutting into the Neogene sediments and consequent substantial acceleration of erosion, further ground water level decreasing and, naturally, also decreasing of well yields, especially in the region close to Bratislava. Thus, prevention of further erosion of the river bed and successive improvements (rising of the bottom) are more than advisable.

1.3. FORECASTING OF GROUND WATER LEVEL WITHOUT GABCIKOVO HYDROPOWER STATION

From the long term ground water level measurements based on statistical analyses, a long-term drop of ground water level was estimated. Based on the data evaluation, the extrapolation for the future was made. It means, that the forecasted ground water levels expressed in equipotential lines will be reached under conditions, that the processes yielding to ground water level decrease would continue without changes. According to our opinion, the river bed erosion will be speeded up after construction of hydropower station in Vienna Freudenau. In the Fig. 1.18, there is shown the real reference ground water level before damming the Danube in so-called pre-dam conditions in 1992. The forecasted ground water levels in 2022 are in Fig. 1.18. This means extrapolation 30 years after damming the Danube. It is evident that the forecasted changes, decrease of ground water level, are from all points of view, and especially from the point of view of ecology, very negative.

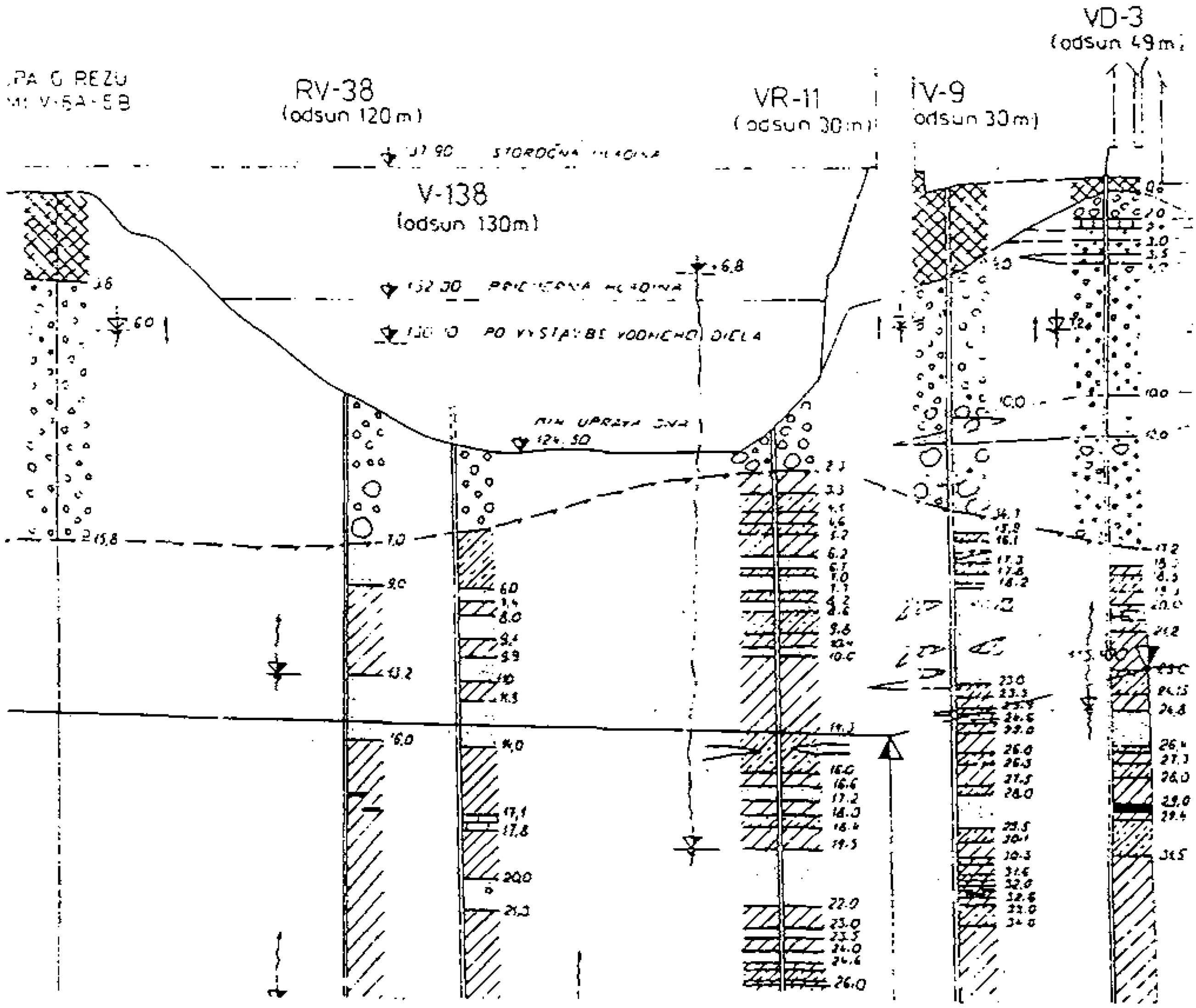
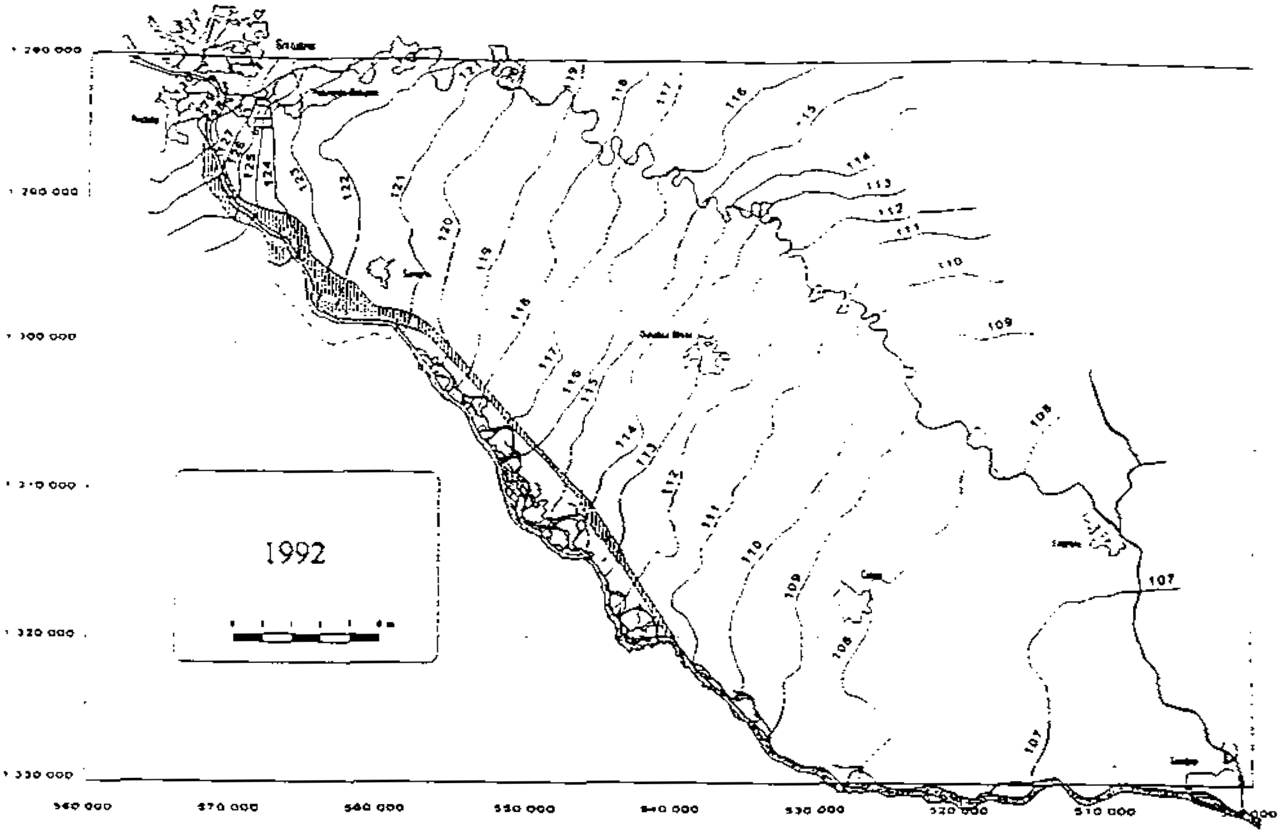


Fig. 1.17: Geological profile downstream of the Old Bridge in Bratislava



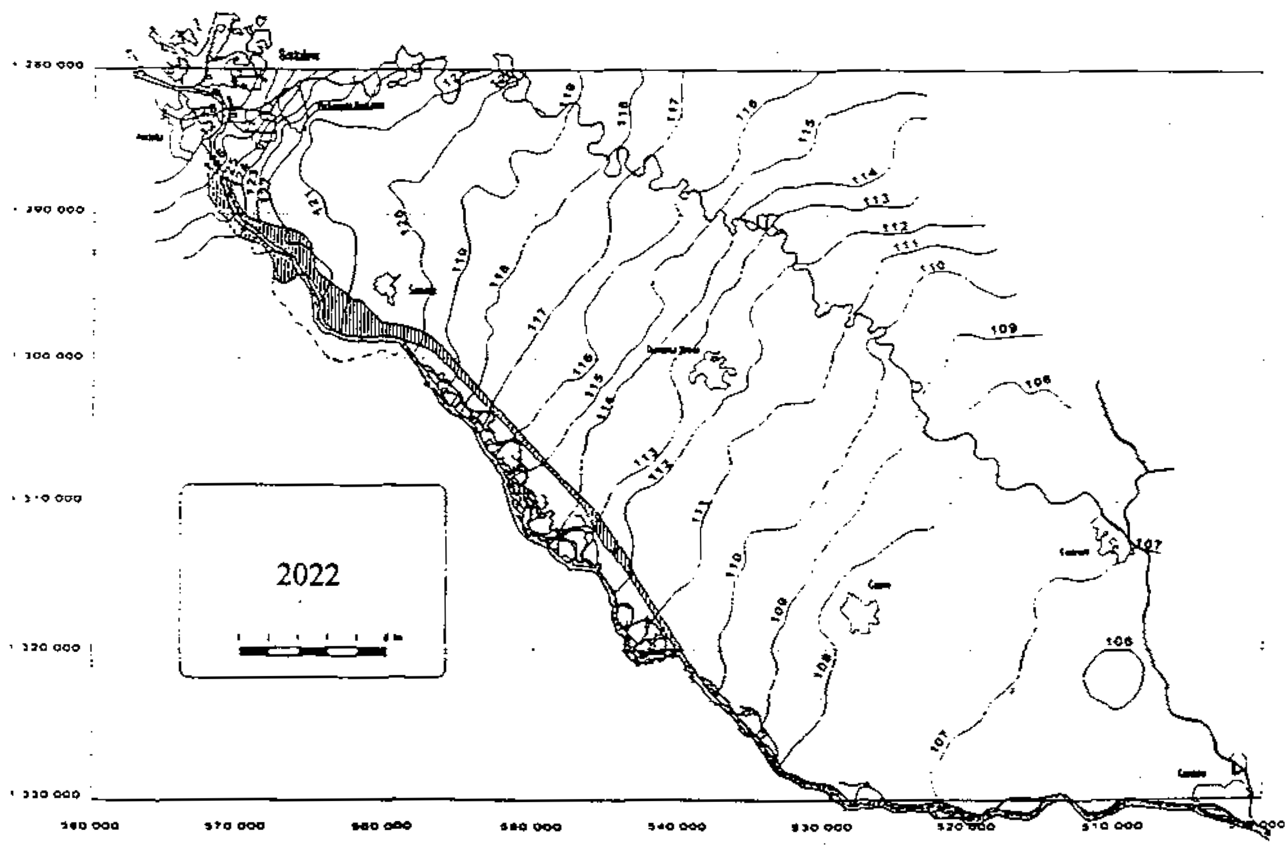


Fig. 1.18: Reference ground water level equipotential lines in 1992 and forecasted reference ground water level equipotential lines in 2022 (for pre-dam conditions)

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1.4. INTERPRETATION OF CHANGES AFTER DAMMING THE DANUBE

1.4.1. Interpretation of Changes 6 Months after Damming the Danube

The influence of damming the Danube can be seen on 3 typical chosen piezometers. Fig. 1.19 represents water discharge in the Danube starting at the time of pre-dam conditions. In Fig. 1.19 there is shown the date of the damming the Danube (October 24, 1992) and starting the filling up the river arms in inundation on the Slovak territory (May 5, 1993). Typical well, not far away from the reservoir, the SHMU well No. 694 (Fig. 1.19, see situation in Fig. 1.9) shows eminent increase of ground water level just after damming the Danube. The SHMU well No. 673 (Fig. 1.20), situated in inundation near the river Danube, shows after damming the Danube the decrease of ground water level and increase of ground water level after filling up the river arms. The SHMU well No. 679 (Fig. 1.20), situated behind the power channel, shows decrease of ground water level after damming the Danube and visible increase of ground water level after filling up the river arms. It is evident the impact of not only the damming the Danube but also of the filling up the river arms.

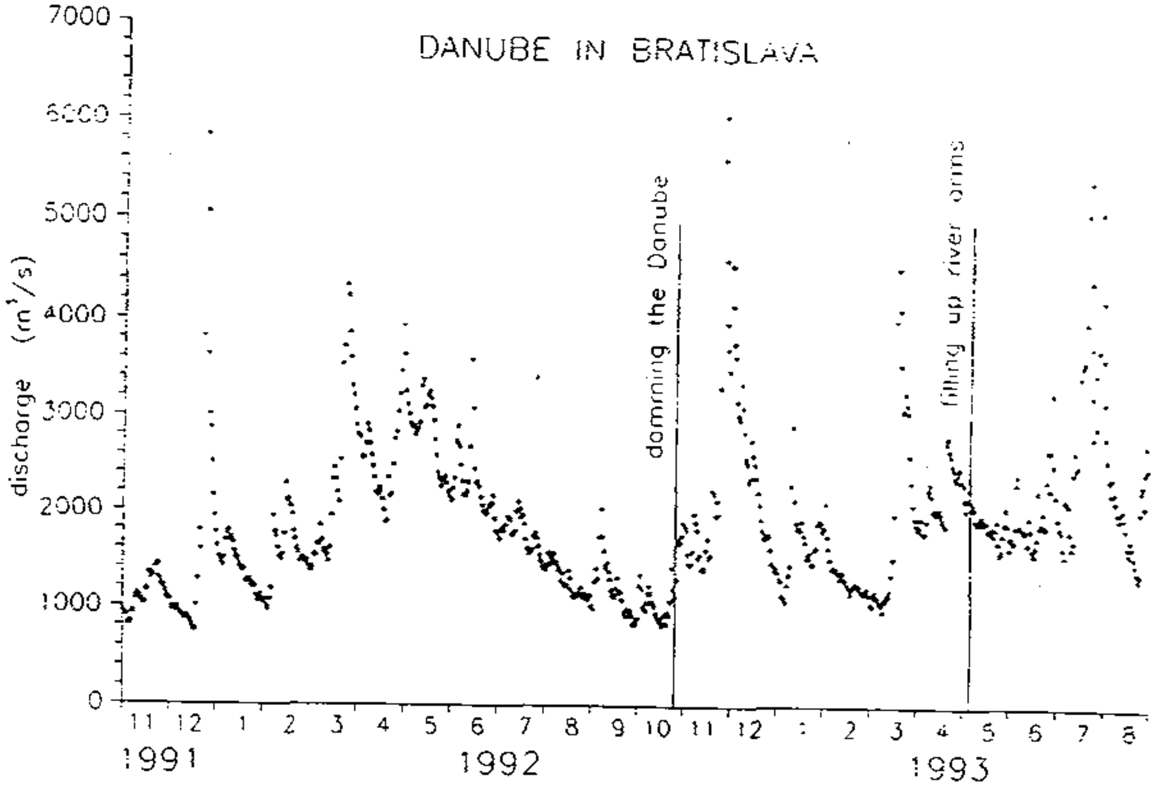
To show the regional impact of damming the Danube and filling up the river arms, the equipotential lines were drawn for both cases. From the SHMU wells, the ground water level equipotential lines were drawn for the date of April 28, 1993 (Fig. 1.21). Reservoir was filled up but the river branches in inundation were still empty. Using prediction of water levels for the situation without filling up the reservoir, the equipotential lines for the same date were constructed (Fig. 1.21). The difference lines, constructed from these two figures, give to us a general overview about changes in ground water level (Fig. 1.22). On wells, situated near the reservoir, there is the increase of ground water level and in opposite, on wells, situated near the intake channel leading to the power plant, there is a temporary decrease of ground water level until some remedy measures are realized.

1.4.2. Interpretation of Changes 8 Months after Damming the Danube

Influence of the filling up the river arms in inundation (May 1993) can be seen on the SHMU well No. 673 (Fig. 1.20), which is situated between the Danube and intake channel. Similar situation is on the SHMU well No. 679 (Fig. 1.20) behind the intake channel.

The main difference between 6 and 8 months after damming the Danube is caused by the filling up the river branches in inundation on the Slovak territory (May 5, 1993). To express the situation after 8 months after damming the Danube (June 30, 1993), the ground water level equipotential lines based on the measured SHMU wells are shown in Fig. 1.23. Using prediction of water levels for the situation without damming the Danube, equipotential lines of ground water level were constructed (Fig. 1.23). Comparing equipotential lines, the difference lines of ground water levels are presented in Fig. 1.24. Fig. 1.24 represents the changes of ground water levels on 30 June 1993 in comparison with the conditions without the damming the Danube. From the figures it is clear that the damming the Danube and filling up the river branches have increased ground water levels on the whole territory including the inundation approximately to the state 30 years ago.

Except this, it is clear that the ground water levels are very sensitive upon the filling up the river branches in inundation. This means that river branches are one of the management tools for ground water level optimization. The changes of ground water level, measured on the SHMU well No. 679 in the second half of June, show the good response on higher water



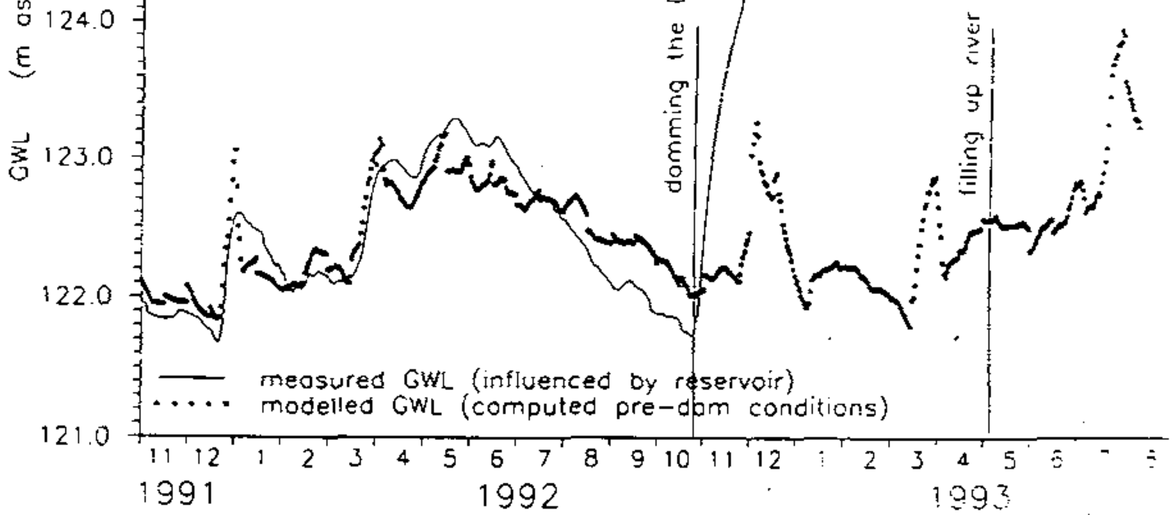


Fig. 1.19: Discharge in the Danube in Bratislava and measured and modeled ground water levels in the SHMU well No. 694

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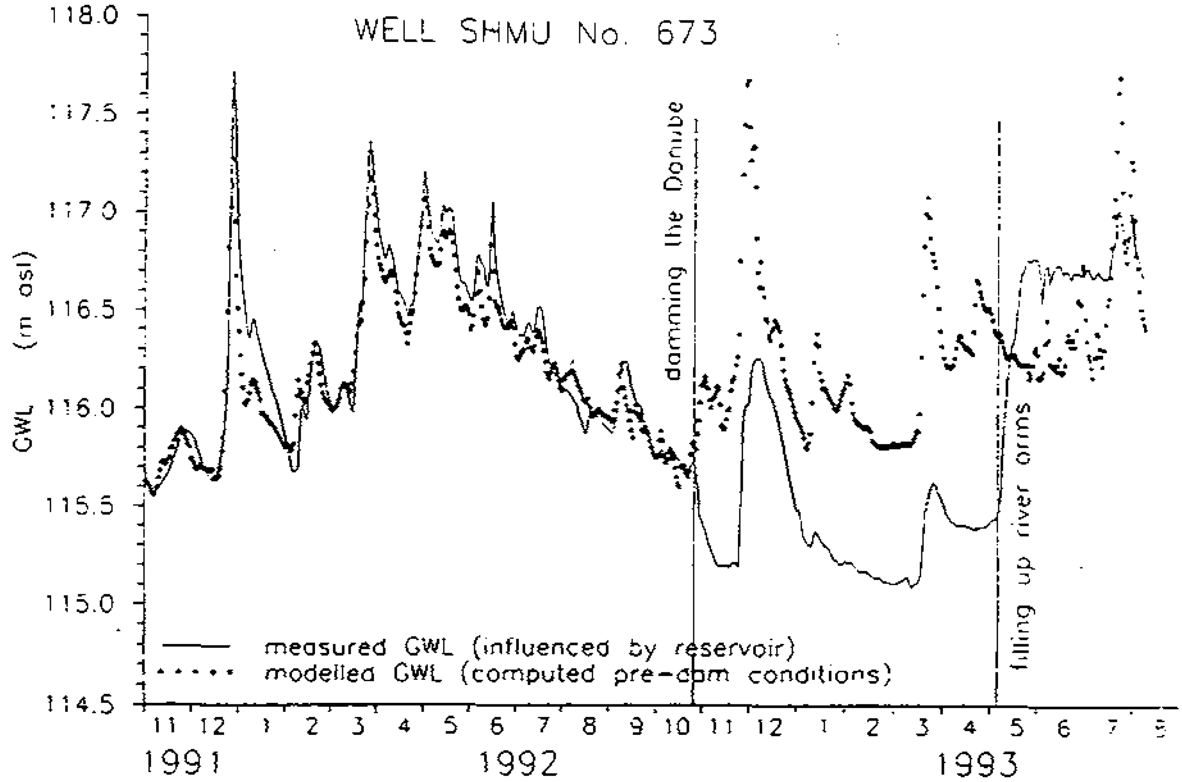


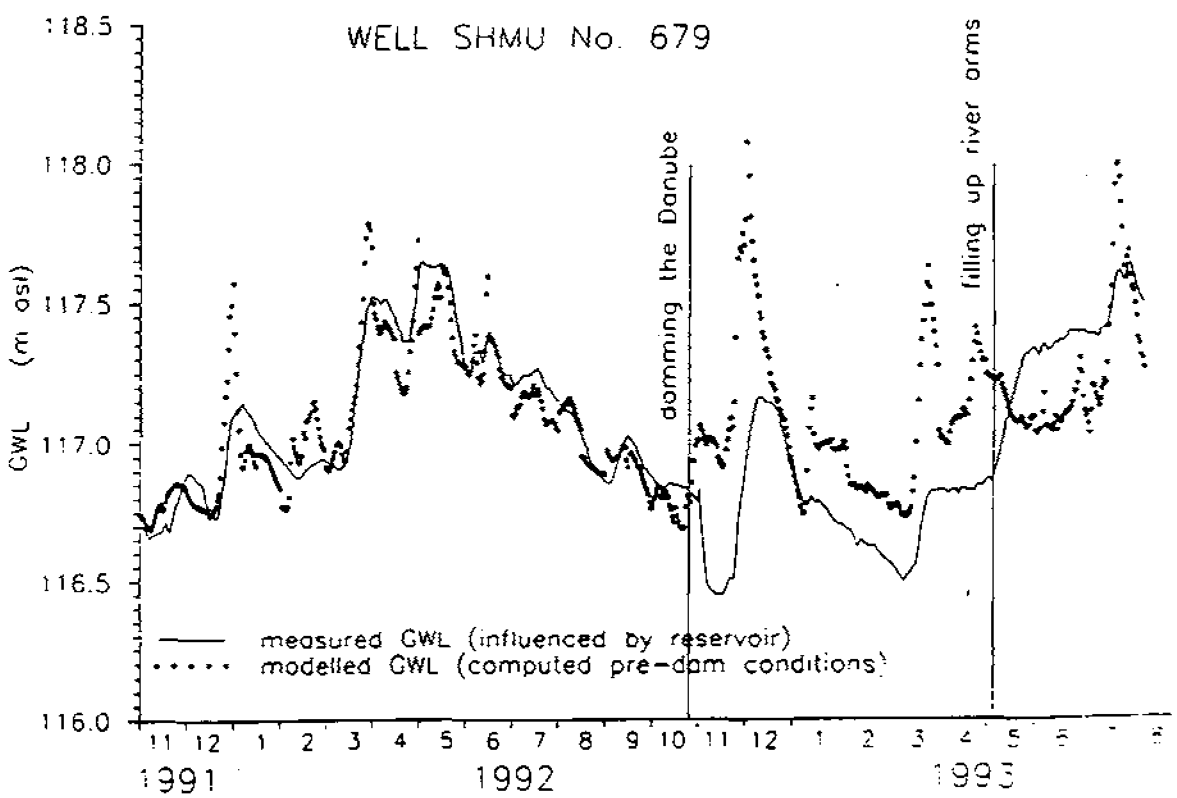
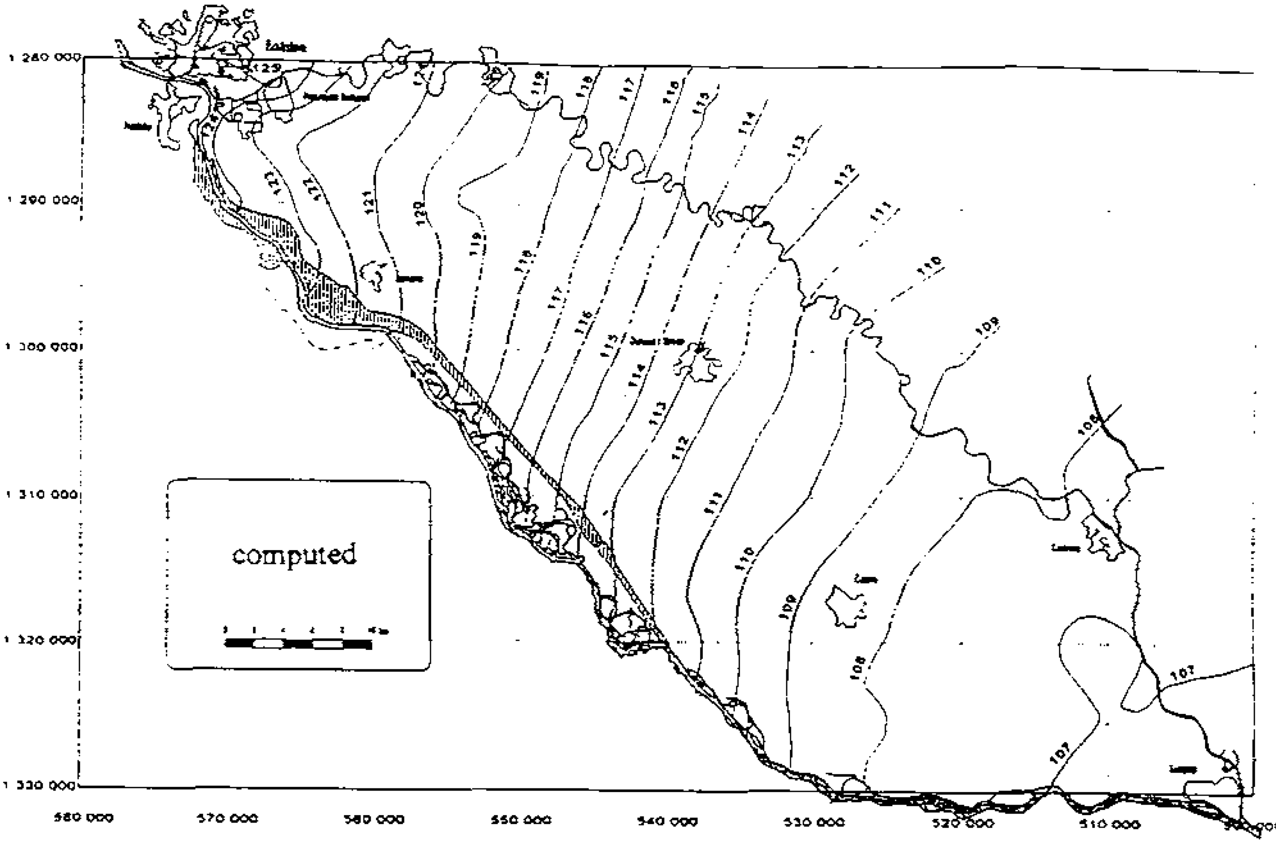


Fig. 1.20: Measured and modeled ground water levels in the SHMU wells No. 673 and 679



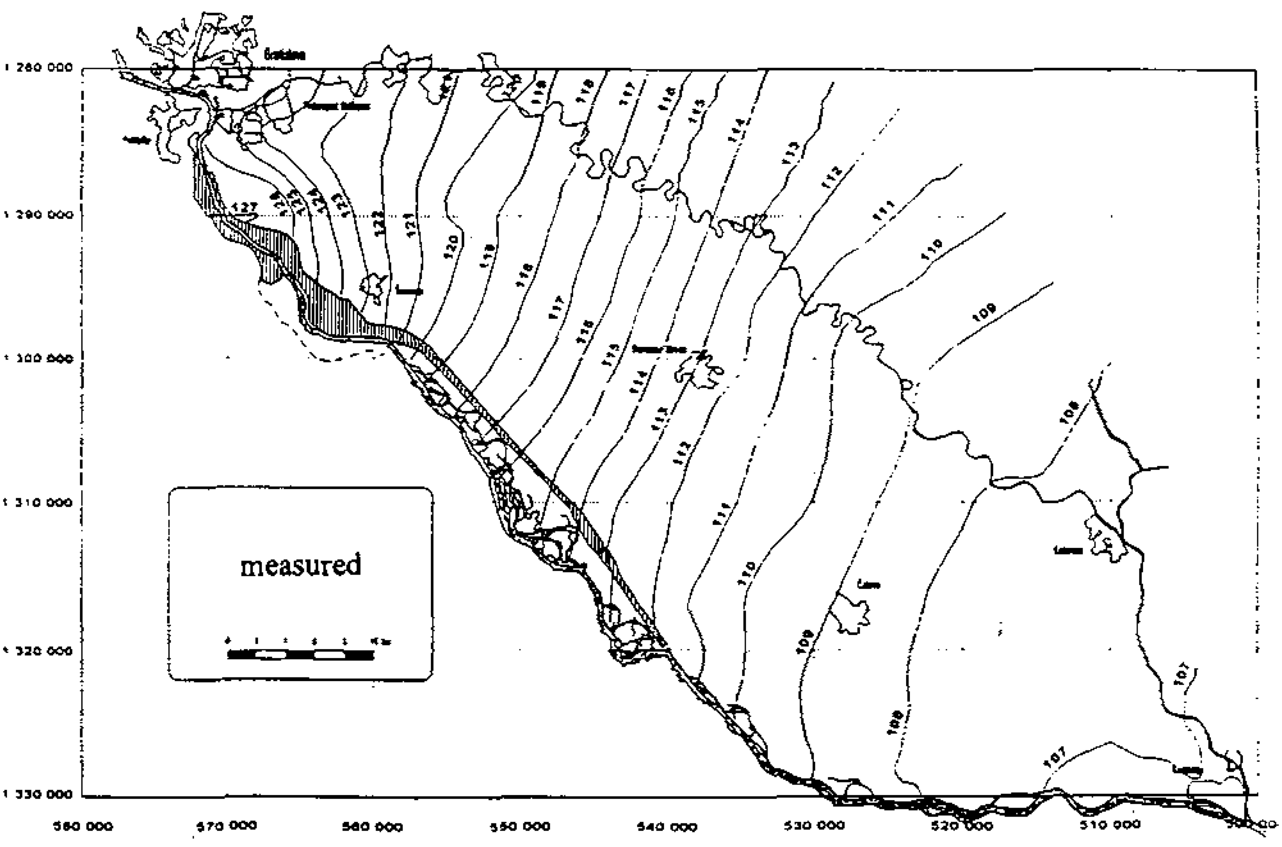


Fig. 1.21: Ground water level equipotential lines computed for pre-dam conditions and measured (April 28, 1993)

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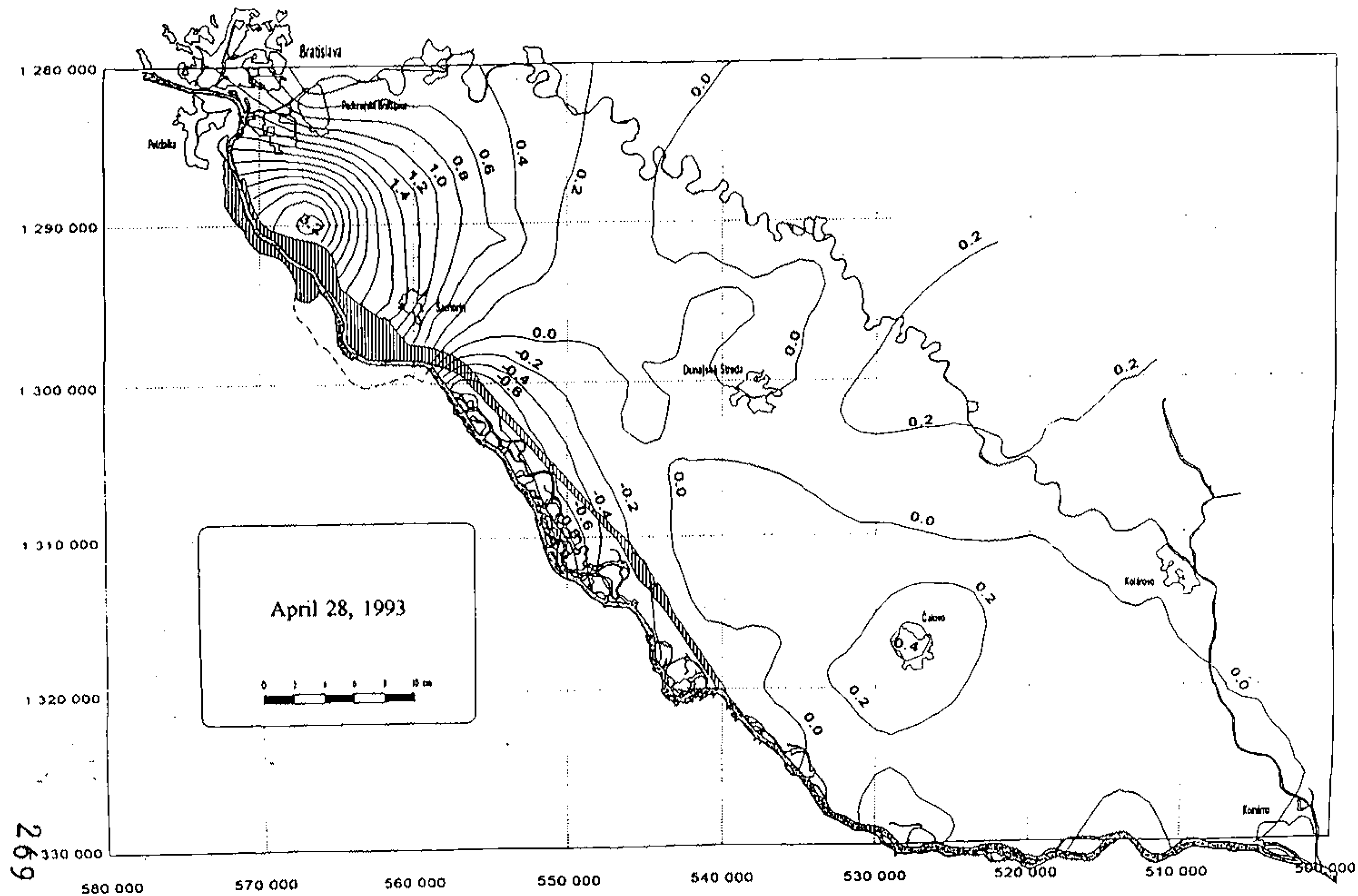
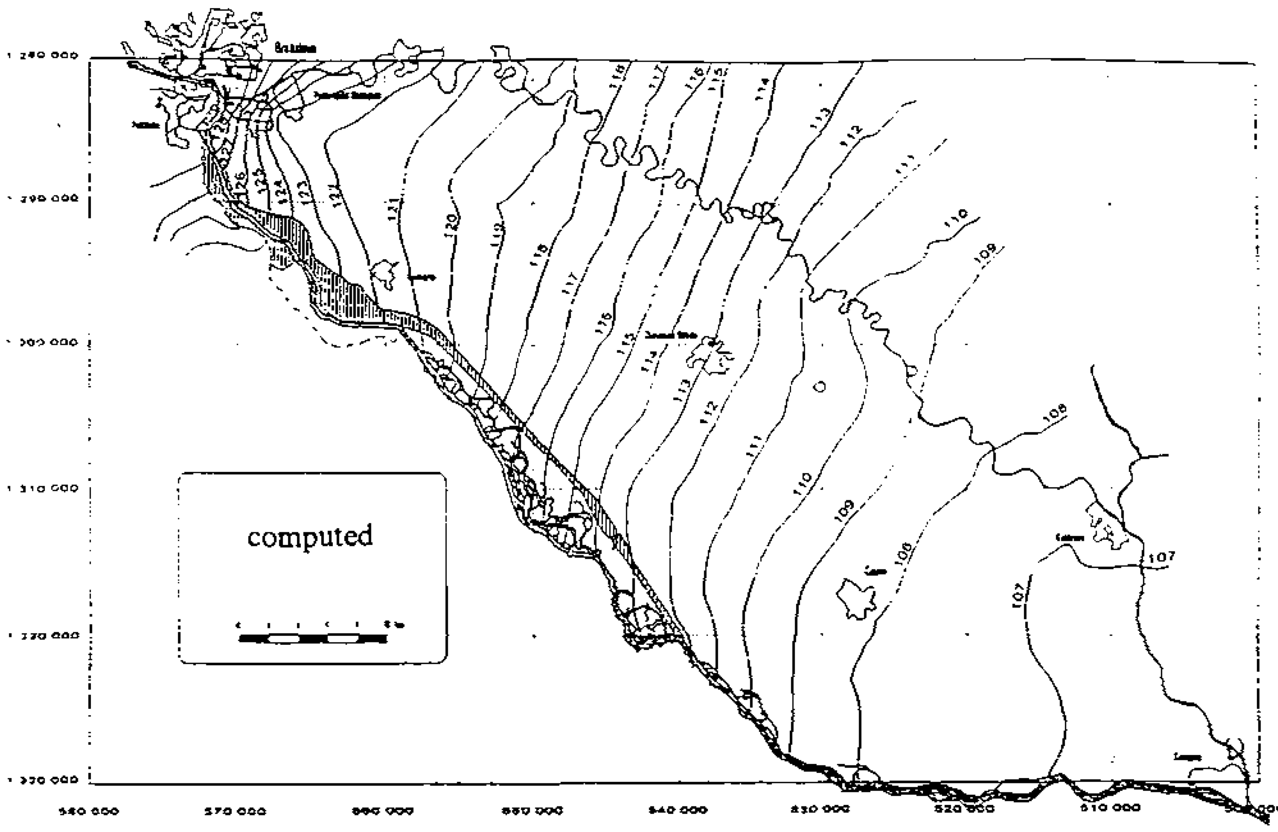


Fig. 1.22: Increase of ground water level 6 months since damming the Danube



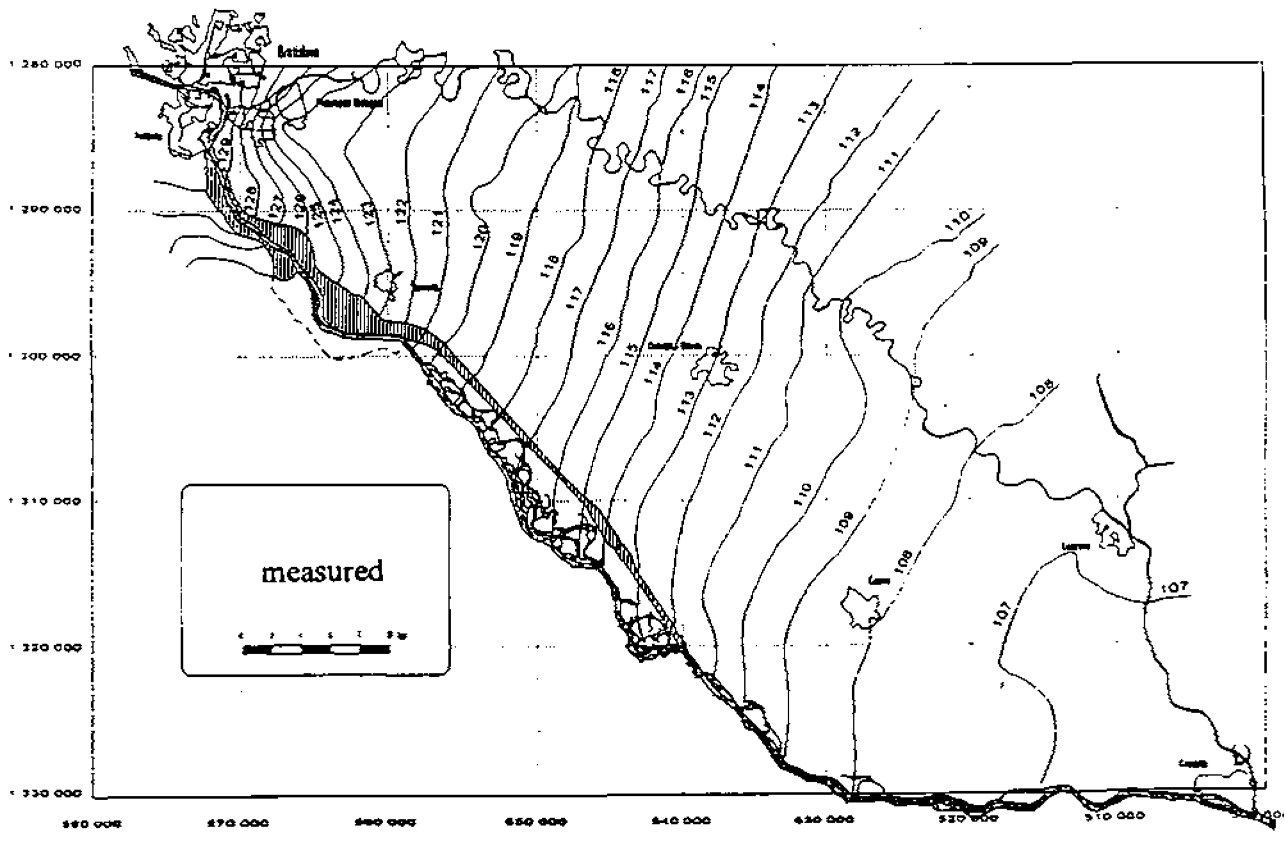


Fig. 1.23: Ground water level equipotential lines computed for pre-dam conditions and measured (June 30, 1993)

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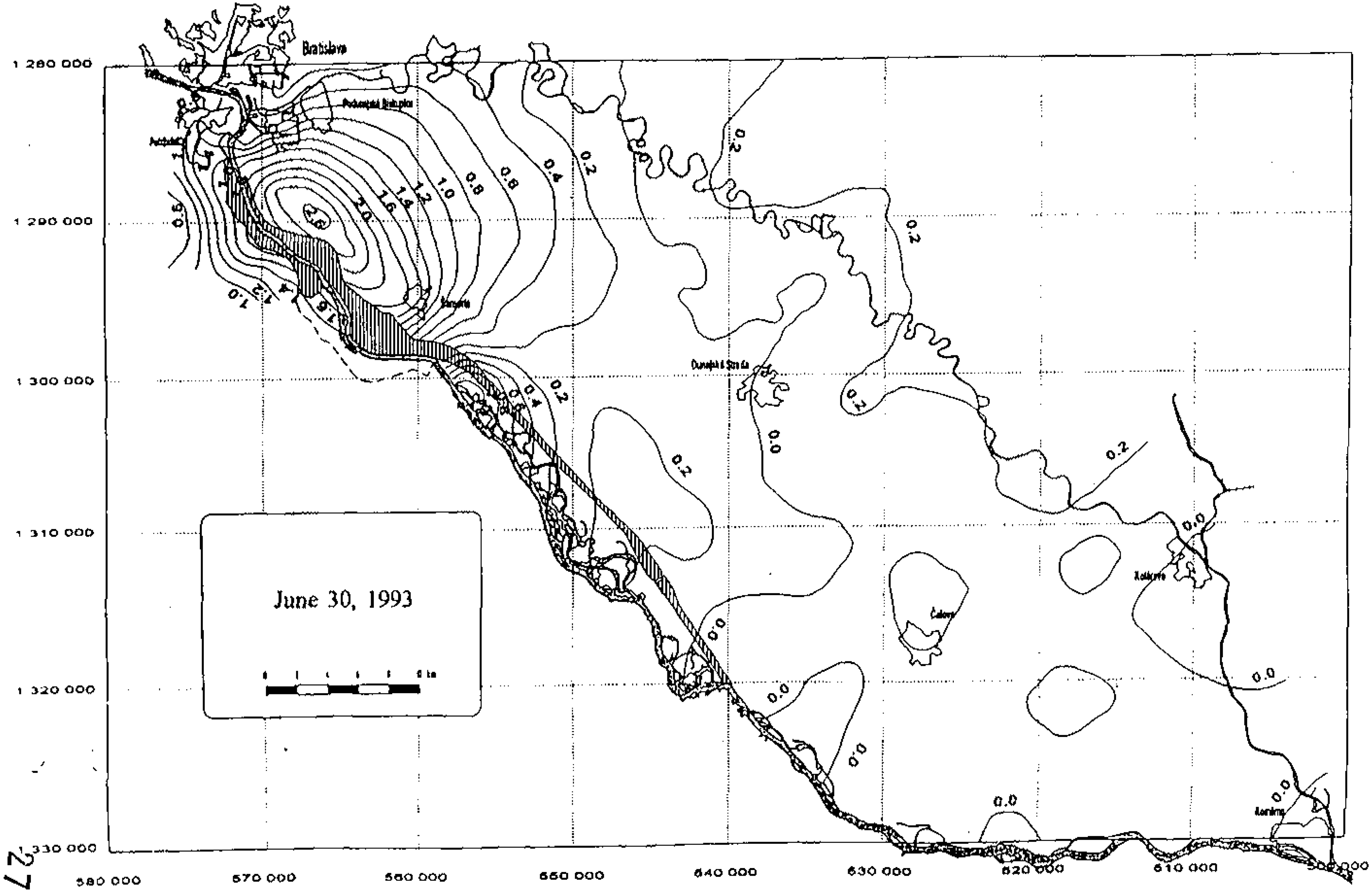


Fig. 1.24: Increase of ground water level 8 months since damming the Danube

levels in the Danube (part of discharge was led through the weir in inundation to the Danube) and confirm that the future construction of small underwater weir in the Danube would act as an additional important means for optimizing ground water levels. The underwater weirs are important not only for the ground water level optimization but also for diminishing the difference between ground water level and water level in the Danube and for better mutual interconnection between the Danube and the river branches from the point of view of fish and ecology.

1.5. WATER QUALITY

1.5.1. Surface Water Quality

The river Danube water quality is evaluated from the point of view of oxidizing - reduction conditions [25]. Following example of evaluation is based on analyses of the water quality taken at the municipal waterworks Sihot in Bratislava.

Concentration of Cl^- and SO_4^{2-} depends on discharge and is presented in Fig. 1.25.

Contents of O_2 and COD(Mn) is in Fig. 1.26. From the figure it can be seen that the trend is in the direction of improvement of water quality from the point of view of recharge of aquifer and river bank infiltration.

Concentration of NO_3^- and NO_2^- is shown in Fig. 1.27. It is shown an increase in nitrates. The maximal contents of nitrites is up to 0.3 mg/l.

The general improvement of the water quality in the Danube is because of improvement and capacity of biological purification plants at the Danube, especially Vienna's main purification plant, which was put into operation in 1980, the Schwechat's refinery and Slovnaft's refinery purification plants and Bratislava's purification plants on both sides of the Danube. Some additional information about the Danube water quality is given in Appendix in PERSPEKTIVEN.

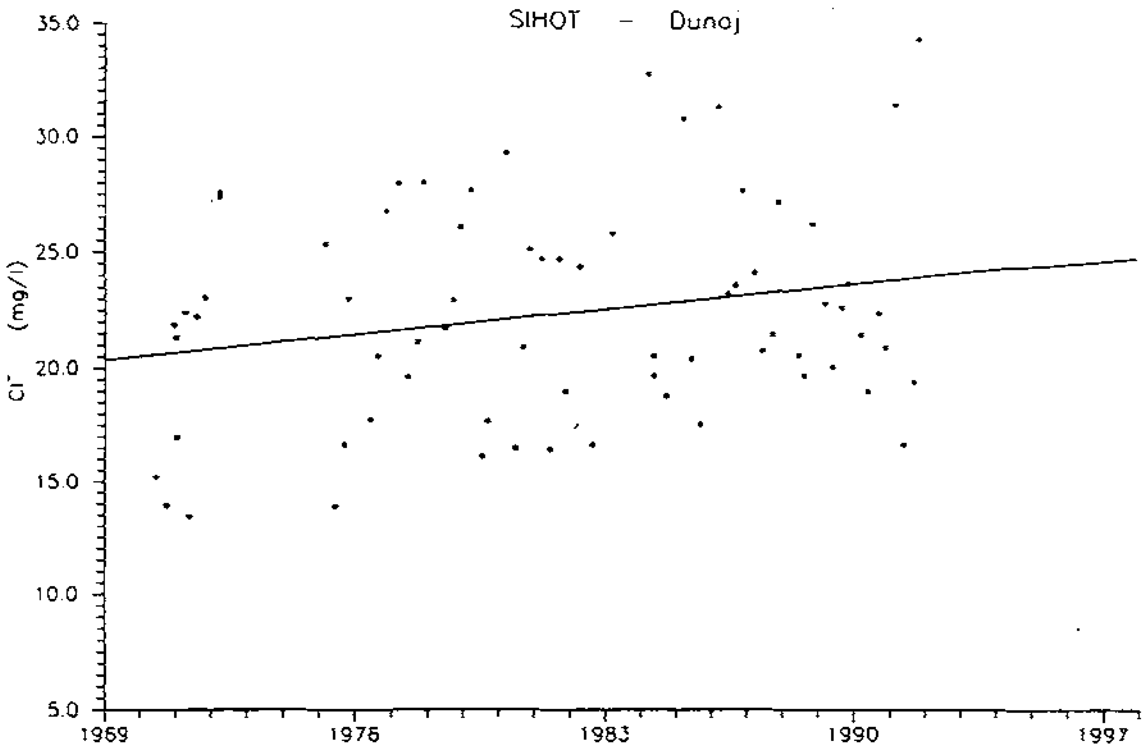
The changes in the Danube water quality since 1960's could be seen when comparing publications [26, 10] with [8, 9].

1.5.2. Ground Water Quality

Aerobic biodegradation is an important mechanism for saving ground water quality. Redox reactions may often be key mechanism controlling the migration of toxic and inorganic wastes in the sediments and in the ground water. Ground water in water supply areas is still of excellent quality and mostly of oxidizing conditions in the Zitny ostrov area. The main goal is to save the favorable oxidizing conditions mainly in the area used for water supply.

Ground water quality, since damming the Danube, is carefully monitored and evaluated in regular reports. In [28] there is evaluation of ground water quality from October 25, 1992 to December 31, 1993. The main results of this evaluation are:

1. In ground water, which is used for municipal water supply, in no case the values, according to the Standards CSN 75 7111, were exceeded



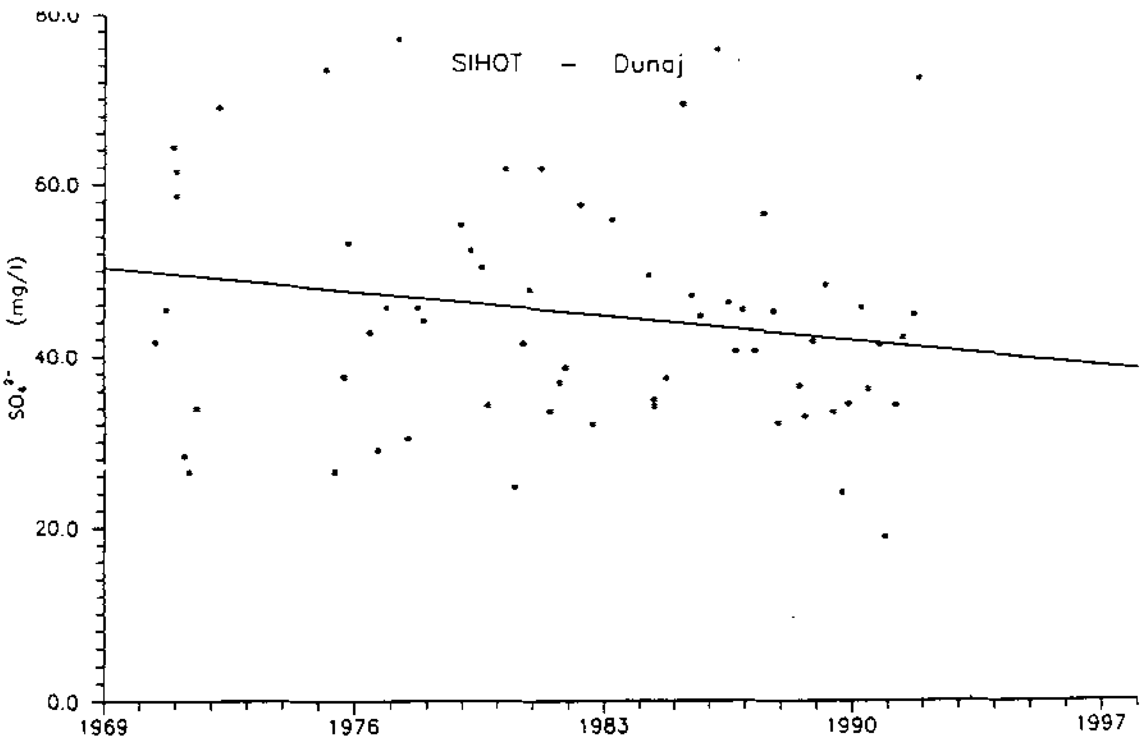
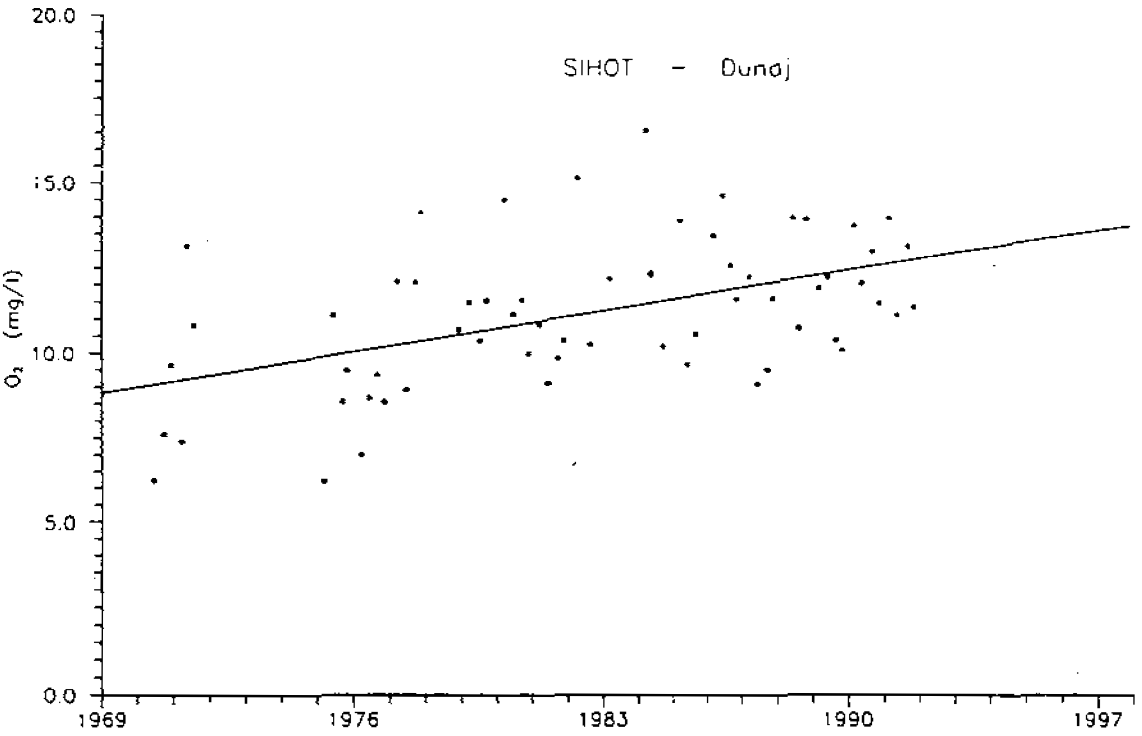


Fig. 1.25: Trend of concentration of Cl^- and SO_4^{2-} in the Danube water



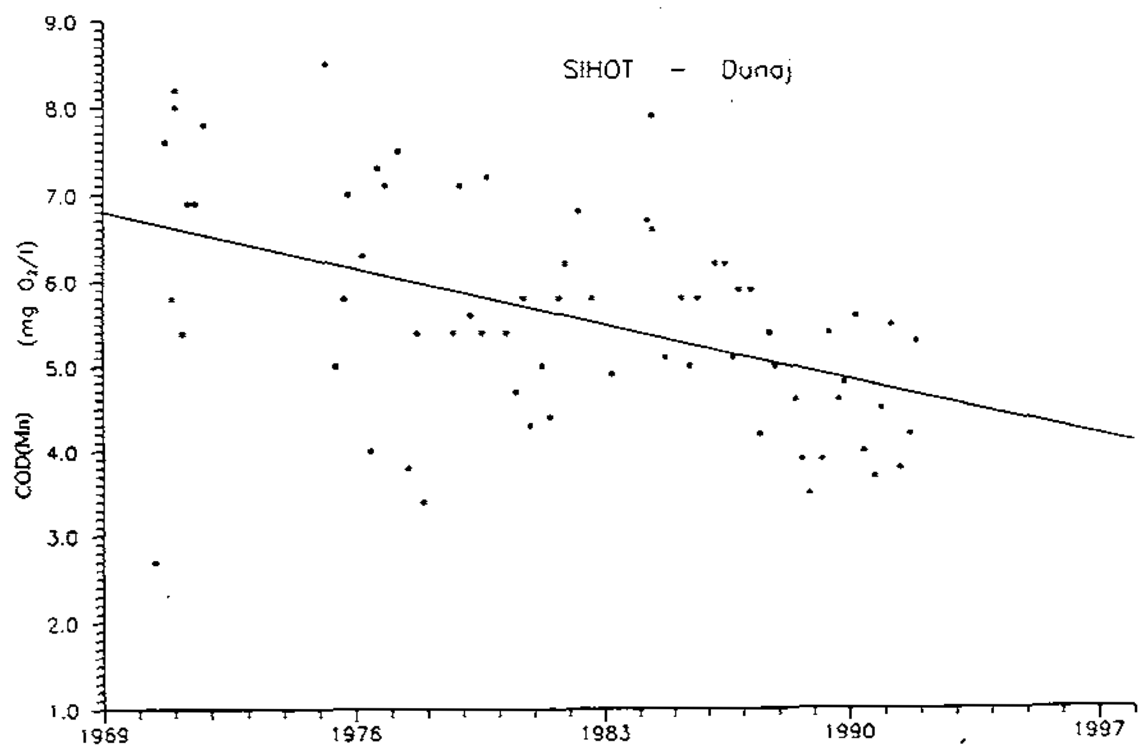


Fig. 1.26: Trend of concentration of O_2 and COD(Mn) in the Danube water

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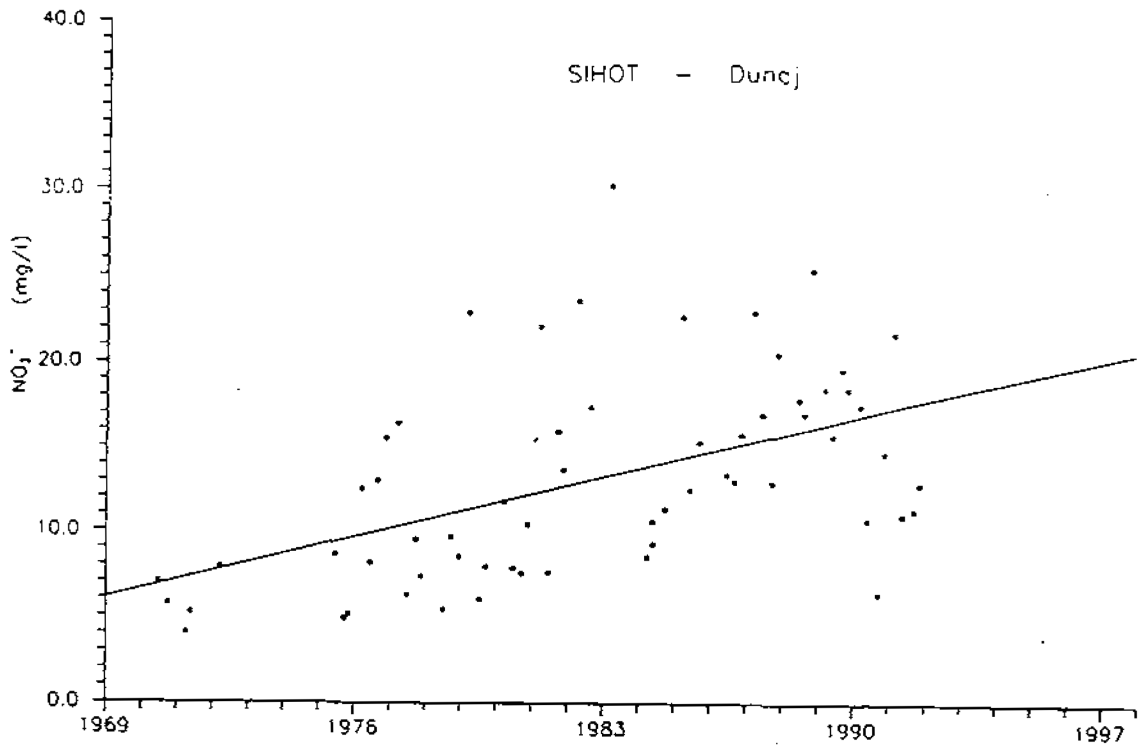

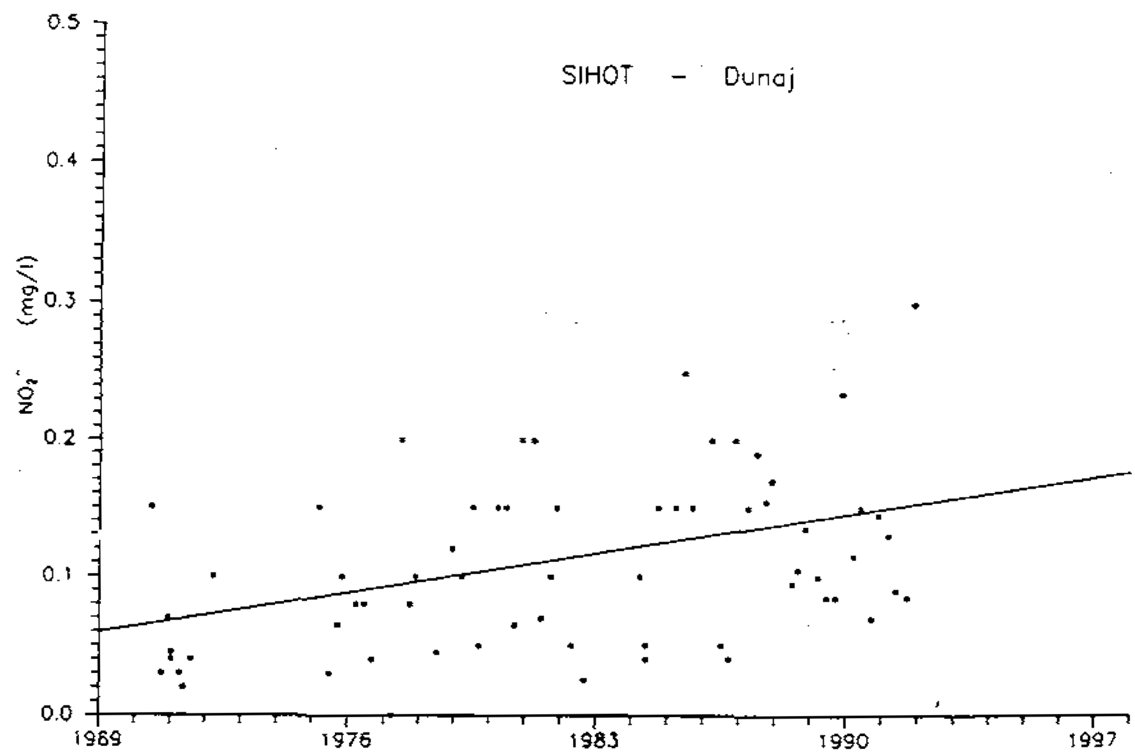

Fig. 1.27: Trend of concentration of NO_3^- and NO_2^- in the Danube water

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2. The basic chemical type of ground waters stayed nearly unchanged in the whole period, the range of fluctuation of the contents of dissolved substances and the changes of the contents of inorganic macropollutants do not go out of range in the long-term trends
3. The most significant changes of chemical composition (which can later affect the ground water quality especially in the vicinity of large water supplies situated in the riverside zone of the Danube at the Zitny ostrov area) occur in oxygen regime.
4. In spite of the more exceeding of water quality indicators (mainly in the first phase of filling up the reservoir), there were positive changes in the development of water quality (especially in the right riverside zone of the Danube - in the vicinity of the water supply Rusovce - Ostrovne Lucky - Mokrad).
5. The hydrogeochemical changes which were monitored, in general confirmed that the ground water quality is unchanged or in some places it is possible to evaluate improving in ground water quality. This improvement is not necessarily definite. Further monitoring is required.
6. Changes in the surface water quality are not significant. The slide changes are in oxidizing conditions and microbiological indicators.
7. In the power channel and tailrace channel the water quality is similar as in the reservoir at Samorin.

1.6. QUALITY OF SEDIMENTS

Complex evaluation of sediments is summarized in [24]. In the database, there is 186 analyses of sediments and 3 analyses of suspended load from the river Danube, taken before damming the Danube. Except this, there is 37 analyses from the last survey in the framework of Project PHARE. Sampling places in the last survey were situated in the areas where there is possible recharge of aquifer and in the areas where the ground water is flowing towards possible places of future ground water extraction. Places of sampling are shown in Fig. 1.28. 8 samples were analyzed in two laboratories, in the Netherlands and in the Slovak Republic. Results are given in the Table 1.5. Based on the evaluation of the expert from the Netherlands, Mr. J. Griffioen, the results could be summarized as follows:

- in the area of Gabcikovo reservoir, the sediments are not evidently contaminated
- sediments are not contaminated by organic contaminants
- in spite of higher contents of heavy metals in sediments analyzed by the method of total decomposition, the situation is not worrying because a large part of the heavy metals in the sediments is in the form of stable rock minerals (e.g. Cu, Ni)
- contents of some metals in oxidizing conditions is in river sediments in Alpine - Carphatians geological conditions high and it does not mean a pollution.

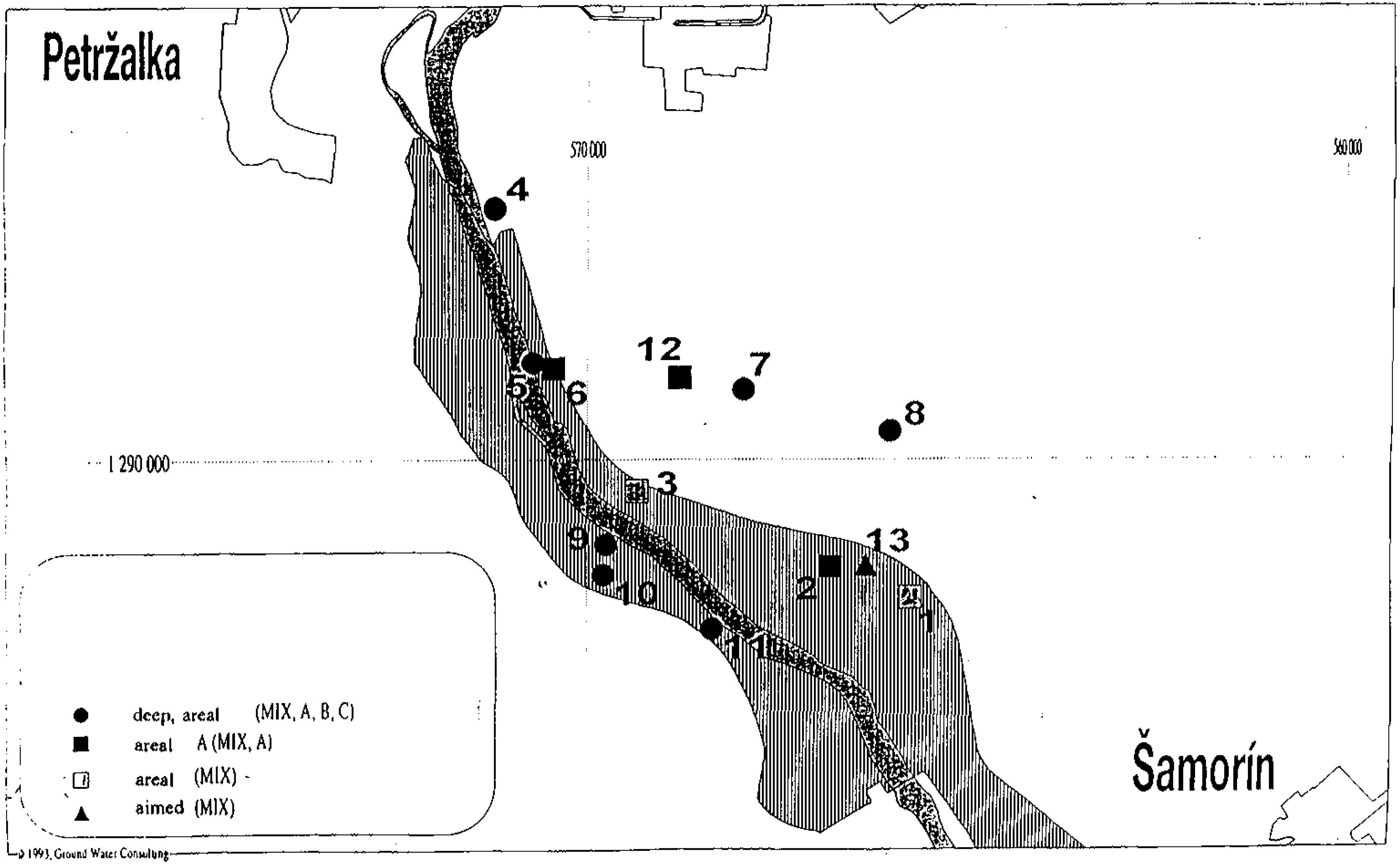

Fig. 1.28: Schematic map of places of sediment sampling in the framework of Project PHARE

A. OMEGAM, H.J.E. Wenckebacheg 120, 1096 AR Amstredam, Holandsko
B. Chemický ústav PriF UK, Mlynská dolina pav. CH-2, 842 15 Bratislava, Slovenská republika

NA - not analyzed
ND - not detected

ukazovateľ (mg/kg)	2/A		4/A		5/A		5/B		5/C		6/A		7/A		8/A	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
$CaCO_3$ (%)	21	22,7	20	23,8	19	20	20	18,6	24	25,6	27	26,9	18	18,4	22	23,4
TOC (%)	2,4	1,1	4,3	1,1	1,5	2,3	1,8	0,4	1,7	1,1	6	1,8	2,6	1,1	4,3	2,2
Dry Rest (%)	82	83	80	80	86	88	91	93	90	92	75	77	86	88	81	83
Mineral Oil	< 50	20	< 50	20	< 50	ND	< 50	ND	< 50	ND	< 50	20	< 50	20	< 50	ND
Cr	25	52	31	61	22	50	18	37	22	41	33	61	23	55	41	72
Ni	22	30,5	25	36	19	24,5	17	22	20	26	27	37,5	18	23	35	45,5
Cu	19	25,2	31	33,8	19	22,1	13	17	17	20	31	36,3	16	19	32	37,4
Zn	45	58,5	77	107	44	55,5	33	47	35	49	74	95,2	42	55	69	87
Cd	< 0,6	0,33	< 0,6	0,48	< 0,6	0,41	< 0,6	0,28	< 0,6	0,36	< 0,6	0,36	< 0,6	0,32	< 0,6	0,44
Mn	420	518	520	594	380	525	300	400	370	493	520	585	400	558	620	698
Fe	18000	23750	21000	23250	16000	17500	13000	19000	17000	20250	22000	24375	15000	19500	29000	30375
EOX	< 0,1	< 1	< 0,1	< 1	< 0,1	< 1	< 0,1	< 1	< 0,1	< 1	< 0,1	< 1	< 0,1	< 1	< 0,1	< 1
naphtalene	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND
acenaphthylene	0,3	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND
acenaphthene	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND
fluorene	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND
phenantrene	< 0,1	ND	< 0,1	0,08	< 0,1	ND	< 0,1	ND	< 0,1	ND	0,1	0,09	0,2	ND	< 0,1	ND
anthracene	< 0,1	ND	< 0,1	0,02	< 0,1	ND	< 0,1	ND	< 0,1	ND	< 0,1	ND	0,2	ND	< 0,1	ND
fluoranthene	0,01	ND	0,1	0,1	0,03	ND	<0,01	ND	<0,01	ND	0,13	0,05	0,54	ND	0,02	ND
pyrene	0,01	ND	0,08	0,1	0,03	ND	<0,01	ND	<0,01	ND	0,1	0,04	0,39	ND	0,01	ND
benzo(a)pyrene	0,01	ND	0,06	ND	0,02	ND	<0,01	ND	<0,01	ND	0,07	ND	0,2	ND	0,01	ND
chrysene	<0,01	ND	0,05	0,03	0,02	ND	<0,01	ND	<0,01	ND	0,07	0,02	0,19	ND	0,01	ND
benzo(b) fluoranthene	0,01	ND	0,06	ND	0,02	ND	<0,01	ND	<0,01	ND	0,07	ND	0,21	ND	0,01	ND
benzo(k) fluoranthene	<0,01	ND	0,03	ND	0,01	ND	<0,01	ND	<0,01	ND	0,03	ND	0,09	ND	<0,01	ND
benzo(a) anthracene	<0,01	ND	0,05	0,03	0,02	ND	<0,01	ND	<0,01	ND	0,06	0,02	0,26	ND	0,01	ND
dibenzo(a,h) anthracene	<0,03	NA	<0,03	NA	<0,03	NA	<0,03	NA	<0,03	NA	<0,03	NA	<0,03	NA	<0,03	NA
benzo(ghi) perylene	<0,03	ND	0,04	ND	<0,03	ND	<0,03	ND	<0,03	ND	0,05	ND	0,1	ND	<0,03	ND
indeno(1,2,3-cd) pyrene	<0,03	ND	0,05	ND	<0,03	ND	<0,03	ND	<0,03	ND	0,06	ND	0,11	ND	<0,03	ND
PAHs (EPA sum)	0,34	ND	0,5	0,36	0,15	ND	< 0,4	ND	< 0,4	ND	0,7	0,22	2,5	ND	0,07	ND

Table 1.5: Comparison of chemical analyses of sediments

2. FROM THE HISTORY OF ORIGIN OF WORKING GROUP OF INDEPENDENT EXPERTS EU

2.1. FACT FINDING MISSION (October 27 - 31, 1992)

After unsuccessful bilateral negotiations between Hungary and Slovakia concerning Gabcikovo - Nagymaros Project, EC Commission (now EU - European Union) invited Czecho-Slovakia and Hungary for a trilateral meeting at Brussels on October 22, 1992. During the negotiations, Czecho-Slovakia handed over the Aide-mémoire, the substance of which was that during the work of the tripartite commission ("Working group of independent experts on Variant C of the Gabcikovo - Nagymaros project"), Czecho-Slovakia would not divert water from the common riverbed and only navigation would be transferred to the Czecho-Slovak territory. Aide-mémoire confirmed that damming of the Danube was not a definite solution, if conclusion of the tripartite commission would prove the principal negative ecological impacts of the Gabcikovo scheme. Hungarian delegation refused proposals contained in Aide-mémoire and conditioned the establishment of tripartite commission by interruption of works leading to the damming of the Danube. This requirement was unacceptable, because of technical reasons and necessity of anti-flood protection and navigation. Czecho-Slovak delegation expressed readiness to receive independent experts who could evaluate the real situation and the earnestness of its proposal. After this unsuccessful trilateral meeting at Brussels the damming of the Danube had been started on 24 October 1992 and on 27 October 1992 the Danube was dammed.

In connection with these talks, the EC Commission has sent a Fact Finding Mission to the area of Gabcikovo project. The mission carried out an on-site inspection of the ongoing work on Tuesday afternoon, October 27, 1992. The mission from the EC Commission consisted of the following three persons:

- Mr. Jens Christian Refsgaard - team leader, Denmark
- Mr. Jan M. Van Geest, Director Infrastructure, DHV, The Netherlands
- Mr. Jesper T. Kjelds, Computational hydraulics engineer, Denmark

<u>Terms of References of the Fact Finding Mission</u>

1. To make an on-site inspection of the ongoing work.
2. To assess the need and urgency of the ongoing work in light of potential flooding risks for damage to already constructed parts.
3. To assess the immediate consequences/impacts of the ongoing work relating to:
    - Navigation
    - Hydrological aspects
    - Environment
4. To assess the irreversibility of the ongoing activities and to assess the cost for restoring status quo.
5. To establish when works on the Danube can be stopped without risks for existing structures or floods.
6. To establish whether and when the Danube waters can go back into the existing bed after the present works have been finalized and the artificial canal filled up. To indicate flows and dates of possible realization.

7. The results of the consultancy must be communicated to Mr. Benavides and Mr. Giunti as soon as possible. Mr. Giunti should receive daily briefing from Mr. Refsgaard on the progress of investigation.

The United Kingdom, in the capacity of the President of the EC Council at that time, came in this situation with a new initiative. During the summit of the prime ministers of the Visegrad group (Hungary, Czecho-Slovakia and Poland) with the Premier of the United Kingdom, John Major, the trilateral negotiations were held in London on 27 - 28 October 1992. There was decided to put together a new Fact Finding Mission composed of one expert from each of the three parties. The following three experts have been appointed to constitute the Fact Finding Mission:

CEC:	Mr. Jens Christian Refsgaard, Chief Hydrologist, Danish Hydraulic Institute, team leader of the Fact Finding Mission
CSFR:	Univ. Prof. Igor Mucha, Faculty of Natural Sciences, Comenius University
Hungary:	Dr. Péter Bakonyi, Managing Director, VITUKY Consult Rt, Budapest

The Mission met in this constellation the first time on 29 October 1992 in Györ. It carried out an on-site inspection of the ongoing work on 30 October 1992 and held the concluding meetings in Bratislava on 30 - 31 October 1992. The Agreed Minutes (see in Appendix) from trilateral negotiations in London were used by The Fact Finding Mission as the Terms of References.

General results of the Fact Finding Mission including the London Agreed Minutes in the original Terms of References are as follows:

- In a possible flood situation some of the not yet finished structures might be damaged depending on the peak and duration of the flood. **To meet the design flood criterion $Q_{0.01\%,year}$ the Phase 2 of Variant C has to be completed** (Fig. 2.1). Although not direct related to works of Variant C, the most flood endangered reach of the Danube in the Area of interest is the left hand side between Palkovicovo (rkm 1811) and Medvedov (rkm 1806).
- As a consequence of the ongoing works **the Danube discharge is separated in two parts. One part supplied the power canal leading to Gabcikovo which serves as the navigation channel as well. The other part of discharge is directed into the existing Danube bed through the by-pass weir. The water management possibilities are restricted until the various parts of the hydraulic structures are fully completed.** After completion of Variant C, the full complex of structures can provide comprehensive possibilities for regulation of the discharges both by low discharge and flood situations.
- **The major environmental impact is related to the ground water resources and to the ecology.** The effect on floodplain ecology is a result of both the lowering of ground water table and a less frequent inundation of the flood plain. Thus the environmental impacts of reducing the discharge in the Danube are negative, unless proper remedial actions are taken. CSFR has included a budget of 2.4 billion CSK for construction of underwater structures as part of Phase 2 of Variant C. **There are indicated some possible remedial measures, e.g. small underwater weirs, gate operation, interconnection of Danube river bed with river branches, adding some material into the river. It is stressed, that such remedial measures are possible to be made because the navigation takes place in the power canal instead of the existing Danube bed in this reach of the Danube.**
- Immediate impacts observed in Hungary are included. **Closure of the Danube resulted in decrease of discharge.** On 24 October 1992 the discharge was 800 - 900 m^3/s. On 28 October 1992 the discharge was 227 m^3/s at Rajka and 356 m^3/s at Dunaremete. Due to

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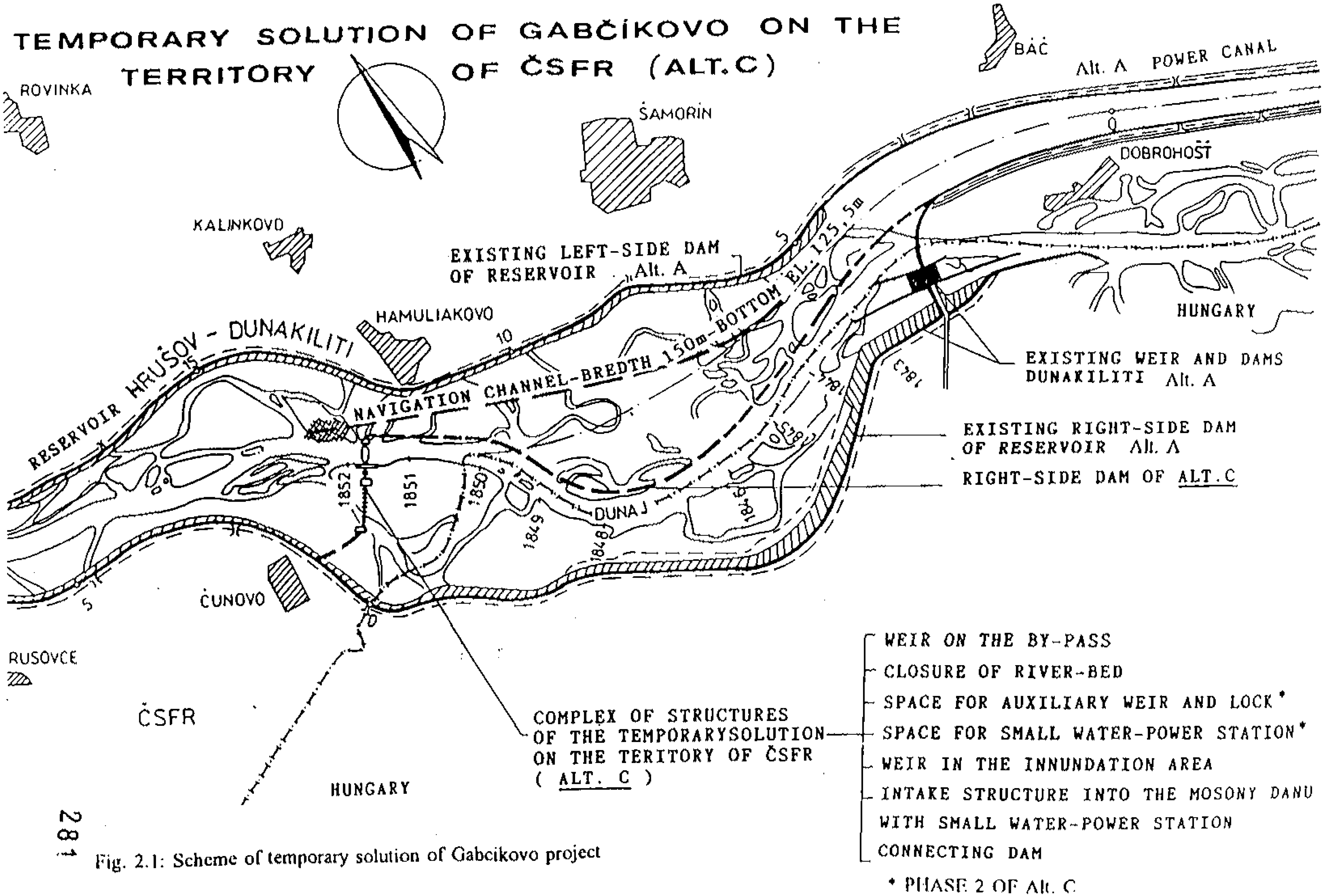

Fig. 2.1: Scheme of temporary solution of Gabcikovo project

the sudden drop of the discharge, the water level decreased in less than 4 days by 3 m at rkm 1850 and by 2.4 m at rkm 1825, according to Hungarian measurements (which is according to Hungarian rating curve exaggerated (Fig. 2.2)).

- Some effects of water level decrease are: **the side branches have been cut off from the main channel, the water from the downstream part of the side branches disappeared immediately, the ground water table has decreased, the river training structures at some places slid into the Danube, the water disappeared from the ports as in Asványráró, Dunaremete, Dunakiliti, the ecological balance of the side branches has become disturbed.**
- As a consequence of the ongoing works, the navigation route in the existing Danube navigation channel has been closed. Instead the new navigation channel and power canal with the navigation locks at Gabcikovo are being opened. The immediate impact of the ongoing works is the disruption of navigation for the period from October 23 to November 3, 1992. **When the navigation channel is operational the navigation should be improved as compared to the previous situation, because the water depth will be larger than in the existing Danube and ships will save a part of the energy required for transport.**

Irreversibility of Ongoing Activities

In principle, the ongoing activities with Variant C could be reversed. The structures, excluding some of the underground parts could be in theory removed. The costs of a such removal are roughly estimated to at least 30 % of the construction costs. There will be negative environmental effect during the demolition of the structures and the deposition of the waste material. It is therefore relevant to evaluate under which circumstances the Variant C structures could have only insignificant effects. Such **"functional reversibility" is possible for a scenario like this: "if the Dunakiliti weir and the other structure on Hungarian territory are being operated according to the original plans the gates in the Variant C structures can be kept fully open and will not have any significant effect."**

General Remarks Written by Fact Finding Mission

Finally, it is important to emphasize that the **environmental conditions in certain respects are deteriorating today due to river bed erosion and thus lower ground water tables.** The decline is varying from approximately 2 m over the last 30 years near Bratislava to approximately status quo near Komarno. Thus, the riverside vegetation is slowly drying out resulting in significant changes in vegetation species, etc. The conditions for agricultural water supply through capillary rise from low ground water tables are no longer good enough and hence more irrigation is required. It is realized that sudden changes as a consequence of e.g. the Gabcikovo - Nagymaros project will occur immediately, and that it will take some time until a new ecological balance develops. However, **the "status quo" situation in pre-dam conditions is neither a stationary nor a natural situation, but rather a slower transition from one cultural landscape to another one, with the inherent consequences of this on the ecological conditions.**

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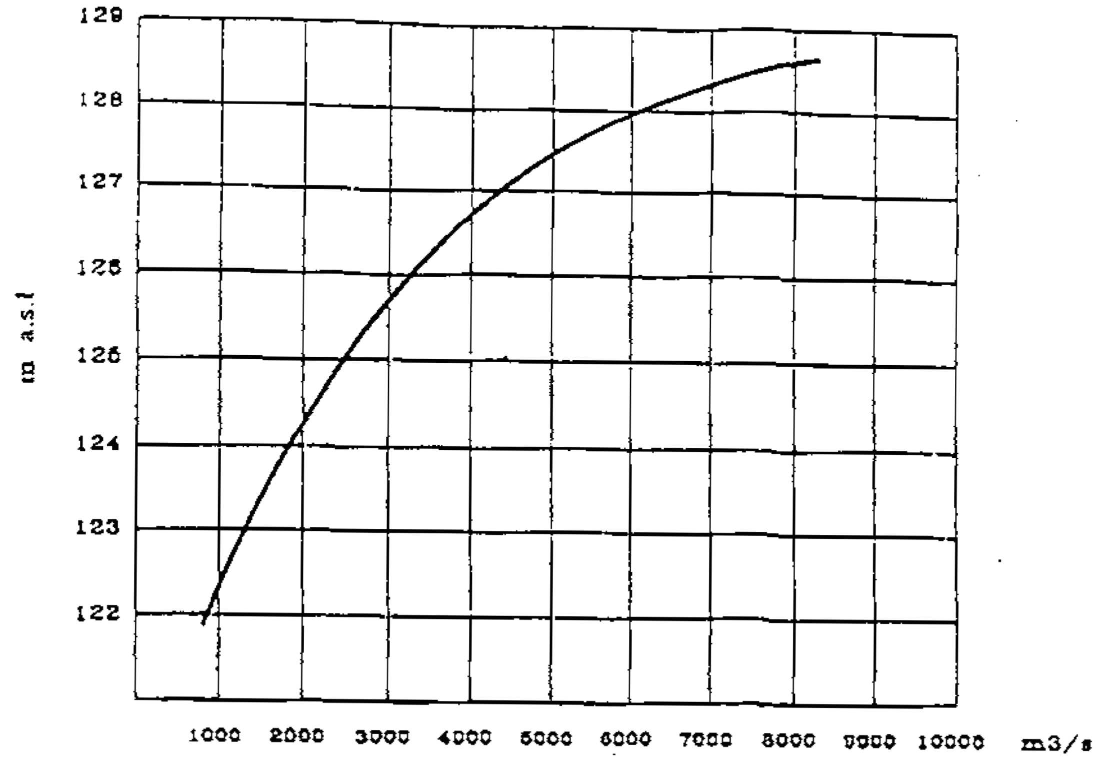
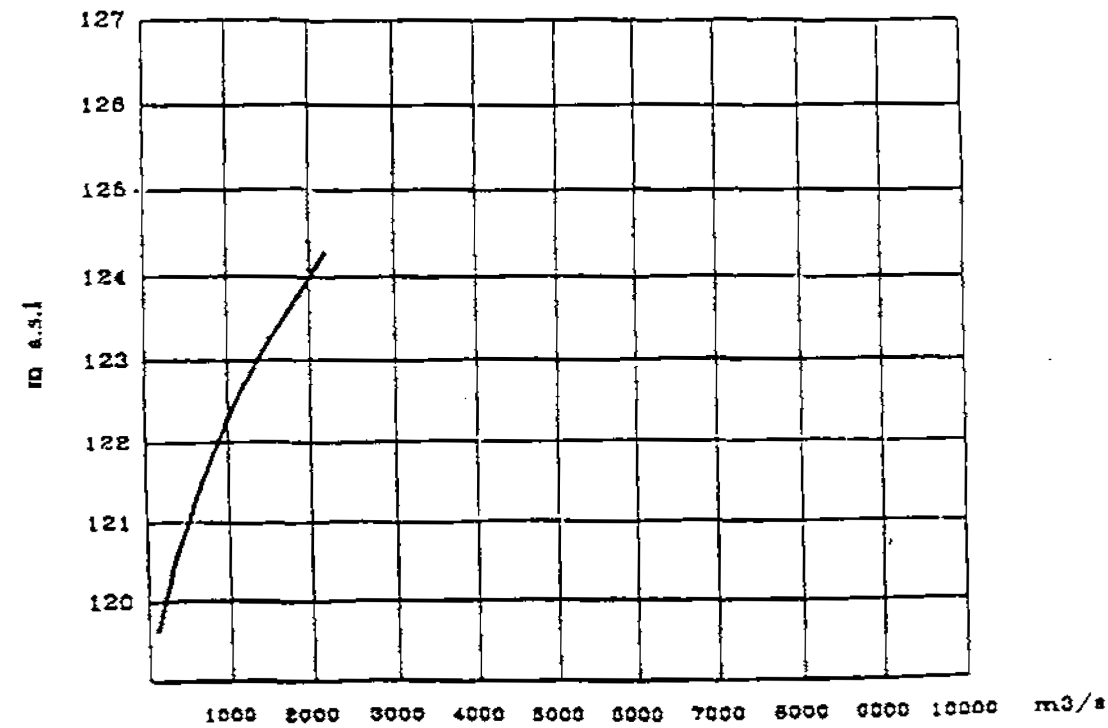
DISCHARGE RATING CURVE

at Rajka rkm 1848.4



Before the damming of Danube



After the damming of Danube

Fig. 2.2: Discharge rating curve

Scenarios

Scenarios, based on the London Agreed Minutes, that the project will be stopped at the date specified by the EC Commission, are as follows:

I. The work will be stopped for a period no longer than one month.
II. The work will be stopped for a period up to three months.
III. The work will be stopped for a period of one year.

Scenarios, based on the London Agreed Minutes, that the whole quantity of water will be maintained in the old Danube riverbed, are as follows:

A. The "whole" quantity of water is directed into the Danube.
B. The main part of the water is diverted to Gabcikovo.
C. A combination of A and B.

All the scenarios were evaluated. The mission believed, that it would be possible to define more optimal scenarios maintaining the major part of the advantages of A and B and at the same time not containing the main disadvantages of A and B. In addition to the above, it is emphasized, that a more final optimization with full weight to the ecological conditions most likely includes a range of regulation measures within the flood plain area itself.

It is evident that no scenario and no date to stop the work was proposed.

2.2. WORKING GROUP OF INDEPENDENT EXPERTS (November 9 - 23, 1992)

As a follow-up to the London Agreed Minutes, a Working Group of six independent experts was established. The Working Group was composed of the following experts:

CEC: Mr. Jens Christian Refsgaard, Chief Hydrologist, Danish Hydraulic Institute, Denmark, Team Leader

Mr. Jan M. Van Geest, Director DHV Environment and Infrastructure, The Netherlands

Mr. Johann Schreiner, Director, Norddeutsche Naturschutzakademie, Germany

Professor Dr. Heinz Löfler, Head of Zoological Department, University of Vienna, Austria

CSFR: Professor Dr. Igor Mucha, Faculty of Natural Science, Comenius University Bratislava

Hungary: Professor Dr. Gabor Vida, Head of Department of Genetics, Eötvös L. University, Budapest

The Working Group consists of hydrologist, water works engineer, ecologist, zoologist, ground water specialist, geneticist. It means generally that **the group consists of one technician, two water specialists and three members of natural sciences dealing with ecological problems.**

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Terms of References

The scope of work of the Working Group of Independent Experts was expressed in the letter sent by the CEC on 29 October 1992 as follows:
The Working Group will:
i) Make an on-site inspection of the structures of Variant C and describe the state of work;
ii) Assess the need and urgency of these structures in the; light of the potential flooding risk, including the risk of causing damage to already constructed parts;
iii)Assess the (immediate) consequences/impacts of these structures relating to:

* Environment, covering:
  - Erosion and Sedimentation in River and River Reservoir System
  - Surface Water Quality
  - Ground Water Regime
  - Ground Water Quality
  - River and Flood plain Ecology
* Hydrological and water management aspects and
* Navigation

The assessment will be based on an outline of existing (pre-dam) conditions and trends.

iv)Assess the reversibility of these structures and assess the cost of restoring the status quo ante, i.e., the situation existing prior to the construction of the dam;
v) Make suggestions for (urgent) measures and, if necessary, studies to be (under) taken to improve the present conditions.

2.2.1. Working Material Prepared by Slovak Expert

Working material was prepared in separated report [C]. The main goal of this working material was the identification of the hydraulic system under the condition of the hydropower station Gabcikovo, called as Variant C and outline the possible optimal and beneficial use of the Danube water for various interests. Report includes:

Outline of state and present trends in the area

- Geological conditions
- Long-term impacts and trends in the area
- General ecological requirements
- Erosion and sedimentation in river system
- Surface water quality
- Ground water regime
  - Trend of ground water level depth
  - Ground water level fluctuation
  - Ground water quality
- River and floodplain ecology
- Conditioning factors for recovering of inundation floodplain
- Trends in the past
- Navigation
  - Capacity, number of boats of navigation company CSPD Bratislava
  - Navigation conditions
  - Problems on the section Bratislava - Komarno

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Immediate and potential long-term consequences/impacts of the Gabcikovo Varian C and outline of possible remedial measures impact of reservoir of hydropower station on ground water levels

- Hydrology and water management
    - Forecasting of ground water levels
    - Immediate impacts of Variant C on ground water levels
    - Immediate impacts of Variant C on Danube water levels from Cunovo to Sap
- Environment
- Improvement of navigation conditions after finishing of Gabcikovo dam
    - Time saving
    - Saving of energy
    - Improvement of depth in harbor of Bratislava
    - Increment of turnover
    - Problems of navigation at the place where the Danube and outlet canal are joining
- Possible remedial measures
    - Hydrology and water management
    - Environment
    - Navigation

Except this, two scenarios have been elaborated:

- Water management scenario based on requirements of the Slovak Ministry of Environment
- Scenario based on treaty between Republic of Hungary and Czech and Slovak Federal Republic

Detailed monitoring of discharge, water levels, ground water levels and ecological factors were proposed. It was stressed that all measurements are carried out on both sides according to agreed monitoring system.

2.2.2. Main Results of the Working Group Report

From the ecological point of view, the following statements are interesting in the Executive Summary.

The hydrological and ecological regime in the area is subject to a **long-term trend of river bed erosion, decreasing water levels and associated ecological changes.** This is caused by a variety of reasons, above all the **large river regulation works**, which implied deliberate **unnatural cutting off and bundling of river branches into one main, straightened and heavily fortified channel for navigation.** In spite of this basically negative trend the floodplain area with its alluvial forests and the associated ecosystems still represents **a very unique landscape of outstanding importance.**

In the past, the measures taken for the navigation constrained the possibilities for the development of the Danube and the floodplain area. Assuming the navigation will no longer use the main river over a length of 40 km a unique situation has arisen. Supported by technical measures the river and the floodplain can develop more naturally.

Variant C Structures and Status of Work

In both countries the original structures for the Gabcikovo scheme are completed except for the closure of the Danube river at Dunakiliti and the installation and testing of turbines.

Variant C (Fig. 2.1) consists of a complex of structures, located in Czecho-Slovakia within the area of the original (according to treaty) Variant A.

The hydropower station is designed for peak power production. At the time of Working Group activity five turbines (from 8 planned) and generators have been installed.

The floodplain weir and the bottom protection **were originally designed for use only in flood situations** (few days per year). During the Working Group activity this design has been modified to allow its daily use as a result of the London Agreed Minutes and a good will and flexibility of CSFR. Along the Danube right bank a spillway was under construction and the downstream bed would be protected with additional 100000 m^3 stone. (The unexpected high flood in November - December 1992 eroded the area between the floodplain weir and the planned spillway along the Danube right bank and the construction is no more realizable.)

The intake structure at entrance to the Mosoni Danube and supply canal on Slovak territory with capacity 25 m^3/s had been constructed.

An intake structure located in the power canal allowing for a maximum intake discharge of 234 m^3/s to supply a river arms and the floodplain downstream the Dunakiliti weir on Slovak territory is completed.

The road on side of the right side dams connecting Bratislava with three villages lying between power canal and the Danube is under construction.

Assessment of the Need and Urgency of the Structures

The designed flood discharge for the project of Variant C (Phase 1 and Phase 2 of construction) is based on 10000-year flood occurrence, risk of occurrence of such flood is 0.01 % within a year. For the construction period, usually larger risk is accepted. The flooding risk of stopping the work depends on the season period during which the work will be stopped and the level of finalization of structures. Stopping the work in summer period needs higher finalization or the risk is much higher. Although not directly related to the works of Variant C, the most flood endangered reach of the Danube in the area of Gabcikovo - Nagymaros system of water works is the left-hand side between Palkovicovo (Sap rkm 1811) and Medvedov (Medve rkm 1806) due to extensive siltation and lack of dredging (problem of erosion upstream of Palkovicovo when dredging without of decrease of flow velocities, see solution in common project of Gabcikovo - Nagymaros).

The Gabcikovo complex can regulate the discharge between 80 m^3/s (discharge for navigation and ship locks) and 5200 m^3/s which is the maximal discharge in power canal. Upon completion the weirs of the Phase 1 of Variant C can regulate discharges between 0 and 6100 m^3/s. **After completion of Phase 2 of Variant C, the full complex of structures can** provide comprehensive possibilities for regulating the discharges, both in low flow and flood situations.

Reversibility of Variant C

In principle, the Variant C could be reversed. The structures, excluding some of the underground parts like sheet piling and injections, could be removed in theory. The cost of removing the structures are roughly estimated to at least 30 % of the (nowadays) construction costs. There will be negative environmental effects during the demolition of the structures and the deposition of the waste materials. It is therefore relevant to evaluate under which circumstances the Variant C structures could have only insignificant and very local hydraulic effect if they are not fully removed. Such "functional reversibility" is possible for a scenario like:

- If the Dunakiliti weir on Hungarian territory is being operated according to the original plans, the gates in the Variant C structures can be kept fully open and will not have any significant effect. However, in this case it should be evaluated, whether it is desirable to maintain the riverside forest on the Hungarian side for the 7 km reach between the two structures by not using the area as a full reservoir. In such case it may be necessary to operate both sets of structures.
- If the Danube closure is removed and the "whole" discharge is routed back to the Danube.

States and Trends in the Area

In general, large monitoring programs are carried out and large data bases exist for both the Slovak and Hungarian areas.

Before the 18th century, the Danube split downstream of Bratislava. Near Bratislava it was partly a braided river with many small islands as a result of progressive sedimentation where the Danube entered into the plain. It was a meandering river system. Large changes occurred in 19th century, when the first regulation works started. Within several decades of instability and retrogressive erosion of other meanders, the system changed into braided river. With the past endikements, the original zonation in vegetation towards higher grounds and associated forests was largely 'diked' out of the natural system. Most of the higher, no longer flooded soils, were converted into agricultural lands. These river regulation works led to deliberate and natural cutting off and bundling of river branches into one main, straightened and heavily fortified channel for navigation. The cut off branches are only activated at higher discharges.

Within the river branches many small weirs and dams were build, so most of them behave like cascade systems at low discharge. Some are continuously overflowing while others may have dried and some sections are with stagnant water depending upon ground water level.

The main river channel has been significantly lowered due to erosion caused by a combination of several factors. In some places the river bed has been lowered more than two meters, leading to lowering of ground water levels, drying out part of river branches and less flushing of most river branches. The lowering of the riverbed during the past 30 years has been particularly larger between Bratislava and Rajka (1.5 m). The quantity of suspended and bed load on the Danube under Bratislava shows a decreasing trend.

The **quality of the Danube water** can be categorized as 1st class regarding to the majority of components, 2nd class with regard to orthophosphate, nitrite, BOD, pH and 3rd class with regard to bacteria and some heavily degradable substances such as hydrocarbons. **Parameters for oxygen contents and organic carbon show slightly improving trend,** while deteriorating trend exists for nitrite and some heavily degradable materials. **Surface water quality is well suited for river bank infiltration which is the major source of water supply along the Danube between Bratislava and Budapest.**

The water quality of the side branches differs from that of the main Danube channel due the lower velocities and periods and places with stagnant water. This negative trend has been observed with high pH, high organic matter and low oxygen contents.

Ground water regime is to large extent determined by the permeability of the main river channel and the variations in river water level. Between Bratislava and Komarno 10 - 20 m^3/s of water infiltrates on Slovakian side and 8 - 9 m^3/s on the Hungarian side. Due to a very large permeability of aquifer, the ground water flow velocities are very high (1 - 3 m/day). The depth **of ground water shows a trend of decrease around 2 m near Bratislava to about zero at Komarno in the last 30 years.** This decrease is due to erosion of the river bed. An important feature is the large ground water level fluctuation.

The **ground water quality** in the area dominated by the **infiltration from the Danube is generally in a good state.** The quality abstracted from the wells located close to the Danube is generally excellent. For the areas further away from river, where the ground water infiltrated partly in agricultural and industrial areas, there are some problems with ground water pollution.

The **ongoing pre-dam trend** with lowering of the Danube water level, changes in the character of the flood peaks, endikements, cutting off the side branches upstream and fortification of the main channel **has stressed the biotic communities substantially during the last decades.** As a result of past ground water decrease, some areas of soft alluvial forests have been turned into hard alluvial forest. The latter was often cultivated with poplar and white willow. Furthermore it was estimated that approximately 200 ha of the originally more than 2000 ha are not alluvial forest any longer. In addition, forestry has replaced many natural forests by plantations, where alien, introduced cultivars of poplar have been used. Due to anthropogene effects the structure and dynamics was considerably disturbed and made the invasion of Solidago, Aster and Impatiens species possible.

Compared to other reaches of the Danube human impacts have until now not been as large as elsewhere. As the original type of alluvial forest almost completely disappeared from Europe, the significance of Szigetköz from the point of view of conserving Europe's natural heritage is of outstanding importance. Similar situation is on the Slovak side in inundation between Dobrohost and Palkovicovo.

However, partly due to the decrease in ground water tables during the past decades it has been necessary to make artificial irrigation for the agriculture. However, artificial irrigation has its disadvantages as compared to the natural situation, because the downward water flux causes a considerable leakage of nitrates and chemicals used in agriculture.

Negative influence of ground water decrease can be still seen in areas close to Bratislava.

Immediate Impacts of Damming the Danube

After the closure of the Danube, the major part of discharge has been diverted to hydropower station. The reduced discharges have led to significant decrease in river water tables, 2 - 3 meters according to Hungarian measurements. **Most of the river arms had no flows at the time just before the closure of the Danube due to low flow season.** However, many of them are open at their downstream connections to the main river and had therefore **stagnant water due to backwater effects.** In all cases the water levels of the river arms has been negatively affected.

The discharge in the Mosoni Danube in Hungary has increased.

The following three factors have had some immediate impacts on ground water regime:

- increase in ground water levels in areas near the reservoir, positive effect
- decrease of ground water levels in areas near the river downstream the closure, negative effect
- higher discharge and water levels in the Mosoni Danube and increase in ground water levels in nearby areas, positive effect.

These effects are spreading to larger areas with time, and in some areas are superimposed and to some degree counterbalancing each other. This is the case in upper part of Szigetköz downstream from Rajka. In some villages in dug wells of limited depth (less than 2 m below ground water level) the drop in ground water level resulted in drying out of some wells. In areas where the ground water abstraction is done from deeper wells, including the bank filtration schemes, no immediate effects on ground water availability have occurred.

Analyses of ground water quality have not indicated so far any impact.

Closure of the Danube has influenced the Danube seriously. There is **reduction of discharge for a reach of about 40 km to an extreme low level.** This causes a huge **immediate damage to all water organisms, especially those living in the side branches.** If the situation will continue until the beginning of the vegetation period, most of the fauna and flora depending on floodplain ecosystem condition will be heavily damaged and may have resulted in the loss of essential portions of populations and thus in reduction of genetic diversity and thus adaptability. (To lower the immediate effects, some measures are in progress, e.g. putting the discharge into river branches and increasing the water level in the Danube.)

Upstream the dam the river changes to an impounded lake with significantly smaller flow velocities. Thus, the river system will change on this reach its character, there will be loss of reophil organisms.

Construction of dam interrupted migration of fish and many species of water insects, so they cannot reach their reproduction zones upstream.

Hydrological conditions for agriculture and forestry have changed (mostly neutral and positive changes).

The new channel and locks represent an **improvement of the navigation.** On the Danube downstream the closure, navigation except small vessels has become impossible. Thus Hungary has lost 40 km of international navigation route.

Variant C created changes in landscape character upstream the dam as well as downstream. **As a substitute the lake (through-flowing reservoir) has been created as a new element in the landscape.**

2.2.3. Possible Remedial Measures Proposed by Working Group

The construction of Variant C causes large impact on the environment. Working Group describes a **list of possible measures** ranging from substantial changes of Variant C to small additional measures.

Division of this chapter is generally divided in the area of reservoir and the area downstream from reservoir. Some other possible measures are mentioned in addition.

Restoration the Floodplain inside of Reservoir Area

Between the left and right side dikes floodplain ecosystems could be restored **to a pre-dam conditions** to a great extent between Bratislava and Rajka, **by removing the closure of the Danube.** In addition, suitable measures can be taken to allow navigation through the navigation canal and to stop the erosion in the Danube. **This statement is according to the London Agreed Minutes with the proclamation of 95 % of discharge into the original river bed. Technically it is not possible to remove closure and to allow navigation through the navigation canal.** For division of water is always necessary some structure on the Danube and it is necessary to rise water level at the entrance of the navigation canal at least to 128.5 m asl.

Remedial Measures for Floodplain downstream Reservoir

It has to be the aim **to restore the dynamics of water and substrate to the conditions similar the natural conditions.** This implies the splitting of the Danube discharge to navigation canal and the Danube. This can be done by managing discharge that way, that the typical water level hydrograph with flood periods and periods with low water level is achieved. In the report it is added that this can be achieved perhaps in the average at a slight level. Using all management possibilities it is possible to achieve better conditions, or conditions similar not only to the pre-dam conditions, but conditions few decades before pre-dam conditions. Management tools are:

- **division of discharge**
- **underwater weirs or other small structures**
- **management of intake structures by Dobrohost and at Dunakiliti**
- **measures inside of inundation**
- **interconnection the Danube and river branch system.**

There exists a technical help for starting natural processes. During the last decades the channel system (the Danube and river branches) was changed to a quite unnatural stage. **The Danube discharge nearly as high as in the pre-dam conditions would not be sufficient to improve the ecological situation compared to October 1992. Measures could be taken to reduce river sole erosion and to start natural processes.**

Shallow **underwater weirs** in the main channel situated in front of river branches could increase the water level and ensure that the ground water table will not be lowered.

Removing the thresholds between the main channel and the side branches will then enable splitting up the discharge so that the flow velocity and the pulling power will reduce.

Removing **the fortifications** from the banks of the main channel will allow the river to saturate its bed load deficiency by lateral erosion.

All these measures together will initiate natural processes that guarantee a sufficient ground water recharge, a high diversity of ecosystems and a reduction of river sole erosion.

These statements of the Working Group are very important. The Working Group sees in the lateral erosion positive influence in opposite to the Hungarian specialists. They included as negative effect that some parallel training structures and other river training works have slid into Danube. The Working Group explicitly expresses that the Danube discharge nearly as high as in the pre-dam conditions (this means the well known 95 %) would not be sufficient to improve the ecological situation in comparison to October 1992. In Executive Summary page iv is clearly stated that "**In the past, the measures taken for the navigation constrained the possibilities for the development of the Danube and the floodplain area. Assuming the navigation will no longer use the main river over a length of 40 km a unique situation has arisen. Supported by technical measures the river and the floodplain can develop more naturally**".

If the priorities will be not given to starting natural processes, but rather to guarantee sufficient ground water levels and/or continuous water supply to side branches (the well known 95 %), technical supply method as small inlets/outlets could be pointed out.

To avoid the bed erosion downstream the dam, dredged gravel from the reservoir can be added. After completion of Phase 2, the spillway weir can help to manage erosion/sedimentation problems.

To reduce river sole erosion it is possible **to build belts of concrete and fortify river bed** in reaches, where sole erosion is observed.

<u>Other Remedial Measures</u>

Other remedial measures are mentioned as:

- fish passes
- shape measures in reservoir
- optimizing floodplain habitats
- prevention of negative impacts on infiltration of water in aquifer.

At some places the mentioned measures have been realized. There are the shape measures by Cunovo and Rusovce, hydraulic structures in reservoir, velocity ensure in reservoir, discharge from power canal into inundation, some fish passes and the others.

2.2.4. Various Water Management Scenarios

Summary of impacts for different scenarios is included in Appendix I of the Working Group Report.

Scenario A: 95 % of average discharge to the Danube
Scenario B: Main part of water to Gabcikovo
Scenario C: According to water levels and discharges planned by the Slovak Commission for Environment
Scenario D: Danube redirected to the former bed
Scenario E: Step by step solution

Scenario A means that 95 % of water should flow into the Danube and some water into power canal for navigation.

Scenario D means pre-dam condition and progress of pre-dam development. This scenario is long-term negative and is taken as the basis for comparison of other scenarios, therefore all items in Appendix I for Scenario D have value of zero.

Scenario B means scenario without remedial measures and with minimal discharge into Danube.

Scenario C means scenario with remedy measures and ensure of water levels analogue to discharges presented by the Slovak Commission for Environment.

Scenario E is step by step solution proposed by CEC experts.

It is interesting to compare pluses and minuses in the Table in Appendix I. It seams, that the best solution is the Variant C with Scenario C. (Scenario D is not using the Variant C and Scenario A is using the Variant C only for navigation and not for hydropower production.)

From the Table in Appendix I of the Working Group Report it can be read that from Scenario C it is expected progressive changes in water level developments, regime of fluctuation similar to pre-dam conditions, lowering of water velocities in the Danube, proper development of floodplain dynamics, positive impact on the Mosoni Danube, positive impact on sedimentation in Bratislava (stopping the erosion and starting the sedimentation), negative effect of sedimentation in reservoir (fine sediments), progressive better situation by Palkovicovo (Sap), unknown changes of water quality in reservoir, but probably better in the Danube, generally progressive better ground water regime near reservoir, within floodplain and on area behind floodplain, no changes in ground water quality, better condition for agriculture near reservoir and no changes downstream and for floodplain forestry, improving navigation in navigation canal, reduction of navigation in the Danube (for small vessels), production of hydropower.

It is interesting to compare this impact assessment with real situation. Ground water regime has improved all over the area on the Slovak side. On Hungarian territory has improved close to the Mosoni Danube and under the Cunovo and Rajka. Negative impacts are to be seen in inundation. This is because the intake structure in Dunakiliti on Hungarian territory has not been put into operation and because small underwater weirs have not been constructed. Ground water quality is generally without changes, with slightly improvement at water work Rusovce - Ostrovne Lucky. There is improvement by water supply of Maly Danube and irrigation canals and general improvements for agriculture and forestry, especially downstream from Bratislava. Surface water quality is still not evaluated, but there are no significant changes. Effect of sedimentation is still not measurable. Erosion under Bratislava has stopped. There is improvement by navigation and by entrance into the Bratislava harbor. Some other aspects are just under evaluation and an additional monitoring supported by CEC is before starting.

2.2.5. Explanation

The whole report is influenced by the London Agreed Minutes. In spite of this, in the whole report there is no once used the word "catastrophe" or "ecological catastrophe". In the opposite, there is stated long-term negative development of the area from various points of view, there is defined the pre-dam situation in inundation area and the river branches. There is description of various scenarios, influenced mainly by London Agreed Minutes, with the more or less proper and realistic evaluation in Appendix I. This part of report was signed by all members of Working Group including Hungarian and Czechoslovak experts.

In Chapter 9 in the report [B] there is recommendation of the CEC group of experts. This recommendation is not signed by Hungarian and Czechoslovak experts. Czechoslovak expert denied to sign the recommendation because of using the London Agreed Minutes as a basis for water management and not mentioning the treaty on construction and operation of Gabcikovo - Nagymaros water works. Except this, according to the situation of the location, the Czechoslovak side was aware on not realistic technical possibilities to fulfill this proposal. Because of denying of Hungarian side to realize underwater weirs and not signing the recommendation, we were aware of possibility of repetition of the "case story" of London by confirmation of putting 95 % of water in the former river bed. This means that the first phase, Scenario A, would be prolonged by not constructing underwater weirs probably into infinity as a status quo for the International Court of Justice.

The evaluation of this report was the meeting between the CSFR, Hungary and EC on Gabcikovo - Nagymaros Project held in the Brussels on 27 November 1992. All participants agreed that the Working Group of independent experts (November 9 - 23, 1992) has prepared the report of high quality (see Agreed Minutes of the meeting given in Appendix). In the Agreed Minutes there is no remark on maintaining of 95 % of discharge into the old Danube, there is no requirement to stop the work and no definition of catastrophe is used. The result of the meeting was the proposal to submit the dispute to the International Court of Justice.

2.3. FIELD INSPECTION AT THE GABCIKOVO CONSTRUCTION SITE (May 24, 1993)

In order to provide an update of the situation, described in the working group report of November 23, 1992 [B], a field inspection was carried out according to the scope of work in the Terms of References of the Commission of the European Community, as follows:

1. Describe the ongoing construction activities (scope and time schedule) in the region and assess preliminary the aim and objectives of these activities in terms of protection of the environmental and ecological resources.

2. Assess the current discharge and establish the discharge in the last three months. Identify, if any, discrepancies in the discharge data provided by the Hungarian and Slovak sides.
3. Preliminary assessment of the environmental/ecological consequences (including the impact on ground water quality and level) of the deviation of the Danube since October 1992.

The inspection team was composed of two experts:
- Mr. Jan M. van Geest, Director DHV Environment and Infrastructure, The Netherlands (team leader)
- Mr. Johann Schreiner, Director, Norddeutsche Naturschutzakademie, Germany

2.3.1. Main Results of the Field Inspection

In the report there is described the status of ongoing work in comparison to previous field inspections.

On the Slovakian flood plain area the remedial measures have nearly all been carried out according to the design of original project. Dams, weirs and spillways have been constructed and the branches filled with running water.

On the Hungarian flood plain area the digging of a water inlet canal has just started. Due to uncertainties caused by vague aims and objectives **there are no clear plans. A closure of the Danube near Dunakiliti** in order to set up the water level **and to use the water intake structure of the Dunakiliti works, is a point of discussion.**

In terms of protection of environmental and ecological resources the aims and objectives of these works are assessed by the inspection team as follows:
- It is not necessary to complete the construction works on the inundation weir.
- If more water should be directed to the old Danube bed, **it is necessary to strengthen the tail protection of the inundation weir** or at least behind a number of openings of the weir. It is also necessary to protect part of the banks of the newly created winter-bed and of the newly created summer-bed. It is not the Slovakian government's objective to prepare the river bed for daily use. It is possible to carry out these works in a few months.
- Under the present circumstances **it is very useful to complete the works in the Slovakian floodplain. The branches are filled with running water.** However not all structures allow migration of species of fauna.
- **It is urgent to build irrigation works in the Hungarian floodplain.** It is also **urgent to build dams or underwater weirs in the Danube** in order to increase the Danube water level in front of the intake structure belonging to the Dunakiliti complex.
- Opening of the road in August this year serves neither any environmental nor any ecological aim, but it is urgent from a human point of view.

One structure of the Phase 2 works is a spillway with a sill level which is the same as the river bed level and a high discharge capacity.

This **spillway makes bed-load transport possible** and makes it possible to **cause floods in the old Danube area.** These two possibilities are very important from the ecological point of view.

Preliminary assessment of the environmental and ecological consequences of the deviation of the Danube since October 1992 have been done.

2.4. WORKING GROUP OF MONITORING AND WATER MANAGEMENT EXPERTS FOR THE GABCIKOVO SYSTEM OF LOCKS (September 8, 1993 - December 1, 1993)

Based on negotiation among EC representative and the State secretary of the Hungary Republic and the Slovak Republic, "Establishment of a Group of Monitoring and Water Management Experts for the Gabcikovo System of Locks" had been realized on 26 August 1993. The goal of the establishment of this Group of Experts is expressed in the Communiqué from the First Meeting held on 8 - 9 September 1993 in Bratislava (see in Appendix).

The Working Group was composed of the following five experts:

CEC: Prof. Johann Schreiner (primus inter pares), Director, Norddeutsche Naturschutzakademie, Germany

Mr. Jan M. van Geest, Director, DHV Environment and Infrastructure, The Netherlands

Mr. Jens Christian Refsgaard, Chief Hydrologist, Danish Hydraulic Institute, Denmark

Slovakia: Prof. Dr. Igor Mucha, Faculty of Natural Science, Comenius University, Bratislava

Hungary: Prof. Dr. Gabor Vida, Head of Department of Genetics, Eötvös L. University, Budapest

The Group of Experts submitted two reports:

- Commission of the European Communities, Republic of Hungary, Slovak Republic. Working Group of Monitoring and Water Management Experts for Gabcikovo System of Locks. **DATA REPORT - Assessment of Impacts of Gabcikovo Project and Recommendations for Strengthening of Monitoring System**, Budapest, November 2, 1993.

- Commission of the European Communities, Republic of Hungary, Slovak Republic. Working Group of Monitoring and Water Management Experts for Gabcikovo System of Locks. **REPORT ON TEMPORARY WATER MANAGEMENT REGIME**, Bratislava, December 1, 1993.

In Appendix D of the second report in separate volume is the "Scenario submitted by the Slovak Expert" entitled: **REPORT ON TEMPORARY WATER MANAGEMENT REGIME, INDEPENDENT SCENARIO,** elaborated by Univ. Prof. Igor Mucha on behalf of Slovak Republic, Bratislava, November 28, 1993.

2.4.1. Review of the Main Impact Assessment

"In the past, the measures taken for the navigation constrained the possibilities for the development of the Danube and the floodplain area. Assuming the navigation will no longer use the main river over a length of 40 km a unique situation has arisen. Supported by technical measures the river and the floodplain can develop more naturally" (report [B], p. iv). This unique situation does not exist on any other Danubian hydropower work, because the Danube was "canalized" by fortified banks in all other hydropower construction sites.

Discharge

"Evidently, there is **no significant long term trend in the Danube discharge**" (report [E], p. 5) at Bratislava for the last 40 years. "Historical discharge data from the **Little Danube show a clear decreasing trend** from the mid 1970's to 1992. This is a result of a general decrease in Danube water level at Bratislava" (report [E], p. 5). "At Mosoni Danube historical discharge data exist from the mid 1980's onwards" (report [E], p. 5). Data are not included in Data Report (report [E]). According to our knowledge, discharge from the mid 1980's onwards at Rajka had been only occasional during high discharge in Danube.

Due to putting Gabcikovo hydropower station into the operation "**In the Old Danube the discharge has in 1993 been reduced to in average about 400 m^3/s corresponding to about 20 % as compared to the pre-dam conditions**" (report [E], p. i). This discharge is higher than originally projected discharge (50 m^3/s) according to the Treaty 1977. This means that only 72.5 % from discharge in Bratislava was used for hydropower production (report [E], p. 9), which is less than on other hydropower plants on the river Danube and the river Rhine. "As an effect of the project **the discharges in the Little Danube and the Mosoni Danube have been increased by 10 - 20 m^3/s, so that Mosoni Danube now permanently carries discharge**" (report [E], p. 56).

Surface Water Level

"Evidently, there is **a significantly decreasing long term trend in the Danube water levels** at Bratislava of about 1.5 m for the last 40 years" (report [E], p. 14). This trend is clear from Bratislava until Dunaremete.

"At Bratislava the water levels during low flow periods have **increased** by 1 - 2 m as compared to pre-dam conditions, i.e. to a **level corresponding to the situation 40 years ago**" (report [E], p. ii). This has solved the problems with river bed erosion at Bratislava and has ensured the ship entrance into the Bratislava harbor during the whole year around. This has ensured the higher discharge into the Little Danube and the permanent discharge of 20 m^3/s into the Mosoni Danube on Hungarian territory.

"In the upstream part of the Old Danube the 1993 **water levels have been reduced by 2 - 4 m as compared to pre-dam conditions**, and have thus reached a level 2 m below the lowest ever recorded values" (report [E], p. ii). "Scenario 3 consists in construction of some underwater weirs for increasing the water level in the Old Danube and for enabling interconnection between the main river and the branch system. Construction of underwater weirs is possible along with any discharge regime" (report [G], p. 48). "In addition, the characteristic natural dynamics of the water level fluctuation have been changed (reduced) significantly" (report [E], p. ii). "This could be influenced by implementation of improved operational rules for day-to-day water management" (report [G], p. 37).

Surface Water Quality

"Due to high oxygen content, low organic carbon contents and very small quantities of fine grained sediments the **surface water quality is generally well suited for river bank infiltration**, which is the major source of water supply along the Danube between Bratislava and Budapest. With exception of November - December 1992, when sudden changes of regime and a high flood event occurred, **no significant changes in surface water quality parameters as compared to pre-dam conditions can be detected after damming the Danube"** (report [E], p. 23).

Inundation Area

"The water quality of the side branches differs from that of the main Danube channel due to the much lower velocity and periods and places with stagnant water. In dryer years a negative trend has been observed with high pH, high organic matter and low oxygen contents" (report [E], p. 23). "**Until about 30 years ago the side branches carried a substantial part of the total discharge.** In the following years the connection between the river branches and the main river were closed in order to ensure high water depths for navigation. This resulted in a pre-dam situation with total lack of connection about half the year and full connection only about 20 days per year" (report [G], p. 17). "The pre-dam situation on the Hungarian side was similar to the pre-dam situation on the Slovak side" (report [G], p. 19).

In order to remedy situation after damming the Danube and the processes described above, "Slovakia has implemented a project with the following key elements:

- Intake of water at an intake structure in the power canal, at Dobrohost. Through a new canal this water is diverted into one of the river branches.
- Construction of a number of hydraulic structures in the side channels."

Using this "it is possible to regulate the intake of water from 0 to 140 m^3/s (234 m^3/s when the structure is completed)" (report [G], p. 17). (see report [G], p. 17 for details). "The system was taken into operation at the end of April 1993, and the discharge has since then varied between 10 and 70 m^3/s" (report [G], p. 17).

"According to the **experience from supplying discharge to the Slovakian branches** after May 1993, 70 m^3/s was apparently sufficient to clean the river bottom from mud at so many places that a very **significant infiltration to the ground water system started.** Correspondingly, such condition will be sufficient for biocenosis" (report [G], p. 27). As a result of the continuous discharge the water quality in side branches has improved.

"As a result of river regulation during the past 30 years merely a limited number of side branches succeeded in preserving virtual connection with Danube. Thus the pre-dam condition Hungarian side was similar to the pre-dam situation on the Slovak side. After damming the Danube the connection between the Danube and the side channels disappeared" (report [G], p. 19). "The water supply to the branch system on the Hungarian side presently comes from the outlet structure at Cunovo reservoir (22 m^3/s) and the right side seepage canal (3 m^3/s)". The originally projected and ready made outlet structure at Dunakiliti is not used for water supply. "**Unlike on the Slovak side** the velocities have not been high enough to remove the fine bed material ..." (report [G], p. 21) because of not sufficient water supply. Thus, **the higher discharge of the branch system on the Hungarian side could improve the state** to the better level as before the damming the Danube.

Sediment Transport and Sedimentation/Erosion

"The main channel has been significantly lowered due to erosion caused by a combination of several man made factors" (report [E], p. 24). "In some places the river bed has been lowered more than two meters since the 1960's, leading to lower ground water levels, occasional drying out of river branches and less flushing of most river branches" (report [E], p. 25).

"Most of the transported material of the river has already settled upstream in the reservoir" (report [E], p. 25). "For quantitative analysis few data exist enabling some tentative but no firm conclusions regarding the impacts due to the Gabcikovo Project". "No major net erosion and sedimentation in the Old Danube" will occur. "During some events sedimentation of fine material will take place. This fine material may be washed away during flood events" (report [G], p. 30, scenario - continuation of the present situation).

Because of measures realized on Slovakian territory "The river bed in **the main branches on the Slovakian side will continue to be free from mud**, so that good infiltration conditions exist" (report [G], p. 30).

"The river bed in **the main branches on the Hungarian side will continue to be clogged with fine material/mud** and prevent significant infiltration to the ground water system" (report [G], p. 31) until similar measures (as on the Slovak side) will not be realized. Such measures have been originally projected.

Ground Water Level

The trend over the past 30 years points out that "the ground water levels have decreased ranging from about 2 meters around Bratislava to about zero at Komarno. This decrease is due to erosion of the river bed" (report [E], p. 28).

"From the most recent map it is noticed that **the ground water levels on all the Slovakian territory have increased or have not been affected. The increase have mainly occurred in the upstream area close to the reservoir, i.e. in the area which has been most negatively affected by the long term trend of decreasing ground water levels**" (report [E], p. 34). "It appears that the ground water levels in Hungary have also increased close to the reservoir. In the middle of Szigetköz between Dunakiliti and Asvanyraro the ground water levels have decreased in areas close to the Danube" (report [E], p. 34).

Nevertheless in our opinion, the Monitoring and Data Report proved sufficiently that the ground water level on the Hungarian territory can be still improved to the better level as before damming up the Danube and i.e. by filling the branch system with water, similarly as it was done on the Slovak side.

Ground Water Quality

"In general **no ground water quality changes** can be identified after the damming the Danube. According to the Hungarian Data Report, no significant changes have been detected in the ground water quality" (report [E], p. 40).

Flora and Fauna

"It can be estimated that forestry and agriculture together with regulation measures in the Danube and construction of dikes have caused changes in flora and fauna in former times but the data base does not allow to analyze the long term trends for most of the taxa. On the other hand in some cases it provides a good basis for analyzing the trend in the past and for monitoring the development in the future" (report [E], p. 45).

For pre-dam conditions "long-term analysis with a good data base can be done with fish species. From 56 native fish species 4 are now extinct, 13 species were introduced by man" (report [E], p. 45).

Agriculture

"Due to the general decline of the ground water table in large parts of the area during the past 40 years the conditions for capillary water supply to the root zone have decreased and the irrigation water requirements have increased correspondingly" (report [E], p. 47).

"Due to the **increase of ground water tables** in large parts of the Slovakian area the conditions have improved. According to an estimate the requirements for irrigation from external sources is expected to decrease by about 25 % as compared to the pre-dam conditions" (report [E], p. 47).

Forestry

"As a result of the changes in ground water levels the forestry has been positively influenced in Slovakia and negatively in Hungary" (report [E], p. iii).

Electricity Production

"The Gabcikovo hydropower plant has produced 150 - 200 GWh/month in 1993. This corresponds to about **10 % of Slovakian's electricity consumption**" (report [E], p. ii).

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Navigation

"The international navigation through the ship locks at Gabcikovo has functioned since its opening on 9 November 1992" (report [E], p. 55). This is surely an improvement of navigation and a positive impact from the point of view of development in the inundation area, decreasing the fuel consumption and exhales.

2.4.2. Review of the Scenarios

In the REPORT ON TEMPORARY WATER MANAGEMENT REGIME [G] five scenarios with different characteristics on discharge regime and remedial measures have been elaborated. All the five discharge regimes are dynamic and characterized by the below average values. The five scenarios and their most important impacts can be summarized as follows:

Scenario 0: November 1993 Situation

* Old Danube: 400 m^3/s
* Slovakian side branches: 40 m^3/s
* Hungarian side branches: 10 m^3/s

The key impacts are as also described in the Data Report:

* The environmental conditions on the Hungarian inundation area are bad due to lack of water.
* The flow velocities and water levels in the Old Danube are too low for providing suitable living conditions for typical flora and fauna.
* The lack of connections between the main channel and the side branches prevents migration of wetland species.

Scenario 1: Increased Water Supply to the Hungarian Side Branches

* Old Danube: 400 m^3/s
* Slovakian side branches: 50 m^3/s
* Hungarian side branches: 50 m^3/s
* 1 - 3 floods of more than 3500 m^3/s are expected to occur each year in the Old Danube.

The key impacts as compared to Scenario 0 are:

* Improvements of the environmental conditions for the Hungarian inundation area.

Scenario 2: Increased Discharge in Main River and in Hungarian Side Branches

* Old Danube: 800 m^3/s
* Slovakian side branches: 50 m^3/s
* Hungarian side branches: 50 m^3/s
* 1 - 3 floods of more than 3500 m^3/s are expected to occur every year in the Old Danube.

The key impacts as compared to Scenario 1 are:

* Improvements of the main river environment to a level where species requiring higher flow velocities (e.g. fish) have suitable living conditions.

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__Scenario 3: Construction of some Underwater Weirs__
Scenario 3 is basically identical to Scenario 2 except for construction of a number of underwater weirs.

The key impacts as compared to Scenario 2 are:
* The connections between the main channel and the side branches on both sides are maintained or even improved as compared to pre-dam conditions.
* For discharge not exceeding 1000 m^3/s the flow velocities in the Old Danube are not sufficient for maintaining the typical flora and fauna.

__Scenario 4: Full Capacity of Variant C Structures Used for Water Supply of the Main River and the Branches__
In Scenario 4 as much water as technically possible will be diverted into the Old Danube and the side channels. However, this will technically not be possible until after the summer of 1996.

2.4.3. Review of some Recommendations and Assumptions

"None of the described scenarios can be recommended without modifications. Therefore the three EC members of the Working Group will recommend a **combination of elements from different Scenarios**". "In addition to the environmental aspects **also economical** aspects should be considered" (p. iii).

"Scenario 3 consists in construction of some **underwater weirs** for increasing the water level in the Old Danube and for enabling interconnection between the main river and the branch system. **Construction of underwater weirs is possible along with any discharge regime**" (p. 48). "Water level fluctuation could be influenced by implementation of improved operational rules for day-to-day water management" (p. 37). "A discharge of 3500 m^3/s twice per year will be enough to clean the river bed sufficiently for fine material deposited during low discharge conditions and to spread this material in the whole inundation area" (p. 25).

"To provide sufficient living conditions for typical fish species living in the Danube under pre-dam conditions a pattern of different flow velocities in the river bed is necessary. Flow velocities near the river bottom of at least 0.6 m/s must occur at several places all over the year" (p. 26). This is according to the study in the Austrian part of Danube. Quotation from the mentioned study (G. Zauner, 1991, Vergleichende Untersuchungen zur Ekologie der drei Donauperciden Schratzer, Zingel und Streber in gestauten und ungestauten Donauabschnitten, Diplomarbeit, Universität für Bodenkultur, Wien). "Unter 35 cm/s (7 cm über Grund) konnte kein einziger Streber nachgewiesen werden. Über 65 cm/s liess sich wiederum kein Streber mehr nachweisen".

In the inundation areas "a variation of the water level within 2 m will be enough to ensure the dynamic character including the flooding according to the pattern in pre-dam conditions" (p. 26). "Until about 30 years ago, the side branches carried a substantial part of the total discharge" (p. 17). At the Slovak side "it is possible to regulate the intake of water from 0 to at present 140 m^3/s" (p. 17), which is ensuring the necessary variation of the water level. This "according to the experience from supplying discharges to the Slovakian branches after May 1993, 70 m^3/s corresponding to a typical flow velocity in the main side channels of 0.1 - 0.3 m/s (cross-sectional average values) was apparently sufficient to clean the river bottom

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from mud at so many places that a very significant infiltration to ground water system started" (p. 27). This is much better than in the pre-dam conditions.

"To ensure ecological conditions which are as good as pre-dam conditions migration of wetland species between the main river and the side branches should be possible all over year in both directions. Migration can be made possible either through fish passes or through direct flows between the main river and the side branches during some periods" (p. 28).

3. COMMENTS TO THE WWF STATEMENTS ON THE EC EXPERTS' REPORTS

Note: the text written in *italic* is the quotation from the WWF paper "A New Solution for the Danube" [5].

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Introduction

WWF has been actively engaged in the Gabcikovo case since 1986. Several experts reported on the most important aspects of Gabcikovo. In January 1993, WWF submitted a joint NGO paper to the EC recommending much needed studies necessary to get a comprehensive overview of the benefits and negative impacts of the hydroengineering project on ecology, the economy, national/international law and on the social situation of the people affected.

The first Czechoslovak attempt to involve the EC and Hungarian experts into the optimization of water regime dates back to September 6, 1990 when the Czechoslovak plenipotentiary for construction and operation of the hydropower system Gabcikovo - Nagymaros submitted this proposal during negotiations with his Hungarian colleague. On 26 October 1990, the plenipotentiary sent a draft agreement on joint Czechoslovak and Hungarian co-operation on the EC PHARE program (see Appendix). Czechoslovakia has never received positive answer. The above mentioned EC PHARE program entitled "Danubian Lowland - Ground Water Model: Surface Water and Ground Water Model of Danubian Lowland between Bratislava and Komarno; Ecological Model of Water Resources and Management" has been subsequently carried out only on the territory of Slovakia [2, 3]. Dr. Emil Diester from the WWF was invited to the workshop at the beginning of this PHARE project, invitation was not accepted.

Working Group of Independent Experts [B] recommended "studies, monitoring and modeling as a basis for water management in 1993 and for the long term". Monitoring of the effects of the conditions after the closure of the Danube by Cunovo has been carried out by the Slovak Center of Monitoring at the Slovak Hydrometeorological Institute according to the original international Treaty from 1977 [4] and to the later proposals and projects of monitoring.

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The goal of the WWF paper "A NEW SOLUTION FOR THE DANUBE" is:

- *to give an independent, scientifically based review on the present situation in the Danube region affected by Gabcikovo*
- *to critically comment on the Reports of the EC Mission and*
- *to give recommendations for the future management of the river.*

WWF, having high competence on the Danube and in the Gabcikovo issue, considers it as its responsibility to produce this independent statement.

Today, circa 8,000 hectares of interconnected, mostly very valuable floodplain biotopes and the second largest drinking water reservoir in Europe for up to 5 million people can still

be saved. This makes this stretch of river between Bratislava and Györ unique at Central and West European scale and an ecological priority area.

It is the objective of our recommendations to prevent the continued, total destruction of this wetland and to develop a long-term, ecologically sound solution for the Danube.

Our aim is to discuss this WWF paper, its competence in the Gabcikovo issue and to clarify the WWF accusation of the Slovak Republic. The titles of the following chapters are identical with the WWF paper chapters.

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Brief Review of the recent Gabcikovo "history"

Following WWF's international law study (3), presented in Bratislava on 20 October 1992, this "Variant C" is illegal because it violates the international principles of good neighbourliness and of equitable utilization of shared resources. Also, Variant C violates several boundary agreements and does not constitute a legitimate response of CSFR or Slovakia to an alleged violation of the 1977 Treaty on Gabcikovo - Nagymaros by Hungary.

WWF is surely aware, that according to the "**Special Agreement for Submission to the International Court of Justice of the Differences Between the Republic of Hungary and the Slovak Republic Concerning the Gabcikovo - Nagymaros Project**" in the Article 2 is written:

(1) The Court is requested to decide on the basis of the Treaty and rules and principles of general international law, as well as such other treaties as the Court may find applicable,
(a) whether the Republic of Hungary was entitled to suspend and subsequently abandon, in 1989, the works on the Nagymaros Project and on the part of the Gabcikovo Project for which the Treaty attributed responsibility to the Republic of Hungary,
(b) whether the Czech and Slovak Federal Republic was entitled to proceed, in November 1991, to the "provisional solution" and to put into operation from October 1992 this system, described in the Report of the Working Group of Independent Experts of the Commission of the European Communities, The Republic of Hungary and the Czech and Slovak Federal Republic dated on 23 November 1992 (Damming up of the Danube at river kilometer 1851.7 on Czechoslovak territory and resulting consequences on water and navigation course).

To make such judgments it belongs to the International Court of Justice and not to the WWF. This is a clear evidence, that **WWF** and a group of "*independent scientists*" **is not independent from the point of differences between the Republic of Hungary and the Slovak Republic concerning the Gabcikovo - Nagymaros Project.**

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After its diversion, the "Old" river bed received only 10 - 20 % (200 - 400 m³/sec) of its water, while the "rest" was countinuously diverted into the turbines of the Gabcikovo power *plant. The debatable, one-sided benefit comes in the form of electricity production. It involves numerous negative impacts on the hydrology and ecology of floodplains as well as on the social situation of local people.*

Hydropower plants are in all countries constructed that way, that water is diverted into the turbines. Gabcikovo uses circa 70 % of water in average for energy production. Water of the Danube is in average used for:

Maly Danube	30 m^3/s	
Mosoni Danube	25	
seepage canals	8	
seepage into Danube	30	
Groundwater recharge	30	
Slovak inundation	40	
Hungarian inundation	40	(in preparation)
shiplocks	30	
by-pass weir, discharge into the old Danube	400	
turbines -electricity production	1392	
Long-term average discharge in Bratislava is	2025 m^3/s	

The debatable, one sided benefits come in the form:
- **flood protection** between Bratislava and Sap, especially the **Hungarian territory** (compare floods and flood territory in 1954 and 1965)
- **electricity production** (10 - 12 % of the whole consumption in the Slovakia)
- less consumption of brown coal, less exhales
- **improvement in shipping** (certainty of dip during the whole year, time saving, saving of energy, improvement of entrance into Bratislava harbor, exclusion of fords and moving sandbanks)
- improvement in **agriculture**, increase of ground water level, decrease of irrigation needed, less impacts upon ground water
- improvement in **forestry**, higher ground water levels, more typical for floodplain
- new **recreation** possibilities
- more water for irrigation
- continuous **supply of the Mosoni Danube**
- improved **supply of the Maly Danube**
- **water for the river branches**, inundation and the valuable floodplain biotopes, Slovak territory
- stopping the erosion at Bratislava
- decrease of problems of sedimentation downstream Sap
- **saving the 40 km long stretch of floodplain** in comparison with other hydropower stations on the Danube
- no village was abolished
- indirectly due to increased revenues

In report [B] the EC Working Group concluded: "**In the past, the measures taken for the navigation constrained the possibilities for the development of the Danube and the**

floodplain area. With the past endikements, especially during the last century the original zonation in vegetation towards higher grounds and associated forests was largely 'diked' out of the system. **Assuming that the navigation will no longer use the main river over a length of 40 km, a unique situation has arisen.** Initiated by technical measures, the river and the **floodplain area can develop more naturally."**

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In the winter of 1993, the Slovak investor company VVsp (Vodohospodarska Vystavba s.p.) started to build an artificial water-input system for the remaining parts of the valuable floodplain system in Slovakia which was about to totally dry up. Since the May of 1993, an input structure in the power canal near the village of Dobrohost has been leading ca. 30 m^3/sec of Gabcikovo reservoir water into a large, sealed canal. This provides a constant filling of the interconnected side-arms which are dissected by newly erected or enlarged lateral dikes (creating 7 "cassettes").

A water-input system for the floodplain system in Slovakia and similar system on Hungarian side had been planned much earlier than in winter 1993. WWF probably does not know that **the water input system for Hungarian floodplain with capacity of up to 200 m^3/s is already ready** and it is a part of the ready made Dunakiliti weir. At nearly the same river kilometer, the water input system from power canal with maximal capacity of 243 m^3/s (to supply the Slovak floodplain) has been build at the same time (together with the construction of power canal), it means much earlier than mentioned in WWF article. Both water-inputs are parts of construction plans. WWF can be sure, that the input system is as large as necessary for yielding this discharge and canal is sealed only near the intake structure. Remember the report [G], p. 27 **"According to the experience from supplying discharge to the Slovakian branches** after May 1993, **70 m^3/s was apparently sufficient to clean the river bottom from mud at so many places that a very significant infiltration to the ground water system started."** And WWF is speaking about sealed canal. Discharge into the river branches on the Slovak side is not constant but permanent with variable similar nature discharge and water level fluctuation. Discharge and lateral dikes make it possible to inundate the area, if needed. Similar work has been done on the Hungarian territory, except the fulfilling the river branches with water via the ready made water intake structure or prepared other intake places upwards Dunakiliti weir.

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Due to the ongoing river diversion and the drying up of its entire side-arm system, Hungary started at the end of July 1993 a similar input of water (10 m^3/sec coming from the Cunovo weir) into its side-arm system.

It is surely not a similar input of water. Water is taken from the **Mosoni Danube which is now supplied with permanent discharge** in average more than 20 m^3/s through the Mosoni water-input structure constructed for this purpose at the Cunovo weir. Ready made input structure in Dunakiliti weir and openings on the Danube upstream Dunakiliti are not used, it means that half of the Mosoni Danube water is now used instead of water from the Danube.

Situation in side-arm system in pre-dam conditions can be described as in report [E], p. 23 "...much lower velocity and periods and places with stagnant water. In dryer years a negative trend has been observed...".

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In April 1993, WWF published excerpts from the first Slovak groundwater monitoring data (26 October to 31 December 1992) indicating some organic pollution in several groundwater observation wells near the storage lake ((7). While this first monitoring is too premature giving sound information about possible changes in the aquifer, WWF's concerned, scientific interpretation contradicted the official, very positive interpretation by Slovak authorities. After this, no more comprehensive information on groundwater monitoring was published or available, not even to the extent needed for the EC experts (see chapter Comments A).

About this accusation we will discuss later. At this point it is necessary to stress that the **Slovak side had prepared for the EC experts all required data.**

On the first formal meeting on 8 - 9 September 1993 in Bratislava, there was present a database specialist, the head of the Center of Monitoring at the Slovak Hydrometeorological Institute and he was ready to grant any data. On this meeting the EC experts had asked "The **Slovak and Hungarian experts to collect data and to prepare the agreed data analysis for the respective territories."** The Slovak side prepared all agreed and required data and except this it confirmed the willingness immediately to grant any data which are in the monitoring database and also the data concerning the putting the hydropower plant into operation.

The situation during the work of Working Group we would like to explain by quotations from the Data Report [E] and from the negotiations on 27 October - 2 November 1993 (Minutes in [E], p. 1) **"the Hungarian Data Report was delayed by a week and did not contain all the data and analyses agreed upon."**

In the report on temporary water management regime (report [G], p. 68 - 69) there is 5 times said that **"The three EC experts and the Slovakian expert recommend that data** on:
- surface water levels
- surface water quality
- ground water levels
- ground water quality
- flora and fauna

from the national monitoring networks should be exchanged. The Hungarian expert **in theory agrees to exchange all relevant environmental data.** Further agreement is necessary, however, on the detailed elaboration of this after the political decision has been made on which TWMR should be implemented." This confirms that the Hungarian side consciously did not grant the data to the EC experts. We suppose that the WWF had compared the data granted by the Hungary and Slovakia.

We would like to confirm that the Slovak side has been willing to grant all data from the National Center of Monitoring to the EC experts. Evaluation of these data in special reports is carried out regularly.

Except this, the EC experts had to disposal special measurements prepared in framework of program PHARE and they had direct access to these data.

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New Important Facts

River bed erosion

Slovak sources often state that over the last two to three decades the growing river bed erosion resulted in decreasing levels of surface and groundwater downstream of Bratislava, causing a serious deterioration of the wetlands and of the drinking water supply. However, the various origins of these effects were never really quantified. A Slovak study from June 1991 reveals that the reason for this impact was neither the river regulation measures for navigation (excavating 3.5 mil. m^3 of gravel over 40 years) nor the catching of river sediments by the Austrian and Bavarian hydrodams located upstream (the regular bedload is 3-400,000 m^3/year). The really outstanding interference was the huge gravel excavation near Bratislava: in the period of 1976 to 1989, ca. 50 mil. m^3 were exploited from the river bed. Following a WWF estimation, this caused ca. two thirds of the deformation and erosion processes monitored both up- and downstream. This can be observed up to Hainburg (Austria) and in the floodplains near Gabcikovo. It also threatened the stability of the bridges in Bratislava and lowered the groundwater table reducing the productivity of several important drinking water wells near Bratislava.

This leads to the conclusion that the recent overexploitation of the gravel resources near Bratislava supported the "urgent need" (as claimed by Slovak river engineers) to finish the Gabcikovo project. The excavated gravel was used for large-scale industrial constructions in Bratislava and for the building of the Gabcikovo scheme. Without this activity, the river bed erosion would be a small problem today.

The EC experts in [B] clearly expressed that **"The main channel has been significantly lowered due to erosion by a combination of several man-made factors:**

- **dam construction in Austria in the last decades resulting in a sediment (bed-load) deficit;**
- **excavation of gravel downstream of Bratislava;**
- **natural erosion due to the very high velocities in the straightened and narrowed navigation channel;**
- **prevention of bank erosion due to fortification of river banks."**

Slovak study from June 1991 [1] shows that from 1976 to 1989 48.3 mil. m^3 and not circa 50 mil. m^3 were exploited from the river bed. This excavation happened not near Bratislava, but between Bratislava and Sturovo, exactly from the rkm 1709.024 downstream from Sturovo up to rkm 1880.00 at Bratislava. This excavation happened on the stretch of length 171.0 km. In the section from the place of the damming the Danube near Cunovo downstream up to Sap, the excavation from 1976 to 1989 was 3.5 mil. m^3 of gravel, or exactly from rkm 1861.74 (near Ostrovne Lucky) downstream up to rkm 1806.95 (near Medvedov) the excavated volume was 3.74 mil. m^3 of gravel. All these data are included in the report submitted by Slovak side [H]. Since 1984 the gravel excavation upstream from Samorin up to Devin had been stopped, except the excavation because of navigation

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(excavation of fords). Average volume of excavated bedload material before 1960 was from 530000 to 730000 m^3 per year.

At the beginning of this century, the riparian states thought to establish safe navigation conditions at low water level. Series of measures were taken to attempt to achieve this aim:

- **Closing of river branches** so as to direct the flow into one main straightened channel
- **Fortification of river banks** with stone and concrete works to stop lateral erosion
- **Dredging of gravel on the river bottom** to prepare navigation route - kinete
- **Placing regulation dikes** (or groynes) to concentrate the flow into the navigation channel
- **Dredging of moving sand banks and fords.**

Several new ford sections appeared in the Bratislava region with low navigation depths and extremely narrow shipping channels - kinete, e.g. at rkm 1868, 1864, 1862 - 1860. In addition, navigation depths in Bratislava's port decreased rapidly. The port, originally designed for navigation depth of 2.5 m was for most of the time without access for larger vessels. This was an irremediable problem because further excavation would progressively undermine the docks' entrance thresholds and walls.

We would like to inform the WWF about a few articles published in PERSPEKTIVEN [6 - 9], (see Appendix).

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Drinking water supply

Numerous informed sources confirmed that, since the summer of 1993, the water works (drinking water wells) at Samorin reduced their production to two thirds, those at Kalinkovo stopped altogether. Official sources explain this by claiming a surplus of drinking water production in other wells upstream, being positively affected by the lifted groundwater due to the Gabcikovo storage lake.

However, other water experts expected before the filling of the lake, that these wells would be the first to be potentially affected by a changed groundwater quality due to infiltration of more polluted Danube water or by enhanced leakage of old waste deposits in the area (including from the refinery Slovnaft).

Simple look at the map and in the field will ensure the WWF experts that Slovnaft is far away from the Samorin and Kalinkovo well fields and that between well fields and reservoir with flowing water (not a lake) there is no old or new waste disposal in the area. Look at the ground water level equipotential map (Fig. 1.23) will disclose the experts that the situation around the Slovnaft is after putting Gabcikovo hydropower station into operation much better than in pre-dam conditions. Kalinkovo well field was created in 1972 as a compensation for the Bratislava's second waterworks. The wells are now situated close to the reservoir and are therefore monitored very carefully. Water is still used for water supply but after reduction of water consumption in reduced form. At present the pumping quantity is continuously 200 l/s.

Samorin well field was enlarged by four wells as a reserve in the case that wells in Kalinkovo would not fulfilled the qualitative standards. Development of pumped water quality in Kalinkovo is still without signs of deterioration. However, the water experts expected that Kalinkovo could be affected firstly. Therefore monitoring and special measures have been performed, including special ground water survey in framework of PHARE project.

WWF is not aware of the fact that there exist natural processes of ground water quality development. One among various criteria is the ground water velocity and time used to fulfill the hydrogeochemical processes. Based on this knowledge, the location of wells is chosen. This is in opposite to situating of water supply wells at Budapest.

WWF is of the opinion that ground water quality will be changed "due to infiltration of more polluted Danube water". What does it mean? Is the Danube water now more polluted than in pre-dam conditions? Does WWF think that after damming the Danube, the Danube water has started to infiltrate into aquifer? The Danube water quality was in the past, especially in 1970's, much worse.

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Economic benefits of self-purification processes
The Finance Institute of the Technical University in Vienna recently concluded a cost-benefit analysis comparing a Danube national park with several variants of hydropower plants downstream of Vienna. The extraordinarily better economic benefits of the national park alternative are based, among others, on the work of water organisms which, in an intact floodplain, significantly contribute to the cleaning of organic water pollution and, thus, to the improvement of water quality on the surface and in the aquifer. Under the alternative of hydrodams, i.e. also in the case of the Gabcikovo scheme, this work has to be done by sewage treatment plants and water purification schemes for the drinking water supply, both very expensive installations. The Austrian Finance Institute calculated that in Austria investments of ca. ATS 640 million (ca. ECU 47 mil.) and operational costs of ca. ATS 60 million per year would be needed as a substitute to the "free work" of floodplain organisms.

This significant economic value has been largely ignored in the evaluation of the EC Working Group Reports (especially in their Scenarios) when comparing the former river situation with the present one, where the water is diverted from the floodplain into the storage lake with its many negative attributes (sedimentation, colmation, infiltration of less purified or even more polluted water into the aquifer and towards the near-by drinking water wells).

WWF is not aware of advantages and disadvantages of different forms of energy production. If Slovakia wished to replace hydropower production through its coal burning plants it would not only be forced to exploit one of its few non-renewable resources but increases the ear pollution by Sulphur and Arsenic, soil pollution, ground water pollution and such production will produce ash-disposal areas. Is this really the scientific wish of WWF?

The Finance Institute obviously is not acquainted with the EC expert report where the inundation of the Hungarian and Slovak side is described. The intact floodplain significantly contributing the cleaning of organic water pollution (in the past mainly from Schwechat refinery) existed earlier. Percentage of discharge through the Danube and through its branches before their cutting off and closing is shown in the Table 1.3. The first number in the table is percentage of the discharge in the main stream of the Danube, the number in brackets is percentage of the discharge through the river branches. It can be seen that e.g. from rkm 1833.0 to 1816.0, in the area of Gabcikovo, the discharge in the river branches was before the closing the river branches (in 1955 - 1961) approximately 20 % of the discharge of the Danube in Bratislava, also at low discharges. Flow in almost all river branches existed (before 1992) in the pre-dam conditions at discharge 3500 - 4500 m^3/s, altogether in 17 days per year. Flow in some river arms existed for 78 days per year at discharge 2500 - 3500 m^3/s. **The main difference between the "intact floodplain" conditions in the late 1950's and pre-dam conditions is that in the far past the main river branches were supplied with water all the time, while in pre-dam conditions only few weeks in a year. Except this, the Danube water was much more polluted that time.**

The EC experts have confirmed the bad qualitative conditions in river branches [B] "**The water quality of the side branches differs from that of the main Danube channel. Due to the much lower velocities and periods and places with stagnant water.**" We draw attention to the Internationale Arbeitsgemeinschaft der Wasserwerke im Rheineinzugsgebiet, 13. Arbeitstagung, 8 - 11. Oktober 1991, Scheveningen, "Trinkwasserschutzgebiete dürfen nicht überflutet werden" presented by Prof. Dr. D. Maier.

WWF is probably not aware of these facts. Therefore the economic benefits of self-purification processes described by the Finance Institute are for area downstream Bratislava turned upside-down. **In the reality, the water in the branch system on both sides in pre-dam conditions was of worse quality than in the main Danube channel and had negative impact on ground water quality.** As an example there could be the ground water quality at the locality Dobrohost. Similar examples are now being evident from Austria where the worsening of ground water quality is caused by creation of polders in floodplains (e.g. Altenwörth). WWF has not considered the fact that there are differences in geological and hydrogeological conditions and between Gabcikovo scheme and the other hydrodams on the Danube.

In its natural state, the Rhine, as the Danube did not have a stable river-bed and the bed changed after each flood. This created a major problem for navigation. The narrowing of the river-bed increased the flow gradient on the Rhine and triggered erosion actively. The bed became deeper, bringing about the gradual isolation and disappearance of most river branches. Project developed by Slovakia and Hungary was able to benefit from the negative experience. One of the objectives of the G - N Project is to reverse the trend in the Danube branches and side areas to dry up and to prevent the disappearance of inundation.

It is necessary to stress that the water was not diverted from the floodplain into the storage lake. Downstream from Bratislava the floodplain is maintained and prevented from drying up, some parts are re-forested. **The inundation area downstream Cunovo was completely saved and on the Slovak side supplied with water. Water was diverted into floodplain.** Sedimentation, colmation and infiltration are kept under control and quality of ground water is maintained. The reservoir area is not larger than it would be in the river variant. **Hydropower stations are not producing pollution in opposite to other types of power stations.**

<u>Therefore it is not the true what is written in the WWF Statement that</u> ***the loss of self-purification capacity due to the diversion of the Danube, together with the lack of***

sufficient sewage treatment schemes has led to a decrease of Danube water quality downstream of Bratislava and to the increased need for respective, expensive investments.

Quotation from the publication "State of the Hungarian Environment" [30] is: "**Bank-filtered groundwater is the main source of supply for the communities situated along the Danube river.** Indeed, Budapest alone withdraws some 312 million cubic meters of bank-filtered water every year for municipal use.

The groundwater is highly polluted under a major part of the island (Csepel Island) for each of the four components considered - nitrate, organic carbon, iron, and manganese.

The water quality in northern and southern well fields has been compared. The percentage of consistently poor quality well water was only 8.7 for the northern fields, but soared to nearly 47 percent in the southern well fields.

The following considerations should be kept in mind:
- The trend towards poorer quality groundwater is an unbroken one;
- It is interesting to note that the annual mean values in the Danube for the same components reflect a deteriorating trend over the same period;
- The rate of deterioration, expressed in percent/year, was lower in the Danube than in the water wells for all components; and
- In addition to the deteriorating quality of Danube water and the partially anaerobic conditions in the bottom sediment, the background pollution in this region is also growing and contributing to poorer quality well water.

This continuing crisis is due fundamentally to the untreated wastewater discharge into the Danube from sewer outlets in Budapest. And the situation is not expected to improve for at least 5 - 10 years."

The list of constructed sewage treatment schemes in the framework of Gabcikovo - Nagymaros project is following:

place	price in Slovak crowns (million)
Gabcikovo	3.0
Petrzalka	344.0
Samorin	68.0
Samorin - Agricultural Cooperative	6.0
Malinovo - I.	6.0
Malinovo - II.	42.0
Rovinka - Hamuliakovo	23.0
Kyselica - Rohovce	47.0
Baka	9.0
Gabcikovo - II.	11.0
Vojka	9.0
Bodiky	19.0

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Legal situation in Slovakia
In February 1993, WWF published an internal document from the Slovak environment ministry stating that the needed permissions for the completion of the Gabcikovo storage lake dikes, for the use of Danube water, for the diversion of the Danube and for the operation of the Gabcikovo scheme could not be granted by the responsible Slovak authorities to the operator VVsp.

Following WWF's present information, these permissions were granted by the responsible district authority Bratislava Vidiek only on 17 May 1993, i.e. ***for more than 6 months the Danube was diverted and the Gabcikovo scheme was operating without the respective, needed Slovak permissions.***

The reason for the delayed permission process is the fact that, already on 25 June 1991, the ***Slovak environment commission (= ministry) SKZP being the central authority for water economy prescribed a specific, binding "Statement"*** *(called the "19 Conditions" under § 14 of the Slovak Water Act no. 138/1973 Zb)* ***as a prerequisite to permit the use of water and to operate Gabcikovo.*** *This statement says that the suggested technical solution for Gabcikovo (i.e. the "Variant C") is only possible by the fulfillment of these specifically determined Conditions.*

Especially, ***the conditions no. 11*** *(demanding the inundation of the Slovak floodplains under natural conditions from the old river bed)* ***and no. 18*** *(demanding 1,300 - 1,500 m³/sec of water during the vegetation period in the Old Danube)* ***are not fulfilled by the investor company.***

On 17 April 1993, a specific permission for the manipulation of Danube water was granted, *apparently replacing the Condition no. 18 for an interim period because the technical situation at the Cunovo weir did not allow a higher discharge at this time. The Slovak state attorney wrote in a letter on 19 August 1993 that, "on 17 May 1993, the investor received the permissions for accumulation and damming of surface waters at the Danube on 17 May 1993. With this decision, the 'Preliminary Manipulation Order for the operation of the Gabcikovo powerplant by the preliminary solution on the territory of the Slovak Republic' was approved."*

However, as the investor was unable to technically provide more water for the Old Danube, this specific order was granted by the authority under the conditions that ***a minimum flow of 600 m³/sec be guaranteed in the Old Danube,*** *that a proposal for a new water manipulation order be presented by the investor by 1 October 1993 and that* ***this order expire on the 15 November of 1993.*** *In fact, the monitoring data in the EC Reports show that only 300 - 400 m³/sec were flowing in the Danube throughout the year, i.e.* ***the order was not fulfilled. Today, this interim manipulation order has again expired and has not yet been renewed.***

To provide the reader with the full information about conditions for putting the Gabcikovo into operation by provisional solution (Variant C) we present the CONDITIONS prescribed by the Slovak Environmental Commission:

1. To demonstrate by documentation the procedure of self-purifying processes and their capacity in the course of infiltration of the surface water into the river-bank region.
2. To demonstrate by documentation the pollution of soil and of underground-water horizons in the dead-branches system of the upper part of Zitny ostrov. To specify more

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accurately the character and the content of pollutants and the propagation into the ground water at present conditions and at a higher hydraulic gradient.

3. To assess and demonstrate by documentation the influence of the temporary solution of the Gabcikovo Project on the regime of underground water, from the point of view of municipal water supply.
4. To make a prognosis of the evolution of the quality of underground-water used for municipal water supply and to propose a technology of treatment, corresponding to the results. To match the time-schedule of the treatment measures with the schedule of finishing the Gabcikovo Project, taking in consideration also the results of the PHARE Project, coordinated by Prof. Mucha.
5. The change in the form of the reservoir may change the conditions of infiltration of surface water into the region of municipal water wells, especially of the source Dobrohost. To demonstrate by a research on an adequate model, the impact of the temporary solution on the capacity of these sources.
6. The flow and sedimentation conditions of the diminished reservoir will be changed. To demonstrate by a research on a mathematical model the impact of the temporary solution on the allocation of sediments and on the infiltration conditions. To estimate by the model also the possibility of reduction of the surface of the reservoir in the vicinity of the municipal water source Samorin.
7. Due to higher hydraulic gradients, especially on the right side of the reservoir, quicker sealing of the bottom by sediments may be expected. The intensity of this process would be a function of water-levels in the reservoir and in the Danube. To propose measures reducing the sealing process of the reservoir and of the unsealed power-canal.
8. To assess the influence of the old river-bed (the possible drainage effect) on the regime of the ground-water levels on both sides of the Danube, after the situation of the weir 11 km upstream of Dunakiliti.
9. To propose a solution for improving navigation conditions downstream of Palkovicovo, taking account of changed conditions of solids flow and increased erosion of the river-bed and reconsidering also the solution of Mr. Bartolcic of March 1991.
10. To secure storage of sediments dredged from the reservoir, outside the protected region of Zitny ostrov, in a form of controlled dumps fulfilling the given conditions of protection of quality of surface and ground waters.
11. To secure communication between the dead-branch system and the Danube in both ways and to enable the flow through the branches from Dobrohost to Pálkovicovo. Periodical inundation with river-water, in correspondence with the natural regime of flows (mainly in May - June, secondarily in August - September) should last 5 to 7 days, but not longer than 14 days.
12. To include into the design: permanent structures, which together with mobile equipment would serve for elimination of pollution of the water by oil products.
13. To secure the supply of water into the Mosoni Danube according to conditions agreed-on by Czecho-Slovakia and Hungary in 1948, on the base of the Paris Peace Treaty.
14. As the construction will be realized in the inundation area of the Danube, to schedule the works into a period of lower flows, but nevertheless, to propose measures for foregoing or reduction of damages, for the case of higher flows of the Danube.
15. In connection with the reduced surface of the reservoir, to assess the possibility of passing floods and ice and to secure flood-protection of the adjacent region in the course of construction and of operation.
16. To secure monitoring of water-levels and flows in all decisive places of the Project, to gain an oversight about the hydraulic regime of the whole influenced region.
17. In the frame of the design of General Flood-Protection Measures, to include (in cooperating with the competent authorities) also the small protected regions - the two

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proposed natural reservation areas "Istragon" and "Island of the Sea-Eagle", the protected natural formations "Kings Meadow" and protected "summer-oaks" at the forester's lodge.

18. To secure the natural physiologic processes of the actual flora of the old bed of the Danube during the vegetation period (mainly from March to September), it is necessary to secure a flow of about 1300 to 1500 cumecs. Further it is inevitable, to secure such a flow in the old river-bed, which would enable the underground water level to touch the soil horizon and which would prevent the drainage effect of the empty river-bed. To evaluate, whether the proposed minimal flow of 600 cumecs would fulfill these conditions. To secure the fulfillment of the above-mentioned conditions also during the construction-period. With regard to the lack of data about the depth of the top-soil cover (above the sterile gravel) and with the aim of finding the optimal water-level, to elaborate a prognosis of the water-level regime in the old river-bed at a flow of 1300 to 1500 cumecs and the corresponding underground water level.
19. To prove the necessary security of the flood-protection measures in the region of the right lateral canal (the Bodiky region) at a 1000-years flow of the Danube.

Most of conditions have been already fulfilled and some of them (conditions No. 9, 11, 17) are under fulfilling. In the WWF report there are mentioned the conditions No. 11 and 18. Flow through the branch system from Dobrohost to Palkovicovo is ensured by the outlet structure at the power canal at Dobrohost. Periodical inundation of the area is ensured by the discharge regulation at the outlet structure where maximal discharge into river branch system of 234 m^3/s is possible. Fish passages are under construction in the whole inundation and between the river branches and the river Danube. Interconnection between the Danube and the river branches is possible via lowering in river banks during the flood situation in the Danube. Improvement of communication between the branch system and the Danube in both ways is projected using underwater weirs and artificial fords which should rise the water level in that way that such communication is possible. Hungarian side has opened the river bank upstream of Dunakiliti at three places. Approved construction of underwater weir of height of approximately 2 m will supply this branch system with water and will ensure both ways communication between the Danube and river branches upstream of Dunakiliti.

Condition No. 18 is aimed to secure such a flow in the old river bed which would enable the ground water level to touch the soil horizon and which would prevent the drainage effect of the river. The necessary water level in the river is estimated for discharge of 1300 - 1500 m^3/s. This ground water level was not only reached but exceeded by supplying the river branch system with the high enough quantity of water (in average 40 m^3/s) by discharge in the old river Danube less than 400 m^3/s. Underwater weirs and artificial fords would additionally improve the situation and would interconnect the Danube with the branch system (see Chapter 2).

From the conditions it is clear that the effort of the government is to optimize the whole system as much as possible with the special emphasis to the floodplain area.

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Comments on the Results of the EC Mission September - December 1993

The political interests of both Hungary and Slovakia strongly affected the selected volume and data of the submitted reports. This led to the exclusion of available data/studies and of competent scientists to which the EC experts should have been given access.

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As for the Hungarian side is concerned, it did not grant the data and analyses agreed upon (see page 74).

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The first result of the review reveals that the largely missing or one-sided information does not actually justify the many general conclusions of the two EC reports.

EC experts have had surely much more information and especially experience than the authors of this WWF report (see Chapter 2).

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Based on the year's experience gained from this section of the Danube, other rivers and similar engineering projects, it must be stated that the river diversion and the operation of Gabcikovo <u>inevitably</u> will result in detrimental alterations for the hydrology/biogeochemistry (ground- and surface waters), for the geomorphological processes (sedimentation/erosion) and for the floodplain ecology (diversity of biocenoses and especially adapted species) during the next years in the wetland and adjacent areas. Even though many impacts are not yet visible to the public, they can already be monitored by experts.

The project Gabcikovo - Nagymaros was based on long-term experience in Slovakia, Slovak scientists and on designer's work on the Rhine, the Danube and other rivers. It is necessary to stress that as early as in 1963, a concerted effort was made to examine the so-called territorial/technical consequences of the project, that is the effect of the Gabcikovo - Nagymaros system on the ecosystems of the surrounding area. It was decided that a territorial plan should be drawn up, the aim of which was to resolve the possibility of negative environmental impacts. On the Slovak side, the work was entrusted to Urbion in Bratislava, while on the Hungarian side it was carried out by VATI in Budapest. The study "Biological project of the territory affected by the construction of the Gabcikovo - Nagymaros project", the so-called "Bioproject" was completed in 1976 by Urbion with the participation of the Slovak Academy of Sciences. In 1986 the "Bioproject" was updated.

According to bioproject 1986 update and subsequent re-examinations it was considered in May 1989 that the Dunakiliti weir should channel 350 m^3/s into the Danube on continual basis with the weekly increased flow up to 1300 m^3/s each week, in order to prevent the deposition of fine sediments in the river-bed. Following modifications were also foreseen:

- construction of 7 - 8 underwater weirs
- constructions of weirs in side areas to maintain the proper water level with openings for fish to pass without difficulty
- construction of lowered sections in the banks of the Danube so that when the flow of 1300 m^3/s was put into the Danube, this could flow into the side areas allowing interconnection between the Danube and the arms
- fish-pass in Dunakiliti.

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The monitoring data, as used for and presented in the EC Reports, only partly refer to the most sensible indicators. The experts' conclusions largely underestimate the importance of monitored impacts. By consequence, the experts' recommendations are based on insufficient knowledge, and miss basic facts and ecological needs crucial for the existence of the floodplain ecosystem and the preservation of the groundwater.

This statement is too general without real background in description. **The main indicators of impact** of putting the Gabcikovo hydropower station into operation **are surely surface and ground water levels and flow parameters.** Knowledge of the EC experts (see Chapter 2) and related experts are surely deeper than the WWF independent scientists. It seems that the opposite of the WWF assertion is true. The WWF does not recognize the real basic ecological differences between floodplain and polder, between ground water quality and ground water pollution. It does not recognize the processes of "self-purification" by ground water recharge and riverbed infiltration, differences between poplars and willows, etc.

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***... any further "independent" scientific study or analysis should involve the local, competent but independent experts.** ... the political pressure on science (which exists in the case of Gabcikovo) will never allow a really objective result. It is very much in the interest of scientists that their work be separated from political interests and interpretation.*

One of "further independent scientific study or analysis" written by the "local competent but independent experts" is: FUTURE of DANUBE, Ecological findings, predictions and proposals based on data from the Slovak part of territory affected by construction of the Gabcikovo - Nagymaros River Barrage System, prepared by Holcik et al. [11], (see Appendix).

At this place we would like to confirm, that the mentioned study is really very well done scientific study, relying on the monitored data from the Slovak territory. This report we will comment later.

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A. Evaluation of the Monitoring

Surface and groundwater quality/quantity

The following findings are based on the two EC Mission Reports (4, 5), the Slovak data reports on "Surface and Groundwater Quality" (6) as well as on the first monitoring report on water quality during the filling of the Gabcikovo dam (26 Oct. - 31 Dec. 1992) (7) which WWF could receive in its complete form; thus, this report (7) can serve as a important reference for comparison with the other data provided.

*The given Slovak information (6) loses credibility in interpreting the changes in the aquifer. The analysis is a general torso of results which is **non-representative** of the changes in the groundwater.*

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** Table 2 indicates observation points ("10" and "RU") on the right banks of the river which are not identical to the selected observation wells for the reservoir's impacts, given in Table 4 (Rusovce-Ostrovne lucky "D1-D6");*

In the part 2/2 of the "Surface Water and Ground Water Quality" [H], (see Appendix), there is a map of all ground water quality monitoring objects and a map of extended monitoring of water quality. As examples there are given 60 figures chosen as typical water sources used for water supply. These are of course not identical with wells D1 - D6, which are included in extended ground water monitoring list of objects. The wells S4, 10 and RU have been chosen, because these wells are typical water supply wells. These wells can show the real ground water quality and impact of Gabcikovo upon the ground water quality used for water supply. In the Table 3 of the report [H], there is an example of basic statistics, using supporting software included in database. Explanation to the results is given in the Tables 3.1, 3.2. Wells D1 - D6 are included in the list of objects of extended ground water monitoring. These wells are observation wells with the untight top and they are not protected against the impact from the surface. These wells are used for observation of all parameters described in mentioned report, but they are not representative for microbiological pollution, organic pollution and microelements pollution. EC experts have had access to all data and parameters listed in the report. Hungary has given neither data nor a list of monitored wells, only statement [J] that "Since the diversion of the Danube no significant change of water quality could be ascertained in surface and subsurface water."

WWF is not aware of a fact that some parameters (e.g. microbiological parameters, organic pollutants as air pollution, pesticides, herbicides, organic solvents, etc.) should not be analyzed from short-term pumped water wells and from not protected open observation wells.

WWF's declaration is based on clear misinterpretation of existing data. If WWF had made a professional and scientifically based analysis they would have reached the opposite conclusion.

Water pumped from the drinking water wells are of course very thoroughly analyzed. No toxic chemicals have ever been found in this groundwater. Analyses carried out so far have shown no changes in ground water quality since the start of Gabcikovo more than one year ago.

The observation wells are monitored on a routine basis. Data from this observation network have for many years shown the accidental occurrence of some of these chemicals. The reasons for this difference between data from the clean drinking water wells and the polluted observation wells are that some observation wells are located in areas with known old pollution, e.g. near refinery, and furthermore that some of the water samples and wells have become polluted from the surface and due to improper sampling technique and other manipulation in the well - water level measuring, etc.

The data from the observation wells, referred to by WWF show the same level of concentration as has been recorded in these wells for many years or some accidental occurrence due to pollution from surface. Furthermore, most of the observations used by WWF were made only one day after the start of operation of Gabcikovo - which also clearly

Table 3.1: Extended monitoring - example of basic statistics

Object	Parameter	N	arit. mean	med.	min.	max.	min--max	st. dev.	V .100
Analysed period: 25.10.92-28.6.93 (SKOV, 1993)									
S4	**Object Name: S-4, exploited well of WS Kalinkovo** **Localization: x=1290959,65, y=566105,91, z=129,8, screen=40-80 m**								
	TDS_{105}	10	350,6	398,5	218	393,8	175,8	63,8	18,2
	O_2	15	0,47	0,8	0,2	0,4	0,2	0,241	50,9
	COD_{Mn}	18	0,76	0,8	0,6	0,9	0,3	0,121	15,9
	Fe	18	0,012	0,02	0	0,02	0,02	0,01	79,8
	Mn	18	0,1	0,1	0,1	0,1	0	0	0
	NO_3^-	18	10,14	10,3	7,3	11,5	4,2	1,16	11,4
	SO_4^{2-}	10	42,35	42,2	41,4	42,6	1,2	0,56	1,3
	Cl^-	10	18,98	18,5	17,5	20,4	2,9	0,86	4,5
	PO_4^{3-}	9	0,028	0,05	0	0,05	0,05	0,025	89,4
	fluoran thene	12	0,027	0,04	0	0,04	0,04	0,019	70,7
	benzo(a) pyrene	12	0,027	0,04	0	0,04	0,04	0,019	70,7
	lindan	11	0,025	0,04	0	0,04	0,04	0,019	75,6
	pentachloro phenol	11	0,395	0,05	0,05	0,05	0	0,457	115,6
	PCB	11	0,001	0,001	0	0,001	0,001	0	75,6
	DDT	11	0,013	0,02	0	0,02	0,02	0,1	75,6

Important notice:

The statistical analysis was performed using accompanied software supporting the database (SKOV Bratislava). As it is obvious from the results, organic contaminants should have a very high concentrations.

After investigation of method of calculations it was found out, that the values < X (*"concentration bellow detection limit of equipment"*) were included in the calculations in the form =X *"concentration equal to detection limit"*. Next table shows the real concentrations of organic contaminants measured in the well S-4. There was **no contamination detected concerning these parameters** during analysed period.

This example demonstrates the importance of method how the data are pre-processed for statistics. Using "standard methods" we can instead of characterisation of contaminants calculate the statistics of detection limits of equipment.

Table 3.2: Extended monitoring - real measurements

Object	Parameter (ug/l)	fluoranthene	benzo(a) pyrene	lindan	pentachlorophenol	PCB	DDT
Period of monitoring: 25.10.92-28.6.93							
S4	**Object Name:S-4, exploited well of WS Kalinkovo Localization: x=1290959.65, y=566105.91, z=129.8, screen=40-80 m**						
	limit [CSN]	*0,04*	*0,01*	*3*	*10*	*0,05*	*1*
	Sample: 1	0	0	0	< 1	0	0
	2	0	0	0	< 1	0	0
	3	-	-	-	-	-	-
	4	0	0	0	< 1	0	0
	5	-	-	-	-	-	-
	6	0	0	0	< 1	0	0
	7	-	-	-	-	-	-
	8	< 0.04	< 0.04	< 0.04	< 0.05	<0.001	<0.02
	9	-	-	-	-	-	-
	10	< 0.04	< 0.04	< 0.04	< 0.05	<0.001	<0.02
	11	< 0.04	< 0.04	< 0.04	< 0.05	<0.001	<0.02
	12	< 0.04	< 0.04	< 0.04	< 0.05	<0.001	<0.02
	13	< 0.04	< 0.04	-	-	-	-
	14	< 0.04	< 0.04	< 0.04	< 0.05	<0.001	<0.02
	15	-	-	-	-	-	-
	16	< 0.04	< 0.04	< 0.04	< 0.05	<0.001	<0.02
	17	-	-	-	-	-	-
	18	< 0.04	< 0.04	< 0.04	< 0.05	<0.001	<0.02

document that these chemicals are a result of past activities and cannot possibly have any link to the Gabcikovo hydropower project, especially in the deep horizons.

Altogether, there is so far no sign of changes in ground water quality after the start of the Gabcikovo, except in the Ostrovne Lucky area just south of the reservoir, where improvements have occurred. Nevertheless, the situation is of course subject to continuous monitoring and thorough analysis.

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* *The data shown in the graphical analysis do not correspond to the data structure and frequency of the monitoring in the indicated period and in the respective tables (e.g. while the sampling frequency is once every 2 weeks, the attached respective graphs show much less sampled data).*

The data in Figs. 1 - 60 of the above mentioned report are taken directly from the municipal waterworks. Waterworks have their own structure and frequency of the data monitoring. Extended ground water monitoring data are in the database. EC experts had access to these data.

♣♣♣♣♣

* *The only given example (well S4 Kalinkovo) does not fulfill the demand of a solid documentation of the changes in chemistry and of the element concentration in the observed aquifer on both sides of the Danube. Looking at the monitoring of groundwater quality changes in the first stage of the reservoir filling (Oct. to Dec. 1992), this object was non-representative from the standpoint of specific organic elements. The presented Table 3 does not show the non-polar extractable matter which is part of every chemical analysis and which could indicate with high evidence the degree of organic pollution of the entire area and of all objects.*

WWF should know what it is spoken about. In any analytical laboratory it is well known that non-polar extractable matters are products used in chemistry, agriculture and some of them are air pollutants, others are sprayed over the surface. In the monitored components, the non-polar extractable matter is included as NEL (see Appendix) and stored in database. In the example of basic statistics (see Appendix) there are included some specific non-polar extractable chemicals (PCB, benzo(a)pyrene, lindan, etc.). Some of them could indicate with high evidence also natural sources, e.g. Algae. This cannot be distinguished only by NEL group analysis.

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Table 10 shows the given technical parameters of observation objects having several horizontal levels. It is questionable why the object S4 Kalinkovo was given as model because

S4 has only one, very large horizon (depth of 40 - 80 m), while most other wells have small horizons of only a few meters depth, being much more precise for the indication of changes.

It is stated that the well S4 is one of the continuously exploited wells from the Kalinkovo municipal woterworks. This a model well for real water supply, well closed in a well housing. Production wells have usually a long screen (horizon), piezometers and observation wells have usually short screen and are not protected against pollution from surface and air.

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Data on hazardous organic pollutants and heavy metals are not presented in the supplied documents in spite of their analysis. According to the first monitoring report (7), elevated concentrations of dichlorethen, dichlorbenzen, pentachlorfenol, benzopyren, hexachlorbenzen and lindan were recorded in the surface and groundwater.

In further discussion we would like to inform WWF about some properties of the mentioned chemicals:

Dichlorethen

1,1-dichloroethene (1,1-dichloroethylene) - limit (CSN): 300 ng/l.
Uses: adhesives; component of synthetic fibers.
Pollution of air. In rural Washington, Dec. 74 - Feb. 75, ground level concentration: < 5 ppt.
Waste water treatment: half life for evaporation from 1 ppm aqueous solution at 25 °C, still air, average depth of 6.5 cm: 27.2 min.

1,2-dichloroethene (1,2-dichloroethylene)
Uses: solvent for fats; additive to dye and lacquer solutions; constituent of parfumes, thermoplastics.
Waste water treatment: half life for evaporation from 1 ppm aqueous solution at 25 °C, still air, average depth of 6.5 cm: 19.4 - 24.0 min.

Dichlorbenzen

1,2-dichlorobenzene - limit (CSN): 300 ng/l.
Uses: solvent; dye; fumigant and insecticide; metal polishes.
Water quality:
- in river Maas (The Netherlands): average in 1973: 0.13 μg/l.
- in Zürich lake: 16 - 26 ppt.
- in tap water (Zürich): 4 ppt.

Waste water treatment: degradation by bacteria Pseudomonas.

Pentachlorfenol

Pentachlorophenol (PCP; penta) - limit (CSN): 10 μg/l.
Source: organic chemical industry, pesticide, agricultural runoff.
Uses: insecticides, algicides, herbicides, fungicides, preservation of wood and wood products.
Biodegrability: decomposition rate in soil suspension > 72 days for complete disappearance by bacteria Pseudomonas.

Benzopyren

Benzo(a)pyrene - limit (CSN): 0.01 μg/l.

Source: coal tar processing, petroleum refining; coal, coke, kerosene processing, heat sources;

natural sources - synthesized by various bacteria, e.g. Escherichia coli,

- by algae Chlorella vulgaris,

man caused: combustion of tobacco, fuels, present in gasoline, used motor oil, tar.

Pollution: Emission from typical European gasoline engine, combustion of fuel oil, natural gas, domestic heating Budapest (1966) 74 ng/m^3 of air.

Degradation: microbial biodegradation to CO_2, transformation by soil micro-organisms.

Brussels sand aquifer water: < 0.4 ng/l

Danube water in Ulm Germany: 0.6 ng/l

tap water Germany (1968): 0.5 - 4.0 ng/l

Treatment: chlorinating: 0.3 mg/l of chlorine by 1 ppb - 92 % reduction in 2 hours

ozonization

mechanical and biological purification.

Hexachlorbenzen

Hexachlorobenzene - limit (CSN): 10 ng/l.

Source: organic chemical industry.

Uses: wood preservation, fungicide, seed treatment, impregnation of paper, herbicide, pesticide.

Degradation: by bacteria Pseudomonas.

Lindan

Lindane (gama - hexachlorocyclohexane) - limit (CSN): 3 μg/l.

Use: medicinal mfg. (scabicide); insecticide mfg.

Biodegradation: anaerobe bacteria up to 90 % degraded in 4 days, transformed to chlorine-free metabolites.

75 - 100 % disappearance from soils: 3 - 10 years.

We would like to stress that the hydropower plant is producing electricity and surely it is not producing all the products of organic chemical industry and emissions from cars, houses, combustion plants, agrochemicals, etc. which all can enter the water in observation wells and the samples during sampling the wells.

The Gabcikovo hydropower station and the whole system is not producing these chemicals and is not polluting surface, soil, water, air, etc. with these pollutants. Why there is not a word against production and use of these pollutants in any of the WWF reports? (see "PRESS" in Appendix). Why WWF is not involved in improvement of water quality of water supply in Budapest for 2 million people (see page 79)?

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Data on selected sampling points and selected water quality parameters are presented in ref. 6. It is not explained why these points and these parameters have been chosen and why only example of statistical evaluation is presented. The important criterion for the impact assessment are the selected sampling points, for those are the most sensitive to the changes in water quality. The selected parameters also have the largest temporal variations and the *most significant impacts on environmental health. This has to be documented before the conclusions about "insignificant impact on water quality" can be made.*

The whole database containing thousands of data was to disposal to the experts. There was given a list of localities and observation points, list of analyzed chemicals and an example how the data could be elaborated on the spot, without delay. Except this, the reports prepared at the Centre of Monitoring were to disposal in Bratislava. **Impact of Gabcikovo on ground water quality in Slovakia after one year of operation is INSIGNIFICANT.**

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According to drinking water standards (in Slovakia CSN 75 7111 approved: 1989, CSFR) important physical and chemical indicators such as heavy metals (Cd, Pb, Hg, Cu, Zn), other trace inorganic elements (Ba, Be, Cr, Ni, Se, Ag, V) and many organic indicators (dichlorbenzen, dichlorethen, pentachlorfenol, hexachlorbenzen, lindan, PCB etc.) are important. Such pollutants can be dangerous even at very low concentrations, especially if they act in combination. Their effect on health is still not fully understood. Some of them tend to accumulate in sediments and later, under changing conditions of the water regime and the water quality, they can be released and migrate to groundwater reservoirs. This phenomenon is called an "environmental time bomb" because of its retardation and accumulation effect.

This is a very general statement. This is well known from various heavy polluted rivers. Special reports and survey have been elaborated. Review of all reports and a new evaluation of sediments is given in [24] prepared in framework of PHARE program (see Chapter 1.6).

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Unfortunately, any data and any discussion which would enable the evaluation of this environmental hazard could not be found in the documents. The data in (7), and previous data known about organic pollution of bottom sediments, indicate that a potential danger is real. *However, the data are not complete enough to make any definite conclusions. From the biogeochemical point of view,* ***the data on pollution*** *of heavy metals, other trace inorganic elements and organic pollutants of bottom sediments, alluvium sediments, surface water and groundwater* ***have to be presented <u>in full</u> before any scientific conclusion can be made as regards to the impacts of Gabcikovo dam on the water quality.***

The data are complete enough to conclude that **alluvium gravel and sediments are not** polluted and surely less polluted than in other European rivers. Exception is hydraulically protected area of Slovnaft's refinery. The data in (7) - organic pollution - e.g. benzo(a)pyrene, lindan, etc., were found in deep horizons in observation wells.

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The properties of sediments can vary considerably. It would be very helpful to know distribution coefficients of organic compounds between water and the sediments as well as experimental data on the ability of the sediments to yield the pollutants to groundwater.

The distribution coefficients are known, experimental data exist [24].

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* *It is not evident why the data are not available for independent evaluation. If it is proved by interlaboratory validity tests that the data are correct, it should be possible for a small team of independent hydrochemical, hygiene and medical experts to evaluate the impact of the Gabcikovo dam on water quality and on consumers of the water.*

Data have been available and they are available for any kind of independent evaluation. Interlaboratory tests have been done, international experts have taken part at sampling, analyzing and evaluating processes. EU experts knew about it very well (see page 74).

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* ***A review of the originally monitored data together with a control sampling and analysis should be made by an independent expert team and not by parties involved in this difficult dispute.***

The party, most involved politically in this dispute, is WWF. Review on control sampling has been done.

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* *Unless the Working Group, which produced this report, had other data available, we do not think that the data are adequate to justify their conclusions.*

In opposite to WWF, the Working Group has had all necessary data and all existing data to disposal. Except this, the experts know the territory very well. According to our opinion and opinion of the experts, the monitoring system and data are adequate to justify the conclusions.

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Flora and Fauna (incl. Forestry)
The Report sections and conclusions dealing with this topic reflect the poor data base which was provided by Slovakia and Hungary for evaluation. Even though a more profound

scientific data base exists, the best available knowledge, data and experts were not involved in the evaluation.

There exists a huge database for flora and fauna and WWF knows very well about it. The database consists of following items (for more information see Appendix):

Soil

Monitoring is carried out at 20 monitoring areas twice a year and at 10 monitoring areas once in 2 years.

Forestry

Monitoring of forestry is carried out at 24 monitoring areas.

Biota - Flora and Fauna

Flora and fauna are monitored at 13 monitoring areas.

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*The **Hungarian report** is insufficient to give any sound statement or conclusion. Large losses in fish biomass and the visible, critical state of the floodplain forests are a remarkable indication of the changed situation. However, these and other indicators are not properly documented and interpreted.*

The situation just after damming the Danube is described in the EC expert report [B]. Yes, the loss of fish biomass was documented. Critical state of the floodplain forests was documented too.

WWF should read e.g. in report [B] "The operation of Variant C has influenced the Danube seriously". ....."This causes a huge immediate damage to all water organisms especially those living in the side branches, e.g. fish and bentic organisms (mainly the mussels)", etc.

Similarly, the situation is described in [H].

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***The Slovak report and the reference list do not contain the very important Slovak monitoring studies or species databases which were produced in the Slovak floodplains over the last years** (especially by the Institute for Ecosozology at the Slovak Academy of Sciences). However, certain details in this report are obviously taken from this monitoring.*

The Slovak report rely upon the mentioned database and older studies. The work of the Institute is well known. Summarizing report [11] (see title page in Appendix) was written i 1992 for the Hungarian organization Ister, involved in the politics around the Danube. Indeed, why the Hungary has not used this report during EU experts' work?

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The authors overestimate the detrimental impacts of the decreased water levels in the last decades ("disappearing of the whole nature biocenoses") and are far too optimistic regarding ecological benefits for the forests through the simulation of floods.

This phrase about overestimation of impact of water is in contradiction to the real high ground water level and dynamic character of water regime in real floodplain which ecosystem needs. This is well accepted scientific knowledge. Floodplain without high enough ground water level and without some flooding of some part of inundation is not a floodplain of 'Au' type but simple 'polder' with stagnant water or without water, with all ecological consequences. Floodplain even requires disturbances to maintain their resilience. We would like to stress that more than 90 % of all forests between Bratislava and Györ were changed to lignoculture of cultivated poplars which have created transformation of the whole previously original vegetation which is now influenced by synantrope and neophyte weeds. Forests are no longer natural but compensated substituted economical forests aimed to produce fast growing woods. Natural forests on the Slovak side have been degenerated by drying up because the ground water level decreased. This is simple a fact visible for example downwards from Bratislava.

WWF should at least read the well known studies of mentioned Institute or at least few quotations in following text (pages 103 - 109).

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The study lacks a more thorough, critical evaluation of the newly constructed lateral dikes (cf. chapter B) in Slovak floodplains and of several important indicator groups other than forests (e.g. birds, beetles, mammals and molluscs).

In the Slovak floodplain, there have not been only recently constructed lateral dikes. Lateral dikes have been re-constructed from previously used lateral structures (see Chapter 2.2.2, page 54 and [29]) with the goal to ensure the proper water level for average discharge of 40 m^3/s, to ensure water level and discharge fluctuation and to ensure interconnection with the Danube using e.g. underwater weirs. Some improvements as fish passages (not fish ladders) are still under construction.

Indicator groups other than forests are included in Slovak report [H] - FLORA, FAUNA AND FORESTRY - English version, Chapter III.

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WWF learned that a special ichthyological prognoses study on the impacts of Gabcikovo was ordered and submitted in the summer of 1993 to the relevant Slovak authorities. However, it did not become part of the Slovak or the EC reports.

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Because of supplying the Danube with average discharge of 400 m^3/s over a length of 40 km with high enough velocities this prognoses are doubtful and dubious. Except this, the old river branches are supplied with running water. A large part of measures is not ready yet, especially the interconnection between the Danube and river branches should be realized. This is delayed because of decisions of the Hungarian Parliament.

The goal of the EU report was an "Assessment of Impacts" based on measured data and not to discuss old prognoses. Mentioned prognoses are studied to undertake such steps and measures that the unfavorable prognoses will not happen or will be minimized. The next goal of the EU experts was to discuss and recommend appropriate measures. In [G] it is written "In order to provide reliable and undisputed data on the most important effects of the current water discharge and the remedial measures already undertaken as well as to make **recommendations for appropriate** measures the Republic of Hungary and the Republic of Slovakia will establish a Group of Monitoring and Water Management Experts."

*****

The Slovak report is incorrect in stating that the decrease of surface and groundwater levels were only caused by river bed regulation and the construction of upstream hydrodams. The huge impacts originating from Slovak and Hungarian gravel excavation are ignored.

In the Slovak report [H] **there is exactly written: "Long-term hydrological development of the region in the past was influenced by:**
- **river regulations, straightening of bed, closing and raising unnaturally the entrance thresholds of previous meanders and river branches** (this was the first impact dated back in previous centuries),
- **exploitation of sand and gravel** (this started in this century),
- **construction of river dams upstream altered the bed-load balance,** etc. (this is recent and present situation).

The result is the higher flow velocity in the Danube, diminishing of the bed-load transport via Bratislava and increasing the river bed erosion. Investigation showed the substantial deepening of the river bed and the trend to further erosion of the river bottom. This caused a long-term lowering of the level in the Danube which resulted also in long-term lowering of ground water levels."

In the **EC Data report** [E] **there is written: "The main channel has been significantly lowered due to erosion caused by a combination of several man made factors:**
- **dam construction in Austria** in the last decades resulting in a sediment (in particular bed load) deficit;
- **excavation of gravel;**
- **bed erosion due to the very high velocities** in the straightened and narrowed navigation channel; and
- **prevention of bank erosion** due to fortification of river banks.

WWF is in contradiction to all EC, Slovak and Hungarian reports. Why? Why the independent nonpolitical WWF is informing the whole world with false and decisive information? What is WWF aiming at?

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There is no comparison with other intact floodplain ecosystems (e.g. the Danube upstream of Bratislava) or with floodplains damaged in the past by other hydroschemes (the Danube upstream of Vienna, the Rhine downstream of Basel, the Rhone etc.) from which the state of the floodplain ecosystem prior and after the Danube diversion could be better compared and estimated (cf. page 65: Hügin 1981). Then it would have been possible to give a better prognosis than the authors did.

There is really no comparison with the floodplain ecosystems upstream of Bratislava, because between them there exists granite thresholds interconnecting the Alps and the Carpathians. There it is no comparison with other hydropower stations on the Danube because only Gabcikovo is saving floodplain over a length of 40 km and is not channeled river with uniform cross-section (except lateral power canal). Only in Gabcikovo the floodplain on the Danube river branch system is supplied with running water and is not creating polders with stagnant or nearly stagnant water behind levees. Also diversity is increased and not decreased in comparison with pre-dam conditions. Cascades and discharges in the Rhine (15 m^3/s) are not comparable with discharge (400 m^3/s in average) and underwater weirs or artificial fords. References to Dister (1988), Hügin (1981) and Seibert (1975) are given in the Slovak report [H], pp. 62 - 64.

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It is not clear how 'a considerable part of biotopes' will 'gradually turn by successive way to 'original state" (at the end of the 50's), if only some forest plantations, an increased water level and a watering of the side-arm system will be provided for the floodplain area.

The crucial importance of the open connection with the floodplain side-arm system is largely ignored. There are no comments on the changed nutrient input and exchange when discussing the artificial water input from the canal in comparison to the natural situation at the end of the '50s.

WWF should read at least condition no. 11 prescribed by the Slovak Environmental Commission. In the Slovak separated report [C] there is stated:
The Danube has been changed during the centuries by embankments, river straightening and regulation to allow for shipping (Fig. 1.4). Man has largely changed the boundary conditions, e.g. by closing the river branches and dikes across the branches. Water management has therefore to reckon with the natural dynamics and may even be forced to copy and support natural processes. The biodiversity which was monotonized in the past is to be recover to reach the variety in abiotic - especially water and moisture regime conditions.

In the chapter "Possible Remedial Measures" there is written:

- **to re-open the fortifications and thresholds on the river branches** (Fig. 1.4) **intakes and to re-open the river branch system**
- **to make some shallow underwater weirs in the Danube to ensure the flow into the river branches**
- **to use the Dunakiliti weir for the water level and ground water level optimization**
- etc.

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We would like to add some ideas. Since the beginning of 1950's, extensive research to inventory of biological diversity of the territory along the Danube river has been carried out. Results indicated, that natural floodplain forest of the Danube was replaced by cultural forests (plantages) of introduced cultivars of poplar (Populus euramericana, cv. Robusta, cv. I-214, and others), with special forest management. Introduction and invasion of several aliens (e.g. species of the genera Solidago, Aster and Impatiens) have changed the character of the forestry. Other changes in wildlife and autochtonous flora were caused by water management and structures, preventing fast flooding, preventing the flow of water in river branches, changes of water quality (oxygen conditions) in river branches, etc. (Fig. 1.5).

As a result of ground water decrease in the area summer oak and narrow leaves ash die out. Instead of original wet hard wood species came black, gray and white poplar, willows and alders. In the 20th century, the soft and transient inundation forest changed into cultivated poplars and Salix alba. This problem is most evident under Bratislava, where until now ca 500 ha of forests have already dried (Fig. 1.13).

Since 1985 the research activity has been concerned upon the definition of the biological diversity in the territory. Conclusions of these studies and other related projects resulted in formulations of requirements, for minimizing the negative effects of the construction and operation of the hydraulic structure on the living organisms, biocenosis and ecosystems in the influenced area. Based on these results, some adjustments in the design of the structure were elaborated. General ecological requirements prescribed by the Slovak Environmental Commission (Ministry of Environment of Slovak Republic) are based on these studies (e.g. the so-called "Bioproject").

The WWF is probably not aware of the following single facts:

- Without inundating the floodplain and without continuously flowing water in the riverside areas and branches, there is no nutrient input
- Nutrient input consists of components in solution and of suspended forms. There is no reduction of content of components in solution in water from the canal. Nutrients in suspended form are bound on the smallest suspended particles. Only the largest suspended particles are settled in reservoir (60 %). The general reduction of suspended nutrients is therefore between 20 - 40 %, but amount of water and the general sum of nutrients is much larger than by pre-dam conditions.

In Hungarian Data report there is written that in the old Danube measured downstream from the damming the Danube in Rajka and Dunaremete, virtually the same sediment concentration levels have been found after the damming as compared to the pre-dam conditions.

Except this, the Slovak side is interested in re-opening the connection between the Danube and floodplain and using underwater weirs and fords to ensure both the way interconnection and flooding the inundation.

During the flood the sediment concentration will be similar as in the pre-dam conditions, therefore the floodplain will be supplied with nutrient input similar as in 1950s.

*****

The estimation, that the needed floods can be simulated from the Dobrohost intake structure of the Gabcikovo canal and that this can recreate the hydropedological situation of this territory at the end of the fifties, ignores all available data and experience about such artificial measures from the Rhine and Upper Danube; it is far too optimistic (cf. chapter B).

There are differences between the Danube in the Gabcikovo reach and the river Rhine. The differences are as follows:

- in the upper Danube there is the floodplain changed by hydropower structures from the typical 'Au' (through flowing) into 'Polder' type (stagnant water). Therefore Gabcikovo is not comparable with mentioned upper Danube's measures. From the qualitative and ecological point of view, there are two completely different types of floodplain. The differences are:

	Au	Polder
Water	flowing v > 0.1 m/s	standing v < 0.1 m/s
Oxygen	oxygen rich	without oxygen
River arms bed	permeable	impermeable -colmated
River bed	sand, fine sand	fine sand with organic matter
Flooding	1 - 3 times per year with flowing water	no real flooding and if, then no flowing water
Ground water	oxygen conditions	reduction conditions
Amonium	no	yes
Iron	no	yes
Mangan	no	yes
Organic matter	little	much
Evaporation/infiltration	infiltration > evaporation	infiltration < evaporation
GWL fluctuation	yes	no

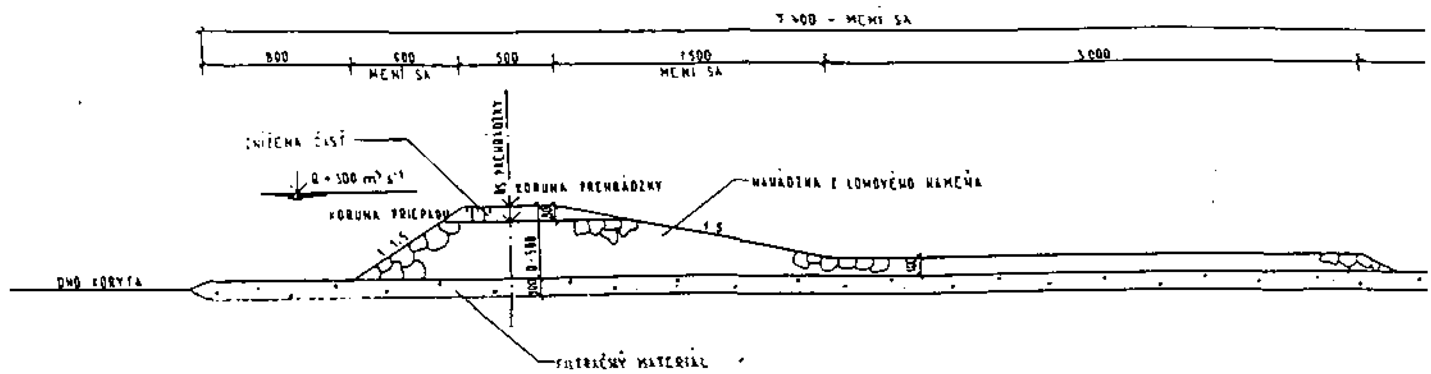
- in upper Rhine discharge in old river is much smaller than at Gabcikovo (only 15 - 30 m^3/s). Except this, in the Rhine there are realized instead of underwater weirs (Fig. 3.1) the transverse barrages (Fig. 3.2).

*****

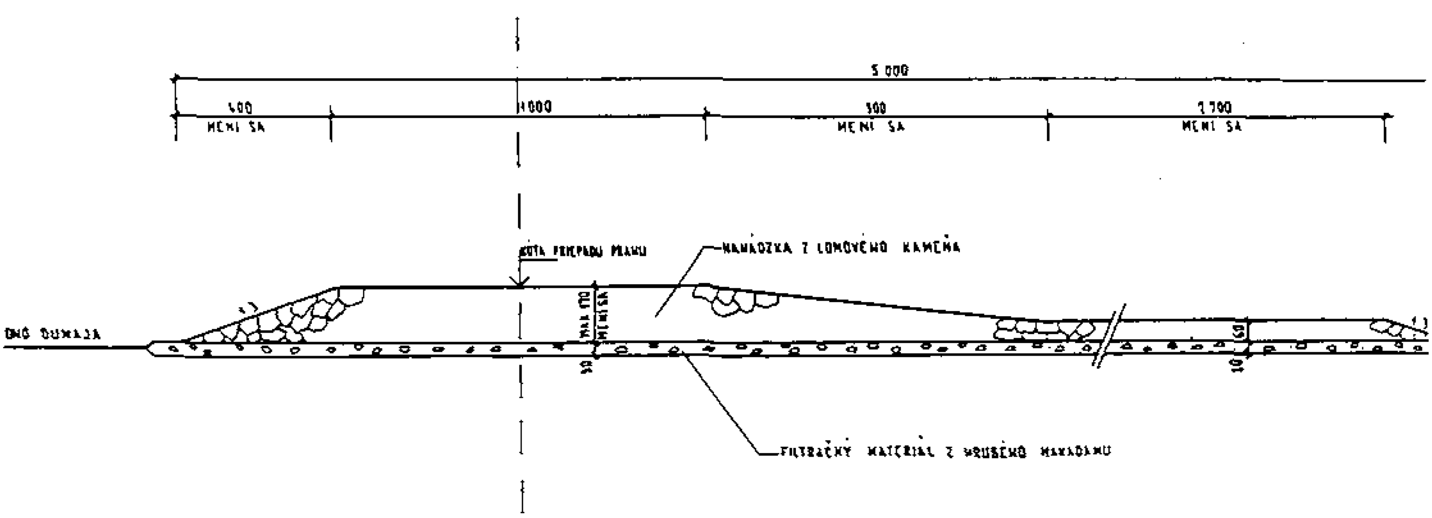
The given example used to "prove " the restoration of soil moisture due to the Gabcikovo scheme, while comparing the mean losses of leaves in August 1992 and 1993, is actually unfair:

* *August 1992 was a very dry period, as even the Slovak authors stress.*

Underwater weir - longitudinal cross-section



Artificial ford - longitudinal cross-section



Transversal cross-section of artificial ford in rkm 1836.6

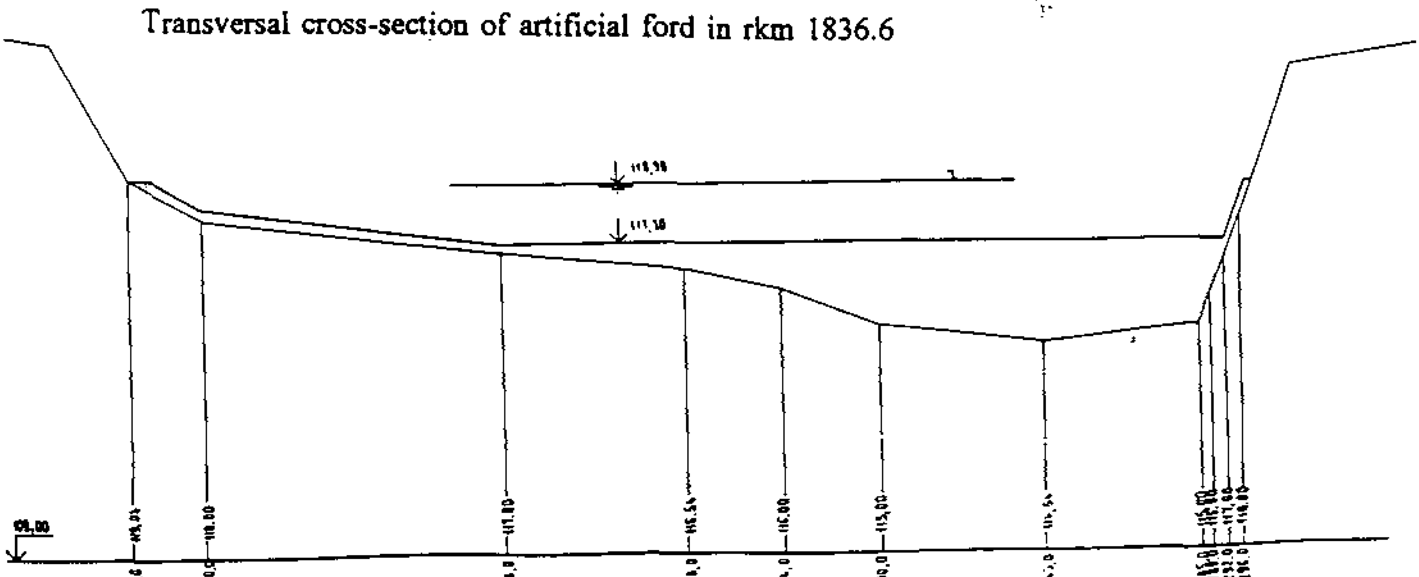


Fig. 3.1: Underwater weir and artificial ford

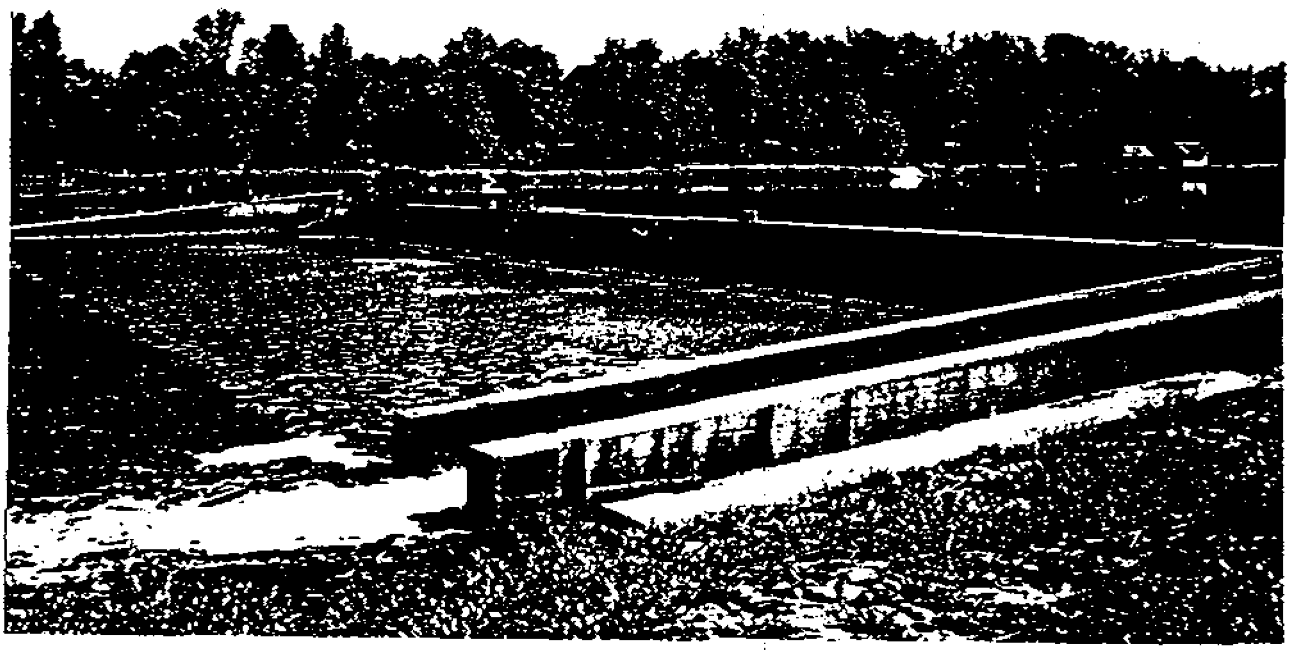


Fig. 3.2: Transverse barrage on the Rhine

* *In other locations (rather than the quoted Cunovo/Rusovce area) especially along the Danube up- and downstream from Dobrohost, the groundwater level was not raised, but lowered by up to 2 meters due to the river diversion: there, not positive but damaging effects in the floodplain forests can be found in 1993, as compared to 1992.*

It is well known that the years 1992 and also 1993 were dry. Differences between these two years could be seen from precipitation (in mm per month) and this could be compared with long-term monthly averages in the period 1951 - 1980 (A) and 1981 - 1990 (B).

Locality SAMORIN:

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1992	24	10	62	17	16	93	32	0	44	57	65	59
1993	29	23	11	20	25	48	64	49	42	65	67	66
A	37	33	34	42	51	71	69	54	34	39	51	40
B	43	43	30	23	52	52	39	56	50	33	43	49

Locality DUNAJSKA STREDA:

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1992	17	5	51	22	20	121	78	2	36	56	46	80
1993	27	18	15	8	15	33	59	36	39	96	68	80
A	29	31	31	42	48	63	68	55	36	40	53	38
B	34	38	32	27	51	48	34	69	41	35	42	39

We would like to remind to the WWF that **for willows and similar woods which are growing on accessible ground water level do not exist dry years or periods.** Metabolism of such plants does not depend on precipitation.

Slovak Data report is based on data from Slovak territory. We have to confirm that downstream from Cunovo (it means from Dobrohost to Sap at the Slovak floodplain area) **ground water was really raised and not lowered as it was stated in the WWF Statement** (see Chapter 1.4.2). So at the Slovak territory there is a positive and not damaging effect. The increase of ground water level in this area can be influenced by water levels in seepage canals, in the Danube and in river branches. Bottom permeability can be influenced by discharge in river branches. Therefore the intake structure is constructed to yield the amount of up to 243 m^3/s.

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Another example is the strange comparison of Aranea species diversity of the very wet, morphologically dynamic Danube inland delta with the xerothermal, stable Jur peat-bog: spiders are no indicators for floodplains because they prefer constant habitat conditions; second, the peat-bog (Carici elongatae - Alnetum) is not a floodplain ecosystem.

The same applies for the example of butterflies. For floodplain biotopes, such a comparison would be much more appropriate using e.g. beetles (Carabidae, Staphylinidae).

In the Slovak report the Jur peat-bog is mentioned only as example for comparison of intensity of research and number of data to disposal.

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The report does not address the problems of the important Istragov side-arm area (upstream of Palkovicovo) which is, as yet, not supplied by artificial water input (a new canal is planned from Gabcikovo power plant!) and has therefore been drying out, since the Danube was diverted in fall 1992.

Istragov area is going to be supplied with water. Interconnection with output canal is under construction.

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... to reconnect the side-arms with the main river even though this is partly recognized as absolutely crucial for the survival of the biocenoses, especially the regeneration and migration of the fish fauna.

This is the Slovak proposal and some of fish passages are under projection and construction. Small underwater weirs or artificial fords are necessary to make this interconnection real. See e.g. the ready made openings upstream Dunakiliti on the Hungarian territory. But this is only possible because the inundation in the area of hydropower structure is intact, what is not the case upstream of Bratislava.

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... the monitoring data could have given many more results than the <u>EC Report</u> has referred to. It is not clear why its summary assessment of impacts ignores the visible damages in fish fauna, forests and habitats. The early general conclusion that the forestry

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has been positively influenced in Slovakia must at least be doubted, especially when looking at the slow reaction of forests to changed environmental conditions.

In the report [B] all visible damages are described e.g. on page 25. "In addition, the operation of Variant C has influenced the Danube seriously. There is a reduction of the discharge for a reach of about 40 km downstream the dam to an extreme low level, which is considerably lower than the ever recorded minimum. In connection with this flow velocities and water depths decreased to unnatural values and most side branches (about 100 km) dried out."

"This causes a huge immediate damage to all water organisms especially those living in the side branches, e.g. fish and benthic organisms (mainly the mussels). The remaining shallow waters fail as spawning grounds. If the situation as described above will continue until the beginning of the vegetation period most of the fauna and flora depending on floodplain ecosystem conditions will be heavily damaged and may have resulted in the loss of essential portions of populations and thus in reduction of genetic diversity and thus adaptability. This especially concerns the four areas that are already protected or are proposed to be protected as nature reserves."

The general conclusion that Slovak forestry has been influenced positively issues from visiting the area and from the fact of increase of ground water level over the whole area, where previously in pre-dam conditions a long-term decrease of ground water levels was recognized. Slow reaction of forest is by slow general lowering of ground water level. By sudden increase of ground water level, there is sudden re-vitalization of forest and bush (Fig. 3.3).

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The suggested monitoring program will help to provide a clearer picture if it will be financed and really executed. This, however, is anything but certain in both countries.

Monitoring program is running. Some suggestions written by EC experts to improve existing monitoring have been accepted and are going to be paid not by EC as promised but by Slovakia. Generally, **Slovak monitoring is described by EU as "adequate".**

At the end of the chapter Flora and Fauna (including Forestry) we would like to inform the WWF about the work of **"Institute of Zoology and Ecosozology, Slovak Academy of Sciences"**. This is the proper title of the institute mentioned in this chapter. The most important report prepared by this institute is the report prepared for The East European Environmental Research Institute in Budapest which is directed by Janos Vargha, who is the laureate of alternative Nobel award for biology. The report is entitled **"FUTURE of DANUBE. Ecological findings, predictions and proposals based on data from the Slovak part of territory affected by construction of the Gabcikovo - Nagymaros River Barrage System"**, edited and written by Juraj Holcik with contributors [11] (see title page in Appendix). **This is the most important report evaluating the Gabcikovo - Nagymaros project area from the ecological point of view, including special evaluation of flora and fauna (including forestry).** Following text is only a short sample of direct quotation.

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Fig. 3.3: Revitalization of forest

"The present number of fish occurring here amounts to 52 native and 13 introduced species. The impact of man, such as hydraulic engineering measures and overfishing eliminated such species as *Huso huso, Acipenser stellatus, A.nudiventris,* and also the migrating race of *A.gueldenstaedti* from this stretch of Danube. **Deepening of the Danube bottom during past three decades and the subsequent change of the floodplain hydrology are the main reasons of the decline of some, particularly phytophilic species** (*Cyprinus carpio, Abramis sapa, Carassius carassius, Scardinius erythrophthalmus, Tinca tinca*) **and some of them are facing the danger of extinction** (e.g. the native wild carp). **The last evaluation of the conservancy status of the fishes in Slovakia** (Holcik 1989), [19] **shows that most threatened fish species is just from the Danube river."**

"Since the mid of 1970's when the Danube river was heavily polluted by waste waters from petrochemical works (Holcik et al. 1981), [20], **the situation significantly improved.** The **purification stations in Vienna, Schwechat and in part also in Bratislava were put in operation and also the Slovnaft petrochemical work in Bratislava is now protected by the hydraulic blanket. Due to this the fish species which were not recorded in the Slovak - Hungarian section of Danube for about 20 years, started to appear again.** The fish killings were not recorded in this stretch of the river and the **fish caught directly in the main channel have lost their pronounced phenol taste and other odor and now are palatable.** Concerning the **nutrient content** it seems, that its amount shows the **decreasing trend during past years.**"

"The following types of forest growths are to be found in the Danube floodplain:

a) soft floodplain woods (assoc. *Saliceto - Populetum*), with home species predominating - willows (*Salix alba, S.fragilis*), in a lesser measure poplars (*Populus nigra, P.alba*) and alders (Alnus glutinosa, A.incana). A characteristic feature is the high GW (up to 1.5 m) and repeated floodings, or at least overflow of the surface. The most valuable are spatially restricted swamp growths of old, purely vegetatively renovated willows;

b) mixed floodplain woods (assoc. *Fraxineto - Populetum*). They represent the most productive forests, well supplied with GW during the vegetation period and are regularly flooded and enriched with sediments. In the original growths, poplars predominate (*Populus nigra, P.alba, P.canescens*), ash trees (*Fraxinus excelsior, F.oxycarpa*), racemose birdcherry (*Padus racemosa*), elms (*Ulmus leavis, U.carpinifolia*), but there are also alders (*Alnus incana, A.glutinosa*) as also willows. At present, the species composition is strongly altered through land use oriented to a monoculture of improved Euro - American cultivars in which strains "I-214" and Robusta" predominate. Such growths are strongly homogenized as to structure and species, with consequences for the functioning and stability of the ecosystems strongly invaded by weeds of the expansive species goldenrod (*Solidago gigantea*) the starwort (*Aster* sp.). As to trees, the species the box-elder (*Acer negundo*) spreads expansively. In parts of the present growths of the mixed forests in the floodplain we may note a shift of certain characteristics towards more xerophilic types, which is locally evident in desiccation of popular monocultures;

c) hard floodplain woods (assoc. *Ulmeto - Quercetum*). The ground water in the original forests lies deeper, below 2 - 3 m but during the vegetation period it can rise up to the root system. Dominant timbers are *Quercus robur, Fraxinus excelsior* and *F.oxycarpa, Ulmus laevis* and *U.carpinifolia*, with admixtures of *Populus alba* and *P.nigra*. The species composition of the growths is somewhat adversely altered by the share of nonoriginal, economically exploited timber species (*Robinia pseudacacia, Juglans nigra, Ailanthus glandulosa, Acer pseudoplatanus*), as also by a change in the prevailing site conditions. These are for the most part affected by a drop in the water table down to the gravel floor (in places to a depth of 8 - 9 m) as a result of deepening the Danube bed and interventions into the regime of GW. This becomes manifest in growth cessation, transparency of tree tops, drying up of trees and in places in a complete destruction of forest;

d) forest-steppe associations of the Danube brambles growth (Assoc. *Crataegeum danubiale*). They represent restricted associations midway between forest and nonforest phytocoenoses. They occur at sites where the gravel subsoil outcrops to the surface relief and vegetation is dependent on precipitation. They are noted for a loose connection of trees and bushes passing into forest-steppe and open spaces. The dominant species are *Quercus robur*, *Fraxinus* sp., *Ulmus* sp., *Crataegeus monogyna* and others."

"The forests in the floodplain were dramatically altered during past 50 years or so. Only remnants of original both soft and hardwood forest growths now exist within the limits of the inland delta of this stretch of the Danube. The total area of forests now amounts to 14000 ha, of which **90 % are represented by introduced poplar plantations composed of highly productive North American cultivars. Except of small parts of forests between Gabcikovo and Palkovicovo, their majority is negatively affected by the water level decline of the Danube river caused by its bed erosion. In the mid of 1970's when the Danube bed in Bratislava decreased by 1.2 m (due to dredging) the subsequent ground water drop resulted to drying of 400 ha of forests within one year."**

"Communities of beetles (Carabidae and Staphylinidae) in the inland delta consist predominantly of the strongly or moderately hygrophilous species."

"The majority of carabids and staphylinids inhabiting the inland delta of the Danube is strongly endangered in regard to their stenotopy, high need for moisture and specialization on the wetland or river-bank habitats."

"Intervention into soil fertility resides in the assumed change of the GW by the RBS Gabcikovo on the greater part of the affected territory. **At the present time, the favorable water regime of soils is conditioned by the level of underground water 0.5 - 2.5 m below the surface** on an area of some 70 thousand ha of agricultural soil, **primarily in the central and eastern part of Zitny ostrov,** representing about 70 % of the total original area of the relevant territory. Some 7 thous. ha are humid areas, the rest (the western sector - or the Upper Zitny ostrov) has water deep below the terrain. **On areas with a favorable water regime, plants moisture needs are covered up to 15 - 65 % with underground water.** Works by Fulajtar and Jambor (1983), [21] imply that **underground water in this area increases wheat crops by 23 - 60 %, maize for grain by 12 - 36 % and sugar beet by 4 - 41 %. In the Upper Zitny ostrov, underground water lies deep below the terrain with gravel and sandy soils and is inaccessible for plants. Moreover, the ongoing long-term decline of the water table (since 1960) as a result of erosive processes in the Danube river bed near Bratislava absolutely rules out any utilization of underground water by plants in this part of Zitny ostrov before the construction of the river barrage system."**

"The original project of the Gabcikovo - Nagymaros River Barrage System (GNRBS) **was repeatedly modified during the course of construction primarily due to pressure on the part of ecologists.** The changes concerned principally the quantities of water to be let into the old channel of the Danube and into the left-bank floodplain. Several projects were elaborated which attempted to ensure a higher level in the old channel and in the present floodplain between r.km 1811 and 1842, demanded by ecologists, with the aid of dikes or

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rocky weirs (in the old river bed), or dams and cascades with a controllable level (during inundation), with a minimum diversion of water from the reservoir, or the diversion canal."

"Later the project was altered so as to permit water to be fed through the diversion canal from the reservoir into the arms of the floodplain. In the first case, the present-day arms systems would for the most part disappear immediately the main channel would be dammed, due to the drop in the water table."

"The project was supplemented only during the course of construction with a facility for taking off water directly from the diversion canal above the village Dobrohost, with a maximum capacity of 234 m^3s^{-1} . With the aid of this facility, the present inland delta is to be supplied with a steady flow (20.0 - 30.0 m^3s^{-1}) a periodically increased, or a flood flow (max. 234 m^3s^{-1}). The inundation territory is to be divided by low transverse dikes into seven sectors with a cascade-like graded, controllable height of level (Szolgay et al., 1985), [22]. In subsequent projects, elaborated at the Hydraulic Research Institute in Bratislava, **the water supply regime of the floodplain was revised and made more precise with proposals for ensuring connection of both ends of the arms with the old channel,** which was not foreseen in the original project."

"The principal criterion for preserving the existing communities of aquatic organisms settling the arms systems is to ensure a mutual dynamic interaction of waters in the old channel and the arms systems."

"Conditions in the inland delta similar to those prevailing prior to the start of construction work on the HPS Gabcikovo, although artificially created, could probably be obtained by the realization of the so-called feedback regime, but solely on condition the dynamic interaction between the main channel and the waters of the inland delta is successfully simulated, with the preservation of the natural seasonal fluctuations and speed of flow at the original."

"The original project of GNRBS planned to feed the abandoned (old) channel in the sector of r.km 1842 - 1811 solely with seepage waters from the reservoir (about 50 m^3s^{-1}) and after the seepage had decreased, by letting 50 m^3s^{-1} from the reservoir through the Hrusov - Dunakiliti weir. Later, proposals were accepted for increasing the volume in the old channel from the reservoir (to 350 m^3s^{-1}) and several projects were elaborated that would ensure the level corresponding to the flow up to 1300 m^3s^{-1}, letting out 350 m^3s^{-1} of water through the weir (weirs, dikes, or raised bottom thresholds at sites of present-day fords)."

"Preservation of communication between the old channel and the arms systems is considered to be the cardinal condition for maintaining the existence of ichthyocoenoses and thereby also of fishery. In addition to the preservation of communications as such, of importance is also a regular **natural pulsation of the water level.** From the ichthyological and fishery aspect, the arms systems represent the most valuable part of the area of the inland delta touched by the construction works. In the interest of preserving the softwood repeated, short-term floods are foreseen."

"A more detailed **prognosis** is possible for two insect families already studied, viz. Carabidae and Staphylinidae:

1) an extinction of the majority of the hygrophilous species or an extreme decline in their abundance;

2) a disappearance of the more tolerant mesohygrophilous species, or these will be very rare due to the lower density of the drying forests and due to their preference of the shadowed sites;
3) the communities will be strongly penetrated by the eurytopic or field species from the surroundings of the remnants of the existing floodplain forests;
4) populations of the majority of the species occurring in the remnants of the floodplain forests will be male dominated and will not be able to exist autonomously;
5) the ecological structure of such communities will be extremely heterogeneous, the probability of their spontaneous regeneration will be very low.
Completion of the river barrage system on the Danube and its running will have the following impact on the inland delta:
   - **An altered water regime and thereby also a gradual disappearance of the inland delta of the Danube;**
   - **Disappearance of wetlands and moist grasslands;**
   - **Perishing, and thereby also the consequent felling of the last remnants of ancient trees with hollows."**

"As a result of the permanent constructions in the river barrage system, forestry has lost 3000 ha of forests and another **2500 ha will dry out within 2 - 3 years after the system is put into operation.** As essential forest reconstruction will have to be carried out on an area of some 3600 ha, with a transition to hardwood trees. **The loss of the forest's recreational function is estimated at about 4200 ha."**

"**Construction of the RBS on the Danube according to the original scheme,** with a minimum discharge in the old channel, would mean considerable changes in the water table on an area of some 38 thous. ha of agricultural land. These assumed changes in the water table, calculated according to Halek (1979) would have the following adverse impact on agricultural production:
- **decrease in crops by 25 thous. tons in terms of cereals (minimum variant)**
- **loss of soil humus through mineralization, minimally by 10.5 million tons**
- **release of nitrates in humus mineralization in a minimum quantity of 1.5 million tons nitrogen."**

"The construction of further large-scale irrigation systems assumed a partial elimination of the decrease in crops."

"The new designs for an improved completion of the river barrage system on the Danube from the aspect of its impact on GW (Mucha et al. 1992), [23] presume a control of its level in soil and this not merely by means of drainage canals, but also through a control of flow between the diversion (upstream) canal to the hydroelectric power station near Gabcikovo and the Danube's natural bed. According to the authors of the project, also the retention reservoir near Hrusov is expected to be used to this end. It is also planned to ensure an optimum fluctuation of the water table in the Danube's littoral zone in order to avoid a deterioration of its quality (nitrates content). **The purposed procedures might help significantly to raise the water table in the Upper Zitny ostrov and thus to improve the water regime of soils for ensuring humidity for agricultural plants. This solution strikingly lowers the danger of lower crops in consequence of the drop of the water table according to the original project. In addition, it removes the danger of humus mineralization and accumulation of an excessive quantity of nitrates in the soil. Its realization does away with the need to solve the deficit of humidity for agricultural produce through the construction**

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of new irrigation systems. Moreover, it permits to lower the intensity of irrigation in Upper Zitny ostrov."

"As the function of the inland delta depends on the mechanism of action of the hydrological regime, the function of the entire ecosystem may be ensured by adhering to the following conditions:

1) **to preserve or renew a permanent connection between the main channel and the arms systems,**
2) **to ensure a permanent dynamic flow in the old river bed,**
3) **to ensure continuous flow not only in the old river bed, but likewise in the arms systems,**
4) **to ensure such a seasonal fluctuation of water levels in the old river bed and arms systems as corresponds to the natural rhythm of the level regime during the course of the year and permits a periodical flooding of the inundation territory.** Seasonality, extent and duration of flooding must be anchored in the manipulation regulations."

"**In the past**, to ensure navigation, a series of measures were adopted at the expense of the arms system i.e. **a uniform river bed was thus created**, its **levees were raised**, whereby the **side arms were impoverished.** Were it not for the favorable properties of the arms systems in reducing the flood wave and taking off large discharge, they would evidently have been completely done away with by now. This, of course, resulted in numerous undesirable consequences, the most conspicuous of which are (as regards the substitution of discharge by swelling) **a gradual earthing and a threatening disappearance of several arms.** The contemporary hydrotechnic structures permit navigation in the diverted sector with considerably lower claims to discharge flow. Nonetheless, despite this, the trend to impoverish the flow through the inland delta is going on, this time in the name of energy claims, and the physiotactically dubious conception of compensating the discharge with swelling is also envisaged for the main channel of the Danube. ... the present-day (inundated) landscape has been modeled and is kept alive by a 2000 m^3s^{-1} discharge. In an area where a considerable part of the energy is planned to be fed into the mains, hence, to take off the system without compensation, we must plan **compensatory inputs** into the landscape. In designing practice, this means to propose adjustments to the river bed so that it would have a **satisfactory level while preserving a CV (flow velocity) over 0.5 $m.s^{-1}$** (preferably around 1 $m.s^{-1}$) and **that the arms system would naturally fill also with a substantially lower Q** (i.e. about 1000 m^3s^{-1})."

"At places where water from the arms will enter the old river bed, it would be enough to construct rocky chutes on one side only, permitting migration from the old river bed into the arms, but in places where a two-way flow will be involved, these chutes should be on either side. On dams where water is to flow from the river bed to the arms, chutes should be built from the side of the arms."

Please, compare this text with the EC Data report and visit the Danube delta between Bratislava and Sap. Please, compare the prediction and the reality written in EC report. The struggle is to eliminate all negative impacts and to optimize the whole system as much as possible. A lot of this has already happened. Water management regime is already elaborated as written above [F].

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B. Comments on the Recommendations for a Temporary Water Management Regime

The ecologically more acceptable range between 40 % and 95 % of water for the Old Danube as an interim solution, which in fact is realistic from the technical point of view, was not discussed at all.

This includes the EC experts not noticing the original Slovak legal prerequisites for the operation of Gabcikovo (the "19 Conditions" demanding 65 - 75 % of water in the Old Danube) as well as the 66 % compromise solution which was suggested in February 1993 by EC Commission and accepted by the Hungarian side. ***Such a scenario would certainly reduce the ecological problems and would still leave a large amount of water for Slovak energy production.***

The suggested minimum discharge of 400 m^3/sec is well below the historical minimum of the river in this region. This will promote the extraordinary drainage effect of the river, affecting the floodplains and the adjacent lands. A minimum discharge of 600 m^3/sec is close to the historic minima and technically feasible at the Cunovo bypass weir.

10 % of discharge (2025 m^3/s = average Danube discharge) means:
- 200 m^3/s in average
- value of 14.3 % of Gabcikovo production
- 300 million kWh per year of electric power
- at least 400 million Slovak crowns per year
- saving of 0.4 million tons per year of coal
- corresponds to 0.125 million tons per year of ashes if burning coal
- saving of 0.45 million tons per year of oxygen

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Underwater weirs

As one "remedial measure", the new construction of two underwater weirs is recommended. The Slovak engineer's plan to build the same kind of such weirs as on the Southern Upper Rhine (e.g. near Strasbourg). ***From the many years of experience about these weirs on the Upper Rhine and the many scientific data produced on their impacts it can be stated that this measure will be inappropriate, inefficient and ecologically detrimental for the Danube and it will rather worsen the situation:*** *it will dissect the river continuum into a chain of ponds and result in higher erosion downstream from each weir (cascade effect); upstream from the weir it will create standing water, higher eutrophication and sedimentation processes (colmation) reducing the river water quality, i.e. a complete change of the former bedload regime. The design of the planned underwater weirs creates such great velocities that fish will not migrate; elsewhere, artificial fish ladders proved to be useless investments.*

On top of this, ***underwater weirs proved to have no decisive, positive impact on the groundwater.*** *The water levels will be adjusting only to the downstream water level of each weir. Even with a narrow sequence of many weirs, these drawbacks could only partly be*

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reduced. In addition, the important exchange between surface and groundwater will be reduced after some time due to upstream colmation. On the Upper Rhine e.g. in the Weisweil weir section, less than 20 % of the "inundated" area maintained ecological conditions similar to floodplains, but over 80 % of the former, typical ecosystem is lost today (Henrichfreise 1993).

The goal of underwater weir is:

* **to rise the water level** so that water can flow into **river branch** situated upstream
* **to rise water level** and at the same time to rise the **ground water level**
* **to slow down erosion** and successively to rise a river bottom to a new stage.

The construction of under water weirs is very shallow, similar to natural fords or moving sandbanks (see Fig. 3.1). Weirs are build up from natural stones and gravel used for river bank fortification and dikes (groynes). Underwater weirs are shaped along the weir and river is narrower upstream of the weir. This is the main difference in comparison with the Upper Rhine, well known the river steps on river branches (Fig. 3.2).

Discharge is large enough to ensure needed velocities. To speak about a chain of ponds is simple sign of not understanding situation. Also there exist no cascade effects, no standing water, no higher eutrophication, no colmation. An example in a smaller scale can be seen in Slovak river branch system, in the main river arm. Velocities are there high enough to clean the river arm bottom, to reduce colmation, to break euthrophication, to force infiltration.

An example is the velocity in the Danube at the Old Bridge in Bratislava, where the water level is now raised 2 m at low discharge (800 m^3/s). There is flowing water, it is not a lake.

On top of this, colmation has its criteria of origin and degree. According to WWF many years' experience, a lot of river bank filtration well fields should be colmated. Why the wells for example in Budapest and in Komarno are still yielding water? Answer is, because of the velocity of flow and its changes. Velocities in the Danube and also in the river branches on Slovak side are high enough, to keep colmation in some extent. Velocity in the Danube, also upstream of planned underwater weirs, will be larger than at Budapest or Komarno.

The water levels will be not adjusted only to the downstream water level of each weir. It is simple neglecting of all natural laws and WWF itself can not believe this. After putting the Gabcikovo into operation because of not dredging the fords, which are natural underwater weirs the ground water after previous decrease is slowly rising. This is documented also in the Hungarian report.

Generally speaking, Gabcikovo system of structures is not comparable with e.g. Weisweil weir. This is clear for every not prejudiced visitor.

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Lateral dikes in the floodplain

Even though in 1991 the Slovak environment ministry expressively(!) criticized such measures as very detrimental and demanded a solution ensuring a water input in the side-arms from the Danube and a removal of the disclosures between the river and the side-

arms (no. 11 of the "19 Conditions" from 25 June 1991), the Gabcikovo engineers started to build this scheme in winter 1992/93 destroying parts of the side-arm system, reinforcing the disclosures with the Danube and starting a permanent inundation of the wetland in May 1993. Condition no. 11 stated already in 1991 that 'the construction of lateral dikes in the inundation area and the creation of cassettes will damage the thru-flowing of the side-arms and result in an unnatural water regime of surface and groundwater, which with their oxygen regime and nutrient contents will not correspond to the needs of floodplain forests. It would provoke a non-desired long-term inundation of the forests causing its complete or significant change.'

This view is strongly supported by the WWF scientists: these dikes will transform the previous continuum of the floodplain into a chain of practically independent ponds which perhaps give the impression of an intact wetland at first sight and in very short term. It may even be true that the new water levels following the new artificial water input from the Dobrohost intake structure lifted the water level to a higher level than under recent predam conditions. However, the single-point inflow of water, its stable, significantly reduced volume and its changed water quality (the water comes from the storage lake having lost most of its suspended matter including nutrients crucial for the floodplain ecosystem) in fact result in detrimental effects.

The water level just upstream from each lateral dike is lifted too high and remains stable over many months. This is damaging for natural floodplain biocenoses. Further upstream from each lateral dike, the water damming has no more impact: the dammed water remains horizontal, while the floodplain morphology is inclined.

No independent ponds (except two new material pits between Vojka and Bodiky), no stable and stagnant water, no horizontal water level, no loss of nutrient. This was explained earlier. We can only recommend to WWF to visit and to work in the area.

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This measure induces a real threat to the affected floodplain forests. Contrary to the propaganda of the Slovak investor company in 1993, the artificial water input has <u>not</u> "saved the Danube inland delta". Moreover, the negative scientific prognosis is already reality, as it was revealed during recent studies by French scientists from the Lyon university who investigated the lower part of this Slovak floodplain section in 1992 and 1993: they found clear signs of physiological problems for willows which in large numbers soon will die or have already died (especially large trees).

Yes, there are known physiological problems of large old willows in pre-dam conditions, which has the French scientist recognized. Ground water level has increased since May 1993 in the whole Slovak floodplain. It means, that he studied the previous pre-dam long-term development in 1992 and 1993.

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In addition, the lateral dikes proved to impede the migration of fish and other water organisms because they created high barriers which no Danube fish can cross. In 1992, there were four small lateral dikes in the side-arms near the village Baka; in fall 1993, the number of even larger barriers increased to ten. The French studies documented a drastic loss of fish biomass as compared to the 1992 situation: apparently almost all large fish have gone, only a few species dominate (e.g. bleaks = Alburnus a.) while the original diverse fish cenoses are largely altered today. The detailed analysis will be available in January 1994.

Slovak Cartography published a map [27] where all older lateral dikes are shown. All 10 dikes are in the map. Lateral dikes were re-constructed, regulation weirs at some places were added.

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Finally, the construction of these new lateral dikes together with the permanent, controlled filling of the channels provided unlimited access for many more visitors (recreation!) and for the often illegal construction of weekend houses all over the floodplain: the wetland, which ***until recently hosted many threatened, but sensible species is today dramatically endangered by the threat of turning into a big recreation area for thousands of people.***

The whole area from Bratislava to Sap is 50 km long and has two sides. Enough space for organized tourism and protected area. 90 % of the area is cultivated (forest plantation). Some areas are already protected and closed for tourism.

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It can be concluded that, after the weirs and dikes were largely tested on the Upper Rhine in the 1960s and 1970s, they will have no satisfying effect on ecology, groundwater or forestry at the Danube.

This is true in the Upper Rhine.

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Unfortunatelly, the most important recommendation of the EC Report suggesting a ***"deposition of gravel"*** *downstream of the Cunovo weir is not discussed any further.*

Deposition of gravel is included in the reports [A, B, I, G (p. 64)].

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C. Technical Limits of the Present and Future Discharge into the Old Danube

Temporary Water Management are largely dependent on the technical situation of the Gabcikovo scheme, especially the Cunovo diversion weir, with its various openings.

Cunovo weir, shiplocks and power station are under construction now and will be ready in 1996. This will extend the discharge capacity at Cunovo to that as in Dunakiliti weir, which is completed, but is used only during the large floods.

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*A relatively small problem arose with the **ferry service** in the Gabcikovo canal providing a second connection to the three isolated villages.*

The road connecting the three villages with Bratislava is under construction. This will be the third connection.

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*... **navigation** was closed several times, especially on 29 days between 20 October and 30 November 1992.*

The 29 days of closing the navigation was during putting the Gabcikovo into operation and a large winter flood. This is common situation on all waterworks and during the flood situations.

Titbit for the WWF was the new stopping of navigation in March and April 1994. Besides, for such cases, operation of shiplock in Dunakiliti was foreseen.

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*The **Cunovo bypass weir** was originally designed for auxiliary purposes with a hydraulic capacity of 1,460 m^3/sec (4 gates). However, after a few hours of operation, it proved to have a faulty design for the strong erosion activities at its downstream parts (9). Therefore, the weir's discharge is limited in all cases to 600 m^3/sec, otherwise it could be destroyed by erosion.*

Cunovo bypass weir is temporary structure now with limited discharge via spillway of 600 m^3/s. Definite weir, shiplocks and hydropower station is under construction with large enough capacity.

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Two tainter gates (each 24 m long and 25 t heavy) were washed 2 km downstream onto Hungarian territory.

Tainter gates are heavy but hollow. Archimedes law is still valid.

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This explains why one of the remedial measures of the EC Working Group recommends the 'construction of an underwater weir at RKM 1845.5 for improving the operational reliability of water supply from the inundation weir (less maintenance of the spillway). ... Without this there is a large risk that the inundation weir spillway will be under repair most of the time'.

WWF is aware of the fact that the proposed underwater weir in rkm 1845.5 ensures the filling the branches system in Hungary with water and ensures at the same time the crucial needed interconnection of Hungarian river branches with the Danube at least on two or three places (Fig 3.4). If the underwater weir is 1 - 2 m high, an increase in the water level will not reach the inundation weir. The Hungarian and Slovak administration agreed with the Hungarian proposal of realization of a similar underwater weir in rkm 1843 which can put into use also the ready made inlet structure of the Hungarian branch system in Dunakiliti. EC Working Group made political compromise and advanced the proposed place of the underwater weir upstream, **so that Dunakiliti inlet structure for supplying Hungarian inundation can not be used.** This was decision to satisfy the wish of the Hungarian Parliament.

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*The **sedimentation processes** in the Cunovo storage lake were always stressed by the Slovak side as an important limit for a higher discharge of water into the Old Danube because a reduced discharge in the storage lake will enhance the undesired settling of suspended load. The new EC Report (4) confirms that 'all bed load and 60 % of the suspended bed load have settled in the reservoir' and that the damming at Cunovo has highly significantly disturbed the sedimentation/erosion balance in the Danube. It must be stated:*

1. ***The Slovak side now admits for the first time that this problem in the storage lake already exists.** Even the building of artificial islands in the storage lake cannot stop this process. Mostlikely, detrimental biochemical processes inducing a threat for the groundwater quality have started and thus will probably threaten the drinking water nearby.*

The Slovak side from the very beginning have been aware of the sedimentation in the reservoir. This sedimentation of the bed load is small in the reach from Bratislava to Rusovce (ca 150000 m^3/year) and has positive effect. Later, gravel and sand will be dredged and added downstream Cunovo weir. Guiding structures in the reservoir (which is now not a storage lake) are not constructed to stop these processes, but to distribute them over the area

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Fig. 3.4: Openings in the river embankments for supplying the Hungarian floodplain with water

so that at some places is **alternating sedimentation and erosion.** This guiding structures are functioning only if the water is flowing with high enough velocity. Under such conditions at these places "mostlikely" detrimental processes will not start and mostlikely detrimental processes will not exist in reservoir. Reservoir is not a polder as it is, the case at the sides of the hydropower structures upstream Bratislava.

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1. *Beside finer bed sediments, there will be a clear deficit of transportable matter compared to the river's transport capacity in the Danube downstream from the reservoir. This will* ***inevitably result in erosion processes downstream from both the Cunovo and the Gabcikovo weirs,*** *similar to such effects on other dams elsewhere.*

WWF is not aware of changed transport capacity in the Danube downstream Cunovo weir. There is not direct similarity with other dams "elsewhere". In the opposite, because of destruction of river bank fortification, meandering of river, interconnection with river branches, underwater weirs and fortified fords and if necessary adding sediments at Bratislava, this all will make this effect no important.

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D. Comments on the Social Situation of Local People

The unreliable ferry service (it runs mostly once an hour due to limited fuel; its limited capacity often leads to long waiting times; it often has to stop during fog, wind and ice) causes unacceptable travel times.

In contrast, the new road will mainly serve those who (now develop an interest in) spend their week-end or recreation time in this area. Together with the new, permanent access to the entire wetland over the lateral dikes, the permanently filled-in waterways, the hundreds of often illegally built week-end houses along the side-arms and the newly planned recreation areas at the gravel pits, ***a total transformation/alienation of the wetland and of the traditional villages with their social structure is now being implemented from the outside:*** *This process is technocratically oriented, ignoring traditional local interests and ecological sensibilities.* ***It is urgent that this will be stopped, and where possible, reversed.***

There will be three access possibilities to the three villages and those are: directly from Bratislava, via Gabcikovo power station and the mentioned ferry boat. There was always permanent access to the entire floodplain between villages and the Danube. Only in the latest 20 years the river branches have not been permanently filled-in with water. We ask WWF to give a list of "hundreds of illegally built week-end houses" in this floodplain. Gravel pits are situated out of a floodplain forest. Lateral dikes are old roads used by forestry.

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Recommendations by WWF and Independent Scientists

A. Recommendations with Respect to the EC Reports

.... WWF suggests producing as soon as possible

* *a water quality study including*
    * *control sampling and analysis on the changes in surface and groundwater quality,*
    * *changes of the underground currents and*
    * *potential impacts on the drinking water reservoir;*
* *a river engineering study investigating*
    * *the present state of the Cunovo scheme,*
    * *the technical possibilities and costs for the improvement of the discharge into the Old Danube and*
    * *the new variant to reduce the undesired sedimentation processes in the storage lake up- and downstream from the Cunovo weir through the construction of a small navigation route.*

***Each study should be worked out by an independent expert team also involving local, competent experts,** providing that they can work independently from the government and the Gabcikovo operator.*

Until now there have been various independent studies. One such a study is under realization in framework of EU PHARE program. The program is not only study but an optimization of all aquatic elements:

- surface water
- ground water
- agriculture and forestry
- environment in connection with water

The main goal of this program is to define and solve problems and to make and realize suggestions. Some results are already available (see pages 103 - 109). Parallel studies are in framework of monitoring at various institutions, universities and the Slovak Academy of Sciences.

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B. Alternative Recommendations for the Future Water Regimes

However, it is clearly a question of the European political interest how quickly the needed political negotiations will produce results and how much time will be allowed to pass by for the realisation of the urgently needed and hopefully agreed steps.

What is the real WWF political interest in this case story? Is WWF really politically independent? Is the Gabcikovo project technical problem or political one?

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The scientists involved are convinced that this "gentle solution" can be achieved faster, cheaper and politically easier, than the "technical solution" the EC Mission's Working Group was able to agree on.

Every new solution has to respect the following priority objectives:

1. ***The reestablishment of the hydrological dynamics both***
   in the old river bed,
   in the side-arm system and
   in the floodplains.

... the water level fluctuations ... have to run in such a way as they were at least under pre-dam conditions, and at best before the serious gravel excavations started (i.e. 1960s). This automatically entails the needed natural input of nutrients into the floodplain.

The Gabcikovo project and the Slovak proposals of water regime fulfill these requirements.

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2. ***The restoration of the groundwater table dynamics***

This is possible only under a non-restricted connection between the surface water and the aquifer.

This requirement is fulfilled by existing state. Proper water management regime has been proposed.

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3. ***The reestablishment of a direct and non-inhibited connection between the river and the floodplain including the side-arms.***

This will allow the migration of organisms and diaspores.

The Hungarian and Slovak project of re-establishment of connection has been stopped by political means by the Hungarian Parliament.

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4. ***The enhancement of the morphodynamics***

Erosion and sedimentation are prerequisites for the habitat and biological dynamics of floodplains. They should be promoted to the largest extent possible.

It has happened on the Slovak floodplain.

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5. The restoration of self-purification processes
They have to be supported to the maximum extent in the entire floodplain and river area.

Restoration has already re-started at Rusovce, between Bratislava and Kalinkovo, in the Mosoni Danube, in the Slovak inundation. "Self-pollution" processes have been stopped in the Slovak floodplain.

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C. Short-term Solution
Based on the technically possible

* *discharge minimum of 600 m^3/sec and*
* *discharge maximum of at least 940 m^3/sec (more up to 1,500 m^3/sec depending on the technical possibilities of the Cunovo weirs and with respect to the Slovak legal order stated in the "19 Conditions" from June 1991).*

Higher average discharge will create eutrophication problems with following water quality changes and secondarily it will create pollution of air, soil, etc. (page 110).

WWF suggests as an urgent measure for the next two years, which are needed for the preparation of the long-term solution, instead of underwater weirs **the accumulation of sediment bodies in the old river bed in the form of gravel banks and islands.**

Better possibility is to let the Danube, at least partially, to meander over the floodplain. To accumulate sediments, it means to excavate and transport sediments to a proper place and then to put them somewhere into water. This process in the large scale is not very ecologically friendly.

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Even though this interim solution cannot balance the drawbacks of underwater weirs concerning the groundwater levels,

* *it largely prevents upstream colmation and*
* *eutrophication,*
* *it preserves the river continuum and*
* *allows free migration of fish and other organisms in the river bed.*
* *In addition, it is no alien construction (like an artificial underwater weir) in the river bed, and uses authochtonous material from the river bed itself and from the banks This measure does not disturb or change the typical environment for the river biocenoses.*
* *These sediment bodies allow an easy transition towards the needed long-term solution which is suggested in D.*

Underwater weir is similar to natural ford. At the same time it is the bottom fortification to some extent. Underwater weirs are not the river steps.

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These sediment bodies can easily be built up within a short-term of a few weeks using the ***existing local gravel and sand deposits in the old river bed.***

Exactly, from this material will be built the underwater weirs or if WWF wishes - artificial fords.

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D. Long-term Solution

Starting from the above-mentioned facts that

* *the previous, natural water level dynamics, with all their positive effects for the floodplains and the groundwater, have to be restored,*
* *the discharge in the Old Danube realistically will remain below the former discharge,*
* *at least the Slovak legal standards (as stated in the "19 Conditions" from June 1991 following § 14 of the Slovak Water Law) will be fulfilled, but in their meaning of a dynamic discharge (cf. description in B) of 65 to 75 % of water,*
* *an acceptable compromise will be found, orienting on the EC proposal from February 1993 (average discharge of 66 %) which was already accepted by Hungary,*

the compensation of the discharge deficit (25 - 35 %) can only be achieved by
lifting and constricting the present river bed
which is entailed by a reduction of the existing discharge area.

The lifting and constricting of the river bed can be achieved by the deposition of gravel and small sized boulders in the old river bed. Similar to the short-term solution, this measure includes the forming of islands and gravel banks. It is expected that a stretch of ca. 20 - 30 km downstream of Cunovo has to be filled up with a volume of one to two meters. For this purpose, an amount of ca. 5 - 10 million m^3 gravel and boulders will be needed.

As a second WWF recommendation it is suggested that
the storage lake up- and downstream of Cunovo be reduced by new dikes to a navigation route.

The objective is to reduce the sedimentation and undesired biochemical processes in surface and groundwater of this artificial lake (which has no efficient sealing to the underground like the power canal) to the minimum extent. This will reduce the potential water pollution threatening the nearby and downstream drinking water wells. The area in-between the new dikes parallel to the navigation route and the present lake dikes should be turned into restoration areas. If done in the appropriate way, these man-made biotopes can develop over the years into secondary wetland biotopes.

It is evident that the entire planning and realisation of this solution has to be examined thoroughly and in detail by an ***independent, international water engineering institute*** ***together with an ecological institute experienced in river management.***

In contrast to other proposals, this "gentle" solution offers a comprehensive approach to the river area. It will help to limit and partly even reverse the detrimental changes induced by the Gabcikovo scheme. It will not only bring a long-term preservation of this floodplain

ecosystem of European importance but it guarantees an improvement of the presently critical groundwater situation. It is a solution for the Danube and the base for an ecologically-oriented, economic development of the border region which is to serve the livelihood of people living on both sides of the river.

Decision making for the long-term solution will be based on thoroughly study of monitored data and on evaluation of long-term development in the area. The solution will be tuned to the best conditions and this with co-operation with the best environmental institutions.

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4. EPILOGUE

Environmental impact of construction of hydropower system lies in construction of weir, function of which is impoundment of water, construction of hydropower station and construction of water supply for turbines. Water supply for turbines is constructed by canalizing a river (making a river into a canal by straightening, building the high embankments along the river), or by building the water supply canal aside from river bringing water to turbines. In the first case, hydropower station is built up directly at the river. This is typical for Nagymaros. Part of the floodplain is covered with impounded water and a part is changed into "polders" (depression with stagnant water behind the embankments). Original floodplain is lost. In the second case, the hydropower station is at some distance from the river. This is typical for Gabcikovo. The floodplain is saved, but the water regime is changed and should be therefore optimized by appropriate measures.

In the past, measures taken for the navigation constrained the possibilities for the development of the Danube and the floodplain area. The ecological changes in the area are subject to a long-term trend of river bed and water levels decreasing caused by a variety of reasons, above all the large river regulation works, which implied deliberate and unnatural cutting off and bundling of river branches into one main, straightened and heavily fortified channel for navigation. Assuming the navigation will no longer use the main river, a unique situation has arisen. Supported by technical measures, the river and the floodplain can develop more naturally.

The **main impact** of a construction of hydropower system **lies in the changes in water and ground water regime.** These changes are the **primary changes.** They are **measurable immediately** or in short time after putting system into operation. Ecological changes (except large losses in fish biomass immediately after diverting larger part of water) and especially the changes of several important ecological indicators, e.g. forest, birds, beetles, mammals, fish, mollusks, are **secondary changes** and are usually measurable **after a longer period**, but at the earliest in the next vegetation period. **It was the aim of the EU experts to estimate the primary changes, changes in water and ground water regime, because the first measures and remedy measures are of hydrological type.** To evaluate and propose such measures, there are needed the characterization of **long-term pre-dam condition trends** and **short-term changes during, before and after damming the Danube. It is therefore only obvious that mainly water regime measurements were taken into consideration in the EU expert's report.**

Gabcikovo - Nagymaros system of barrages, locks, dikes, canals, etc. represents an **extremely complex system.** To understand this system, it is necessary to create a **plausible and consistent framework for thinking about the problem and a tool to organize and analyze the available information in specific project-oriented context.** Except this, it is necessary to have a **deep interdisciplinary knowledge.** A simple example for an "independent" reader can be the problem of occurrence of benzopyrene in an observation well (page 90). An independent scientist should not only know that benzopyrene is an hazardous organic pollutant and he should not only compare analyzed concentration with some standards, but should know something about the possible pollution sources of chemicals, about its degradation, transformation, treatment, etc. But this is only one part. He should know about ground water flow, recharge of aquifer, processes in the aquifer and this all according to the local geological, hydrological, etc. conditions. Except this, the independent scientist should know something about construction of production water wells and observation wells and especially of concrete wells if some anomalies are measured. In our example organic pollutants have been detected in a deep observation well (Rusovce - Ostrovne Lucky D3/3) in a depth of 71 m, only one day after fulfilling of reservoir with water, in the upper part of the reservoir by Rusovce where there was not flooded area and the Danube is flowing in its previous river bed. Water level was raised, that time not unnaturaly high, to the level 128.5 m asl which is approximately level at previous average discharge in summer period. The real scientist should ask a few questions:

- What is the origin of pollution?
- What is polluted, ground water, well or sample by sampling?
- Is it possible that this kind of pollution can travel from river into the well in such short time?
- What can be the reason for this occurrence?

The answer will be: scientifically and theoretically it is not possible that e.g. lindan could occur in the ground water in this observation well. Occurrence of such substances in the mentioned well is probably from the air and dust, because this wells are observation wells constructed for measurements of ground water levels and not for microbiology and special chemicals. Wells are not pumped continuously and are not isolated from air pollution and dust. Pump the wells properly and try again. This was also done and no pollution was measured. We have discussed all these topics with the WWF independent scientist on the Conference in Papiernicky, one of the authors of the WWF Statement. Is he really independent and is he really scientist? Is WWF really interested in scientific dispute or in political one?

Comprehensive statement, as the WWF Statement seems at the first sight to be, **however should also look at the positive impacts,** i.e. environmental improvements that are possible directly (e.g. hydropower replacing fossil fuel), (see page 110) or indirectly (due to increased revenues) as a consequence of a new development project, e.g. supplying floodplain with water, new road, tourism, etc. Further such statement should be comparative, not an absolute assessment.

Recommendations by WWF and independent scientists are trivial. Surface and ground water flow and quality including sedimentation processes are already studied in the Slovakia very carefully e.g. in the EU PHARE project, and measured and studied by various other organizations in framework of Centre of Monitoring. Independent experts are included, control sampling and analyses are carried out.

The **re-establishment of the hydrological dynamics** in old river bed, river branches, floodplain and ground water have been proposed [I, F]. For WWF scientists it is known that such real proposals have been elaborated. For example, discharge in river branches on each side should be 1/50 of discharge in Bratislava, which ensures natural discharge and water levels fluctuation (up to 2 m) and the whole variety of flow velocities. Except this, in special occasional flooding of floodplain is foreseen. Similar water management is proposed for the Danube including more water in vegetation period, fluctuation of discharges and water levels, according to previous studies. The means for ground water fluctuation are the Danube, seepage canals, inundation area, reservoir. By superposition of these means, necessary ground water fluctuation estimated by previous studies could be reached. There is no fear that connection between the surface and ground water would be lost (see experience from the Slovak floodplain, page 64).

There was not non-inhibited connection between the river and the floodplain in pre-dam conditions. Proposals and approved projects for such connection exist. Some of them in floodplain are under construction. Co-operation of Hungarian side would be welcome and would yield into much better conditions than there were the pre-dam conditions. Erosion and sedimentation is promoted from Devin down to Rusovce, from Cunovo to Sap and in reservoir from Cunovo to Samorin.

Self-purification processes are restored in the Mosoni Danube, in the Danube at Petrzalka and Rusovce, from Bratislava to Kalinkovo and in the floodplain area. This will be improved in addition after connecting the Danube with river branches.

Slovak side will ensure the necessary discharge into the Mosoni and Maly Danube, into the Danube and will optimize step by step the whole structure, based on evaluation of monitoring.

Meandering of old Danube, new islands, new banks, fords, erosion of river bank fortification, etc. are realities. This process will continue. Some underwater weirs are needed to start the process of river flow via floodplain and eventual to start new partial meandering in floodplain.

Underwater weirs are not colmating because velocities in all cases and at all places will be higher than 0.3 m/s. There will be in all cases turbulent flow, no thermal stratification and no eutrophication in the Danube. Underwater weirs are similar to natural fords and preserve the river continuum well. They do not prohibit migration of fish and other organisms. Underwater weir will be created by large stones and gravel using authochtonous material from river bank fortification and river banks.

Lifting and constricting the present river bed already started. Some gravel will be added after construction of Cunovo shiplocks or after putting Dunakiliti into operation. To construct new dikes in reservoir downstream of Cunovo is not realistic because the needed amount of gravel. It will in addition create polder situation and from the point of view of ecology, such proposal is not sound. There is not fear at present conditions that some undesired biogeochemical processes could start in reservoir. Sedimentation is regulated in the reservoir area. Reservoir is not a lake.

In general, the WWF Statement is based on very simplified way of thinking. The WWF has all materials and data as the EC experts and in addition some more data from Hungary and probably some special reports from Slovakia. The result is slandering of EC experts, slandering of Slovak and Hungarian institutions, scientists, experts and designers.

WWF sentences are very emotive, but in very general level. In the whole Statement there is no exact number, scientific demonstration of facts, no discussion. Perhaps, the text give the impression of the whole wisdom and sound judgment.

Typical sentences are:

WWF has been actively engaged in the Gabcikovo case since 1986.

Until now we have not seen any real scientific study on so much discussed topics.

The goal of this WWF paper is:

- *to give an independent, scientifically based review on the present situation in the Danube region affected by Gabcikovo*
- *to critically comment on the Report of the EC Mission*
- *to give recommendations for the future management of the river*

WWF Statement is neither independent, nor scientific review. It can be seen e.g. from the "PRESS" (see Appendix) or from the letter of one of the authors: "Der WWF und die anderen NGO Kämpfen seit mehreren Jahren gegen die Wasserbau-Lobby und besitzen unfangreiches Datenmaterial."

But neverthless, for WWF is typical:

- to put themselves into position of independent scientific organization
- to criticize EU experts and other experts outside of WWF
- to give "clever" advice
- to distribute appeals and organize press-conference

... along the Danube up- and downstream from Dobrohost, the groundwater level was not raised, but lowered by up to 2 meters due to river diversion ...

Well, we have simple no words. This is complete negation of all measurements. Simple advice of ground water level increase up- and downstream Dobrohost is at following places:

- Strkovec - lake
- Zlate piesky - lake
- Biskupicke rameno - river branch
- cottage settlement at Hamuliakovo
- gravel pits - lakes between Vojka and Bodiky
- lakes and not interconnected depressions in the floodplain on the Slovak territory
- all observation wells in the Slovak part of inundation
- domestic wells in the upper part of Zitny ostrov area

On 28 April 1993 WWF spread an appeal (see "PRESS" in Appendix) for "Urgent Action by European Ministers to Avert Further Disaster at Gabcikovo". There it is written:
"The only way to prevent a disaster is to immediately restore at least 80 % of water to the original riverbed, said Mr. Alexander Zinke, a WWF biogeographer who visited Gabcikovo a few days ago."

Such arguments as WWF is using (after visiting Gabcikovo) simply put the whole Gabcikovo - Nagymaros cause on the plane of pity and injured feelings, and are a direct admission of bancruptery as regards real scientific arguments and principles in WWF. We would advise to all who want to make an independent examination of the environmental effects of Gabcikovo project to visit the place, to speak with people, designers and other specialists in all related topics and to study all opinions.

REFERENCES IN THE WWF STATEMENT

(1) WWF (1989): Stellungnahme des WWF zum Staustufenprojekt Gabcikovo - Nagymaros. I.A. Ungar. Inst. f. Intl. Angelegenheiten. Rastatt.

(2) WWF (1992): Energy for Slovakia - Options of an environment - oriented policy. Ed.: Austrian Ecology Institute, Vienna.

(3) WWF (1992): Construction and operation of Variant C of the Gabcikovo - Nagymaros project under international law. Legal study by Dr. G. Berrisch, Brussels.

(4) EC Mission Data Report (2 November 1993) on Assessment of Impacts of the Gabcikovo Project and Recommendations for the Strengthening of the Monitoring System. Budapest.

(5) EC Mission Report (1 December 1993) on Temporary Water Management Regime. Bratislava.

(6) Surface and Groundwater Quality (October 1993): Parts 1/2 and 2/2 by RH Union, Bratislava.

(7) Extended Monitoring of Water Quality during the Filling of the Gabcikovo Dam (period 26 October - 31 December 1992): Slovak Hydrometeorological Institute SHMU, Bratislava.

(8) EC Mission Report (November 1992): Working Group of independent experts on Variant C of the Gabcikovo - Nagymaros project.

(9) EC Mission Report (May 1993): Field inspection at the Gabcikovo construction site.

EC REPORTS

[A] Commission of the European Communities, Czech and Slovak Federative Republic, Republic of Hungary. Fact Finding Mission on Variant C of the Gabcikovo - Nagymaros Project, Mission Report, Bratislava, October 31, 1992.

[B] Commission of the European Communities, Czech and Slovak Federative Republic, Republic of Hungary. Working Group of Independent Experts on Variant C of the Gabcikovo -Nagymaros Project, Working Group Report, Budapest, November 23, 1992.

[C] Commission of the European Communities. Working Group of Independent Experts on the Gabcikovo - Nagymaros dam. Part of Working Group Report elaborated by Univ. Prof. Igor Mucha on behalf of Czech and Slovak Federative Republic, Final version, Bratislava, November 20, 1992.

[D] Commission of the European Communities. Field Inspection at the Gabcikovo Construction Site. Mission Report, Bratislava, May 24, 1993.

[E] Commission of the European Communities, Republic of Hungary, Slovak Republic. Working Group of Monitoring and Water Management Experts for Gabcikovo System of Locks. DATA REPORT - Assessment of Impacts of Gabcikovo Project and Recommendations for Strengthening of Monitoring System, Budapest, November 2, 1993.

[F] Commission of the European Communities, Republic of Hungary, Slovak Republic. Working Group of Monitoring and Water Management Experts for Gabcikovo System of Locks. REPORT ON TEMPORARY WATER MANAGEMENT REGIME, INDEPENDENT SCENARIO. Appendix D of the report [G] in separate volume, elaborated by Univ. Prof. Igor Mucha on behalf of Slovak Republic, Bratislava, November 28, 1993.

[G] Commission of the European Communities, Republic of Hungary, Slovak Republic. Working Group of Monitoring and Water Management Experts for Gabcikovo System of Locks. REPORT ON TEMPORARY WATER MANAGEMENT REGIME, Bratislava, December 1, 1993.

[H] Comenius University, Faculty of Natural Sciences, Ground Water Division. CONTRIBUTIONS TO DATA REPORT. Bratislava, October 15, 1993. List of included data reports:
SURFACE AND GROUND WATER REGIME IN THE SLOVAK PART OF THE DANUBE ALLUVIUM
1. General Description
1.1. Surface and Ground Water Regime in the Slovak Part of the Alluvium
1.2. Discharge Data
1.3. Surface Water Level Data
1.4. Ground Water Level Data - part 1
1.4. Ground Water Level Data - part 2
2. Surface Water and Ground Water Quality - part 1
2.1. Tab. 1: Surface Water
Surface Water and Ground Water Quality - part 2
2.2. Tab. 2: Water Sources
2.3. Tab. 3: Extended monitoring
SEDIMENT TRANSPORT AND SEDIMENTATION/EROSION
FLORA, FAUNA AND FORESTRY
IRRIGATION WATER AND AGRICULTURE
ELECTRICITY PRODUCTION AND NAVIGATION

[I] Slovak Republic. Temporary Regime of Water Management and Remedial Measures (Gabcikovo - Nagymaros Project), Bratislava, January 18, 1993.

[J] Group of Monitoring and Water Management Experts for the Gabcikovo System of Locks. Data Report of Hungarian Party, prepared by G. Vida et al., Budapest, October 21, 1993.

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REFERENCES

[1] Stancikova, A., Bacik, M., 1991: Analyza doterajsieho morfologickeho vyvoja stareho koryta Dunaja a prognoza zmien pri dlhodobej prevadzke VD Gabcikovo. VUVH, Bratislava.

[2] Czech and Slovak Federative Republic, 1990: Surface Water and Ground Water Model of Danubian Lowland between Bratislava and Komarno: Ecological Model of Water Resources and Management. Invitation of Proposals. Bratislava.

[3] Commission of the European Communities, Czech and Slovak Federative Republic, 1991: Danubian Lowland - Ground Water Model, No.: PHARE/90/062/030/001/EC/WAT/1, Tender Dossier of Study Contract. Bratislava.

[4] Treaty between the Hungarian People's Republic and the Czechoslovak Socialist Republic Concerning the Construction and Operation of the Gabcikovo - Nagymaros System of Locks. United Nations - Treaty Series, Vol. 1109. I-17134. came into force on 30 June 1978.

[5] Dister, E., Roux, A. L., Paces, T., Bernhart, H. H., Zinke, A., 1994: A New Solution for the Danube. WWF Statement on the EC Mission Reports of the "Working Group of Monitoring and Management Experts" and on the Overall Situation of the Gabçikovo Hydrodam Project. Vienna/Rastatt, 31 January 1994.

[6] Kresser, W., 1988: Die Eintiefung der Donau Unterhalb von Wien. PERSPEKTIVEN, Heft 9/10, pp. 41 - 43.

[7] Prazan, H., 1988: Staustufe Wien - Freudenau. Geschiebetransport und Sohleintiefung der Donau. PERSPEKTIVEN, Heft 9/10, pp. 44 - 45.

[8] Zottl, H., 1988: Staustufe Wien - Freudenau. Sohlstabilität im Raum Wien bis Bad Deutsch Altenburg. PERSPEKTIVEN, Heft 9/10, pp. 46 - 51.

[9] PERSPEKTIVEN, 1991: Die Donau als Lebensraum. Heft 1A/1991.

[10] Mucha, V., et al., 1966: Limnológia československého úseku Dunaja. SAV, Bratislava.

[11] Holcik, J., et al., 1992: Future of Danube. Ecological findings, predictions and proposals based on data from the Slovak part of territory affected by construction of the Gabcikovo - Nagymaros River Barrage System. Report prepared for ISTER. Institute for Zoology and Ecosozology of Slovak Academy of Sciences, Bratislava.

[12] Duba, D., 1968: Hydrologia podzemnych vôd. SAV Bratislava, s. 349.

[13] Fink, J., 1966: Die Paläogeographie der Donau. In Limnologie der Donau, (Hrsg. R. Liepold), Liefg.2. Stuttgart, pp. 1 - 50.

[14] Franko, O., Remsik, A., Fendek, M., Bodis, D., 1984: Geotermalna energia centralnej depresie podunajskej panvy - prognozne zasoby. Ciastkova zaverecna sprava GUDS, Bratislava.

[15] Janacek, J., 1967: Vyskum tektoniky juznej casti Podunajskej niziny s ohladom na vystavbu vodneho diela Dunaj. Zaverecna sprava, GUDS.

[16] Pospisil, P., 1991: Vyhodnotenie efektivnosti cistenia studni a urcenie novych odbernych mnozstiev - Pecensky les. Manuskript, Bratislava, Archiv VaK.

[17] Pospisil, P., Kucera, K., 1992: Vplyv erozie koryta Dunaja na zdroje podzemnej vody v pririecnej zone. Vodohospodarsky casopis, 40, c. 5, ss. 459 - 467.

[18] Vaskovsky, I., et al., 1982: Vysvetlivky ku geologickej mape juhovychodnej casti Podunajskej niziny 1:50000. GUDS Bratislava, s. 115.

[19] Holcik, J., 1989: Navrh cerveneho zoznamu ohrozenych kruhoustnych a ryb Slovenska. Pamiatky a priroda 20, 6:26 - 28.

[20] Holcik, J., Bastl, I., Ertl, M., Vranovsky, M., 1981: Hydrogiology and Ichthyology of the Czechoslovak Danube in relation to predicted changes after the construction of the Gabcikovo - Nagymaros river barrage system. Prace Lab. Rybar. Hydrobiol, 3:19 - 158.

[21] Fulajtar, E., Jambor, P., 1983: Prognoza vplyvu sustavy vodnych diel na Dunaji a dolnom Vahu na pôdne pomery v prilahlej oblasti. Geograficky casopis, 35:292 - 312.

[22] Szolgay, J., Lindtner, J., Harton, W., 1985: Uprava ramennej sustavy v lavostrannom inundovanom uzemi a stareho koryta Dunaja v useku 1842 az 1811. VUVH, Bratislava. Final Report. Unpublished.

[23] Mucha, I., (ed.), 1992: Optimalizacia dokoncenia vodneho diela Gabcikovo na uzemi CSFR z hladiska vplyvov na podzemnu vodu. Prirodovedecka fakulta UK, Bratislava. Final Report. Unpublished.

[24] Rodak, D., et al., 1993: Kvalita sedimentov dunajskych naplavov z hladiska obsahu a migracie kontaminujucich latok v podzemnych vodach. PFUK, Konzultacna skupina "Podzemna voda", Bratislava.

[25] Mucha, I., et al., 1992: Mechanizmus samocistiacich procesov pri brehovej infiltracii a kvalita podzemnej vody vodnych zdrojov. PFUK, Konzultacna skupina "Podzemna voda", Bratislava.

[26] Liepolt, R., 1965 - 1967: Limnologie der Donau. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.

[27] Subova, A., Mucha, I., Klauco, S., 1993: Zitny ostrov - prehodnotenie vyuzitelnych zasob podzemnych vod. C. 16/92-HG, Vodne zdroje, a.s., Bratislava.

[28] Klauco, S., Pospiechova, O., Vyskocil, P., 1994: Rozsirene sledovanie kvality vody pocas napustania a prevadzky SVDG. Suhrnne hodnotenie vysledkov za obdobie 25. oktobra 1992 - 31. decembra 1993. SHMU, Bratislava.

[29] Vodacka a rybarska mapa, 1987, Bratislava.

[30] Hungarian Academy of Sciences, Ministry for Environment and Water Management, Hungarian Central Statistical Office, 1990: State of the Hungarian Environment. Budapest.

Annex 25

(Translation)

Fish, Fisheries and the G/N Project, Ing. A. Kirka, 1994

Ing. Anton Kirka :

Fish, Fisheries and the G/N Project

The construction of the G/N Project on the upper Danube and the deepening of the Danube bottom for navigation purposes changed the hydrological regime on the Slovak section of the river. Thus, the substantial changes in transport of bedload, its depositions and the progressive sinking of the bottom occurred over a major part of the river. It had an unfavourable influence on the water level in the branch systems and also on fisheries, whose output decreased progressively. It must be said that, besides these above-mentioned effects, there was an excessive elimination of some fish species. Later, with the adjustment of the river bed, a significant deterioration of water quality resulting from extensive industrialisation occurred as well. In 1973, the water quality at the river inlet on Slovak territory reached the 4th degree in quality (alfamezosaprobia).

ICHTHYOFAUNA

Table 1 represents the list of fish species which existed up until about 1970. The number of species was 57. From this number, 54 were found in the main flow, 49 in the branches and 33 in the waters behind flood protection dykes.

In the period from 1970 until the damming of the Danube, there were no sturgeon species in the involved section. Nevertheless, the total number of fish species increased to 61, owing to the introduction of species. During this period, 50 species existed in the main river flow of the Danube, 56 in the branches and 36 in the waters behind flood protection dykes up until the damming of the Danube (Table 2).

The presence of 43 species is expected in the reservoir, 50 species in the original old river bed and 55 species in the branch system. There were 35 species confirmed in the old river bed and 29 species in the branch systems (Table 3).

THE RESERVOIR

The species composition and zooplankton biomass in the reservoir will be the same, for the most part, and a little higher than in the main flow. The phytoplankton biomass will increase several times.

No great changes will occur in the species of ichthyofauna of the reservoir as compared to the main river flow. It is supposed that typical reofile species, e.g., Rutilus Pigus virgo, Pelecus culturatus, Zingel zingel, Zingel Streber and Cottus gobio will decrease. Where water quality is ameliorated, populations of such species as Barbus barbus, Vimba vimba, Chondrostoma nasus, Stizostedion lucioperca and others will be found. In parts less exposed to flow, increases in populations of phytolitophyle species, e.g., Perca fluviatilis, Alburnus alburnus, Rutilus rutilus, Abramis bjoerkna, Abramis brama, Gymnocephalus cernuus may be expected. The occurrence of economically preferred species such as Stizostedion lucioperca and Silurus glanis will increase. The species Esox lucius, Cyprinus carpio and Tinca tinca will be influenced by water purity and the steadiness of the water level, especially during the spawning (reproduction) and development periods. An increase in the number of Acipenser ruthenus can be expected, too. Most likely, the predominant fish will be the species Leuciscus cephalus and Abramis brama. The relative density of ichthyocenose (per hectare) as well as the production and possible fish clearance will be slightly higher than it was up until now in the main flow. Similarly, the total sum of clearance (sport and commercial clearance) can be higher than it was in the branches before inundation.

With regard to the construction of the dyke and bypass canal, the reservoir will become practically an isolated ecosystem, with ichthyocenoses depending on their own reproduction, and the system of control and partial completion from the upper situated sections of the Danube and the lower part of the river Morava.

The construction of fish passes at Gabèîkovo and Èunovo was abandoned because, given the anticipated hydrological regime and the particular composition of the ichthyofauna, the effectiveness of fish passes is eliminated. The same is true for the weir in Dunakiliti.

HEADWATER CANAL

It is not expected that large amounts of strong ichthyocenose will be formed in the headwater canal because the bottom and banks of the canal will be smooth, thus, lacking in hiding places for fish. This is not the case for the neighbouring parts of the intake structure of the branch system where, in particular, salmonoids and rheophils species are concentrated. The headwater canal will surely have a great effect on the negative impact on the ichthyofauna of the reservoir and it will have no great effect on fishing.

SEEPAGE CANALS

The thermal regime of the water of these canals is different from the thermal regime of the Danube and it is distinguished by its greater uniformity of temperature, because the water temperature does not fall below 4°C in winter, and does not rise above 15°C in summer. The water quality is classified in the I and IB classes. Both canals were relatively quickly over grown, especially with submersion vegetation. Good living conditions created a rich benthic zoocenose and, subsequently, a ichthyocenose composed of about 25 species, including salmonoids.

TAILRACE CANAL

A steady hydrocenose is formed successively with the predominance of species seeking a lotic environment with a flow speed and water volume which are greater than in those in the old river bed. After putting the waterworks into operation, conditions similar to those in the main flow were created here. Already during the winter months of 1994, species like Abramis sapa, Abramis ballerus, Abramis bjoerkna, Abramis brama, Vimba vimba, Chondrostoma nasus, but also Stizostedion lucioperca, S. volgense and esox lucius were located (water temperature of 2,8°C), in addition to species such as Acipenser ruthenus and Pelecus cultratus, which were also present. It must be said that this ichthyofauna is not representative of the entire system which is in continuous formation. The influence on fishing of this condition will be considerable.

ORIGINAL (OLD) RIVER BED OF THE DANUBE

It should be stated that phytoplankton and zooplankton in the old river bed were not of substantial importance for the existence of fish. The central bottom area is substantially different from the littoral area. The fauna of the central bottom area consists exclusively of oligochets and of chironomid larvae. In the littoral area - with its solid bottom - one finds richer fauna in terms of quality and quantity. Besides the groups already mentioned, gastropods, bivalves, hirudines, crustacea and other groups of amphibians e.g., ephermerophers and trichopters are present here. The low ichthyomass was the result of a low density of food organisms, a strong flow, a mobile bottom, high turbidity and a minor articulation of the bottom and banks.

The main flow and the branches were settled with about 28 potamic species i.e., about 50% of the total number of all determined taxons. They belong to 14 ecological groups. The most characteristic and typical species are, for example, Acipenser ruthenus, Pelecus cultratus, Barbus barus, Zingel zingel, Zingel streber and Hucho hucho. Some rare and protected species also belong here, besides those already mentioned, Cyprinus c. carpio, Gobio uranoscopus and G. Kessleri are to be found.

The actual old river bed has a smaller discharge, lower flow velocity, and a higher water purity as a consequence of sedimentation in the reservoir. Its bottom is more stable during the season and it has a richer fauna of macrozoobentose. The food base is also richer, although its structure is being gradually rebuilt. An intensive sedimentation of drifted components occurs in the lower part of the water course due to the broad and shallow river bed and slower flow. Thus, the original gravel bottom is superimposed with fine sand. Due to this fact, the ratio of oligochets increased, but the number of amphipods and trichopters decreased, becoming almost totally extinct.

The first results of ichthyofauna monitoring brought about some changes in species variety and quantity. These changes should be related to only some of the inhabitants of the littoral area. The greatest part of these species have also settled in the tailrace canal. The permanent presence of some species, such as Lota lota and especially Gobio gobio in the old river bed, offers evidence of an ameliorated water quality in the Danube.

BRANCH SYSTEMS

Initially, the branch systems carried out more important functions. During long lasting and high discharges, the area of production increased. Nutrients found in soils were transferred into the water and conditioned the dynamic development of phyto-and zooplankton. The flow velocity in the main water way exceeded 3 m.s-1. Migrant fish found refuge in the inundation system. During that period, the abundance and biomass of fish changed in the branch systems, as did species diversity, because fish typically found in the main flow were present here for the above mentioned reasons (Acipenser ruthenus, Pelecus cultratus).

These inundations coincided with the spawning period of most fish and the inundation area functioned as a natural spawning place. During decline, young fish floated away into the branches where intensive feeding went on. These fish passed progressively from the temporary branches into bigger branches and also into the main water course. At the same time, the zooplankton, which multiplied during inundation, passed progressively into the branches and the main flow. The low water levels, which occurred regularly during the autumn, caused its active migration into the branches for hibernation purposes.

This complex, but effective, mechanism began to be affected and disrupted in the 1950s. Since the end of the 1950s, it has often occurred that fish at the littoral level ended up on dry land. Moreover, inundation occurred and continued to occur periodically, but the periods of inundation did not correspond to spawning periods from a thermal point of view. This means that the spawning of the fish did not occur during optimal conditions of inundation.

The continual decrease in fish clearance beginning in the second half of the 1960s (Table 5) is the consequence of the above mentioned changes in the water regime and river topography, especially given the reduced area of inundation and the shortening of inundation duration.

On the basis of studies performed during a period of 30 years by the former Institute of fishing and hydrobiology in Bratislava, we have data on the numbers and biomass and partial data on fish production in this section of the Danube. In stationary, periodic waters, the ichthyomass reached an average of 260 kg per hectare, in the branches of the parapotamal type, it reached 400 kg per hectare and in the branches of plesiopotamal type, following a reduction in water area, up to 1200 kg. In similar branches near the source of pollution, there were only 60 kg and in the main water course 35 kg. The low ichthyomass of the water course was caused by a high flow velocity, a shifting bottom, high turbidity and a low density of food organisms. The annual fish production could be characterized similarly. In the main water course, the average value of this parameter was 18 kg. hectare-1. In branches it was about 200 kg. The three most numerous species were Alburnus alburnus, Rutilus rutilus and Gymnocephalus cernus. Their ratio related to total abundance was 89.10% and 80.66% on the total ichthyomass. The ratio of economically preferred species were 0.49-0.55% of the total number and 3.15 up to 3.30% of the mass of the whole ichthyocenose. The secondary species formed 0.88-6.27% of the total number and 6.89-11.54% of the whole ichthyomass. The accompanying species represented 98.63 to 93.18% of the number and 89.96 - 85.16% of the mass. The number of species increased from 19 to 29. The ichthyocenoses were in an unbalanced state with a predominance of non-ravenous species over ravenous ones in a very unfavourable ratio. Such had unfavourable consequences, for example, the decrease in production and a progressive decrease in valuable species, and decreases in economic value of ichthyocenose and total catch.

It is clear that the experts were not satisfied with the state of things and they looked intensively for ways to stop it. A possible way to stop it was the construction of the G/N Project. It was determined that the most effective way to maintain fishing areas would be to dam the river and fill it through the intake structure from the bypass canal in order to reach optimum fish production.

Table 1 - The original state of ichthyofauna in the concerned area of the G/N Project

(Explanation - 1 - main water course/flow, 2-inundation area
3 - area behind the flood protection dyke
4 - E:original species with higher Europ.spread
I:introduced species, K: katadrom species
PK-species with pontokaspic spread
D- endemic species in the Danube river
5 - Re - rheopfil species, L-limnophil species,
Eu - eurytop species
6 - division according to reproduction (table 4)

Species	Biotopes 1	2	3	Geogr. spread 4	Ecol a.econ. character. 5		6
I. PETROMYZONTIDAE							
1. Eudontomyzon mariae (Berg, 1931)	+	+	-	PK	Re	A.2.3	-
II. ACIPENSERIDAE							
2. Acipenser gueldenstaedti Brandt, 1833	+	-	-	PK	Re	A.1.2	HP
3. Acipenser nudiventris Lovetzky, 1828	+	-	-	PK	Re	A.1.2	HP
4. Acipenser ruthenus Linnaeus, 1758	+	+	-	PK	Re	A.1.2	HP
5. Acipenser stellatus Pallas, 1771	+	-	-	PK	Re	A.1.2	HP
6. Huso huso (Linnaeus, 1758)	+	-	-	PK	Re	A.1.2	HP
III. SALMONIDAE							
7. Hucho hucho (Linnaeus, 1758)	+	-	-	D	Re	A.2.3	HP
8. Salmo trutta morpha fario Linnaeus, 1758	+	+	-	E	Re	A.2.3	HP
IV. ESOCIDAE							
9. Esox lucius Linnaeus, 1758	+	+	+	E	Eu	A.1.5	HP
V. UMBRIDAE							
10. Umbra krameri Walbaum, 1792	-	+	+	D	L	B.1.4	-
VI. ANGUILLIDAE							
11. Anguilla anguilla (Linnaeus, 1758)	+	+	+	K	Eu	A.1.1	HP
VII. CYPRINIDAE							
12. Abramis ballerus (Linnaeus, 1758)	+	+	+	E	Eu	A.1.4	V
13. Abramis bjoerkna (Linnaeus, 1758)	+	+	+	E	Eu	A.1.5	S
14. Abramis brama (Linnaeus, 1758)	+	+	+	E	Eu	A.1.4	V
15. Abramis sapa (Pallas, 1811)	+	+	-	PK	Re	A.1.5	V
16. Alburnoides bipunctatus (Bloch, 1782)	+	+	-	E	Re	A.1.3	S
17. Alburnus alburnus (Linnaeus, 1758)	+	+	+	E	Eu	A.1.4	S
18. Aspius aspius (Linnaeus, 1758)	+	+	+	E	Re	A.1.3	HP
19. Barbus barbus (Linnaeus, 1758)	+	+	-	E	Re	A.1.3	V
20. Carassius auratus (Linnaeus, 1758)	+	+	+	I	Eu	A.1.5	S
21. Carassius carassius (Linnaeus, 1758)	+	+	+	E	L	A.1.5	S
22. Chondrostoma nasus (Linnaeus, 1758)	+	+	-	E	Re	A.1.3	V
23. Cyprinus carpio Linnaeus, 1758	+	+	+	E	Eu	A.1.5	HP
24. Gobio albipinnatus Vladykovi Fang, 1943	+	+	+	PK	Eu	A.1.6	S
25. Gobio gobio (Linnaeus, 1758)	+	+	+	E	Eu	A.1.6	S
26. Gobio kessleri Dybowski, 1862	+	+	-	PK	Re	A.1.6	-

27. Gobio uranoscopus friči Vladykov, 1929	+	+	-	D	Re	A.1.6	-
28. Leucaspius delineatus (Heckel, 1843)	-	+	+	E	L	B.1.4	S
29. Leuciscus cephalus (Linnaeus, 1758)	+	+	+	E	Re	A.1.3	V
30. Leuciscus idus (Linnaeus, 1758)	+	+	+	E	Eu	A.1.4	V
31. Leuciscus leuciscus (Linnaeus, 1758)	+	+	+	E	Re	A.1.4	S
32. Pelecus cultratus (Linnaeus, 1758)	+	+	-	PK	Re	A.1.1	-
33. Phoxinus phoxinus (Linnaeus, 1758)	+	-	-	E	Re	A.1.3	-
34. Rhodeus sericeus (Pallas, 1776)	+	+	+	E	Eu	A.2.5	S
35. Rutilus pigus (Lacépede, 1804)	+	+	-	D	Re	A.1.3	V
36. Rutilus rutilus (Linnaeus, 1758)	+	+	+	E	Eu	A.1.4	-
37. Scardinius erythrophthalmus (Linnaeus, 1758)	+	+	+	E	L	A.1.5	S
38. Tinca tinca (Linneaus, 1758)	+	+	+	E	L	A.1.5	HP
39. Vimba vimba (Linnaeus, 1758)	+	+	-	E	Re	A.1.3	V
VIII. COBITIDAE							
40. Cobitis taenia Linnaeus, 1758	+	+	+	E	Eu	A.1.5	S
41. Misgurnus fossilis (Linnaeus, 1758)	-	+	+	E	L	A.1.5	S
42. Noemacheilus barbatulus (Linnaeus, 1758)	+	+	+	E	Eu	A.1.6	S
43. Sabanejewia aurata (Filippi, 1865)	+	+	-	E	Re	A.1.5	S
IX. ICTALURIDAE							
44. Ictalurus nebulosus (Le Sueur, 1819)	+	+	+	I	L	B.2.7	S
X. SILURIDAE							
45. Silurus glanis Linnaeus, 1758	+	+	+	E	Eu	B.1.4	HP
XI. GADIDAE							
46. Lota lota (Linnaeus, 1758)	+	+	+	E	Re	A.1.2	V
XII. CENTRARCHIDAE							
47. Lepomis gibbosus (Linnaeus, 1758)	+	+	+	I	L	B.2.2	S
48. Micropterus salmoides (Lacépede, 1802)	+	-	-	I	L	B.2.5	V
XIII. PERCIDAE							
49. Gymnocephalus cernuus (Linnaeus, 1758)	+	+	+	E	Eu	A.1.4	S
50. Gymnocephalus schraetser (Linnaeus, 1758)	+	+	-	PK	Re	A.1.3	S
51. Perca fluviatilis Linnaeus, 1758	+	+	+	E	Eu	A.1.4	S
52. Stizostedion lucioperca (Linnaeus, 1758)	+	+	+	E	Eu	B.2.5	HP
53. Stizostedion volgense (Gmelin, 1788)	+	+	+	PK	Eu	B.2.5	V
54. Zingel streber (Siebold, 1863)	+	+	-	PK	Re	A.2.5	-
55. Zingel zingel (Linnaeus, 1758)	+	-	-	PK	Re	A.2.3	-
XIV. GOBIIDAE							
56. Proterorhinus marmoratus (Pallas, 1811)	+	+	+	PK	Eu	B.2.7	S
XV. COTTIDAE							
57. Cottus gobio Linnaeus, 1758	+	+	-	E	Re	B.2.7	S

Table 2 - The state of ichthyofauna in the concerned area just before damming of the Danube

(Explanation - 1 - main water course/flow, 2-inundation area
3 - area behind the flood protection dyke
4 - E:original species with higher Europ.spread
I:introduced species, K: katadrom species
PK-species with pontokaspic spread
D- endemic species in the Danube river
5 - Re - rheopfil species, L-limnophil species,
Eu - eurytop species
6 - division according to reproduction (table 4)
7 - HP - species economically preferred
V - species with secondary
8 - Degree of threatening
Ex - extinct species ,
E - species critically threatened
V - threatened species
R - valuable species
I - species demanding the attention

Species	Biotopes			Geogr. spread	Ecol a.econ. character.			
	1	2	3	4	5	6	7	8
I. ACIPENSERIDAE								
1. Acipenser ruthenus Linnaeus, 175	+	+	-	PK	Re	A.1.2	HP	I
II. SALMONIDAE								
2. Hucho hucho (Linnaeus, 1758)	?	-	-	D	Re	A.2.3	HP	E
3. Oncorhynchus mykiss (Walbaum,1972)	+	+	+	I	Eu	A.2.3.	HP	-
4. Salmo trutta morpha fario Linnaeus,1758	+	+	-	E	Re	A.2.3	HP	I
III. COREGONIDAE								
6. Coregonus Lavaretus (Linnaeus,1758)	+	+	-	E	Eu	A.1.3.	HP	-
7. Coregonus peled (Gmelin, 1788)	-	+	-	I	Eu	A.1.2.	HP	-
IV. ESOCIDAE								
8. Esox lucius Linnaeus, 1758	+	+	+	E	Eu	A.1.5	HP	-
V. UMBRIDAE								
9. Umbra krameri Walbaum, 1792	-	+	+	D	L	B.1.4	-	E
VI. ANGUILLIDAE								
10. Anguilla anguilla (Linnaeus, 1758)	+	+	+	K	Eu	A.1.1	HP	I
VII. CYPRINIDAE								
11. Abramis ballerus (Linnaeus, 1758)	+	+	+	E	Eu	A.1.4	V	I
12. Abramis bjoerkna (Linnaeus. 1758)	+	+	+	E	Eu	A.1.5	S	-
13. Abramis brama (Linnaeus, 1758)	+	+	+	E	Eu	A.1.4	V	-
14. Abramis sapa (Pallas, 1811)	+	+	-	PK	Re	A.1.5	V	I
15. Alburnoides bipunctatus (Bloch, 1782)	+	+	-	E	Re	A.1.3	S	I
16. Alburnus alburnus (Linnaeus, 1758)	+	+	+	E	Eu	A.1.4	S	-
17. Aristichthys nobilis (Richardson,1844)	+	+	-	I	Re	A.1.1	HP	-
18. Aspius aspius (Linnaeus, 1758)	+	+	+	E	Re	A.1.3	HP	I
19. Barbus barbus (Linnaeus, 1758)	+	+	-	E	Re	A.1.3	V	-
20. Carassius auratus (Linnaeus, 1758)	+	+	+	I	Eu	A.1.5	S	-
21. Carassius carassius (Linnaeus, 1758)	-	+	+	E	L	A.1.5	S	R

22. Chondrostoma nasus (Linnaeus, 1758)	+	+	-	E	Re	A.1.3	V	I
23. Ctenopharyngodon idella (Valencien.1844	+	+	+	I	Re	A.1.1.	HP	-
24. Cyprinus carpio Linnaeus, 1758	+	+	+	E	Eu	A.1.5	HP	R
25. Gobio albipinnatus Vladykovi Fang, 1943	+	+	+	PK	Eu	A.1.6	S	I
26. Gobio gobio (Linnaeus, 1758)	+	+	+	E	Eu	A.1.6	S	-
27. Gobio kessleri Dybowski, 1862	+	+	-	PK	Re	A.1.6	-	I
28. Gobio uranoscopus friči Vladykov, 1929	+	+	-	D	Re	A.1.6	-	I
29. Hypophthalmichthys molitrix (Valen1984	+	+	-	I	Re	A.1.1.	HP	-
30. Leucaspius delineatus (Heckel, 1843)	-	+	+	E	L	B.1.4	S	R
31. Leuciscus cephalus (Linnaeus, 1758)	+	+	+	E	Re	A.1.3	V	-
32. Leuciscus idus (Linnaeus, 1758)	+	+	+	E	Eu	A.1.4	V	I
33. Leuciscus leuciscus (Linnaeus, 1758)	+	+	+	E	Re	A.1.4	S	I
34. Pelecus cultratus (Linnaeus, 1758	+	+	-	PK	Re	A.1.I	-	I
35. Pseudorasbora parva (Schlegel,1842)	-	+	+	I	Eu	B.2.2	-	-
36. Rhodeus sericeus (Pallas, 1776)	+	+	+	E	Eu	A.2.5	S	I
37. Rutilus frisii meidingeri (Heckel,1852)	+	-	-	E	L	A.1.3	-	I
38. Rutilus pigus (Lacêpede, 1804)	+	+	-	D	Re	A.1.3	V	R
39. Rutilus rutilus (Linnaeus, 1758)	+	+	+	E	Eu	A.1.4	-	-
40. Scardinius erythrop.(Linnaeus,1758)	+	+	+	E	L	A.1.5	S	-
41. Tinca tinca (Linneaus, 1758)	+	+	+	E	L	A.1.5	HP	-
42. Vimba vimba (Linnaeus, 1758)	+	+	-	E	Re	A.1.3	V	I
VIII. COBITIDAE								
43. Cobitis taenia Linnaeus, 1758	+	+	+	E	Eu	A.1.5	S	-
44. Misgurnus fossilis (Linnaeus, 1758	-	+	+	E	L	A.1.5	S	V
45. Noemacheilus barbat. (Linnaeus, 1758)	+	+	+	E	Eu	A.1.6	S	-
46. Sabanejewia aurata (Filippi, 1865	?	?	-	E	Re	A.1.5	S	V
IX. ICTALURIDAE								
47. Ictalurus nebulosus (Le Sueur, 1819)	+	+	+	I	L	B.2.7	S	-
X. SILURIDAE								
48. Silurus glanis Linnaeus, 1758	+	+	+	E	Eu	B.1.4	HP	I
XI. GADIDAE								
49. Lota lota (Linnaeus, 1758)	+	+	+	E	Re	A.1.2	V	I
XII. GASTEROSTEIDAE								
50. Gasterosteus aculeatus, Linnaeus,1758	-	+	+	I	Eu	B.2.4.	S	-
XIII. CENTRARCHIDAE								
51. Lepomis gibbosus (Linnaeus, 1758	+	+	+	I	L	B.2.2	S	-
XIV. PERCIDAE								
52. Gymnpcephalus baloni Holčík et H.1974	+	+	-	D	Re	A.1.3.	S	V
53. Gymnocephalus cernuus (Linnaeus, 1758)	+	+	+	E	Eu	A.1.4	S	-
54. Gymnocephalus schraetser (Linna, 1758)	+	+	-	PK	Re	A.1.3	S	V
55. Perca fluviatilis Linnaeus, 1758	+	+	+	E	Eu	A.1.4	S	-
56. Stizostedion lucioperca (Linns, 1758)	+	+	+	E	Eu	B.2.5	HP	-
57. Stizostedion volgense (Gmelin, 1788)	+	+	-	PK	Eu	B.2.5	V	V
58. Zingel streber (Siebold, 1863)	+	+	-	PK	Re	A.2.3	-	I
55. Zingel zingel (Linnaeus, 1758)	+	-	-	PK	Re	A.2.3	-	I
XV. GOBIIDAE								
56. Proterorhinus marmoratus (Pallas, 1811)	+	+	+	PK	Eu	B.2.7	S	-
XVI. COTTIDAE								
57. Cottus gobio Linnaeus, 1758	+	+	-	E	Re	B.2.7	S	I

Table 3. Temporary state of ichthyofauna after the construction of the Variant C

(+) probable occurrence, (++) confirmed occurrence,
(-) the occurrence is not supposed, (?) uncertain occurrence

Species	Reservoir	Headwater canal	Orig. r.bed	Branch system
I. ACIPENSERIDAE				
1. Acipenser ruthenus Linnaeus, 175	+	-	+	+
II. SALMONIDAE				
2. Hucho hucho (Linnaeus, 1758)	-	-	?	?
3. Oncorhynchus mykiss (Walbaum,1972)	+	?	++	+
4. Salmo trutta morpha fario Linnaeus,1758	+	-	++	+
5. Salvelinus fontinalis (Mitchill,1815)	-	-	?	-
III. COREGONIDAE				
6. Coregonus Lavaretus (Linnaeus,1758)	+	-	++	+
7. Coregonus peled (Gmelin, 1788)	+	-	-	+
IV. ESOCIDAE				
8. Esox lucius Linnaeus, 1758	+	-	++	++
V. UMBRIDAE				
9. Umbra krameri Walbaum, 1792	-	-	-	+
VI. ANGUILLIDAE				
10. Anguilla anguilla (Linnaeus, 1758)	+	?	+	+
VII. CYPRINIDAE				
11. Abramis ballerus (Linnaeus, 1758)	+	-	++	+
12. Abramis bjoerkna (Linnaeus, 1758)	+	-	++	++
13. Abramis brama (Linnaeus, 1758)	+	-	++	++
14. Abramis sapa (Pallas, 1811)	-	-	++	+
15. Alburnoides bipunctatus (Bloch, 1782)	-	-	+	+
16. Alburnus alburnus (Linnaeus, 1758)	+	-	++	++
17. Aristichthys nobilis (Richardson,1844)	+	?	+	+
18. Aspius aspius (Linnaeus, 1758)	+	-	++	++
19. Barbus barbus (Linnaeus, 1758)	+	-	++	++
20. Carassius auratus (Linnaeus, 1758)	+	?	++	++
21. Carassius carassius (Linnaeus, 1758)	+	-	?	+
22. Chondrostoma nasus (Linnaeus, 1758)	+	?	++	++
23. Ctenopharyngodon idella (Valencien.1844	+	?	++	+
24. Cyprinus carpio Linnaeus, 1758	+	-	++	++
25. Gobio albipinnatus Vladykovi Fang, 1943	+	-	+	++
26. Gobio gobio (Linnaeus, 1758)	+	-	+	+
27. Gobio kessleri Dybowski, 1862	-	-	+	+
28. Gobio uranoscopus friči Vladykov, 1929	-	-	+	+
29. Hypophthalmichthys molitrix (Valen1984	+	?	++	+
30. Leucaspius delineatus (Heckel, 1843)	+	-	-	+
31. Leuciscus cephalus (Linnaeus, 1758)	+	?	++	++
32. Leuciscus idus (Linnaeus, 1758)	+	-	++	++
33. Leuciscus leuciscus (Linnaeus, 1758)	-	-	+	+
34. Pelecus cultratus (Linnaeus, 1758	?	?	++	+

35. Pseudorasbora parva (Schlegel,1842)	+	-	+	+
36. Rhodeus sericeus (Pallas, 1776)	+	-	+	++
37. Rutilus frisii meidingeri (Heckel,1852)	?	-	+	-
38. Rutilus pigus (Lacépede, 1804)	+	-	++	+
39. Rutilus rutilus (Linnaeus, 1758)	+	-	++	++
40. Scardinius erythrop.(Linnaeus,1758)	+	-	+	++
41. Tinca tinca (Linneaus, 1758)	+	-	++	++
42. Vimba vimba (Linnaeus, 1758)	+	-	++	++
VIII. COBITIDAE				
43. Cobitis taenia Linnaeus, 1758	+	-	+	++
44. Misgurnus fossilis (Linnaeus, 1758	-	-	-	++
45. Noemacheilus barbat. (Linnaeus, 1758)	+	-	+	++
46. Sabanejewia aurata (Filippi, 1865	-	-	?	?
IX. ICTALURIDAE				
47. Ictalurus nebulosus (Le Sueur, 1819)	?	-	?	+
X. SILURIDAE				
48. Silurus glanis Linnaeus, 1758	+	-	++	++
XI. GADIDAE				
49. Lota lota (Linnaeus, 1758)	+	-	++	++
XII. GASTEROSTEIDAE				
50. Gasterosteus aculeatus, Linnaeus,1758	+	-	-	+
XIII. CENTRARCHIDAE				
51. Lepomis gibbosus (Linnaeus, 1758	+	-	++	++
XIV. PERCIDAE				
52. Gymnpcephalus baloni Holčík et H.1974	+	-	++	++
53. Gymnocephalus cernuus (Linnaeus, 1758)	+	-	+	++
54. Gymnocephalus schraetser (Linna, 1758)	-	-	++	+
55. Perca fluviatilis Linnaeus, 1758	+	-	++	++
56. Stizostedion lucioperca (Linns, 1758)	+	-	++	++
57. Stizostedion volgense (Gmelin, 1788)	?	-	++	+
58. Zingel streber (Siebold, 1863)	-	-	++	+
59. Zingel zingel (Linnaeus, 1758)	-	-	++	-
XV. GOBIIDAE				
60. Proterorhinus marmoratus (Pallas, 1811)	+	-	++	++
XVI. COTTIDAE				
57. Cottus gobio Linnaeus, 1758	+	-	++	++

Table 4 - Ecological groups of fishes according to reproduction manner

A. Fishes not protecting fish-eggs (spawns)

A.1 Not spawning on free substratum

A.1.1. Pelagophil
A.1.2. Litopelagophil
A.1.3. Litophil
A.1.4. Phyto-litophil
A.1.5. Phytophil
A.1.6. Psamophil

A.2. Fishes protecting spawns

A.2.3 Litophil
A.2.5. Ostrakophil

B. Fishes protecting spawns and young fish

B.1. Not constructing nests

B.1.4. Phitophil

B.2. Constructing nests

B.2.2. Polyphil
B.2.4. Ariadnophil
B.2.6. Phitophil
B.2.7. Speleophil

Table 5. Fishing in the Slovak - Hungarian section of the Danube

Period	Total fishing	Econom.preferred species	Total fishing on the Hungarian side of the common section
1966 - 1970	233,8	67,8	-- (no data)
1971 - 1975	181,8	49,6	-- (no data)
1976 - 1980	181,8	41,6	364,2
1981 - 1985	145,4	41,5	337,8
1986 - 1990	83,8	30,3	249,2
1991 - 1992	38,5	13,9	151,0

Annex 26

(Translation)

VVNP RESEARCH OIL COMPANY for Exploration and Production
Bratislava

Comparison of Older and Present Views on
Geological-Tectonic Structure of the Danube Basin in
Relation to Seismic Situation of the Water Work Gabčíkovo

Final Report

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Bratislava, October 28, 1994

COMPARISON OF OLDER AND PRESENT VIEWS ON GEOLOGICAL-TECTONIC STRUCTURE OF THE DANUBE BASIN IN RELATION TO SEISMIC SITUATION OF THE WATER WORK GABČÍKOVO

Introduction

Water work Gabčíkovo is situated in the central part of the Danube Basin limited by faults from Malé Karpaty Mts on the west, by Považský Inovec and Tríbeč Mts on the north, by promontory of the Central Slovak Neovolcanites on the northeast and by Komárno block on the east. It is continuing southward to Hungary as Kisalföld.

A detailed analysis of views development on geological structure of the Danube Basin was elaborated in the stage report of this study. There was treated history of learning about geology and tectonics of its Neogene filling, underlier structure and engineering geology and hydrogeology and seismic geology studies. Stage report is supported by list of references solving these questions. For this reason the final report is limited to the most important results of older research in a manner to keep evident continuation with findings directly concerned.

Chapter 1

Older view on geological structure of the Danube Basin

In spite of the fact, that geological structure of the Danube Basin has been solved during more stages in the past, more reliable information enabling creation of comprehensive view, conception on the basin structure was acquired as late as in 50.s and later mainly thanks to immense exploration aimed at searching for hydrocarbon reservoirs namely by virtue of application of seismic and other geophysical methods and boreholes inclusive deep main boreholes (M.Dlabač, 1959). Depth range of that period methods was only 2 000 to 3 000 metres, which limited a interpretation possibility of the basin structure in its deeper parts.

In elaborated syntheses it is necessary point to especially to demonstration of continuation of horsts limited by marginal faults of Považský Inovec and Tríbeč Mts into the basin underlier and their gradual dying away southwards and demonstration of complicated fault system accumulated namely in marginal parts of the basin. Extremely complicated fault system in the marginal southeastern part of the basin in contact with Komárno block (B.Gaža, 1982) verifies signification of the Raba line in the Danube Basin forming process.

Works above all of "oil geologists" served as a basis at the basin presentation in synthetic representative achievments of Czechoslovakia as Tectonic Map of Czechoslovakia in scale 1:500 000 (M.Maheľ et al., 1984) and Tectonic Map of the Underlier of the Inner Carpathians (O.Fusan et al., 1985). Both of them are linked with analogical maps of the Hungarian territory (Füllöp - Dank et al., 1987) as a reflection of mutual cooperation of Slovak and Hungarian geologists, which started already at compilation of the Tectonic Map of the Carpathian - Balkan Mountain System and Adjacent Areas (M.Maheľ et al., 1974).

Tectonic Map of Czechoslovakia 1:500 000 points out:

- Two-levelled structure with a Pannonian level characteristic for the southern part of the basin having several disconnected Miocene small basins in its underlier.

- Transversal tectonic lines as continuation of gaps from Malé Karpaty Mts: Lamač gap (the Danube fault between Bratislava and Gönyü till the Komárno block margin), Cajla and Dobrá Voda gaps (Ludince line). Deeper range of these faults is underlined above all in Tectonic Map of the Underlier. We shall take a particular attitude to this problem later.

The latter map assumes in the whole area prevalent extent of crystalline complex of tatric type till the Čertovica fault and veporic type more easternwards in the underlier of Neogene filling. Lack of Mesozoic complexes in the Neogene filling underlier southernward of Ludince line is derived from results of a few deep boreholes.

Chapter 2

Results of new geological and geophysical research

(RNDr.Igor Hrušecký, VVNP, Bratislava)

During years 1991 to 1993 there was carried out seismic research in an extent of 550 km (Annex 1). Its Results are introducing a completely new viewpoint on deep geological structure of the area by their depths reach of interpretative information. There is a substantial change in view on the Lower Neogene level structure and course of faults, their signification, nature and structural dissection of underlying units.

Neogene development was controlled by two different phases of tectonic forming:

1. phase of crustal extension accompanied by rapid subsidence during the Karpatian, Sarmatian and Lowermost Pannonian,

2. phase of thermal subsidence from the Pannonian to Recent.

The first stage of the Danube Basin Neogene development is characterized by origin of a pull-apart basin in its central part iniciated on a left Principal Displacement Zone (PDZ) of northeast - southwest strike (it correspond to Mojmírovce fault). Process of the opening and filling of the pull-apart basin was in progress during the Karpatian till the Lower Badenian (Annex 2,4), when at its northern margin took place neovolcanic extrusions (stratovolcanoes Kráľová and Šurany).

In the Middle Badenian development of the pull-apart basin stopped in consequence of faults activity attenuation limiting the basin from the northeast and southwest. Activity of faults limiting the pull-apart basin from the northwest (Mojmírovce fault) and southeast (Raba line) is however continuing and simultaneously in the central part of the basin, westward from the pull-apart structure, is lifting-up a ridge of the northern - southern direction dividing the basin into an eastern halfgraben part and a western extensive Blatné depression in the Middle and Upper Badenian (15.5 - 13.6 million years) (Annex 5). Volcanic activity attenuated. The youngest Upper Badenian sediments are missing volcanic admixture and covering stratovolcanic formation.

Right strike-slip movement is still probably taking place on Mojmírovce fault during the Sarmatian and creating a positive flower structure in the area southward from Dunajská Streda (Annex 5). This development is continuing till the Lowermost Pannonian. The Sarmatian represents in general a period of distinctive fault activity attenuation. In some places the normal fault activity is completely stopping. There is no creation of new more important faults.

Maximal present depth of pre-Neogene underlier in the central part of the basin reaches nearly 8 000 metres and in the pull-apart basin probably 9 500 to 10 000 metres (Annex 2,4,9,10).

The first stage of development was succeeded during the Lower Pannonian (9.5 - 11.5 million years) by the second stage of the basin development (the Pannonian - Recent) characterized by nearly complete attenuation of volcanic activity in its central part. However fault activity is continuing at basin margins. There are indications of an areal (thermal) subsidence induced by changes (collapse) of deep underlier (crust, mantel) start to manifest simultaneously with the unification of up to that time partial basins into a unified sedimentation area with the deepest part in broader vicinity of Gabčíkovo (Annex 3,6,9,10).

Activity on the southwestern part of the Mojmírovce fault also gradualy fades during the Lower Pannonian (9.5 - 11.5 million years) and this its part is extint to the end of the Lower Pannonian (Annex 3,6). There is no more expressive activity on the Raba line during the same period.

The Middle Pannonian to Quaternary are marked by a very unified sedimentary sequence in the whole area of the central depression. It is an image of basin subsidence as a whole without faults participation during the phase of the thermal subsidence (Annex 3,6,9,10). However the fault activity is continuing in marginal parts of the central depression. Only long-living (renewed) faults are active among master faults, such as the southern part of Mojmírovce fault and other in bay parts of the basin. The Raba line probably renewed its activity during this period and undertakes a function of marginal fault system on the eastern side of the central depression. A negative flower structure creates in area between wells Komárno-4 and Zelený Háj-1 directly on this line (Annex 6, 9, 11). Thickness of sediments of Pannonian - Recent basin filling reaches to 5 500 m (Annex 9,10).

Tectonical-sedimentary regime

During the Badenian sedimentation was influenced by an extension tectonical regime with volcanic activity along large fault zones with a system of strike-slip and normal faults of N-S and NE-SW strike. Marine basins were represented by narrow grabens and halfgrabens with steep slopes. T s is documented by presence of extension slide bodies id tifiable in several seismic sections.

The tectonic regime have been gradually changed during the Sarmatian and Lower Pannonian. A gradual extinction of narrow grabens and halfgrabens and forming of the extensive central depression is characteric for this development (Annex 3,9,10). The start of a deltaic sedimentation was becoming the distinctive feature since the Lower Pannonian. An extension deltaic plain gradually prograding to the east and southwest starts to form in the western part of the basin. To the end of the Pannonian central depression was completely filled by deltaic sediments and in the Upper Pannonian to Pliocene predominated shallow-water lacustrine-fluviatile sedimentation.

Pre-Neogene underlier of the Danube basin is built by several tectonic units. Tatric crystalline complex is pressent in the western part. According to seismic sections Upper Paleozoic to Mezozoic envelope and nappe units predominantly of the Veporicum and North Gemericum are present in the central and northern part. They are areally predominating over the crystalline complex here. Paleogene, more or less continuous sedimentary cover lays above the latter in northern embayment parts. The tatric crystalline complex continues eastward up to the Principal Displacement Zone where it submerges (Annex 9) under a thick complex expressed in seismic sections by strong continuous reflections. It represents the most probably sediments or metasediments of more internal Central Carpathian units. Mass of Veporic crystalline complex encroaching upon the basin from east, submerges in its eastern part southwestwards, under high reflecting complex, probably Mesozoic envelop of the Veporicum or remnants of left wing of the Bakony synclinorium, respectively already of the Graz Paleozoic (Annex 10,11), and southwards under Paleozoic - Mezozoic to Paleogene rock sequences of the Bakony synclinorium (Transdanubium Central Range - TCR) (Hrušecký et al., 1993).

Chapter 3

Position of the Danube Basin in the West Carpathians tectonic scheme (Annex 12)

(RNDr. Michal Maheľ, VVNP, Bratislava)

The Danube Basin has a particular position in the Carpathian system by its morphological character (an extensive lowland), bowl-shaped frame and an intensive subsidence in the Pannonian without influence of more important faults since the Middle Pannonian to Recent. Thickness of these youngest sediments representing an independant tectonic level is manifold than on the rest of the West Carpathian area, where an uplift region prevails during this period.

The Lower Miocene level (Karpatian to Sarmatian) is already by its structural-tectonic character and thickness of sediments comparable with the Vienna Basin and East Slovakian Basin.

Individuality of the Danube Basin is in consequence of the fact that in its area we observe transition of the Carpathian tectonic style into the Alpine one. The Carpathian style is characterized by elongated horsts and deep inner basins in the Paleogene, Lower and Middle Miocene. The Alpine style is characterized by a huge belt of crystalline complex with infolded young Paleozoic - Mesozoic sequences. From the north this stripe is fringed by Northern Calcareous Alps belt with nappes analogical to Carpathian subtatric nappes (Krížna and Choč nappes).

Results of the latest geophysical research in the Danube Basin show the presence of Young Paleozoic - Mesozoic units infolded into crystalline complex. It refers to areas limited to deep faults as it is indicated by seismic sections in Mojmírovce fault (complex with a high reflectevity). It is evidently an analogue of the Alpine style of structure namely of the "Middle East Alpine".

On the other hand ties with Carpathians are proved by course of deep trans-Carpathian lines into area of the Pannonian Basin and also by course of the crystalline complex (Tatric and Veporic).

Basic tectonic lines which continuation we can follow in the basin, or in its vicinity are as follows:

- Čertovica line, continuing in the basin by two paralel branches - Mojmírovce and Šurany faults.

- Muráň line, linking through arch of Komárno faults to the Raba line. At margin of the Komárno block links to them also system of Inner Carpathian lines - Trans-Gemeric and Dios - Jenö lines.

Particular lines delimitates basic zones of the Carpathian crystalline complex. The Tatric crystalline complex reaches to Mojmírovce system. Veporic one creates a wedge between the Mojmírovce fault and Raba line. Gemeric units wedges out between Trans-Gemeric and Dios - Jenö lines. Trans-Danubian Zone of Bakony synclinorium (TCR) appears southward and southeastward of the Raba line. The former one has according to nature of lithotypes and the newest knowledge and also by character of its structure many common signs with the Inner Carpathians (Slovak Karst). A common genetical sign is also presence of thick Paleogene complex of Pannonian type.

Converging of tectonis lines (Muráň, Trans-Gemeric and Diós - Jenö lines with Raba line) and wedging out of basic belts creates a significant knot area in the Komárno arch. A notable sign of the West Carpathians is the creation of knots, wedging out of basic belts and converging of deep faults. This differs the West Carpathians from the Alps, where structural phenomena have as a rule a paralel course.

In accordance with the newest knowledge of Hungarian geologists (Horváth et al., 1993) an extensive area of Hungary trated until recently as an allochthonnous block, has basic signs of the West Carpathian structure. With this is connected a change of view on such important tectonic elements as the Raba line. This stops to functionate as a boundary between two genetically completely different blocks (the Carpathian - Alpine and Pannonian) and is becoming one of important systems of the Carpathian and Alpine system.

A separate question is function of transversal faults of northwest - souteast trend in basin structure. Their manifestations are indisputable in marginal parts of the basin, that means in Malé Karpaty Mts. Upon them are based transversal gaps (Lamač, Cajla and Dobrá Voda gaps) and upon the Komárno block they disturb the Paleogene. These distinctive manifestations led to an efford to judge them regional character and important role in the process of forming the Danube Basin also during the Neogene. The course of the Danube river and axis trend of the Quaternary depression contribute to such conclusion. The Ludince line was credited as dividing line of two types of basins: on the north Miocene depressions and on the south bowl-shaped Pannonian depression.

Manifestations of transversal faults were especially traced by seismic surveying but excepting Ivánka faults in continuation of the Lamač gap, knowhere in the Miocene were confirmed as rupture disturbances. The newest researche showed that the Ludince line is neither dividing line between different types of lines nor southern limit of spreading of Central Carpathian Mesozoic units. There are indications, that the role of these faults in the Miocene is overvaluated. They played a certain part in morpho-structural forming of the basin surface: for example transversal ridges dividing transversal depressions. However the influence of transversal faults in forming of sedimentation area is possible to observe only in orientation control of Lower Miocene depressions. Tectonic disturbance of ruptural nature is known practically from areas built by the Paleogene. Significance of these tectonic disturbancies is minimal in the Middle and Upper Miocene. In spite of this in the next chapter 4 are mentioned all indications (even if they are disputable) possible signalizing the fault presence of such directions. The conclusion of this question is that during last 700 000 years is impossible to identify any tectonic movement with a trend corresponding to such faults.

Chapter 4

Neotectonic Map of the Southwestern Part of the Region Podunajsko - DANREG (Annex 13)

(RNDr.Ján Horniš, GÚDŠ, Bratislava)

From geological viewpoint presented Neotectonic Map of Southwestern Part of the Region Podunajsko - DANREG (hereinfater Neotectonic Map) represents a map of the central depression of the Danube Basin. The map expresses surface geological setting (predominantly of the Quaternary with isopachs of the total thickness of Quaternary sediments, mainly Danube alluvia. On this map there are delineated and interpreted neotectonic faults and structures, creating actual contents of the map. As neotectonic activity we understand expressions of tectonic activity during so called neotectonic period of Alpine orogene documented during period of the Upper Pliocene and

Quaternary i.e. during last more than 3 million years.

Compiling the neotectonic map we applied three basic methodic procedures. Critical reevalution up to now existing conceptions on tectonic and mainly neotectonic development of area concerned served as original source. Existing studies are giving exhaustive analysis of tectonic structure of the central depression. However mostly they are missing data which can be provided by complex elaboration of Quaternary sequences. Therefore could not be specified function of interpreted faults in the depression during the Quaternary even at their relatively considerable number. it is valid as viewpoint of defining the relation of Quaternary faults compared with older tectonic lines as from viewpoint of more precise time definition of the Quaternary faults activity.

Reevaluation of boreholes documentation both from archives and one·s own was another important source of information for compilation of the Neotectonic Map. Results of sedimentary-petrographic, lithofacial and in a case of positive findings also micropaleontological or palynological studies of Quaternary sediments were used in division of Quaternary complex into basic stratigraphic sequences, which are clue to interpretation of neotectonics. All older, the same as complementary new obtained data, were considered also in compilation of Geological Map and Map of Quaternary thicknisses compiled in the frame of the programm DANREG. These maps simultaneously serve as data maps for compilation of the Neotectonic Map.

Space condensation of borehole.s data was provided by geophysical survey, mainly electric measurements. Simultaneously there were reinterpred results of older surveys and complexively evaluated new surveys realized in the frame of the program DANREG.

Mentioned methodical procedures provided sufficient quantity of information enabling to carry out the first abundantly exact, detailed and reliable neotectonic analysis of area concerned. We stress this statement in spite of that interpretation of fault surfaces in the filling of basin structure of the central depression cannot be always absolutely unanbiguous. More detailed time delimitation of activity of individual faults during the period of Upper Pliocene - Quaternary is based on stratigraphic classification of tectonically disturbed key dividing lines among relevant sequences. Simplified illustration of the surface geological map served as a base for expression of the Neotectonic Map. In this map there is depicted spreading of basic lithologicàl and genetical types of sediments at the surface and their rough stratigraphical classification (the Holocene, transitional period Pleistocen - Holocene and Pleistocene undivided). Areal colouring depicts stratigraphical incorporation, in the case of eolitic and slope sediments also their genesis. Lithology of sediments is expressed by uncoloured shading. Pre-Quaternary groups croping out on the surface only in a small extent at the margin of the area concerned are undivided in the map. The thickness of Quaternary sequences is expressed by isopachs in metres. Fault types are classified according to the youngest registered activity. With regard to intensive frequency of discussions on the influence of the Raba line on the youngest geological-tectonic development of area concerned we depict its course in the map although unanbiguously it is a non- -active structure during the neotectonic period. Besides the depiction of individual fault lines in the map there is for the first time interpreted tendency and relative differentiation of movements of structures limited by faults ("blocks").

Megastructure of a basin type is determining for young tectonic development of studied area (the central depression). Its subsiding and flexural down-bend was the primary tectonic activity already in the Neogene and have been continuing during the whole neotectonic period. During the neotectonic period it came to light by origination of faults of basin type consequently to balancing of stresses originated at primary flexural down-bend, mainly in marginal parts of the basin. These faults, mainly in clastic, coarser-grained and incompact sediments (sand, gravel) are marked by individual nature. There is a smaller expressiveness of fault surfaces, their low dip and occasional presence of isolated faults nonproducing structures. These faults together with a certain limitation of fault surfaces extent, mainly in vertical direction, evidently make difficulties in the identification of these faults at seismic surveying.

The basin down-bend of the central depression keeps an approximate trend westnorthwest – eastsoutheast. The depression is limited from northeastern side by distinctive Saliby fault situated northeastward of the Small Danube (out of the map). From the northwest it is limited by piedmont marginal faults of Malé Karpaty Mts and Hainburg Mts. Slovak part of the depression continues in southwestern direction continuously to Hungary. Natural boundary between Slovak and Hungarian part of the basin is given by present river bed of the Danube founded on the system of the Danube longitudinal faults. Mentioned faults are partly concordant with the course of axial line of depression.

In the following part will be given a description of territorial course of identified faults and simultaneously they will be incorporated into relevant group according to a period of their youngest documented activity. Malé Karpaty Mts marginal faults represent to a considerable extent an exception as to the character of majority of the central depression faults described above as faults of the basin type. Malé Karpaty Mts faults differ from the majority of faults of the depression by an evident coincidence with faults of pre-neotectonic period. It does concern the piedmont line of the Malé Karpaty Mts, transversally divided along Danube faults of the Devín (or Hainburg) gate into Bratislava piedmont fault (1a), Pečenský les fault (1b) and marginal Berg - Gattendorf fault (1c) in Austrian territory. Malé Karpaty Mts marginal faults belong to the youngest faults of the area concerned. Their activity have been continuing also during the Holocene and they are seismically active. The Danube fault of Bratislava (2) and Wolfsthal fault also belong to mentioned faults of Danube trend. Their youngest activity was proved from the Upper Pleistocene. These faults have similarly as Malé Karpaty Mts faults character of block faults, however the Wolfsthal fault gains gradually in direction to the centre of depression substantially a character of the fault of basin type. Biskupice fault (4) and Small Danube fault of Kráľová (5), split of the former one, belong unanbiguously to faults of basin type. These faults were, similarly as Danube faults, active still in the Upper Pleistocene. The Biskupice fault, together with the Kráľová fault, limit from the southeast an area with the terrace development of Quaternary of the proper area of the basin development. From the northeastern side identical role is played by the youngest, southeastern part of the Wolsthal fault together with the Biskupice fault.

Other neotectonic fault lines limit in territory and time partial structures of proper area of the depression. They are: Dunajská Lužná fault (6), Small Danube fault of Jelka (14) and isolated Vydra fault (13). First two faults limit a marginal, in Quaternary slightly subsiding zone of depression from its deeper parts. Activity continuing till the Middle Pleistocene was proved on all three faults. We were able to identify a few faults, predominantly of transversal direction to the Danube stream in the mentioned deep part of the depression. They are distinctive Šamorín fault (7) and Dobrohošť (8) and Gabčíkovo (16) faults limiting the most deeply subsided part of the depresion. From southeastern side the deep part of the depression is limited by Veľký Meder (former Čalovo) fault (17) and Kľúčovce fault (18) and from the northeast by Lehnice fault (12) of Danube direction. All mentioned faults, inclusive frequently discussed Gabčíkovo fault, have no geologically proved activity younger than the Lower Pleistocene. That means that there were no found out tectonic movements along these faults during the last 0.7 million years. Even older are the Danube fault of Čilistovo (9), its continuation the Danube fault of Sapa (10) and transversal to them Sapa fault, i.e. former Palkovičovo fault (11). The former one is significant also by limiting the southeastern part of the depression in which were not preserved Upper Pliocene sediments. Mentioned faults do not disturb overlying Quaternary sequences, thus their activity is not younger then the Upper Pliocene.

The Kľúčovce fault (Győr - Kolárovo line), already mentioned, limit the marginal part of the depression against its deeper parts. Very important fault of Klížska Nemá (19) and fault of Zlatná (20) belong to marginal zone faults. The Danube fault of Komárno - Ostrihom (23) is an significant and long one on Hungarian side of the Danube stream. The last three mentioned faults divide areas of the basin and terrace development of Quaternary on Slovakian and Hungarian territory. Faults of the marginal zone are marked by a relatively young activity, with the youngest activity in the Upper Pleistocene. The marginal zone of the central depresion is limited from eastern side by a part of Dolný Váh fault (22).

The territory southeasternward from the Zlatná fault already belongs to the neotectonic area of so called Komárno high blocks. As we indicated, this area is marked by terrace development of the Quaternary. Contact of the Dolný Váh fault termination with Komárno fault (21) represents a distinctive neotectonic knot of faults of Holocene - Recent activity. It is evidenced by found out high seismicity in Komárno and its vicinity similarly as at the norhtwestern margin of the territory, depression have also at its southeastern termination faults of the marginal zone and Komárno high blocks a distinctive coincidence with fault lines of the pre-neotectonic period.

Based on the neotectonic analysis of area concerned it was possible to mark off individual neotectonical structures with a different tendence and extent of movements. Marked off structures represent a comprehensive expression of repeated neocentonic and pre-neotectonic activities of the territory of depression and its margins. In proper depression their intensity represents a sum of flexural down-bend and internal differentiating movements along faults. From the map there is clear rejuvenation of faults activity from the centre of depression to its margin. From this follows that in the central part of the depression differentiating movements along faults practicaly stopped during the Quaternary and remains only a continuous flexural subsidence of the whole megastructure of the central depression. It is reflexed also in largest thicknesses of superpositionally accumulated Quaternary alluvia. The Slovak part of the central depression has a uninerrupted continuation into Small Hungarian Lowland (Kisalföld), which represents aproximatelly its symmetric image.

Chapter 5

Geodynamic model of the Danube Basin in area of the Water work Gabčíkovo

(RNDr.Miroslav Pereszlényi, VVNP, Bratislava)

During last years there was published number of studies on extension origin of sedimentation basins (e.g.McKenzie, 1978, 1981, Steckler and Wattes, 1978, 1980, Royden et al., 1980, Scalter and Christie, 1980, Royden, Horváth, Nagymrosy and Stegena, 1983, Swift et al., 1987, Friedinger, 1988 and so on). Even if details of assumed extension process are different by individual authors, basic estimates in each of these studies are resembling and according to Royden et.al. can be summarized as follows.

1. Origin of the basin is a result of an extension of underlying lithosphere acompanied by attenuation or breaking of the crust, or lithosphere and passive bulging of a hot astenospehric material.

2. Thermal anomaly produced this way cools to an original temperature of the structure and causes a thermal contraction of rocks of lithosphere and subsidence.

3. Using mathematical modelling it is possible to determine extent and time relations of extension of lithosphere from data on subsidence, sedimentation and this way it is possible to restruct thermal and tectonic history of the basin development.

For analytical purposes it is advantageous to divide the development of an extension basin into few main stages with characteristic sedimentologic and structural feateures. First stage corresponds to rifting process for that reason the lithosphere (the crust and a portion of the upper mantle) attenuates and is replaced by a passive bulging of the hot astenosphere. Simultaneously it is usually induced an initial or synrift subsidence of the basin. Both of these phenomena proceed as an isostatic response to mass changes (in the rock column to an arbitrary compensation depth) resulting from attenuation of the crust (increase of the mass) and from increase of mean temperature in the upper mantle (decrease of the mass). This phase is an response to active extension processes in the lithosphere and subsidence area is usually well placed and limited by faults. Sediments accumulated during this stage are frequently deposited very quickly and are usually disturbed by faults. The following second stage of subsidence is a passive process corresponding to cooling of the crust and the upper mantle into a state of thermal balance. Thermal contraction of lithospheric rocks causes long-term subsidence, which can be designated as a thermal or post-rifting subsidence. Thermal subsidence has usually larger areal extent than the first phase and is not limited to trogs demarcated by faults. Sediments are relatively flat laying and undisturbed. During both phases the subsidence is intensified by an isostatic compensation as a result of loading by sediments.

For modelling of the Danube Basin - broader area of the Water work Gabčíkovo we have choosen Programm BASTA by P.J.J.Frietzinger (Marine Geoscience Unit, University of Cape Town, South Africa). Program was developed for modelling of subsidence and paleotemperature in rift basins. We have choosen this program because it contains so called "best fitting model", that means that it specifies model which best fits to parameters of our area. Mathematic apparatus and program description is very extensive. It calls practically for a separate work and for this reason we do not present it here.

The isostatic compensation caused by accumulation (load) of sediments cannot completely explain the subsidence observed in majority of sedimentation basins. That is why there were developed several geodynamic models for explanation of supplementary, so called tectonic subsidence. The tectonic subsidence is "sedimentary striped and isostatically corrected depth of a given level in different times in the past". In our solving we have concentrated predominantly on mean velocity of tectonic subsidence (indiferent times of the past) which very well characterize the dynamics of basin development.

As input parameter into the model we used results of 28 deep wells of geothermal and oil exploaration supplied by results of approximately 400 km of seismic sections (Table 1 to 4). We computed mean velocities of the tectonic subsidence in separate development periods for the basin of Pannonian sediments. It is clear at first sight on maps of mean velocity of tectonic subsidence of Pannonian basin (Annex 14 to 16), that the tectonic activity of territory since the beginning of the Pannonian (11 million years) up to Recent intensively decreased. From maximum value about 4 metres per 10 000 years in the Pannonian to 0,4 metres per 10 000 years in the period of the Rumanian to Quaternary. It is visible in the period of the Rumanian to Quaternary (Annex 14, 22 respectivelly) that middle tectonic activity is manifested mainly in Komárno area what is in a good coincidence with finded earthquake epicentres at present. It is possible to state that tectonic activity of territory in the area of Water work Gabčíkovo is as twicefold lower as in Komárno area.

For an illustration there is given also mean velocity of tectonic subsidence in nothern part of the basin (Blatné depression) in the Badenian period (Annex 19), where mean velocity of tectonic subsidence culminated in the Middle Badenian period and have been reaching maximum values about 15 metres per 10 000 years.

Mean velocities of sediments accumulation in the Rumanian and Quaternary period (Annex 17) documents that the tectonic activity of an area does not need to be direct proportional to quantity of accumulated sediments, or does not to be bounded to deepest parts of the basin as the case may be.

More or less for the control of the model we constructed map of extension fo the lithosphere (Annex 18 - regular model). Coefficient of the lithosphere attenuation (β) in the centre of the basin reaches value of 1.8. At choosen start thickness of the lithosphere 100 km we are getting at present thickness of the lithosphere in centre of the basin about 55 km. It well coindicides with geophysical model (Babuška et al., 1986) and with magnetotelluric exploration. Also this fact confirm acceptability of used model (Referencies to this chapter are included in Annex 11.)

Chapter 6

Main conclusions in relation to Water work Gabčíkovo
(RNDr.Michal Mahel, Ing. Ivan Pagáč, VVNP, Bratislava)

From viewpoint of seismological conditions of Water work Gabčíkovo is important a distinctive change of views on Komárno block of Bakonicum. Until recently it was considered to be a deep anchored allochtone block. Recent studies of prominent Hungarian geologists and geophysicists (Horváth et al., 1993) convincingly show nappe-scale structure with a dominant role of thursts und regional overthrusts. This has an individual significance also for the judging of seismicity of the territory and for the character of the Raba line. In conceptions of geologists the latter one is recognized no more to be a tectonic boundary between two autonomous systems (Alpine and Pannonian). Both of them at present show to be parts of uniform system with large number of dominant longitudinal lines of regional significance. So thus the Raba line is becoming only one link in this system with a close linking on the system of Carpathian lines (Muráň and Trans-Gemeric lines).

The West Carpathians are linked with the Bakonicum also by other regional Carpathian line - the Čertovica line passing through Gabčíkovo area and continuing to Hungary. In new seismic sections both on our and Hungarian side it shows to be a typical positive flower structure. It is a remarkable phenomenon on the West Carpathian regional tectonic lines. It is related to the forming of Carpathian arch. Even it determinates also aproach to the solving of several tectonical problems in territory of the Danube Basin and leads to following conclusions:

1. The tectonic line found out in Gabčíkovo territory is neither the Raba line nor its branch. It represents a part of the Čertovica system. By its geological structure this system differs from innermore one which the Raba line belongs to. Any more distinctive seismic manifestations were never recorded on this Čertovica system.

2. In its northern part in Slovak territory the Raba line changes its direction from southwest - northeast to westsouthwest - eastnortheast and by an arch form documented by the Komárno faults system is linked to the Inner Carpathian system represented by Diós - Jenö line and its branch - Trans-Gemeric line (Plešivec line). It links also to northern more Muráň line. Komárno sector thus represents a knot of convergency of these three significant lines. Moreover the arch nature is expressed by branching of Komárno faults into a form of en echelon structures. It is typical for knot regions. In this lies individuality of the

Komárno area and directly with this is connected its increased but regionally limited and by tectonic controlled seismicity.

Mentioned basic tectonical phenomena have as a rule deep nature. This explains also a deep position of earthquake centre as it follows from the earthquake manifestation analysis.

3. Close structural link of Carpathian units with the Bakonicum (the Komárno block is its marginal part) as well as with Alpine units asks for a new view on forming and role of transversal faults in geological structure. Then phenomena manifest only during some periods of the development, for the last time in the Oligocene and Lower Miocene (that means before 20 to 25 million years). It is necessary to approach also to the evaluation of fault significance along the Danube from this viewpoint. There are no reasons for assuming young activities along faults. Even as meaningfull lines as Ludince line in the northern part of the basin, according to the nevest knowledge, does not represent the southern boundary of spreading of Carpathian units. Seismic sections 551 and 556 show that the pull-apart basin in Gabčíkovo territory (far southward of this line) is filled even more than 10 kilometres thick sediments evidently of Carpathian type.

4. Result of stage forming of Carpathian arch and rotation is the fact that single development stages (mainly in the Neogene) show individualities also in the forming of structures. It is possible to consider a levelled structure here. That is why also structural plan in upper more level mostly does not copy plans of lower more levels. An example is given by disconformity of Middle Miocene (Middle Badenian) directions, being unanbiguously diagonal to older Upper Cretaceous ones. For this reason in the Danube Basin

it is incorrect to draw directly all round Miocene faults into underlier. It is very important in judgement of seismicity sources, e.g. in relation to horizontal movements. Such movements functionated along the Mojmírovce fault (Čertovica line) in the Lower Miocene to Lower Pannonian with a different nature of tectonic expression, but not in the Upper Pannonian and Pliocene.

5. The Danube Basin from viewpoint of the tectonic development during the Neogene can be divided into three tectonically different areas developing by their own way. Westernmost is the Malé Karpaty Mts area involving a belt of approximately 10 kilometres in width at eastern margin of the Malé Karpaty Mts. Specific for this belt is existence of prolonged marginal down-bend (Blatné depression) predestinated by faults of northeastern - southwestern direction and an intense decreasing of thickness of the Miocene approaching to margin of the Malé Karpaty Mts.

Another marginal area are Komárno blocks with the Paleozoic, Mesozoic and so called Pannonian type of the Paleogene and with an intensive tectonical disturbance by faults system in the Miocene and Paleogene. In the Paleogene it is possible to follow also manifestations of transversal faults of northwestern - southeastern direction here. Western limitation of this block is represented by the Raba fault system.

The central part of the basin is represented by block with the tectonic development in the Upper Miocene and Pliocene to Quaternary connected above all with a total subsidence, particularly intensive in the Pannonian (thickness to 5 500 metres) and dying away in Quatenary (thickness up to 500 metres).

Characteristic sign of the neotectonic development of the Danube Basin is then downthrow along marginal faults and down-bend in central parts. That is why marginal faults at

Malé Karpaty Mts and at Komárno block disturb the whole Miocene filling, while faults in the central part in direction to younger sediments die out.

6. Study of the neotectonic development of the central depression of the Danube Basin in all basic questions is in accordance with results of pre-neotectonic developments studies.

Also in the youngest stage of the development it is evident rejuvenation of movements in direction from the centre of depression to its margin. In the central part there are no traces of differentiating movements along faults. It remains only flexural transversal down-bending of the whole Neogene structure of the central depression. Faults transversal to the direction of the Danube, inclusive Gabčíkovo fault, do not manifest younger tectonic activity than the Lower Pliocene.

It is possible to identify a tectonic knot of Holocene - Recent activity at linking of the Dolný Váh fault to Komárno fault also in the youngest development stage. This explains existence of the earthquake centre in Komárno area.

Certain difference in comparison with conclusions following from the study of reflection-seismic sections is interpretation of larger number of faults in the central depression. In seismic sections faults disappear in the Upper Pannonian and Pontian. Neotectonic study identifies them still in the Lower Pleistocene. This discrepancy is explained by inexpressiveness of these faults, small dip, limited extent of fault surfaces and by fact that these faults do not produce accompanying structures in youngest stages of the basin development. That is why they are unidentifiable by seismic survey.

The Neotectonic Map also depicts faults of so called basin type originated as a result of balancing of stresses at flexural down-bend of the central depression. Their spreading mainly at northern margin of the depression creates an impression of continuous faults. They do not represent deeper reaching vertical disturbancies, but in majority of cases only shallow non-ruptural discontinuities. Thus they are faults genetically different from deep and Neogene faults. That is why majority of them does not link directly to older faults.

7. An extraordinary relevant factor which has to be taken into account in consideration of the seismic menace of the Water work Gabčíkovo are confirmation and partly new findings on lithological nature of young filling in a broader territory of its location. Primarily those are 300 to 500 metres thick Pleistocene - Quaternary gravels and at the same time also to 3 500 - 4 000 metres thick complex of deltaic and lacustrine sediments of the Pannonian with prevalence of sands and gravels. Silencing effects of these formations has for judging of the seismic menace and construction engineering conditions a particular significance and gives unanbiguous favourable recomendations for the benefit of this construction.

8. From geodynamic viewpoint the maximum of tectonic movements in the Danube Basin took place during the period of Lower (22 to 16.5 million years) and mainly Middle (16.5 to 13.6 million years) Miocene when tectonic subsidence has culminated during the period of Upper Miocene (13.6 to 5.6 million years) the tectonic phase of subsidence is gradually silenced and practically already only dies away during the period of Pliocene (5.6 to 1.8 million years) or Quaternary when starts to dominate thermal stabilization of the basin.

Conclusions

Presented report contains some findings being completely new from viepoint of up to this time knowledge. VVNP, Bratislava had a possibility to gain and interpret such knowledge above all for that reason that in frame of a joint company with firm MAXUS ENERGY CORPORATION, Dallas, Texas, USA realized seismic research of top quality, processed by Western Geophysical, USA. High quality, communication value and large depth range of these measurements was possible to utilize also for the solution of question of seismicity in territory of the Water work Gabčíkovo.

(Translation)

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ANALYSIS OF CONTRIBUTION OF WATERWORK GABČÍKOVO FOR INTERNATIONAL NAVIGATION

The Danube as a natural transport connection point to the Western part of Europe and its connection with Black Sea was already in the past the object of efforts to utilise it for navigation purposes also from non-riparian countries. Therefore one cannot wonder that assertion of these ideas was put also into respective international treaties with aim to guarantee transport utilization of the Danube watercourse for all countries.

It is natural that the fact to guarantee the interests ensuing from transport politics of individual countries and in utilization of the Danube phenomena, had to be manifested in establishing international regimes of navigation.

(....)

The Danube countries have expressed their will to realize all necessary works to guarantee and improve navigation conditions so as it is ensuing from the "Convention concerning the regime of navigation on the Danube, Belgrade 1948.

The realization of this obligation was pointed out - besides other profits - with conclusion of an international Treaty between Hungary and Czecho-Slovakia. If these aims were not fulfilled, what was the cause of protests for.ex. of industrial and commercial chambers from West-Europe sent to Governments of Hungary and ČSFR, it is necessary to examine causes why these international and legal obligations of both states were not realized and fulfilled within the provision of article 3 of Belgrade convention.

It is important to stress that with regard to these obligations, it is not allowed to deteriorate navigation conditions on the Danube watercourse.

Just this fact - besides other evident profits - was a cause to conclude an International Treaty which had to guarantee fulfilment of obligations ensuing from Convention concerning the regime of navigation on the Danube in the whole continuity. If conditions of Convention is accepted also by the Agreement on regulation of water management issues on boundary waters between riparian states with a common section, i.e. between Hungary and Czecho-Slovakia in such a way that maintenace and signing of watercourse (Danubian) and demarcation of navigation route should be according to recommendations of the Danube commission (article 13 of the said treaty), a question is raised how and in which way can be this problem objectively solved. The answer is old: with a System of waterworks G/N. (....)

From this point of view, the said analysis of contribution of waterworks Gabčíkovo concerns the basic condition in the above-mentioned meaning - to make the Danube watercourse navigable.

The continuity of the development of national navigation was demonstrated also by the fact that there was a substantial qualitative change in used navigation technologies in the last 20 - 30 years. These changes had, of course, impact on demands concerning navigation depths, widths of navigation route and radius of windings on navigation route.

This fact is very important because gradually dominant technology of push navigation differs substantially in demands on parameters which must be held for a watercourse. Taking into account all these viewpoints, it is obvious that analysis of navigation conditions before and after putting the Gabčíkovo part of the project into operation has a principal importance also for international navigation on the Danube in rkm 1870 - 1810.

In the years 1988 -1992 before putting the Gabčíkovo into operation, there were in annual average, in the mentioned section, 7 ford sections and 1 permanent strait (narrorws). Their occurence caused that the utilization of ship draft (plunge) (25 dm and more) could have been realized as follows:

	in days	% of given time
1988	225	61,6
1989	181	49,6
1990	165	45,2
1991	167	45,7
1992	222	60,7

The utilization of ship capacities was thus naturally very limited. In the observed period, it represented in annual average practically only half of time funds. Naturally, the limited navigation depths did not allow to utilize the whole year for navigation.

At already mentioned changes concerning used technologies of navigation, it is necessary to state that predominant push navigation asked for a need to guarantee sufficient navigation depths especially for push tugs with regard that their draft (plunge) is between 18 - 22 dm according to respective tug type. It is clear that by disburdening freight (cargo) ships, push tugs are determinant. If the proportion of push vessels is about 60%, it is natural that this reality (fact) is very expressive at utilization of watercourse for navigation.

For illustration, the quantity of vessels (ships) going through profile Gabčíkovo in examined period was:

	quantity of vessels
1988	21 344
1989	21 519
1990	20 857
1991	18 104
1992	17 876

Even if there is a decrease in number of vesels, it must be taken into account that it is caused by change of political situation in former Yugoslavia and it cannot have a permanent character.

After mentionning these facts, we can procede to evaluation of contributions of the Gabčíkovo project for international navigation on the Danube between 1870 - 1810.

First, 7 ford sections were eliminated which formed the greatest obstacle in international navigation and thus unproductive standing of vessels was also eliminated. The velocities of ships and groups of vessels increased due to decreased of water flow velocity. This positive component (decrease of water flow velocity) had an expressive impact also in upstream navigation in the profile of the old bridge in Bratislava where, in the past, occured a lot of accidents due to these causes and due to cross components of water flow.

The diversion of navigation from the old Danube eliminated a unfavourable navigation narrows in Bagomer (length 1000 m and width 100m)

The creation of favourable navigation depths in port basins in Bratislava is of the same importance. As compared to previous period the ships had greater problems with low water levels, or their manoeuvre was rendered impossible, the present situation eliminated it, even if the level of impounded water has not yet reached 131, 10 B.p.v. Response of navigation staffs (teams) is positive to the solution of navigation. But it must be stated that some technical deficiencies, especially those of navigation locks, were not yet removed, lowers the total impression and positive impacts of Gabčíkovo contribution.

(....)

Annex 28

(Translation)

RESOLUTION
OF THE PRESIDENCY OF THE SLOVAK NATIONAL COUNCIL

of May 28, 1966, No. 85

concerning the report of the Central Commission of Public Control and Statistics on causes of dyke break and damages arisen in the Danube Lowland during the 1965 flood and the Government proposal of the resolution concerning this report.

The Presidency of the Slovak National Council, on its session on May 28, 1966, discussed the report of the Central Commission of Public Control and Statistics on causes of dyke break and damages in the Danube Lowland during the 1965 flood as well as the proposal of the government resolution and takes the following

p o s i t i o n:

the report identifies correctly the objective and subjective causes of the dyke break on the Danube, in the light of actual degree of knowledge and available documentation.

I.

Together with deficiencies in the methodology of water management and application of subjective views in its organizational structure, it considers alarming that the allocation of financial and material means for maintenance and operation of dykes, of drainage canals and pumping stations was insufficient, and that the fulfilment of decisions of state authorities concerning the comprehensive solution of the Danube (the term covering also GNP) was inconsistent, what constributed in a considerable measure, the rise and extent of damages during the Danube flood in 1965. The flood protection and comprehensive utilization of the Danube were not solved hand in hand with the economic development of the region.

The Presidency of the Slovak National Council, in this period, considers as for the most important task to ensure the flood protection of the territory in connection within the compprehensive utilization of the Danube. It underlines mutual relationship between flood protection and prompt decision of the concept of Danube utilization and the necessity of their interdependence as to the content and time scope. The actual situation is the situation of permanent flood danger which demands permanently significant expenditure for flood protection as well as for the reconstruction of water management facilities, but does not guarantee permanent protection of territory.

Following the submitted analysis and recent experience, it considers the consistent fulfilment of adopted decisions concerning the comprehensive utilization of the Danube as the most advantageous solution from the viewpoint of development of agriculture, industry, settlement, navigation, utilization of energy, together with protection of the Danube Lowland.

II.

Within the 2nd stage, circa 800 billions of Kčs are planned for reconstruction works on the Danube till 1970. The definitive protection of territory (without the construction of the water work project on the Danube), including adaptation of water management situation in the Danube Lowland would cost additional 2,1 billions Kčs, according to the study of Hydroprojekt and the Directorate of Water Management Development in Bratislava.

Thus, it would mean that financial means isolately spent for flood protection of the territory and for adaptation of water management situation in the Danube Lowland would reach 2,9 billions Kčs. But the proportion of costs of the Czechoslovak side on an economically more effective solution of the Danube with its comprehensive utilization would be about 4 - 5 billions Kčs and at the same time, flood protection of the territory, adaptation of internal water regime, utilization of energy and improvement of navigation would be reached.

The experience with the 1965 flood demonstrated that contrarily to previous economic analyses in evaluation of contribution of water works on the Danube, a substantially higher proportion should be attributed to the flood protection of territory.

(....)

(Translation)

The Government of the Czechoslovak Socialist Republic

RESOLUTION
of the Government of the Czechoslovak Socialist Republic
of April 10, 1967, No. 101
concerning the report on causes of dyke break and damages arisen in the Danube Lowland during the 1965 flood

The G o v e r n m e n t
after discussing the report on results of verification of causes of dyke break and damages arisen in the Danube Lowland during the 1965 flood s t a t e s (....)

Even if the problem of filtration failures and its possible consequences have been already well-known for some years, the protection against filtration failures was not technically solved. This complex problem, with regard to considerable length of dykes and very variable geological composition, should be eliminated only in the 3rd stage of reconstruction works and safety works on the dykes and their foundations or within the construction of new dykes in connection with the water work project on the Danube.
(....)

It is unfavourable that the utilization of the Danube and its coordination with reconstruction works and definitive flood protection of the Danube Lowland was not yet clarified. The coordinating authorities responsible for the preparation of the concept of the water work project so far considered the construction of the Danube Project in isolation from the demand for territory protection and with considerable time delays.
(....)

IV. r e q u e s t s
1. the President of the State Planning Office to ensure the harmonization of the G/N Project with other intentions and possibilities of development of the Czechoslovak economics up to 1970 and in following years, starting from

the principle that sooner or later this Project is to be constructed. The result shall be submitted to the Government with proposal of choice of optimum variant of water works on the Danube which will be discussed later by the Government.

2. the Head of the State Planning Office, Ministers of Finances and for Forest and Water Management to ensure financial means, in the plan for 1967 and 1970, to guarantee smooth transit to the 3rd stage of protection of territory, according to the demands of the Minister for Forest and Water Management.

Annex 30

(Translation)

The Government of the Slovak Socialist Republic

Number:1019/1072

Material for the Government
of ČSSR

P r o p o s a l
for the comprehensive utilization of the Danube

(....)

Bratislava, March 1972

Annex No.I - Detailed report concerning the proposal of the comprehensive utilization of the Danube

(....)

The safety and flood protection of the whole interested territory of the Danube Lowland, places and communications, industrial structures, agriculture and forest areas, as well as the intensification of agricultural production demand to increase the level of the protection against breaking of dyke foundations and control of seepage, precipitation and groundwater regime.

The reconstruction works envisaged in the 1st and 2nd stages don't guarantee the necessary flood protection parameters as proposed within the 3rd stage.

In the wider complex of the 3rd stage of flood protection measures, some separate constructions are organically included, such as:
Komárno - flood protection of the city (in the 2nd stage - without antifiltration measures), flood protection of Bratislava (will be realized in the 3rd stage and therefore it is not included in the Annex No.2), protection of water supplies of island Sihoť.

The realization of protection measures envisaged within the 3rd stage is urgent, but it is necessary to harmonize it with the construction of water work on the Danube. In case of realization of the 3rd stage of protection measures and subsequent construction of the water work project, majority of financial means for the 3rd stage would be useless because significant number of structures of the 3rd stage would loose its function.

Therefore it would be useful to utilize financial means, calculated for the 3rd stage of reconstruction works, directly for the construction of the water work project on the Danube which would guarantee, in addition to its own functions, also the protection of the Danube Lowland with even higher degree of safety than the 3rd stage could guarantee. The costs for the 3rd stage was calculated for 2.042 millions Kčs (Annex No.2). This solution would guarantee the protection of territory below Bratislava against floods, but from the national and economic viewpoint it is not advantageous, because it is solution with only one purpose. The majority of investments, in the case of the G/N Project construction, would be useless and would burden only the Czechoslovak side.

Active protection of the Danube Lowland (Annex No.3)

If the protection of the Danube Lowland is not constructed separately, but integraly with the construction of the derivation alternative of the water work project on the Danube, then majority of financial means necessary for the protection of territory would be used for more purposes.

The designed water work on the Danube and protection measures would have many common structures, for ex. dykes on both sides of the Danube below Bratislava, along the rivers Hron, Nitra, Žitava, the Malý Danube etc...

The calculation of advantages of the joint solution of definitive protection of the Danube Lowland with the construction of the G/N Project demonstrates that the construction of the Project can substantially lower the costs for flood protection. (....)

Annex 31

(Translation)

Final Protocol from the negotiations of Czechoslovak-Hungarian Government Delegations, 18-20 April 1963

FINAL PROTOCOL
OF GOVERNMENT DELEGATIONS
April 18-20, 1963

about the results of negotiations of government delegations of Czechoslovak Socialist Republic (ČSSR) and the Hungarian People's Republic (HPR) on common utilization of the Danube in the section Bratislava-Nagymaros held in Budapest on April 18-20, 1963.

The government delegations of ČSSR and HPR discussed in Budapest on April 18-20, 1963 main principles of common utilization of the Danube in the section Bratislava-Nagymaros. At the discussions took part:

from Czechoslovak side:

Stanislav Vlna - Vice-Minister of the State planning commission chief of the government delegation

Michal Sabolčík, CSc. - President of the State planning commission

Ing. Jiři Baier - Vice-Minister of the Central office of energetics

Ing. Ladislav Mertl - director of dept. Water management of the State Planning commission

from Hungarian side:

Dr.Ing.Miklos Ajtai - President of the State planning office chief of the government delegation

Ing. Imre Dégen - chief of the Main Office of water management

Ing. Andráš Levai - Vice-Minister of heavy industry

Ing. György Osztrovszky - Deputy president of the State planning office

Dr.Ing.János Szabó - Vice-Minister of Industry of construction

After discussing the results of preparation works up to this time and the report of common commission of experts, the government delegations came to the following conclusions:

I. Checking on the fulfilment of agreements contained in the final protocol about the results of negotiations of government delegations of Czechoslovak Republic and HPR about the utilization of water energy of the Danube in the section between Bratislava and Nagymaros on October 7, 1958.

1) The government delegations state that both sides fulfilled the main task which the government delegations determined at their

session in October 1958, i. e. to solve in the most advantageous way the utilization of the Danube in the section Bratislava-Nagymaros. They appreciate help of the Soviet experts from Hydroprojekt USSR to this problem.

2) A detailed analysis of fulfillment of these tasks is in Annex A of this protocol.

II. Approval of the new concept of the utilization of the Danube in the section Bratislava-Nagymaros and main parameters of the waterwork.

1) After evaluation of studies, after their estimation by Soviet experts and with regard to schema of complex utilization of the Danube agreed by the Council for Mutual Economic Help, the government delegations approve the new concept of the utilization of the Danube between Bratislava and Nagymaros with construction of Water System of Locks (installed output ca 900 MW, annual production of electric energy ca 3.700 GWh - these values will be precised with the elaboration of the common investment task).

In this water system, the upper diversion construction would produce mostly peak energy and lower waterwork Nagymaros would function as balance reservoir and would produce current energy.

2) Further data about the new concept are in Annexes B and C of this protocol.

III. Conditions of common realization

Route of diversion canal.

1) The government delegations state that the route of diversion canal can be considered as practically equal if it is led on right or left side of the Danube.

2) The government delegations agree that the diversion canal be led on the left bank, Czechoslovak bank of the Danube.

3) The government delegations agree that two local corrections of state border take place in a way that the state border would follow the axis of diversion canal leading to hydropower plant, crossing the hydropower plant and going upright back to the original state border in the river bed of the Danube. Similarly at the weir in Hrušov (Dunakiliti), the state border would pass the axis of the weir with a local correction.

4) The government delegations agree that within the framework of planned modification of boundary flow between both states, the corresponding territory substitution be given for the territory ceded according to par. 3.

5) The orientation situation of proposed modification of state border is in Annex D. The precise situation will be elaborated after the definitive placement of hydropower plant at Gabčíkovo and at weir Hrušov-Dunakiliti.

Ratio of produced energy and division of costs and works.

6) The government delegations determine the ratio of produced electrical energy from the Water Scheme on the Danube in the proportion 50%:50%, this proportion related to both sorts of produced energy (basic and peak energy)

7) The government delegations agree that both sides take over the investment costs in the proportion 50%-50% each, i. e. investment costs for energy production. The investments which are not immediately related to energetic utilization or which should serve for amelioration of present state, will be guaranteed by each side on its own territory with own means.

8) The costs for the second navigation lock at the river step Nagymaros and for second navigation lock at diversion water scheme, which construction is demanded by navigation, will be covered in the proportion 50%-50%.

9) The government delegations consider for necessary that both sides guarantee also the investment costs which are not immediately connected with energetical utilization, but which are absolutely necessary and designed for putting the waterwork into operation.

10) According to the results of preparation works and by ratio on produced energy 50%:50% it is supposed that the Czechoslovak side would cover from the total of the investment costs 6.100 mil.Kčs (11.182 mil. Ft) 3.085 mil. Kčs (5.666 mil. Ft) and the Hungarian side 5.516 mil. ft (3.015 mil. Kčs) the calculation of costs was made on the basis of prices valid in both states in 1960 and on the basis of elaborated studies and calculations. Design costs and costs for investment supervision are not included in these prices. By elaboration of common investment task it will be necessary to reach the effectivity of this

project and to think over the extent of investment supervision, design works and unforeseen costs.

11) The government delegation agree that the participation of both sides on the construction of water project on the Danube in the section Bratislava-Nagymaros would be as follows:

a) both sides realize necessary investments first of all on the own territory

b) the compensation of differences which arise by the division of investment works, will be done during common realization according to special agreement.

Management, operation and maintenance

12) The government delegations agree that both sides manage, operate and maintain the water project on the Danube as the common investment. The costs connected with management, operation and maintenance cover both sides in the proportion of agreed ratio on produced energy (50%-50%)

13) The government delegation agree that both sides participate in advantages and disadvantages ensuing from the common construction, management operation and maintenace in the proportion 50%-50%.

Period of construction

14) The government delegations agree that according to the present documentation, the period of construction of water schemes will last seven years, and both water schemes will be constructed parallely. Both sides will try to shorten the period of construction.

15) The government delegations recommend that the State planning commissions of both states discuss by the end of May 1963 in presence of representatives of common experts commission the possibilities and conditions of including the construction of water schemes into long-term plans. It is recommended that the construction begins in the shortest period possible and be finisted by 1975.

IV. Elaboration of common investment task, main principles of interstate treaty and organisational quarantee of further works

1) The government delegations agree that the common investment

task of water schemes is elaborated on the basis of principles mentioned in this final protocol.

2) There will be main principles for elaboration of interstate treaty concerning construction, management, operation and maintenace of water project in the common investment task.

3) As basis for common investment task will serve the design documentation elaborated up to this time.

4) The government delegations determine the following course for other works:

a) they appoint the common experts commission to let elaborate at latest in one year period the common investment task including main principles of interstate treaty

b) they impose on the common experts commission to establish "The group for preparation of design works" and "The group for elaboration of interstate treaty" and to determine the directives for work of these groups as well as to determine time schedule,

c) the common experts commisssion will evaluate the proposition of common investment task and submits it to the government delegations for approval

d) the government delegations will submit the approved commmon investment task to competent authorities for approval.

This final protocol was done in two copies, one in Czech language and one in Hungarian language.

Both copeis have the same validity.

The government delegation will submit this final protocol to their respective governments and will inform each other about the stance of their governments.

In Budapest, April 23, 1963

/Stanislav Vlna/	/Dr. Ajtai Miklós/
Chief of gov. delegation	Chief of gov. delegation
ČSSR	HPR

Possibilities of River Restoration

on the Danube in relation to the Gabčikovo scheme

Martin N.R. Jaeggi, Swiss Federal Institute of Technology, Zurich

(short version of a lecture given at the Ministry of Environment of the Slovac Republic, Bratislava, October 8, 1993)

First, a more precise definition of river restoration, or river revitalization, as it is sometimes called, is needed. Normally, it is supposed to reverse the effects of a river regulation which has been executed in a purely technical way for flood protection, navigation or hydro power use. Such works may have left little or no natural elements. By river restoration, it is hoped to reintroduce natural elements and in particular a variety of natural habitats which has been lost.

The original natural river as it existed before the impact of major regulation schemes has to be the model for a river restoration. In Central Europe, this means looking back into the middle of the 19th century. Consultation of old maps is very useful, but also the comparison to natural environment with similar characteristics. The study of New Zealand rivers has proven to be extremely useful in Swiss river restoration projects.

A full recovery of the natural conditions is normally not possible. A combination of technical and environmental aims conditions a river restoration project. The question may be raised if there are pure restoration projects. On a small scale and as pilot projects a number of them have been realized. Recent experience shows however that large scale river restoration is possible only if some technical problem must be solved anyway (Jaeggi, 1992b). The restoration project then represents an alternative to a conventional purely technical solution.

The introduction of environmental impact studies has triggered important modifications to planned hydro power schemes. If river restoration has been included in the project, the impact study became more positive and the chances of passing the project at the authorities and in the public were increased. The more the actual river concerned with the project had been altered compared to its natural situation, the more such a combination of hydro power use and restoration was seen in a favorable way.

For the Danube reach concerned by water retrieval by the Gabčikovo scheme, it is therefore important to distinguish the following situations :

1. The more or less natural situation before 1850

2. The situation resulting form the major regulation realized by the Austro-Hungarian Empire to improve mainly the navigation, and the subsequent works. The intensive dredging near Bratislava which resulted in an improved flood safety, but also in a dramatic lowering of the bed, should be mentioned here

3. The present situation with the scheme in operation. Less water is flowing in the Danube. No changes have been made to the river bed

4. The eventual future situation after inclusion of the restoration of the concerned reach of the Danube into a multi-purpose project. Restoration should be orientated to situation 1 and not 2

The Reussdelta project in Switzerland (Jaeggi and Peter, 1983; Lang, 1985; Jaeggi, 1986) may now be considered an early successful example of river restoration. Flood protection in the alluvial plain upstream of Lake of Lucerne was achieved by river training and the realization of a cutoff creating a new mouth. When sediment was deposited there, the river levees were continuously advanced into the lake. The fine sediment being deposited in the deep part of the lake, shore erosion now occurred in the region of the old delta. Later, gravel dredging accelerated the erosion.

A renewal of the mining licence was obtained only after a long public debate and after the proposal of a multi purpose project had been accepted. The idea was brought up to restore a natural delta landscape. Thus, fine sediments would be resupplied to the shore, and gravel dredging could be concentrated to the zone of deposits which occurred between 1850 and 1900. The idea was very unusual in 1980 when it was put forward. Only the study of natural river morphology in New Zealand and a specific hydraulic model investigation could convince the authorities concerned. In 1991 the project was accomplished. It is expected that in the delta zone wide habitat variety is created which should attract endangered species. Therefore, the delta zone is closed to the public.

The study Emme 2050 (Hunziker and Jaeggi, 1988) and the subsequent realization of the local widening on the Emme river near Utzenstorf (Jaeggi and Pellandini, 1988; Zarn, 1992) is another example of a technical solution which covers restoration aims. The regulation works, which extended over a period of about 50 years and which were started around 1870 induced a slow but consistent erosion trend. Originally this had been well accepted since the major fear at the time was aggradation. Furtherly, evacuation of bed material was deliberately left to the river. With time, an increasing number of drop structures had to be built to compensate the overcapacity concerning sediment transport. If the same policy is followed in the future, the Emme river will show at low flows a series of cascades with ponding reaches in between. There will be no more reaches with free flowing conditions. This in turn will result in a loss of habitats.

As an alternative, a solution with local widenings has been proposed. In the widened reaches sediment transport capacity will be reduced and and a steeper energy slope will be established there. These steep reaches will compensate for the general trend towards a flat slope in the reaches narrowed by the original regulation. The solution is technically and economically equivalent to the traditional approach using drop structures. Environmentally, it is far more acceptable since these reaches contain a lot of elements of the original natural river. A large variety of morphological elements like gravel bars and islands and also variable flow conditions (pool and riffles) can be expected. Specific model tests showed which type of training works have to be foreseen to prevent excessive lateral erosion.

Water power development has become increasingly difficult in Switzerland over the last years. A first proposal to increase the production of the existing plant near Wynau on the Aare river which included the dredging of the bed downstream of the power plant on a length of about 1.5 km was turned down by the Swiss Supreme Court in 1983 because of violation of the law on fishery. A second project proposed the building of a bypass gallery to use the head in this downstream reach, leaving a reduced discharge in the river. This proposal had to be investigated by an environmental impact study, a procedure which had just been introduced by law.

This study suggested modifications to the flow regime and showed, that with a few other modifications the project reach could become environmentally more valuable that the actual river. In particular, there are hardly no remnants of the original alluvial forests. The reason was mainly extensive agricultural land use right to the river bank. Because of the changed flow regime, development of such areas in the existing river bed can be expected. While in the same period many water power projects have been turned down because of environmental reasons the Wynau project obtained the licence for further development in the Cantons concerned.

Recently, the planned development on the Alpine Rhine between Domat/Ems and Mastrils has been given a positive advice by the Environmental Authority of the Canton of Grisons. Here, the main environmental concern was the future development of the Mastrils alluvial zone. It was feared, that the open gravel bars may disappear, which are an important habitat for a rare bird species. The environmental impact study showed that much damage in this respect was due to gravel mining over the last years. The future development including water derivation for power production would even create a higher proportion of open gravel bars compared to the today's situation. There is also a general erosion trend on this river. Local widenings like on the Emme river may be financed through the power project and thus the environmental value of the river again improved compared to the actual situation. The positive advice of the Canton was therefore linked to the condition that the project should include such restoration measures.

The Danube river downstream of Vienna to the Slovac boarder is one of the last remaining free flowing reaches of this river. The alluvial zone which had developed on the floodplain confined between the main channel and the flood protection dykes is internationally recognized as being extremely valuable. After an intense public debate, the project of building a power plant in Hainburg was given up by the Austrian government and it was decided to turn this area into a National Park.

However, plans of a such a development had to cope with the conditions which navigation on this river reach imposes. The development of power plants upstream of Vienna and the present construction of the Freudenau pant in Vienna will reduce the sediment supply to this reach to insignificant values. Erosion has therefore to be expected. To secure the conditions of navigability, on the other hand still groynes are built which are confining the flow section and thus increasing sediment transport capacity, and even material is dredged form fords and deposited on the banks or between groynes. A numerical simulation (Jaeggi, 1992a), where gravel extraction has been neglected, showed that the erosion trend is slow and amounts to a 1 m at maximum near km 1800 (20 km downstream of Freudenau) for a period of 80 years. It may be concluded that it is sufficient to protect the river bed just in the Vienna reach to allow the access to the ports, but that a dynamic approach should be chosen for the other part. The actual discussions among experts however still show little coincidence. the main reason may be that it is very difficult to combine the idea of the National Park with optimum conditions for navigation. The simulation also showed that the erosion in this reach will saturate sediment transport capacity at the downstream end for the next decades and that nearly 80'000 m^3 of gravel are to be expected to be deposited near Devin each year.

From all the described examples ideas may be transferred to the Gabčíkovo project. Between the water derivation and restitution remains a reach now called the Old Danube. Before the realization of the Gabčíkovo scheme, the navigation had to pass on this reach. Now, navigation uses the canal. This is a major difference compared to the Austrian Danube. All the training works which have been installed on what is now the Old Danube are now of little use. Riprap at the outside of bends and groynes had had the purpose to confine the river into a main channel. Furthermore, intense gravel mining near Bratislava had induced a substantial erosion. Of course, the water derivation without any compensation measures (those were not possible because of political reasons) led to a further lowering of the water level.

For the moment, a lot of efforts are made to preserve the alluvial zone in the present state by irrigating the secondary channel system from the derivation canal. On a short term basis, such efforts are certainly very valuable. On a long term basis, however, a more dynamic approach may be necessary. The official proposal to build low weirs in the old Danube is in this respect also very static and only of some use on a short term basis. The flow conditions will be seriously altered..

The alternative is to recreate natural morphological elements. Taking off some of the existing training structures may induce lateral erosion and widening of the existing channel of the Old Danube. Of course, a dynamic development of such a channel is possible only if periodically bed forming flows of the order of about 3000 m^3/s are sent into this reach. A wider channel can then be expected to bifurcate and braid. With time, a channel system comparable to the one existing before the main regulation may develop.

Obviously, such a development must be monitored and boundary conditions in terms of flood protection, sediment management and stability of the flood protection dykes against lateral erosion have to be formulated. Furthermore, the river will develop its channel according to the conditions imposed by the water power. A compromise has to be found concerning the residual discharge in the Old Danube. Like in the Wynau project, the duration curve has to reflect the original conditions with some short duration bed forming floods and higher base flow in summer, which can be compensated by lower flows in winter. On the whole, the new river will be some sort of a model of the original river and thus not be identical to it. But the expected natural development of a channel system comparable to the original will favour the reforming of natural morphological elements where pioneer plants can settle and the cycle of formation of an alluvial forest may start again. Also the natural alternances with reaches of higher and smaller flow velocities will be preserved. In general terms, a higher habitat variety compared to the present situation can be expected.

In a political discussion where the completion of a more or less purely technical project or the destruction are the only issues in debate the presented ideas may be seen as a third alternative which may lead to a realization of a multi purpose project combining water power use with a substantial river restoration.

References

Hunziker R. und Jaeggi M. 1988. Numerische Simulation des Geschiebehaushalts der Emme. Internat. Symposium INTERPRAEVENT, Graz, Tagungspublikation Bd. 3, S. 7-16

Jaeggi M. und Peter W. 1983. Naturnahe Gestaltung einer Flussmündung; Hydraulische Modelluntersuchungen für das Projekt eines Reuss am Urnersee. Mitteilung der Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie der ETH Zürich, Nr. 68

Jaeggi M. 1986. Non-Conventional Solution for River Mouth Design. Journal of Hydraulic Engineering, Vol. 112, No. 1, January 1986

Jaeggi M. und Pellandini St. 1988. Naturnahe verzweigte Flussabschnitte als Mittel gegen Sohleneintiefung. Interpraevent 1988, Graz, Bd. 4, pp. 327-337

Jaeggi, M. 1992a. Effect of Engineering Solutions on Sediment Transport, in 'Dynamics of Gravel-Bed Rivers', Edited by P. Billi, R.D. Hey, C.R. Thorne and P. Tacconi, John Wiley & Sons Ltd.

Jaeggi, M. 1992b. Sediment Regime and River Restoration. European Workshop on Ecological Rehabilitation of Floodplains, Arnhem, 22-24 September 1992. International Commission for the Hydrology of the Rhine Basin, Report No. II-6, pp. 147-156.

Lang O.	1985, Revitalisierung von Fliessgewässern, dargestellt am Beispiel des Reussdeltas. 3. Seminar Landschaftswasserbau an der Technischen Universität Wien
Zarn, B.	1992, Lokale Gerinneaufweitung als Mittel gegen Sohlenerosion. Mitteilung der Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie der ETH Zürich, Nr. 118
Remark:	The reports on the mentionned environmental impact studies are printed in limited editions and not accessible

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Annex 33

(Translation)

Magyar Hírlap, 1.3.1994
(Extract)

Professor Mosonyi is against the demolition of the coffer dam Gabčíkovo-Nagymaros; demands new examination.

At the extraordinary session of parliamentary council for the environment on Monday ... it was said that the construction of a temporary weir could unfavourably influence the decision of the ICJ in The Hague ... Lajos Zsebök, the deputy of the Hungarian Democratic Forum drew attention to the danger of a solution consisting in underwater weirs. We could confirm with this solution that is is possible to eliminate unfavourable effects of the Danube diversion through technical measure and thus we would give up the idea of the return of the river and a decision of the Hague favourable for us.

Annex 34

(Translation)

Magyar Hírlap, 7.3.1994

János A. Szilágyi:
Unpredictable decision with unpredictable consequences

We are in an emergency situation, we must act immediately. We must finish with hesitations. It will no more be possible to repair all what we don't do today in two years - Mr. Boross expressed his view when visiting Szigetköz. `Naturally, if Parliament rejects the project of the inhabitants of Szigetköz supported by the government, the underwater weir will not be constructed. Then, it will be necessary to face the public and tell why the environment is dying out' - the Prime Minister highlighted the water appropriation question as a national matter. According to the experts of the Department for the Environment, some members of the Danube Circle and the Parliamentary Council for Environmental Protection, the realisation of the governmental proposal would negatively influence the long-term interests of Hungary. We would admit, with this solution that it is possible to prevent negative sides of the Danube diversion, we would give up the return of the river and a favourable decision of the Court.

Annex 35

(Translation)

Kisalföld, 10 September 1994

Kisalföld 10.9.1994

With time going on, the negotiations and position of the country worsen

The government is weakening, Szigetköz becomes desolate

"There is no more fuel, all money was spent, therefore we put aside since this morning, eight o'clock, gradually pumps in Szigetköz" - informed yesterday György Jakus, the chief of the North-Danube water management office. There were phones ringing, faxes were working in the Győr head office and the director took the car equipped with car telephone to see directly what was happening in the site. The visit was planned already some days ago, independently from the problems with fuel: the important representatives of water management came with the parliamentary deputy Károly Szentkuti (SZDSZ) to see the inundation territory of Szigetköz and to give information about the situation in water supplies. The lack of fuel actualized this expert visit.

The water management director first informed Károly Szentkuti about the results of pumping.

The setting of equipment cost 120 millions Ft and further 90 millions Ft, which were at disposal for operation, lasted for 50 days. The water management got already some millions forints from other areas, but all was spent and it is impossible to credit the pumping and thus the equipment was stopped. The last fuels were brought on Thursday evening.

The pumps of Cikolasziget have no more worked yesterday and at Dunaremete, there was little fuel left for some hours when a statement of KVHM (Ministry of Transport, Communication and Water Management) came that the Government, at its session on Thursday procured further 20 millions Ft for water supply with pumping and the Ministry ordered the Office to guarantee fuel and further operation of pumps. The measures were immediately realized, as all three pumping stations were already working with full capacity in the early afternoon. The 20 millions quick help did not excite one-minded joy among the experts because as they mentioned, the impact of pumping lays behind the awaiting state according to actual measurements.

The result of hundred millions investment is the water level increase of some centimetres in the mid of Szigetköz and the negative impacts failed to be stopped, including spreading of sea-weeds. These 20 millions Ft will be sufficient for about ten days, then it will be necessary to "tear off" other millions from the budget. The costs for planned setting of electrical pumps are between 500 millions - 1 billion Ft. But the gravitation water supply would have diminished the Szigetkőz damages much more effectively and with lower costs.

Károly Szentkuti was informed on place about the actual situation of water supply and then, on the other side of the border, on the territory of the Variant C, he could get acquainted with the II.stage of construction near Čunovo.

With passing months, the possibilities of favourable development of situation in Szigetkőz decrease progressively- said the parliamentary deputy. - If the construction of the Variant C will be finished, the negotiations positions of Hungary will still be worse than they are today. Then Slovakia will really have no interest to look for a compromise solution with our country. According to the plan, the construction of the hydroelectric power plant and navigation lock in Čunovo will be completed by the end of 1995, i.e. the Variant C will get the final form.

The parliamentary deputy has promised that he would demand decisive steps from the Government. Such a step could be for ex. a partially putting of the Dunakiliti reservoir into operation. The Slovak side cannot oppose this step because it would oppose all own steps, arguments, i.e. against itself if it would not support the utilization of navigation lock for water supply.

I have a feeling that the Hungarian Government is weakening in an incomprehensible way if the discussion is about Szigetkőz. Gyula Horn mentioned before his visit to Bratislava that the Szigetkőz question had to be solved. It seems that he avoids this question since that time and the Minister of Foreign Affairs has got also more reserved in the last weeks. The Ministry of environment and territorial development is being more and more a puppet of some interest groups. They once more look for excuses. If the things go on in this way, I don't see chances that our interests would be taken into account in the Cabinet - said Károly Szěntkuti.

Csaba Nyerges

Annex 36

Letter from Dr. M. Sylven, Director of WWF's Europe and Middle East Regional Programme, to Prof. I. Mucha, 14 June 1994

Letter from Dr. C. Martin, Director General of WWF, to Ing. D. Kocinger, 21 June 1994

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14 June 1994

Professor RNDr Igor Mucha
Ground Water Consulting Ltd.
Bratislava, Slovakia

Dear Professor Mucha,

Thank you very much for your kind reception at the time of WWF's visit to Gabcikovo on June 3.

I apologize for not having written earlier but, unfortunately, I have been away from my office more or less ever since then. However, this delay has enabled me to have the opportunity to carefully read your study entitled "Gabcikovo - WWF". I would like to tell you how impressed I am by your work and knowledge on this subject, and how embarrassed I personally feel about WWF's past involvement.

As I promised you when we met, I have asked the team who put the report together for a response, which will be carefully scrutinized by WWF-International. Hopefully something positive can come out of such an effort.

I have today had an opportunity to assess the case with the Director General of WWF-International, Dr. Claude Martin. We have both agreed to immediately stop all further involvement from WWF-Austria. Dr. Martin will be sending a personal letter to Ing. Dominik Kocinger assuring him that there will be no future involvement from WWF unless a formal request is received from the Slovak side which, of course, we do not expect.

I wish you every success in your future endeavours. Perhaps we will meet sometime in the future under more positive circumstances.

Yours sincerely,

Magnus Sylvén

Dr. Magnus Sylvén
Director, Europe and Middle East Regional Programme

WWF World Wide Fund
For Nature
Office of the Director General

Avenue du Mont-Blanc
1196 Gland - Switzerland
Telephone : (41-22) 364 92 92
Telefax : (41-22) 364 54 68

Sent by fax

Gland, 21 June 1994

Ing. Dominik Kocinger
Ministry of Agriculture
Slovak Republic
Dobroviocova 12
81266 Bratislava
Slovakia

Dear Mr Kocinger,

On behalf of WWF-International, I would like to express my sincere thanks for the hospitality shown to the WWF delegation on June 3, 1994.

I would also like to acknowledge your letter of June 13, 1994. I have taken note of the criticism expressed by Professor Mucha in the document "Gabcikovo - WWF", and appreciate your reaction. I will, in this context, also look into the performance of WWF staff.

On the other hand, it is important for me to receive the comments of WWF staff on some of your statements. We are therefore reviewing present and past activities and we have requested Dr. Dister to provide us with comments on Professor Mucha's report. As soon as this review is finalized, I will be in touch with you again.

In the meantime, and after consultation with Dr. Magnus Sylven, Director of the Europe/Middle East Programme of WWF, we are suspending any further involvement of WWF in the Gabcikovo issue.

./..

I understand that it is now for the International Court of Justice to assist the parties to reach an agreement which will take into account local, national and transnational needs, and hopefully be beneficial for the environment.

With kind regards.

Yours sincerely,

Dr. Claude Martin
Director General

Annex 37

Letter from Dr. C. Martin to Ing. D. Kocinger

3 October 1994

WWF® World Wide Fund
For Nature
Office of the Director General

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Telephone : (41-22) 364 92 82
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Gland, 3 October 1994

Ing. Dominik Kocinger
Slovak Government Commissioner
for Gabcikovo
Ministry of Agriculture
Slovak Republic
Dobroviccova 12
81266 Bratislava
Slovakia

Dear Mr. Kocinger,

In my letter of 21 June 1994, I informed you that WWF would evaluate Professor Mucha's report "Gabcikovo - WWF: The Pros and Cons" which, inter alia, commented on WWF's study published in January 1994 and criticized WWF staff.

I also indicated that until such time as we had received comments on Professor Mucha's report, further WWF involvement in the Gabcikovo issue would be temporarily suspended.

We are now in a position to share our assessment of Professor Mucha's report with you and others, to whom you took the liberty of copying my letter of 21 June 1994. However, before doing so, I must tell you that WWF's experts and staff have been quite distressed by the report's numerous, personal, derogatory and/or polemic remarks. These remarks are not considered to be appropriate to appear in a technical report. Prof. Mucha's adverse reactions to the WWF study also contrasts with the favourable reactions received from many other sources.

Referring to the contents of Prof. Mucha's report, it has to be recognized that this report deals only with a limited part of the impact pattern of the Gabcikovo scheme, essentially concentrating on the groundwater

./..

issue. Ecological issues of similar or even higher importance, such as the floodplain dynamics have been largely omitted. The report also leaves out any consideration of the deterioration of ecological functions and the biodiversity of the entire floodplain, caused by the drastic hydrological changes. In addition to these shortcomings, the report concentrates only on the Slovakian part of the Danube floodplain and hardly refers to the important Hungarian part of the system. Another major weakness of the report is the fact that it does not address potential long-term effects.

In conclusion, the report of Prof. Mucha is seriously limited. It is concerned with only a partial aspect of the changes brought about by the drastic alteration of the hydrology, deals with only a part of the area affected, and encompasses a very limited time horizon. It therefore does not invalidate WWF's scientifically based argumentation.

In the light of these facts, WWF can see no reason to change its position laid out in its study published in January 1994 "A New Solution for the Danube". More specifically, WWF maintains its view that an ecologically acceptable solution entails, the following three short-term measures:

- a discharge varying between 600 m^3/sec and at least 940 m^3/sec (depending upon the technical possibilities) of Danube water in the natural ("old") river bed;

- the constriction of the river bed by islands and gravel banks, and

- reconnection with the side arms.

On a longer term basis a dynamic discharge of about two thirds of the Danube water in the old bed should be envisaged; together with a lifting and constriction of the present river bed over 20-30 km down stream of the Cunovo weir. These measures can be taken in both an ecologically sensitive way and without risking permanent interference with the river ecosystem.

As you undoubtedly realize, WWF's Mission is to conserve nature and ecological processes through the preservation of genetic, species and ecosystem diversity. WWF is therefore primarily concerned with the severe impact of the Gabcikovo scheme on the biodiversity of the Danube floodplain. Thus WWF in its position focuses primarily on the need to maintain the floodplain dynamics based on a sufficient and dynamic discharge in the old river bed. This focus should in no way be read as disregard of or assent to effects on groundwater tables, changes in the hydrodynamics of water quality and other likely consequences of the scheme.

I herewith request you to inform your Government of WWF's assessment of Prof. Mucha's report and the confirmation of our standpoint published earlier this year. WWF, on its part, will communicate its position outlined above internationally, ending the temporary suspension of its involvement about which I wrote to you in June 1994.

Yours sincerely,

C. Martin

Dr. Claude Martin
Director General

copy: Prof. Dr. Igor Mucha
Government of Hungary
Dipl.Ing. Johanna Mang, WWF-Austria
Dr. Emil Dister, Aueninstitut, WWF-Germany
PD Dr. H.H. Bernhart
Prof. Dr. Tomas Paces, André Jager
Prof. Dr. A.L. Roux
Dipl. Geogr. Alexander Zinke

Annex 38

Letter from Prof. T. Pačes to WWF Europe and Middle East Regional Programme, 6 September 1994

From: Tomáš Pačes
(Assoc. Prof., DrSc, Dr. Tech., h.c.)
Na baště sv. Tomáše 9
CZ - 118 00 Praha 1
Czech Republic

WWF
Europe and Middle East Regional Programme
P.O.B. 1
A-1162 Vienna
Austria

6/9/94

Gentlemen,

Thank you for asking me to express my opinion about the report "Gabčíkovo - WWF the pros and cons " by Prof. I. Mucha (April, 1994).

I will address the relevant parts dealing with the chemical composition of surface water, ground water and sediments associated with the "Gabcikovo dam" in relationship to biogeochemical processes within the system.

The critique in the Mucha's paper dealing with this subject is on pages 84 to 93. Some of his comments are directly related to the part of " A new solutions for the Danube, WWF Statement" which has been based on my evaluation of documents given to me by WWF (Paces, 1993).

Before I answer the Mucha's critical comments, I wish to make clear, that I did not study the Gabcikovo problem in field or laboratory and that my opinions have been based on the documents offered to me by WWF and based on my knowledge which I gained when I was appointed to be an opponent of Slovak research reports by Slovak authorities (Biliková, Szolgay, et al., 1991, Kelnárová, et al., 1991, Liptáková, et al., 1991, Holubec , et al., 1991, Hucek, et al., 1991 and Mucha et al., 1992). I am not part of any "WWF Gabcikovo Campaign". I have acted as an invited expert on the issues of biogeochemistry in natural water systems. I have tried to be as objective as possible and I am not influenced by any political pressure. My opinions are my own and not related to any activity of the Czech Geological Survey.

Mucha's report refers to problems which are connected with the monitoring of pollution in the gravel aquifer on p. 84 - 88. The report states that the observation wells are not representative for microbiological pollution, organic pollution and micro element pollution. It goes to some details why this is so. This would imply, that the extensive monitoring which goes on for several years has been incorrect and the obtained data can be misleading. While I know, that sampling of wells is very difficult and some errors can always occur, systematic changes deserve appropriate attention. Before the dam was built, there was an indication, that the organic pollution in groundwater has increased when the water level has increased due to a high level in Danube. In analogy, there is a possibility, that similar phenomenon can appear after the dam lake builds up its maximum water level. It is a good news when Mucha states that after one year of Gabcikovo operation ground water in drinking water wells so far have shown no changes in ground water quality (p. 85). Mucha writes that the observations used by WWF were made only one day after the start of operation of Gabcikovo - which clearly documents that these chemicals are a result of past activities and cannot possibly have any link to the Gabcikovo hydropower project. I do not know about this specific WWF observation, however, Mucha sounds misleading by stressing the past origin of the pollution. I have never heard anyone to maintain that the organic or trace metal pollution is produced by the dam and the lake. However, filling up an artificial lake changes the oxidation-reduction conditions in surface water as well as in the aquifer and the residence time of water in both the reservoirs. As a consequence, some pollutants stored in sediments may be liberated, for example by reduction of the chemical compounds and their desorption or dissolution, and transferred to water. A probable cause of the misunderstanding is that I point to potential dangers which can be activated by the changes in biogeochemical processes, while Mucha refers to positive results on the present chemical composition in drinking water wells. I base my opinion on the results of a detail research of the Research Institute of Water - Economy in

Bratislava (VÚVH) (Bilíková, Szolgay, et al., 1991, Kelnárová, et al., 1991, Liptáková, et al., 1991, Holubec , et al., 1991, Hucek, et al., 1991), and monitoring data by Slovak Hydro - meteorological Institute offered to me by WWF. These data indicate pollution of bottom sediments with organic trace substances and their occurrence in infiltrated water which passes through the sediments. The behavior of this system is extremely difficult to predict. The results of modeling which I had chance to review (Mucha et al., 1992) were too simplified to justify any definitive conclusion. This is the reason why I speak about a "chemical time bomb" and point to the fact, that the building of the dam, is a huge biogeochemical experiment. Nobody can predict exactly what will happen. I am sure, that Slovak scientists and engineers know all this and this is the reason why "the situation is subject to continuous monitoring and thorough analysis" (p. 88).

I criticized the data from the well S4 Kalinkovo as possibly non representative and wondered why this was chosen as an example of the state of the ground water system. I pointed to the low quality of the data. Mucha goes even further and indicates in the two tables on p.86 and 87 that the data given to me were statistically incorrect. Such a table should not ever appear in any serious evaluation. (The table was taken from a report of a Slovak institution and is not product of WWF). Mucha is right when he criticizes the WWF report by requiring data on the sum of non-polar extractable matter in water when the analyses give concentrations of individual non-polar compounds (p. 88).

I have called for observation points which would represent the most sensitive part of the groundwater system and not the most stable one. Mucha explains why S4 has been chosen (p. 85 to 88). He points to the fact, that Kalinkovo ground water wells are the closest drinking water wells to the dam lake. In this respect the choice is well justified. I do not know whether this part of the groundwater system is the most sensitive to pollution by trace elements and organics or not. It depends on the degree and nature of the clogging of infiltration bottom and riversides as well as on other biogeochemical factors.

Properties of some organic micro pollutants are given on p. 89 to 90. The conclusion of Mucha is that these pollutants are not produced by the hydropower station. This section is irrelevant to the problem. Nobody would accuse the station of producing the pollutants. These and other pollutants are stored in bottom sediments and their traces have been found in some of the groundwater samples. The question is whether these compounds can be released from the sediments into infiltrating Danube water when the lower flow velocity and higher water table in the dam lake will change the oxidation-reduction state and microbiological conditions of the water - sediment system. Here I see a discrepancy which requires clarification. Mucha introduces new chemical data on sediments (p. 44) indicating no organic pollution and probably very small amounts of adsorbed trace metals. These data look very reliable because they were produced by two independent laboratories. On the other hand, the extensive research of the sediments by the the Research Institute of Water - Economy in Bratislava (VÚVH) in 1991 (Biliková, Szolgay, et al., 1991) has indicated the existence of the organic pollution of the sediments. What is the reason for the discrepancy? The answer may be perhaps found in the report by Rodak D., et al. (1993). However, I was not given the report for evaluation.

The most important statement is made by Mucha in the first paragraph on p. 91 as his reaction to my criticism that the EC report was too optimistic with respect to surface water and groundwater quality prospect considering the data which have been available. Mucha says that the experts have available the whole data base and that the impact of Gabcikovo on ground water quality in Slovakia after one year of operation is insignificant. If it is true that the EC experts had all data available, including those of the research conducted by the Institute of Water - Economy in Bratislava (VÚVH) and all data on temporal changes in response to changes of water level in Danube and in aquifer, then I am very surprised, that they were so positive. There were indications that the situation with respect to the quality of ground water could deteriorate. It is of course a good news that the quality of ground water has changed insignificantly after one year of Gabcikovo operation.

My point that the behavior of this biogeochemical system has a character of a "chemical time bomb" is dismissed as a general statement on p. 91. Reference is made to a new evaluation of sediments prepared in the framework of PHARE. I admit, that my reference to the "chemical time bomb" is a general statement. It is supported by numerous examples, when engineering solutions of various projects have generated with some retardation harmful effects to environment. It is not specific to Gabcikovo only. Gabcikovo means a huge impact into environment and we will see its effects to groundwater, surface water and sediments in years to come. Projects such as the one under PHARE program are useful steps in our understanding of anthropogenically influenced biogeochemical systems. I do not know the results of this particular project and I hope that they will be published and readily available.

My statement that the data on pollution have to be presented in full before any scientific conclusion can be made as regards to the impact of Gabcikovo dam on water quality is dismissed with the note that data are complete enough to conclude that alluvium gravel and sediments are not polluted (p. 91). It is true that my statement is directed to my knowledge of the system and my inability to make definitive conclusion about the pollution state of the aquifer and bottom sediments. I cannot judge whether there are other data which are complete enough to make such conclusion. This is a subject for an objective evaluation by a multidisciplinary research team independent on constructors and defenders of Gabcikovo work.

My comment that the properties of sediments can vary considerably and that it would be helpful to have experimental data on the ability of the sediments to yield the pollution to ground water is commented in the Mucha's report by a reference to distribution coefficients and experimental data in Rodak et al., 1993. I do not know this report and cannot comment on it. I know, that some preliminary experiments with the sediments were conducted by Hucek et al., (1991). These experiments showed that selected sediments yielded PCB and in a lesser extend other organic pollutants into percolating water. The experiments were not very exact and were difficult to apply to field conditions. I do not know if these results have been taken into account by Rodak et al. (1993).

My suggestion, that a small team of independent hydrochemical, hygiene and medical experts to evaluate impact of the Gabcikovo dam on water quality and consumers of the water has been answered by Mucha positively. He states that the data are available for any kind of independent evaluation. It means, that WWF can find out what is presently known about the state of groundwater and surface water and can reduce uncertainties and misunderstanding to minimum. Only after all data are independently studied, it would be justified for WWF to criticize reports on water quality by Slovak scientists.

My general impression is that the data on water quality with respect to Gabcikovo dam, which I had opportunity to study, have been collected and evaluated seriously and that mistakes and omissions have been exceptions rather than a rule in reports by the Slovak scientists and engineers. Neither I have found any reasons why to doubt Mucha's statement that the ground water quality has not significantly changed after one year of the Gabcikovo operation. In spite of that, it is puzzling for me that the studies by the Institute of Water - Economy in Bratislava (VÚVH) which were conducted independently of the Gabcikovo management indicated groundwater and sediment pollution while the studies which have continued under the support of Gabcikovo management indicate only positive results.

If WWF wishes to learn more about the state of groundwater and surface water quality, it should perform a detail study of all data. As stated by Mucha, all such data will be made available. I have a feeling that groundwater and surface water quality will be a minor problem within the Gabcikovo issue.

Sincerely yours,

Tomás Paces

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References

Biliková, Szolgay, et al. (1991) Posúzenie chemických vlastností súčasných sedimentov a plavenín v Dunaji a ramenných systémoch. Správa B-PÚ DOD-A 56, VÚVH, Bratislava.

Kelnárová, et al. (1991) Zmeny obsahu kyslíka v zdrži Hruškov - Dunakility. Správa B-PÚ DOD-A 56, VÚVH, Bratislava.

Liptáková. et al. (1991) Analýza procesov tvorby a metamorfózy chemizmu infitrovaných vôd zo zdrže Hrušov - Dunakility. Správa B-PÚ DOD-A 56, VÚVH, Bratislava.

Holubec, et al. (1991) Význam samočistiacich procesov vo vzťahu VD Gabčíkovo - VZ Kalinkovo - Šamirín - Dobrohošť - Gabčíkovo. Správa B-PÚ DOD-A 56, VÚVH, Bratislava.

Hucek, Mišút, et al. (1991) Analýza vplyvu sedimentácie v zdrži Hrušov - Dunakiliti na infiltráciu z kvantitatívného a kvalitatívného hl'adiska.Správa B-PÚ DOD-A 56, VÚVH, Bratislava.

Mucha I et al. (1992) Optimalizacia dokončenia diela Gabčíkovo na území ČSFR z hladiska vplyvov na podzemnu vodu, PFUK, Bratislava, Final Report.

Pačes T. (1993) Gabcikovo: Independent scientifically based comment to the new EC Mission Report on Gabcikovo in field of hydrochemistry. (Letter to A. Zinke).

Rodak D., et al. (1993) Kvalita sedimentov dunajskych naplavov z hladiska obsahu a migracie kontaminujucich latok v podzemnych vodach. PFUK, Konzultacna skupina Podzemna voda, Bratislava.

Copy sent to:

Dr. Claude Martin, Director General, WWF, Avenue de Mont Blanc, 1186 Gland, Switzerland

Dipl. Geogr. A. Zinke, WWF, P.O.B. 1, A-1162 Vienna, Austria

Ing. Dominik Kocinger, Ministry of Agriculture, Dobrovicova 12, 81266 Bratislava, Slovak Republic

Prof. Igor Mucha, Ground Water Consulting Ltd., Karloveská 2, 841 04 Bratislava, Slovak Republic

Annex 39

(Extract)

Preparation of Input Parameters for Model of GroundWater Flow

Danubian Lowland - Model SHE,

PHARE Project EC/WAT/1

30 December 1993

procesmi a typom pôdneho horizontu. Nepredpokladá sa rýchle rozpúšťanie karbonátov a uvoľňovanie na nich viazaných zložiek. Preto aj možná kontaminovaná plocha zaujíma len časť pôvodnej ramennej sústavy v zdrži, ktorá bola čiastočne a v kinete celkom odstránená.

- Práca [1] a zčasti práca [2] sa zaoberala hlavne kontamináciou plavenín a sedimentov Dunaja a ramennej sústavy, teda práve tými sedimentami, kde sa kontaminácia môže nachádzať vo zvýšenej až extrémnej miere. Histogramy poukazujú na to, že i v takýchto podmienkach, kde sa dajú očakávať extrémne koncentrácie, nadlimitné a extrémne vysoké hodnoty (časté napr. u plavenín vo vznose) sa vyskytujú ojedinele. Treba poznamenať, že holandská norma nie je normou na plaveniny vo vznose a priamo recentné sedimenty plavenín.
- Obsahy viacerých látok, pokiaľ sú sorpčne aktívne, sa viažu na íly, organickú hmotu, glejové polohy v pôdach a na určité polohy v pôdných horizontoch. Ich obsah sa preto s hĺbkou znižuje až pod detekčné limity. V súčasnosti je to dokázané neprítomnosťou týchto látok vo vode existujúcich využívaných vodných zdrojov.
- Vzhľadom na lokálne rozšírenie kontaminantov, ktoré sú naviac minimálne priepustné a vzhľadom na snahu zachovať oxidačné podmienky v zvodnenom prostredí, nepredpokladáme rozšírenie sa týchto kontaminantov do podzemnej vody v nadlimitnej miere.
- výsledky prieskumu v rámci programu PHARE preukazujú, že vzorkované sedimenty nie sú významne znečistené a nie sú znečistené organickými kontaminantami. Napriek vyšším obsahom niektorých ťažkých kovov v sedimentoch analyzovaných metódou totálneho rozkladu, nehodnotíme situáciu ako znepokojujúcu, pretože značná časť ťažkých kovov vystupuje aj vo forme stabilných horninotvorných minerálov (pozri príklad Cu, Ni).

V Bratislave, 30.12.1993.

RNDr. Dalibor Rodák

Translation of underlined section:

"The results of the survey within the PHARE project framework are showing that sampled sediments are not significantly polluted and are not polluted by organic pollutants."

Annex 40

Telephone interview between Mr. Hričovský, representative of the Slovak Embassy in Bonn and Mr. Ott on 29.9.1994 .

Regional representative of BDB (Federal Union of river transport contractors) in Regensburg and the head of navigation company Bayerischer Lloyd AG (VEBA AG) Mr. Ott submitted the following information. He agreed with the citation.

The German side welcomes the operation of Gabčíkovo waterwork and considers the decision of the Hungarian side not to construct Nagymaros for negative. The transport is much more regular and many problematic river points from the past were eliminated (Mr.Ott worked as the captain on the river ship in this section of the Danube in the years 1963 - 1975). Komárno is considered for breaking point. The navigation is now much more better up to Komárno. If Nagymaros waterwork would be constructed, it would be possible to load ships about 2-3 dm more what means 200 tonnes of transport more. It would lead automatically to decrease of transport density and decrease of transport costs. The German transport contractors consider for problematic the closing of navigation locks which occur relatively often and last from 2 to 12 hours. This is rather a complication for shuttle transport of lorries between Passau and Budapest because this transport is bound to customs handling and slippage of some hours means supply postponement about one day. The German side would welcome if these closings would be as few as possible and if maintenance is needed, it should be announced at least 14 days in advance to plan the river transport. Mr. Ott announced that his company planned to include also Bratislava into the shuttle transport from beginning of the next year.

Conclusion: Clear technical and economic reasons speak for the operation of Gabčíkovo. The German river transport evaluates positively Gabčíkovo. But for better improvement, completion of Nagymaros should follow. For transport up to Bratislava, the decisive importance is dependent on the completion of Freudenau and weir at Wolfsthal. Then, the river transport on the upper Danube would be without any problems.

Annex 41

(Translation)

COMPANIA DE NAVIGATIE FLUVIALA ROMANA "NAVROM" S.A.

Nr. 2265/17.X.94

To
Embassy of the Slovak Republic
Str. Otetari 3, BUCURESTI

To your letter Nr.2571/1994, we inform you as follows:

After putting the navigation lock in Gabčíkovo into operation, the navigation conditions improved significantly due to the fact that thus with navigation through the canal, one of the most difficult sections of the Danube (km 1811 - 1856) is avoided.

Even if there were some problems (of technical character) during the operation of the navigation lock and some undesirable events happened which led to the utilization of only one part of the navigation lock, generally navigation took place under normal conditions.

We only don't understand why the number of ship convoy is limited to maximum 3, even if the dimensions of the navigation locks make possible the entry of 6 units.

(Max. dimensions: length 275 m, width 34 m)

Sincerely,

Viorel Stefan
general director

Annex 42

Komárno (Effects of Project on local shipbuilding)

Slovakia, June 1993

DOMESTIC AFFAIRS

SLOVENSKÉ LODENICE a. s. KOMÁRNO

The main production output of Komárno's shipyard is the production of sea freighters. One of them is the sea freighter named „HEINRICH BOJEN" which we finished assembling in Komárno in mid-June. We were supposed to deliver this ship to a customer at a Black Sea harbor, where final testing and delivery procedures were to take place.

The ship's dimensions are:
length max.
82.50 m
width
11.30 m
max. loaded draft on sea
4.75 m
lowest draft for navigation
2,90 m
height max. from ship's bottom
12,60 m

The long-lasting drought and other causes resulted in a low water level in the Danube. This made the water transport of HEINRICH BOJEN, especially in the stretch of the Danube around Sturovo and Nagymaros, impossible. The low water level virtually blocked the delivery of the ship, because the minimum draft for short-term navigation is 2.4 m. This requires a water level of at least 1.2 m to pass through extremely cautiously.

The water lavel in the Danube in Nagymaros on June 14. 1993 was 108 centimeters and continued to drop (June 16. – 80 cm, June 17. – 68 cm) and did not allow navigation.

Vodohospodarska vystavba, the company that operates the Gabcikovo construction, has upon our request very willingly risen the water level under the dam, so that the ship could safely pass through the critical passage. This operation took place on Friday, June 18. 1993. At 7 a.m. the dam started to let increased amounts of water into the Danube. At 10 a.m. the Danube's water level in Komarno started to rise. Soon after 11 a.m. the ship slowly started on its way towards Sturovo. It reached the critical passage at about 2 p.m., there it had to wait for a further rise of the water level. At about 7 p.m. it continued very slowly and carefully on its way through the shallow passage around Nagymaros where the water level was only 120 cm. It took one hour to pass through this critical passage. There were no more obstacles to safe navigation ahead, and the ship now serves its new owner.

This operation has confirmed another advantage of the Gabcikovo construction, however, the described problem would not have arisen if the Nagymaros part of the construction had been completed, and our shipyard could assemble even larger ships.

Photo by Milan Drozd

Frantisek

Annex 43

(Translation)

The Slovak Commission of the Environment, 19 Environmental Conditions for the Implementation of Variant "C"

1. To demonstrate by documentation the procedure of self-purifying processes and their capacity in the course of infiltration of the surface water into the river-bank region.

2. To demonstrate by documentation the pollution of soil and of underground-water horizons in the dead-branches system of the upper part of Žitný Ostrov. To specify more accurately the character and the content of pollutants and the propagation into the ground water at present conditions and at a higher hydraulic gradient.

3. To assess and demonstrate by documentation the influence of the temporary solution of the Gabčíkovo Project on the regime of underground water, from the point of view of municipal water supply.

4. To make a prognosis of the evolution of the quality of underground-water used for municipal water supply and to propose a technology of treatment, corresponding to the results. To match the time-schedule of the treatment measures with the schedule of finishing the Gabčíkovo Project, taking in consideration also the results of the PHARE Project, coordinated by Prof. Mucha.

5. The change in the form of the reservoir may change the conditions of infiltration of surface water into the region of municipal water wells, especially of the source Dobrohošť. To demonstrate by a research on an adequate model, the impact of the temporary solution on the capacity of these sources.

6. The flow and sedimentation conditions of the diminished reservoir will be changed. To demonstrate by a research on a mathematical model the impact of the temporary solution on the allocation of sediments and on the infiltration conditions. To estimate by the model also the possibility of reduction of the surface of the reservoir in the vicinity of the municipal water source Šamorín.

7. Due to higher hydraulic gradients, especially on the right side of the reservoir, quicker sealing of the bottom by sediments may be expected. The intensity of this process would be a function of water-levels in the reservoir and in the Danube. To propose measures reducing the sealing process of the reservoir and of the unsealed power-canal.

8. To assess the influence of the old river-bed (the possible drainage effect) on the regime of the ground-water levels on both sides of the Danube, after the situation of the weir 11 km upstream of Dunakiliti.

9. To propose a solution for improving navigation conditions downstream of Palkovičovo, taking account of changed conditions of solids flow and increased erosion of the river-bed and reconsidering also the solution of Mr. Bartolcic of March 1991.

10. To secure storage of sediments dredged from the reservoir, outside the protected region of Žitný Ostrov, in a form of controlled dumps fulfilling the given conditions of protection of quality of surface and ground waters.

11. To secure communication between the dead-branch system and the Danube in both ways and to enable the flow through the branches from Dobrohošť to Palkovičovo. Periodical inundation with river-water, in correspondence with the natural regime of flows (mainly in May - June, secondarily in August - September) should last 5 to 7 days, but not longer than 14 days.

12. To include into the design: permanent structures, which together with mobile equipment would serve for elimination of pollution of the water by oil products.

13. To secure the supply of water into the Mosoni Danube according to conditions agreed on by Czecho-Slovakia and Hungary in 1948, on the base of the Paris Peace Treaty.

14. As the construction will be realized in the inundation area of the Danube, to schedule the works into a period of lower flows, but nevertheless, to propose measures for foregoing or reduction of damages, for the case of higher flows of the Danube.

15. In connection with the reduced surface of the reservoir, to assess the possibility of passing floods and ice and to secure flood-protection of the adjacent region in the course of construction and of operation.

16. To secure monitoring of water-levels and flows in all decisive places of the Project, to gain an oversignt about the hydraulic regime of the whole influenced region.

17. In the frame of the design of General Flood-Protection Measures, to include (in cooperating with the competent authorities) also the small protected regions - the two proposed natural reservation areas "Istragon" and "Island of the Sea-Eagle", the protected natural formations "Kings Meadow" and protected "summer-oaks" at the forester's lodge.

18. To secure the natural physiologic processes of the actual flora of the old bed of the Danube during the vegetation period (mainly from March to September), it is necessary to secure a flow of about 1300 to 1500 cumecs. Further it is inevitable, to secure such a flow in the old river-bed, which would enable the underground water level to touch the soil horizon and which would prevent the drainage effect of the empty river-bed. To evaluate, whether the proposed minimal flow of 600 cumecs would fulfill these conditions. To secure the fulfillment of the above-mentioned conditions also during the construction-period. With regard to the lack of data about the depth of the top-soil cover (above the sterile gravel) and with the aim of finding the optimal water-level, to elaborate a prognosis of the water-level regime in the old river-bed at a flow of 1300 to 1500 cumecs and the corresponding underground water level.

19. To prove the necessary security of the flood-protection measures in the region of the right lateral canal (the Bodiky region) at a 1000-years flow of the Danube.

Annex 44

Hidrológiai Közlöny N° 5, September-October 1994 (questions of the water regulation of the Upper Danube, the restoration of Szigetköz and completion of the G/N Project)

synopses of

I. Volgyesi, "Unconfined and Confined Groundwaters in the Kisalföld Region"

L. Halupa, "The Forests in Kisalföld Region"

L. Féjer, et al., "The Hungarian Upper Danube - A Historical Review"

M. Csanády, et al., "The Hygienic Quality of Danube Water"

J. Juhász, "Canalization of the River in Europe Development of the Network of Waterways"

F. Papp, "Environmental Considerations in Engineering for the Danube River Dam Project"

T. Dora, "The Present State of the Bös-Nagymaros Project and the Economic Consequences"

Unconfined and Confined Groundwaters in the Kisalföld Region
Völgyesi, L.

Abstract: Following the analysis of the hydrogeological structure and subsurface flow pattern in the Kisalföld and particularly in the Szigetköz Region the changes observed after the diversion of the Danube in 1992 are described. The drop in the groundwater table was less than anticipated, which is believed to be due to the fact that the role of the Danube in controlling the groundwater is a smaller one, while that of percolating precipitation a greater one that presumed earlier.

Keywords: Unconfined groundwater, confined groundwater, rain infiltration, backwater effects, draining effects

The Forests in Kisalföld Region
Halupa, L. – Csőkáné Szabados, I.

Abstract: The soil conditions and the present forest pattern in the Hanság Wetlands and in the Szigetköz Region are described. In the Hanság Wetlands the shallow and medium deep marsh and meadow topsoils permanently moist to he terrain predominate. Minor areas are covered by skeleton soils, humified alluvial soils and chernosem soils.
The majority (85–90%) of the Hanság forests are plantations made possible by reclamation-drainage works. They depend on irrigation for their further existence and continued growth.
The famous alder stands in the Hanság Wetlands were also planted, but in the wake of changes in the ecological and economic environment they were replaced by poplar plantations.
Soil fertility in the Szigetköz area is determined by the variations in elevation and the depth to the gravel layer. Prior to comissioning the „C" Alternative the proportion of the sites at medium-high and medium-low elevations was highest.
The flood-plain forests comprise 65 % poplar stands. These are the poplar stands of highest yiled and value in Hungary.
The forests on the protected part of the flood plain show a wider diversity of species with ahigher proportion of deciduos hardwoods.
The forest observations since 1986 have revealed that the main factor controlling tree growth is not the climate, but the Danube and the changes of the groundwater table induced by the river. Diversion had different, but invariably negative effects on tree growth in the different forest parts.
The adverse hydrological changes must be compensated by completing and operating in a controlled manner the network of recharging canals, learning also the lessons gained on the Slovak side.

Keywords: Forests in the Hanság and Szigetköz area, reclamation, predominant tree species, tree growth, hydrologic effects recharging

The Hungarian Upper Danube – A Historical Rewiew
Fejér, L. – Baross, K.

Abstract: The Pozsony-Komárom river section, referred to also as the Hungarian Upper Danube, had been an ubstable, irregularly meanderling, extensively braided river section, on which navigation was extremely difficult and often impossible. The people in the region adjusted their lifestyle to these cinditions. River regulation, thus stabilization of the waterway and providing flood control by levees remained but partly sucessful. A complete solution was expected from the Bős-Nagymaros river dam project, but the abandonment thereof hasn had grave consequences to the Szigetköz area. The country must rely on the professional skill of the hydraulic engineers for averting disaster.

Keywords: Bős-Nagymaros River Dam Project, river regulation, flood control, hydraulic engineering history.

The Hygienic Quality of Danube Water
Csanády, M. – Kádár, M. – Schiefner, K.

Abstract: Regular monitoring of the Quality of Danube water was sterted at the National Public Health Institute in 1951 and continued since. Up to the end of 1993. by inciuding the network of Public Health and Epidemic Control Stations and the medical officer service. These have run parallel to the monitoring started in the 1960ies in the water service and subsequently by the environmental inspectorates. The main chemical and bacterial data of the period starting with 1977 are reviewed, illustrating in greater detail the data on some parameters over the last two years (1992, 1993). The organics content expressed in terms of the COD has changed but little over the past 15 years. Increases have been registered in the nitrate content and in the concentration of chlorophyll-a, regarded a measure of eutrophication. Bacterial pollution (in terms of faecalindicators) has increased perceptibly in the early parts of the period. The data of the recent years show sowe improvement, but the effects of the large volumes of untreated sewage (Győr, Budapest) are pronounced. Diversion of the Danube in October, 1992 has not resulted in any deterioration of microbiological Quality, which according to the results for 1993 was appreciably better than in the previous year.

Keywords: Danube, bacterial pollution, faecal indicator bacteria, chemical oxygen demand phosphate, nitrate, chlorophyll-a.

Canalization of the River in Europe Development of the Network of Waterways
Juhász, J.

Abstract: Canalization was introduced for regulating the rivers in Europe and then in the United States, using the method to these days. More than one hundred river dams were built in Europe. Construction work is in progress on five and engineering work on serval others is under way. The experiences gained over the past close to 70 years demonstrate that this method offers solution to the major problems encountered in regulating the low- mean- and highwater beds. By complementary river training measures nature compatible and environmentally sound designs are possibile. The environemntal protection measures associated with river canalization provide aesthetically pleasing high-diversity landscapes even in the most demanding river valleys. Untreated discharges represent the gravest hazard to the streams and the life in them and must be discontinued regardless whether the river is canalized or not. Canalization of rivers in close to natural condition tends to improve, rather than deteriorate their quality. Experiences gained over centuries of attemots have demonstrated regulation of the Danube as an international waterway to be impossible without canalization along the Upper Danube and downstream of Paks if compliance with internationally accepted standards is desired.

Keywords: River regulation, canalization, navigation channel, river dam, enviromental protection, navigation, international agreements

Environmental Considerations in Engineering for the Danube River Dam Project
Papp, F.

Abstract: The engineers of the Bős-Nagymaros River Dam Project have displayed from the very beginning interest, open-midedness and readiness to reasonable modifications when confronted with the new requirements of environmental protection and ecological interests. Unfortunately, diverse political objectives, like change of the political regime, hostility to technology, have invaded public life in Hungary under the green flag of environmentalism. Professionally highly qualified biologists, ecologists, limnologists, foresters and landscape architects are, however, fully aware of the possibility of reaching a balance between man and his biological surroundings in new ways tailored to his needs and requirements. The Bős-Nagymaros river dams are also designed to serve human needs without any detriment to the environment.

Keywords: Bös-Nagymaros River Dam Project, environmental protection, landscaping, engineering

The Present State of the Bős-Nagymaros Project and the Economic Consequences

Dóra T.

Abstract: River dams, as facilites producing renewable, nonpolluting, environmentally sound energy have been built all over the world. On the Danube there are 29 dams upstream and 2 downstream of Hungary. Two additional dams will be inevitable in Hungary downstream of Budapest. The living conditions modified by river dams create natural values superior to the existing ones. The political attitude in Hungary vis-a-vis the Bős-Nagymaros Project, the most recent decrees, decisions were absurd, unfounded and detrimental in the economical and environmental sense alike. The mistakes made so far must be corrected urgently by involving clear-headed, properly qualified professionals observing high ethical standards in the process of decision making.

Keywords: Bős-Nagymaros River Dam Project, cost-benefit analysis, water management

Annex 45

Report of the Joint Czechoslovak-Hungarian Sub-Commission, 4 April 1958

(Extracts in translation)

On the basis of the Protocol of January 15, 1958 from the technical session in Budapest the technical sub-commission was established with following members :

Hungary : Ziegler K./chief /, György I., Illeyi V., Czakó J., Pétenyi O., Kovács G.

ČSR: Danišovič /head/, Jablonský A., Fojtík Š., Chlumský V. Jiroušek Z., Halabrinová N., Duba D., Procházka J.

In the work of sub-commission took part the representatives of Hydropojekt SSSR: Titov S.V., Galaktionov V.D., and representants of the regular commission in the COMECON - Kazak V.R.

The task of the sub-commission was the clarification of following issues involved in the scheme of the Danube utilization from Bratislava to Zlatná :

....

IV. Groundwater regime changes and their impact on soil, land, forest and fish management Determination of the minimum discharge in the old Danube channel

1/ Groundwater regime changes

Designed water reservoir downstream of Bratislava and diversion of water from the Danube channel into the diversion canal will bring about variations in groundwater regime on the Danube Island and Szigetköz. Adjacent to the reservoir groundwater level increasing will occur, and in the area of diversion groundwater level decreasing. In the diversion section as water will infiltrate from the Danube into the gravel subsoil of the valley than hitherto, and on the contrary, in the area of the reservoir more water will infiltrate than hitherto. These two impacts will again be compensated in some parts of the concerned region, however the empty old Danube channel will act on a considerable length as a mighty open drain.

Relative change in groundwater level as compared with the hitherto state is presented in Annex No.1.

2/ Effect of groundwater regime changes on agriculture

According to studies carried out by agricultural organizations the conditions for soil management and agriculture will not be negatively influenced in the area of designed water reservoir, since the designed water level increasing above the present state is not considerable /3,5 m and less/, and the water infiltrating from the water reservoir will be collected by means of dykes in open drains /in canals and lateral branches, which will be used for this purpose/, and will be conveyed downstream of the weir.

Three influenced zones may be defined within the area of diversion:

In the upper zone the groundwater level occurs deep in the gravel layer and does not reach the cover clayey-sand layer, in which, due to capillary rise, it could get to the plant roots. In this zone a further groundwater level decrease could not impair present conditions for agriculture.

In the central zone the groundwater level reached, under hitherto conditions, up to the cover layer and saturated, together with atmospheric precipitation, the plant roots. Groundwater level decrease in this zone may impair present agricultural conditions.

In the lower zone the groundwater levels are close to the territory surface under present conditions, and in wet years due to waterlogging these soils cannot be fully utilized. Groundwater level decreasing in this area would be favourable for agriculture.

The area of the central zone, where losses may be expected due to groundwater level decrease, is demonstrated on the enclosed plan 1:75000 /Annex No.1/and covers about 29000 ha on the Czechoslovak side and 15600 ha on the Hungarian side. The territory Hansag was not considered, since it was not examined and investigated yet.

3/ Effect of the diversion hydropower project on forest management

The results of studies of institutions for forest management showed, that no deterioration of conditions in the area of the water reservoir may be expected for forestry

In the section of diversion into the old channel 100 m3/s will be passed over the growing season, and only during flood events the remaining discharges will be conveyed there. Only minimum discharge will flow in winter period in the old channel, and in frosty periods it would be practically without discharge. Groundwater level decreasing in the adjacent area will cause deterioration of conditions for forest management.

According to surveys and investigations the groundwater level decreasing will influence an area of about 2.600 ha of forests on the Czechoslovak side, and approximately the same area covered with forest on the Hungarian side.

Losses ensuing from lower annual increase of wood mass, according to preliminary estimation, would not exceed 1,000.000 kčs /2,3 mil. forints according to the Hungarian studies/. This loss affecting the forest management due to groundwater level decrease could be reduced, since systematic felling of those wood species which are not able to adapt to the new conditions is envisaged. They would be replaced by more precious species, able to prosper in new conditions.

4/ Influence of diversion hydropower project on fishery

The fish management in the area of diversion canal will be damaged due to considerable limitation of water areas, however the guaranteed discharges in the old channel will moderate this negative effect.

5/ Minimum discharges in the old Danube channel

At present no special water withdrawal occurs from the old Danube channel in the section of envisaged diversion. The regular navigation will be displaced into the canal.

6/ However, it would be necessary to provide a certain permanent discharge in the old Danube channel due to the following reasons :

a/1/ It will be necessary to maintain in the old Danube channel a minimum sanitary discharge, since in this section several depressions and fords will occur as well as dead branches, creating together a considerable water surface. Without permanent washing of the old channel with clean water the hazard of water borne diseases may occur.

b/2/ It is required to maintain the old channel in good conditions as to be able to ensure normal passing of flood waters. It is also necessary to provide transport of construction machines and smaller construction barges and excavators using the old channel.

c/3/ The permanent flushing of the channel will prevent overgrowing.

d/4/ It is reasonable to reduce the drainage effect of the empty channel and to attain groundwater level stabilization at a certain level, what is desirable for the wells on one hand, and for the agriculture demands of the adjacent area on the other hand. Thus, it is necessary to pass 30-50 m3/s through the old channel.

e/5 Continuous water discharge in the old channel is required also for the fish management, since the Danube section in the area of diversion canal is a favourable place for fish breeding.

f/6/ Future demands for water utilization along the old Danube channel are to be also considered.

Taking into account the above-mentioned requirements the sub-commission recommends to define the discharge of the 100 m3/s in the old channel. However this discharge may be reduced or stopped in winter and during the project operation this discharge will be regulated.

6. Maintenance and training of the Danube channel in the section of diversion

a/ Maintenance of the channel

After construction completion of the diversion canal the present Danube channel will have the following functions:

1/ to pass flood waters, reduced by the volume passing through the diversion canal, and to convey bedload from these floods

2/ to pass ice run

3/ to divert discharges supplying decreased groundwater levels.

To meet all these requirements it is necessary to maintain the old channel in adequate conditions. The closures of some branches must be fortified by rock rip-rap to prevent scouring during rapid water level increasing in the main channel and at water level decreasing in lateral branches, i.e. at increased overflow. Deposits in the channel, which could create obstacles for ice run, or flood water passing must be removed by dredging. Development growth in the old channel must be systematically removed.

Realization of special training works in the old channel will not be necessary in the future, since the navigation will take place through the diversion canal. A navigation lock close to the weir is proposed for providing transport of barges into the old channel.

b/ Flood protection levees

The construction of the diversion canal will not require increasing or fortification of existing levees. However, the safety of the protected territory will be somehow increased in the section of the canal, because the major part of flood water will be passed through the diversion canal /up to 3.600 m3/s/. Considered deepening of the Danube channel in the section downstream of diversion canal outlet will also decrease in a certain extent the flood water level.

c/ Sediments and their removal

On the basis of investigations and surveys it may be stated, that under present conditions about 600.000 m3/year of sediments, chiefly gravel, is carried down from the upper Danube reach into the concerned reach. From this amount about 450.000 m3/year of coarser sediments get deposited on the ford sections and about 150.000 m3/year of finer suspended load is carried away.

After construction completion of the Wolfsthal-Bratislava project a substantial part of bedload will be retained there. Finer suspended load will pass through turbines and weir of this project and also through the turbines and weir of the hydropower plant located on the diversion canal. Since the channel of the diversion river power project is rather narrow, the deposited bedload in the reservoir will be partially flushed away during floods, causing also movement of gravel deposits in the old channel and its deformation. These deformations must be carefully monitored. A part of deposits may sediment also in the diversion canal.

The bottom of the Danube channel in the section downstream of diversion canal outlet will be deepened by dredging.

Generally it may be stated that the Wolfsthal-Bratislava project will have favourable impact on issues connected with sedimentation in the diversion canal section.

d/ Ice regime

One of the key issues, connected with the designed water reservoir downstream of Bratislava, will be ice flows discharging, since this problem is connected with the protection of the capital Bratislava and Petržalka. For ice discharging through the weir into the old Danube channel a considerable amount of water is required for channel filling. This amount of water in the channel must be provided even if power production will be decreased, since without adequate water in the old channel ice jams could develop.

2/ An adequate ice breaker must be available in this section for timely ice crushing and discharging.

3/ As to ensure higher protection and safety of Bratislava it would be purposeful to consider in designing the possibility to divert catastrophic flood waters through the flood plain area.

....

Bratislava April 4, 1958

P. Danišovič
Head of the sub-commission
/ČSR/

K. Ziegler
Head of the Hungarian sub-commission

S.V. Titov
V.D. Galaktionov
Representants of
Hydroprojekt SSSR

(Translation)

Annex 46

Protocol

from the negotiations of representatives of the Central Office of Water Management ČSSR (ÚSVH) and the Main Office of Water management of HPR (OVF) concerning further procedure of construction of the joint Czechoslovak-Hungarian System of Water Works on the Danube taking place on August 23 -31, 1966 in Budapest

Czechoslovak delegation:

Ing. Vladimír Dvořák - ÚSVH, chief of the delegation
ING. Jan Fabry - ÚGÚ
Ing. Karol Hofman - ÚSR
Ing. Ladimír Mudrunka - ÚSVH
Ing. Jiří Borna - ÚSVH
Ing. Pavel Petrík - SLKT
Ing. Augustín Ulrich - SKT
Ing. Štefan Palko - RVT
Ing. Gabriel Kaiser - HDP
Ing. Vladimír Lokvenc - HDP
Ing. Jozef Obložinský - RVT
Alexander Vitschek interpretor - RVT
Terézia Boryová - interpretor - HDP

Hungarian delegation:

Dr. Ing. Gábor István - OVF, chief of the delegation
Ing. Gyorgy István - OVF VIZITERV
Ing. Mátrai István - OVF DUNABER
Ing. Krempels Tibor - OVF
Ing. Kocsvay László - NIM
Ing. Csikor Imre - NIM
Dr. Tárkány-Szücz Ernő - NIM
Dr. Frommer Jozsef - OVF
Dr. Balázs Jeno - OVF DUNABER
Dr. Ing. Hevessy István - OVF DUNABER
Ing. Pour Ernö - OVG DUNABER
Ing. Szollár József - OVF DUNABER
Ing. Galli László - OVF VIZITERV
Ing. Illei Vilmos - OVF VIZITERV
Ing. Marót Gyula - OVF VIZITERV
Dr. Ing. Mistéth Endre - OVF VIZITERV
Benko Józsefné, interpretor - OVF DUNABER
Ing. Petenykó János, interpretor OVF VIZITERV

The sides agreed the program as follows:

I. Checking the tasks from the negotiations of representatives of ÚSVH and OVF taking place in Prague on April 27 - May 5, 1966.

II. Joint position of ÚSVH and OVF to the choice of optimum variant of the utilization of the Czechoslovak-Hungarian section of the Danube and approval of basic data of the Variant determined for the elaboration on the level of an investment task.

III. Discussion of further works concerning the elaboration of the joint investment task of the System of water works on the Danube.

IV. Questions on the preparation of the proposal of principles of the Interstate Treaty.

V. Elaboration of a joint report for negotiations of water management authorities of ČSSR and HPR.

VI. Different issues.

Individual paragraphs of the working program were discussed as follows:

ad I. Checking the tasks from the negotiations of representatives of ÚSVH and OVF taking place in Prague on April 27 - May 5, 1966.

The fulfilment of tasks following from the protocol of the Prague meeting of central investment authorities and it is stated that these tasks were fulfilled by investment organs and designers with exception of the following ones:

1. A joint approval of research tasks handed over till 31.12.1965 with remarks of the other side (par. I/2 of the cited protocol) began at the negotiations on 13.-16.6.1966 and 22.-26.6.1966. From the mentioned tasks, the research works concerning groundwater II/2, II/2, II/3, III/9 and VII/3 were not yet definitely evaluated.

The Czechoslovak side considers for necessary to agree still besides the above-mentioned the following tasks:

a) Tasks elaborated by the Cz. side: II/4, II/5, III/6, III/7, 8, IX/11 /not yet handed over to Hungary/, B.1.1., I/3b, V/2/already handed over/.

b) Tasks elaborated by Hungarian side: I/8 /not yet handed over to Czechoslovakia/, I/9 already handed over to Czechoslovakia/.

Central investment authorities agreed that investment authorities and designers

- would mutually hand over missing final reports of above-mentioned research tasks till 30.9.1966

-would mutually hand over remarks to these reports till 15.11.1966.

- approval would take place till 30.11.1966

They agreed further that the results of research tasks approved till 30.11.1966 might be respected in investment task only after a mutual agreement in such a way that the schedule of elaboration of investment task be respected.

2. There are still differences between both sides in principles of dimensioning the anti-filtration measures (I/12). The central investment authorities asked designers to agree joint principles till 15.10.1966.

ad II. Joint position of ÚSVH and OVF to the choice of optimum variant of the utilization of the Czechoslovak-Hungarian section of the Danube and approval of basic data of the Variant determined for the elaboration on the level of an investment task.

1. the Choice of optimal variant

In conformity with further joint approved procedure of preparation of the construction of a joint Czechoslovak-Hungarian System of water works on the Danube, ÚSVH informed about the result of its evaluation of documents of the scheme of diversion and two-step river variant.

The Hungarian side informed about its evaluation of both variants at the negotiations of central authorities on 27.4-5.5.1966 in Prague.

On the basis of discussions of results of both sides, the central investment authorities agreed on the following position:

a) In spite of differences in depth of elaboration of individual variants, it is possible already in this period to choose the final variant based on elaborated documentation and recommend it for completion on the level of investment task. It is following from extensive research, examination, study and design works elaborated in past years for clarification of comprehensive questions concerning the optimum solution of a comprehensive utilization of the said section of the Danube.

b) It states that the depth of elaboration of diversion variant extends in many directions the demanded depth for elaboration of investment task. The elaboration of two-step river variant is in many points much more wider than it is demanded form a technical-economical study. In spite of this difference, the elaboration reached a satisfied level of comparison for the needs of comparison and choice of final solution.

c) By evaluation the solution of utilization of the mentioned section of the Danube it is clear that the diversion variant be better adapted to existing geological and hydrogeological situation than the river variant.

d) Control of water regime of the river and adjacent territory is solved in substance by both variants equally.
But the Czechoslovak side does not consider the comprehensive protection of Bratislava for sufficiently proved from the point of view of ice, flood, bedload regime and the regime of groundwater. With regard to importance of this question, it is important to reexamine the optimalization of the backwater elevation point of 131,10 m a.s.l. /B/ of the reservoir Hrušov-Dunakiliti within the works of the investment task. The importance of the whole problem, possible higher presence of some unfavourable impacts (ice blocks etc.) which will occur after the construction of the joint system of water works, demand a comprehensive evaluation of individual research works and studies which should be object of examination by both sides, because these are impacts caused by a joint Czechoslovak-Hungarian work. The examination of the optimalization of the backwater elevation point to 131,10 m a.s.B. of the reservoir Hrušov will be realized by the Czechoslovak side and it will inform the Hungarian side up to 20.11.1966 about the result.

The Hungarian side states that about 12 studies were concerned in the past with the issues of protection of Bratislava against floods, bedload, ice regime and elevation of ground water levels.
None of these studies stated unfavourable impacts, respectively threatening of Bratislava as consequence of elevation point to 131,10 m a.s.B. from the point of view of flood protection, ice blocks and unfavourable elevation of ground water levels. These studies proposed at the same time such measures which have been necessary for the protection of Bratislava at least on the actual level or still better. The studies imposed necessary measures with which it was possible to realize the protection of Bratislava. On the basis of actual documents, the Hungarian side does not consider for important the examination of the elevation point to 131,10 m a.s.B.

The proposal to decrease the originally planned elevation point would have an unfavourable impact on operation and economy of water works. A bigger change of the elevation point could cause further examination of such variants of the utilization of the mentioned section of the Danube which were already rejected before by the Hungarian side, respectively, it makes possible to find out new variants of the solution - what had already happened - and it would mean the postponement of the realization of water works.

The mixed committee set up the date for the elaboration of the investment task on April 30, 1967. If the Czechoslovak side wants to reexamine the elevation point or any other basic information, this date would become doubtful. If the position of the Czechoslovak side to 20.11.1966 would hinder observance of prescribed date, the Hungarian side would be obliged to stop works on the investment task till the period of satisfactory answer by the Czechoslovak side.

The Hungarian side considers the elevation point of 131,10 m a.s.B. for definite and continues all works according to the agreed program till the information of the Czechoslovak position.

e) One of the decisive points of view for the evaluation of the comprehensive solution of the examined section of the Danube is its energy utilization. From all indicators expressing the relation between the value of produced electrical energy in a year and investment or operation costs, <u>the most advantageous variant seems to be the diversion variant.</u> Installed output and the production of electrical energy in a year are higher in this variant if compared to the river variant. The diversion variant supposes a lower number of turbines, therefore it is more disposable and more advantageous for operation.

f) The construction of the system of water works in the section between Bratislava and Nagymaros will form more <u>favourable conditions for navigation</u> if compared to existing conditions <u>without regard to chosen variant.</u> In both considered variants, the parameters recommended by the Danube Commission will be perspectively guaranteed and thus the demanded conditions for navigation are fulfilled by the Czechoslovak and Hungarian authorities. The river variant has some advantage with regard to navigation conditions by peak operation of hydroelectric power plants and higher emergency navigation.

g) <u>In case of realization of any considered variant, it is possible to guarantee a successful development of agriculture in mentioned territory</u>. The occupation of agricultural land are smaller in a river variant but occupation of forest areas are higher. According to the Czechoslovak side, the investment costs for elimination of unfavourable impacts as consequence of the construction of water works on agriculture production are approximately equal by both variants.

According to Hungarian studies, these costs are higher in the river variant.

h) It may be stated fundamentally that both variants comply with the comprehensive development of the territory, they guarantee development of settlement and industry of the said region with some specific differences. By comparing both considered variants from the point of view of impact on landscape and biology of the region, <u>it is possible</u>

to state on the basis of existing materials that the diversion variant be more acceptable. It will be necessary to solve the given subject in the next period of design works.

i) The technical solution of structures planned in both variants are convenient from the points of view of safety, function and feasibility. The advantage of diversion variant is that the realization of construction works of decisive structures will be done outside of inundation territory what is much more favourable from the point of view of continuation and dates of construction.

j) Evaluation of construction and assembling works were done on the basis of principles approved by central investment authorities, or by respective national authorities of both sides. The above-mentioned principles were applied in equal measure in both variants and a sufficient comparison of budgets was reached. It results from the comparison that investment costs by the diversion variant are lower.

k) The proportion of effectiveness of individual variants was calculated on the basis of simplified suppositions. The utilized method of calculations may be described as conformed for the comparison of variants on this level of elaboration. The comparison of results of economic effectiveness of both variants showed that the diversion variant was more effective.

After evaluation of all above-mentioned facts, the Central office of water management of ČSSR (ÚSVH) and Main office of water management of HPR (OVF) recommend to elaborate only diversion variant on the level of investment task for the utilization of examined section of the Danube with regard to indisputable advantages of this solution if compared to all examined variants till nowadays.

2. The approval of basic data for the investment task

In conformity with negotiations of central offices of investment authorities taking place in Prague on 27.4. - 5.5.1966, the basic data of investment task according to annex "A" of this protocol could have been elaborated and submitted for approval.
The given task was fulfilled with following results:

a) Basic data for investment task were agreed and approved by central investment authorities as mentioned in Annex 1 of this protocol.

b) From the list of basic data were excluded, as less important data, following data (Numbers don't correspond to numbers of the annex A) 08,09,10,21,28,29,30,31,41,42,43,57,60,62,65, 67,69,70,71,72.
Some of these data were already accepted during former negotiations of investment authorities and designers and

remain to be valid, the other data will be discussed and approved in further working meetings of investment authorities and designers.

c) At the following basic data, no agreement was reached (Numbering according to Annex 1 of the protocol)

- Basic data 26, 27, 32 (dimensions of navigation locks). Czechoslovak side demands on the basis of results of elaborated studies that the navigation locks constructed on the Gabčíkovo and Nagymaros step be of the same dimensions, i.e. 2 x 34 x 260 in Nagymaros and 1 x 24 x 260m and 1 x 34 x 190m in Gabčíkovo with minimum width of anchorage 155 m.

The Hungarian side persists that according to the recommendations of the Danube Commission, the navigation locks in Nagymaros should be 2 x 34 x 260 m and in Gabčíkovo 2 x 24 x 230 and the width of anchorage 120.

In case of realization of navigation locks in Gabčíkovo, according to Czechoslovak proposal, the difference in investment costs would not be considered for a joint investment.
Both sides agreed that this difference would be submit to decision to the heads of water management authorities.

- Basic data 48 (principles for the proposition of anti-filtration protection).
The central investment authorities demand investors and designers to examine the documents which are at disposal and agree the principles for investment task till 15.10. 1966.

d) Czechoslovak side states to the basic data No. 03a/, b, 04a/, b, 05a/, 06a/, 07a/, b, 19b this note: these data are actually valid, their eventual change will be agreed after verification of the optimal backwater elevation point in reservoir Hrušov.

e) The sides agreed that recommendation resulting from the Moscow consultation in May 1966, will be utilized by the elaboration of investment task.

ad III. Discussion of further works concerning the elaboration of the joint investment of the System of water works on the Danube.

1. Contents, division of design works and ruble budget of the investment task

The sides agreed the contents and division of design works for the elaboration of investment tasks between investment authorities and designers of both sides.
The content and division of works is in annex 2 of this protocol.

The sides agreed that the budget of the joint investment task will be elaborated in ruble according to the "Directives to the ruble evaluation of the system of water works" agreed in January 1966. Both sides will submit documents to quantity of works according to agreed extent.
The Czechoslovak side informs that it needs these documents for budget elaboration in national currency.
Both sides agreed to ask their respective Ministries of Finances for solution of the way of evaluation of forests and lands in ruble currency as soon as possible .
The extent of contents and documents for the investment task will be agreed by investment authorities and designers up to 15.9.1966.

2. Schedule of elaboration of investment task

Both sides agreed the schedule of elaboration of investment task of the system of water works on the Danube as submitted by investment authorities and designers, on 16.-19.8.1966.

The Czechoslovak side draws attention to the point II/1/d of this protocol which could endanger final term of elaboration of investment task as mentioned in the schedule.

3. Central investment authorities agreed that by elaboration of investment task, they will follow the proposition of the joint investment task of the system of water works on the Danube from 1964 which should be completed, respectively reelaborated with utilization of further results of research, examinations and designs, including remarks of national authorities of both sides to this investment task of 1964.

ad IV. Questions on the preparation of the proposal of principles of the Interstate Treaty

Both sides exchanged information on their position to the preparation of main principles of the Interstate Treaty. It resulted from the discussions that the sides were not of the same opinion in these issues.

Position of the Hungarian side:
The Hungarian side with regard to innovative management of national economy being introduced in both states, considers the principles of interstate Treaty as elaborated in 1963 - 1964 for out-dated. The head of the Hungarian group of central investment authorities sent to the Czechoslovak counterpart a proposal including also some of necessary changes. The Hungarian side informed that it would discuss at the meeting of central investment authorities only new basic issues and it would welcome mutual information without demanding detailed discussion or text adaptations of submitted proposal.

According the position of Hungary, the elaboration of a proposal of an interstate treaty for the diversion variant would be sufficient. But this variant is not yet quite clear in all points, nor the basic data for elaboration of an investment task are available, therefore the possibility of keeping the term of 30 of April 1967 seems to be doubtful.

The agreement of the investment task which should be elaborated by both sides by 30.4.1967 needs a longer period for approval which is necessary also for positions of the heads of planning authorities and on including it into the plans of the national economy.

On the basis of mentioned facts, in the opinion of the Hungarian side it would be necessary to elaborate once more the proposal of principles of the interstate treaty.

By elaboration of a new proposal, the innovative management of national economy of those branches should be taken into account which are concerned with the construction of the System of water works. The proposal of new principles of the interstate treaty must concern the variant which will be realized on the basis of recommendations of the heads of water management authorities. It must guarantee commonly determined technical and economic parameters during the construction as well as during operation, it must determine responsible authorities for further works, their relations and obligations.

The proposal of interstate treaty has to be elaborated parallel with approved joint investment task, respectively with declarations of the heads of planning authorities. The Hungarian side will demand the heads of water management authorities to propose the extension of the term - 31.3.1967 - which was set up by the Joint committee for elaboration of principles of the interstate treaty.

According to the position of the Hungarian side, it is necessary to sign only one interstate treaty and no former governmental agreement is needed. The date of signature of interstate treaty will become actual only after declarations of the heads of planning authorities and the approved investment task will form an indivisible annex of this interstate treaty.

Position of the Czechoslovak side:

The basic proposals of the head of Hungarian delegation of central investment authorities for conclusion of an interstate treaty concerning the construction and operation of the System of water works, based on the investment task, as well as the determination of relations of contracting parties for coordination, regulation and control of the joint construction are not acceptable for the Czechoslovak side.

The conclusion of the interstate treaty on the basis of the investment task is not in conformity with actual Czechoslovak standards on preparation and project documentation of investments, with the law on water management and does not guarantee correct division of investment costs of the construction between both sides.

The subject of regulation and coordination of the construction of the System of water works by investment organizations with exclusion of a joint operative authority, is incompatible with necessary division of responsibility on respective levels for obligations resulting from the treaty for both governments, resp. states. It does not guarantee better observation of obligations and the problems arising during construction or disputable issues, which could not be solved by these organizations, should be then solved by some court. The realization of these subjects would demand a long period, the date for approval of investment task could not be observed and the realization of work would be postponed. Finally, the subject is not in conformity with discussions and agreements of these organizations up to this time.

Therefore the Czechoslovak side recommends to observe the agreed idea, i.e. to conclude an Agreement of governments on preparation of construction on the basis of investment task and the interstate treaty concerning construction and operation on the basis of contractual project. The whole construction would be directed by a Joint Commission as an authority of the mixed Czechoslovak-Hungarian committee for economic, scientific and technical cooperation.

The Czechoslovak side proposes further to continue immediately all common preparation works, especially the works concerning the Agreement for preparation of construction with related annexes and to solve still unsolved proposals of the Main principles of the treaty concerning the issues of administration, operation and maintenance of the System.

All works must follow from agreed principles and documents from the year 1964, they must observe compliance with investment task and some subjects which have not yet been discussed, should be taken into account (for. ex. question of division of costs of both sides from the beginning of the joint preparation of works up to the approval of investment task etc.)

ad V. Elaboration of a joint report for negotiations of main water management authorities of ČSSR and HPR.

On the basis of results of works done up to now for the preparation of the joint Czechoslovak-Hungarian System of water works on the Danube and conclusions of the protocol of this negotiation, the representatives of ÚSVH and OVF elaborated a joint report which would be submitted to the heads of water management authorities.

ad VI. Different issues

a) the Czechoslovak side informs that the last results of drills of tectonic exploration suppose that there could be a tectonic line near Gabčíkovo where a dislocation of 20-50 m may be found. It considers for necessary to examine the existence of this dislocation because the results may influence the situation of Gabčíkovo work. The Czechoslovak side proposes that the experts of both sides discuss the extent of further research works for verification of theses suppositions.

The Hungarian side takes into account the information of the Czechoslovak side and cannot take a position without knowing the opinion and view of their expert institution - the Hungarian State Geological Institute. The common evaluation of geological data is being performed. The issue will be discussed after getting expert report to tectonic research.

2. Both sides agreed that the next meeting would take place in Prague at the end of November 1966.

The protocol was done in two copies in Slovak and Hungarian version of the same validity. The annexes form an indivisible part of the protocol.

Ing. Vladimír Dvořák	Dr.Ing.Gábor István
For Czechoslovak side	For Hungarian side

Annex 47

(Translation - tables omitted)

Report

on

Comparison and Estimation of the Diversion and Competitive Variant of the System of River Power Project on the Danube (submitted at the negotiations of Representatives of the Czechoslovak and Hungarian Ministries of Forestry, 28 June 1969)

Report on Comparison and Estimation of the Diversion and Competitive Variant of the System of River Power Project on the Danube (submitted at the negotiations of Representatives of the Czechoslovak and Hungarian Ministries of Forestry, 28 June 1969

Pursuing the agreement of governmental commissions of ČSSR and MLR of November 1967 the concerned investors and designers under the leadership of representants of central investors worked out project documentation of the competitive variant and compared it with the diversion variant.

On the basis of comparison and estimation the central investors drew following conclusions:

Technical-economical evaluation and comparison of both variants was elaborated by central investors in their own system of currency, using principles and assumptions, as well as basic data of the economic computation technique agreed and approved in advance as follows:

1. Comparison of volumes/ amounts/

   The variants were estimated according to

   - the volume of main works/Tab.1/,
   - the volume of main construction materials/Tab.2/,
   - extent of technologies and constructions/Tab. 3/,
   - permanent land occupation/Tab. 4/,
   - investment cost/Tab. 5/,
   - main energetic data of projects/Tab.6/,
   - outputs and power production/Tab. 7/,

The data presented in tables show, that except for some types of works/ e.g. dredging in water, compacted fillings, protection works/ and some types of material/ gravel-sand, steel sheet pile walls, asphalt/ all parameters of volumes are more advantageous in case of the diversion variant.

2. Comparison of technical-economical parameters

Within the scope of the economic estimation of both variants following technical-economical indicators were drawn up according to the joint methodology:

- investment cost 1 KW of installed output,
- investment cost for 1 KWh of equivalent daily energy,
- total cost for 1 KWh of equivalent daily energy,
- time of pay-off of not-interest-bearing cost,
- average gross profit of interest-bearing cost after starting of full operation,
- average investment yield over the first 8 years of full operation,
- average investment yield over the first 8 years of operation since putting into operation the first aggregate,
- present value of profits and expenses for the period of economic service life/65 years/.

These indicators and their comparison are in Tab. 8

It may be stated that the indicators of the competitive variant are less favourable, namely:

- costs by about 20 - 30%
- profits by about 10%
- economics by about 40%

Deviations of some data given in Tab. 8 from the average percentage value are due to computations carried out in different currency systems.

3. Comparison of other impacts

Qualitative differences of other impacts of both variants were evaluated with regard to:

- the process of operation starting,
- energetic operation,
- the effect - impact on the environment,
- potential application of advanced construction and organization methods.

3.1 Advantages and disadvantages of the successive/gradual operation starting are in both variants following:

- Energetic capacities are put into operation in approximate the same time in both variants, however the absolute value of the diversion variant are higher. Except for the first year of operation, the produced power over the whole construction period is higher in the diversion variant.

- With regard the period of construction both variants are equivalent.

- Average annual investment cost as well as maximum annual cost are in absolute and relative value lower in case of diversion variant.

- Gradual putting into operation of the diversion variant improves the navigation conditions on the concerned reach by one year sooner.

- Gradual construction of respective stage of the competitive variant would, according to executed examinations, considerably and negatively influence the economic parameters, and thus this construction process was not taken into account. It was proved, that even the eventual prolongation of the construction period of diversion variant would be more advantageous than the gradual construction of the competitive variant.

With regard to the gradual putting into operation it is evident on the basis of above-mentioned data, that the diversion variant is more advantageous.

3.2 Aspects of energetic operation

- Requirements for maintenance, service and number of personnel for operation of diversion variant are lower.

- Regulation of frequence, of output and providing of idle power are more advantageous in case of diversion variant.

- Considering the influence on navigation and winter regime it may be stated, that both variants are equivalent.

- Capacity and efficiency in case of flood events are higher at diversion variant.

Thus it is evident, that the diversion variant is more advantageous.

3.3 With regard to the impact on environment it may be stated:

- The competitive variant provides better conditions for the requirement of minimum changes in the Danube channel, however the long diversion canal is more advantageous with respect to flood water passing.

- Concerning the conditions of minimum possible alternation of biological conditions there is no substantial difference between the two variants.

- With regard to agricultural development there is no decisive difference between the variants. Under present conditions of agricultural production the competitive variant seems to be slightly more advantageous, since lower groundwater level decreasing is expected.

- Taking into account other impacts on the environment/location of industry, settlements, potential recreation and sports/there is no substantial difference between the two variants.

It is to be mentioned that the competitive variant is more advantageous with regard to sport and recreation, however it requires substantially larger expropriation of buildings, and at the same time provides more advantageous conditions for location of industry on the Hungarian side.

As far as the requirements of water management is concerned/flood protection, diversion of internal waters, bedload transport, water quality, navigation route/ both variants may be considered as equivalent. However, the diversion variant is more favourable for ice passing.

Taking into account the impacts on environment both variants have some positive and negative influences which are not decisive for final estimation.

3.4 With regard to potential application of advanced methods and construction organization both variants are equivalent. Whatever variant will be realized the most advanaced methods of construction organisation must be applied.

After the comparison and estimation of data and results of the investment task of the diversion variant of 1967 and the documentation of the competitive variant of 1969 have been completed it may be stated, that:

- the majority of technical parameters,
- all cost and yield indicators,
- all technical-economical inidicators,
- the method of putting into operation respective capacities,
- and the energetic operation conditions

are by about 10 - 40% more advantageous in case of diversion variant.

Other examined and studied impacts are in both variant approximately similar.

On the basis of the general comparison of concerned data the central investors drew a uniform conclusion, that with respect to the majority of decisive parameters the diversion variant is more advantageous and therefore it is recommended for further project preparation.

Budapest, June 28, 1969
On behalf of the ČS party:
Ing. Viktor Drozda

On behalf of the Hungarian party
Dr. Ing. István Gábor

Annex 48

Danube Commission, 52nd Session CD/SES 52/24, Plan de Travail

COMMISSION DU DANUBE | CD/SES 52/24
Cinquante-deuxième session

PLAN DE TRAVAIL

de la Commission du Danube
pour la période du 22 avril 1994 jusqu'à
la Cinquante-troisième session

1. Rééditer en 1994 la Carte de pilotage du Danube tome III.2 (secteur km 845,5-610).

2. Rééditer au courant de la première moitié de 1995 la Carte de pilotage du Danube tome IV.1 (secteur km 943-845,5).

3. Entamer en 1994 la réédition de la Carte de pilotage du Danube tome VII (secteur km 1880-1656).

4. Editer les "Recommandations relatives à l'utilisation du système INMARSAT-C dans la navigation sur le Danube"; tirage 150 exemplaires en russe et 150 en français.

5. Envoyer les "Recommandations relatives à l'utilisation du système INMARSAT-C dans la navigation sur le Danube" au Secrétariat de la CEE/ONU et au Secrétariat de la Commission Centrale pour la navigation du Rhin afin de porter à leur connaissance les Recommandations adoptées et de recevoir des informations relatives à la possibilité d'appliquer le système INMARSAT-C dans la navigation fluviale.

6. Editer les "Recommandations relatives à la délivrance du Certificat d'opérateur de station radio de bord travaillant en régime de radiotéléphonie"; tirage 150 exemplaires; édition bilingue.

7. Rassembler jusqu'au 1er août 1994 les avis des autorités compétentes des pays danubiens relatifs à l'application sur le Danube des Règles relatives au transport de marchandises dangereuses sur le Rhin (ADN-R) Dresser une information récapitulative, l'envoyer aux pays et la soumettre à l'examen de la réunion d'experts pour les questions techniques.

8. Envoyer au Secrétariat de la CEE/ONU et au Secrétariat de la Commission Centrale pour la Navigation du Rhin les "Recommandations relatives à la délivrance du Certificat d'opérateur de station radio de bord travaillant en régime de radiotéléphonie" pour information et en vue de la reconnaissance dans les plus brefs délais sur le Rhin du document danubien unifié. Informer des avis de la CEE/ONU et de la CCNR les autorités compétentes des pays membres de la Commission du Danube et des autres pays danubiens.

9. Recueillir, jusqu'au 1er août 1994, auprès des autorités compétentes des pays membres de la Commission du Danube et des autres pays danubiens des informations relatives au nombre et aux principaux paramètres techniques des installations radar utilisées à bord des bâtiments danubiens de diverses catégories. Sur la base des informations reçues dresser une information récapitulative et préparer le projet des nouvelles "Recommandations relatives aux principaux paramètres techniques des installations radar utilisées à bord des bâtiments naviguant sur le Danube". Envoyer aux pays les documents préparés et les présenter, avec leurs

éventuelles observations, à la réunion d'experts pour les questions de navigation et pour les questions de radiocommunication de novembre 1994, en vue d'examen.

10. Recueillir, jusqu'au 1er août 1994, auprès des autorités compétentes des pays membres de la Commission du Danube et des autres pays danubiens, des informations concernant les exigences nationales en vigueur relatives à la délivrance du certificat d'opérateur d'installation radar de bord ainsi que, si possible, les modèles de ce certificat. Préparer, sur la base des renseignements reçus le projet de "Recommandations relatives à la délivrance du certificat d'opérateur d'installation radar de bord" ainsi que le projet de ce certificat. Diffuser aux pays les projets préparés et les présenter, en même temps que les éventuelles observations, à la réunion d'experts pour les questions de navigation et les questions de radiocommunication de novembre 1994, en vue d'examen.

11. Recueillir jusqu'au 1er juillet 1994 les avis et les propositions des autorités compétentes des pays membres de la Commission du Danube sur le projet d'Arrangement relatif au service de radiocommunication dans la navigation sur le Danube et sur le Rhin (élaboré par les experts des PTT des pays rhénans) et proposé par le Secrétariat de la Commission Centrale pour la navigation du Rhin.

Sur la base des avis et des propositions reçus, dresser une Information récapitulative et la soumettre à l'examen de la séance du groupe restreint d'experts pour les questions de radiocommunication des Secrétariats de la

Commission du Danube et de la CCNR ainsi qu'à la réunion d'experts pour les questions de navigation et pour les questions de radiocommunication de la Commission du Danube, en novembre 1994.

12. Convoquer du 27 au 28 septembre 1994 à Budapest, une réunion du groupe mixte d'experts des Secrétariats de la Commission du Danube et de la Commission Centrale pour la navigation du Rhin, avec la participation d'experts en questions de radiocommunication des pays membres des deux organisations qui désireraient y participer, afin d'examiner les questions rélatives à leur future collaboration dans le domaine des radiocommunications, y compris la possibilité d'élaborer un accord respectif pour le Danube et le Rhin et d'unifier les prescriptions relatives aux installations radar. Soumettre les propositions préparées à l'examen de la réunion d'experts pour les questions de navigation et les questions de radiocommunication en novembre 1994.

13. Convoquer du 8 au 10 novembre 1994 une réunion d'experts pour les questions de navigation et les questions de radiocommunication; inclure à son ordre du jour à titre d'orientation les points suivants:

a) Examen de l'Information récapitulative relative aux principaux types d'installations radar existant dans la navigation sur le Danube ainsi que du projet de nouvelles "Recommandations relatives aux principaux paramètres techniques des installations radar utilisées à bord des bâtiments naviguant sur le Danube", en même temps que des éventuelles observations des autorités compétentes des pays;

b) Examen du projet de Recommandations relatives à la délivrance des certificats d'opérateur d'installation radar de bord dans la navigation sur le Danube et du projet de Certificat, en même temps que des éventuelles observations des autorités compétentes des pays;

c) Examen des propositions du groupe restreint d'experts des Secrétariats de la Commission du Danube et de la CCNR avec la participation d'experts des pays membres de ces organisations, relatives à la collaboration future dans le domaine de l'unification des prescriptions relatives aux installations radar et des questions de radiocommunication.

14. Rassembler jusqu'au 1er août 1994 les propositions des autorités compétentes des pays membres de la Commission et des autres pays danubiens au sujet de l'amélioration des conditions de navigation et du balisage du Danube, conformément au schéma approuvé. Diffuser aux pays les propositions reçues et les soumettre à la réunion d'experts pour les questions techniques en vue d'examen.

15. Rassembler jusqu'au 1er août 1994 les avis et propositions des autorités compétentes des pays membres de la Commission du Danube et des autres pays danubiens portant sur le projet de "Recommandations sur les prescriptions minimales relatives à la délivrance des certificats de conducteur de bateau de navigation intérieure effectuant des transports en trafic international sur le Danube". Diffuser aux pays les avis et les propositions reçus, dresser sur leur base une information récapitulative et la soumettre, avec le projet de Recommandations, à la réunion d'experts pour les questions techniques en vue d'examen.

16. Poursuivre le rassemblement de la part des autorités compétentes des pays membres de la Commission et des autres pays danubiens, des renseignements relatifs à la mise en vigueur du "Certificat de bateau" unifié, adopté par Décision de la Cinquante-et-unième session de la Commission du Danube (CD/SES 51/28) et des "Recommandations relatives aux prescriptions techniques applicables aux bateaux de navigation intérieure", adoptées par Décision de la Cinquantième session de la Commission du Danube (CD/SES 50/32). Sur la base des renseignements reçus dresser une information récapitulative, la diffuser aux pays et la présenter à la réunion d'experts pour les questions techniques en vue d'examen.

17. Poursuivre jusqu'au 1er août 1994 le recueil des avis des autorités compétentes des pays membres de la Commission du Danube et des autres pays danubiens relatifs à l'application sur le Danube de la nouvelle classification des voies d'eau navigables de l'Europe, adoptée par la CEE/ONU. Diffuser ces avis et les soumettre en même temps que l'Information récapitulative préparée en 1993 à l'examen de la réunion d'experts pour les questions techniques.

18. Convoquer du 5 au 9 décembre 1994 une réunion d'experts pour les questions techniques; inclure à son ordre du jour à titre d'orientation les points suivants:

a) Examen des avis et des propositions des autorités compétentes des pays membres de la Commission et des autres pays danubiens au sujet de l'amélioration des conditions de navigation et du balisage du Danube;

b) Examen de l'information récapitulative relative à l'application sur le Danube de la nouvelle classification des voies d'eau navigables adoptée par la CEE/ONU, ainsi que des avis supplémentaires reçus des pays membres de la Commission du Danube et des autres pays danubiens;

c) Examen de l'information récapitulant les avis des pays membres de la Commission et des autres pays danubiens sur la mise en vigueur du Certificat de bateau unifié et des Recommandations relatives aux prescriptions techniques applicables aux bateaux de navigation intérieure;

d) Examen du projet de Recommandations sur les prescriptions minimales relatives à la délivrance des certificats de conducteur de bateau de navigation intérieure effectuant de transports en trafic international sur le Danube et de l'information récapitulative sur les propositions des autorités compétentes des pays membres de la Commission et des autres pays danubiens au sujet de leur précision;

e) Examen de la question de l'application sur le Danube de l'ADN-R.

f) Examen de l'information récapitulant les avis des pays danubiens au sujet des possibilités de dresser et de diffuser les prévisions des niveaux de l'eau du Danube;

g) Examen des avis et des propositions des autorités compétentes des pays membres de la Commission et des autres pays danubiens relatifs à l'application des Recommandations relatives à la prévention de la pollution des eaux du Danube par la navigation et aux possibilités de leur perfectionnement;

h) Examen des propositions communes des autorités compétentes de la République Slovaque et de la République de Hongrie pour l'amélioration des conditions de la navigation sur le secteur km 1811,00-1708,20 du Danube afin d'atteindre des gabarits de chenal conformes aux Recommandations de la Commission du Danube.

19. Editer l'Information sur l'entretien du chenal navigable et sur les seuils du Danube d'Ulm à Sulina pour la période du 1er avril 1992 au 31 mars 1993; tirage: 70 exemplaires en russe et 70 exemplaires en français.

20. Poursuivre le rassemblement, jusqu'au 31 août 1994, des données des pays danubiens et des administrations fluviales spéciales pour l'établissement du projet de l'Information sur l'entretien du chenal navigable et sur les seuils du Danube d'Ulm à Sulina pour la période du 1er avril 1993 au 31 mars 1994 et soumettre l'Information à la Cinquante-troisième session de la Commission du Danube pour examen.

21. Sur la base des données supplémentairement reçues des pays danubiens, préciser le contenu du Guide des bateliers et l'éditer dans un tirage de 150 exemplaires en russe et 150 exemplaires en français.

22. Inclure les données supplémentairement reçues des pays danubiens dans les "Projets et propositions des pays danubiens et des administrations fluviales spéciales relatives à l'établissement du Projet de Plan des grands travaux pour la période 1991-2000, visant l'obtention des gabarits du

chenal, des ouvrages hydrotechniques et autres recommandés sur le Danube", dans le but d'en préciser le contenu et de l'éditer dans un tirage de 75 exemplaires en russe et 75 exemplaires en français.

23. Les autorités compétentes de la Slovaquie et de la Hongrie enverront au Secrétariat de la Commission du Danube jusqu'au 1er juillet 1994 leurs propositions communes relatives à l'amélioration des conditions de la navigation sur le secteur km 1811,00-1708,20 du Danube dans le but d'atteindre des gabarits de chenal conformes aux Recommandations de la Commission du Danube. Le Secrétariat diffusera les propositions reçues aux pays membres de la Commission du Danube ainsi qu'aux autres pays danubiens afin de recevoir leurs observations jusqu'au 1er octobre 1994. Les propositions et les observations seront soumises à la réunion d'experts pour les questions techniques de décembre 1994 en vue d'examen".

24. Après réception, jusqu'à la fin de 1994, des données définitives de la part des autorités compétentes de l'Allemagne et de la Slovaquie, préparer le calcul des nouvelles cotes de l'étiage navigable et de régularisation par stations hydrométriques principales sur le Danube et l'éditer dans un tirage de 150 exemplaires (édition bilingue).

25. Rassembler jusqu'au 31 juillet 1994 les avis et les propositions des autorités compétentes des pays danubiens sur le perfectionnement des Recommandations relatives à la prévention de la pollution des eaux du Danube par la navigation. Diffuser lesdits avis et propositions aux pays membres et les soumettre à l'examen de la réunion d'experts pour les questions techniques.

26. Rassembler, jusqu'au 1er juillet 1994, les données des pays danubiens pour l'Annuaire hydrologique 1993. Préparer et éditer l'Annuaire dans un tirage de 150 exemplaires (édition bilingue).

27. Poursuivre la diffusion aux pays membres de la Commission du Danube et aux autres pays danubiens des prévisions mensuelles des niveaux d'eau du Danube.

28. Rassembler, jusqu'au 1er juillet 1994, les avis et les propositions des pays membres de la Commission et des autres pays danubiens au sujet des possibilités de l'élaboration et de la diffusion des prévisions des niveaux d'eau du Danube. Sur la base des documents reçus, dresser une information récapitulative, la diffuser aux pays et la soumettre à l'examen de la réunion d'experts pour les questions techniques.

29. Préparer et éditer l'Ouvrage de référence hydrologique du Danube pour la période 1921-1990 dans un tirage de 150 exemplaires (édition bilingue). Inclure dans l'Ouvrage les données de la RFA si elles sont présentées au Secrétariat avant le 1er juin 1994.

30. Préparer et éditer, sur la base des données reçues des pays danubiens jusqu'au 1er août 1994, l'Annuaire statistique pour 1993; tirage: 200 exemplaires (édition bilingue).

31. Rassembler jusqu'au 1er juillet 1995 les données des pays danubiens pour l'Annuaire statistique de la Commission du Danube 1994.

32. Dresser une Information sur le flux de marchandises sur le Rhin, le Main et le Danube et la diffuser aux pays membres de la Commission et aux autres pays danubiens.

33. Poursuivre le rassemblement, auprès des pays membres de la Commission du Danube et des autres pays danubiens, des données relatives aux prescriptions du domaine de la surveillance phytosanitaire réglementant l'importation et le transit des matières de provenance végétale. Sur la base des informations reçues, dresser une liste récapitulative des prescriptions du domaine de la surveillance phytosanitaire réglementant l'importation et le transit des matières de provenance végétale, et la diffuser aux pays.

34. Charger le Secrétariat de la Commission du Danube d'étudier la pratique d'établissement du niveau des traitements dans les organisations internationales du système de l'ONU et présenter une information aux Etats membres de la Commission du Danube.

35. Elaborer jusqu'au 1er août 1994 le projet de Dispositions relatives au système de pensions pour les fonctionnaires du Secrétariat de la Commission du Danube, le diffuser aux pays membres de la Commission du Danube et le soumettre à l'examen de la réunion d'experts pour les questions juridiques et financières.

36. Participer à la réunion d'experts du Centre Administratif de la sécurité sociale pour les bateliers rhénans près la CCNR, consacrée à l'élaboration de l'Arrangement administrafif relatif à l'application de l'Accord européen concernant la sécurité sociale des bateliers de la navigation intérieure.

37. Convoquer du 25 au 27 octobre 1994 une réunion d'experts pour les questions juridiques et financières. Inclure à son ordre du jour à titre d'orientation les points suivants:

a) Examen des questions surgissant dans le domaine de l'harmonisation des dispositions juridiques et professionnelles en connexion avec la liaison du Danube et du Rhin;

b) Examen du projet de Dispositions relatives au système de pensions pour les fonctionnaires du Secrétariat de la Commission du Danube.

c) Examen de la création d'un fonds de réserve en vue de son inclusion dans le Règlement relatif à la gestion financière de la Commission du Danube (dispositions de l'ancien projet de Règlement (doc. CD/SES 52/18) se référant à la création d'un tel fonds);

d) Examen de la question d'intérêts à payer en cas de versement des annuités après les délais prescrits par le Règlement relatif à la gestion financière de la Commission du Danube. Etude de l'information du Secrétariat sur la pratique existant dans ce domaine au sein d'autres organisations internationales.

38. Maintenir les contacts, poursuivre l'échange de documentations et, après s'être concertés de part et d'autre, consulter les organes compétents des pays danubiens ainsi que les institutions de recherches scientifiques et d'établissement de projets des pays danubiens et autres s'occupant de l'étude de questions d'ordre nautique - y compris les questions de radiocommunication - , hydrotechnique, hydrométéorologique, statistique et juridique présentant de l'intérêt pour la navigation danubienne.

39. Conformément à la décision de la Trente-troisième session de la Commission du Danube sur les relations internationales de la Commission, maintenir les contacts avec les organisations internationales, participer aux travaux des organisations internationales et des réunions s'occupant de questions présentant de l'intérêt pour la navigation sur le Danube.

40. Conformément aux Décisions des sessions de la Commission du Danube ainsi qu'à l'accord intervenu en 1976 entre la Commission du Danube et la Commission Centrale pour la Navigation du Rhin, continuer et développer les contacts de travail entre la Commission du Danube et la Commission Centrale pour la Navigation du Rhin et contribuer à la recherche des voies pour l'harmonisation et l'unification des prescriptions et recommandations sur le Danube et sur le Rhin.

41. Poursuivre le rassemblement de la documentation selon la Liste des questions intéressant la navigation danubienne en connexion avec la liaison Rhin-Main-Danube et la réalisation de la liaison Danube-Oder(Elbe)(Annexe 2 au doc. CD/SES 30/26) adoptée par la Commission du Danube. Traduire la documentation dans les langues officielles de la Commission du Danube et la diffuser aux pays membres de la Commission du Danube et aux autres pays danubiens.

42. Participation du Directeur Général du Secrétariat de la Commission du Danube aux réunions de préparation de la conférence diplomatique.

43. Editer les Règlements relatifs aux droits et obligations des fonctionnaires, et respectivement des employés du Secrétariat de la Commission du Danube; tirage: 100 exemplaires en russe et 100 exemplaires en français.

44. Dresser et imprimer sur ronéo les documents suivants:

a) Procès-verbaux préliminaires de la Cinquante-deuxième session de la Commission du Danube (tirage: 50 exemplaires en russe et 50 en français);

b) Procès-verbaux de la Cinquante-deuxième session de la Commission du Danube (tirage:200 exemplaires, édition bilingue).

45. Dresser:

a) le projet de Plan de travail de la Commission du Danube pour 1995/1996;

b) le projet de budget de la Commission du Danube pour 1995.

Remarque: L'observation, dans la mesure du possible, des délais prévus pour la présentation des matériaux est orientée vers l'amélioration de l'accomplissement du plan de travail.

Annex 49

Magyar Hírlap, 19 October 1994

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Magyar Hírlap, 19.10.1994

The coffer dam will be opened at the end of November

The narrowing began already, perhaps in one month, at the end of November, the dam will be open and working site at Nagymaros will be flooded.

The restoration of the country began in the Danube bench the last year. This is a unique and from technical viewpoint very complicated work which is to be finished in 1996 according to the plan. The realization of investments in amount of 9 billions Ft was won by Strabag Hungária and Vízép in a competition.

The works go on according to the schedule - informed Arpad Szentiványi, the chief of the Danube restoration office of the Dept. of Transport. The road tunnel Nagymaros- Visegrad was finished in the area protected against water with the dam and the adaptation of the river bed to guarantee navigation will be finished soon. The works are performed and probably in a month, at the end of November, the dam will be opened and the former working site will be flooded. The other parts of some kilometer long rocky wall will be demolished in the next year directly from water.

The new river bed will have the same location, but it will be narrower. In the section of Viségrad with small islands and shallow waters two bends will be formed for water sports. The restoration of the country with complete restoration of banks, plaanting of trees, restoration of area and demolition of coffer dam should be finished till 31.7.1996. Reacting to Binder's declaration last week in Budapest, - "It cannot be determined if construction or demolition is realized near Nagymaros" - Arpád Szentivąnyi said: "restoration of the country is irreversible already today." The Binder's statement is right in such a measure that the construction continued in working site also during the preparation of navigation route.

The voices, arguing for completion of the hydroelectric power plant, were raised in the last period. A part of inhabitants in Nagymaros and the Club of Real Greens initiated the reevaluation of decisions on demolition of the work. Even if the Horn's Government hase declared several times its willingness to compromise in the case of the Danube, the coalition does not suppose for justified the reevaluation of governmental and parliamentary resolutions concerning Nagymaros.

CERTIFICATION

I, the undersigned, Dr. Peter Tomka, Agent of the Slovak Republic, hereby certify that the copy of each document attached in Volume 2 of the Counter-Memorial submitted by the Slovak Republic is an accurate copy; and that all translations prepared by Slovakia are accurate translations.

(Signed) ____________________

Dr. Peter Tomka

Agent of the Slovak Republic