INTERNATIONAL COURT OF JUSTICE

GABČÍKOVO-NAGYMAROS PROJECT

(HUNGARY/SLOVAKIA)

MEMORIAL

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Annex 23

Evaluation of Preparatory Works relating to the G/N Project executed by 31 December 1973, prepared by VVIP and Hydroconsult of Bratislava, and OVIBER and VIZITERV of Budapest

INTRODUCTION

This part of directions involves evaluation of design, research, and survey works, completed by 31. 12. 1973 in the connection with the Gabčíkovo-Nagymaros Project, with regard to their application for the elaboration of the contractual project. From works, included into the evaluation, have been drawn up - the total list, and
- the abstract, including short information on the content and evaluation of respective work.

The evaluation has been estimated with following classification of application:

A/ Application in full extent,

B/ Partial application,

C/ Application after supplementation,

D/ Application as subsidiary material.

Works, estimated as unsuitable for elaborating the contractual project are not listed.

C O N T E N T

1. L I S T

LIST OF PREPARATORY WORK FOR THE GABČÍKOVO-NAGYMAROS PROJECT AS A WHOLE

Number	Title of the work	elaborated	Year	
2.1	HYDROLOGY OF FLOWS			
1/1	Hydrological data in the section between Bratislava and Nagymaros	HYDROPROJEKT Báno, Binder	1965	A
1/2	Fixed Danube water levels km 1770 - 1800	VÚVH Bratislava	1966	A
1/3	Assessment of flood events on the Czechoslovak-Hungarian	HMÚ Bratislava Zatkalík	1965	B
1/4	Probable periodicity of maximum discharges on the Danube at Bratislava /1.-2.part/	VÚVH Bratislava Procházka	1964	A
1/5	Course of flood waters in the Danube after construction of Hydropower projects /1.-2.part/	VÚVH Bratislava Procházka	1964	B
1/6	Hydropower assessment of the 1965 flood on the Danube	VÚVH Bratislava Gyalokay, Náter, Prochácka, Szolgay, Bartolčič	1966	B
1/7	Natural water stages and discharges of the Danube	VIZITERV Takács	1964	B
1/8	Backwater curves of the Nagymaros project on the basis of data accepted in 1964	VIZITERV Takács	1964	D
1/9	Identification of the flood water levels of the Danube in 1965, without dam-break	VITUKI Csoma	1965	A
1/10	Hydrological data for the project HC Nagymaros, Basic data, Volume VIII/A	VIZITERV Takács	1965	C
1/11	Project task of the system of hydropower projects Gabčíkovo-Nagymaros. Backwater curves of the Ipel river water level	VIZITERV Papp	1965	A
1/12	Degree of safety of flood water passing through the G/N Project, using the method of probability computation	VIZITERV Mistéth	1965	D
1/13	Study of flood waves course within the backwater area	VITUKI Csoma	1966	A

2.2 BED LOAD

2/1	Bed load regime with regard to present regulation.Material for the trilateral consultation	VÚVH Bratislava Szolgay	1964	A
2/2	Study of parameters of the Váh river channel with respect to the G/N Project construction	VÚVH Bratislava Szolgay, Náther	1966	C
2/3	Study of bed load sedimentation within the backwater area, using the data of model experiments	VITUKI Csoma János	1966	A
2/4	Study of colmatation on the territory affected by the G/N Project	VITUKI Starosolszky	1966	A

2.3 ICE PHENOMENA

3/1	Study of relationships of typical climatic situations to the ice regime on the Danube	HMÚ Bratislava Patrovič	1965	A
3/2	Expected winter regime changes on the Danube after the construction of the G/N Project	HDP Bratislava Hanus	1964	B
3/3	Winter regime of functional structures of G/N Project	VÚVH Bratislava Šrámka	1965	A
3/4	Ice phenomena on the Danube in the reach Devín-Palkovičovo	VÚVH Bratislava Szolgay, Stančíková	1966	A
3/5	Winter regime of reservoir and canals of G/N Project on the Danube	VÚVH Bratislava Brachtl	1966	C
3/6	Study of measures for elimination of ice floods in the area of Bratislava	VÚVH Bratislava Brachtl	1966	C
3/7	Occurrence of ice phenomena and freeze-up on the Danube in dependence upon air temperature and atmospheric situations	HMÚ Bratislava	1965	A
3/8	Hydrological study of the Danube winter regime and forecasting of changes due to the construction of G/N Project:Study of ice phenomena in the abandonned channel and Nagymaros reservoir	VITUKI Szilágyi	1965	C
3/9	Development of ice and navigation conditions in respective stages of G/N Project construction	VIZITERV Zsilák	1966	B
3/10	Hydrological study of the Danube winter regime and ice phenomena downstream of Nagymaros	VITUKI Csoma	1966	B

3/11	Winter operation of drainage and seepage canals in the Danube section Nagymaros-Gönyü and in tributary flows	VIZITERV Póka	1966	B
2.4	WATER QUALITY, BIOLOGY PROTECTION OF NATURE, Territorial plan			
4/1	Hydrochemical prognosis of groundwater quality in the Danube riparian zone	VÚVH Bratislava Jacko	1965	C
4/2	Prognosis of water quality changes in the Danube as influenced by construction of the G/N Project	VÚVH Bratislava Rothschein Antonič	1966	A
4/3	Study of the most suitable groundwater levels for agricultural production	SAV Bratislava Benetin		A
4/4	Influence of the G/N Project on agricultural production	ŠÚTVPLS, Herda	1966	B
4/5	Assessment of agricultural production on areas, occupied temporary or permanently for the construction of G/N Project, and assessment of agricultural production increasing on areas taken out from river floodplain	PPÚ	1967	B
4/6	Assessment of the effect of groundwater level changes on agriculture production in the area of Nagymaros project	ŠÚTVPLS Herda	1967	B
4/7	Methodology of restoration of soils, occupied temporarily during the construction of the G/N Project	ŠÚTVPLS Bella	1966	A
4/8	Utilization of drainage systems for irrigation in the connection of the construction of the G/N Project	RVT-SVP Vongrej	1966	B
4/9	Study of fruit growing on the areas adjacent to G/N Project - namely Hrušov-Palkovičovo	PPÚ Bratislava Musil, Gergely	1967	B
4/10	Economic evaluation of the effect of the G/N Project on forest management in the area of decreeased groundwater level, considering eventual forest irrigation. Preliminary information	VÚLH B.Štiavnica Biskupský, Faith Váchov, Vojtuš Jurko	1963	B
4/11	Study of the river hydropower project on the Danube	Institute for forest management Zvolen, Galla	1964	B

4/12	Research of groundwater supplies of Žitný ostrov for irrigation and other aims	VÚVH Bratislava	1968	B
4/13	Project of the G/N Project and the development of environment. Material from a Symposium, held on 29.-30.4.1965 in Bratislava	SAV - CZESTC	1965	D
4/14	Assessment of three variants of the G/N Project with regard to environmental and nature protection	SÚPSaOP Bratislava, Fekete SAV-Ružička	1966	B
4/15	Principles of bank line regulation at low water level	VIZITERV Pőka	1965	A
4/16	Groundwater level regulation in the area of old channel	VITUKI Csoma	1966	B

2.5 GROUNDWATER, SEEPAGE

5/1	Groundwater regime on the Žitný ostrov	VÚVH Bratislava Lehký, Gyalokay	1964	A
5/2	Prognosis of water level stages on the Žitný ostrov after the construction of the bypass canal of the G/N Project	VÚVH Brno Hálek	1966	C
5/3	Groundwater regime in the area of the G/N Project	ČSA-Kratochvíl VÚVH-Gyalokay VÚV Brno Hálek,Čištín VÚV Praha Zajíček	1958	B
5/4	1966 Regulations for proposal of measures against the effects of seepage from reservoirs and river channels in the connection with the G/N construction	ČVUT Bažant	1966	B
5/5	Knowledge obtained from the study of research reports concerning piping and reconstruction of the Danube dykes	SVŠT Bratislava Peter	1967	B
5/6	System of river power projects on the Danube-two experimental sections of dykes	SVŠT Bratislava Peter, Urban Hulla	1966	D
5/7	Investment task of the Hungarian-Czechoslovak system of hydropower projects on the Danube Calculation of seepage below the dykes. Collection of formulas	VIZITERV Galli	1966	E
5/8	Expert's account on the efficiency of Larsen sheet pile driven at the upstream toe of the flood-	VITUKI Varrók	1959	A

	protection dyke in case of stratified subsoil			
5/9	Hydrological research required for the construction of G/N Project Outlet of seepage canal into the Szigéti Duna	VIZITERV Molnár Gántiné	1965	A
5/10	Study of groundwater regime in the area of Žitný ostrov, lower Váh, and Nitra rivers, and forecasting of its changes due to the construction of hydropower project Nagymaros. Preliminary orientation results	VÚV Bratislava Duba, Supek VITUKI, Ubell	1959	B

2.6 PEAK OPERATION

6/1	Hydraulic regime of canal hydropower plant at frequency regulation	VÚVH Bratislava Gabriel, Taus Sikora	1966	A
6/2	Support of the G/N Project construction and operation	HDP Bratislava Ježek	1966	A
6/3	Hydraulic calculations of peak operation. Material for consultation	HDP Bratislava Ježek	1965	B
6/4	Hydraulic calculations of wave motion at peak operation of G/N Project. Investigated for the bypass scheme Wolfsthal-Bratislava-Gabčíkovo-Nagymaros	HDP Bratislava	1966	A
6/5	Examination of justification of requirements of the CZ electrification system concerning the rise time transductance with regard to eventual increasing of investment and operation costs	HDP Bratislava Hraško	1966	A
6/6	Evaluation of experimental peak operation at Tiszalok hydropower project with regard to channel stability. Year 1960	VIZITERV Horváth	1961	B
6/7	Study of the course of discharge wave caused by peak operation /Partial Report/	VITUKI Csoma	1964	A
6/8	Channel development as influenced by peak operation	VITUKI Csoma	1965	A
6/9	Water levels, discharges, velocity variations. Calculations according to equations of non-permanent water motion	VITUKI Csoma	1965	A
6/10	Calculation of discharge and velocity variations at water level decreasing by means of equations	VITUKI Csoma	1965	A

	of non-permanent flow			
6/11	Calculation of water levels and velocity variations in tributaries according to equations of non-perm manent water motion	VITUKI Csoma	1965	C
6/12	Study of non-stationary movement in reservoirs and canals of the G/N Project	ČSAV - Puzanov VITUKI - Kozák	1966	A
6/13	Study of the course of wave motion for the investment task G/N Project	VITUKI Nagy	1966	A
2.7	REGULATION OF FLOWS			
7/1	Basic laboratory study of growth resistance	VÚVH Vincent	1972	B
7/2	Study of establishment and cultivation of hydraulically advantageous growth within the land band between dykes of the Danube	VÚV Cifra	1973	B
7/3	Study of channel modifications due to peak operation according to calculations in the theme 3.5.13	VITUKI Csoma	1965	D
7/4	Study of regulation work connected with the G/N Project construction and assessment of costs for the bypass variant	VITUKI Csoma	1966	D
7/5	Elaboration of principles for the regulation flow in the section Bratislava-Budapest	VITUKI Csoma	1966	A
7/6	Influence of the G/N Project and its operation on the outlet section of the Ipeľ river	VITUKI Dohnalik	1965	A
7/7	Effects of backwater and peak operation in the excavated channel development in the outlet section of the Mosoni branch	VITUKI Dohnalik	1965	A
2.8	DISTRIBUTION OF DISCHARGES, WATER BALANCE			
8/1	Preparatory study for the investment task "Water balance for the average year 1938, dry year 1934 and wet year 1910"	VIZITERV Blalló, Papp	1967	B
2.9	GEOLOGY, SEISMCITY			
9/1	Tectonic research in the area of water project on the Danube	GUDŠ Janáček+col.	1967	A
9/2	Study of earth dams stability with regard to seismicity	VIZITERV Juhász,Maté	1966	A

9/3	Survey of the structure of the Danube Island /Kisalfold/	VIZITERV Völgyesi	1966	D
9/4	System of the Danube river power projects Vojka-Dunaszeg-Nagymaros, competitive alternative Engineering-geological report	VIZITERV Volgyesi	1968	D
2.10	ENERGETICS, INFORMATION TECHNIQUE			
10/1	Cooperation of hydroel.power plant Wolfsthal-Bratislava and hydroel. power plant Gabčíkovo	HYDROPROJEKT Ježek	1966	B
10/2	Cooperation of hydroel.power plant Gabčíkovo and hydroel.power plant Nagymaros	HYDROPROJEKT Ježek	1966	B
10/3	Study of the conception of optimization and automation of control of a group of aggregates of the hydropower plant, working for two electrification systems. Study	EGÚ Bratislava Elbert	1965	C
10/4	Study of principles of optimum programming of outputs of hydropower plant working for two electrification systems. Study	EGÚ Bratislava Ihnaťo	1965	C
10/5	Connection of hydropower plants on the Danube into the electrification systems in ČSSR and Hungary	EGÚ Brno, Pasák Kozák, Viktorínová	1966	D
10/6	Study on connection of hydropower plants on the Czechoslovak-Hungarian Danube section into the system of automatic frequency control and power transfer control	EGÚ Praha Vítek, Josefus	1966	C
10/7	Study of optimum utilization of hydropower plant outputs, working for 2 electrification systems	VÚE Bratislava Grígel	1966	C
10/8	Connection of the G/N Project into the electrification systems of both countries	ERÖTERV Bajzané	1966	C
10/9	Design of the scheme of connection of hydropower plants into the joint system of hydropower projects on the Danube	EROTERV Sárközy	1966	D
10/10	Energetics - data for the G/N Project	HYDROPROJECT Danišovič VIZITERV-Fehér	1967	D
10/11	Investment task for telecommunication of the G/N Project (I.version)	POTI	1966	B

2.11 NAVIGABLE WATERWAY

11/1	Summary and evaluation of materials from international navigation congresses	HYROPROJEKT Šebele	1966	B
11/2	Effect of wind on navigation	HYDROPROJEKT Šebele	1966	B
11/3	Proposal of assessment of the effect of G/N Project and of respective projects on improvement of navigable waterway and navigation conditions	RVT SVV Liška	1968	A
11/4	Issues connected with navigation in the area of Nagymaros	VIZITERV-Nagy Horváth, Zemplényi	1965	B
11/5	Investigation of navigation conditions on the Danube section influenced by the construction of the G/N Project, special attention being payed on peak operation	VIZITERV Rácz	1966	A
11/6	Comparative study of navigation locks dimension	VIZITERV Nagy	1968	D
11/7	Examination of the proposal of a substitute navigable waterway through the Bagomerský branch	VIZITERV Kiss	1966	A
11/8	Substantiation of the substitute navigable waterway through the abandonned channel	VIZITERV Hankovszkyné	1966	A

2.12 MAINTENANCE AND OPERATION

12/1	Proposal of principles of maintennace and general repairs of energetic facilities of the G/N Project	HDP, Žúrek	1966	B
12/2	Investment task of 1967. Materials elaborated by the CZ side. Equipment and operation of the G/N Project	HDP, Liozin	1967	D
12/3	Investment task of 1967. Materials elaborated by CZ party. Housing construction Gabčíkovo-Nagymaros	HDP, Cénik	1967	D
12/4	Proposal of principles for maintenance and general repairs of structures and facilities of the G/N Project	ERŐTERV, Kiss	1966	D

2.13 CONSTRUCTION MATERIALS

13/1	Prefabrication and specification of the G/N structures	VÚIS Bratislava Brno	1966	B

13/2	Prefabrication and specification of concrete structures of G/N	HYDROSTAV Bratislava Huječek, Balko Chlubna	1966	D
13/3	Expert's account on concreting of the Nagymaros Project	ÉKME, Palotás	1964	C
13/4	Proposal of concrete mixtures composition	ÉKME, Palotás	1965	C
13/5	Investigation of grinded concretes	ÉKME, Palotás		A
13/6	Report on the survey of clays for dam sealing /Territory between Pilismarót and Lábatlan/	MAGYAR ÁLLAMI FÖLDTANI INTÉZET Sipos	1965	A
13/7	River hydropower project on the Danube-river alternative /results/	VIZITERV Mantuano	1966	D

2.14 TRILATERAL CONSULTATIONS

14/1	Trilateral consultations and preparatory materials	VIZITERV HYDROPROJEKT GIDROPROJEKT	1958 - 1964	B
14/2	Consultation on the G/N Project	VIZITERV HYDROPROJEKT GIDROPROJEKT	1964	B
14/3	Preparation of trilateral consultations on the G/N Project	VIZITERV	1966	D
14/4	Materials prepared for consultation in May 1966 /unified CZ-Hungarian materials/	VIZITERV HYDROPROJEKT	1966	D
14/5	Consultation on respective issues concerning the designing of the Project on Hungarian and Czechoslovak section of the Danube. Expert's account	GIDROPROJEKT	1966	A

LIST OF PREPARATORY WORKS FOR THE HYDROELECTRIC POWER PROJECT GABČÍKOVO

Number	Title of work	elaborated by	Year	Applicability
3.1	GENERAL			
1/1	Hydropower plant Gabčíkovo - determination of optimum backwater elevation	HDP - Hraško	1966	D
1/2	Determination of optimum absorption capacity of hydropower plant Gabčíkovo-Study	HDP - Hraško	1966	D
1/3	Investigation of the duration of the peak op. at maximum output of hydropower plant Gabčíkovo	HDP - Danišovič	1966	C
1/4	Investment task of 1967 Materials elaborated by CZ party Project of organization of construction - Hydropower project Gabčíkovo	HDP - Kotala	1967	B
1/5	Investment task of 1967 Materials elaborated by CZ party Expropriation of land and buildings Gabčíkovo	HDP - Ľupták	1967	D
1/6	Operation of hydropower project Gabčíkovo in winter period and during floods	HDP - Schulz	1966	B
1/7	Winter regime of drainage canals	VÚVH Bratislava Gyalokay	1965	A
3.2	HRUŠOV - DUNAKILITI RESERVOIR			
2/1	G/N Project, Hrušov reservoir	IHGP Bratislava Buroš+kol.	1965	C
2/2	Reservoir, construction material	GP Bratislava Žakovský+kol.	1964	C
2/3	Hrušov reservoir - Hydrological data	HDP-Frankovský	1965	D
2/4	Study of problems of reservoir colmatation nearby Hrušov	VÚVH Brno Čištín		A
2/5	Model study of bed load regime of the Danube at Bratislava and of flood protection	VÚVH Bratislava Vincent	1969	A
2/6	Hrušov reservoir - bed load and suspended load regime	HDP Frankovský	1965	D
2/7	Study of the regime and forecasting of groundwater levels in the section Petržalka - Čuňovo	VÚVH Bratislava Bartolčič	1965	C

2/8	Study of flow ad reservoir arrangement of Hrušov-Dunakiliti	VÚVH Bratislava Komora, Sumbal	1965	A
2/9	Study of layout solution of the hydropower project and reservoir Hrušov - Dunakiliti	VÚVH Bratislava Komora, Gallay	1967	C
2/10	Study of regulation arrangements in the Danube downstream of Bratislava and diversion of floods	VÚVH Bratislava Vincent	1966	A
2/11	Optimum width of prolongated apron in Hrušov reservoir	VÚVH Brno Hálek	1964	B
2/12	Construction of prolongated sealing apron before them dam of the river reservoir	SVŠT-Geotechnic Peter, Jesenák, Hulman, Kubán	1966	B
2/13	Study of the sealing apron in front of Hrušov dykes	SVŠT Bratislava Peter	1966	A
2/14	Construction of dykes for the upper and lower retention reservoir Assessment of soils	VÚIS Bratislava Mach	1966	D
2/15	Investment task of 1967 Material elaborated by CZ party Hrušov-Dunakiliti reservoir	HDP Bratislava Šebena	1967	B
2/16	Study of hydraulical problems of hydrojunction and reservoir Hrušov-Dunakiliti	VÚVH Bratislava Komora	1968	A
2/17	Engineering-geological survey of the reservoir and protection dyke at Dunakiliti	VIZITERV Erhardt	1966	C
2/18	Study of application of sealing apron in construction of G/N Project	VITUKI Bográdi	1964	D
2/19	Supplement to the investment task Dunakiliti reservoir	VIZITERV Peto	1966	D
2/20	Investment task Dunakiliti-Hrušov reservoir	VIZITERV Peto	1967	C

3.3 HRUŠOV-DUNAKILITI WEIR

3/1	Engineering-geological survey of Dunakiliti weir /preliminary results/	VIZITERV Volgyesi	1966	C
3/2	Hrušov-Dunakiliti project Documentation for layout	VIZITERV Szabó	1964	B
3/3	Examination of dammed-up water levels at Dunakiliti	VIZITERV Zsilák	1966	B
3/4	Examination of backwater levels at Dunakiliti project	VIZITERV Zsilák	1966	C

3/5	Capacity of Dunakiliti project, of headwater canal and Gabčíkovo project during floods	VIZITERV Zsilák	1965	C
3/6	Capacity of the weir of Dunakiliti-Hrušov project	VIZITERV Pipó	1965	A
3/7	Number of openings for ice runs discharging through Dunakiliti-Hrušov project	VIZITERV Zsilák	1965	C
3/8	Passage of flood waters through the Dunakiliti-Hrušov project during construction	VIZITERV Zsilák	1966	C
3/9	Examination of issues connected with the Dunakiliti-Hrušov navigation lock	VIZITERV Pipó	1966	B
3/10	Possibilitiy of leaving out the navigation lock at Dunakiliti	VIZITERV Czákó	1965	C
3/11	Seepage around and under structure Kiliti	VITUKI Ubell	1964	C
3/12	Seepage under Kiliti dykes	VITUKI Ubell	1964	C
3/13	Investment task for the G/N Project. Lateral seepage of the Dunakiliti-Hrušov project. Project study	VIZITERV Zsilák	1965	D
3/14	Short report on results obtained by means of model study performed in 1965 aimed at estimation of groundwater movement adjacent to the reservoir and structures of Dunakiliti	VITUKI Varrók	1965	B
3/15	Drainage of Dunakiliti project construction pit	VITUKI Varrók	1965	D
3/16	Dunakiliti project-Foundation variants	VIZITERV Maté	1965	D
3/17	Research work connected with construction of river power projects on the upper Danube. Bottom sealing of large construction pits	FTI Regele	1966	D
3/18	Experiments with new methods of subsoil consolidation. Final report Sealing of construction pit bottom by grouting at Dunakiliti project	FTI Regele	1966	D
3/19	Uplifts affecting foundation plate of Dunakiliti project. Variant with bypass canal	VITUKI Varrók	1966	D
3/20	Hydraulic research of stop-log weir stilling basin at Dunakiliti project	VITUKI Haszpra	1965	C
3/21	Hrušov-Dunakiliti weir-First design of water side travelling crane	UVATERV Kákedy	1965	D

3/22	Programme study of long-distance transmission line to power plants Gabčíkovo and Dunakiliti	Eröterv Halácsy	1967	C
3/23	Projects of hydropower plants Gabčíkovo and Dunakiliti. Documentation on affected land	ERÖTERV Halácsy	1967	C
3/24	Dunakiliti-Hrušov project, damming of the old Danube channel	VIZITERV Fékné	1964	D
3/25	Dunakiliti-Hrušov weir.Supplement to investment task	VIZITERV Marko	1966	A
3/26	Approach road to Dunakiliti project	UVATERV Fogarassy	1965	D
3/27	Bridges in floodplain constructed on the approach road to Dunakiliti	UVATERV Papp	1965	D
3/28	Hrušov-Dunakiliti weir. Investment task. Basic data.	VIZITERV Zsilák	1967	A

3.4 HEADWATER CANAL

4/1	The G/N Project, headwater canal, consruction material	Bratislava Žakovský	1964	C
4/2	The G/N Project, bypass canal for hydroelectric power plant Gabčíkovo	IGHP Bratislava Sladký+col.	1965	C
4/3	Concrete sealing of headwater canals and the methods of lining	VÁHOSTAV Žilina,Tamchyna Rozprávka	1964	B
4/4	Bituminous sealing of bypass canal bottom. Experiment	Road development Brno,Meluzín	1964	B
4/5	Estimation of main variants of dyke construction with regard to used material,seismicity, piping and tectonics. /Construction of dykes for upper and lower reservoir/	CZAV-Institute of theoretical and applied mechanics,Prague Havlíček	1965	A
4/6	Installation of reverse filters on interfaces between materials with low and high permeability in earth dams	VÚVH-VUT Brno Čištín	1965	B
4/7	Construction of the dykes of the G/N Project	VÚIS Bratislava Mach	1965	B
4/8	Construction of the dykes of the G/N Project Construction and technology	SVŠT Bratislava Peter	1965	B
4/9	Construction of the G/N dykes estimation of technological procedures with regard to existing machinery	IPS Engineering and industrial structutres Prague Suva	1965	D

4/10	Construction of SHP G-N dykes. Method of extraction, pouring and consolidation with regard to envisaged machinery	VÚPS-Praha Rataj, Florián	1965	C
4/11	Technology of headwater canal construction. Transport band	HDP Bratislava Kotala	1965	B
4/12	Effect of wave movement on bituminous lining of earth dams	VÚVH Praha, Vlček	1963	B
4/13	Sealing of headwater canal bottom of hydropower project Gabčíkovo. Sealing with soils	VÚIS Bratislava Mach	1966	C
	a/ Report on resluts of mechanical stabilization of a large-scale consolidation experiment, Podunajské Biskupice	TSÚS/Technical testing building Institute-Polák	1966	D
	b/ Field experiment of headwater canal bottom sealing /project	HDP Bratislava Schulz	1965	E
	c/ Field assessment of stability of consolidated earth against contact piping	GHP Bratislava Tichý	1966	D
	d/ Sealing of headwater canal bottom of hydropower plant Gabčíkovo	HYDROSTAV Bratislava Huječek	1966	D
	e/ Sealing of headwater canal bottom of hydropower plant Gabčíkovo. Largescale experiment.	VÚIS Bratislava	1966	D
4/14	Study of drainage of headwater canal bottom	HDP Bratislava Schulz, Mach	1966	C
4/15	Sealing of headwater canal bottom of hydropower plant Gabčíkovo. Sealing of bottom with stabilized earth	VÚIS Bratislava Medelský	1966	C
	a/ Sealing of headwater canal bottom with stabilized earth, membrane and bituminous concrete. Brief conclusion of the task S-1-26-2/1-II/	VÚIS Bratislava Medelský	1966	D
	b/ Report on results of chemical stabilization of a field experiment Podunajské Biskupice	TSÚS Bratislava Polák	1966	D
	c/ Sealing of headwater canal bottom of hydroel. power plant Gabčíkovo	Hydrostav, Bratislava Huječek	1966	D
4/16	Preparation of tripartite consultations on alternative technical solution of headwater canal	HDP Bratislava Lokvenc, Schulz	1966	B
4/17	Monitoring of changes during filling and emptying of the canal Trenčianske Biskupice - Pieštany	SVŠT Bratislava Peter, Urban Hulla	1966	B
4/18	Anchoring layer in the headwater canal of hydropower plant Gabčíkovo	HDP Bratislava Martinický	1965	A
4/19	Investment task of 1967. Materials worked out by the CZ party. Headwater canal	HDP Bratislava Schulz	1967	B
4/20	Headwater canal Gabčíkovo with bentonite sealing /lining/	VIZITERV Gántiné	1964	A

4/21	Experiments with anchorage for assessment of a protective layer over navigation canals lining	Translation of an article	1965	D
3.5	HYDROELECTRIC POWER PROJECT GABČÍKOVO			
5/1	Engineering-geological survey of Gabčíkovo project	IGHP Bratislava Kačník+col.	1965	C
5/2	Hydroelectric power plant Gabčíkovo, Assessment of number and dimension of turbines	HDP Bratislava Hraško	1965	B
5/3	Assessment and justification of optimum installed power plant capacity, production and number of equipment in hydroel.power plant Gabčíkovo	HDP Bratislava Hraško, Schulz	1966	A
5/4	Hydroel.power plant Gabčíkovo	VÚVH Bratislava Gabriel, Sikora Grund	1966	C
5/5	Determination of navigation locks dimension in Gabčíkovo Bypass alternative	VÚD Praha Kubec	1966	B
5/6	Optimum system of filling and evacuation of navigation locks at Gabčíkovo project and proposal of navigation of vessels and discharging of ice runs	VÚV Praha Doležal	1966	C
5/7	Foundation of hydropower plant on permeable subsoil. Symposium 16.-17.7.1964	CZETSC	1964	D
5/8	Hydropower plant Gabčíkovo Foundation	HDP Bratislava Hraško	1965	A
5/9	Hydropower plant Gabčíkovo-power production	HDP Bratislava Hraško	1965	B
5/10	Study of fall-out of hydroel.power plant Gabčíkovo	HDP Bratislava Hraško	1966	B
5/11	Monitoring of rise time velocity in hydropower plant Gabčíkovo	HDP Bratislava Hraško	1966	A
5/12	Investigation of possible frequency regulation on hydropower plant Gabčíkovo	HDP Bratislava Hraško	1966	A
5/13	Results of experimental grouting of gravel-sand deposits and dredging of uncased trenches in the site of designed hydropower plant Gabčíkovo	IGHP Brno Verfel, Láníček	1966	A
5/14	Results of experimental grouting of gravel-sand deposits and dredging uncased trenches in the site of designed hydropower plant Gabčí-	IGHP Brno Verfel	1967	D

	kovo. Supplement:Pumping experiments			
5/15	Data for hydropower plant Gabčíkovo design-foundation	VÚIS Bratislava Plch	1964	B
5/16	Data for design of hydropower plant Gabčíkovo foundation. Forming of vat walls and bottom by grouting, or eventually by trenching	HYDROSTAV Bratislava Hartel IGHP Brno Verfel	1964	A
5/17	Data for design of hydropower plant Gabčíkovo foundation. Distribution of casings by means of vibro-ramming engine /pile driver/ VUPS 20/11	HYDROSTAV Bratislava Balko	1964	D
5/18	Proposal of composition of concrete mixtures for construction of hydro-power plant and navigation lock Gabčíkovo	VÚIS Bratislava 1964-I.stage B Žigrai, Hornič 1965-II.stage		
5/19	Study of the G/N-foundation of structures on the basis of pumping large-scale experiments	VÚIS Bratislava Gregor VUT-VVÚVHS Brno Hálek	1966	B
5/20	Hydropower plant Gabčíkovo-Layout solution of the project and adjacent canal sections	HDP Bratislava Hraško, Šebele	1965	C
5/21	Hydropower plant Gabčíkovo and idle outlets	HDP Bratislava Hraško Jaroševič Goljer	1965	B
5/22	Hydropower plant Gabčíkovo-Study of construction solution of navigation locks	HDP Bratislava Šebele	1965	C
5/23	Investment task of 1957. Materials worked out by CZ party, Gabčíkovo project	HDP Bratislava Hraško	1967	B
5/24	Hydropower plant Gabčíkovo-Construction site equipment and building procedures	HDP Bratislava Kotala	1965	B
5/25	Investigation on 8 engine-pump sets of hydropower plant Gabčíkovo	HYCO Bratislava Schulz, Hraško	1971	B
5/26	Optimum dimensions and shapes of spiral casings for turbines of the hydroel.power plant Gabčíkovo	VÚVH Bratislava Žajdlík	1965	C
5/27	Development of construction of the hydroaggregate for hydropower plant Gabčíkovo	ČKD Blansko Bím	1966	B
5/28	Model tests in water for acceptance of the turbine block 4-H-69 and assessment of its effect on efficiency	ČKD Blansko Vitvar	1966	B

5/29	Effect of spiral width variation and shortening of suction piping conus 4-K-69 on the course of efficiency and cavitation	ČKD Blansko Vitvar	1966	D
5/30	Effect of idle outlet and turbine penstock 4-K-69 on efficiency course	ČKD Blansko Vitvar	1966	A
5/31	Long-term turbine run 4-K-69 at loose linkage of guide wheel and runner	ČKD Blansko Rempášek	1966	C
5/32	Development of throttle control in turbine suction piping	ČKD Blansko Prachář	1966	C
5/33	Research and development of a progressive solution of technological part for investment task of the G/N - Project Hydropower plants Gabčíkovo, Vojka and Čičov	ČKD Blansko Vitvar	1966	B
5/34	Study of pure compensation operation and determination of apparent generators output	HDP Bratislava Gardián	1966	D
5/35	Investment task G/N Project.Gabčíkovo project-machinery-hydraulic part	HDP Bratislava Kaufmann	1967	B
5/36	The G/N Project. Supplement to project task. Study on 8 units of hydroel. power plant Gabčíkovo. Machinery-hydraulic part	HYCO Bratislava Chmeľ	1966	C
5/37	Design of the basic scheme of the hydropower plant Gabčíkovo	HDP Bratislava Kedrovič	1966	D

3.6 TAILWATER CANAL

6/1	Overall arrangement of tailwater canal discharging from hydropower plant Gabčíkovo into the Danube	VÚVH Bratislava Štich, Sumbal	1964	A
6/2	Protection of slopes of the tailwater canal	HDP Bratislava Šoltés	1965	A
6/3	Protection /lining/ of slopes of the tailwater canal from the hydropower plant Gabčíkovo	ČVUT Praha Votruba	1965	A
6/4	Protection of banks of the tailwater canal of hydropower plant Gabčíkovo	ČVUT-Hydraulics Votruba HYDROSTAV Huječek		
6/5	Investment task of 1967. Materials worked out by CZ part. Tailwater canal	HDP Bratislava Schulz	1967	B

3.7 CHANNEL DEEPENING DOWNSTREAM OF PALKOVIČOVO

7/1	Extent of deepening of the Danube section downstream of Palkovičovo Study	HDP Bratislava Schulz	1966	A
7/2	Estimation of optimum way and extent of the Danube channel deepening, investigation of deepened channel stability	VÚVH Bratislava Pirkovský	1966	A
7/3	Calculation of water level course in the dredged Danube section. Deepening 1,7 m	HDP Bratislava Schulz	1966	A
7/4	Written longitudinal water level profile in the section Gönyü-Gabčíkovo after dredging	HDP Schulz	1966	A
7/5	Investment task from 1967 Data worked out by the ČS party The Danube channel deepening downstream the tailwater canal mouthing	HDP Schulz	1967	B

3.8 ADAPTATION OF THE OLD RIVER CHANNEL

8/1	Study of runoff conditions aimed at designing uniform channel in the section Hrušov-Palkovičovo	VÚVH Bratislava Szolgay, Náther	1965	A
8/2	Study of a succesive transition from the abandonned into the deepened Danube channel	VÚVH Bratislava Štich	1965	B
8/3	Study of the bed sill above the deepened Danube channel	VÚVH Bratislava Vincent	1965	B
8/4	Temporary /transient/ Danube channel section upstream of Palkovičovo	HDP Bratislava Mach	1966	B
8/5	Study of temporary /transient/ section and the Danube channel deepening at Palkovičovo for the bypass variant	VÚVH Bratislava Pirkovský	1966	B
8/6	Study of conditions occuring at the confluence of tailwater canal with abandonned channel	VITUKI Csoma	1965	B
8/7	Study of the abandonned channel in the section downstream of weir	VITUKI Csoma	1965	A
8/8	Effect of distribution of discharges on flood control safety /headwater canal, abandonned channel/	VITUKI Dohnalik	1965	B
8/9	Securing of the tailwater section of the Mosoni Danube. Supplement of investment task	VIZITERV Rácz	1966	A

8/10	Investment task. Safeguarding of the tailwater section of the Mosoni branch	VIZITERV Rácz	1967	A
8/11	Adaptation in the old river channel	VIZITERV Fékné	1967	A
8/12	Adaptation in the old river channel	VITUKI Csoma	1967	A

LIST OF PREPARATORY WORKS FOR THE HYDROELECTRIC POWER PROJECT NAGYMAROS

4.1 GENERAL PART

1/1	Data for determination of weir sluice number and dyke safety. Hydroel.power project Nagymaros	HDP Bratislava Velič	1966	B
1/2	Arrangement of prolongated sealing apron in front of dykes of the reservoir of the lower project	VUIS Bratislava Mach	1966	B
1/3	Arrangement of prolongated sealing apron in front of reservoir dykes	HYDROSTAV Bratislava Džadoň	1966	D
1/4	Protected areas of Nagymaros reservoir	VIZITERV Péczely, Póka, Kiss	1966	D
1/5	Proposal of cost distribution for protective measures. Hungarian regions	VIZITERV Péczely, Póka, Kiss	1967	D

4.2 PROTECTIVE MEASURES ON CZECHOSLOVAK TERRITORY

2/1	Hydrogeological regime of groundwater. Hydroel.power project Nagymaros	HDP Bratislava Velič	1967	B
2/2	Investment task of 1967. Materials worked out by CZ party. Project of organization of construction. Nagymaros project	HDP Bratislava Halaša	1967	D
2/3	Investment task of 1967. Materials worked out by CZ party. Relaying of roads	HDP Bratislava Marek	1967	B
2/4	Investment task of 1967. Materials worked out by CZ party. Connections 22 kV and pumping stations	HDP Bratislava Kedrovič	1967	B
2/5	Investment task of 1967. Materials worked out by CZ party. Disposession of lands and buildings-Nagymaros	HDP Bratislava Ľupták	1967	D
2.01/1	The Danube - Szalka. Chľaba	GP Praha, Lucek	1965	C

2.01/2	Investment task of 1967. Materials worked out by ÇZ party. Region No.1-Lower Ipeľ River	HDP Bratislava Lichý	1967	B
2.02/1	The Danube at Štúrovo	GP Praha, Lucek	1964	C
2.02/2	Alterations in grounwater regime in the Štúrovo region	UK Bratislava Duba	1966	A
2.02/3	Investment task of 1967. Materials worked out by ČS party. Region No.2-Lower Hron River	DHP Bratislava Goljer	1967	B
2.03/1	III. Kravany region	GP Praha Lucek	1964	C
2.03/2	Study of the regime and forecasting of groundwater regime after completion of the G/N Project in Kravany region	UK Bratislava Duba	1966	A
2.03/3	Investment task of 1967. Materials worked out by CZ party. Kravany region No.3	HDP Bratislava Dinga	1967	B
2.04/1	The Danube - Iža region	GP Praha, Lucek	1964	C
2.04/2	Study of the regime and forecasting of groundwater levels after completion of the Nagymaros part of the project in the region Iža and left Nitra river bank	UK Bratislava Duba	1966	C
2.04/3	Investment task of 1967. Materials worked out by CZ party. Region No.4 Iža	HDP Bratislava Dinga	1967	B
2.05/1	Komárno - city	GP Brno Brázda	1964	C
2.05/2	Investment task of 1967. Material worked out by ČS party. Region No.5 city of Komárno	HDP Bratislava Valašík	1967	B
2.06/1	Komárno - Medveďov	GP Brno Hradský	1965	C
2.06/2	Investment task of 1967. Materials worked out by CZ party. Region No.6 Komárno - Medveďov	HDP Bratislava Urbanec	1967	B
2.07/1	Left Váh river bank	GP Praha Lucek	1965	C
2.07/2	Investment task of 1967. Material worked out by CZ party. Region No.7 - Left Váh river bank	HDP Bratislava Lichý	1967	B
2.08/1	Right Váh river bank and Little Danube	GP Brno Svoboda	1965	C
2.08/2	Right Váh river bank and Little Danube	GP Brno Holéczyová	1965	C
2.08/3	Analysis of groundwater regime in the region Šaľa-Kolárovo and forecasting of the effect of Nagymaros project on this regime	VÚVH Bratislava Gyalokay	1965	C
2.08/4	Investment task of 1967. Materials worked out by CZ party. Region No.8 - right Váh river bank and the Malý Danube	HDP Bratislava Goljer	1967	B

4.3 PROTECTIVE MEASURES ON HUNGARIAN TERRITORY

3.01/1	Displacement of stone quarry at Visegrád	IPARTERV Lázár	1959	B
3.01/2	Investment task. project of protective measures in regions. Region Visegrád-Domos	VIZITERV Kéry, Péczely	1967	C
3.02/1	Groundwater regime in region Pilismarót and forecasting of expected state	VITUKI Ubell	1964	C
3.02/2	Report on geoelectric measurement of resistance of engineering-geophysical characteristics in the region Pilismarót	Geofizikai intézet Jósa	1964	D
3.02/3	Experts account of town design and urbanization in the region Pilismarót	VÁTERV Turosányi	1965	B
3.02/4	Engineering-geological survey of the region Pilismarót /Final report/	VIZITERV Erhardt	1965	A
3.02/5	Investment task. Project of protective measures in the region Pilismárót	VIZITERV Kézi, Pécsely	1967	B
3.03/1	Hydraulic research of the Kis Duna branch and bay at Esztergom	VITUKI Dohnalik	1964	A
3.03/2	Investigation of hydrologic conditions in the bay at Esztergom	VITUKI Csoma	1965	A'
3.03/3	Groundwater regime in the area of Esztergom and forecasting of expected state	VITUKI Ubell	1964	A
3.03/4	Engineering-geological survey of Esztergom region /preliminary results/	VIZITERV Takács	1965	C
3.03/5	Engineering-geological survey of the city Esztergom /Final report/	VIZITERV Erhardt	1966	C
3.03/6	Industrial waterwork Dorog	VIZITERV Kovács	1959	D
3.03/7	Rising of the ropeway /cableway/ at Dorog	UVATERV Sidlovics	1959	D
3.03/8	Investment task. Project of protected areas. Esztergom region.	VIZITERV Kéri, Kiss	1967	B
3.04/1	Région Nyergesújfalu - Dunaalmás Preliminary engineering-geological report	VIZITERV Bognár	1966	C
3.04/2	Experience gained during the 1965 flood in industrial plants situated on the Danube section affected by Nägymaros backwater	VIZITERV Póka	1965	D
3.04/3	Survey of soil-mechanics with regard to sewerage networks of the enterprise for transite production at Nyergesujfalu	IPATERV Szalay	1964	C
3.04/4	Experts account on hydrogeological survey in the connection with displacement of shaft well of paper mill at Lábatlan	MÉLYÉPTERV Zoller	1965	D
3.04/5	Project of regional waterworks protection at Lábatlan	VIZITERV Páris	1965	D
3.04/6	Project of regional sewerage network protection at Lábatlan	VIZITERV Kérey	1965	DD

3.04/7	Safeguarding of thermal water for bathing place at Dunaalmás	VIZITERV Pucher	1964	D
3.04/8	Location of bathing place at Duna-almás	VIZITERV Ludwig	1965	D
3.04/9	Nyergesujfalu - Dunaalmás region	VIZITERV Lindner, Marko	1964 1965	D
3.04/10	Protective measures in Nyergesuj-falu - Dunaalmás region	VIZITERV Karpáti, Kéri	1967	B
3.05/1	Engineering-geological survey of Komárom region /Preliminary results II/	VIZITERV Bognár	1966	C
3.05/2	Engineering-geological survey of Komárom region /Final report/	VIZITERV Erhardt	1965	C
3.05/3	Groundwater regime in Komárom region and forecasting of expected state.	VITUKI Vargay, Ubell	1964	A
3.05/4	Further development in groundwater regime assessment in Danubian regions	VITUKI Varrók	1953	A
3.05/5	Danube islands	VIZITERV Kéri, Molnárné	1964	C
3.05/6	Project of protective measures. Komárom region. Investment task.	VIZITERV Kéri, Póka	1967	B
3.06/1	Transfer of machine industry at Nagymaros	KCMTI	1959	C
3.06/2	Protective measures for G/N Project. Displacement of suction piping at Zabegényi. Informative soil-mechanical judgement.	MÉLYÉPTERV Asbóth	1964	D
3.06/3	Investment task. Protective measures for Nagymaros region-Ipel rive	VIZITERV Kárpáti, Kéri	1967	B
3.07/1	Engineering-geological survey of Ács region /Final report/	VIZITERV Bognár	1966	A
3.07/2	Region Komárom-Gönyü-Nagybajcs. Investment task. Project of protective measures	VIZITERV Kéri	1967	B
3.08/1	Professional watermanagement judgement concerning designed bridges at railway junctions Esztergom - - Almásfuzito and railway Tata and the creek Pényes	VIZITERV Póka, Csoregh	1964	B
3.08/2	Protective measures. Protection of railway Szob-Nagymaros, Esztergom-Almásfüzito, track for bauxite at Komárom	MÁVTI Lesz	1967	C
3.09/1	Watermanagement expert's account on roads No.1 and 11	VIZITERV Csorgh	1964	B
3.09/2	Soil-mechanics part of the road project No.11. Expert's account for road and bridge	UVATERV Tárpataky	1965	D
3.09/3	Soil-mechanics part of road project No.121. Expert's accounts for roads and bridges	UVATERV Tarpataky	1965	D
3.09/4	Proposal of drainage of the road 121, in the section of Nagymaros	UVATERV Tóth	1964	D
3.09/5	Contractual project of the road No.121	UVATERV Petz	1965	D

3.09/6	Contractual project of the road No.11	UVATERV Petz	1965	D
3.09/7	Reconstruction project for roads No.1, 11, 121	UVATERV Petz	1967	E

4.4 NAGYMAROS PROJECT

4/1	Hydraulic study of navigation locks at Nagymaros project. Hydraulic characteristics of different systems of filling and evacuation	ČSAV Mäsiar	1964	C
4/2	Surveying of the channel of Nagymaros section of the Danube from 1964. Registered cross-sections	VITUKI	1965	C
4/3	Engineering-geological survey of the hydropower scheme Nagymaros /preliminary results on engineering - geological conditions/	VIZITERV Erhardt	1965	C
4/4	Engineering-geological survey of the hydroel.power plant Nagymaros /II.preliminary results on engineering-geological conditions/	VIZITERV Bognár	1966	C
4/5	Expert's account on wind conditions within the locality of Nagymaros project	State meteorol. institute Hajósi, Béll	1964	C
4/6	Competition aimed at urbanistic and architectonic solution of the Nagymaros project, and its environment	IPATERV	1964	B
4/7	Urbanistic and architectonic solution of the Nagymaros project and its close environmnet	VIZITERV /Consideration Commission/	1964	B
4/8	Project task for the G/N Project. Effect of the Nagymaros project operation	VIZITERV Szabó, Elek	1965	B
4/9	Water projects on the Danube and Tisza. Assessment of dimension and types of main damming structures	VIZITERV Mistéth	1964	D
4/10	Nagymaros project. Investigation and comparison evaluation of mechanical and hydraulic movable devices of steel gate constructions.	VIZITERV Neumann	1965	D
4/11	Nagymaros project. Steel constructions and machinery equipment of the weir	VIZITERV Dévényi	1965	D
4/12	Initiative project of steel constructions at Nagymaros. Lower cutwater of navigation lock. Strutting gates	VIZITERV Gödry	1965	D
4/13	Nagymaros project. Movable mechanisms of strutting gates	VIZITERV Lovas Godry, Dévényi	1966	D

4/14	Nagymaros project. Introductory project of cranes	KGKTI	1966	D
4/15	Nagymaros project. /Electrical part/ Investment task	VIZITERV Andor,Ákos	1967	B
4/16	Structures of long-distance mains of the hydroel.power plant Nagymaros. Data for investment task.	ERŐTERV Haláczy	1966	C
4/17	Programme study of long-distance main 110 kV for hydroel.power plant Nagymaros and mean-voltage mains, which are to be laid down or re-constructed	ERŐTERV Haláczy	1967	C
4/18	Connection of 120 kV, 110 kV, 35 kV and 20 kV long-distance mains to hydroel.power plant Nagymaros. Statement of affected lands	ERŐTERV Haláczy	1967	D
4/19	Study of variants of construction site fencing	VIZITERV Pécsely	1965	D
4/20	Hydraulic investigation of Nagymaros project fencing during construction	VIZITERV Andor	1964	D
4/21	Model study of navigation locks filling and evacuation at Nagy-maros project	VITUKI Rusz B.-né	1966	C
4/22	Hydraulic model study of damming structures, stilling basin and weir gates of Nagymaros project	VITUKI Haszpra	1965	C
4/23	Investigation of weir gates vibra-tion at Nagymaros project	VITUKI Haszpra	1965	D
4/24	Study of Nagymaros fish-pass deve-lopment	VIZITERV Gócza	1965	D
4/25	Hydraulic capstan at Nagymaros	UVATERV	1965	D
4/26	Winter regime at Nagymaros project	VIZITERV Burian	1966	B
4/27	Manipulation with trash from screen-bars of the hydroel.plant Nagymaros	VIZITERV Szabó	1965	B
4/28	Drainage of sewage and rainwater /precipitation/ from the operation territory of Nagymaros project	VIZITERV Kéry	1965	B
4/29	List of land sites for housing schemes and equipment of the con-struction site of the hydropower plant Nagymaros	BUVÁTI	1964	B
4/30	Detailed territorial plant of the settlment of provisional accomo-dation at hydroel. power plant Nagymaros	BUVÁTI	1964	B

4/31	Study of railway siding construction at Nagymaros	VIZITERV	1965	D
4/32	Network of railway sidings at Nagymaros project	UVATERV Gömôri	1964	D
4/33	Extension of the railway station Nagymaros	UVATERV Gömöri	1966	C

4.5 CHANNEL DREDGING DOWNSTREAM OF NAGYMAROS

5/1	Abridged G/N project task Soil survey in the section of lower water channel dredging	VIZITERV Kovács	1960	A
5/2	Preparation for mechanical-hydraulic calculation for channel deepening	VIZITERV Takács	1963	A
5/3	Investigation of slopes stability in the section of dredged channel in connection with the G/N Project	VITUKI	1966	D
5/4	Channel dredging downstream of Nagymaros. Supplement to investment task	VIZITERV Petö	1966	A
5/5	Effect of dredging downstream of Nagymaros on drinking water supply of Budapest	PTV Aujeszky	1966	B
5/6	Effect of dredging downstream of Nagymaros on riparian structures	VIZITERV Varga,Rácz	1967	C
5/7	Channel dredging downstream of Nagymaros	VIZITERV Petö,Pékné	1967	C

2. EVALUATION OF PREPARATORY WORKS FOR THE G/N PROJECT AS A WHOLE

2.1 HYDROLOGY OF FLOWS

2.1/1 Hydrological data in the section between Bratislava and Nagymaros — HYDROPROJEKT Báno, Binder — 1965 — A

Content
- Stage-discharge curve and characteristic discharges in stream-gauging station Bratislava
- Stage-discharge curve of stream-gauging station Dunaalmás
- Stage-discharge curve of stream-gauging station Esztergom
- Stage-discharge curve and characteristic discharges of stream-gauging station Nagymaros
- Natural discharges and water stages of the Danube in the reach between Nagymaros and Bratislava
- The course of impounding water levels /backwater/ of the Nagymaros project.

Evaluation

Results of the study may be applied in full extent for preparation of contractual project.

2.1/2 Fixed Danube water levels km 1770 - 1800 — VÚVH Bratislava — 1966 — A

Content - Data on the course of water levels of various discharges, measured since 1923 by 1958 in the concerned Danube reach by the enterprise Dunaj-Váh, had been summarized in the study.

Evaluation

Results of the study may be applied in full extent for working out of the contractual project.

2.1/3 Assessment of flood events on the Czechoslovak-Hungarian — HMÚ Bratislava Zatkalík — 1965 — B

Content - Evaluation of hydrologic data, simulation reconstruction of flood wave in 1965 due to dyke failure, with regard to probability of occurrence. It was concluded that water level STK Q 1% had been defined low in the section downstream of Palkovičovo, and it is necessary to increase it according to submitted calculations.

2.1/4 Probable periodicity of maximum discharges on the Danube at Bratislava /1.-2.part/ — VÚVH Bratislava Procházka — 1964 — A

Content - Calculations of probability of maximum discharges frequency on the Danube at Bratislava as bases for preparation of the construction of the System of Projects Gabčíkovo -Nagymaros /the G-N Project/.

Evaluation

Results of the study may be applied in full extent for working out of the contractual project.

2.1/5	Course of flood waters in the Danube after construction of Hydropower projects /1.-2.part/	VÚVH Bratislava Procházka	1964	B

Content - Consideration of the study worked out by the Hungarian party "Effect of backwater on flood water passage", and VÚVH opinion on the course of flood discharges on the Danube after construction of the bypass variant of G/N Project

Evaluation

Results of the study may be partly applied for working out of the contractual project.

2.1/6	Hydropower assessment of the 1965 flood on the Danube	VÚVH Bratislava Gyalokay, Náter, Prochácka, Szolgay, Bartolčič	1966	B

Content - Original data on the course of flood event in 1965 on the Czechoslovak Danube reach due to failure of dykes and diversion of flood discharges from flooded territories.

Evaluation

Results of the study may be partly used for working out of the contractual project

2.1/7	Natural water stages and discharges of the Danube	VIZITERV Takács	1964	B

Content - Relevant water stages and discharges on the Danube between Nagymaros and Bratislava in the reach, influence by the G/N Project, according to kilometer sections in written and diagram form /800-8000 m^3/s/

Evaluation

Data were agreed at Hungarian-Czechoslovak negotiations in 1964-1965 and after some modification accepted. Final data are in the Volume VIII/a. Results may be partly used for working out of the contractual project.

2.1/8	Backwater curves of the Nagymaros project on the basis of data accepted in 1964	VIZITERV Takács	1964	D

Content - Using basis data, accepted in 1964, backwater curves were developed for the channel section rkm 1696+250 - 1819+00, using the method of discharge modules for two backwater levels for both respective variants of backwater at Nagymaros project, and at both variants for two discharges. Backwater curves do not consider the effect of envisaged dredging of the channel in rkm 1785 - 1811. The material includes also the curve of discharges at Nagymaros, accepted under No.2.02.04.159

Evaluation

The study was used for working out the study "Hydrologic data for the G/N Project" in the Volume VIII/A of basic data.

Results for the study may be used as helpful material in working out the contractual project.

2.1/9 Identification of the flood water levels of the Danube in 1965, without dam-break | VITUKI Csoma | 1965 | A

Content - The study presents evaluation of the effect of dyke bursting on the left Danube bank on June 15,1965 at rkm 1 753,3 /Patince/ and on June 17,1965 at rkm 1 799,5 /Čičov/, on water stages and claims, that only the first dyke failure at rkm 1 753,3 had decisively influenced the culminating water stages. The study presents computed water levels without dyke bursting for the Danube section rkm 1 694,6 - 1 791.

Evaluation

The results of the study may be used in full extent for working out of the contractual project.

2.1/10 Hydrological data for the project HC Nagymaros, Basic data, Volume VIII/A | VIZITERV Takács | 1965 | C

Content - Course of natural and dammed up discharge 6 000 m^3/s in the profile Nagymaros, discharges with various probability in the lower water, backwater curves to elevations 107,33 - 107,87 above sea level, and pertinent natural water stages - discharges in the section Nagymaros - Bratislava to elevations 107,33 - 108,33, duration of water stages in head water at natural and dammed up conditions.

Evaluation

The material may be considered as a summary processing hydrological data of the Nagymaros project, valid also at present for computation of water level curves of the permanent stage. It is necessary to examine, whether the raining works performed in recent years influenced in a decisive way the natural channel conditions. Results of the study may be used for working out the contractual project.

2.1/11 Project task of the system of hydropower projects Gabčíkovo-Nagymaros. Backwater curves of the Ipel river water level | VIZITERV Papp | 1965 | A

Content - Using the method of discharge module the natural water levels were computed for the Ipeľ river section km 0,0 - km 12,2, corresponding to the discharge 2 300 m^3/s in the Danube and 26,5 m^3/s in the Ipeľ, and backwater curves corresponding to a discharge 2 000 m^3/s in the Danube and 26,5 m^3/s, or 760 m^3/s in the Ipeľ river.

Evaluation

Results of the study may be used in full extent for working out of contractual project.

2.1/12 Degree of safety of flood water passing through the G/N Project, using the method of probability computation | VIZITERV Mistéth | 1965 | D

Content - Based on the probability theory the study examines the tightness of discharge outlets in case of various flood events.

Evaluation

based on recommendation of Moscow consultation held on May 20.-26.1966 the number of discharge openings was quoted in the basic data of the investment task. The study has a character of documentation data. Results may be used as helpful material for elaboration of the contractual project.

2.1/13	Study of flood waves course within the backwater area	VITUKI Csoma	1966	A

Content - The study deals with water discharges surpassing 4 100 m^3/s. Observation of the course of flood wave enabled to determine retention decreasing due to damming up. Values on increasing of natural flood water discharges are presented. The procedure was verified during the flood in July 1954.the research task does not consider backwater by weir piers.

Evaluation

Results may be used in full extent for contractual project.

2.2 BED LOAD AND SUSPENDED LOAD

2.2/1	Bed load regime with regard to present regulation.Material for the trilateral consultation	VÚVH Bratislava Szolgay	1964	A

Content - Development of training works on the Danube /to low, mean and high water/, and impact of these works of morphologic channel development of mean and low water. On the basis of direct measurements and by means of theoretical relationships the present bed load and suspended load regime was estimated. Prognosis is submitted considering the construction of hydropower projects in Austria.

Evaluation

Research results may be used in full extent for contractual project /CP/.

2.2/2	Study of parameters of the Váh river channel with respect to the G/N Project construction	VÚVH Bratislava Szolgay, Náther	1966	C

Content - Research task dealing with the morphologic study in the section Hlohovec - Komárno. Results of bed load computations show that bed load would not cause extraordinary problems for the Nagymaros project.

Evaluation

After completion, the research results may be used for CP elaboration. Prognosis of sedimentation of the dammed up Váh channel section with suspended load is to be completed.

2.2/3	Study of bed load sedimentation within the backwater area, using the data of model experiments	VITUKI Csoma János	1966	A

Content - According to preliminary computations, from the annual amount of bed load 590 000 m^3/s on the average, the most part is deposited in the section rkm 1 860 - 1 872, and is to be removed by dredging - excavation. According to preliminary computation about 2 - 2,5 mil. m^3 of suspended load will be deposited in Dunakiliti reservoir. The period of reservoir dead storage filling is 95 years. Larger bed load sedimentation should not be expected neither in bypass canal nor in the abandonned channel.

Evaluation

The study provides acceptable results on amount, movement and deposition of bed load and suspended load and is suitable for CP elaboration. No further research, or study is necessary, the results may be used in full extent for CP.

2.2/4	Study of colmatation on the territory affected by the G/N Project	VITUKI Starosolszky	1966	A

Content - The research and laboratory experiments proved, that it may be considered that natural colmatation due to the Danube bed load, would occur.

Evaluation

The effect of colmatation was evidenced, though it would not be included into the project and would represent a certain safety reserve.
Further study for CP is not required.
Research results may be used in full extent for CP elaboration.

2.3 ICE PHENOMENA

2.3/1	Study of relationships of typical climatic situations to the ice regime on the Danube	HMÚ Bratislava Patrovič	1965	A

Content - The task is based on statistical evaluation and long-term observation of mean daily temperatures in respective region. The dependence of the beginning, duration, and end of ice phenomena on temperature variations had been worked out.

Evaluation

Research results may be used in full extent for CP.

2.3/2	Expected winter regime changes on the Danube after the construction of the G/N Project	HDP Bratislava Hanus	1964	B

Content - The study presents characteristic data on ice regime on the Czechoslovak section of the Danube over the period 1881 - 1950. The expected course of winter regime of the G/N Project is described. Experience gained during winter regime on hydropower project on rivers Aar and Rhine, and on the Váh river.

Evaluation

Results of the study may be partly used for CP.

2.3/3	Winter regime of functional structures of G/N Project	VÚVH Bratislava Šrámka	1965	A

Content - Review and evaluation of used methods for providing winter operation of functional structures of hydropower projects in Czechoslovakia and abroad. These methods had been verified in practice on hydropower projects on the Váh river at Krpelany and Nosice as well as by means of experiments in the field laboratory of VÚVH Bratislava. Proposals of suitable application of respective methods in specific conditions, their technological description, operation conditions and comparison of their efficiency and economic aspects.

Evaluation

Results may be used in full extent for CP elaboration

2.3/4	Ice phenomena on the Danube in the reach Devín-Palkovičovo	VÚVH Bratislava Szolgay, Stančíková	1966	A

Content - Present ice regime and prognosis of ice regime, developed by means of empiric materials and method of analogy. Proposal of winter regime solution in the abandoned channel and conditions of reservoir flushing and old river channel rinsing.

Evaluation

Results of the study may be applied in full extent for CP. For working out of operating regulation for the system of hydropower projects it is required to accumulate experience from additional winter periods.

2.3/5 Winter regime of reservoir and canals of G/N Project on the Danube — VÚVH Bratislava, Brachtl — 1966 — C

Winter regime of reservoir and canals of the G/N Project on the Danube

2.3/6 Study of measures for elimination of ice floods in the area of Bratislava — VÚVH Bratislava, Brachtl — 1966 — C

Content - Values of resistance coefficients in the reservoir and headwater canal during operation under ice cover. Assessment of water amount required for ice drift from the reservoir.
Determination of optimum water level decreasing, needed for ice discharging from the reservoir Hrušov
Location of guiding dykes and structures with regard to carrying away of ice.
Method of ice releasing before the ice run and required number of ice breakers.
Cooperation of hydropower projects on the Danube during ice run discharging.

Evaluation

After completion, the results of this research may be used for CP elaboration. For working out of operation regulation it is necessary to include the recent knowledge and experience, obtained on constructed hydropower projects on the Danube.
The results are to be compared and put in accordance with research results, quoted under paragraph 3.6.55, "Number of openings for ice floes discharging through the Dunakiliti - Hrušov project" /VIZITERV/, and eventually perform a complementary study on hydraulic model, aimed at the study of lay-out solution of the Hrušov-Dunakiliti project and reservoir.

2.3/7 Occurrence of ice phenomena and freeze-up on the Danube in dependence upon air temperature and atmospheric situations — HMÚ Bratislava — 1965 — A

Content - Hydrological data processed by the Hydrometeorlogical Institute /HMÚ/ Bratislava and data unified between HMÚ and VITUKI Budapest.
Ist part: Petrovič /HMÚ/:Beginning of ice phenomena and freeze up on the Danube in dependence upon air temperature" /article in Meteorological News No.5-1965/.
IInd part: Petrovič /HMÚ/: Supplement to the above mentioned report.
IIIrd part. Petrovič - Szillagyi /HMÚ-VITUKI/ "Chronological occurrence of ice phenomena on the Danube between

Vienna and Budapest over the period 1900-1965"
Unified tabulated data: date of the 1st day of ice run, date of the 1st day of freeze up, date of the 1st day with ice run after freeze up, date of the last day with ice phenomena.
IVth part: Petrovič, Hak, Forgáč, Mokrá /HMÚ/: Beginning of ice phenomena on the danube in dependence upon atmospheric conditions".

Evaluation
Results of the survey may be used in full extent for CP

2.3/8	Hydrological study of the Danube winter regime and forecasting of changes due to the construction of G/N Project:Study of ice phenomena in the abandoned channel and Nagymaros reservoir	VITUKI Szilágyi	1965	C

Content - Using mathematical-statistical methods the probability of ice phenomena occurrence had been determined for the present state and for the state after the G/N Project operation.

Evaluation
After completion, the research results may be used for CP, though additional research is required, and verification in the connection with:
- peak operation
- ice conditions in headwater canal with regard to special attention on frazil ice
- the discharge diverted through the abandoned channel in winter period

2.3/9	Development of ice and navigation conditions in respective stages of the G/N Project construction	VIZITERV Zsilák	1966	B

Content - During the 1st and 2nd stage of construction the ice cover in Nagymaros project will increase by 10%, but the navigation can be safeguarded by means of two ice-breakers. In the 3rd stage of construction, it will be necessary for ice floes discharging to use all openings. Navigation would be interrupted over 63 days. At Hrušov-Dunakiliti weir no alternation of ice phenomena would occur until the Danube channel damming. Then it is necessary to support development of ice cover in the Dunakiliti reservoir, as to prevent, if possible, ice discharging.

Evaluation
In the meantime the arrangement of construction site fencing of Nagymaros project had changed, and problems connected with putting into operation the Hrušov-Dunakiliti weir and Gabčíkovo project have not been solved yet.
Results of the study may be partly used for CP. A new study has to be worked out on the basis of design directions for the construction stages and putting into operation.

2.3/10	Hydrological study of the Danube winter regime and ice phenomena downstream of Nagymaros	VITUKI Csoma	1966	B

Content - Probabilities of ice phenomena occurrence have been assessed by means of mathematic-statistic methods for natural conditions and for conditions after the G/N Project putting into operation. Effects of the Adony project were also dealt with.

Evaluation

Research results may be partly used for CP, since the effects of the river project Iron Gates had not been considered. Additional research of ice discharging is necessary, performed in cooperation with respective river projects, including the Austrian section of the G/N Project and the section downstream of Nagymaros

2.3/11	Winter operation of drainage and seepage canals in the Danube section Nagymaros-Gönyü and in tributary flows	VIZITERV Póka	1966	B

Content - The study presents following results on the basis of thermal and hydraulic computations, and empiric data:

a/ It is not necessary to consider freezing up of covered drains and wells.

b/ Temperature of water flowing into drains may be permanently +1 - +2°C, a temperature so low, that - in contradiction to the opinion of Czechoslovak experts - the development of ice cover on the canal cannot be avoided.

c/ Ice thickness of 30 cm is to be considered, /ice thickness up to 50 cm occurs rather rarely./

d/ Ice cover decreases water discharge in seepage canals, therefore it is necessary to increase water level in the canal before freezing.

e/ Groundwater level increasing in winter in intra-villanes and industrial residential areas cannot be allowed, therefore closed seepage canals must be used.

Evaluation

Research results may be partly used for CP.

2.4 WATER QUALITY, BIOLOGY, PROTECTION OF NATURE, TERRITORIAL PLAN

2.4/1 Hydrochemical prognosis of groundwater quality in the Danube riparian zone — VÚVH Bratislava, Jacko — 1965

Content - The task is aimed at justification and description of groundwater quality changes due to alterations of hydraulic parameters, or climatic conditions, and some artificial factors /e.g.water pollution/.

Evaluation

Research results may be used, after supplementation, for CP. It is proposed to work out more precise prognosis of groundwater quality within the riparian zone in the area of Hrušov-Dunakiliti reservoir.

2.4/2 Prognosis of water quality changes in the Danube as influenced by construction of the G/N Project — VÚVH Bratislava, Rothschein Antonič — 1966 — A

Content - The task is dealing with basic properties, as the Danube water quality - chemical and biological, with dependence of water composition changes upon hydrologic conditions, season of the year, etc. The Danube water quality is chiefly influenced by discharging of industrial wastewaters and sewage. Especially unfavourable is pollution with petroleum products.

After evaluation of the effect of several reservoirs, as well as of the whole system of reservoirs it was stated a predominantly positive influence on water quality. From biological point of view unfavourable effect was indetified as Dreissensia reproduction and oil films on water level.

Finaly a series of proposal, how to provide good water quality after the G/N Project construction, is presented.

Evaluation

Research results may be used in full extent for CP.

2.4/3 Study of the most suitable groundwater levels for agricultural production — SAV Bratislava, Benetin — A

Content - Research task dealing with suggestion of favourable groundwater levels for providing agricultural plant production on the territory affected by construction of the G/N Project. Research results bring data for a choice of most favourable solutions of protective measures after the G/N Project construction.

Evaluation

Research results may be used in full extent for CP.

2.4/4 Influence of the G/N Project on agricultural production — ŠÚTVPLS, Herda — 1966 — B

Content - Areal demarcation and description of the territory.

Present groundwater regime.

Groundwater levels favourable for agricultural production.

Suggestion of crop alteration.

Defining of areas where worsening or improvement of groundwater levels is expected with regard to agricultural pro-

duction.
Economic estimation of river power projects variants with respect to agriculture, evaluation of annual losses in case of:
- bypass variant
- two-step river variant
- Petržalka - Gabčíkovo scheme
- river-bypass variant

Finally it is stated, that utilization of canal network, complemented by irrigation systems development, will make. possible to decrease the losses in agricultural production, caused by the G/N Project construction.

Evaluation

Research resutls may be partly used for CP

2.4/5 Assessment of agricultural production on areas, occupied temporary or permanently for the construction of G/N Project, and assessment of agricultural production increasing on areas taken out from river floodplain PPÚ 1967 B

Content - Estimation of plant production on ladns, permanently or temporary occupied due to the G/N Project construction. Balance of agricultural soil losses according to districts, cultures, and character of occupation on protected territory and flood plains.
Assessment of gross plant production on permanently and temporary occupied lands. Estimation of plant production increasing on lands withdrawn from flood plains. Estimation of annual growth increase of forests in permanent and temporary occupation and its price estimation.

Evaluation

Research results may be partly used for CP.

2.4/6 Assessment of the effect of groundwater level changes on agriculture production in the area of Nagymaros project ŠÚTVPLS Herda 1967 B

Content - Determination of suitable groundwater levels for agricultural production. Characteristics of geological and hydrogeological conditions, groundwater regime, prognosis of groundwater regime, estimation of the influence of hydropower project in regions, where improvement of production conditions will occur and deterioration of production conditions in agriculture will take place.

Evaluation

The study may be partly used for CP.

2.4/7 Methodology of restoration of soils, occupied temporarily during the construction of the G/N Project ŠÚTVPLS Bella 1966 A

Content - Description of expected land quality deterioration/ utilization of land for construction/
Impact of building-up on soil fertility /deterioration

of soil quality by increased pressure, decreasing microbiological activity of microorganisms, development of putrefying bacteria, squeezing of volumes of gravel into the sub-topsoil layer, depreciation of soil by mineral oils on parking lots, etc./
Rival of biological life in soil, restoration of the original state Premoval of gravel, ploughing of lands, spreading of topsoil, five-year fertilizing process/.
Estimation of cost for the fertilizing process.
Economical evaluation - price level in 1965.
Proposal of measures for topsoil protection during construction.

Evaluation

Research results and namely proposal of measures for topsoil protection during construction may be used in full extent for CP.

2.4/8 Utilization of drainage systems for irrigation in the connection of the construction of the G/N Project — RVT-SVP Vongrej — 1966 — B

Content - Possibilities and extent of utilization drainage systems for irrigation in the connection with the G-N construction, for diversion and two-step variant.
Analysis of natural conditions /geomorphology, hydrology, hydrogeology, soil conditions, climatic conditions/.
Estimation of the influence of G/N Project on the adjacent territories with regard to irrigation possiblities and requirements.
Description of drainage systems, envisaged for irrigation purposes.
Feasibility to utilize drainage canals for irrigation.
Technical solution of irrigation, two methods have been proposed:

1. Surface irrigation using main and connection drainage canals for supply, distribution and withdrawal of irrigation water.
2. Regulation of water levels within the network of canals, thus obtaining optimum groundwater level depth, providing water supply of plants by means by means of capillary rise.

Economic assessment /investment costs, operation cost/.

Evaluation

The study may be partly used for CP.

2.4/9 Study of fruit growing on the areas adjacent to G/N Project - namely Hrušov-Palkovičovo — PPÚ Bratislava Musil,Gergely — 1967 — B

Content - Possibility of fruit-growing orchards on the territory between bypass canal and the Danube channel in the section from Hrušov to Palkovičovo. Technical solution of orchards is suggested, economy and profits are described.
Planting out is envisaged in two alternatives:

1. in the area between bypass canal and the Danube floodplain dyke.
2. the same as above and in addition also in the area between floodplain dyke and the Danube channel.

The study involves: general data, evaluation of the present state of agricutural production, proposal of planting out, economical aspects.

Evaluation

The study may be partly used for CP.

2.4/10 Economic evaluation of the effect of the G/N Project on forest management in the area of decreeased groundwater level, considering eventual forest irrigation. Preliminary information — VÚLH B.Štiavnica Biskupský, Faith 1963 Váchov, Vojtuš Jurko — B

Content - Problems and requirements for solution.
Demarcation of production areas.
Present production conditions in respective regions.
Production in future - changed production conditions
Comparison of production
Production on adjacent land belonging to state forests
Increment of forest land after desiccation of a part areas covered with water.
The Danube branches
Artificial irrigation of poplar growths /poplar plantations/
Estimation of damages caused to forest management
Concluding tables of production are presented, showing economic and growth structure after the G-N construction.

Evaluation

Study may be partly used for CP.

2.4/11 Study of the river hydropower project on the Danube — Institute for forest management Zvolen, Galla 1964 — B

Content - Assessment of cost for exploitation, number of workers, housing, machinery, losses for forest management due to the G-N Project construction. Assessment of losses in forest management, caused by the G-N construction, had been performed according to the methodology of the Ministry of Agriculture, forest and water management /a copy is enclosed in the study/. Two alternative solutions for saving forest growth between the old Danube channel and bypass canal had been worked out:
a/ construction of dykes for retention of water in Danube branches /according to the requirements of forest authorities/,
b/ study of the Research Institute of Forest Management in Banská Štiavnica.

Evaluation

The study may be partly used for CP.

2.4/12 Research of groundwater supplies of Žitný ostrov for irrigation and other aims — VÚVH Bratislava 1968 — B

Content - Final report estimating present groundwater regime of the Danube Island, taking into account changes, caused by artificial interventions in last years /The Malý Danube adaptations, construction of closing structure, building of Dedinka weir and construction of the second water supply resource at Podunajské Biskupice/.

Evaluation
Results may be partly applied for CP.

2.4/13	Project of the G/N Project and the development of environment. Material from a Symposium, held on 29.-30.4.1965 in Bratislava	SAV - CZESTC	1965	D

Content - Contributions at the Symposium held in 1965
Danišovič: Project of the Danube utilization and protection of the nature
Hálek: Hydrological regime and water quality in concerned area
Szolgay: Alternation of hydrological regime of the Danube in the section Hrušov-Palkovičovo in case of the G-N Project construction
Antonič: Water quality in the Danube as influenced by the G-N construction
Jacko: Groundwater quality in the Danube Lowland
Mucha: Implementation of hygienic principles in planning and construction of hydraulic structures.
Ružička: Biological problems in the environment demonstrated by the envisaged the G-N construction
Sub-reports: Geology, Hydrology, Urbanistic-architectural aspects,
Danubian forests, Agricultural issues, Fishery.

Evaluation
Material may be helpful for solution of the biotechnical project and CP.

2.4/14	Assessment of three variants of the G/N Project with regard to environmental and nature protection	SÚPSaOP Bratislava, Fekete SAV-Ružička	1966	B

Content - Comparison of three variants of the G-N Project according to following criteria:
- environmental protection-hydrology
- effect on agricultural production
- protection of forests
- water quality in flows
- influence on groundwater regime
- impact on the character of the country as a whole and on its biological balance
- possibility to realize some criteria of the environmental biology and natural protection.

Relative comparison have brought following sequence of acceptability or suitability of respective variants: The most favourable is the variant with bypass canal. The second being the variant with project Petržalka-Gabčíkovo II. The less acceptable is the variant with two river projects /Vojka, Dunaszeg/.

Evaluation
The study may be partly used for CP.

2.4/15 Principles of bank line regulation VIZITERV
at low water level Póka 1965 A

Content - Suggestion for uniform solution of the construction of shore line at low water, created due to backwater of the G-N project, as to prevent overgrowing of water plants along the banks, development of swamps and marshes and reproduction of mosguitos, and last but not least protection against surfs on
- bank sections of intravilanes
- bank section outside of intravilanes
- bank section of recreation areas.

Evaluation
Research results may be used in full extent for CP. No additionl investigation is necessary.

2.4/16 Groundwater level regulation VITUKI
in the area of old channel Csoma 1966 B

Content - The study defines the development of groundwaters of Szigotkoz and of flood plain /during growing season/, as influenced by diversion of 100 m^3/s of water from the Dunakiliti reservoir into the abandonned channel, as well as by non-permanet water motion due to of operation hydropower plant Gabčíkovo and Nagymaros. Alternative solutions of groundwater level regulation in the floodplain of the right old channel bank had been dealt with.

Evaluation
Research results may be partly used for CP. Further investigation is not necessary.

2.5 G R O U N D W A T E R , S E E P A G E S

2.5/1 Groundwater regime on the Žitný ostrov — VÚVH Bratislava, Lehký, Gyalokay 1964 A

Content - Final report assessing current groundwater regime in the Žitný ostrov as basis for designing the G/N Project.

Evaluation

Research results may be used in full extent for CP.

2.5/2 Prognosis of water level stages on the Žitný ostrov after the construction of the bypass canal of the G/N Project — VÚVH Brno, Hálek 1966 C

Content - Data for estimation of the impact of the G/N Project construction on agriculture in the cencerned area. Prognosis was developed using the network analyzer RO and by means of network systems in three alternatives, assuming various boundary conditions. Research results have shown, that if the present situation was to be preserved, the draingae system had to be suitably modified.

Evaluation

After completion, the research results may be used for CP. Further model study is required, considering also seepages from the canal bottom.

2.5/3 Groundwater regime in the area of the G/N Project — ČSA-Kratochvíl, VÚVH-Gyalokay, VÚV Brno, Hálek, Čištín, VÚV Praha, Zajíček 1958 B

Content - Hydrologic, geologic, and hydrogeologic conditions.
Theory of nonstationary flow of groundwater.
Theory of experimental solution of nonstationary flow of groundwater.
Used instruments and description of applied experimental technique.
Verification experiments.
Application of theory in solving problems of groundwater flow in the Danube lowland and on the Žitný ostrov.
Hydrological methods.
Bibliography.

Evaluation

Study may be partly used for CP.

2.5/4 1966 Regulations for proposal of measures against the effects of seepage from reservoirs and river channels in the connection with the G/N construction — ČVUT Bažant 1966 B

Content - Guidelines ensuing from theoretical solution of filtration stability of the subsoil along protection dykes, or reservoir dams, from hydraulical and geomechanic point of view.
Basis for hydraulic solution was the computation of nonstrationary groundwater flow, making possible solution

of the flow gradients, the course of pressure line and seepage volume.
Results of analyses show the causes of filtration stability disturbance,

Evaluation
Research results may be partly used for CP.

2.5/5 Knowledge obtained from the study of research reports concerning piping and reconstruction of the Danube dykes — SVŠT Bratislava, Peter — 1967 — B

Content - Estimation of results of piping studies and their application in reconstruction of the Danube dykes. The most important studies are:
IGHP Bratislava: Visual recording of piping
VÚVH Brno: Investigation of colmatation of Hrušov reservoir
Havlíček: Dam for the upper and lower reservoir
VÚIS Bratislava: On filtration stability of cohesive and incohesive soils.

Evaluation
Research results may be partly used for CP.

2.5/6 System of river power projects on the Danube-two experimental sections of dykes — SVŠT Bratislava, Peter, Urban, Hulla — 1966 — D

Content - Proposal of monitoring equipment for two experimental reservoir sections /1st at Medveďovo, 2nd at Šurany/, each 400 m long. Expriments performed on those sections should have verified the function of measures against piping.

Evaluation
Research results may be used as subsidiary material.

2.5/7 Investment task of the Hungarian-Czechoslovak system of hydropower projects on the Danube Calculation of seepage below the dykes. Collection of formulas — VIZITERV, Galli — 1966 — E

Content - Collection of formulas, describing the methods of calculation, worked out by the author, using the formulas of Benett-Kamensky, Dachler and Forcheimer.

Evaluation
**For calculation of seepage below the dykes Galli's method for comparison with the proposal, which will be submitted by the Czechoslovak party may be used, besides other well known methods /Kovács, Juhász, etc./
Results may be partly used for CP.**

2.5/8 Expert's account on the efficiency of Larsen sheet pile driven at the upstream toe of the flood-protection dyke in case of stratified subsoil — VITUKI, Varrók — 1959 — A

Content - **Expert's account based on the hydraulic model study of** amount and distribution of infiltrated water on the

downstream face of dykes at 100 m thick permeable subsoil, without sheet pile and with sheet pile down to the depth of 16,6, 33,3 and 50,0 m.
Results obtained by measurements on model are compared with computations of Kovács, which correspond fully to the requirements of practice.

Evaluation

Expert's account may be used for control of the method of seepage computation below dykes.

2.5/9	Hydrological research required for the construction of G/N Project Outlet of seepage canal into the Szigéti Duna	VIZITERV Molnár Gántiné	1965	A

Content - Study of the need and method of water level regulation in seepage canal on the downstream face of the dam of Hrušov-Dunakiliti reservoir. Three alternatives are dealt with:
- water level is not regulated
- bridge openings in the floodplain will be closed, and a gate will be installed in one opening
- seepage canal will mouth through a gate into the dead branch

The study recommends to perform the measures for water level regulation only after 2-3 years of operation, if it will be necessary.

2.5/10	Study of groundwater regime in the area of Žitný ostrov , lower Váh,and Nitra rivers, and forecasting of its changes due to the construction of hydropower project Nagymaros. Preliminary orientation results	VÚV Bratislava Duba, Supek VITUKI, Ubell	1959	B

Content - Present groundwater regime in the territory confined by the Danube and municipalities: Palkovičovo - Dunajská Streda - Tomášikovo - Šurany - Nové Zámky - Hurbanovo - Marcelová - Žitavská Toň.
- Hydrologic description
- Data on evaluations of the territory
- Present groundwater regime:
1. Water table contoures and main directions of groundwater flow
2. Groundwater level depths below the terrain
3. Definition of regions with prevailing influence of rivers and precipitation on groundwater regime.
4. Analysis of groundwater level /1953-1957/
5. Hydrological cross-sections with characteristic groundwater levels.
6. Characteristic features of time course of groundwater stages in the area with prevailing effect of rivers and precipitation.

Evaluation

Research results may be partly used for CP.

2.6 PEAK OPERATION

2.6/1 Hydraulic regime of canal hydropower plant at frequency regulation — VÚVH Bratislava, Gabriel, Taus, Sikora — 1966 — A

Content - Results of measurements executed on the river power project Madunice were extrapolated for the Gabčíkovo project. Investigation showed that it would be possible to use diversion hydropower plant Gabčíkovo for frequency regulation in the required extent and delivered output. Results of the solution with actual data on waves heights, occurring during regulation operation /about 20-40 cm/ showed, that the waves would not be dangerous with regard to navigation and with respect to slope stability, namely of tailwater canal. Thus frequency regulation is admissible with regard to safety and navigation.

Evaluation

Research results may be used in full extent for CP.

2.6/2 Support of the G/N Project construction and operation — HDP Bratislava, Ježek — 1966 — A

Content - The task dealt with the cooperation of the hydropower plant Gabčíkovo and hydropower plant Bratislava - Wolfsthal, and cooperation of the hydropower plant Gabčíkovo with the hydropower plant Nagymaros at peak operation.

Evaluation

Research results may be used in full extent for CP.

2.6/3 Hydraulic calculations of peak operation. Material for consultation — HDP Bratislava, Ježek — 1965 — B

Content - The study summarizes results of hydraulic calculations of non-uniform water flow in bypass canal and applies them for consideration of different duration of rise times until the full power plant output is reached

- the canal shape influences on wave motion in the headwater canal
- velocities in headwater and tailwater canal
- the effect of emergency events frequency regulation
- cooperation of the hydropower plants Gabčíkovo and Nagymaros

Evaluation

The results may be partly used for CP:

2.6/4 Hydraulic calculations of wave motion at peak operation of G/N Project. Investigated for the bypass scheme Wolfsthal-Bratislava-Gabčíkovo-Nagymaros — HDP Bratislava — 1966 A

Content

On the basis of results of computations of non-permanent flow the computations of power production were more precise, the intensity of wave phenomena in diversion canal was estimated and flow velocities in respective canal sections and in the reservoir were defined.

Evaluation

Research results may be used in full extent for CP.

2. 6/5 Examination of justification of requirements of the CZ electrification system concerning the rise time transductance with regard to eventual increasing of investment and operation costs — HDP Bratislava, Hraško, 1966, A

Content

The rise times and run downs were examined for the approach canal after 5, 10, 20, 30 and 60 min. in four characteristic profiles according to following criteria:
- velocity and extent of water level drop
- longitudinal water surface slopes
- cross-sectional flow velocities
- changes of flow velocity

For the outlet canal computation of values were carried out only for rise time over 5 and 30 min. THe results demonstrated, that the investigated rise times to maximum output and run downs do not cause a dangerous hydraulic regime in the headwater canal of the hydropower plant Gabčíkovo with respect to navigation and project structures.

Evaluation

Research results may be used in full extent for CP.

2.6/6 Evaluation of experimental peak operation at Tiszalok hydropower project with regard to channel stability. Year 1960 — VIZITERV, Horváth, 1961, B

Content - Evaluation of experimental results obtained on the hydropower project Tiszalok with regard to wave surfing in the upper and lower reservoir during peak operation. Results of experiments of 1960 are not reliable due to inadequeate instrumentation and few measurements. However, the study brings some useful information on experience gained during experiments.

Evaluation

Research results may be partly used for CP.

2.6/7 Study of the course of discharge wave caused by peak operation /Partial Report/ — VITUKI, Csoma, 1964, A

Content - Calculations using the Archangelsky method, include the first part of calculation from the river section Gabčíkovo-Nagymaros. They dealt with: water stages, discharges, and velocity changes.

Evaluation

The computation principle is also nowaday correct, in those days it was applied for comparison of computations according to Puzanov.
Research results may be used in full extent for CP.

2.6/8 Channel development as influenced by peak operation — VITUKI, Csoma, 1965, A

Content - Following issues had been dealt with:
a/ intensity of water stages chages during peak operation
b/ velocity changes during peak operation
c/ effect of peak operation on channel development

Evaluation

Research results may be used in full extent for CP.

2.6/9	Water levels, discharges, velocity variations. Calculations according to equations of non-permanent water motion	VITUKI Csoma	1965	A

Content - The study includes water-level curves, discharge rating curves, and curves of velocity variations, computed for the Danube section Nagymaros - Gabčíkovo under non-permanent peak operation. The simplified method of Ing. Puzanov is dealt with as well as modification of Dr. Kozák and the program of computerized system of computation, elaborated on the basis of these arrangement.

The principle of Dr. Kozák's method - VITUKI - is consideration of the effects of branch discharges and of the floodplain. Neglecting these effects may cause considerable inaccuracies in computations.

Evaluation

Research results may be used in full extent for CP.

2.6/10	Calculation of discharge and velocity variations at water level decreasing by means of equations of non-permanent flow	VITUKI Csoma	1965	A

Content - The water level stage in the reservoir Dunakiliti has been determined at a discharge of 1000 m^3/s, and at 4 - 5 hour peak operation of the Gabčíkovo project. By means of the computation the operation, lasting 5 hours, between rkm 1858,864 - 1880,005 has been examined and curves $z^{/t/}$, $Q^{/t/}$, $v^{/t/}$ are presented.

Computations were performed on ELLIOT 803 B computer

Evaluation

Research results may be used in full extent for CP.

2.6/11	Calculation of water levels and velocity variations in tributaries according to equations of non-permanent water motion	VITUKI Csoma	1965	C

Content - For lower reaches of tributary streams the presented quantities were computed in dependence upon time, from the beginning of peak operation over 24 hours.

Evalutation

Computation method and advantages of its application are described in the Study No.8.08.03.02.01 - I/1b-1965, which is applicable also currently, while making more precise the input data. Research results may be used after supplementation.

2.6/12	Study of non-stationary movement in reservoirs and canals of the G/N Project	ČSAV - Puzanov VITUKI - Kozák	1966	A

Content - The task was solved by Dr. Puzanov on the basis of a program developed for computer Elliot 503 using the method of characteristics in orthogonal system of fixed nodal points and considering the variable distance of profiles and large variations of retention capacities of lateral tributaries in their emptying sections.

Evaluation

Both parties unified their results. In case an important channel shape training would occur, the computation is to be repeated. Research results may be used in full extent for CP.

2.6/13 Study of the course of wave motion for the investment task G/N Project — VITUKI Nagy — 1966 — A

- Content - The study deals with estimation of wave dimensions, caused by various factors in upper and lower reservoirs of Nagymaros and Hrušov, and in the headwater canal. Waves are caused by wind, navigation, and hydropower plant operation: i.e. abrupt turbine closing, frequency regulation, quick opening of stop logs, filling of navigation locks.
Probabilitity of occurrence of respective types of waves were studies and their possible unified action.

Evaluation

Research results may be used in full extent for CP.

2.7 RIVER ADAPTATION

2.7/1 - Basic laboratory study of growth resistance — VŮVH, Vincent, 1972, B

Content - Tree growth resistance had been investigated in a flume with variable slope.
Variations of spaces and stem thickness of trees were studied for 3 variants of growth lay out.
Research results have significant application in practice.

Evaluation
Results may be partly used for CP.

2.7/2 - Study of establishment and cultivation of hydraulically advantageous growth within the land band between dykes of the Danube — VŮV, Cifra, 1973, B

Content - Study dealing with the forest management problems connected with space layout of forest growth within the Danube flood plain. As to increase the capacity of the Danube floodplain it is necessary to cultivate forests in distances larger than 6 m, and to propose technology for undergrowth removal. The study showed, that the Euroamerican poplar is the most suitable type for these conditions. For permanent undergrowth removal on large areas the rolling chisel was proved as suitable in pilot-plant operation.

Evaluation
Research results may be partly used for CP. It was suggested to further verify in pilot-plant conditions the efficiency of rolling chisels for undergrowth removal in floodplain.

2.7/3 Study of channel modifications due to peak operation according to calculations in the theme 3.5.13 — VITUKI, Csoma, 1965, D

Content - Study of channel development due to different boundary conditions.

Evaluation
The study was used as basis for an investment task. For preparation of contractual project it would be necessary to execute new computations.
Results may be used as auxiliary material for CP.

2.7/4 Study of regulation work connected with the G/N Project construction and assessment of costs for the bypass variant — VITUKI, Csoma, 1966, D

Content - Required regulation works and investment costs in the connection with the G/N project construction

Evaluation
Research resluts may be helpful for CP, however the respective cost are to be calculated again

2.7/5	Elaboration of principles for the regulation flow in the section Bratislava-Budapest	VITUKI Csoma	1966	A

Content - Direction for uniform designing of river adaptation.
Evaluation
Research results may be used in full extent for CP.

2.7/6	Influence of the G/N Project and its operation on the outlet section of the Ipeľ river	VITUKI Dohnalik	1965	A

Content - Study of channel development due to Nagymaros backwater, and Gabčíkovo peak operation, in the outlet section of the Ipeľ river.
Evaluation
Research results may be used in full extent for CP.

2.7/7	Effects of backwater and peak operation in the excavated channel development in the outlet section of the Mosoni branch	VITUKI Dohnalik	1965	A

Content - Alteration in channel developing in the outlet section of the Mosoni branch have been dealt with in details and it was stated, that river bank protection was to be provided on a length of about 19 km.
Evaluation
Research results may be used in full extent for CP.

2. 8 DISTRIBUTION OF DISCHARGES WATER BALANCE

2.8/1	Preparatory study for the investment task "Water balance for the average year 1938, dry year 1934 and wet year 1910"	VIZITERV Blalló, Papp	1967	B

Content - On the basis of methods agreed with VIZITERV and RVR 5.-7.IV.1966, and basic data from 17.V.1966, the study presents water blance according to decades for representative average year 1938, dry year 1934 and wet year 1910. Water balance includes actual discharges in those years, and for 1980 planned and expected water demands. Finally it presents discharges according to decades, which should be passed through the Dunakiliti projects, and discharges utilizable in the projects Gabčíkovo and Nagymaros

Evaluation

Study results may be partly used for CP. For the years 1985 or 1990, its verification with regard to new envisaged intentions and plans may be desirable .

2.9 GEOLOGY, SEISMICITY

2.9/1	Tectonic research in the area of water project on the Danube	GUDŠ Janáček+col.	1967	A

Content - Results of tectonic survey in the area of the G/N Project in the section Bratislava - Štúrovo. The survey was focused on identification of structural-tectonic units in pre-quaternary formations.

Evaluation

Research results may be used in full extent for CP.

2.9/2	Study of earth dams stability with regard to seismicity	VIZITERV Juhász,Maté	1966	A

Content - The seismic zones and MCS, agreed during joint negotiation of CZ and Hungarian geophysicists and geologists, were considered /Bratislava, Nov.22.-25.1965/. Computation procedures for: determination of seismic load, shearing force, safeguarding the dam against shearing failure, assessment of shearing, assessment of slopes stability, were suggested.

Evaluation

Research results may be used in full extent for CP.

2.9/3	Survey of the structure of the Danube Island /Kisalfold/	VIZITERV Völgyesi	1966	D

Content - Data on tectonic surveys of wells, carried out on the Hungarian side by July 1966. Endeavour to define sites of tectonic faults, taking into consideration also results of geophysical measurements in this territory.

Evaluation

Based on later performed well surveys it is necessary to overwork the conclusions. Results may be helpful for CP.

2.9/4	System of the Danube river power projects Vojka-Dunaszeg-Nagymaros, competitive alternative Engineering-geological report	VIZITERV Volgyesi	1968	D

Content - Results of surveys performed earlier for other purposes. /for designing of two-stage alternative, dismissed in the mean time/. Data were arranged and evaluated according to new requirements, data of some new deep wells were applied. Attention is focused on the tectonics of Kisalföld and Žitný ostrov, on data on the change of the Danube river flow, of characteristic properties of soil cover, and on several horizonts of one well. There is an attempt to confine the stage of permeability in the down direction within the Danube gravel complex on the basis of tectonic structure.

Evaluation

Summation of survey of wells of both parties in one report. may be helpful for CP.

2.10 E N E R G E T I C S , I N F O R M A T I O N T E C H N I Q U E C O M P U T A T I O N T E C H N I Q U E

2.10/1 Cooperation of hydroel.power plant Wolfsthal-Bratislava and hydroel. power plant Gabčíkovo — HYDROPROJEKT, Ježek — 1966 — B

Content - Possibilities and advantages of hydraulic cooperation of the hydropower project Wolfsthal-Bratislava with the hydropower project Gabčíkovo on the basis of computation of non-stationary flow at peak operation of both systems.

Evaluation

Research results may be partly used for CP.

2.10/2 Cooperation of hydroel.power plant Gabčíkovo and hydroel.power plant Nagymaros — HYDROPROJEKT, Ježek — 1966 — B

Content - Possibilities and advantages of hydraulic cooperation of the hydropower project Gabčíkovo with the hydropower project Nagymaros on the basis of computation of non-stationary flow at peak operation of both hydropower plants

Evaluation

Plants research results may be partly used for CP.

2.10/3 Study of the conception of optimization and automation of control of a group of aggregates of the hydropower plant, working for two electrification systems. Study — EGÚ Bratislava, Elbert — 1965 — C

Content - Study is dealing with the optimum operation of groups of aggregates, operating into one and two electrification systems, with increasing of efficiency and production of power, of operation reliability, with remote control of hydropower plant at simultaneous decreasing of operators - personnel.
Conditions of optimum operation and ensuing requirements for automatic operation unit.

Evaluation

Research results my be used, after completion, for CP. The study should be updated by actual data on agreed out put transmission of the hydropower plant Gabčíkovo into the Czechoslovak and Hungarian electrification system.

2.10/4 Study of principles of optimum programming of outputs of hydropower plant working for two electrification systems. Study — EGÚ Bratislava, Ihnato — 1965 — C

Content - Criterion of the optimum determination of technical-economical characteristics of a hydropower plant, principles for the choice of limiting condition and the amount of produced power with regard to optimization. Methods, programs and computations, and several cases of computation of optimum out puts of hydropower plant, operating for two electroenergetic systems.

Evaluation

After updating the results may be used for CP.

2.10/5 Connection of hydropower plants on the Danube into the electrification systems in ČSSR and Hungary — EGÚ Brno, Pasák, Kozák, Viktorínová — 1966 — D

Content - Solution of the basic scheme of the hydropower plant Gabčíkovo according to the requirments of the CZ and Hungarian electrification systems. Connection into a common 220 kV switching station was worked out. /Two transmission lines were designed on the ČS side - 220kV to Podunajské Biskupice and one to Šaľa, and two transmission lines 220 kV on the Hungarian side to Györ, and one as reserve/. The study is based on technical-economical evaluation and drawing documentation on division of active output in both systems at various operation conditions of the hydropower plant.

Evaluation

According to Protocol from the workshop of experts from Hungary and Czechoslovakia, held on October 2.-4. 1973 in Piešťany an agreement was reached on new connection of the hydropower plant Gabčíkovo, designed with reagrd to new requests of CZ and Hungarian electrification systems: 400 kV switching station. 110 kV switching station on the CZ side and 120 kV switching station on Hungarian side.

The study may be helpful for working out CP.

2.10/6 Study on connection of hydropower plants on the Czechoslovak-Hungarian Danube section into the system of automatic frequency control and power transfer control — EGÚ Praha, Vítek, Josefus — 1966 — C

Content - Connection of the hydropower plant Gabčíkovo into the automatic regulation of transmitted power frequency with estimation of the magnitude of regulation zone, load varation, etc. Evaluation of efficiency of regulation output is also presented.

Evaluation

After completion it may be used for CP. Updating would be also required.

2.10/7 Study of optimum utilization of hydropower plant outputs, working for 2 electrification systems — VÚE Bratislava, Grígel — 1966 — C

Content - Conception concerning optimization and automation of control of the group of turbines of the hydropower plant, operating into two electroenergetic systems. Supplemental parts to the gorup regulation of the active output according to various regulation parameters.

Evaluation

After completion the results may be used for CP. The task should have been dealt with againg with regard to actual parameters of the hydropower plants Gabčíkovo and Nagymaros.

2.10/8 Connection of the G/N Project into the electrification systems of both countries — ERŐTERV Bajzané — 1966 C

Content - The study proceeds from the conditions of electrification systems of two countries and specifies the energy level of connection to hydropower plants Gabčíkovo and Nagymaros, number and cross-section of long-distance transmission lines into the networks of both countries, and also the situation in connection of regional networks.
The connection of 220 kV, or 400 kV hydropower plant Gabčíkovo is dealt with in detail, and only partly the connection of the hydropower plann should be realized by long-distance transmission lines to hydropower plant Gabčíkovo 2+3 ks 220 kV and to Nagymaros 1+1 ks 120, or 110 kV.

Evaluation
The study is no more topical at present, however some of the conclusions are still valid, and may be used for CP.

2.10/9 Design of the scheme of connection of hydropower plants into the joint system of hydropower projects on the Danube — EROTERV Sárközy — 1966 D

Content - The study dealt with the scheme of electric connection of the hydropower plant Nagymaros, including some basic layout issues. The hydropower plant is connected ot two voltage systems. In addition to the proposal to connect 10 direct-current hydroalternators 15 MVA also supplying with electric power of some auxiliary process units and appliances was considered.

Evaluation
The final standpoint will be decided after decisions of the connection to the network. Results may be helpful for working out the CP.

2.10/10 Energetics - data for the G/N Project — HYDROPROJECT Danišovič VIZITERV-Fehér — 1967 D

Content - Energetic data on coopeation of the system of hydropower projects at continous and peak operation with given accumulation, on the basis of guarantee curves of the study on non-permanet water flow, agreed balance for wet, dry, and average year, and other limitations.

Evaluation
Data may be helpful for working out of CP.

2.10/11 Investment task for telecommunication of the G/N Project (I.version) — POTI — 1966 B

Content - Based on general through survey of all issues connected with communication technique of the Project, a more detailed solution of these problems on the Hungarian territory had been designed, as for instance, telephone, teleprinter, remote signalling, radar and industrial TV, in the connection with navigation, as well telephone connection between other structures.

Evaluation
The study may be partly used for CP, while considering changes, which occurred in the past years.

2.11 N A V I G A B L E   W A T E R W A Y

2.11/1 - Summary and evaluation of materials from international navigation congresses — HYROPROJEKT Šebele — 1966 — B

Content - Some materials from the XVII - XX Navigation Congresses are summarized, applicable either directly, or indirectly for the G/N Project.

Evaluation

Results may be partly used for the CP

2.11/2 - Effect of wind on navigation — HYDROPROJEKT Šebele — 1966 — B

Content - Estimation of wind effects on navigation from two points-of view:

a/ by the pressure on emerged parts of vessels /parts of vessels above the water level/

b/ by influencing water level /surface - wave formation/

Technical characteristics of the reservoir and bypass canal are described, intensity and duration of winds. It is stated, that waves caused by wind lasting one hour, with frequency once in a year, do not reach the value of design waves.

Evaluation

Results may be partly used for CP.

2.11/3 Proposal of assessment of the effect of G/N Project and of respective projects on improvement of navigable waterway and navigation conditions — RVT SVV Liška — 1968 — A

Content - Computation methods - applied literature

Description of navigable sections

Costs required for maintenance and deepening of navigable waterway

Flow velocity

Navigation depths

Downbound and upbound cargoes

Characteristics of the vessel park

Length of navigable season

Contribution of the complex Danube development for navigation

Contribution of the G/N Project to improvement of navigation conditions - distribution of costs

Proposal of additional works for methodology completion

Contribution of respective projects from improvement of navigation locks.

In independent supplement of the suggestion of methodology, an example of computation according to proposed methodology is presented.

Evaluation

The study will be used as bases for dealing with problems concerning navigation and the results may be used in full extent for the CP.

2.11/4 Issues connected with navigation in the area of Nagymaros — VIZITERV-Nagy, Horváth, Zemplényi 1965 B

Content - Data on existing and expected types of vessels and tow-boats during the period of construction. Analysis of conditions during the construction and after putting the G/N Project into operation. The study relates to the divided hydroelectric power plant.

Evaluation

The disposition arrangement of the hydropower project had been changed in the investment task. With regard to it, the part of study concerning flow conditions, cannot be used for CP. The section "Problems of enegetics involved in navigation", and the data on types of vessels and tow-boats may be used for CP.

2.11/5 - Investigation of navigation conditions on the Danube section influenced by the construction of the G/N Project, special attention being payed on peak operation — VIZITERV Rácz 1966 A

Content - On the basis of studies performed by VIZITERV and HDP, the expected impacts of construction and operation of the G/N Project on navigation are summarized in the connection with

- navigable waterway
- flow rate
- ice phenomena
- peak operation.

Evaluation

Research results may be used in full extent for CP.

2.11/6 Comparative study of dimensions of navigation locks — VIZITERV Nagy 1968 D

Content - Comparison of the capacity and efficiency of navigation locks of the G/N Project in the section Nagymaros - Bratislava:

2 x 34 x 260 m
34 x 260 + 34 x 190 m
2 x 260 + 24 x 230 + 12 x 100 m

Evaluation

Final dimensions of navigation locks are defined by the investment task of 1973. Results of the study may be helpful for the methodology of other studies.

2.11/7 Examination of the proposal of a substitute navigable waterway through the Bagomerský branch — VIZITERV Kiss 1966 A

Content - Examination and survey of structures, concerning the substitute navigable waterway through the abandonned channel, considering the technical and economic aspects.

Evaluation

Results may be used in full extent for CP.

2.11/8	Substantiation of the substitute navigable waterway through the abandonned channel	VIZITERV Hankovszkyné	1966	A

Content - Examination of the need of providing a substitute navigable waterway. On the basis of results, its realization is not recommended.

Evaluation

Results of the study may be used in full extent for the CP.

2.12 MAINTENANCE AND OPERATION

2.12/1 Proposal of principles of mainten- nace and general repairs of energetic facilities of the G/N Project — HDP, Žůrek — 1966 — B

Content - Assessment of the expected demand of workshops, their equipment, required for repair and maintenance of energetic facilities at respective structures of the G/N Project. Estimation of manpower. In case of Gabčíkovo and Nagymaros projects independent workshops for maintenace and reapairs are envisaged. Large repairs for the Hrušov-Dunakiliti projects are considered to be provided in the Gabčíkovo workshops.

Evaluation

Research resutls may be partly used for CP.

2.12/2 Investment task of 1967. Materials elaborated by the CZ side. Equipment and operation of the G/N Project — HDP, Liozin — 1967 — D

Content - Specification of equipment for the operation of G/N Project, as for instance inspection motor boats, diver equipments, equipment of workshops, ice-breakers, hydraulic suction dredge, helicopter, etc. for the projects
- Hrušov-Dunakiliti
- Gabčíkovo
- Nagymaros

Evaluation

Project may be helpful for CP.

2.12/3 Investment task of 1967. Materials elaborated by CZ party. Housing construction Gabčíkovo-Nagymaros — HDP, Cénik — 1967 — D

Content - It is necessary to construct permanent housing for the employees of the operation of the G/N Project, and for maintence of dykes and other watermanagement facilities, on CZ and Hungarian territory, according to principles agreed between both countries.
The extent of housing construction was specified with regard to the demands of energetics, navigation, weir operation, operation and maintenace of dykes, pumping stations and requirements of the joint CZ-Hungarian Commission for construction and operation.
About 268 dwellings are assumed on the Czechoslovak territory, and 199 dwellings on the Hungarian territory, in the form of settlements and scattered houings.

Evaluation

Project may be helpful for CP.

2.12/4	Proposal of principles for maintenance and general repairs of structures and facilities of the G/N Project	ERŐTERV, Kiss	1966	D

Content - Requirements and possibilities of repair and maintenace at the G/N Project according to the bypass variant have been dealt with. For the study purpose Kaplan turbines were used at Nagymaros project. According to results obtained it is advantageous to perform small repairs within the hydropower plants, and larger ones at the producer. Research results presented in this study cannot be considered as final.

Evaluation

Research results may be helpful for CP.

2.13 C O N S T R U C T I O N   M A T E R I A L S

2.13/1 Prefabrication and specification of the G/N structures — VÚIS Bratislava, Brno — 1966 — B

Content - Development designs of navigation locks, design of prefabrication and prestressing
Constructional arrangement of ship guiding beams of navigation locks approaches
Sealing of mounting and expansion joints
Tests of anchorage into the subsoil /bedrock/
Study of progressive prestressing technology
Requirement, methods and extent of control and research measurements on the G/N Project structures
Economic evaluation

Evaluation
Research results may be partly used for CP.

2.13/2 Prefabrication and specification of concrete structures of G/N — HYDROSTAV Bratislava, Huječek, Balko, Chlubna — 1966 — D

Content - Verification of anchorage in water-bearing gravel-sands at different anchorage depths. Results are included in the Report for S-1-26-2/12.
Design of prestressing equipment for 200 Mp, testing of prototype of prestressing jack.
The parameters were observed. The function of the equipment is reliable.
Testing aimed at assessment of the effect of reinforced panels with concrete filler. Own production of test beams.
Evaluation si submitted in the VÚIS Report S-1-26-2/12.

Evaluation
Research results may be helpful for CP.

2.13/3 Expert's account on concreting of the Nagymaros Project — ÉKME, Palotás — 1964 — C

Content - Conclusions of an expert's account:
- The Danube gravel, which can be exploited in the surrounding area is, after grain-size treatment, or eventualy sorting, a suitable material for concrete production at the Nagymaros project. As improvement material is not recommended andesite occuring below the Danbue. It is suggested to use dark gray andesite from a locality near Szob, or the andesite from the hill Matyás nearby Visegrád. However, for both types a more detailed mineralogic and rock survey is to be carried out.
- Cement DCM /research of 1964/ is not suitable for concretes used in water structures due to its high hydration heat. Further research was proposed for treatent of cement of required quality.

Evaluation
Results concerning aggregates are valid also at present. However it is necessary to carry out research of cement, which is now produced at Vác.
Results may be used, after completion, for CP.

2.13/4 Proposal of concrete mixtures composition — ÉKME, Palotás — 1965 — C

Content - a/ Concrete used in water structures building I.
Review of the literature
The expert's account deals with following groups of issues:
1/ main parameters of large dams
2/ suggested concretes
3/ Technology of massive concrete
4/ Thermal investigation of massive concrete

Evaluation
Literature published worldwide on concrete used in water structure by 1965. The study is to be completed by information on professional literature published since 1965.

b/ Concrete used in water structures building I.
Annexes

Content - Close connection to the above material - literature revies, Tables, diagrams, construction details and photos of construction machinery.
At the beginning the Department of building materials submits in a separate enclosure a design of a concrete mixture composition for the Nagymaros project.

Evaluation
Data necessary for working out of the investment task. For the final designs the recommendations must be verified by experiments.

c/ Concrete used in water structures building II.
Tests of suitable aggreagtes as fillers of the concrete.

Content - This volume deals with the survey and investigation of andesites, occurring in the Danube channel in the area of designed hydropower plant, and chiefly of andesites occurring in the mountain Matyás in the section Szob-Visegrád, and with testing their suitability as fillers for concretes used in water structures building.
Also main technical data are included concerning operation and material from these stone quarries and gravel-sand grading plants, managed by the trust "Stone and Gravel Industry".

Evaluation
After completion with topical data, it may be used for the project.

d/ Concrete used for water stgructures building III.
Cement for the abovementioned concrete

Content - Selection of the most suitable cement of inland production, for massive concretes used in water structures, from 8 types of cements, recommended by experts as tested with various experimental methods.

Evaluation
Research should be supplemented for cements produced at present.

e/ Concrete used for water structures building IV.
Summary, conclusions

Content
- Summary of chapters I-III
- Evaluation of the state of the art on the basis of literature review concerning aggregate fillers, binder, /cement/, admixtures, quality control, production technology af massive concrete, and thermal investigation of massive concrete.
- Investigation of aggregates occuring in the area of

the future construction with regard to its use as filler.
- Cement for concretes used for water structures.

Evaluation

After supplementing with the advanced information may be used for designing.

f/ Project of concrete study

Content - The study is a supplementing part of volumes I-IV on concrete fof water structures and contains
1/ methods for concrete designing, recommendations concerning composition of concretes of solid consistency, proposal of production of construction massive concrete, sand quality, sand content.
2/ Investigation of concretes with the aim to obtain optimum composition of massive concretes.
3/ Application of electro-analogous model for determination of hydration temperatures developing in massive concrete.

Evaluation

Study may be applied after verification by authors.

2.13/5 Investigation of grinded concretes ÉKME, Palotás A

Content - Examination of application of stone admixtures from the valley of the river Váh together with the Danube aggregates. Characteristics of stone admixtures from the Váh river valley are considered in the study according to Czechoslovak research workers.
Basic materials with regard to resistance to abrasion are separately dealt with.

Evaluation

Results of the study may be used in full extent for CP. No further research is necessary.

2.13/6 Report on the survey of clays for dam sealing /Territory between Pilismarót and Lábatlan/ MAGYAR ÁLLAMI FÖLDTANI INTÉZET Sipos 1965 A

Content - surveys revealed that for construction of water-tight embankments/filling/, suitable binding earths at Leányvári /279 000 m3/, at Tokod /24 000m3-and at Šarišápa /15 000 m3 may be exploited- From the total supply 313 000 m3 84 000 m3 belong into the category C_2 and the rest in D category.

Evaluation

Results may be used in full extent for CP.

2.13/7 River hydropower project on the Danube-river alternative /results/ VIZITERV Manuano 1966 D

Content - From many surveys, the most interesting is the detailed survey of cover layers between Rajka and Győr. Estimation of materials suitable for embankments with regard to quantity and quality. Partial estimation of materials for the core, or static part of dam. Supplies are in the category C_2.

Evaluation

Valuable information on hydrogeological and tectonic conditions, it may be helpful for CP.

2.14 T R I L A T E R A L   C O N S U L T A T I O N S

2.14/1	Trilateral consultations and preparatory materials	VIZITERV HYDROPROJEKT GIDROPROJEKT	1958 - 1964	B

Content - Documentation including following preparatory materials for consultations, minute-books summarizing results of consultations and experts accounts:
- 3.III. - 4.IV.1958 /Budapest - Bratislava/
- 11.-28.I.1960 /Budapest - Bratislava/
- 13.XI. - 7.XII. 1963 /Moscou/
- 28.XI.-17.XII.1963 /Moscou/
- 13.-29.IV.1964 /Budapest - Bratislava/

The first four consultations clarified the conception of the utilization of the common Hungarian-Czechoslovak Danube section. On the basis of this conception, a joint investment task was workded out in 1964.
The last consultation dealt with following issues:
I. GABČÍKOVO project
- parameters
- layout and construction of structures
- structures of Hrušov - Dunakiliti reservoir
- organization of construction works

II. NAGYMAROS project
- alternatives of construction site fencing
- geological survey
- state of research works

Evaluation
Parts related to the conception solution are valid also at present. Respective partial issues were dealt with during further consultations and in the joint investment task from 1967. Results may be partly used for CP.

2.14/2	Consultation on the G/N Project	VIZITERV HYDROPROJEKT GIDROPROJEKT	1964	B

Content - Consultations dealt with the issues of engineering geology:
- seismicity of the Nagymaros area
- completion of the engineering-geological survey in the area of Nagymaros project
- infiltration conditions in the area of backwater from the Gabčíkovo project
- completion of the engineering-geological survey of the Gabčíkovo project

Mechanization of construction works, organization of works and construction and assembly /installation/ works schedule and sealing of the bottom of headwater canal were also negotiated.

Evaluation
Results of consultations were considered in the joint investment task, worked out in 1967. They may be partly used for CP.

2.14/3	Preparation of trilateral consultations on the G/N Project	VIZITERV	1966	D

Preparation of trilateral consultations on the G/N Project 1966

2.14/4	Materials prepared for consultation in May 1966 /unified CZ-Hungarian materials/	VIZITERV HYDROPROJEKT	1966	D

Materials prepared for consultation held in May 1966 /Unified Czechoslovak-Hungarian materials/ 1966

2.14/5	Consultation on respective issues concerning the designing of the Project on Hungarian and Czechoslovak section of the Danube. Expert's account	GIDROPROJEKT	1966	A

Content - The first two materials are preparatory works for the proper consultation. The third one is an expert's account of GIDROPROJEKT Moscou concerning following issues:

- probability of occurence of flood waters, which are to be passed through the Danube river power projects, determination of the height of dams and weirs crests, exposed to a permanent effect of backwater
- hydrological and engineering-gelogical justification of alternatives, filtration stability of the bedrock
- ensuring the filtration stability of the bedrock and measures against seepage
- technical solution of headwater and tailwater canals of the bypass alternative
- issues connected with the auxiliary navigable waterway in the abandonned Danube channel.

Evaluation

Results of consultation were considered in working out of the joint investment task in 1967. They may be used for CP.

3. EVALUATION OF PREPARATORY WORK FOR THE HYDROELECTRIC POWER PROJECT G A B Č Í K O V O

3.1 G E N E R A L P A R T

3.1/1 Hydropower plant Gabčíkovo - determination of optimum backwater elevation — HDP - Hraško — 1966 — D

Content - The study dealt with the optimum backwater elevation at Gabčíkovo project with regard to technical-economical aspects.
In decision making about the optimum backwater elevation the state with and without the hydropower project Wolfsthal-Bratislava was considered. The study considers continuous operation in both projects.
As to provide dyke protection against piping, as well as to avoid further increasing of relatively high dykes of the headwater canal, it is recommended to leave the backwater elevation at 131,10 m above sea level.

Evaluation
Results of the study were used for investment task drawing up, they may be used for CP.

3.1/2 Determination of optimum absorption capacity of hydropower plant Gabčíkovo-Study — HDP - Hraško — 1966 — D

Content - The costs, energetic poarameters and indexes /parameters/ of absorption capacities alternatives 2000 - 3000 - 4000 - 5000 m3/s were compared at continuous operation. It was stated that designed absorption capacity 4000 m3/s could be considered as adequate.

Evaluation
Results may be partly used for CP.

3.1/3 Investigation of the duration of the peak op. at maximum output of hydropower plant Gabčíkovo — HDP - Danišovič 1966 — C

Content - At the request of Hungarian energetics the possibility of power plant operation at permanent maximum load was examined and duration of peak operation at maximum load was assessed. The results show, that the peak duration at output 700 MW, and Q = 2000 m3/s is 5 hours.

Evaluation
Results may be, after completion, used for CP.

3.1/4 Investment task of 1967 — HDP - Kotala — 1967 — B
Materials elaborated by CZ party
Project of organization of construction
- Hydropower project Gabčíkovo

Content - Materials, worked out for the project of construction works organization, include description of construction site equipment, list of main construction machinery, schedule of construction, manpower. The materials are arranged according to respective main structures.

Evaluation
The project will be partly used for CP.

3.1/5 Investment task of 1967 HDP - Ľupták 1967 D
Materials elaborated by CZ party
Expropriation of land and buildings
Gabčíkovo

Content - Statement of land for the hydropower project Gabčíkovo was worked out on maps in the scale 1:10 000. The directions for this mapping were observed. The total statement of land was elaborated according to respective main structures, for permanet and temporary occupation.
- Hrušov - Dunakiliti reservoir
- headwater canal
- approach roads
- Gabčíkovo project
- tailwater canal
- dredging of the Danube canal
- change of the state borders
- dredging of the Danube channel downstream of Palkovičovo /evluation of the dumping site No.1 and 3/.

Evaluation
Final land occupation will be specified in more details according to the design of structures in the Contractual Project.
Results may be helpful for CP.

3.1/6 Operation of hydropower project Gabčíkovo in winter period and during floods HDP - Schulz 1966 B

Content - Possibilities and ways of operation over the winter period, and during floods. Limiting assumptions for operation, i.e. water levels, discharges, roughness, etc.

Evaluation
Results may be partly used for CP.

3.1/7 Winter regime of drainage canals VÚVH Bratislava Gyalokay 1965 A

Content - Results of groundwater temperature measurements showed, as well as calculation of infiltrating water velocities, that water from the infiltration canal would have enough high temperature and velocity, as to avoid in given climatic condition the freeze up. Thus winter regime of infiltration canals of the G/N Project would not require special measures against freezing.

Evaluation
Results may be used in full extent for CP.

3.2 HRUŠOV - DUNAKILITI RESERVOIR

3.2/1 G/N Project, Hrušov reservoir — IHGP Bratislava, Buroš+kol. 1965 C

Content - The surface complex of clays and sands had been searched in zones along the designed dykes. The zone width is getting narrower in the upstream direction independence upon the height of designed backwater. In addition, also the whole territory of the reservoir mouthing into the bypass canal between both dykes was investigated. Wells are executed in profiles, their spacing being 100 m, respective wells are in the distance 75 m. Excavated test pits were situated on the basis of results obtained by means of bore holes, performed by means of earth auger, as to obtian undisturbed samples and execute Nester infiltration tests. Hydrological wells are situated in the dyke line, in the distance of 1 km on the average. Their depth is 30 m, or down to neogene, if it is higher. Pumping tests lasting 7 - 21 days were carried out on 30 hydrogeological wells.
18 engineering-geological wells 10 m deep are in the route of the infiltration canal. Material of old dykes had been examined by means of 9 core drills.

Evaluation
Research results may be applied, after completion, for CP

3.2/2 Reservoir, construction material — GP Bratislava, Žakovský+kol. 1964 C

Content - Assessment of the survey programme for searching sealing clays for dykes and concretes of C_2 catagory.

Evaluation
After completion the results of the survey may be used for CP. It is necessary to carry out investigation in clay deposits and computations of supplies of C_1 category.

3.2/3 Hrušov reservoir - Hydrological data — HDP-Frankovský 1965 D

Content
- Water level regime between Hrušov and Bratislava before and after the G/N Project construction
- Flow rate in the reservoir before and after construction
- Flow rate in the headwater canal
- Air temperatures
- Water temperatures
- Wind directions and velocities

Evaluation
Research results may be used as helpful material for CP.

3.2/4 Study of problems of reservoir colmatation nearby Hrušov — VÚVH Brno, Čištín A

Content - The research task dealt with the possibility of depth and surface soil colmatation in case of earth types, occurring in the area of the bottom and dykes of the designed Hrušov reservoir, either due to natural colmatation with Danube suspended loads, or artificial colmatation with light ash and clinker.
Theoretical analyses and laboratory tests showed, that natural surface, or depth colmatation may be expec-

ted, caused by Danube suspended load.

Evaluation

Research results may be used in full extent for CP. The effect of colmatation had been proved, however it would not be considered in the project, thus creating a certain safety reserve.

3.2/5 Model study of bed load regime of the Danube at Bratislava and of flood protection — VÚVH Bratislava, Vincent, 1969, A

Content - Several methods of the Danube channel dredging had been investigated on a hydraulic model with movable bottom. The study showed the effect of deforestation of a part of floodplain and of channel bottom deepening on water level decreasing in Bratislava region.

Evaluation

Research results may be used in full extent for CP

3.2/6 Hrušov reservoir - bed load and suspended load regime — HDP Frankovský, 1965, D

Content - The study includes brief review on the present bedload and suspended load regime in the section of the Danube in the area of envisaged the G/N Project, i.e. in rkm 1840-1880, taken out from VÚV Report by Szolgay: "Regime of the Danube bedload and suspended load as related to present training":
- runoff conditions
- surface gradients of water levels
- qualitative changes of the channel material
- bedload regime
- suspended load regime
- bedload and suspended load transport in Bratislava profile.

Evaluation

Research results may be used as helpful material in CP.

3.2/7 Study of the regime and forecasting of groundwater levels in the section Petržalka - Čuňovo — VÚVH Bratislava, Bartolčič, 1965, C

Content - Assessment of the present groundwater regime and forecasting of groundwater levels after the G/N Project construction. Groundwater level prognosis had been dealt with using network analyzer.
Issues of bedrock /subsoil/ stability, supporting masses of dykes stability, and stability of interception canals had been also dealt with.

Evaluation

Research results have to be supplemented by the study of new situation, considering the recent development of the territorial solution of the area Bratislava - Petržalka Then they may be used for CP.

3.2/8 Study of flow ad reservoir arrangement of Hrušov-Dunakiliti — VÚVH Bratislava, Komora, Sumbal, 1965, A

Content - The task had been solved on an aerodynamic model on one hand, and by means of computation methods on the other hand. By means of experimental research 9 various reservoir alternatives were studied, considering the effect of various direction of guiding embankments, and various weir locations. Sites of reservoir sedimentation with suspended load were determined using analogue computer.

Evaluation

Research results may be fully used for CP.

3.2/9	Study of layout solution of the hydropower project and reservoir Hrušov - Dunakiliti	VÚVH Bratislava Komora, Gallay	1967	C

Content - Within the scope of the task a large hydraulic model of the reservoir in the scale 1:200 and 1:75 was constructed. Optimum location of the hydropower project and of the cutoff had been assessed by means of the model study. The function of guide-structures in the reservoir was verified with regard to the course of flood waters and ice discharging.

Evaluation

After final solution of regulation arrangements in the reservoir the results may be used for CP.

3.2/10	Study of regulation arrangements in the Danube downstream of Bratislava and diversion of floods	VÚVH Bratislava Vincent	1966	A

Content - Examination of the design of protection dykes adaptation at the end of the backwater of Hrušov-Dunakiliti reservoir from the point of view of flood protection of Bratislava. The task was solved on an there-dimensional model.

Research results showed, that it was possible to move the left-side protection dyke downstream of Bratislava closer to the Danube channel, without deteriorating the present protection of Bratislava.

As to improve discharge conditions and thus also protection of Bratislava, straightening of the bend downstream of Bratislava had been suggested in rkm 1862 and 1865.

Evaluation

Research results may be used in full extent for CP.

3.2/11	Optimum width of prolongated apron in Hrušov reservoir	VÚVH Brno Hálek	1964	B

Content - Working out of methodology for hydraulic solution of protective measures against seepage from the Hrušov reservoirs.

For given conditions an algorithm of solution was elaborated, providing that for seepage interception only one infiltration canal would be used, sunk down to the permeable gravel-sands. According to the computation method a design and estimation of protective measures was submitted in four selected profiles, with a detailed computation proceeding.

Evaluation

Research result may be partly used for CP.

3.2/12 Construction of prolongated sealing apron before the dam of the river reservoir — SVŠT-Geotechnic, Peter, Jesenák, Hulman, Kubán — 1966 — B

Content - Examination of possible dyke subsoil sealing with a sealing apron in geological and hydrological conditions of the Hrušov reservoir area.
- Construction of apron made of local clays
- Estimation of apron dimensions in eight dam profiles
- Feasibility and technological conditions of apron construction.

Results of the study:
- Most efficient measure against seepage in case of Hrušov reservoir dykes is the sealing apron.
- Stability of dykes subsoil and the criterion of permissible amount of losses due to seepage require a sealing apron L = 150 to 460 m long.
- Earth apron assumes a hydraulically and functionally efficient drainge system - an open canal is recommended.
- With regard to technology the construction of sealing aprons in conditions of left-side dyke of the Hrušov reservoir is feasible.

Evaluation

Research results may be partly used for CP.

3.2/13 Study of the sealing apron in front of Hrušov dykes — SVŠT Bratislava, Peter — 1966 — A

Content - The task solved appropriate length of the apron, construction and material of the apron, interaction of the apron and infiltration system.

Evaluation

Research results may be used in full extent for CP.

3.2/14 Construction of dykes for the upper and lower retention reservoir Assessment of soils — VÚIS Bratislava, Mach — 1966 — D

Content - Soils showed to have good characteristics for compacting by means of ramming and rolling in a relatively large range of humidity.
- In principle, all 3 tested types of soils may be used with regard to permeability in the sealing dykes elements. The permeability coefficient is lower as the required limiting one $k = 1.10^{-7}$ m/s.
- Model tests of water flow and development, and course of piping below the dyke were carried out.

Evaluation

Research results may be used as helpful material for CP.

3.2/15 Investment task of 1967 Material elaborated by CZ party Hrušov-Dunakiliti reservoir — HDP Bratislava, Šebena — 1967 — B

Content - According to the basic materials and data the Hrušov-Dunakiliti reservoir, with its backwater elevation 131,10 m above sea level, has the capacity 234 mil. m^3, of which available storage capacity for utilization of the upper 1 -m layer is about 60 mil. m^3.

The dam crest is 2,5 m above the backwater at a discharge 4000 m³/s. Research results are summarized in the basic materials.

Evaluation

Project may be partly used for CP.

3.2/16 Study of hydraulical problems of hydrojunction and reservoir Hrušov-Dunakiliti — VŮVH Bratislava, Komora — 1968 — A

Content - Suspended load regime of the Danube in the area of the reservoir and the section below the dam at various stages of the G/N Project construction had been studied on three-dimensional hydraulic model, as well as impacts of various manipulation with weir sluices on bottom deformations, navigation during the construction and after putting the G/N Project into operation.

Evaluation

Research results may be used in full extent for CP.

3.2/17 Engineering-geological survey of the reservoir and protection dyke at Dunakiliti — VIZITERV, Erhardt — 1966 — C

Content - Data for dam designing on the Hungarian side of the reservoir, or eventually results of the survey of cover layers for assessment of dyke dimensions and infiltration systems. Surpassing general geological characteristics, the work presents detailed information on soil-mechanics and engineering-geological characteristics of the cover complex, or eventually of the water-bearing gravel complex. Special attention was given to determination of filtration coefficients in assessment of hydrogeological conditions.

Evaluation

It will be necessary to assess the presented filtration coefficients, or the state of permeability downwards.
After completion the results may be used for CP.

3.2/18 Study of application of sealing apron in construction of G/N Project — VITUKI, Bográdi — 1964 — D

Content - After studying technical literature dealing with sealing aprons with bituminous bond the author worked out a review according to types of sealings.
On the basis of laboratory tests following types of sealing aprons were estimated:
- soil consolidation with diluted bitumen
- soil consolidation with light ash
- consolidation with cement
- bituminous-oncrete sealing apron
- bituminous membrane
- bentonite sealing apron
- sealing apron made by means of bituminous emulsions.

It was stated, that sealing apron made of clayey sands of local origin /from the cover layer/ with diluted bitumen corresponds to requirements.
Laboratory investigations showed, that sealing apron made of local materials with cement stabilization did not meet requirements.

Evaluation

Since only laboratory investigations were performed and field experiments were not carried out, the research results cannot be used for CP. Field experiments are to be considered, using the above material.

3.2/19 Supplement to the investment task Dunakiliti reservoir — VIZITERV, Peto, 1966, D

Content - Lay-out and model cross-sections of the project are actually modified drawing supplements to the investment task, worked out in 1964. It includes also statement of amounts, main volumes of works in the connection with reservoir construction on the Hungarian side.

Evaluation

Results may be helpful for CP.

3.2/20 Investment task Dunakiliti-Hrušov reservoir — VIZITERV, Peto, 1967, C

Content - Overworking of the investment task from 1964, supplemented with comments, though observing the main principles: Brief description of preparatory works, more detailed description of the protection line /dykes, sealing apron, infiltration system/, and hydraulic computations.

Evaluation

After completion of the project it may be used for CP. It is very important to examine the relationship of the infiltration canal and Mosoni Danube branch, as well as altitude and route solution of the infiltration canal.

3.3 H R U Š O V - D U N A K I L I T I   W E I R

3.3/1 Engineering-geological survey of Dunakiliti weir /preliminary results/	VIZITERV Volgyesi	1966	C

Content - Results of the survey, processed by January 1966. Evaluation of soil-mechanics of cover layers and some engineering-geological characteristcs of gravel layers.

Evaluation

Only a small part of planned survey works had been completed by the time of working out this report, thus important questions concerning the Dunakiliti project could not be answered. It would be necessary to investigate very thoroughly infiltration coefficients and anisotropis values, the depth of impermeable subsoil, and to reevaluate old data. After completion, the results may be used for CP.

3.3/2 Hrušov-Dunakiliti project Documentation for layout	VIZITERV Szabó	1964	B

Content - Lay-out and cadaster data, required for alignment. The lay-out of the main structure was in the meantime modified.

Evaluation

May be partly used for CP.

3.3/3 Examination of dammed-up water levels at Dunakiliti	VIZITERV Zsilák	1966	B

Content - Assessment of discharge conditions in the headwater canal and on the weir, and of water levels in the section of ramification in case of flood discharges with 1% - 0,1% and 0.01% probability, assuming, that the maximum flow rate in the headwater canal would be 1,5 m^3/s.
Extension of the headwater canal was suggested. Reason: At the end of peak opeation flow rates would reach 1,5m^3/s in the headwater canal. At the same time, even at the original discharge with 1% probability higher flow rates were not planned. Thus, the maximum flow rate at operation should be decreased, by means of headwater canal expansion.

Evaluation

The study may be partly used for CP.

3.3/4 Examination of backwater levels at Dunakiliti project	VIZITERV Zsilák	1966	C

Content - By means of computation methods stage-discharge curves of the weir were developed for 6,7 and 8 numbers of openings. The stage-discharge curve of the headwater canal is stated in the protocol.

Evaluation

After completion the study may be used for CP. It is necessary to examine the water levels on the model with movable bottom, planned for the elaboration of CP, /investigation of arrangements and flow in the Dunakilliti-Hrušov reservoir/.

3.3/5 Capacity of Dunakiliti project, of headwater canal and Gabčíkovo project during floods — VIZITERV, Zsilák — 1965 — C

Content - Determination of the common capacity of Dunakiliti-Hrušov weir and of the Gabčíkovo project, and study of the optimum extent of construction. It is recommended:
- to remove the old flood control levee at the inlet into the headwater canal,
- to excavate the inlet section of the headwater canal to elevation 123,50 above sea level,
- to provide three 24 m openings on the Dunakiliti-Hrušov weir,
- to unite the segment idle sluice and the ice sluice on the Gabčíkovo project to a 2 x 9,0 m wide opening with the elevation at the sill 120,70 m.

Evaluation

It is necessary to examine the removal of the old flood control levee and excavation of the inlet section of headwater canal on the level of Contractual Project as and alternative of construction process. The investment task specified the number of weir openings at Dunakiliti as well as the arrangement of idle sluices at Gabčíkovo. Thus the suggestions of the study are subjectless.

3.3/6 Capacity of the weir of Dunakiliti-Hrušov project — VIZITERV, Pipó — 1965 — A

Content - Capacity of valve and let down segment at 1 -8 openings and at backwater level at the elevation 131,10 m a.s.l.
- Capacity of the Dunakiliti project at the elevation of the sill 120,30 - 121,50 m a.s.l., at backwater level 131,10 m a.s.l. and with 3-5 openigs.
- On the basis of model study the overflow amount at water level decreasing is specified as 1-6 m and at number of openings 1-8.
- Suggested sill elevation was 120,30 m a.s.l.

Evaluation

The study may be used in full extent for CP, though furhter research is required.

3.3/7 Number of openings for ice runs discharging through Dunakiliti-Hrušov project — VIZITERV, Zsilák — 1965 — C

Content - Design of ice floes discharging and number of openings for ice passing. It is suggested to construct two sluice fields for that purpose, having also a role to replenish discharges in the abandonned Danube channel.

Evaluation

Openings for ice floes discharging were not prescribed in the investment task. This issue is to be furhter examined after completion of the study of flow within the reservoir Dunakiliti-Hrušov, and after final elucidation of hydraulic conditions of ice passing from the reservoir. It would be necessary to consider new research results and experience from existing river power projects.
After completion, the study may be used for CP.

3.3/8	Passage of flood waters through the Dunakiliti-Hrušov project during construction	VIZITERV Zsilák	1966	C

Content - For safe solution of flood water diversion over the G/N Project construction, it would be required a 600 m wide, bridged opening within the floodplain. It would be also necessary to remove the forest in the floodplain and to increase the crest height of protection dykes.
For extension of dyke cross-section on the down stream face gravel-sand would be used. As to decrease upward pressure /lifting force/ cofferdam system of dykes is to be constructed.

Evaluation
After supplementation the study may be used for CP. On a three-dimensional hydraulic model, planned for elaboration of CP. It will be necessary to control the backwater during construction and flow conditions.

3.3/9	Examination of issues connected with the Dunakiliti-Hrušov navigation lock	VIZITERV Pipó	1966	B

Content - Dismantling of the old dam and excavation influence favourably the capacity of headwater canal during floods.
The diagram presents situation at 2, 3, 4 and 8 openings.
At 1% flood maximum 7130 m3/s may be passed and at 0,1% flood 7800 m3/s.
Power increase 5,7 MW.
Auxiliary navigation lock can cope with transportation from 1.XII. to 30.IV. In case, that the navigation lock sill at Gabčíkovo, and the headwater canal bottom will be at the elevation 123,10, the headwater canal will manage to provide navigation over the construction period.
In case of auxiliary navigation lock, it is necessary to perform damming to the elevation 125,60 m a.s.l. during 79 days, over the period from December 1st, to April 30.
Without auxiliary navigation lock during 20 days in December.

Evaluation
Research results may be partly used for CP.

3.3/10	Possibilitiy of leaving out the navigation lock at Dunakiliti	VIZITERV Czákó	1965	C

Content - Design of the inlet section of the headwater canal, for removal of existing flood control levee to the elevation of the navigation lock sill at Gabčíkovo, as well as for testing of headwater canal. On the basis of results obtained the possibility is presented to leave out the navigation lock at Dunakiliti in case of a 20-day navigation interruption.

Evaluation
It is necessary to examine the design for removal of the old flood control levee, excavation of bypass canal inlet section, the schedule of channel damming, and testing of headwater canal on the level of contractual project, within the scope of the project organization and construction.
The suggestion to leave out the navigation lock is subjectless.
A part of this study may be used, after supplementation, for CP.

3.3/11 Seepage around and under structure Kiliti — VITUKI Ubell — 1964 — C

Content - The report presents in diagrams the values of seepage below the structures, and distribution of lifting forces according to various computation methods.

Evaluation

After supplementing the study may be used for CP.

3.3/12 Seepage under Kiliti dykes — VITUKI Ubell — 1964 — C

Content - Seepage amounts below the dam and the effect of a prolongated sealilng apron are examined by means of various computation methods. Results are presented as diagrams.

Evaluation

After supplementing the study may be used for CP.

3.3/13 Investment task for the G/N Project. Lateral seepage of the Dunakiliti-Hrušov project. Project study — VIZITERV Zsilák — 1965 — D

Content - By means of Bligh-Lana-Zamarin approximation method the required dimensions of sheet pile cut-offs for prevention seepage around the Dunakiliti weir, were studied considering alternative methods of foundation with grouted vat, on wells and in open construction pit.

Evaluation

The study may be helpful for CP.

3.3/14 Short report on results obtained by means of model study performed in 1965 aimed at estimation of groundwater movement adjacent to the reservoir and structures of Dunakiliti — VITUKI Varrók — 1965 — B

Content - Using the EGDA /electro-analogy/ method following was examined:

- upward pressures and seepage below the foundation plate of the structure,
- amounts of seepage, infiltrating from the reservoir through subsoil of the dam into the protected territory, amounts of seepage, intercepted by infiltration canal, and eventually seepage not intercepted by the infiltration canal.

  Dimensions and lay out of the examined structure are, with regard to applied water level decreasing /surface drainage deep drainage/, and construction methods satisfactory /underground wall from the upstream face to the /level/ elevation 96,0 m a.s.l. and from the tailwater to 108,0 m a.s.l. In case of construction using the grouted vat, the research results are inadequate.

  Seepage below the dam body was assessed in nine selected characteristic profiles, considering the characteristics of concerned profiles and various groundwater levels.

Evaluation

A part of the study, dealing with seepage below the dam body, may be used for CP.

3.3/15	Drainage of Dunakiliti project construction pit	VITUKI Varrók	1965	D

Content - Issues of seepage during construction pit draining were investigated using the EGDA method for the case of surface drainage and two-step deep drainage. Various subsoil stratification was considered, different depth of external levels and alternatives with underground wall and without it. In the connection with surface drainage following was studied:
- the course of depression curve of infiltrating water,
- the course of filtration velocity,
- the value of a specific seepage in one studied profile.

As far as deep drainage is concerned following was studied:
- water motion, which will occur in the area of the construction pit,
- amounts of seepage /14,7 - 17,9 m3/s/.

Evaluation

The study deals only indirectly with the solution with grouted vat, given in the investment task. Thus for selecting the foundation method in grouted vat, the study may be used only as auxiliary material for CP.

3.3/16	Dunakiliti project-Foundation variants	VIZITERV Maté	1965	D

Content - Foundation of Dunakiliti-Hrušov weir was examined in following four variants:
- variant with drop caissons
- variant with grouted vat
- variant with needle filters
- variant with surface drainage.

The variant with grouted vat was designed as final.

Evaluation

The study may be helpful for CP.

3.3/17	Research work connected with construction of river power projects on the upper Danube. Bottom sealing of large construction pits	FTI Regele	1966	D

Content - Survey of subsoil in the area of Dunakiliti weir with regard to the possibility to perform grouting on the basis of obtained data /wells, bore holes, etc./, which were available.
- Specification of materials for grouting.
- Examination of various cements and domestic materials, required for grouting.
- Draft of methodology of theoretical dimensioning.

Evaluation

Results are suitable only for starting of the research and designing work, considering the unified design directions. They may be helpful for CP.

3.3/18	Experiments with new methods of subsoil consolidation. Final report Sealing of construction pit bottom by grouting at Dunakiliti project	FTI Regele	1966	D

Content - Practical realization of grouting works at the construction of the sealing vat of the construction pit of Dunakiliti weir. Required equipment, suggested technology, materials,

assumed time needed.
Organization of grouting works, estimation of cost, time schedule.

Evaluation

The study may be partly used for CP. The results of design study are based on that time conditions and available machinery of foreign production, considering the circumstance, that the delivery will be executed by the Hungarian enterprise /Mélépito vállalat/. Therefore, the study must be updated and modified according to the respective agreements.

3.3/19 Uplifts affecting foundation plate of Dunakiliti project. Variant with bypass canal — VITUKI Varrók — 1966 — D

Content - The method EGDA /electro-analogy/ was used for investigation of
- upward pressures, exerting influence on the foundation plate of the structure,
- value of seepage below the structure for the case of water-proof and permeable stilling basin. Variants with sheet pile wall, reaching on the upstream face to the elevation 96,0 m a.s.l., and with sheet pile wall reaching on the original side to the elevation 108,0 m a.s.l. without sheet pile wall on the original side were studied on a model.

Evaluation

The examined foundation plate is satisfactory in case of foundation in the open construction pit. The study may be helpful for CP.

3.3/20 Hydraulic research of stop-log weir stilling basin at Dunakiliti project — VITUKI Haszpra — 1965 — C

Content - Effect of the weir sill on the flood water level height /in several alternatives/,
- determination of the rating curve of a segment with valve,
- effect of pressure distribution on closing structure and on the weir sill,
- investigation of the required force for lifting,
- study of the stilling basin of normal sluice and of stilling basin of the sluice for ice passing,
- assessment of the capacity of one weir opening.

The study had been perfomed in a glass flume, respective phenomena being considered as horizontal problems. Model study on the level of the investment task brought satisfactory answer to above-mentioned questions. Study of some other issues is to be performed on three-dimensional model.

Evaluation

Research results may be, after completion, used for CP. Further research is necessary regarding the operation and sluice arrangement for ice floes discharging.

3.3/21 Hrušov-Dunakiliti weir-First design of water side travelling crane — UVATERV Kákedy — 1965 — D

Content - Schematic design of crane runway made of
- steel construction
- coupled construction and
- reinforced concrete construction.

Evaluation
Schematic design may be used as helpful material for CP.

3.3/22 Programme study of long-distance transmission line to power plants Gabčíkovo and Dunakiliti — Eröterv Halácszy — 1967 C

Content - Programme study of long-distance transmission line to power plants Gabčíkovo and Dunakiliti

3.3/23 Projects of hydropower plants Gabčíkovo and Dunakiliti. Documentation of affected land — ERÖTERV Halácsy — 1967 C

Content - Both documentions realized simultaneously and to the same order are identical with regard to technical contents.
The scope of data included in the study is broader, enclosed is also the minute book about construction site selection.
Both documentations are dealing with the realization of long-distance transmission lines in the investment task /route, construction issues, electric data, etc./
For transport of electric power produced in the hydropower plant Gabčíkovo a long-distance line 220 kV is considered, for providing own consumption 35 kV, and for interconnection of the Dunakiliti project, two transmission lines 35 kV.

Evaluation
Results of both works may be applied, after completion, for CP. Connection of the hydropower plant Gabčíkovo to the electric /power/ network will be realized on the basis of negotiations held in Piešťany on 2.-4.X.1973
Design of the line of long-distance transmission from the Dunakiliti project seems to be partly applicable, with regard to the voltage the designed 35 kV lines as well as assumed kV lines present a real possibility.

3.3/24 Dunakiliti-Hrušov project, damming of the old Danube channel — VIZITERV Fékné — 1964 D

Content - Consultation on channel damming up in four alternatives, first of all with regard to the construction period. Two alternatives use for damming up quarry stone and gravel-sands, and two alternative apply prefabricated concrete panels and gravel sand. For both of those alternatives two variants of arrangement were worked out:
In the first arrangement, a supporting dam of stone and concrete will be constructed on the original side, for protection of the gravel-sand dam body.
In the second arrangement the stone, or concrete damming up is located on the upstream face. In this case the hell of the gravel-sand dam is ensured by smaller stone dyke, constructed on the original side in two stages.

Evaluation
Results may be used as auxiliary material for CP. Conclusions must be examined with regard to construction period and required machinery.

3.3/25 Dunakiliti-Hrušov weir.Supplement to investment task — VIZITERV, Marko, 1966, A

Content - Answers to comments regarding the investment task of 1964, supplements.

Evaluation

Project may be used in full extent for CP.

3.3/26 Approach road to Dunakiliti project — UVATERV, Fogarassy, 1965, D

Content - The approach road will serve for two purposes. In the course of construction of the hydropower project building material will be transported, arriving by railway to the Mosonmagyaróvár station, and from there on this road to the community Dunakiliti and to the construction sited. After completion of this project it will be an approach road to the weir.

Evaluation

Study may be helpful for CP.

3.3/27 Bridges in floodplain constructed on the approach road to Dunakiliti — UVATERV, Papp, 1965, D

Content - Bridges are of temporary character and are built with regard to flood water diversion over the construction. Dimensions of continuous bridge sections: 3x200 m. Examined alternatives:

- steel construction with truss
- steel construction with plate girder
- definite reinforced-concrete bridge

Evaluation

The study may be helpful for CP.

3.3/28 Hrušov-Dunakiliti weir. Investment task. Basic data. — VIZITERV, Zsilák, 1967, A

Content - Project documentation on the level of investment task includes design of the building part, project of steel construction, of machinery and electric facililties.

Evaluation

Documentation may be used in full extent for CP.

3.4 HEADWATER CANAL

3.4/1 The G/N Project, headwater canal, construction material — Bratislava Žakovský 1964 C

Content - Assessment of the searching survey of sealing clays and gravel-sands for the dykes and concretes of C_2 category.

Evaluation

After completion, the resutls may be used for CP. In potential deposits it is required to perform survey and computations on stores of C_1 category.

3.4/2 The G/N Project, bypass canal for hydroelectric power plant Gabčíkovo — IGHP Bratislava Sladký+col. 1965 C

Content - Thickness and position of surface sedimetns had been investigated by means of manual prospect holes in a network 50 x 50 m, in the section 16,9 - 18,5 km. Another section of the headwater canal was surveyed by means of a network, in which the profiles spacing was 100 m and respective ing was 100 m and respective bore holes 75 m. The spacing of profiles in the tailrace was 100 m. In each profile there are 6 bore holes, axial, in slopes, below dumping grounds and in the site of the drainage canal. Character and deposition condition of subsoil gravel-sand sediments were verified by means of engineering-geological and hydrogeological bores, situated in the route of headwater canal in 1 000 m distance, 5 bores being in one profile. Axial bores are 20 - 30 m deep, below dams 50 - 60 m deep.

The profiles of engineering-geological and hydrogeological bore holes in the route of tailwater canal are situated in a distance of 500 m. In respective profiles are 3 - 5 bore holes, 20 - 25 m deep. Axial bores in headwater and tailwater canals are hydrogeological.

Evaluation

After completion, the results may be used for CP.

3.4/3 Concrete sealing of headwater canals and the methods of lining — VÁHOSTAV Žilina, Tamchyna Rozprávka 1964 B

Content - Summary of knowledge and experience with concrete sealing of headwater canals on the Váh river. During canal construction the working processes were improved, accelerated, and the concreting itself underwent several-year development. Also applied machines were improved.

Evaluation

The study may be partly used for CP.

3.4/4 Bituminous sealing of bypass canal bottom. Experiment — Road development Brno, Meluzín 1964 B

Content - Orientation report involving research methods, calculations and estimation of labor with regard to other potential technologies.

Preliminary laboratory study of bituminous-concrete sealing of the bottom /bed/ was performed.

Evaluation

Research results may be partly used for CP.

3.4/5 Estimation of main variants of dyke construction with regard to used material, seismicity, piping and tectonics. /Construction of dykes for upper and lower reservoir/ — CZAV-Institute of theoretical and applied mechanics, Prague — Havlíček — 1965 — A

Content - Characteristics of applied soils
- Design of dykes /stability of dykes subsoil, threat of piping/
- Safety of designed dykes
  properties of soils
  effect of water, infiltrating through dykes subsoil
  effect of eartquake

Computed safety degree did not drop in this case below 1,2.

Evaluation

Research results may be used in full extent for CP.

3.4/6 Installation of reverse filters on interfaces between materials with low and high permeability in earth dams — VÚVH-VUT Brno — Čištín — 1965 — B

Content - Theoretical and experimental works carried out for verification of the requirements and compositon of inverted filters in dykes and on the headwater canal bed.
- Analysis of potential occurence of respective types of piping, to be considered in canal designing, namely the internal piping of gravel-sands, contact piping, and washing out on the contact with soil of different grain-size. It was proved, that gravel-sands are piping materials.
- Determination of critical resistance gradients for various samples of gravel-sands.
  Stability of the contact of sealing soils with gravel-sand material, specification of the demand to apply filters.

Evaluation

Research results may be partly used for CP.

3.4/7 Construction of the dykes of the G/N Project — VÚIS Bratislava — Mach — 1965 — B

Content - Selection of materials
- Compactibility of cohesive materials with special emphasis on high initial soil humidities
- Control of the degree of compaction, of volume mass and soil humidity by means of advanced methods /e.g. radioisotopes, deformation module/
- Assessment of permeability coefficients
- Determination of seepage for the solution of dykes stability and for canals and drains designings
- Development of equipment, instrumentation, and testing facilities for the solution of the task.

Evaluation

Research results may be partly used for CP.

3.4/8 Construction of the dykes of the G/N Project Construction and technology — SVŠT Bratislava — Peter — 1965 — B

Content - Estimation of 10 alternatives of dyke designing of the headwater canal with regard to construction, 13 alternatives

with regard to technology. Besides, the dykes were estimated also from other points of view: static safety, functional and operational safety, costs, power consumption, mass, man-hours.
The dyke stability at seismicity of the territory 6-7° MCS is sufficient. Deformation will occur during the construction, there is no danger of sealing failure.
Elevation of dykes by 2 m is adequate also with regard to seismic effects.
According to complex evaluation there are following priorities of economy:
1. dykes with concrete sealing
2. dykes with bituminous coating
3. dykes with wide clayey sealing

Evaluation
Research results may be partly used for CP.

3.4/9 Construction of the G/N dykes estimation of technological procedures with regard to existing machinery — IPS Engineering and industrial structutres Prague, Suva, 1965, D

Content - Estimation of technological procedures (filling and compacting/ and of machines for three headwater canal sections
- Estimation of technological procedures for tailwater canal
- Peak demand of machinery
- Average utilization-exploitation of designed equipment
- Total demand of machinery

Evaluation
Study may be helpful for CP.

3.4/10 Construction of the G/N dykes. Method of extraction, pouring and consolidation with regard to envisaged machinery — VÚPS Praha, Rataj, Florián, 1965, C

Content - Methods of earthwork execution on headwater and tailwater canal
- Comments to machinery application
- Application of respective types of machines
- Construction and modernization of machines
- Organization of machines operation
- Analysis of possiblities to apply machines of domestic production or from abroad

Selected machine sets will provide required outputs and managing of works in stated terms.

Evaluation
After completion, the results may be used for CP. The results must be verified according to the recent development in machinery.

3.4/11 Technology of headwater canal construction. Transport band — HDP Bratislava, Kotala, 1965, B

Content - Technological procedures of headwater canal construction to the hydropower plant Gabčíkovo. Decisive factor for dykes building is continuous loading, transport, deposition of gravel-sands excavation 1500 m3/h. The transport is solved by means of conveyer belts, situated at the dyke hell, and being continuously supplied from the storage site. The

proper filling of the dyke made of gravel-sand is executed by 4 dumping machines, spreading of poured material before compacting is done by buldozers. Thus a compensation of surplus material on tailwater canal with the lack of gravel-sand for headwater canal dykes occurrs.
Canal bed construction is designed using scrapers, which utilize local materials for sealing layer. Construction of dykes and bed is harmonized with works on headwater canal. The suggested solution may be realized under following assumptions:

a/ The equipment will be delivered by one producer, who will also provide the necessary service over the whole period of canal construction

b/ The future utilization of the whole transportation equipment will be solved.

Evaluation

Study may be partly used for CP.

3.4/12 Effect of wave movement on bituminous lining of earth dams — VÚVH Praha, Vlček 1963 — B

Content - Research of bituminous-concrete samples showed a good resistance of bituminous-concrete mixtures against mechanical deterioration caused by water waves impacts. All samples were not damaged by more than 10 000 hours of testing. Application of machine compacting on large areas of sealing provides a perfect protection and sealing of upstream dam faces. Samples made of natural gravel-sand mixtures have somewhat lower resistance as compared with samples of crushed material. Similarly a relatively lower resistance show samples with lower bitumen content.

Evaluation

Results will be partly used for CP.

3.4/13	Sealing of headwater canal bottom of hydropower project Gabčíkovo. Sealing with soils	VÚIS Bratislava Mach	1966	C
	a/ Report on resluts of mechanical stabilization of a large-scale consolidation experiment, Podunajské Biskupice	TSÚS/Technical testing building Institute-Polák	1966	D
	b/ Field experiment of headwater canal bottom sealing /project	HDP Bratislava Schulz	1965	E
	c/ Field assessment of stability of consolidated earth against contact piping	GHP Bratislava Tichý	1966	D
	d/ Sealing of headwater canal bottom of hydropower plant Gabčíkovo	HYDROSTAV Bratislava Huječek	1966	D
	e/ Sealing of headwater canal bottom of hydropower plant Gabčíkovo.Largescale experiment.	VUIS Bratislava	1966	D

Content - Within the scope of the research task, the possibility to utilize natural surface layers in the route of the headwater canal, after their compacting, as sealing element was investigated.
3 types of soils were selected from cohesive earths - on the basis of engineering-geological survey - as representative: clay, clay-loam and sandy clay. Tested soils may be used for canal sealing when prescribed technology is kept.

Laboratory results were verified in field experiments /not in the canal route/. Results are presented in separate reports, worked out by cooperating organizations /a-e/.

Evaluation

After comlpetion, the complex report may be used for CP.

3.4/14 Study of drainage of headwater canal HDP Bratislava bottom Schulz, Mach 1966 C

Content - For the smooth, undisturbed course of construction works should be provided, that also at the Danube discharge of 5000 m3/s a grounwater level in the canal axis should be about 2 m below the terrain, as to be able to build the canal bed in dry conditions. Ing. Hálek, CSc. worked out the methodology of computation in the works "Drainage of the area of bypass canal during the construction of the diversion alternative of the G/N Project" 1966. The elaborate, worked out by HYDROCONSULT, presents solution according to this methodology.

Evaluation

After completion, the study may be used for CP.

3.4/15 a/ Sealing of the headwater canal bed with stabilized soil, with a membrane, and bituminous concrete /brief conclusion of the task S-1-26-2/1-II/, 1966, VUIS Bratislava, Medelský

b/ Report on results of chemical stabilization in the field experiment at Podunajské Biskupice, 1966, TSÚS Bratislava, Polák

c/ Sealing of the headwater canal bed of the Gabčíkovo project 1966, Hydrostav Bratislava - Huječek

Content - Design of different sealing methods and their estimation:
- Stabilization of cohesive soils with lime and cement
- Stabilization of gravel-sands with bitumen by precoating with heat treating
- Soil stabilization by means of cold precoating
- Sealing with bituminous membrane
- Binary soil stabilization /cement + bitument admixture/
- Bituminous concrete
- Grouted gravel-sands
- Large-scale experiments at Gabčíkovo and Podunajské Biskupice

The mixture of gravel-sands and clay, stabilized with cement, as recommended as most suitable.

Evaluation

Research results may be used for CP.

3.4/16 Preparation of tripartite consultations on alternative technical solution of headwater canal HDP Bratislava Lokvenc, Schulz 1966 B

Content - Brief summary of results of research tasks from various research institutes, study and design works of HYDROPROJEKT Bratislava.

Evaluation

The material may be partly used for CP.

3.4/17 Monitoring of changes during filling and emptying of the canal Trenčianske Biskupice - Piešťany — SVŠT Bratislava, Peter, Urban, Hulla — 1966 — B

Content - Workers of the Slovak Technical University - Department of Geotechnics, Bratislava, carried out measurements and monitoring on the cascade of river power projects on the Váh river downstream of Trenčín over September - November 1966:
- observation of groundwaters nearby the canal
- stability changes and deformations of the territory
- assessment of all visible faults and failures on canals
- assessment of outflows
- cracks and fissures in concrete sealing
- deposits in canals
- special measurements of cracks and fissures permeability, of water-tightness of concretes on the bottom and slopes, of water motion, using radioactive isotopes.

Evaluation

Research results may be partly used for CP.

3.4/18 Anchoring layer in the headwater canal of hydropower plant Gabčíkovo — HDP Bratislava, Martinický — 1965 — A

Content - On the basis of experiments performed in West Germany it was stated, that it was necessary to provide in the headwater canal a protective layer of gravel-sand /about 50 cm thick/, enabling anchorage of vessels, without disturbing the watertight subsoil.

Evaluation

Research results may be used in full extent for CP.

3.4/19 Investment task of 1967. Materials worked out by the CZ party. Headwater canal — HDP Bratislava, Schulz — 1967 — B

Content - Basic material worked out for headwater canal with discharge capacity 4000 m3/s, at mean cross-sectional velocity 1,0 m/s, while at peak operation the mean cross-sectional velocity 1,3 m/s will not be surpassed, and in case of passing of 10 year flood 1,5 m/s. In front of the hydropower plant the canal is extended as to abate the wave motion at operation, or at fall-out of electric energy.
The results obtained by the year 1967 are summarized in the materials:
- water level courses during peak and continuous operation
- course of maximum and minimum velocities at peak operation of the hydropower plant
- water level course at frequency regulation
- height of waves caused by wind and vessels
- seepage through the canal /through the dam and bed/
- assessment of the thickness of concrete sealing
- soilmechanic properties of cover soils

Evaluation

The project may be partly used for CP.

3.4/20 Headwater canal Gabčíkovo with bentonite sealing /lining/ | VIZITERV Gántiné | 1964 | A

Content - Two types of bed sealing are described. If the cover layer is thicker than 1 m, a mechanic stabiliazation 60 cm thick will be provided in two layers, with 50 cm thick gravel layer on the stabilized layer. If the cover layer is thinner than 1 m a bentonite-clayey rip-rap 40 cm thick with protective gravel layer 50 cm thick will be deposited on the above-described stabilization.
Ratio of bentonite and clay is 1:9.
Technology of working processes of construction works and mechanization, computation of dimensions and cost estimation are included in the project.

Evaluation
Project documentation may be used in full extent for CP.

3.4/21 Experiments with anchorage for assessment of a protective layer over navigation canals lining | Translation of an article | 1965 | D

Content - Navigation canal, designed between Bamberg and Nurnberg, was provided with sealing. Several experiments with anchorage showed the thickness of the cover layer /stone, gravel, sand/, which must be spread over the sealing layer, so that the anchoring vessels would not damage it. By means of experimental results significant saving of construction cost was attained.

Evaluation
Research results may be helpful for CP.

3.5 HYDROELECTRIC POWER PROJECT GABČÍKOVO

3.5/1 Engineering-geological survey of Gabčíkovo project — IGHP Bratislava, Kačník+col. — 1965 — C

Content - Engineering - geological survey dealt with the choice of the most suitable site for the construction of the hydropower plant Gabčíkovo on an area of about 2 x 2,5 km.

Evaluation

After completion, the results may be used for CP.

3.5/2 Hydroelectric power plant Gabčíkovo, Assessment of number and dimension of turbines — HDP Bratislava, Hraško — 1965 — B

Content - Substantiation of the height of power plant installed output, the most adequate type of turbine, dimensions of the runner of the turbine, and number of aggregates. Technical and economical estimation of this design.

Evaluation

Results of the study were used in drawing up of the investment task. These results may be partly used together with the new study "Study of 8 aggregates of the hydropower plant Gabčíkovo" from 1971.

3.5/3 Assessment and justification of optimum installed power plant capacity, production and number of equipment in hydroel.power plant Gabčíkovo — HDP Bratislava, Hraško, Schulz — 1966 — A

Content - Following issues were dealt with in the study:
- Assessment of the optimum elevation of backwater of the hydropower plant Gabčíkovo
- Operation of the hydropower plant Gabčíkovo in winter period and during flood events.

Study results were considered in working out of the investment task.

Evaluation

Research results may be used in full extent for CP.

3.5/4 Hydroel.power plant Gabčíkovo — VÚVH Bratislava, Gabriel, Sikora, Grund — 1966 — C

Content - Several alternative solutions of the lay out of functional structures of the Gabčíkovo project with connection to the headwater canal had been studied on hydraulic and aerodynamic models. The final design is based on the study of shock waves on the hydraulic model and on computations of continuous waves occurring at peak operation. Navigation conditions were studied on the hydraulic model of the original atlternative.

Evaluation

It is recommended to develop a model of the final design of the structure in the scale 1:70, as to solve the problem of navigation in winter regime, and bottom deformations at extreme operation conditions. Research results may be used, after completion, for CP.

3.5/5 Determination of navigation locks dimension in Gabčíkovo - Bypass alternative | VÚD Praha Kubec | 1966 | B

Content - Estimation of three alternatives of main dimensions of navigation locks, based on the agreed transportation intensity in 2000.
From the economic evaluation it folows, that it would be purposeful to construct a pair of navigation locks, having dimensions 260 x 34 m and 190 x 34 m respectively, with the possibiity to elongate the shorter navigation lock.

Evaluation
Results may be partly used for CP.

3.5/6 Optimum system of filling and evacuation of navigation locks at Gabčíkovo project and proposal of navigation of vessels and discharging of ice runs | VÚV Praha Doležal | 1966 | C

Content - Computation of navigation locks and results of the study of upper cutwater of the navigation lock at Gabčíkovo had been dealt with. Three types of navigaion locks computations are described, namely of simple navigation locks, of simple navigation lock with dual velocity of opening of bypasses closures, and of combined navigation locks. The experimental part dealt with the arrangement of the flowing to navigation locks, with segment gates and with ice floes discharging, and flood water passing through navigation lock.

Evaluation
After completion, the research results may be used for CP.

3.5/7 Foundation of hydropower plant on permeable subsoil. Symposium 16.-17.7.1964 | CZETSC | 1964 | D

Content - The national symposium attended by experts dealt with the problems of foundation of the Gabčíkovo project. Conclusions and recommendation had been considered in further study and research works.

Evaluation
Results may be helpful in CP.

3.5/8 Hydropower plant Gabčíkovo Foundation | HDP Bratislava Hraško | 1965 | A

Content - Suggestions for foundation of the hydropower plant and navigation locks of the Gačíkovo project, their combination and last but not least their economic comparison and evaluation with regard to realization. Following was considered:
- groundwater level dereasing,
- foundation by means of grouted vat,
- open caisson foundation,
- foundation by means of caissons,
- combinations: vat and water level decreasing
  at water level decreasing
- combinations: foundation on caissons
  at water level decreasing

As realizable and economically efficient was considered the foundation of the Gabčíkovo project in a vat with grouted bed and clayey-concrete walls in combination with groundwater level decreasing.

Evaluation

Research results may be used in full extent for CP.

3.5/9 Hydropower plant Gabčíkovo-power production — HDP Bratislava, Hraško — 1965 — B

Content - Computation of production of continuous and peak power of the hydropower plant Gabčíkovo, estimation of losses of energy production due to peaking.

Evaluation

Results may be partly used for CP.

3.5/10 Study of fall-out of hydroel.power plant Gabčíkovo — HDP Bratislava, Hraško — 1966 — B

Content - In case of an unexpected fall-out of the whole hydropower plant Gabčíkovo, which is not very likely, since the hydropower plants operates into two systems, a shock wave 1,5 m high would develop, which is not dangerous for the project, however it is not permissible for navigation. These shock waves could be prevented by

- idle outlets
- turbine coupling releasing.

When both methods are combined the waves would not surpass 50 cm, what is acceptalbe also for navigation. Similarly it is possible to provide permissible navigation conditions only by means of released coupling.

Evaluation

Research results may be partly used for CP.

3.5/11 Monitoring of rise time velocity in hydropower plant Gabčíkovo — HDP Bratislava, Hraško — 1966 — A

Content - The study deals with:

- solution of hydraulic problems at various steepness of rise time of the hydropower plant,
- estimation of the rise time with regard to the safety of the structures of the hydropower plant, continuity of operation and navigation.

Rise times 5, 10, 20, 30 and 60 minutes were tested.

Evaluation

Research results may be used in full extent for CP.

3.5/12 Investigation of possible frequency regulation on hydropower plant Gabčíkovo — HDP Bratislava, Hraško — 1966 — A

Content - Summary of research results, experiments and theoretical investigation about possibilities to regulate the frequency and the delivered output from the hydropower plant Gabčíkovo in the range 10% of installed output according to the requirements of Czechoslovak energetics. Experiments with regulation of frequency at the hydropower plant Madunice, theoretical computations of hydraulic phenomena, occuring at frequency regulation and their estimation with regard to safety, continuity and safety of navigation showed, that utilization of the hydropower plant Gabčíkovo for regulation of the delivered output at peak operation is permissible.

Evaluation

Research results may be used in full extent for CP.

3.5/13 Results of experimental grouting of gravel-sand deposits and dredging of uncased trenches in the site of designed hydropower plant Gabčíkovo — IGHP Brno, Verfel, Láníček — 1966 — A

Content - Study, carried out on the basis of laboratory experiments and pilot plant tests proved, that it was possible to construct a water-tight vat for foundation of the Gabčíkovo project.
The bed of the vat will be realized by grouting, vertical walls of the vat by grouting or by construction of underground walls.
For drilling fluid preparation may be used clay from the locality Stupava. Specified values of permeability coefficient are adequeate at vertical grouting $k = 2 - 3 \times 10^{-7}$ m/s and for underground wall $k = 2 - 4 \times 10^{-8}$ m/s

Evaluation

Research results may be used in full extent for CP.

3.5/14 Results of experimental grouting of gravel-sand deposits and dredging uncased trenches in the site of designed hydropower plant Gabčíkovo. Supplement: Pumping experiments — IGHP Brno, Verfel — 1967 — D

Content - Evaluation of pumping tests, carried out in terrain in the area of Gabčíkovo at the site of vertical grouting and underground wall.
Pumping tests proved, that

- even in case of water level decreasing by more than 20 m no washing out of material occurred, neither in the site of vertical grouting, nor in the area of underground walls,
- the permeability in the area of vertical grouting decreased from $2 - 3 \times 10^{-3}$ m/s to $1,4 \times 10^{-6}$ m/s,
- underground walls have very low permability. In the first stage $k = 2 - 4 \times 10^{-8}$ m/s, after nine months $k = 9 \times 10^{-9}$ m/s. Pumping tests lasting almost one year confirmed, that construction of a vat for foundation of the Gabčíkovo project is realizable.

Evaluation

Research results may be used as subsidiary material for CP.

3.5/15 Data for hydropower plant Gabčíkovo design-foundation — VÚIS Bratislava, Plch — 1964 — B

Content - 1. Experimental solution and technology of groundwater level decreasing as one of the alternatives of foundation of the structures of Gabčíkovo project by means of surface pumping from an experimental construction pit, by means of deep drainage using drilled wells.

2. Ramming of sheet piles

- Larsen IV. n to a depth of 18 to 22 m

- Ramming engine DELMAC D-22 /suitable/
- Vibratory pile-driver /not suitable/

3. Composition of clayey-cement concretes. From tested mixtures neither was proved as adequte.

Evaluation

Research resutls may be partly used for CP.

3.5/16 Data for design of hydropower plant Gabčíkovo foundation. Forming of vat walls and bottom by grouting, or eventually by trenching — HYDROSTAV Bratislava, Hartel, IGHP Brno, Verfel — 1964 A

Content - The research task dealt with
- areal grouting of the vat bottom for foundation of the Gabčíkovo project
- vertical underground walls by means of vertical grouting,
- or by means of clayey-concrete screen in trenches, dug by means of consistent drilling fluid.

Results:
- the vat bottom is sufficiently stable and impermeable
- clays from Stupava are suitable for dense fluid drilling
- design of machinery for sheet piles ramming
- design of equipment for mixture production and for grouting
- for vertical walls, the underground clayey-concrete screen, created by the dense fluid drilling in the trench, is more adequate,
- vertical grouting is less adequate and less safe.

Evaluation

Research resutls may be used in full extent for CP.

3.5/17 Data for design of hydropower plant Gabčíkovo foundation. Distribution of casings by means of vibro-ramming engine /pile driver/ VUPS 20/11 — HYDROSTAV Bratislava, Balko — 1964 D

Content - Vibratory pile-driver is suited for ramming of sheet piles to the depth 50 - 55 m.
- Results obtained during investigation of sheet piles ramming using vibratory pile driver VÚPS 20/11.
- For pulling out of sheet piles a crane with a crane hook having a power at least 80 - 100 Mp is recommended, as to be able to take out the sheet piles quickly.
- Construction details of sheet piles.
- Velocity of /drilling/ ramming: about 3 sheet piles to a depth of 55 m over 24 hours at three-shift operation.

Evaluation

Research results may be helpful for CP.

3.5/18 Proposal of composition of concrete mixtures for construction of hydro-power plant and navigation lock Gabčíkovo — VÚIS Bratislava, Žigrai, Hornič — 1964-I.stage B, 1965-II.stage

Content - Ist stage:
- Petrographic analysis of gravel-sands from localities nearby the construction pit of the Gabčíkovo project /gravel pit of the Unified agricultural farm, the Danube channel, excavated probe KS III, drilled probe VK-133/.

- Determination of the volume coefficient and specific weight of gravel fractions grains.
- Characteristics of gravel-sands /grain-size distribution, clay content, absorption capacity, etc./
- Grain size distribution of gravel-sands in various depths along the route of the tailwater.
- Characteristics of applied cement.
- Tests of concrete, analysis of test results, suggestion of the composition of mixture for respective types of concrete, suggestion of grain size distribution of aggregates, and allowable limits of grain size distribution.

IInd stage:
More thorough knowledge on aggregate properties in areas, which could be considered as sources of extraction /from the pit excavation for grouting experiment, from drilled probes close to the construction pit, from drilled probes in the locality of the material pit in km 9,0 of the headwater canal/. Within the scope of the task also tests and proposals of concretes, resistant to abrasion, were performed.

Evaluation
Research results may be partly used for CP.

3.5/19 Study of the G/N-foundation of structures on the basis of pumping large-scale experiments — VÚIS Bratislava, Gregor; VUT-VVÚVHS Brno, Hálek — 1966 — B

Content - Pumping experiment at Gabčíkovo
- Experimental solution of the effect of areal layout of peat interlayer /on globular model/
- Experimental solution of groundwater level decreasing /on earth model/
- Technological and mechanical study
- Processing and evaluation of results of experiments performed in terrain and on models.

Groundwater level decreasing for foundation of the hydropower plant Gabčíkovo is in principle possible. The range of decreasing depends upon the pumping system capacity and location of pressure horizons. Due to complicated geological conditions it is not recommended to consider the lifting force decreasing at the sealing vat bottom due to water level dereasing. A more detailed survey of geological conditions will be required for the combination of the vat and water level decreasing /peat layers and pressure horizons/.

Evaluation
Research results may be partly used for CP.

3.5/20 Hydropower plant Gabčíkovo-Layout solution of the project and adjacent canal sections — HDP Bratislava, Hraško, Šebele — 1965 — C

Content - Solution of adjacent canal sections: prismatic canal with concrete sealing, non-prismatic canal with extended section in front of the hydropower plant with concrete sealing.
- Canal designed within the investment task: with concrete or clayey sealing.
- Alternative solution of the layout of the project and adjacent sections of the canal /5 alternatives/, and estimation with regard to peak operation, considering the potential fall-outs of the hydropower plant.
- Preliminary design of the layout of the project and adjacent

canal sections with extension to 650 m.

Evaluation

Results of this study were applied for elaboration of the investment task, and therefore only data from 1967 will be used for CP. Further research works will deal with the final width of the headwater canal in front of the power plant, the arrangement and layout of the adjacent section of the tailwater and lower lock headwaters. After completion, the results of the study may be used for CP.

3.5/21 Hydropower plant Gabčíkovo and idle outlets — HDP Bratislava, Hraško Jaroševič, Goljer, 1965, B

Content - Anlysis of the problems of idle outlets with regard to their main functions:

a/ moderation of the unfavourable effect of hydropower plant falling-out

b/ discharging of ice floes and ice slush

c/ flood water passing

- Constructional designing:

a/ hydropower plant without bypasses /with water resistance/, with lower bypasses, with upper bypasses.

b/ idle outlets outside the hydropower plant blocks, or between the blocks of the hydropower plant.

Evaluation

Results of the study are included in the investment task from 1967. They may be partly used for CP.

3.5/22 Hydropower plant Gabčíkovo-Study of construction solution of navigation locks — HDP Bratislava, Šebele, 1965, C

Content - Description of respective variants of the constructional design. Various types are divided into four basic groups.

I. reinforced concrete structure of half-frame type /two variants/

II. type I.with modified hydraulic system /3 variants/

III. construction with bottom dilatated from side walls /10 variants/

IV. special construction types /2 variants/

- Evaluation of variants with regard to organization of works and technology /earth works and foundation, concreting works/,
- economical estimation.

Evaluation

After completion the results of the study may be used for CP.

3.5/23 Investment task of 1957. Materials worked out by CZ party, Gabčíkovo project — HDP Bratislava, Hraško, 1967, B

Content - Basic data of the investment task from 1967 include design of the hydropower project in 17,6 km of the canal stationing at Gabčíkovo village.

The project consists of the hydropower plant with installed power output 700 MW will operate chiefly as peak operation and at higher flow rates also continuously. Two navigation locks are situated on the left side of the hydropower plant,

having dimensions 34 x 260 m. The basic data include namely:
- determination of the optimum backwater elevation, of installed capacity, providing of output at different discharges, limitation of coutput during winter period and flood events,
- evidence of the possibility of frequency regulation and automatic water passing at falling-out of the hydropower plant,
- navigation conditions at navigation discharges and various conditions of the hydropower plant operation,
- foundation, construction pit, filtration and piping,
- prefabrication

The study includes evaluation of research and survey works carried out by 1967.

Evaluation

Project may be partly used for CP.

3.5/24 Hydropower plant Gabčíkovo-Construction site equipment and building procedures — HDP Bratislava, Kotala, 1965, B

Content - Project study dealing with the layout of the main construction yard of the hydropower plant Gabčíkovo and the output of main structures of the construction site equipment. Simultaneously the main mechanization equipment for concreting, and assembly /installation/ works of the respective structures are described.

Evaluation

With regard to the elapsed time and new schedule of works it will be necessary:

1. To control and test the required outputs of concreting and installation works at the structures of the hydropower plant and navigation locks and to design also required structures of construction site equipment. With regard to rather difficult production of drilling fluid, and to construction of sealing vats it will be necessary to modify the design with regard to the recent development.
2. Attention should be focused on caterpillar cranes. The study may be partly used for CP.

3.5/25 Investigation on 8 engine-pump sets of hydropower plant Gabčíkovo — HYCO Bratislava, Schulz, Hraško, 1971, B

Content - The original study with 9 turbines was based on the production capacities of the firm ČKD Blansko in 1965 /runner dimension 8 m/. The new study with 8 turbines is based on new production possibilities of ČKD Blansko /runner dimension 8,50 m/.
The study with 8 turbines is advantegeous with respect to power transmission between ČSSR and Hungary, and cost saving for foundation /smaller construction ptis/.

Evaluation

Research results may be partly used for CP together with the study of the alternative with 9 turbines.

3.5/26 Optimum dimensions and shapes of spiral casings for turbines of the hydroel.power plant Gabčíkovo — VÚVH Bratislava, Žajdlík, 1965, C

Content - Investigation were carried out in three stages on an aerodynamic model. The first stage solved the dependence of hydraulic losses on the spiral dimensions. The second stage examined the effect of the spiral shape and tail skid location on discharge distribution and on the velocity field on the perimeter of the distributor inlet. In the last stage the pressure distribution along the spiral perimeter was measured using the spiral type B = 2,81 D.

Evaluation

The study of the shape of hydraulic turbine profile continues. The complex of issues connected with the hydropower plant is to be completed by the study of the arrangement of inlets and outlets of bypasses /idle outlets/ in turbine blocks, and by investigation of hydraulic phenomena, occurring in the turbine block at abrupt closing of the suction pipe, or inflow at released coupling between guide and runner blades. After supplementation the research results may be used for CP.

3.5/27	Development of construction of the hydroaggregate for hydropower plant Gabčíkovo	ČKD Blansko Bím	1966	B

Content - The research task consists of following sub-taks:
- Development of the equipment for pressure tests of runner blade pins
- Development of the sealing of turbine guide blades
- Development of the technology of main turbine units
- Development of the construction of control turbine units
- Tensiometric and deformation measurements of the model of the upper blade circuit and turbine cover
- Casting of runner blade
- Computation of the cover

Evaluation

Research results may be partly used for CP.

3.5/28	Model tests in water for acceptance of the turbine block 4-H-69 and assessment of its effect on efficiency	ČKD Blansko Vitvar	1966	B

Content - Model measurements of a turbine block /inlet with damming grooves, spiral, suction pipe with damming grooves and idle outlet/. Efficiency measurements were processed as a characteristics, according to which the turbine for the Gabčíkovo project was designed.

Evaluation

Research results may be partly used for CP. At present new model studoes and measurements are carried out by the producer.

3.5/29	Effect of spiral width variation and shortening of suction piping conus 4-K-69 on the course of efficiency and cavitation	ČKD Blansko Vitvar	1966	D

Content - Testing of two types of spirals with equal width, but different tail skid turning, and verification of the cavitation coefficient of the model turbine 4-K-69 with angular suction pipe.

Evaluation

On the basis of this research task the spiral type and suction pipe type were selected for the investment task.

Research results may be helpful for CP.

3.5/30 Effect of idle outlet and turbine penstock 4-K-69 on efficiency course — ČKD Blansko, Vitvar — 1966 — A

Content - Testing of the idle outlet located in the spiral inlet, and of the idle outlet located in the spiral wall.
Suggested location and solution of the coutlet have no effect on the turbine efficiency.

Evaluation

Conclusions of the research task were applied for designing of the idle outlet in the turbine block. Research results may be used in full extent for CP.

3.5/31 Long-term turbine run 4-K-69 at loose linkage of guide wheel and runner — ČKD Blansko, Rempášek — 1966 — C

Content - Testing and verification of idle water passing through Kaplan turbine at released coupling between the runner and guide wheel in case of failure and hydroaggregate cut off. Results of measurements carried out at the hydropower plants Považská Bystrica and Hričov.
The work was focused on assessment of the range of pressure pulsation in the area of turbine and suction pipes, or eventually on assessment of discharge and revolutions, of the effect of throttling of the outflov profile of the suction pipe. Finally measures are presented, which should be considered in aggregate dimensioning, as well as additional new measurements or verification which are to be realized.

Evaluation

Research results may be used for CP after supplementation

3.5/32 Development of throttle control in turbine suction piping — ČKD Blansko, Prachář — 1966 — C

Content - suggestion and solution of the throttle valve for the suction pipe of turbine for utilization of water passing through turbine at released coupling of guide and runner blades.

Evaluation

After supplementing the research results may be used for CP.

3.5/33 Research and development of a progressive solution of technological part for investment task of the G/N - Project Hydropower plants Gabčíkovo, Vojka and Čičov — ČKD Blansko, Vitvar — 1966 — B

Content - The research task dealt with the determination of turbine dimensions, the efficiency and cavitation properties and assumptions for more efficient construction and water power utilization.

Evaluation

Results may be partly used for CP.

3.5/34 Study of pure compensation operation HDP Bratislava
and determination of apparent gene- Gardián 1966 D
rators output

Content - Possibilities of pure compensation operation of hydroaggregates of the hydropower plant Gabčíkovo have been dealt with from technical point of view, and comparison with other compensation method. Conclusion is, that the pneumatic method of compensation operation is not recommended for the Gabčíkovo project.

Evaluation

Research results may be helpful for CP.

3.5/35 Investment task G/N Project.Gabčíkovo HDP Bratislava
project-machinery-hydraulic part Kaufmann 1967 B

Content - Solution of the Gabčíkovo project with 9 hydroaggregates p_i = 700 MW, with idle outlets in turbine blocks. Conceptual sollution in main cross-sections, technical specification of machinery, estimation of weight, cost, prices and finaly a technical report is presented.

Evaluation

Study may be partly used for CP together with the study of the alternative with 8 turbines.
For elaboration of the study tenders and technical data of main contractors ČKD Blansko and Škoda Plzeň were applied.

3.5/36 The G/N Project. Supplement to HYCO Bratislava
the project task. Study on 8 units Chmel 1966 C
of hydroel. power plant Gabčíkovo.
Machinery-hydraulic part

Content - solution of machinery-hydraulic part of the hydropower plant Gabčíkovo with 8 hydroaggregates, and turbine runner diameter 8500 mm.
Enclosed to the study are drawings, technical specifications, budget, and technical report.
It is stated, that the solution with 8 hydroaggregates is definitely most adequate.

Evaluation

After supplementation the results may be used for CP.

3.5/37 Design of the basic scheme of the HDP Bratislava
hydropower plant Gabčíkovo Kedrovič 1966 D

Content - Design of the basic scheme of the hydropower plant connection for given parameters and for 9 hydroalternators. Switching station 220 kV with 6 cable outlets is designed with two systems of connections and auxiliary connections. 4 machines are connected to each half, the ninth machine may be connected to optional side of the switching station. The own consumption is provided from the distribution networks of both countries. Layout of main electrotechnical facilities is also presented in the study.

Evaluation

With respect to a new method of output carrying of the hydropower plant Gabčíkovo /400 - 110 - 120 kN/ is this design of the basic scheme groundless. Though, the study may be helpful for CP.

3.6 TAILWATER CANAL

3.6/1 Overall arrangement of tailwater canal discharging from hydropower plant Gabčíkovo into the Danube — VÚVH Bratislava, Štich, Sumbal — 1964 — A

Content - Examination of the correctness of direction linkage of the canal to the river channel, influence of various methods of height linkage on head losses. Optimum slope of transition sill, sections of the bank exposed to increased stress of flowing water had been assessed by the study. Areas of streaming separation from the /river/ banks were identified and required measures were suggested. Distribution of velocity in the area of the outled at operation discharge was determined with regard to navigation requirement.

Evaluation

Research results may be used in full extent for CP.

3.6/2 Protection of slopes of the tailwater canal — HDP Bratislava, Šoltés — 1965 — A

Content - Description of the tailwater canal
- Construction process
- Geological conditions
- Operation conditions
- Estimation of effects influencing outlet canal slopes: waves caused by wind, waves caused by vessels, effect of hydropower plant peak operation, static effect of ice, dynamic effect of ice, other impacts.
- design of protection: rip-rap of ungraded stone, rip-rap of graded stone, concrete plates mat.
- estimation of suggested protection alternatives. Finally it is stated tht the alternative of protection with rip-rap in two layers /lower one as filter, and upper one as protection/ is considered as most adequate.

Evaluation

Research results may be used in full extent for CP.

3.6/3 Protection /lining/ of slopes of the tailwater canal from the hydropower plant Gabčíkovo — ČVUT Praha, Votruba — 1965 — A

Content - As less expensive slope fortification of the tailwater canal is recommended in this research report a rip-rap of rubble, as compared with concrete mats.

Evaluation

Research results may be used in full extent for CP.

3.6/4 Protection of banks of the tailwater canal of hydropower plant Gabčíkovo — ČVUT-Hydraulics, Votruba; HYDROSTAV Huječek

Content - Consideration of various types of fortification:
- stone rip-rap
- concrete prefabricates joined into a mat
- fortification applying bitumen

The choice of fortification types was governed by the standpoint to be taken into consideration, that it would be necessary to

- carry out construction under water in a considerable depth
- to work under difficult operation conditions
- to provide highest safety of operation.

Recommended type of protection - rip-rap of ungraded stone - is less expensive than concrete mats, realization is more simple, more durable, less sensitive against damages, the repair and maintenace being easy. The results should have been verified with field experiments, /HYDROSTAV/, however the disastrous flood in 1965 prevented realizaton of those experiments.

Evaluation

The study may be used in full extent for CP.

3.6/5	Investment task of 1967. Materials worked out by CZ part. Tailwater canal	HDP Bratislava Schulz	1967	B

Content - Materials and data worked out for the tailwater canal discharge capacity 4000 m3/s, at mean profile water velocity 1,0 m/s. At peak operation, water velocity does not exceed 1,2 m/s, in case of maximum flood 1,5 m/s.

Following data are summarized in this investment task:
- natural conditions of the construction of tailwater canal
- geological condition in the canal route
- data on earth materials and on climatic conditions
- construction design of the canal
- hydraulic computations
- technological proceeding of the construction
- structures

Evaluation

The project may be partly used for CP.

3.7 CHANNEL DEEPENING DOWNSTREAM OF PALKOVIČOVO

3.7/1	Extent of deepening of the Danube section downstream of Palkovičovo Study	HDP Bratislava Schulz	1966	A

Content - Investigation of the optimum extent of the Danube deepening and its energetic-economic effect, further the issue had been dealt with, whether the deepening 1,7 m, assessed for steady flow, is the most effective also for non-steady flow /at peak operation of the Gabčíkovo project/. Deepening alternatives 1 m, 2,25 m and 2,5 m were investigated. Technical-economical computations showed, that deepening 1,7 m was the most effective also for non-steady water flow.

Evaluation

Research results may be used in full extent for CP.

3.7/2	Estimation of optimum way and extent of the Danube channel deepening, investigation of deepened channel stability	VÚVH Bratislava Pirkovský	1966	A

Content - The bedload and suspended load regime had been studied under current conditions and after the completion of the G/N Project, as well as bedload and suspended load regime in case of an uncomplete system, problems connected with the Danube channel deepening and flood water diversion.

Evaluation

Research results may be used in full extent for CP.

3.7/3	Calculation of water level course in the dredged Danube section. Deepening 1,7 m	HDP Bratislava Schulz	1966	A

Content - Computation of water level course in the dredged Danube section was executed in the connection with longitudinal profile of water levels in the section Gönyü - Gabčíkovo.

Evaluation

Research results may be used in full extent for CP.

3.7/4	Written longitudinal water level profile in the section Gönyü-Gabčíkovo after dredging	HDP Schulz	1966	A

Content - Written longitudinal profile of water levels in the section of artificial Danube channel deepening from rkm 1 791,113 to rkm 17,590 for discharges /related to Nagymaros/: Q = 1000-2300-2780-5787-7650-8700-9000 and 10450 m3/s.

Evaluation

Research results may be used in full extent for CP.

3.7/5	Investment task from 1967 Data worked out by the ČS party The Danube channel deepening downstream the tailwater canal mouthing	HDP Schulz	1967	B

Content - Downstream of the tailrace canal mouth in the section from rkm 1811 to rkm 1791 channel deepening was proposed in such a way, that water level decreasing 1,7 m at a discharge of 4000 m3/s would be attained downstream of the hydropower plant Gabčíkovo. The material includes hydraulic computations, technical solutions, design of technological procedures, and evaluation of the research in this field, carried out up to the present /S-1-13-1/26/.

Evaluation

The project may be partly used for CP.

4. ESTIMATION OF PREPARATORY WORKS FORTHE HYDROPOWER PROJECT NAGYMAROS

4.1 GENERAL PART

4.1/1 Data for determination of weir sluice number and dyke safety. Hydroel.power project Nagymaros — HDP Bratislava, Velič — 1966 — B

Content - Summary of data consisting of abstracts from studies worked out by VIZITERV and HDP, and abstracts from articles in professional journals.

1. Abstract of the VIZITERV study /Dr. Mistéth/ "The safety degree of the river power projects on the Danube in case of flood water diversion applying the method of probability computation". As conclusion it is recommended to accept for main dimensions the risk 0,5 o/oo.
2. Abstract from the HMÚ publication of 1963, dealing with forecasting of flood water culmination in Bratislava, in dependence upon water stages change at Schwarzholz.
3. Abstract from the article, published in "Vizügyi Közlemények" in 1960, Annex 4 and 5. Some hydrologic issues of the Danube canalization. Improper manipulation may bring about flood water levels increasing by 30 - 50 cm. Prognosis of flood water in Budapest in dependence upon water lavel stages alterations and according to precipitation in Austria.
4. Translation of the article according to item 3.
5. Abstract from the HDP study No.6600/9.1 of 1965. Flood water passing and protective measures.

Evaluation

Study may be partly applied for CP.

4.1/2 Arrangement of prolongated sealing apron in front of dykes of the reservoir of the lower project — VUIS Bratislava, Mach — 1966 — B

4.1/3 Arrangement of prolongated sealing apron in front of reservoir dykes — HYDROSTAV Bratislava, Džadoň — 1966 — D

Content - In the first task the attention was focused on the behaviour of experimental soils, which shall have the function of the apron, and on their stability against piping on gravel-sand subsoil. Investigated subsoil gravel-sands should have the function of filter.

The second task includes the design of technology and complex mechanization of construction of the sealing apron, with regard to applied soils and climatic conditions.

Evaluation

The results may be partly used for CP.

4.1/4 Protected areas of Nagymaros reservoir — VIZITERV, Péczely, Póka, Kiss — 1966 — D

Content - a/ List of main works of protective measures in all areas on the Hungarian territory, affected by the Nagymaros backwater.

b/ Design of the area No.5 Komárom /worked out on the basis of investment task of 1964/.

c/ Schedule of works for the area No.7 Komárom - Gönyü /worked out on the basis of investment task of 1964/.

Above mentioned proposals were drawn up for working out of the proposal of investment cost division in 1967.

Evaluation

The project may be helpful for CP.

4.1/5 Proposal of cost distribution for protective measures. Hungarian regions — VIZITERV Péczely, Póka, Kiss 1967 D

Content - In the period from February 2.-10.1967 the principles of cost distribution for the G/N Project were processed and approved as joint and national investments /Protocol ONV - MLVH of 2.-10.II.1967. item III/.
This volume of projects includes proposal for cost distribution, worked out on the basis of approved principles and relates to following regions:
Section Visegrád - Domos, area Pilismarót, area Esztergom, section Nyergesújfalu - Dunaalmás, area Komárom, section Nagymaros - Ipoly, area Komárom - Gönyü - Nagybajcs, Dunakiliti-Hrušov reservoir.
Project includes cost distribution of respective structures in percentage, without forint value.

Evaluation

Project may be used as starting material for CP.

4.2 PROTECTIVE MEASURES ON CZECHOSLOVAK TERRITORY

4.2/1 Hydrogeological regime of groundwater. Hydroel.power project Nagymaros — HDP Bratislava, Velič — 1967 — B

Content - Abstract from the study of Dr. Dub "Assessment of changes in groundwater regime in the territory influenced by backwater of the Nagymaros project by means of balance method"
Respective parts include:
a/ development of balance equation and evaluation of the period 1955-56
b/ water balance changes after the backwater due to Nagymaros project
c/ balance in the form of tables /for the state before the construction in 1966-56 and after the G/N completion. Situation demonstrates areas of prevailing effect of respective members of balance equation.
Finally the requirement of repumping after construction is specified.

Evaluation
Results may be partly used for CP.

4.2/2 Investment task of 1967. Materials worked out by CZ party. Project of organization of construction. Nagymaros project — HDP Bratislava, Halaša — 1967 — D

Content - Materials describing designs of construction organization, of protective measures on the CZ territory, specification of the total demand of construction equipment, full cubic contents of main construction works and orientation schedule of construction.

Evaluation
Project may be helpful for CP.

4.2/3 Investment task of 1967. Materials worked out by CZ party. Relaying of roads — HDP Bratislava, Marek — 1967 — B

Content - Materials presenting designs for roads relaying in the section of the Nagymaros project:
State road Moča - Kravany - Čenkov
State road Kamenica - Chľaba
Municipal road Kolárovo - Topoľníky

Evaluation
Project may be partly used for CP.

4.2/4 Investment task of 1967. Materials worked out by CZ party. Connections 22 kV and pumping stations — HDP Bratislava, Kedrovič — 1967 — B

Content - Proposals for transmission lines and connections 22 kV to pumping stations, as well as designs and cost for electrotechnical part of pumping stations in the section of the Nagymaros project.

Evaluation
External transmission lines 22 kV were partly realized for new pumping stations M. Kosihy, Lándor and Štúrovo. Project may be partly used for CP after examination of

the actual state of realized transmission lines 22 kV and realized electritechnical equipment of new pumping stations.

4.2/S Investment task of 1967. Materials worked out by CZ party. Disposession of lands and buildings-Nagymaros — HDP Bratislava, Ľupták — 1967 — D

Content - Statement of occupied land especially for protected flood control territory and floodplain. Areas for permanent occupation and for temporary occupation were determined. Material was worked out for respective regions of protective measures on CZ territory in the section of Nagymaros project.

Evaluation
Project may be helpful for CP.

4.2.01/1 The Danube - Szalka. Chľaba — GP Praha, Lucek — 1965 — C

Content - Geological conditions in routes and localities of respective protective measures are estimated in the report.

Evaluation
After completion the results may be used for CP

4.2.01/2 Investment task of 1967. Materials worked out by CZ party. Region No.1-Lower Ipeľ River — HDP Bratislava, Lichý — 1967 — B

Content - Protection of the territory nearby the Ipeľ confluence with the Danube and in the reach Salka - Letkés, was dealt with. The design includes also protection of railway embankment in the section Chľaba - Kamenica.
The protection is realized by protection embankment - dykes, and seepage canals. Infiltrating water is repumped by means of pumping stations. In the section Salka - Letkés the Ipeľ channel adaptation is designed by means of a cutoff on the Hungarian territory.

Evaluation
Project may be partly used for CP. Changes may be expected in the seaction Salka - Letk=s. Within the scope of boundary rivers development adaptation of the old Ipeľ channel was considered without cutoff.

4.3.02/1 The Danube at Štúrovo — GP Praha, Lucek — 1964 — C

Content - The submitted report presents geological data on the level of a detailed survey for the area No.II.

Evaluation
Results of the survey may be used for CP.

4.2.02/2 Alterations in grounwater regime in the Štúrovo region — UK Bratislava, Duba — 1966 — A

Content - Groundwater regime had been evaluated on the basis of processed hydrogeological and hydrological data, obtained by means of survey and long-term observation.
The result of solution is the prognosis of groundwater levels. Groundwater level, after completion of the G/N Project construction will get stabilized in the region of average stages, with a lower fluctuation as experienced up to the present.

Evaluation
The investigation confirmed the good efficiency of the designed seepage and drainage system. Research results may be used in full extent for CP.

4.2.02/3 Investment task of 1967. Materials worked out by ČS party. Region No.2-Lower Hron River — DHP Bratislava, Goljer — 1967 — B

Content - Design for protection of the territory on both river banks at the Hron river confluence with the Danube, and of the adjacent Štúrovo region in the Danube section rkm 1716-1720. The protection includes reconstruction of existing flood plain dykes of the Danube and Hron, construction of seepage canals and covered drains, building of the pumping station Kamenica n/Hronom and extension of the new pumping station Štúrovo, which would repump internal and seepage waters.

Evaluation

Project may be partly used for CP.

4.2.03/1 III. Kravany region — GP Praha Lucek — 1964 — C

Content - Submitted report presents results of the survey works on the level of the detailed stage in III. region.

Evaluation

After completion, the results may be applied for CP.

4.2.03/2 Study of the regime and forecasting of groundwater regime after completion of the G/N Project in Kravany region — UK Bratislava, Duba — 1966 — A

Content - The task dealt with the groundwater regime on the basis of observation of groundwater levels changes, with theoretical analysis of data, obtained from the engineering-gelogical survey. The research results show, that groundwater level changes will ocur only in a narrow riverine zone, where decreasing of groundwater level fluctuation will take place. Protective measures were experimentally verified and some modifications suggested.

Evaluation

Research results may be used in full extent for CP.

4.2./03/3 Investment task of 1967. Materials worked out by CZ party. Kravany region No.3 — HDP Bratislava, Dinga — 1967 — B

Content - Design of protection of the territory along the Danube in the section rkm 1722,6 - 1746,0. Reconstruction of existing inundation levees of the Danube was designed, as well as construction of paralled seepage canals, building of pumping stations Obid and Čenkov for repumping of seepage and internal waters, and adaptation of existing canals Obid, Ebedfok and Marasks for divesion of internal and seepaged waters to new pumping stations.

Evaluation

The project may be partly used for CP. In designing dyke reconstruction the actual state of dykes, repaired after the flood in 1965, is to be considered.

4.2.04/1 The Danube - Iža region GP Praha, Lucek 1964 C

Content - The report presents results of survey works on the level of a detailed survey in IV. region for all structures according to the task.

Evaluation

After completion the results may be used for CP.

4.2.04/2 Study of the regime and forecasting of groundwater levels after completion of the Nagymaros part of the project in the region Iža and left Nitra river bank UK Bratislava Duba 1966 C

Content - Evaluation of the present groundwater regime on the basis of observed stages. Prognosis of groundwater levels was dealt with experimentally on a two-dimensional hydraulic integrator of prof. Lukjanov. By means of groundwater-table contours the original stage at low and high waters was compared with the groundwater level stages after the construction.

Evaluation

After completion, the results may be used for CP.

4.2.04/3 Investment task of 1967. Materials worked out by CZ party. Region No.4 Iža HDP Bratislava Dinga 1967 B

Content - Design for the protection of the territory along the Danube in the section rkm 1751 - 1766 and in the area of confluence with the Váh from the mouth to the road bridge in km 1,53 of the Váh river.
Reconstruction of existing inundation levees had been designed, construction of new pumping stations at Žitavská Toň and Iža, and construction of parallel seepage canals.

Evaluation

Project may be partly used for CP, though the actual state of inundation levees, repaired after 1965 flood, is to be considered.

4.2.05/1 Komárno - city GP Brno Brázda 1964 C

Content -Summary of the detailed engineering-geological survey for the region V - for all designed structures.

Evaluation

Results of the survey may be used, after supplementation, for CP.

4.2.05/2 Investment task of 1967. Material worked out by ČS party. Region No.5 city of Komárno HDP Bratislava Valašík 1967 B

Content - Data including designs for protection of the city Komárno against floods, against seepages due to Nagymaros project backwater. Flood control is provided by means of construction of a protection line, leading from the railway bridge over the Danube, along the isle Červená Flota, through the closing structure and shipyard basin to the left Danube bank, further along the harbour to the Váh river mouth, and further along the left Váh river bank to the km 10,5 of the Váh downstream of the pumping station Nová Osada. Seepage waters /due to the permanent backwater and during flood events/ are intercepted by covered drains and lead to pumping stations at the Danube, on the Váh and on the isle Červená Flota.

Evaluation

Project may be partly used for CP.

4.2.06/1 Komárno - Medveďov GP Brno Hradský 1965 C

Content - The report presents results of the engineering-geological survey in the region VI., executed for respective structures.

Evaluation

After completion, the results may be used for CP.

4.2.06/2 Investment task of 1967. Materials worked out by CZ party. Region No.6 Komárno - Medveďov HDP Bratislava Urbanec 1967 B

Content - Materials including designs of protective measures for the territory along the Danube in the section rkm 1770,4 to 1800. Seepage canals are also designed along the dykes, mouthing into pumping stations Nová Stráž, Pavol and Kosihy.

Evaluation

Project may be partly used for CP. Adaptation of dykes after 1965 flood is to be considered, as well as the new pumping station Kosihy, which will have to be reconstructed for repumping of seepage waters.

4.2.07/1 Left Váh river bank GP Praha Lucek 1965 C

Content - The report presents results of survey works in the region VII on the left Váh river bank.

Evaluation

Survey results may be used for CP after completion.

4.2.07/2 Investment task of 1967. Material worked out by CZ party. Region No.7 - Left Váh river bank HDP Bratislava Lichý 1967 B

Content - Materials include the design of protective measures for the territory along the left Váh river bank from the road bridge over the Váh at Komárno to the village Komoča.
Seepage canal along the dyke will mouth into the existing pumping station Lándor.

Evaluation

Project may be partly used for CP, though the reconstruction of the left-bank dyke of the Váh, realized as flood control measure, is to be considered.

4.2.08/1 Right Váh river bank and Malý Danube GP Brno Svoboda 1965 C

Content - Evaluation of the results of survey works in the region VIII in the section from Komárno - Nová Osada to Kolárovo.

Evaluation

After supplementation the survey results may be used for CP.

4.2.08/2 Right Váh river bank and Malý Danube GP Brno Holéczyová 1965 C

Content - The report presents results of survey works executed in the region VIII in the section from Kolárovo to the pumping station Aszód, as well as along the Váh river from Kolárovo to the Dedina Mládeže.

Evaluation

After completion, the survey results may be used for CP.

4.2.08/3 Analysis of groundwater regime in the region Šaľa-Kolárovo and forecasting of the effect of Nagymaros project on this regime VÚVH Bratislava Gyalokay 1965 C

Content - Critical evaluation of works dealing with the groundwater regime on a territory covering 32 800 ha between Šaľa and Kolárovo, on both sides of the Váh river.
The report presents a complex evaluation of the present groundwater regime and forecasts the potential expected changes after the G/N construction.

Evaluation

The results may be used, after supplementation, for CP. A more detailed prognosis of the state after the G/N construction is to be worked out.

4.2.08/4 Investment task of 1967. Materials worked out by CZ party. Region No.8 - right Váh river bank and the Malý Danube — HDP Bratislava, Goljer — 1967 — B

Content - Data including design of protective measures for the territory along the right Váh river bank in the section from Komárno to Kolárovo, and of the territory on both sides of the Malý Danube in the section Kolárovo - Asód. Parallel seepage canals will discharge into existing pumping stations Nová Osada, Čergov, or Kolárovo, and also into the new pumping station Viničné.

Evaluation

Project may be partly used for CP. In designing dyke reconstruction it is necessary to consider the training of the right-bank dyke /especially the new dyke in the section Kameničné-Lohoť/, and also channel adaptation of the Váh river at Kameničné, realized within the scope of flood control measures.

4.3 PROTECTION MEASURES ON THE HUNGARIAN TERRITORY

4.3.01/1 Displacement of stone quarry at Visegrád — IPARTERV Lázár 1959 B

Content - The study dealt in details with the displacement of a stone quarry due to the coonstruction of the river project, in two alternatives - without stone quarry development and with development. Economical computation for both alternatives.

Evaluation

The study may be used for further designing and its results may be partly used for CP.

4.3.01/2 Investment task. project of protective measures in regions. Region Visegrád-Domos — VIZITERV Kéry, Péczely 1967 C

Content - Design of required protection measures after creating of backwaters, necessary dimensions of those measures, terrain training, data on industrial plants to be removed as well as on agricultural land to be occupied.
Elevation or transfer of the road No.11, belonging in the region, displacement of the stone quarry at Visegrád are included in a separate project.

Evaluation

Results of the project may be used, after supplentation, for CP. However changes, that occured in the meantime are to be considered. It is necessary to verify the harbour reconstruction at Domos, since the project was not accepted by the Navigation Department of the Ministry of transportation and communication.
The demand for the stone quarry is to be examined, since it was proposed to liquidate it in the investment task 1973.

4.3.02/1 Groundwater regime in region Pilismarót and forecasting of expected state — VITUKI Ubell 1964 C

Content - Unfavourable increasing of groundwater stages is expected only in one narrow riparian zone, where due to backwater the groundwater would occur in the depth 1,5 m under the terrain. Considered backwater does not influence unfavourably groundwaters deeper than 1,5 m.

Evaluation

Research results may be, after supplementation, used for CP. Model study will be advantageous.

4.3.02/2 Report on geoelectric measurement of resistance of engineering-geophysical characteristics in the region Pilismarót — Geofizikai intézet Jósa 1964 D

Content - Gravel layers and various subsoil strata have different specific resistance. By means of measurements in the dyke route it was possible to assess the thickness of the gravel layer, the depth of the subsoil and quality of the material, as well as data on the permeability of gravel complexes.

Evaluation

Based on this investigation it would be possible to limit the number of survey drilling works on territories with similar structure.

Results may be helpful for CP.

4.3.02/3 Experts account of town design and urbanization in the region Pilismarót — VÁTERV, Turosányi — 1965 — B

Content - The project deals with the raining of the bank line of the recreation area, which will be constucted according to the recommendations of the chief architect for Dunakanyar.

Evaluation

Project may be considered as starting material for one alternative solution. It may be partly used for CP.

4.3.02/4 Engineering-geological survey of the region Pilismarót /Final report/ — VIZITERV, Erhardt — 1965 — A

Content - The report gives an accurate image on the conditions in the region on the basis of a survey, completed in April 1965. The most important Quatenary, Miocene, and Oligocene formations with regard to soil mechanics and engineering geology were invewstigated, taking into consideration two alternatives of protection measures. Since in the time of the elaboration of the report the location of respective structures was not known, no detailed survey for them had been performed. Groundwater dynamics in characterized by means of a large number of observation wells. Various methods concerning seepage ad its occurence are presented.

Evaluation

Survey results may be used in full extent for CP.

4.3.02/5 Investment task. Project of protective measures in the region Pilismárót — VIZITERV, Kézi, Pécsely — 1967 — B

Content - According to the project the major part of the region will be inundated, 60 ha of the territory will be protected. A separate project deals with the vertical alignment of the road No.11 /its elevation/, formation of bank lines of the abandonned territory, and arrangement of isles.

Evaluation

- The project may be partly used for CP, however changes that occured in the mean-time are to be considered /Construction of new building, recreation cottages and weekend houses, etc.
  It is necessary to examine the cost for eventual possible protection.

4.3.03/1 Hydraulic research of the Kis Duna branch and bay at Esztergom — VITUKI, Dohnalik — 1964 — A

Content - Investigation of the sedimentation of the branch Kis Duna at the island Esztergomi Primás Sziget, and hydrologic research of brooks discharging into the Danube in the bay at Esztergom.

Evaluation

The study is to be estimated together with the study: "Survey of hydrological conditions of the day at Esztergom" No.8.08.03/10/I/13.
Results may be used in full extent for CP.

4.3.03/2 Investigation of hydrologic conditions in the bay at Esztergom — VITUKI, Csoma — 1965 — A

Content - After channel closing and due to backwater 80 m3 of bedload will reach into the branch Kis Duna annually, the volume.

which may be considered as negligible.

Evaluation

Research results may be used in full extent for CP.

4.3.03/3 Groundwater regime in the area of Esztergom and forecasting of expected state — VITUKI, Ubell, 1964, A

Content - The study defines the groundwater movement along the river bank. Under backwater conditions and operation of designed seepage canals the groundwater level will be similar as at present time. In the northern part of the region the groundwater level will increase, however without any unfavorable effects.

Evaluation

Research results may be used in full extent for CP.

4.3.03/4 Engineering-geological survey of Esztergom region /preliminary results/ — VIZITERV, Takács, 1965, C

Content - On the basis of older geological surveys and studies the report deals with in details the geological structure of the territory, of the surface soil, water-bearing gravel layer and of the impermeable subsoil strata. Hydrological phenomena are dealt with considering the smaller streams, passing through this territory. Also karst waters of Triassic limestone subsoil are mentioned, and the hydrodynamics of groundwater in gravel layers. It includes valuable data for designing the 13 km long flood-control protection dykes, informing also about the survey of clays in the surrounding.

Evaluation

Survey results may be used, after completion for CP.

4.3.03/5 Engineering-geological survey of the city Esztergom /Final report/ — VIZITERV, Erhardt, 1966, C

Content - Based on survey works completed in 1966 and on older data the report presents engineering-geological paramenters, required for designing of protection measures. Hydrogeological conditions are dealt with in details, the relationships of warm karst waters and grounwater are also studied, especially with regard to the Danube water level changes. Attempt to forecast the behaviour of springs in the situation of assumed backwater.

Engineering-geological and hydrogeological data are also summarized in tables and maps.

Evaluation

Sufficient basic data for designing protection measures. Further study is needed for protection of respective measures, structures and housings. These issues had been also dealt with recently.

Survey results may be, after supplementation, used for CP.

4.3.03/6 Industrial waterwork Dorog — VIZITERV, Kovács, 1959, D

Content - The design had been worked out for two alternative waterworks at Dorog. One alternative retains existing equipment of the waterworks, or considers reconstruction with regard to backwater. The second alternative suggests to construct waterworks on another site and to leave the wells in the

present locality.
Evaluation
The project may be helpful for CP.

4.3.03/7 Rising of the ropeway /cableway/ at Dorog — UVATERV, Sidlovics, 1959, D
Content - Description of the elevation of the unloading station of the cableway at Dorog by 1,5 m.
Evaluation
Project may be helpful for CP.

4.3.03/8 Investment task. Project of protected areas. Esztergom region. — VIZITERV, Kéri, Kiss, 1967, B
Content - Project describes required protection measures and their dimensions due to impounding of water levels, design of flood control dyes, of external waters divesion, a networks of seepage systems, water main, wastewater discharging and other industrial structures.
Evaluation
Project may be partly used for CP, however changes occuring in the meantime are to be considered /waterworks, wastewater discharging, development of retention reservoirs, assessment of pumping stations capacity due to these circumstances, etc./ It is necessary to examine the problem of cableway elevation at Dorog and the displacement of military area, as well as the issue of waterworks wells at Dorog and conveying of water in an open tailrace.

4.3.04/1 Region Nyergesújfalu - Dunaalmás Preliminary engineering-geological report — VIZITERV, Bognár, 1966, C
Content - Concerning the protection of industrrial plants on a 20 km long section of the river shore only a few survey works were realizaed. Also laboratory processing of described materials in not sufficient. On the basis of available data the report dealt with general geological condition of the concerned territory and presents approximate engineering-geological and hydrogeological data, utilizable for planning of respective industrial plants /factories/.
Evaluation
Survey results may be, after supplementation, used for CP.

4.3.04/2 Experience gained during the 1965 flood in industrial plants situated on the Danube section affected by Nagymaros backwater — VIZITERV, Póka, 1965, D
Content - Summary of experience obtained during the flood events from May 24 to June 30 1965 in industrial enterprises. situated along the Danube in the section between Nyergesujfalu and western margin of Komárom. The study presents consequences of long-lasting high water stages on low-laying structures, and flood control measures of affected industrial enterprises.
Evaluation
Research results may be used as auxiliary material for CP.

4.3.04/3 Survey of soil-mechanics with regard to sewerage networks of the enterprise for transite production at Nyergesujfalu — IPATERV, Szalay — 1964 — C

Content - Data obtained in soil-mechanics survey of the route of sewerage system, being constructed on the territory of the transite works at Nyergesújfalu. Expert's account.

Evaluation

Survey results may be used for CP after supplementation.

4.3.04/4 Experts account on hydrogeological survey in the connection with displacement of shaft well of paper mill at Lábatlan — MÉLYÉPTERV, Zoller — 1965 — D

Content - Feasibility to displace the shaft well of the paper mill Lábatlan, situated on the Danube banks, to a higher altitude was examined. On the basis of 3 experimental bore holes it is recommended to construct a new well nearby the bore hole No.2.

Evaluation

Project may be helpful for CP.

4.3.04/5 Project of regional waterworks protection at Lábatlan — VIZITERV, Páris — 1965 — D

Content - Investigation of the effect of Nagymaros backwater on the regional waterworks at Lábatlan.
Required protection measures and providing of trouble-free operation are assessed and data needed for further designs.
Estimation of cost is also enclosed.

Evaluation

The project is out-of-date. Present state of waterworks is to be examined and the conception of future development is to be taken into consideration.
The project may be used only as auxiliary material for CP.

4.3.04/6 Project of regional sewerage network protection at Lábatlan — VIZITERV, Kérey — 1965 — DD

Content - The study dalt with following tasks:

1. Investigation of the system of regional sewerage networks of Lábatlan industrial plants and pertinent housing centres-project and description of network operation and operation of the wastewater treatment plant.
2. Determination of quantitative and qualitative paramenters
3. Investigation of the effect of backwater on the structure and its operation
4. Potential protection of the structure, suggested protection measures and cost estimation.

Evaluation

Project may be helpful for CP.

4.3.03/7 Safeguarding of thermal water for bathing place at Dunaalmás — VIZITERV, Pucher — 1964 — D

Content - Investigation of conditions in the locality, chosen for bathing place at Dunaalmás, as to provide water of adequate quality and amount. Further survey would be performed to obtain more detailed data for designing.

Evaluation

Study may be helpful for CP.

4.3.04/8 Location of bathing place at Duna- almás — VIZITERV, Ludwig — 1965 D

Content - The study deals with two alternatives:
1. Rising of the territory of present bathing place above backwater level.
2. Displacement of the bathing place within a distance of 1 km.
On the basis of cost comparison it is recommended to displace the bathing place to a locality at the cross section of roads Vécsi and Tatai.

Evaluation
The study may be used as auxiliary material for CP.

4.3.04/9 Nyergesujfalu - Dunaalmás region — VIZITERV, Lindner, Marko — 1964, 1965 D

Content - A volume of projects, including correspondence and auxiliary material for the projects of Production of building materials, of the factory Viscose and Cement production.

Evaluation
Results may be used as auxiliary material for CP.

4.3.04/10 Protective measures in Nyergesuj- falu - Dunaalmás region — VIZITERV, Karpáti, Kéri — 1967 B

Content - Documentation including projects of structures:
a/ Filling of low-laying areas behind the railway.
b/ Reconstruction of the underpass of the small railway and stone loading at Suto.
c/ Reconstruction of the port for the watch-room construction for boundary guard at Dunaalmás.
d/ Reconstruction of accesses to the Danube.
e/ Displacement of teh bathing place at Dunaalmás.
f/ Liquidation of the Danube islands
g/ Protection of industrial establishments.
Brick factory at Nyergesújfalu
Factory Viscosa
Regional sewerage system at Lábatlan
Transite factory
Factory for production of reinforced concrete
Cement Factory Stone factory at Lábatlan
Paper mill at Lábatlan
Project includes also suggestion of buildings dispossession in concerned territories.

Evaluation
Project may be partly used for CP.

4.3.05/1 Engineering-geological survey of Komárom region /Preliminary results II/ — VIZITERV, Bognár — 1966 C

Content - Processing of data from drilling works completed by May 10, 1966, and results of observations. It is a supplement to preliminary results No.I., published on May 10, 1965. Detailed treatise of experience gained during the flood in 1965.

Evaluation
Sufficient basic data for designing of planned protection measures, apart from the pumping station and assumed protection line on the Danube side. Additional survey drilling works may be necessary for data completion.
After completion the survey may be used for CP.

4.4.05/2 Engineering-geological survey of Komárom region /Final report/ — VIZITERV — Erhardt — 1965 — C

Content - On the basis of data gathered after concluding of preliminary surveys, and results of earlier works, it was possible to summarize geographical, geomorphological and general geological condition, as well engineering-geological characteristics, important for designing protection measures. The report evaluates hydrogeological conditions and enables dimensioning of seepage canals. The majority of data is presented also in the map 1 : 5 000.

Evaluation

All necessry basic geological data for designing of protection measures, however it does not consider the situation after impounding and realization of protection measures. After completion, the survey may be used for CP.

4.3.05/3 Groundwater regime in Komárom region and forecasting of expected state. — VITUKI — Vargay,Ubell — 1964 — A

Content - The study is based on the data resulting from the study of groundwater observation wells, performed in 1954 - 1963, and by means of the study of water regime the effects of Nagymaros beckwater on groundwater regime in Komárom region had been assessed. The effect of flood waves on the Danube under unsteady flow, effect of permanent low water stages and groundwater movement from the marginal parts of southern slopes, considered as steady flow, were also investigated. It was stated, that in case of construction of designed drains, it may be expected approximately the same groundwater state as at present. The groundwater level will increase only in places where it is at present very low, however this increasing will be very advantageous.

Evaluation

Research results may be used in full extent for CP.

4.3.05/4 Further development in groundwater regime assessment in Danubian regions — VITUKI — Varrók — 1953 — A

Content - The effect of Nagymaros backwater on the Komárom region was studied using analogous computer. Also spatial effects were investigated, however only permanent water motion was considered with regard to simplification /assuming always impoundment conditions corresponding to Q = 3760 m3/s./ The study confirmes, that in case of construction of designed seepage facilities the groundwater regime in the Komárom region will be suitable, and no deterioration of existing conditions may be expected.

Evaluation

Research results may be used in full extent for CP.

4.3.05/5 Danube islands — VIZITERV — Kéri,Molnárné — 1964 — C

Content - The study is dealing with the effect of Nagymaros backwater on the Danube islands. Following islands were considered: Gelemba, Nesdmély, Prépost, Szőny, Monostor, Concó, Gönyü. It was stated, that due to the impoundment the ground level of the island will be flooded, or will be very close to the water level. Thus present utilization for orchards or agriculture will be impossible. Some places may be used as meadows and grassland.

Evaluation

After examination of the possibilities to use the islands the research results may be used for CP.

4.3.05/6 Project of protective measures. Komárom region. Investment task. VIZITERV Kéri, Póka 1967 B

Content - Protection measures designed for Komárom region as influenced by the Nagymaros backwater.
Reinforcement of protection dykes, training of the stream to low water, draining of internal waters, protection of the structures of the city of Komárom, of Petroleum industry at Almásfüzitő, Bauxite factory at Almásfüzitő, Petroleum industry at Szőnyi, protection of agricultural land. Seepage canals and pumping stations are considered.

Evaluation

The project may be partly used for CP.

4.3.06/1 Transfer of machine industry at Nagymaros KCMTI 1959 C

Content - Study is dealing with the transfer of the machine industry at Nagymaros and operation of the factory Metal-working industry No.II. At Esztergom.

A/ In the connection of the machine factory transfer at Nagymaros detailed operation data are presented: number of employees, existing machines and equipment, basic area, turnover of material, power consumption. New locality specified for displacement and the transfer stages are also described.

B/ The operation of the Metal-working industry No.II at Esztergom will not be disturbed after completion of the G/N Project, thus it is not necessary to transfer the factory.

Evaluation

After completion the project study may be used for CP.

4.3.06/2 Protective measures for G/N Project. Displacement of suction piping at Zabegényi. Informative soil-mechanical judgement. MÉLYÉPTERV Asbóth 1964 D

Content - On the basis of 5 bore holes and one suction test, executed in the depth of 2,2 m in the place of designed suction pipe and in its surrounding, it is not recommended to realize this suction pipe. Another site for suction pipe should be marked out, or another method of manipulation and drainig of wastewaters should be recommended.

Evaluation

The expert's account may be used as auxiliary material for CP.

4.3.06/3 Investment task. Protective measures for Nagymaros region-Ipel rive VIZITERV Kárpáti, Kéri 1967 B

Content - Documentation includes designs of following structures:

a/ Protection dykes, drain in the municipality Szob and pumping station.

b/ Cut-off at Létkés, dykes, drains and pumping station.

c/ Protection of banks at Zebegény village, arrangement of intravillane, filling of low-laying areas.

d/ Adaptation of the terrain in low-laying areas at Ipolydamásd.

e/ Reconstruction of the port and ferry at Szob.
f/ Reconstruction of stone-load and small railway at Szob.
g/ Sealing measures at the stone-crushing enterprise at Zebegényi.
h/ Reconstruction of the suction arrangement for wastewaters at Zebegényi.
Project includes also a suggestion of buildings expropriation in the concerned territories.

Evaluation
The project may be partly used for CP, though it is necessary to take into consideration changes occuring in the mean-time.

4.3.07/1 Engineering-geological survey of Ács region /Final report/ — VIZITERV, Bognár, 1966, A

Content - Report, representing a final summary of data. 96 bm small-diameter soil-mechanical bore holes, planned for the survey of the lay out of designed structures, have not been realized until the report completion, however, they will not have changed already developed geological pattern. General geologic, structural, engineering-geological and hydrogeologic conditions are dealt with in two parts of the region, namely Koppánmonostor high bank and Lovad meadow. Different characteristics of gravel-sand sediments of the system of the Danube alluvial terraces were examined.

Evaluation
On the basis of data available it is possible to choose and design the most efficient method of protection on the level of CP.
Survey results may be used in full extent for CP.

4.3.07/2 Region Komárom-Gönyü-Nagybajcs. Investment task. Project of protective measures — VIZITERV, Kéri, 1967, B

Content - Protection against the effect of Nagymaros backwater in following areas:
a/ From the west end of Komárom to the west end of the Cuhai Bakonyér valley at Gönyü.
b/ From above area to the west, lower part of Szigetköz /Nagybajcs area/ between Kisbodak - Vánek.
Prevalining part of the eastern part of this area has a high bank, thus only protection of some places is necessary.
Project dealt with also the protection of Lovad meadow /summer dyke, seepage drains, canal for internal waters, pumping station/, reconstruction of bank protection structure at Kopánymonostori, liquidation of agricultural lands at Concó at the mouth of the Cuhai Bakonyér, treatment of internal waters at the lower part of Szigetköz.

Evaluation
Project may be partly used for CP.

4.3.08/1 Professional watermanagement judgement concerning designed bridges at railway junctions Esztergom - - Almásfüzitő and railway Tata and the creek Pényes — VIZITERV, Póka, Csoregh, 1964, B

Content - Professional account from the water resources development view on 9 structures of the railway line Esztergom - Almásfuzitó. Standard discharge of flood water is assessed for respective structures, and considering the backwater. required dimensions of openings are determined. Necessary channel protection is designed at velocities occuring within the structures.

Evaluation

The study may be partly used for CP.

4.3.08/2 Protective measures. Protection of railway Szob-Nagymaros, Esztergom-Almásfűzito, track for bauxite at Komárom — MÁVTI, Lesz, 1967, C

Content - A/ Railway line Szob-Nagymaros.
Project includes railway line protection against back-water effects and construction of necessary structures, together with cost estimation.
B/ Railway line Almásfuzito-Esztergom.
Project described required works for railway line protection, drainage works and reconstruction of structures, together with cost estimation.
C/ Railway for bauxite at Komárom.
According to the project the railway for bauxite will be elevated and transferred also horizontally. Construction of structures is not necessary.

Evaluation

The project of railway line protection is to be examined and according to the results ot investigaiton overworked. Then it may be used for CP.

4.3.09/1 Watermanagement expert's account on roads No.1 and 11 — VIZITERV, Csorgh, 1964, B

Content - Expert's account concerning the structures of the roads nos. 1 and 11.

Evaluation

The account may be partly used for CP, however the height dimensions of road bridges and their lay out are to be described in more details.

4.3.09/2 Soil-mechanics part of the road project No.11. Expert's account for road and bridge — UVATERV, Tarpataky, 1965, D

Content - Professional soil-mechanics judgement of the road section No.11 between km 44 + 000 - 49 + 100, as well as of the structure in the road cross-section 48 + 638 km, 45 + 353 km, 58 + 648 km.
Judgement may be partly used for CP, however the heights of road bridges and their lay out are to be specified.

4.4.09/3 Soil-mechanics part of road project No.121. Expert's accounts for roads and bridges — UVATERV, Tarpataky, 1965, D

Content - Professional soil-mechanics judgement of the road section No.12 between km 14 + 800 - 34 - 740, as well as professional soil-mechanics judgements of the structures in the road cross-section 20 + 325 km, 21 + 918 km, 33 + 495 km.

Evaluation

The survey and the judgement have an informative character, and may be used as auxiliary material for CP.

4.3.09/4 Proposal of drainage of the road 121, in the section of Nagymaros UVATERV Tóth 1964 D

Content - Project deals with two issues: Dimensions of bridge openings on the new route of the road No.121, and drainage of the road, leading through the new route 3 km long.
Dimensions of the canal, draining the 3 km long road section is 60.

Evaluation

Project may be used as auxiliary material for CP.

4.3.09/5 Contractual project of the road No.121 UVATERV Petz 1965 D

Content - Documentation includes the project of the road No. 12, using technical characteristics of the existing road, without assuming a modernization. As basis for designing the project minimum executed at UVATERV in 1960, was applied.

Evaluation

Project may be used as auxiliary material for CP.

4.3.09/6 Contractual project of the road No.11 UVATERV Petz 1965 D

Content - Project of public road No.11 without modernization. Minimum executed by UVATERV in 1960 was applied as bases.

Evaluation

It may by used as auxiliary material for CP.

4.3.09/7 Reconstruction project for roads No.1, 11, 121 UVATERV Petz 1967 E

Content - Project of reconstruction of roads Nos.1 11 and 121 without modernization.

Evaluation

May be partly used for CP.

4.4 NAGYMAROS PROJECT

4.4/1	Hydraulic study of navigation locks at Nagymaros project. Hydraulic characteristics of different systems of filling and evacuation	ČSAV Mâsiar	1964	C

Content - The most suitable method of filling and evacuation of navigation locks was dealt with on the basis of recent research of similar problem with navigation locks Wolfsthal/Bratislava.

Evaluation

The research results may be used, after completion, for CP.

4.4/2	Surveying of the channel of Nagymaros section of the Danube from 1964. Registered cross-sections	VITUKI	1965	C

Content - A photograph of the Nagymaros Danube channel in the section between rkm 1964 - 1968. The distance of profiles is on the average 50 m. The work includes data on 80 cross-sections of the channel.

Evaluation

Data may be used for CP.

4.4/3	Engineering-geological survey of the hydropower scheme Nagymaros /preliminary results on engineering - geological conditions/	VIZITERV Erhardt	1965	C

Content - The report, taking into account data from all bore holes executed for the Nagymaros project, presents a general information on engineering-geological condition of the region. Laboratory processing of samples, taken from the bore holes, was not completed until completion of this report, thus more detailed engineering-geological data are presented in preliminary results No.II, worked out as a supplement /Taz: 14 183/ 35 28.12.1966/

Evaluation

Geological conditions of the Nagymaros project area are dealt with in this report only in rough features, thus issues important with regard to practice can be decided only after additional drillings of water pressure tests and grouting tests. The survey may be used after completion for CP.

4.4/4	Engineering-geological survey of the hydroel.power plant Nagymaros /II.preliminary results on engineering-geological conditions/	VIZITERV Bognár	1966	C

Content - Approximate description of engineering-geological conditions taking into account all data from bore holes, collected for the Nagymaros project, of soil-mechanics and hydrogeological data, which are available. Attention is focused on the required additional tests by means of bore holes, water pressure tests and grouting tests.

Evaluation

The survey may be, after completion, used for CP.

4.4/5	Expert's account on wind conditions within the locality of Nagymaros project	State meteorol. institute Hajósi, Béll	1964	C

Content - The study deals with wind conditions, which may be expected in the area, where Nagymaros project and navigation locks are designed, with wind distribution according to force and intensity, extent of wind surges.
It was stated, that the direction of winds with high fequency is in agreement with the direction of the strongest winds and strongest wind impacts.

Evaluation
After completion, the study may be used for CP.

4.4/6	Competition aimed at urbanistic and architectonic solution of the Nagymaros project, and its environment	IPATERV	1964	B

Content - 1/ Design of the building-up plan for
- operation territory
- territory adjacent to the Nagymaros village
- territory where the tourist hotel and camp grounds should be constructed
- recreation territory, playgrounds

2/ Guidelines for designing of structures with regard to existing natural condition of the Danube bend.

Evaluation
Project may be partly used for CP.

4.4/7	Urbanistic and architectonic solution of the Nagymaros project and its close environmnet	VIZITERV /Consideration Commission/	1964	B

Content
- Invitation of tenders
- Answers conserning question on project competition
- Proposal of the methodology of estimation
- Final report of project competition
- Model scheme of the invitation of tenders

Evaluation
Material may be partly used for CP.

4.4/8	Project task for the G/N Project. Effect of the Nagymaros project operation	VIZITERV Szabó, Elek	1965	B

Content - Study is dealing with problems of the hydropower plant operation in case of the alternative with divided power plant, further the possiblities to moderate unfavourable phenomena occurring due to the G/N operation.
By means of approximate computation following was studied:
- water discharging under normal operation of the weir
- dimensions of the stilling basin
- surge waves resulting from abrupt closing of the power plant and during manipulation with stop-log weirs.

The mutual effects of the power plant, weir and navigation lock during operation and eventual negative phenomena and necessity to carry out additional experiments and detailed studies concerning the G/N operation.

Evaluation
Due to the fact, that majority of data, used for elaboration

of the study, had changed, and a more thorough study of several operation situations was executed, the above study may be only partly used for CP.

4.4/9 Water projects on the Danube and Tisza. Assessment of dimension and types of main damming structures — VIZITERV Mistéth — 1964 — D

Content - Specification of the unified type of weir construction of the Danube and Tisa and design of
- height /11,0 m/
- clear span /inner diameter/ of the gated opening /24,00 m/
- construction system /segment with valve/ closing facilities according to optimimum efficiency and economy

Evaluation
May be used as auxiliary material for CP.

4.4/10 Nagymaros project. Investigation and comparison evaluation of mechanical and hydraulic movable devices of steel gate constructions. — VIZITERV Neumann — 1965 — D

Content - Mechanical and hydraulic motion equipments aimed for manipulation with hydraulic constructions, are presented and estimated, and finally recommended.

Evaluation
Results of the study meet also present requirements and may be used as auxiliary material for CP.

4.4/11 Nagymaros project. Steel constructions and machinery equipment of the weir — VIZITERV Dévényi — 1965 — D

Content - Schematic drawings of machinery equipment and steel constructions of the weir /operation and preliminary damming, movable mechanisms, construction details/. Various systems of segment gates and valves are described and compared, as well as apllication of mechanisms with hydraullic drive.

Evaluation
May be used as auxiliary material for CP.

4.4/12 Initiative project of steel constructions at Nagymaros. Lower cutwater of navigation lock. Strutting gates — VIZITERV Gödry — 1965 — D

Content - Schematic drawings of the construction solution of strutting gates of the lower cutwater of the navigation lock, in four alterantives. On the basis of comparison examination of additional two alterantives is necessary.

Evaluation
Project may be used as auiliary material for CP.

4.4/13 Nagymaros project. Movable mechanisms of strutting gates — VIZITERV, Lovas, Godry, Dévényi — 1966 — D

Content - Project presents schematic solution of
- movable mechanisms of strutting gates
- manipulation with gates of filling and evacuation openings, as well as operation and temporary closing of the weir and navigation lock, together with movable mechanisms.

Evaluation
May be used as auxiliary material for CP.

4.4/14 Nagymaros project. Introductory project of cranes — KGKTI — 1966 — D

Content - Introductory project and main technical parameters of
- two gantry cranes with lifting capacity 63 Mp at span 18,0 m,
- two travelling cranes located in the machine room, with lifting capacity 105/15 Mp span 15,8 m,
- frame cranes with a console for manipulation with temporary closing of the hydropower plant in the lower water, with lifting capacity 2 x 63 Mp, span 6,5 m,
- frame cranes with console for manipulation with upstream side temporary closing of the hydropower plant, with lifting capacity 2 x 25 Mp + 2 x 5 Mp, span 10 m,
- two cable cranes with lifting capacity 3 Mp

Evaluation
May be used as auxiliary material for CP.

4.4/15 Nagymaros project. /Electrical part/ Investment task — VIZITERV, Andor, Ákos — 1967 — B

Content - Electrotechnical part of the documentation, included in the investment task, was drawn up according to data of studies, worked out earlier by EROTERV. In addition to the scheme of connection and connection to the networks the study dealt with also th actual issues of lay out. Required protection of electric equipment is described and suggested principles of management of the Hydropower plant, of its operation and safety, of technological equipment of the weir and navigation locks, as well as basic issues of navigation signalling equipment are presented.

Evaluation
Project may be partly used for CP.

4.4/16 Structures of long-distance mains of the hydroel.power plant Nagymaros. Data for investment task. — ERŐTERV, Haláczy — 1966 — C

Structure of long-distance mains of the hydropower plant Nagymaros and mean-voltage mains, data for the investment task

4.4/17 Programme study of long-distance main 110 kV for hydroel.power plant Nagymaros and mean-voltage mains, which are to be laid down or reconstructed — ERŐTERV, Haláczy — 1967 — C

Content - Both studies dealt with reconstruction of long-distance mains of the hydropowr plant Nagymaros approximately according to the same conception. It is suggeted to carry the produced power to the Hungarian side by means of one two-system mains 120 kV, and to the CZ side also by one 110 kV long-distance mains. The study specifies the routes and point of connection, necessary modification of mean-voltage long-distance mains, due to the backwater. In addition, also power supply of the construction site is discussed.

Evaluation

Realization of the conception of long-distance mains 110kV is dependent upon the comment quoted in the first study. As far as mean-voltage mains is concernde, the statements quoted in both studies are partly valid also nowadays, however due to changes in local mean-voltage distribution networks, which occurred in the meantime, many statements are no more topical. The project may be used for CP after updating.

4.4/18	Connection of 120 kV, 110 kV, 35 kV and 20 kV long-distance mains to hydroel.power plant Nagymaros. Statement of affected lands	ERÖTERV Haláczy	1967	D

Content - Documentation was elaborated simultaneously with the investment task with the aim, to install the long-distance mains in required routes.
The minutes from the meeting held on February 14.-15,1967 charged with the selection of construction site it is evident, that authorized bodies agreed principally with the submitted project scheme of long-distance mains, and required only smaller modifications, or consideration of comments.

Evaluation

Since some territorial conditions of the route underwent changes it is inevitable to examine them.
The way of connection of the hydropower plant ot the energetic network will be propably changed, if the concept of produced power transfer to energy systems of both countries will be changed. Project may be used as auxiliary material for CP.

4.4/19	Study of variants of construction site fencing	VIZITERV Pécsely	1965	D

Content - Examination of different variants of construction site fencing in the connection with realization of one older conception /divided power plant, or power plant situated nearby the navigation lock at the left bank/.

Evaluation

The lay out of the project, number of weir openings and type of turbines were changed. Results of the study may be used as auxiliary material for CP.

4.4/20	Hydraulic investigation of Nagymaros project fencing during construction	VIZITERV Andor	1964	D

Content - By means of analogous cases, described in professional literature, the author tried to forecast the impoundement /due to dyking/ in respective stage of construction, considering

the divided power plant, constructed according ot the conep-
tion accepted in 1964.

Evalutaion

Since the conception is already out-of-date, the results may be used only as auxiliary material for CP.

4.4/21	Model study of navigation locks filling and evacuation at Nagymaros project	VITUKI Rusz B.-né	1966	C

Content - Model experiment revealed several insufficiencies of the initial model arrangement /unfavourable design of filling and evacuation canals, higher forces in ropes than administsible, too high velocity of segment gate movement/. Even the performed changes did not resolve all problems. The evacuation solution was more adequate, though over filling the forces, acting on vessels and tow boats surpassed the permissible values by as much as 50 -150 %- Further experiments are requried.

Evaluation

After completion the study may be used for CP.

4.4/22	Hydraulic model study of damming structures, stilling basin and weir gates of Nagymaros project	VITUKI Haszpra	1965	C

Content - The examined construction elements are identical with those, used in the joint investment task. The dimensions of the stilling basin are considere as suitable, however for specifying the backwater volume spatial model test is recommended.

Evaluation

Results may be used as auxiliary material for CP.

4.4/23	Investigation of weir gates vibration at Nagymaros project	VITUKI Haszpra	1965	D

Content - Methods and issues of instrumentation equipment for a vibration research of weir gates, performed in a gloss flume. The applied method is considered as suitable for detailed examination of vibration of steel construction in water engineering.

Evaluation

Research results may be, after supplementation, used for CP. For an investigation of damming by peirs a spatial model is to be developed.

4.4/24	Study of Nagymaros fish-pass development	VIZITERV Gócza	1965	D

Content - Project study estimating applicability of fish- passes, developed in Hungary and abroad up to the present. For decision making in this aspect it is necessary to gain more experience about quality and operation of already existing fish-passes and sluice gate fish lifts.

Evaluation

Research results may be used as auxiliary material for CP.

4.4/25 Hydraulic capstan at Nagymaros UVATERV 1965 D

Content - Documentation and technical report, as well as schematic drawings of facilities for ship lifting.

Evaluation

Project may be used as auxiliary material for CP.

4.4/26 Winter regime at Nagymaros project VIZITERV Burian 1966 B

Content - The study deals with following issues:
- ice phenomena
- facility and measures for ice protection
- weir protection against ice
- protection of hydropower plant against frost
- protection of navigation lock against frost
- ice discharging through the weir
- effect of winter operation
- winter regime of navigation locks
- ice disposal from navigaiton lock by means of warm water /UVATERV study/.

Evaluation

May be partly used for CP.

4.4/27 Manipulation with trash from screen-bars of the hydroel.plant Nagymaros VIZITERV Szabó 1965 B

Content - Expected types and quality of floating debris trash, their approximate amounts.
- Capacity, approximate price, eventual description of the function of considered equipment, required for manipulation with debris and impurities of various quality, intercepted on screens.
- Suggestion of manipulation with intercepted debris in case of a divided power plant.
- Official opiniom of respective authorities.

Evaluation

Study may by partly used for CP.

4.4/28 Drainage of sewage and rainwater /precipitation/ from the operation territory of Nagymaros project VIZITERV Kéry 1965 B

Content - Drainage of right-banks sewage waters and longitudingal profile of the main header.
- Longitudinal profiles of the left-bank drainage of precipitation and sewage waters.

Evaluation

Study may be partly used for CP.

4.4/29 List of land sites for housing schemes and equipment of the construction site of the hydropower plant Nagymaros BUVÁTI 1964 B

Content - Project study deals with a rational lay out of the temporary housing schemes nearby Nagymaros project, considering the perspective urbanization plan of the Nagymaros village. Annexed is the statement of data on land expropriation

/Nagymaros, Visegárd/.

Evaluation

Documentation may be partly used for CP.

4.4/30	Detailed territorial plant of the settlment of provisional accomodation at hydroel. power plant Nagymaros	BUVÁTI	1964	B

Content - Document is identical with the project No.4.4/29

4.4/31	Study of railway siding construction at Nagymaros	VIZITERV	1965	D

Content - The study is dealing with the issue, if it is substantiated to leave the railway siding, constructed for the period of Nagymaros project construction /about 7 years/ also after completion of the construciton works, in operation. Conclusion: The railway siding is to be dismantled by three year from completion of the G/N Project.

Evaluation

Study may be used as auxiliary material for CP.

4.4/32	Network of railway sidings at Nagymaros project	UVATERV Gömöri	1964	D

Content - The railway siding for the construction and operation of the Nagymaros project was designed by UVATERV so, that in the railway station Nagymaros a new railway sill be provided designated as railway No.VII., from which will divert a shifting railway. From shifting railway will branch two temporary railway sidings /F1 and F2/ and in the length 604 bm the railway No. 1, which has a definite character. Schematic design of the railway sidings network was worked out with agreement with the public road No. 121 and connected networks of internal communications for the water project.

Evaluation

Project may be used as auxiliary material for CP.

4.4/33	Extension of the railway station Nagymaros	UVATERV Gömöri	1966	C

Content - Reconstruction and extension of the railway trackage Nagymaros, which is a part of the reconstruction of the railway line Budpest - Szob. 3 alternatives were worked out by UVATERV.

Evaluation

It will be necessary to identify, which alternative was realized and the possibility to connect the railway siding of the Nagymaros project to existing state.
Project may be used, after completion, for CP.

4.5 CHANNEL DEEPENING OF THE DANUBE DOWNSTRAM OF NAGYMAROS

4.5/1	Abridged G/N project task Soil survey in the section of lower water channel dredging	VIZITERV Kovács	1960	A

Content - Evaluation of bore holes investigation /1959 - 1960/, carried out with the aim to search the material of the Danube channel and the Danube branch downstram of Ngymaros.

Evaluation

Enginnering-geological character of the work, it may be used in full extent for CP.

4.5/2	Preparation for mechanical-hydraulic calculation for channel deepening	VIZITERV Takács	1963	A

Content - Presented data will be applied in the research task No. S-1-30-1/27 "Study of unsteady flow in reservoirs and canals of the G/N Project.

Evaluation

The study may be used in full extent for CP.

4.5/3	Investigation of slopes stability in the section of dredged channel in connection with the G/N Project	VITUKI	1966	D

Content - The study deals with the stability of the channel and banks, resulting from dredging, and methods of providing slopes stability.

Evaluation

Research results may be used as auxiliary material for CP.

4.5/4	Channel dredging downstream of Nagymaros. Supplement to investment task	VIZITERV Petö	1966	A

Content -Answers to the comments concerning the investment task of 1964 and supplements.

Evaluation

Material was used for the investment task in 1967. It may be used in full extent for CP.

4.5/5	Effect of dredging downstream of Nagymaros on drinking water supply of Budapest	PTV Aujeszky	1966	B

Content - Measurement and observations performed on the terriotry of the waterworks Horány I by means of drilled wells. The capacity of water resources was decreasign only at the Danube water stages lower than the average ones. At the Danube water stage drop by 1 cm the probable water yield drop 220 m3/day may be expected. In computations were considered existing water resources, as well as resources, which have been devgelopd b 1970.

Evaluation

Research results may be partly used for CP.

4.5/6 Effect of dredging downstream of Nagymaros on riparian structures | VIZITERV Varga, Rácz | 1967 | C

Content - The cost requrired for necessary reconstruction of waterworks structues and of sewerage systems, for navigation facilities, /ports, ferries, accesses to ferries/ were investigated in dependence upon water level decreasing due to dredging in the lower water, considering changes of various Danube discharges according to kilometeres.

Evalution

After completation the study may be used for CP.

4.5/7 Channel dredging downstream of Nagymaros | VIZITERV Petö, Pékné | 1967 | C

Content - Deals with the dredging tin the lower water downstream of the project, in the reach between rkm 1969,250 and rkm 1957,0 in both Danube branches. The aim of dredging of the channel in increasing of outputs and improving of navigable way. In the profile of the project the elevation of the bottom is 95,80 m above sea level. The gradient of the dredged bed is 4,7 cm/km in the Váci branch of the Danube, 5,2 cm/km in the Szentendre Danube branch. In rkm 1957 the bed is on the elevation 94,00 m above sea level. The bed width of the dredged channel is 450 m in front of the bifurcation, 350 m in the Váci branch, and 130 m in the Szentendre branch. For providing a new river channel it is necessary to construct 8,3 km of bank protection to ensure the bansk of the Szentendre island. The suggested dredging amounts to about 25 mil. m3.

Evaluation

Dredged voluems are assessed in the project on the basis of measurement data, specified by VITUKI in 1959. The channel was measured in profiles in the distance of about 1 km. It is necessary to examine, how the dredging works, performed in last period, as well as the changes in natural channel state had influenced the computed dredged volumes. After completion the project may be used for CP.

Annex 24

List of Studies, Research Works and Experts' Accounts, elaborated since the Approval of the G/N Project by the Czechosolvak Government in 1973 to the end of 1990, including Materials worked out by the Hungarian Party

LIST OF STUDIES, RESEARCH WORKS, AND EXPERTS'ACCOUNTS, ELABORATED SINCE THE APPROVAL OF THE PROJECT TASK "SYSTEM OF HYDROPOWER PROJECTS GABČÍKOVO-NAGYMAROS" BY THE CZECHOSLOVAK GOVERNMENT IN 1973, BY THE END OF 1990, INCLUDING MATERIALS, WORKED OUT BY THE HUNGARIAN PARTY

Elaborated by: Hydroconsult Bratislava
HIP G/N Project: Ing. Rosina
Ing. Schulz
No.of order: 156914-49-30240
Bratislava, January 1994

LIST OF WORKS FOR THE SYSTEM OF HYDROELECTRIC POWER PROJECTS

1. Hydrological data. Natural state
VIZITERV, Budapest, 1975
Content
The study includes hydrological data for the natural state:
- Bratislava, daily discharges over the period 1901-50
- Nagymaros, daily discharges over the period 1901-50
- data for the stream gauge profile Bratislava
- data for the stream gauge profile Nagymaros
- the Danube reach Bratislava - Budapest
- outlet sections of tributaries
Evaluation
The study was used for elaboration of the Joint Contractual Project.

2. Hydrological data - altered state during the construction period and after the completion of the construction. Permanent state.
VIZITERV, Budapest, 1975
Content
The study presents mutually verified hydrological data of the G/N Project at permanent regime. Permanent operation means, that hydropower plants and weirs are in operation, however without peak power production. The natural Danube discharge passes continuously through the hydropower projects.
Evaluation
Data presented in the study were used as basic material for elaboration of the JCP.

3. Hydrological data, altered state during the construction period and after the completetion of the system of hydropower projects - non-permanent state
VIZITERV, Budapest, 1975
Content
Peak operation at Gabčíkovo project is possible up to the discharge of about 4000 m^3/s. Results of hydraulic computations under these operation conditions are given.
Evaluation
Data presented in the study were used for JCP elaboration.

4. Study of ice regime alteration in the Danube after G/N Project completion /č.15/ Ist part
VÚVH Bratislava, 1975
Content
All available data on foreign experience and knowledge achieved till now in our country concerning the Danube winter regime are evaluated in the report. Experience obtained during the winter operation of the cascade of reservoirs on the Váh river were also considered.
The prognosis of ice regime for the reservoir Hrušov-Dunakiliti was determined by means of Šuljakovski thermal-balance method. Limiting values of ice phenomena duration in the future Nagymaros reservoir were derived from statistical processing of data from the stations Esztergom and Nagymaros.
Evaluation
Research results were used for processing of the JCP.

5. Study of the Danube ice regime alteration due to G/N Project construction
VÚVH Bratislava
VITUKI Budapest, Csoma, 1975
Content
On the basis of results of statistical processing of the characteristics of slush ice run, ice run, and freeze-up, derived from the observed present state, and of statistical evaluation of ice regime in reservoirs and lakes, serving as analogy, prognosis of the ice regime in the Hrušov-Dunakiliti reservoir was set up. On the basis of these results the method of ice discharging in the Hrušov-Dunakiliti reservoir was recommended, as well as ice regime in the bypass canal and old Danube channel.
Evaluation
Results were included into the JCP.

6. Establishment of instructions on navigation transport and of navigable way parameters
HYCO Bratislava, 1975
Content
The study presents data on navigation, required for the G/N Project, drawn up on the basis of data of the Danube Commission.
Evaluation
Data were considered in the JCP.

7. Design of the extension of the monitoring network structures aimed at the investigation of groundwaters within the area adjacent to the G/N Project.
VÚVH Bratislava, Mišút, 1975
Content
The solution of the study consists of
- processing of the scheme of monitoring structures
- evaluation of data on the basic and purpose network of groundwater level observation within the concerned area verification of the state and estimation of the acceptability of survey structures for monitoring network
- comparison of the design of network extension with existing suitable observation structures
- design of additional observation structures.

8. Computations of water levels, flow rates, discharges and velocities in the Hrušov-Dunakiliti reservoir, in the bypass canal, and in the Nagymaros reservoir under conditions of unsteady flow, aimed at verification of the final solution
VÚVH Bratislava, Hartoň, Komora, 1976
Content
On the basis of CZ-Hungarian consultations it was recommended to precise the results of former investigations concerning the peak operation, using a mathematical model of the final design of the G/N Project, taking into consideration 3 alternative cases
- power plant output 630 MW + 70 MW
- power plant output 700 MW
- power plant output 665 + 35 MW
At present the half-peak operation is considered at Nagymaros project.
Evaluation
Results were considered in processing of JCP.

9. Solution of water management tasks of the Lower Žitný ostrov in the connection with the water management solution of the G-N Project
HYCO Bratislava, 1976
Content
Complex solution of the internal water regime of the Žitný ostrov in the connection with the G/N Project, i.e. the concept of protection measures against permanent water level increase along the Danube and Váh.
The concept of
- flood control measures
- seepage control
- method of internal waters drainage
are proposed in the study.
Evaluation
Study served for elaboration of JCP.

10. Water balance
VIZITERV Budapest, 1976
Content
Water balance was worked out for discharges in an average year 1938, in the dry year 1934 and in the wet year 1910 /representative years/, and for envisaged extractions, or improvements by 1990.
Evaluation
Results were considered in projects.

11. Monitoring and measuring facilities for the G/N Project
VV IP Bratislava, Bálik
VITUKI Budapest, Nagy 1976
Content
The study was aimed at designing control measuring and observation facilities in structures, connected with the G/N Project, and was based on the solution, designed in the Joint Investment Task.
Evaluation
The study served as basis for JCP elaboration.

12. Equipments for the navigation control in the reach of the G/N Project
HYCO Bratislava, Danišovič, 1976
Content
The study presents recommendations of the Danube Commission from 1968, and regulations of the Order of navigation safety on inland water ways of CZSR from 1974. The study includes proposals for navigable way delimitation, marking of turning places for vessels, anchorage of vessels, mooring of ships, prohibition of landing and mooring, emergency ship landing, signalization of instructions for passage of vessels through the Gabčíkovo project.
Evaluation
Important basis for JCP elaboration.

13. Planned technology of the navigation operation for the G/N Project
VÚD Praha, Kubec, 1976
Content
The study deals with the prognosis of demands for transportation and development of navigation technology on the Danube. Stress is laid on the lack of statistic data for working out prognosis concerning transport and traffic in the Gabčíkovo profile.
Evaluation
The study has an orientation character

14. Investigation and reclamation of forest ecosystems within the concerned region of G/N Project
VÚLZ Zvolen, Cifra, 1977
Content
Data on the present state of forest ecosystems are presented, as well as information on the extent of deforestation before the G/N construction. Analysis of the effect of the G/N Project on floodplain forest ecosystem after the completion of construction
Evaluation
The study has an informative character

15. Summary documentation on the G/N Project
HYCO Bratislava, Schulz, Velič, 1979
Content
Summary documentation consists of
- part A - accompanying report, including basic data, purpose and significance of the system, description of the concerned territory, preparatory works, description of the system, main structures, realization and investment cost
- part B - re-counting to respective structures and total cost
- part C - economic report
- part D - requirements for realization of structures according to the character of investments, divided into water management part and energetic part, and for planning purposes into 3 structures
- part E - drawings
- part F - documents and budgets

Evaluation
Summary documentation was used as basis for elaboration of project documentation

16. Network graphs /plots/ of the process of construction - and updating
HYCO Bratislava, Cábel, 1979
Content
Input data for computation of the critical way for main structures
- Hrušov-Dunakiliti reservoir, CZ territory
- headwater canal
- Gabčíkovo project
- tailwater canal
Evaluation
The study created a basis for processing project documentation.

17. Data for the mechanization project of concreting works
HYCO Bratislava, Švábik, 1980
Content
Study was worked out for the contractor of civil engineering works - HYDROSTAV, and was used for elaboration of the project of concreting works mechanization
Evaluation
Data have informative character and were considered for verification of time schedules of Gabčíkovo project construction.

18. Coordination situations of heavy-current and weak-current cables- the G/N Project
HYCO Bratislava, Mach, 1980
Content
The study has dealt with clearly arranged coordination situations of heavy-current and weak-current cables in the area of Gabčíkovo project, which are already constructed or will be constructed.
Evaluation
The study was useful for contractors, designers and administration authorities.

19. Effects on the Austrian territory-original data
HYCO Bratislava, Báno, 1980
Content
The study was aimed at the estimation of the effect of the Gabčíkovo project on the common CZ-Austrian Danube section. Data from the Contractual Project of the Wolfsthal-Bratislava scheme were used.
Evaluation
The study has an informative character

20. Effects on the Austrian territory-new data
HYCO Bratislava, Báno, 1982
Content
The study was elaborated according to the experts agreement of July 7, 1981, oriented towards the estimation of effect of the Gabčíkovo project on the common CZ-Austrian Danube reach. Computations of impounded water levels were executed on the basis of new data.
Evaluation
The study has informative character, stating, that computed water

levels are lower than water levels, computed according to the original data.

21. Concept of the Danube utilization in the section Gabčíkovo-Hainburg
HYCO Bratislava, Báno, 1982
Content
Standpoint of the general designer, putting stress on the requirement to locate the Gabčíkovo structures on the CZ territory and to utilize in the maximum possible extent the structures under construction on the CZ territory.
In the Alterative "A" the weir was situated nearby Čilistov village, and in alternative "B" close to Čuňovo village.
Evaluation
The study has informative character.

22. Concept of the Danube utilization in the section Gabčíkovo-Hainburg
HYCO Bratislava, Báno, 1983
Content
Two schemes were studies, the first one assuming the step Bratislava upstream of the Gabčíkovo project in rkm 1853,500, the second scheme assumes the first step upstream of the Gabčíkovo project in rkm 1873,3, i.e. Wolfsthal-Bratislava project.
Evaluation
The study has informative character.

23. Project of the groundwater regime and water quality monitoring within the area of the Gabčíkovo project
VÚVH Bratislava, Mišút, Lehocký, 1982
Content
The study specifies structures, occuring within the concerned area, suitable for long-term monitoring of groundwater quality alterations. The existing and new structures amount to 25 sampling points.
Evaluation
The study has informative character

24. Economical consideration on the limiting level of reimbursement of works and deliveries, carried out on behalf of Hungarian party on the Gabčíkovo part pf the Project in various alternatives of credits, and way of refundment
HYCO Bratislava, Liška, 1983
Content
Economical efficiency of granting a credit to Hungary had been considered in the connection with Gabčíkovo project construction in two variants:
- within the extent agreed in May 1991, amounting to 3945,8 mio. Kčs in 82
- within an increased extent of 5 789,3 mil. CSK, representing practically the whole completion of the Gabčíkovo project by the CZ party, except for structures occurring in Hungarian inland.

Evaluation
Payment of the credit and interest rates was assumed to be realized in three alternatives.

25. Computation of water level courses in case of ice jam occurrence on the Danube in the rkm 1859,600
VÚVH Bratislava, Brachtl, 1988
Content
It was necessary to assess by means of computations under agreed extreme conditions the effect of ice jams on the water level in original state, and after completion of the polder and of the recreational area with rowing track, protected by the dyke. Computations were done by means of mathematical model developed at VITUKI Budapest.
Evaluation
The material has informative character. It was stated, that construction of the recreation areal and of the polder in the right-side floodplain would influence only slihtly the course of ice jam.

26. Updating of computations of the permanent flow in the G/N Project
VÚVH Bratislava, Szolgay, 1988
Content
Channel-forming processes, occuring due to altered runoff conditions in the Danube, and due to engineering interventions, have changed the geometric parameters of the channel. Therefore, the original computations were updated, and investigations were executed, in what extent the new channel geometry influences water level courses during permanent flow.
Evaluation
Updated water level courses, for instance in the region of the impounded area of Hrušov-Dunakiliti reservoir show water level depression within the Bratislava area.

27. Updating of computation of the permanet flow /Váh - Hron/
VÚVH Bratislava, Szolgay, 1988
Content
Updating of computaions of permanent Váh river flow in the section Kolárovo - Komárno and in the Hron river in the section Ústie - Kamenín, as continuation of measurements executed on the Váh over the year 1979-1982, and on the Hron in 1981-1986.
Evaluation
Computations updating was included into projects.

28. Updating of computations of the permanent flow /water gauge Bratislava-confluence with the Morava river/
VÚVH Bratislava, Szolgay, 1989
Content
Updating of computations of normal and impounded water levels between the stream gauge Bratislava and Morava river mouth was performed as to estimate the effect of the Danube channel development /deepening/.
Evaluation
Updating of computation was included into projects.

H R U Š O V - D U N A K I L I T I R E S E R V O I R

29. Model study of the Hrušov-Dunakiliti reservoir on a three-dimensional model, aimed at the verification of the total arrangement
VÚVH Bratislava, Komora, 1976
Content
- assessment of the effect of successive removal of forest growth in the area of the reservoir on flood water level
- verification of the final reservoir design and its effect on flood water level courses in the section of Bratislava
- study of the deposit development within the reservoir, and prognosis of reservoir sedimentation with suspended load.

Evaluation
Model study results were considered in the project.

30. Dunakiliti reservoir, sealing of dykes and aprons with foils - alternative solution
HYCO Bratislava, Oravec, 1979
Content
Information on technical specifications of the plastic foil IZOFOL BB, on possibility of its application as sealing material for the dam and for sealing aprons in conditions of the Hrušov-Dunakiliti reservoir, with respect to construction technology, as well as on economic effect of this solution.
Evaluation
The study has informative character.

31. Protection line Bratislava-Hamuliakovo
HYCO Bratislava, Oravec, 1983
Content
Analysis of priority construction of the left-side dyke from km 18,800 to km 9,787 in variant "A" and "B". Variant "A" consists of priority construction of the section from km 18,8 to Hamuliakovo branch, and variant "B" consists of priority completion of the section 2 and 3 and partly also 4, i.e. to the damming-up structure in km 7,938.
Evaluation
The study was used as basis for elaboration of the project documentation.

32. Modification of the technical solution of JCP - Hrušov-Dunakiliti reservoir
HYCO Bratislava, Oravec, 1983
Content
The study deals with the technical solution of JCP for the Hrušov-Dunakiliti reservoir, namely
- asphalt-concrete sealing of the left-side dyke 0,0-13,2
- arrantements on the left-side dyke and infiltration canal
- hodling area for vessels
- arrangements within the reservoir - left bank
- transition of the existing dyke and filling structure

Evaluation
Alterations were considered in further project documentation.

33. Estimation of propoased modifications at the end of the Hrušov-Dunakiliti reservoir with regard to safe ice discharging
VÚVH Bratislava, Brachtl, 1987
Content
It was necessary to estimate the course of the Danube winter regime in the past, to consider the effect of the designed system on winter regime on the basis of computations and model study, and to suggest measures to provide its safe course after putting the G/N Project into operation .
Evaluation
Suggested measures in the right-side floodplain between rkm 1862 - 1856 do not increase the course of flood waters and do not prevent the manipulation in case of ice jam liquidation in the area of Bratislava and at the backwater end of the Hrušov reservoir.

D U N A K I L I T I   W E I R

34. Model study of the general arrangement and lay out of the Duankiliti-Hrušov weir
VÚVH Bratislava, Komora, 1976
Content
The study confirmed, that the lay out of the weir and cut-off are suitably designed.
Results of model studies were continuosly delivered to the Hungarian professionals within the scope of the coordinated group of investors and designers over the years 1975 and 1976.
Evaluation
Results of the model study were included into the designs.

35. Model study of the Dunakiliti-Hrušov weir on a three-dimensional hydraulic model
VITUKI Budapest, Decsi Sándorné, 1976
Content
Model study resuts, achieved in 1976 at the VITUKI Budapest on an undistored three-dimensional model in the scale 1:100, with special attention focused on total stream flowing in the area of the Dunakiliti weir, on deformations of the cut-off bed after flood passings, and ice run, and ice floes discharging from the Hrušov-Dunakiliti reservoir.
Evaluation
Results of the model study were considered in the designs.

36. Hrušov-Dunakiliti weir
VIZITERV Budapest, 1975
Content
The investment task suggested closing of weir openings by means of shifting segment gates. The study recommends a weir construction supported by the sill, i.e. radial gate with flap.
Evaluation
The construction alteration was considered in the design.

37. Energetic utilization of the Dunakiliti weir
HYCO Bratislava, Tomaschek, Gardian, 1983
Content
In the JCP the power plant Dunakiliti was designed for a discharge 30 m^3/s, with possiblity to install one turbine set. On the basis of this study it is reommended to solve the Dunakiliti part with designed capacity of 2 x 50 m^3/s.
Evaluation
The study has informative character.

HEADWATER CANAL

38. Proposal of the asphalt-concrete coating composition for the headwater canal to the Gabčíkovo project
ČSSI Brno, Kratochvíl, 1974
Content
Designing the sealing zone of asphalt-concrete the utilization of local resources of the Danube gravel-sands was considered. Due to the seismicity of the territory of the headwater canal 6-7° MCS softer asphalt types were chosen for the sealing layer. Priorities of asphalt-concrete sealing for energetic and navigation canals of large dimensions have been proved namely in Germany in case of the Main-Danube canal.
Evaluation
Results were included into the Joint Contractual Project.

39. Testing of the method of dyke dimensioning of the headwater canal with regard to seismec conditions
HYCO Bratislava, Lányi, 1975
Testing of stability under seismic effects had been executed according to principles accepted in joint design regulations and supplemented at the meeting of investors and designers in Budapest, held from 18.-22. November 1974.
Evaluation
The study had to prove, that the main dimensions and the dam profile, designed in the Investment task should not be changed.

40. Testing of the headwater canal filling
HYCO Bratislava, Mach, 1975
Content
The possiblity of earlier testing headwater canal filling up to the level 125,50 m above sea level was studied, as well as the possibility of the navigation way transposition into the headwater canal at a hydrostatic level of 125,50 m. The navigation-economic and energetic-economic aspects were considered.
Evaluation
The study was used as basic information for Joint Contractual Project preparation.

41. Investigation of the headwater canal dykes sealing
VÚIS Bratislava, Hobst, 1975
Content
The study was focused mainly on constructional solution of headwater canal slopes protection, as well as on other structures.
Evaluation
The study has informative character

42. Sealing of the headwater canal bottom
VÚIS Bratislava, Medelský, 1975
Content
Review of possibilities of headwater canal bottom sealing with stabilized earth. Three alternatives were considered: sealing

with compacted earth, with earth stabilized with concrete, and sealing with textile.
Evaluation
This methods of headwater canal bottom sealing were not considered in the designs.

43. Design of the technology of asphalt-concrete coating of approach and outlet canals of the Gabčíkovo project
ČSSI Brno, Kratochvíl, 197 ?
Content
In designing the coating technology of asphalt-concrete for the headwater canal experience gained during construction of navigation canals in Germany were applied. The lagging unit is the cetre of machine equipment. Slope finisher was recommended for deposition of asphalt-concrete layers, with precompacting of the deposited mixture. Deposition of the mixture maybe executed in the gradient direction, or parallelly with the canal axis. It is recommended to use lighter machinery, which may be used several times. For deposition of asphlat mortar for rock rip-rap the line Wibau MPE-10-M20 was recommended /rotor pump/.
Evaluation
The results were partly applied for designing the technology of asphalt-cencrete, and asphlat concrete mortar deposition.

44. Hydraulic dimensioning of the headwater canal
HYCO Bratislava, Schulz, 1976
Content
Dimensions and shapes of the headwater canal were designed in the Joint Investment Task on the basis of hydraulic computations, considering a continuous 5-hour peak with the power output of 630 MW, while ensuring possibility of frequency regulation within the range + 70 MW for 900 m^3/s. The Hungarian electrifying system prefered the output of 700 MW? without a reserve for frequency regulation. Technical-economical analysis was performed in three alternatives
- extension of the canal
- increasing the thickness of the protection layer
- application of screened material.

Evaluation
The results have informative character and were considered in the final solution of headwater canal bed construction.

45. Construction solution of the headwater canal
HYCO Bratislava, Martinický, 1976
Content
Sealilng and protection of dyke slopes of the headwater canal was solved in three alternatives
- continuous asphalt-concrete coating
- coating of prefabricated reinforced concrete slabs
- coating of concrete slabs, executed on the slope

Evaluation
Results have informative character.

46. Sealing of fissure cracks in concrete protection on the slopes of headwater canal by colmatage
VÚVSH Brno, Čistin, 1976
Content
Descreasing of seepage through fissure cracs in the concrete sealing on the slopes of headwater canal may occur under certain conditions of colmatage. Colmatage process and its intensity depends upon the suspended load supply. In case of Gabčíkovo project peak operation the colmatage would be reduced due to turbulence.
Evaluation
The material has informative character.

47. Technical assistance for consultations with Soviet Union - investigation of dynamic characteristics of headwater canal dykes
HYCO Bratislava, Hobst, 1979
Content
Evidence of seismic stability of earth dykes of the headwater canal, reaching the height up to 17,5 m is very important and due to the extraordinary significance of this water scheme the effect of seismic impuls in case of potential earthquake has been studied by meaas of the available advanced scientific knowledge and current computation technique.
Evaluation
The study served as basic material for consultations in Soviet Union.

48. Informative study of headwater canal sealing and of reservoir packing using asphalt concrete
HYCO Bratislava, Čomaj, Oravec, 1979
Content
The informative study should estimate the possibility of asphalt-concrete sealing application for PK and reservoir in the connection with the offer of Doprastav. According to the request of hydroconsult the "Design of asphalt-concret sealing coat for the Gabčíkovo Project" was prepared.
Evaluation
The study was used for capacity providing of the sub-contractor.

49. Sluice below the canal in km 4,0 - design of equipment for identification of vat untightness
HYCO Bratislava, Kolárik, 1979
For designing methods to detect eventual vat leekage it is recommended to build in wells in respective casttes or control observation bores.
Evaluation
The study was helpful for sub-contractor capacity providing.

50. Sluice below the canal in km 4,0 - study of water mains transfer through the sluice
HYCO Bratislava, Zagorodnov, 1980
The study is dealing with the feasible conveying of drinking water mains through the structure. It was concentrated on the possibility to install water mains within the sluice profiles,

and on necessary modification of inlet and outlet section of the structures.
Evaluation
The study confirmed the technical solution of conveying a discharge volume of 6,8 m^3/s.

51. Test sections for estimation of the feasibility to realize AB mantle sealing
Doprastav Bratislava, Patratur, 1980
For estimation of the feasibility of sealing the bottom and slopes of the headwater canal and of the reservoir with coating AB sealing it was necessary to
- investigate, verify, and prove, whether it is possible to deposit AB layers on the compacted area of the plain
- to find the required modul of plain deformation
- to verify the impermeability of the bed
- to propose the mixture and estimate its flexibility
Evaluation
The study was used for project preparation

52. Preparation of subsoil of canal dykes
HYCO Bratislava, Čomaj, 1982
The aim of the study was estimation of the optimum utilization of gravel-sand sources for the construction of the headwater canal, in the connection with the consideration, that the tailwater canal would be exploited only to the elevation 101,50 Bpv and with the feasibility to open a borrow pit "D".
Evaluation
The study has informative character and gives information on various combinations of exploitation and transportation.

53. Headwater canal - rationalization of gravel-sand transport - supplement
HYCO Bratislava, Čomaj, 1983
Content
The study was elaborated with aim to consider the optimum utilization of sources of grave-sand for the headwater canal, while the tailwater canal is assumed to be exploited to the elevation 101,5 Bpv.
Evaluation
The study has an informative character

54. Headwater canal - rationalization of gravel-sand transport - supplement to the study I/83
HYCO Bratislava, Čomaj, 1983
Content
The study is linked up with the study I/83, where the tailwater canal is source of gravel-sand, and it is assumed to exploit it to the elevation 101,5 Bpv. Further sources are the pits "A", "B", "D" and the Bakan branch of the Danube "volume 4,0 mil.m^3/.
Evaluation
The study deals with various combination of gravel-sand exploitation for the demands of headwater canal construction.

55.Modification of the technical solution of the JCP - Headwater canal
HYCO Bratislava, Čomaj, 1983
Content
The study deals with the alterations of the technical solution of JCP, mainly in
- sealing of slopes with PK alphaconcrete
- sealing of canal bed with a foil
- arrangement and completion of structures 1-32 sluice below the canal, and 1-33 right-side infiltration canal, and 1-34 left-side infiltration canal.
Evaluation
Alterations were included into the project documentation.

56. Rationalization of gravel-sand transport for the headwater canal-Hungarian participation
HYCO Bratislava, 1983
Content
Balance of requirements form real sources at changed conditions of contractor's providing of exploitation for the years 1984-85.
Evaluation
Results of the study were included into the project.

57. Flowing through the subsoil of the headwater cnal inlet section
VÚVSH Brno, Hálek, 1988
Content
The headwater canal is from the km 0,0 in the downstream direction sealed by foil. The inlet section is extended in the upstream direction. At the beginning the bed is sealed with clay and in the upstream direction an apron about 300 m wide was designed in the flood land between dyke and river on both sides. Inner paret is not sealed and the design considers plugging and reclamation of the existing cover.
The area of the end of well row is a rather vulnerable part. It is recommended to increase the number of wells and to arrange them so as to decrease the effects of flow concentration.
Evaluation
The results were included into the project.

T H E   G A B Č Í K O V O   P R O J E C T

58. Final lay out of the Gabčíkovo project with regard to tectonic conditions
HYCO Bratislava, Hraško, 1974
Content
Within the scope of preparatory works for the Joint Contractual Project final reports of executed research and investigation works were evaluated, especially the final report concerning tectonic research. With respect to potential scattering of seismic shakes slong the Gabčíkovo fault it was recommended to shift the Gabčíkovo step into km 17,00 of the canal.
Evaluation
Results of the study were considered in the project.

59. Geological estimation and evaluation of the final lay out of the Gabčíkovo project
GÚDŠ Bratislava, Janáček, 1974
Content
On the basis of analysis of the tectonic structure of the Danube region the estimation is positive concerning the shift of the Gabčíkovo step into km 17,00 of the bypass canal.
Evaluation
Conclustions of the expert's account were accepted.

60. Specification of turbines number for the Gabčíkovo project
HYCO Bratislava, Hraško, 1975
Content
On the basis of this study the CZ party approved at the negotiation held on May 29, 1974 the concept of the hydropower plant Gabčíkovo with 8 turbines.
Evaluation
The results of the study were considered in the project.

61. Lay out solution of the Gabčíkovo project
HYCO Bratislava, Hraško, 1975
Content
Several alternatives of lay out solution were prepared, with various solutions of the problems of output section of the tailwater canal. In all eight alternatives it was assumed, that it is not possible to empty simultaneously both locks, thus accumulating large discharges.
Evaluation
The study was used as useful material for elaboration of JCP.

62. Filling and emptying system of Gabčíkovo navigation locks
HYCO Bratislava, Hraško, 1975
Content
Alternative designs of the systems of filling and emptying of the Gabčíkovo navigation locks, using knowledge from the literature on large navigation locks. At the same time specific conditions of foundation were taken into account with resulting constructional solution of navigation locks.
Evaluation

From suggested alternatives the final solution was recommended for JCP.

63. Architectural solution of the Gabčíkovo project for the System of hydroelectric power plants Gabčíkovo-Nagymaros
ŠPTŮ Bratislava, Skoček, 1975
Content
In the architectural study, following structures have been dealt with:
- engine house of the hydroelectric power plant
- assembly hall of the hydroelectric power plant
- administrative building
- control room and switching stations
- tower for navigation control
- auxiliary operation and process structures

Evaluation
Architectural study was used for elaboration of the Joint Contractual Project.

64. Foundation of the Gabčíkovo project
VÚIS Bratislava, Gregor, 1975
Content
The aim of the study was to consider the concept of the design Gabčíkovo project from the point of view of present state of the art and scientific knowledge as optimum and realizable in our conditions.
Evaluation
The study has informative character.

65. Model study of the Gabčíkovo project on a three-dimensional hydraulic model
VÚVH Bratislava, Štich, 1976
The study was carried out on a three-dimensional hydrauic model and was oriented toward verification of the new lay out of the project, taking into consideration
- the shift of the hydropower plant profile
- reduction of the area upstream of the hydropower plant
- decreasing of the turbine number from 9 to 8
- alteration of the shape and dimensions of the lower lock approach and of the separating island
- output section of the tailwater canal

Evaluation
Research results were included into the project.

66. Model study on a three-dimensional model of one block
VÚVH Bratislava, Žajdlík, 1976
Content
Study of lowing in the turbine block and idle runoff was performed on hydraulic model, aimed at verification and testing of the effect of the shape and dimensions of the idle outlet on turbine efficiency.
Evaluation
Research results were used in decision making concerning the shape of the turbine block of Gabčíkovo project.

67. Power transmission line from the hydropower plant Gabčíkovo
HYCO Bratislava, Tomaschek, 1976
Content
On the basis of development of electrification systems in Hungary and Czechoslovakia, the idea of connection the hydropower plant Gabčíkovo into the 220 kV network was abandoned and connection into the 400 kV network was suggested by means of the transmission line Biskupice - Győr.
Evaluation
Results of the study were included into the project.

68. Model study of the filling and emptying system of navigation locks at Gabčíkovo project
SVŠT Bratislava, Mäsiar, 1976
Content
The goal of the model study was testing the designed system of filling and emptying of navigation locks, provided by two bypasses located in lateral walls and by groups of transverse filling canals.
Evaluation
As criteria for estimation of the hydraulic system of locks were chosen the period of filling of 15 minutes, and forces acting on passing vessels, which must not exceed 1-600 of displacement. The designed hydraulic system meets the main criteria and may be recommended for realization.

69. Study of the structure of navigation locks interconnection at Gabčíkovo project - Final Report
VÚVH Bratislava, Hlavačka, 1977
Content
The aim of the study on three-dimensional model of navigational locks connection was the assessment of the discharge from head losses in interconnecting canals, depending upon closing device opening at both flow directions, and the determination of flow conditions on the basis of pressures in interconnecting canals.
Evaluation
Model study results were used for estimation of the final design of the connecting structure.

70. Study of the modelling part of the navigation lock filling gallery of the Gabčíkovo project - Final Report
SAV Bratislava, Strauss, 1977
Content
On the basis of a detailed analysis of experimental results it was recommended to realize the alternative "N". According to this alternative the separating structure divides uniformly the discharge, has not high resistance, with resulting more uniform pressure distribution within the hydraulic system, its symetry providing operation over the filling and emptying of the lock.
Evaluation
Research results were used in the project.

71. Model study of navigation locks filling and emptying system of the Gabčíkovo project. Partial report - non-combined locks.
SVŠT Bratislava, Mäsiar, 1978
Content
Study of the filling system performed on the model of the lock in the laboratory of the University of Civil Engineering, Hydraulic branch, showed that the geometric asymetry of the filling system of the lock ensues in non-uniform distribution of discharges along the width and length of the lock, resulting in somewhat larger longitudinal and transversal forces than originally assumed.
Evaluation
The results were used for the project.

72. Study of the filling and emptying system of combined navigation locks of the Gabčíkovo project - preliminary report
SVŠT Bratislava, Mäsiar, 1978
Content
Designed system of combined locks filling complies with required parameters, while 47% saving of water is attained over the filling period of 19,24 min. Emptying period of combined locks is about 24 min.
Evaluation
Research results were used in the project.

73. Study of ice floes discharging and of the hydrodynamic loading and of the hydrodynamic loading on the upper head of navigation locks of the Gabčíkovo project
VÚVH Bratislava, Žajdlík, 1987
Content
The study was oriented toward the assessment of discharge and hydrodynamic loading of damming-up segment of the upper head and bottom of the navigation lock in the course of sub-negative filling and ice floes discharging, as well as flood water passing.
Evaluation
On the basis of research results modification in the project were realized.

74. Model study of the filling and emptying system of combined navigation locks of the Gabčíkovo project
SVŠT Bratislava, Mäsiar, 1978
Content
Model study was focused on
- time course of the opening and closing of the closing devices of the filling and emptying, and connection system
- time course of filling and emptying
- cross-sectional velocities of water flow in filling and emptying and connection canals
- velocity of rising and decreasing of water level in locks
- forces acting on series of vessels during filling and emptying.
Evaluation
Recommendations derived from this study were considered in the project.

75. Study of the closing segment in bypasses of navigation locks of the Gabčíkovo projects
SAV Bratislava, Strauss, 1978
Content
The model study was focused on
- estimation of the shape of bearing part of the segment
- testing of hydrodynamic load of the segment and sides of the bypass nearby the closure, in dependence upon operation conditions
- evaluation of dicharge characteristics for various degment openings

Evaluation
Research results were considered in the project.

76. Providing of the overpressure flow regime in bypasses of navigation locks of the Gabčíkovo project
VÚVH Bratislava, Hlavačka, 1978
The research task was aimed at preventing air entrainment in the system, at assessment of the discharge and pressure conditions in case of failure of one of the closing devices, and to estimate the effect of time shift of gate openings on discharge compensation /balancing/ in the inner and outer connection circuit.
Evaluation
Research results were considered in the project.

77. Study of the alternative solution of the separation part of the navigation lock section - Gabčíkovo project
SAV Bratislava, Strauss, 1978
Content
Testing of other possibilities of uniform discharge distribution from the main gallery into the central canal by means of the most possible shortening of the spur and modification of central canal cross-sections, with the aim to attain the most uniform discharge distribution in the longitudinal direction. Further the flowing in the dividing structure, velocity and pressure distribution in the outlet gaps, and effect of the connecting opening between the main gallery and original branch of the central canal were tested.
Evaluation
Research results were considered in the project.

78. Model study of the filling and emptying system of non-combined and combined navigation locks - Gabčíkovo project
SVŠT Bratislava, Măsiar, 1978
Content
The Final Report summarizes results of the study of filling and emptying system of navigation locks achieved up to the present. Following measures were recommended:
- radius of gallery arches of the filling and emptying system
- variation of the dividing spur shape
- prolongation of the central dividing canal below the sections of filling gaps
- dimension of gap areas in the ceiling of the longitudinal dividing canal

- extension of the discharge cross-section of transversal canals.
Evaluation
Research results were considered in the project.

79. Study of navigation locks of the Gabčíkovo project
VÚVH Bratislava, Žajdík, 1979
Content
Comprehensive report on the most important research results, decisive for the project and operating regulation of navigation locks operation. Enclosed are also detailed analyses of the methodology of solution of respectie tasks, description of models, experimental equipments, and evaluation of all experimets.
Evaluation
Research results were incorporated into the project.

80. Data for negotiations with Soviet experts - Gabčíkovo project-navigation locks
HYCO Bratislava, Hraško, 1979
Content
Submitted materials deal with the concept and construction solution of some parts of navigation locks at the Gabčíkovo project, namely
- design of layout of lock approach and of the filling and emptying system on the basis of hitherto achieved results of hydraulic model study
- design of closure device solution
Evaluation
Results of consultations were incorporated in the projects

81. The Gabčíkovo project - data for consultations with Soviet experts - in Russian language
HYCO Bratislava, Hraško, Schulz, 1979
Content
Submitted materials present
- design of layout solution of lock approaches and of the filling and emptying system on the basis of achieved results from hydraulic model research.
Evaluation
Results of consultations were considered in the project documentation.

82. Lay out of lock approaches with respect to navigation technology
HYCO Bratislava, Dinga, 1979
The study analyses the navigation organization at the Gabčíkovo project.
Evaluation
The study has an informative character.

83. New design of the hydropower plant Gabčíkovo - provisional standpoint
HYCO Bratislava, Báno, 1979
Content
The study presents preliminary data on flow through turbines which in case of fall-out loss would operate in idle run regime. On the basis of these data a curve was developed on discharge course in dependence upon time after the fall-out of the hydropower plant from the network.
Evaluation
The study has an informative character and will be considered as useful for the provisional standpoint towards the submitted design.

84. Effect of the new design of the hydropower plant Gabčíkovo on navigation and flood water diversion
VÚVH Bratislava, Komora, Štich, Žajdlík, 1981
Content
The issue of leaving out idle outlets at the hydropower plant Gabčíkovo had been dealt with, as well as passing of flood discharges and effect on navigation safety.
Evaluation
The account has an informative character.

85. Estimation of the proper and joint project for the contractor of the technological part of the IVth and Vth structure
HYCO Bratislava, Švábik, Cábel, 1981
Content
The study gives the investment cost, required for providing construction of structures and equipment of the construction site of the IV and V structure of the Gabčíkovo project for the contractor of the technological part.
Evaluation
The study has informative character

86. New design of the hydropower plant Gabčíkovo - provisional standpoint, supplement No. 1
HYCO Bratislava, 1981
Content
The study gives answers to the questions
- how the Dunakiliti weir will join in passing of discharges
- how the Gabčíkovo project will join in passing of discharges
- effect of fall-out loss in the hydropower plant Gabčíkovo on water levels in the reservoir and in the headwater canal
- how long will last the fall-out loss at Gabčíkovo and how will the turbines be put into operation after the fall-out.

Evaluation
The study has informative character and was worked out using the balance method.

87. New design of the hydropower plant Gabčíkovo - provisional standpoint - supplement No. 2
HYCO Bratislava, Báno, 1981
Content
The submitted study, supplement No. 2 is a continuation of the supplement No. 1. As to work out supplement No 2 it was necessary to investigate following:
- the disintegration of the COMECON transmission system is not assumed ?
- in spite of that a failure in 400 kV system or in 110 kV network may occur
- fault clearing in 400 kV system is assumed in 30 min., and in 110 kV network in 3-15 min.

Evaluation
The study states, that under proper cooperation between the weir and Gabčíkovo project it would be safe to pass the supply into the reservoir through the weir and Gabčíkovo step. The study has informative character.

88. Operation centre Gabčíkovo
HYCO Bratislava, Ambrož, 1987
Content
The study dealt with the feasibility of utilization of the equipment of the construction site belonging to the contractor Hydrostav in Gabčíkovo, and the selection of locality for the operation centre of the Danube River authority.
Evaluation
The study has informative character and indicates the necessity to work out a suitable plan.

89. Data for the draft of the final operating regulations for navigation locks of the Gabčíkovo project - Ist part
SVŠT Bratislava, Mäsiar, 1987
Content
Intensity of permitted forces acting in mooring ropes of vessels, or of forces acting directly on vessels in the starting point for the design of the filling and emptying system, of the velocity of gates opening and general manipulation with them, as well as of the method and technique of discharge.
Evaluation
Results of this research report will be used for drawing up operation regulations of navigation locks.

90. Flood water discharging through the Gabčíkovo project
HYCO Bratislava, 1988
Content
The discharge 10 600 m^3/s was considered as basis for computation of flood waters discharging through the Gabčíkovo project. The most crucial situation will occur, when the whole flood discharge will have to be passed through the Dunakiliti weir. The computations were completed in March 1991 and March 1992, when 4, or 8 turbines were installed at Gabčíkovo project and the Danube river bed was successively dredged downstream of Palkovičovo

Evaluation
The study was used for elaboration of the updating of the plan of putting the Gabčíkovo project into operation.

91. Study of the abruptness of rise time ending of peak operation at Gabčíkovo hydropower plant under normal and emergency operation conditions with regard to navigation safety
VÚVH Bratislava, Štich, 1989
Content
Estimation of improvement of dynamic characteristics of the hydropower plant and a supplement to the initial project with regard to navigation conditions, and obtaining data for the proper operation of the power plant. Two operational cases of power plant control were analysed, i.e. normal operation and emergency operation.
Evaluation
It is assumed that model research results wil be verified and supplemented by continuous monitoring directly at the project.

92. Hydrological data for guarantee measurements at the Gabčíkovo hydropower plant
HYCO Bratislava, Báno, 1989
Content
Data for elaboration of the method of determination the extent and assumed duration of guarantee measurements on turbines at the Gabčíkovo hydropower plant are presented. In analyzing the feasibility of manipulation on Dunakiliti weir and on Gabčíkovo project three cases were considered according to the ratio between the supply into the reservoir and the discharge, required for guarantee measurements.
Evaluation
Guarantee measurements were planned for summer 1991 /May, June, July and August/.

93. Data for guarantee measurements at the Gabčíkovo hydropower plant
VÚVH Bratislava, Sumbal, Štich, 1989
Content
Estimation of the effect of navigationa locks function in the course of guarantee measurements on fluctuation and stabilization of headwater and tailwater levels /abrupt discharge variations from 2400 m^3/s to 1800 m^3/s during about 30 minutes and vice versa/, by means of computations. Computations should be carried out under assumption, that the Nagymaros project would not be in operation yet.
Evaluation
The estimation was considered in the project.

T H E   T A I L W A T E R   C A N A L

94. Filtration stability of the tailwater canal
VÚVSH Brno, Čistin, 1989
Content
Admissible hydraulic gradients and composition of filters on canal slopes were assessed by means of the study, with regard to water level variations, resulting in non-stationary filtration in a wider range of soils.
Evaluation
Results of the study were incorporated into the design of the filtration layer on tailwater canal slopes.

95. Laboratory study of the appropriate composition of the hardening element and asphalt concrete for the tailwater canal
ČSSI Brno, Kratochvil, 1975
Content
The laboratory study dealt with the composition of the hardening element of asphaltconcrete on the slopes of the tailwater canal of the hydropower plant Gabčíkovo. With respect to seismicity of the territory of tailwater canal 6 - 7° MCS it was recommended to provide stone rip-rap, run-in with asphalt mortar /half-blown asphalt P 80/.
Evaluation
Results were considered in selecting final design of tailwater canal slopes protection.

96. Study of the floating of the dredger into the tailwater canal outside the closing structure in km 25,022
HYCO Bratislava, Mach, 1978
Content
It is recommended to construct within the protected area relaying of the dyke in such an extent, as to make possible floating of bucket ladder dredge KBT 400/200 into the tailwater canal. The existing flood control dyke will be dismantled and after entering of the dredger the dyke will be again put into the original state.
Evaluation
The study was included into the project.

97. Construction arrangements aimed at placing the dredger in the tailwater canal
HYCO Bratislava, Uhlár, 1979
Content
Floating bucket ladder dredge was chosen for excavation of the tailwater canal /KB 160/60/. The first part of the study deals with the access road and assembling site, the second deals with the construction of the basin with requisite arrangements for lowering the dredger on water.
Evaluation
The study was incorporated into the project.

98. Tailwater canal - leftside protection dyke, navigation and drainage ingate
HYCO Bratislava, Uhlár, 1979
Content
The Hungarian party asked to modify the route of the navigation and drainage ingate, formerly designed in about 50 m on the left side of the tailwater canal axis, and to locate it immediately close to the left bank. Excavated material from the ingate should be used for construction of the leftside protection dyke.
Evaluation
Results of the study were included into project documentation.

99. Study of optimum technological transport of gravel sands and feasibility of gravel-sand materials sources alteration
HYCO Bratislava, 1981
Content
Investigation on the sources of gravel-sand material for the construction of tailwater canal dykes, aimed at the shortening of haulage distances and cost saving.
Evaluation
Study was used for processing of project documentation.

100. Estimation of the possible location of pumping station Bebrava into the tailwater canal
HYCO Bratislava, Mach, 1981
Content
Feasibility to use the pumping station Bebrava instead of pumping station Pohronie.
Following main issues were dealt with
- the effect of decreasing the total repumping capacity by 2,5 m^3/s on carrying away of seepage from bypass canal
- feasibility of the layout and altitude arrangement of pumpung station Bebrava and pumping station Ponitrie along the transposition of the dyke "A" at the closing structure.

Evaluation
The study was incorporated into the project.

101. Provisional estiamtion of the tailwater canal stability downstream of Gabčíkovo hydropower plant without impoundment of the Nagymaros project
VÚVH Bratislava, Kališ, 1983
Content
According to the Joint Contractual Project it was considered to locate the tailwater canal bed on the elevation of 96,5 Bpv. The study estimated the tailwater canal stability at the elevation 101,50 Bpv.
Evaluation
In place where bottom and slopes consist of gravel and sand, or eventually gravel-sand the bottom and slope deformation will be negligible. In case of sand and gravel the section of the canal must be protected with rip-rap. The slope of the unprotected part of banks of the canal is recommended to be 1:5.

102. Model study of the separted alternative of the tailwater canal downstream of Gabčíkovo project
VÚVH Bratislava, Štich, 1986
Content
The task was oriented toward the solution of hydraulic problems and providing favourable conditions of flowing in the tailwater canal, in the area of its output section, and in the deepened Danube channel downstream of the mouth. The research was realized in cooperation with VITUKI Budapest.
Evaluation
The study has informative character.

103. Study of the hydrologic-hydraulic scheme for the biotechnical project of the arrangemet of the Danube flood land between dykes from rkm 1842 to rkm 1810
VÚVH Bratislava, Szolgay, 1975
Content
Analysis of assumed effects of the System of G/N Project on the old river bed and design of hydrologic-hydraulic scheme for the biotechnical project of the arrangement of the Danube flood land between dykes from rkm 1842 to rkm 1810, based on designers proposals and results of the study of groundwater level alteration /prognosis/.
Evaluation
The study was used for elaboration of the Joint Contractual Project /JCP/.

104. Arrangement for floating of dredgers into borrow pits "A" and "B"
HYCO Bratislava, Oravec, 1979
Content
Feasibility of entering heavy extraction mechanisms into borrow pits "A" in rkm 1835 and into the borrow pit "B" in rkm 1832 - 1934.
Evaluation
The study was used for project elaboration.

105. Data for solution of the task "Effect of the old Danube river bed on the groundwater regime" by means of the EGDA model
VÚVH Bratislava, Mišút, Szolgay, 1988
Content
The task was focused on
- height position of the top soil
- lay out of the flooded territory and duration of flooding
- upper and lower boundary of the area investigated
- capillary rise within the top soil
- prognostic groundwater levels
- filtration coefficient of the water bearing horizon and filtration coefficient of the branch system bed
Evaluation
Research results were used for the project.

P R O T E C T I V E   M E A S U R E S

106. Effect of dredging downstream of Nagymaros on drinking water supply of the area and of Budapest
VIZITERV Budapest, 1975
Content
According to this study the groundwater level decreasing due to the Danube bed dreadging downstream of Nagymaros will result in well yield decreasing by about 130 000 m^3/d at the water level stage in the Danube 670 m^3/s.
Evaluation
The study has informative character.

107. Protection measures on CZ territory, alternative solution of the area VI and VIII.
HYCO Bratislava, Vlčko, 1975
Content
The drainage of seepage waters by means of smaller pumping stations in Nová Stráž and Zlatná na ostrove is in this design substituted with a concentrated drainage of seepage waters into internal /inland/ canlas and by pumping in one larger pumping station in Komárno.
Evaluation
Material for negotiations with Hungarian party. The insufficient capacity of the pumping station Komârno is compensated by the increased capacity at Viničné pumping station.

108. Protection measures on CZ territory, alternative solution of the area IV and VII - left bank of the Váh and Iža
HYCO Bratislava, Bitter, 1975
Content
The study deals with the comprehensive solution of structures:
- infiltration canals Harčaš - Iža - Patince
- Žitavská Toň 7,25 m^3/s
- infiltration canals Komoča - Landor - Komárno

Evaluation
Results of the study were incorporated in the project.

109. Alternative solution for the area IV and VII - protective measures on CZ territory
HYCO Bratislava, Müller, 1976
Content
Protective measures in the area No. VII and IV in the connection with already constructed canals of internal waters. Within the area No. VII the section Landor - Komoča and Lándor-Martovce has been dealt with, and within the area No. IV the section Iža.
Evaluation
Results of the study were used for the project.

110. Protection measures on CZ territory - area city of Komárno - alternative solution
HYCO Bratislava, Vinkler, 1978
Content
The suggested protection of the city of Komárno consists of a bank line, protecting the city against flood waters, of underground curtain, series of wells, siphons, drains, infiltration canals and pumping stations aimed at groundwater level stabilization at about 1,5 m below the terrain.
Evaluation
The study was used for elaboration of the project.

111. Komárno - Slovak shipyards, protection of the area against the effect of the Nagymaros project
HYCO Bratislava, Bradáč, 1977
Content
Protection of the Slovak Shipyards in Komárno has been solved in 5 variants, which are compared here. The complex of the shipyard cannot be protected by means of usual protection and anti-seepage measures as in case of the city. The protection must be provided in accordance with production activity and in the connection with envisaged development and innovation programme.
Evaluation
The study was used for elaboration of the project.

112. Operation centre Komárno
HYCO Bratislava, Hledík, 1979
Content
Design of dispatching centre in Komárno and orientation design of equipment. The study does not include measuring stations, nor connection roads.
Evaluation
The study has informative character.

113. Alternative technical solution of the Váh alluvial plain protection in the section Komárno - Kolárovo
HYCO Bratislava, 1979
Content
The protection of the flooded area is solved by means of four protection steps, suggested at given localities in dependence upon the with of the terrain strip, altitude of the terrain, feasibility to divert water, local conditions, etc.
Evalution
The study was used for elaboration of project documentation.

114. Protection of historical relics in the area Iža - Roman castelium, Leányvár
HYCO Bratislava, Rybár, 1980
Content
Protection of the historical relics is provided by the /transfer/ displacement of the present Danube dyke close to the water stream. The dyke will be sealed, protected on the water face. It will be built into the subsoil by means of a sealing underground wall.

Evaluation
The study was used for elaboration of the project.

115. Protection measures on CZ territory-pumping stations - comparison study of vertical and volute-type pumps
HYCO Bratislava, Kubík, 1982
Content
On the basis of a review of total investment cost of the constructional and technological part of respective alternatives it was realized that alternative using volute-type pumps is more expensive than the original solution using vertical pumps.
Evaluation
The study has informative character.

116. Area Komárno-city, substantiation of the technical solution alterations
HYCO Bratislava, Bradáč, 1982
The study was elaborated on the basis of the requirement of Hungarian party with the aim to estimate, whether the new technical solution of Komárno protection is equivalent to he solution of the Joint Contractual Project, underground wall of self-setting suspension 60 cm thick is designed, the other structural arrangements remaining as in original design.
Evaluation
The study was used for prepration of the project.

117. Evaluation of hydroisohyetal lines in the Danube section in Kravany, the Lower hron, and Ipeľ areas
VÚVH Bratislava, Gažovič, 1985
Content
Estimation of hydrological conditions, of hydroisohyetal lines and directin of groundwater flow at flood water events in 1975 for sequential stages, and design for completion of groundwater monitoring network in areas Kravany, lower Hron and lower Ipeľ.
Evaluation
Results were used for elaboration of project documentation.

118. The dead branch Čičov - state natural reservation - technical solution of protection
HYCO Bratislava, Kissová, 1982
Content
It is necessary to prevent drying up of the state natural reservation of the Čičov dead brach due to the Danube bed deepening downstream of Palkovičovo, and to provide fishery management with water, amounting to 2, 86 m^3/s, and the Čičov dead branch with 60-70 l/s.
Evaluation
The study was used for project documentation.

Annex 25

(Extracts)

Gabčíkovo-Nagymaros Barrage

Project Study

March 1989

Compiled and edited by Christine Reid

("the Massachusetts study")

Comments of the Director of OVIBER, 29 March 1989

(Extracts in Translation)

Gabcikovo-Nagymaros Barrage

Project Study

March 1989

Compiled and Edited by Christine Reid, Project Manager

Professor Robert D. Yaro, Project Director

Table of Contents

Acknowledgements

The idea for this project arose during a series of meetings on regional planning held in Budapest in June 1988. The study that emerged from these informal discussions was a tremendous learning experience and a number of people are owed thanks for helping to make this opportunity a reality. Karacson Eory, Director of INFORT, was instrumental in arranging for the team to visit Hungary and meet with top officials involved in the Gabcikovo-Nagymaros project. The help of Marcel Alper and Andrew Toth and the generous support of INFORT is also gratefully acknowledged.

We would also like to thank Professor Arpad von Lazar of the Fletcher School of Diplomacy and Law at Tufts, and Professor Janos Beer of the Department of Chemical Engineering at MIT, for their careful review of this paper. They both provided excellent insights into the issues under discussion.

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Over the past few years, a growing number of issues concerning the environmental, social, and economic consequences of the GNB project have surfaced. In the course of our brief stay we reviewed available documents pertaining to the project, interviewed key project officials, scientists, and other concerned parties, and visited both the Dunakiliti and Nagymaros sites. From this information, and the team's experience in engineering and resource management, we believe that effective steps can be taken to address some of the major concerns over environmental degradation. Although a great deal of construction has already taken place, and key structures are nearing completion, flexibility in project design and operation will permit mitigation of some adverse environmental impacts, provided that this flexibility is used to address the identified resource issues. In so doing, Hungary can better obtain the navigational, hydroelectric, and economic benefits expected of this project, while lessening many of the project's adverse impacts.

In reviewing the project and information gathered during our visit, we feel it is essential that four conditions be met <u>prior</u> to putting the system in operation:

- installation of a <u>monitoring system</u> to track water quality, at least five years prior to barrage operation, to create a baseline set of data;

- development of a 3-dimensional computer <u>modeling system</u> to better understand the complex operation of the river system, such as the movement of pollutants to, and within, the groundwater;

- establishment of a <u>Geographic Information System</u> to integrate the data collected from the monitoring and modeling systems, and to facilitate spatial evaluation of the potential consequences of the project; and

- formation of an <u>independent water authority</u> (the proposed Gabcikovo-Nagymaros Environmental Commission) to evaluate and comment on decisions made about the project, and to serve as a public forum for information dissemination and exchange.

Each of these ideas is discussed in greater detail later in this report. Only through their implementation, however, will Hungary make steps towards balancing the potential benefits of the GNB project with mitigating the adverse environmental impacts that may result from project construction and operation.

COMMENTS

(Draft report of MBE 472 Amherst)

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 socalled "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 how 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.

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 26

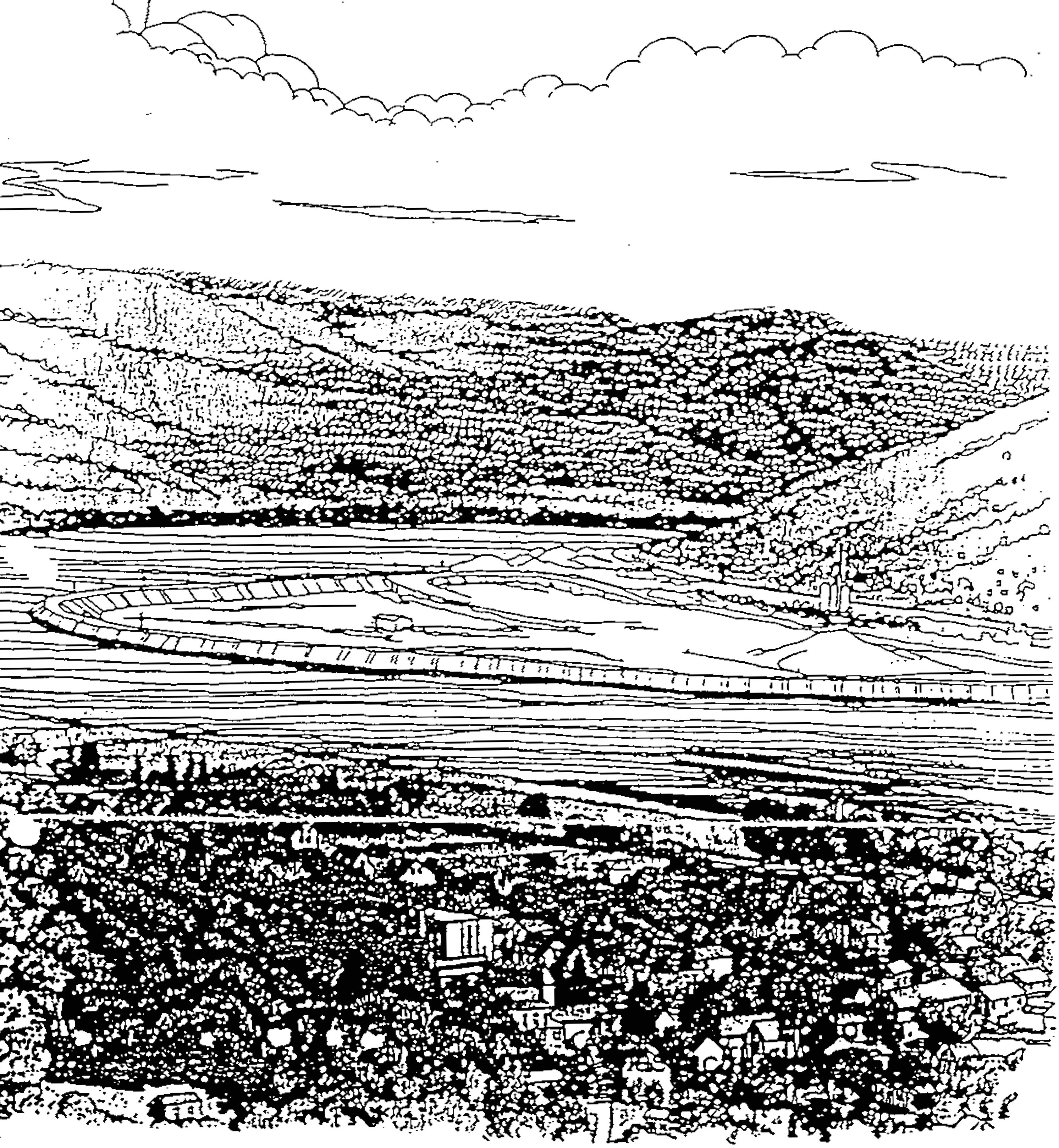
(Extracts)

Bös (Gabčíkovo)-Nagymaros Barrage Study
Program Options and Impacts
May 1989

("Massachusetts study of May 1989")

Nagymaros Barrage Study
Program Options and Impacts

Május 1989
May 1989



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An Engineering Evaluation of the Bős-Nagymaros Barrage System

Professor Harry Schwarz
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This evaluation deals with the engineering features of the project and their physical effects. It is based on the result of two trips of five and four working days respectively. The area around the project was visited on these trips, as were the construction sites at Dunakiliti and Nagymaros. OVIBER and VITUKI engineers working on the project were interviewed and general maps inspected. Detailed plans, specifications and basis of design reports, items that would be available for equivalent public works in the United States, were not available. In a number of additional meetings, the opinions of those opposing the projects were heard.

The Danube between Bratislava and Budapest

This reach is the beginning of what is usually called the Middle Danube. From the Porta Hungarica, where the Danube passes between the Hainburg Hills and the Little Carpathians, it divides into three streams, the Small Danube in the north, the Mosoner Danube in the south and the main stem that, through historic time, was a braided stream. The land between the major branches includes the Large Gravel Island north of the main stem and the small one, the Szigetköz, south of the main stream. The branches combine before the river breaks through the Pilis-Borzsony Mountains at the Visigrad Gate. From 1886 and 1896, between Bratislava and Gönyü the main stream was stabilized, cuts were made, side arms closed, and curves made more gradual. Further work to improve navigation at low flow through the construction of groins and through dredging was carried out around 1900. Levees to control flooding were built in Hungary in the early 19th century and by the middle of that century along most of the major branches. Large construction works in the Budapest area followed the catastrophic flood of 1838.[1]

Further changes in the river through the construction of dams have been contemplated for some time. In the 1930s and 1950s studies of two, three, four, and five dam schemes for navigation and power production were made. Under present conditions there are ten or twelve hazards to navigation at low flows. It is estimated that navigation in this reach can proceed for an average of 200 days per year. During about 100 days, low flow conditions hinder navigation, and for about 65 days, ice or fog make it impossible.[2] Flow data for Bratislava and Nagymaros are shown in Table 1.

Table 1: Flows of the Danube River

	Bratislava	Nagyramos
Distance form the Mouth (km)	1868.8	1694.6
Drainage area (km^2)	131,300	183,530
Observation since	1823	1872
DISCHARGE (m^3/sec)		
Lowest estimated flow	570 (12/28/48)	590 (11/4/47)
Highest estimated flow	10,400 (7/15/54)	8,140 (6/17/65)
Exceeded 95% of the time	882	1,124
Exceeded 50% of the time	1,810	2,248
Exceeded 10% of the time	3,298	3,837
Flood probabilities (m^3/sec)		
0.01% (10,000-year flood)	15,000	11,100
0.1 % (1,000-year flood)	13,000	10,000
1.0 % (100-year flood)	10,600	8,700
5.0 % (20-year flood)	8,750	7,650

Source: OVIBER. *The Bős-Nagymaros River Barrage System.* National Investment Enterprise for Hydraulic Projects, Budapest.

The Reach from Bratislava to Dunakiliti

Current structures in this reach include an earth/rock fill dam from the entrance of the canal to the old Danube bed. There is located a gated structure to act as a flood spillway. The structure includes also a temporary lock for ships during construction and eventually a bulb turbine discharging a continuous flow of 30 m^3/sec into the river bed. The barrage will lift the water level to an elevation of 131.2 m above sea level or about 16 m above the present river bed. The sides of the reservoir created are protected by dams reinforced with concrete linings. Seepage is expected to be 40 to 50 m^3/sec and is guided by a drainage canal into the old Danube bed below the gated structure. The opening for the bulb turbine can discharge 50 m^3/sec without the turbine. There is also an outlet in the temporary navigation lock that can discharge up to 200 m^3/sec, and an outlet in the right bank dike up to 50 m^3/sec more. The main structure, consisting of seven 24 m wide gated openings, will discharge flood waters in 187 excess of the capacity of the power canal into the pre-project Danube bed. The reservoir will contain 200 x $10^6 m^3$ with the top 1 meter containing 49 x $10^6 m^3$. It will equalize the daily water discharge of the Danube. Downstream water elevation during a 1% probability flood will be about at 124.9 msl and at about 115 msl at low flow.

At present the river at the Dunakiliti site is diverted into a bend towards the left bank so that the concrete structural portion of the project an be built within a dry pit protected by a cofferdam. Construction at the time of our visit appears to be about 85% complete. All foundations were complete, most of the superstructure was complete or nearing completion, and some of the gates were already installed. The dikes on the right bank were complete and an outlet water to the Danube arms in its final state of completion. The work appeared to be carried out in an excellent professional manner and the work site generally well-organized and well cared-for.

It has been suggested that the completed construction could be removed and original conditions restored. Such an attempt would likely cost as much or more than building it, and there is a question if total restoration is even possible. Even with spending inordinate amounts of money, major scars on the landscape would likely remain.

The reservoir is underlain by a large and deep aquifer. The raised water level in the reservoir will increase inflows into it. The aquifer, relatively unpolluted and today only slightly used, represents a considerable regional asset for future exploitation.

Water quality in the reservoir is controlled by the inflows. The treatment plants in Austria and the treatment of a major part of Bratislava's sewage have improved the conditions in this reach. Problems exist, however, due to the poor quality of the Morava entering from Czechoslovakia. Retention time of water in the reservoir is short, and therefore will not effect surface water quality. Depending on the flow it is somewhere between 0.5 and 2.0 days.[3]

The environmental impact of the reservoir is twofold. First, it will create a large flat water body with little variation in level regardless of flow conditions. Only at the upper end near Bratislava will flood conditions be near pre-project levels. Operating variations of the reservoir are expected not to exceed one meter.[4] The second and more important impact will be on the groundwater. The raised water surface, five to six meters above ground level, will increase seepage. Much of it will be carried off by ditches along the side dams and returned to the stream, and some will enter the groundwater. Groundwater levels are expected to rise about 0.5 m, based on electric analog and digital model studies.[5] There is likely to be some increase in pollution entering the aquifer. This can only be eliminated by consistent improvement in the quality of the water entering the reservoir. It appears, however, a relatively less important component of pollution entering the aquifer when compared with local pollution from agricultural activities. This should not be considered an excuse for reducing efforts to improve treatment of Danube inflows or of reducing agricultural non-point sources.

The Dunakiliti to Gönyü Reach (The Szigetköz)

Construction in this reach consists of a 17 km long channel leading to the Bős Power Station, the station itself, and an 8.2 km downstream channel that returns the flow to the original Danube bed. The upstream channel is designed to carry 4000 m^3/sec at an average velocity of 1 m/sec. It is initially 542.5 m wide, narrowing to 267.5 m, and finally widening to 730 m to form a forebay that will dampen out wave action due to the starting and stopping of power releases. Normal operating level will be the same as at Dunakiliti, 131.2 m above sea level. Protecting side levees have a freeboard of 2 m, and are at their highest point 18 m high. They are constructed of compacted fill, and are concrete lined. The canal was located on the left of Czechoslovakian side of the river, because a canal on the Hungarian side would have required the relocation of some settlements.

The Bős power station contains eight Kaplan turbines and generators with 90 MW rated output each. Working head may vary from 16.0 to 23.4 m and through flow form 420 to 651 m^3/sec. Two lock chambers, each 34 m wide and 275 m long, provide for the navigation passage. Piers and guide structures protect the entrances and exits of the navigation locks.
The downstream channel is excavated to increase the head available to the power plant. Its bottom is 18 m below ground level. Near the power outlets, the bottom is protected from surges by layers of 70 cm row over a 50 cm sand filter layer.[6]

While we were not able to visit these works due to their location in Czechoslovakia, views from aircraft showed that most of the work is completed both on the canals and on the power station and lock. Just as at Dunakiliti, removal and restoration to pre-project conditions would be enormously expensive, and would likely leave a major scar on the landscape.

The existing mainstream of the Danube in this reach is characterized by many branches and new and old meanders. It is the home of a complex and unique riverine forest ecosystem. The entire area from the main stem to the Moson Danube is a gravel island, the Szigetkős. The unforested area is in extensive agricultural use. An extensive network of groundwater observation wells and a number of ecologic monitoring stations are planned in this sector covering the entire Szigetkős. 189

Original plans call for the existing Danube bed to carry, during average and low flow periods, only the flow of the bulb turbine outlet flow at Dunakiliti and the seepage at that site. The flow during such periods in the Danube may vary between 30 and 70 m^3/sec depending on the amount of seepage. During river discharges in excess of 4000 m^3/sec, the excess amount will be released into the old river bed through the Dunakiliti dam's sluiceways. Releases of approximately 4500 m^3/sec can be expected in five percent of years, and discharges of over 6000 m^3/sec in one percent. At mean high water about 500 m^3/sec would enter the old Danube beds. Also during low flow periods, the opportunities exist to release up to about 200 m^3/sec additional flow through outlets at Dunakiliti and at another point in the right bank protective dam. Flows of about 22 m^3/sec are expected to be flowing in the Moson Danube, a change from the present flow of no more than 6 m^3/sec.[7]

The concern here is for the riverine woodlands and for agriculture in the region. The lower water levels in the existing river bed would lower the groundwater level and flood inundation of the riverine forest would be reduced. This could significantly alter the ecology of the region, and make irrigation necessary on some of the agricultural enterprises.

Groundwater modeling showed that the effect of the diversion of the river into the power canal would lower the groundwater level near the existing river bed by about 3.5 meters leveling to no change at the Moson Danube.[8] This being considered unacceptable, a system of recharge ditches are contemplated in this area. Modeling shows that these ditches will mitigate the reduction of the groundwater level to no more than 1.5 m, and that only in the area near the mouth of the Moson Danube. In most other areas of this reach the reduction can be expected to be between 0 and 1.0 m.[9]

Monitoring of water and ecological parameters would be a tool for anticipating change and managing mitigation of detrimental effects on the riverine forest ecology in a timely manner. The planned observation network, if fully developed and used, would provide the necessary data. Using the sluices and even the gates in the Dunakiliti dam, and sending more water into the old Danube beds, and less to the power station, could be accomplished with the present design configuration at Dunakiliti. This type of operation must be considered as an option. Major modification of the arrangement for power distribution would have to be made, and the costs compared with the benefits to the riverine ecology.

The Gönyü to Nagymaros Reach

Works in this reach consist of the Nagymaros barrage and power station and the system of dikes lining the banks of the created reservoir following the existing shoreline of the Danube and up some of the tributaries. The purpose of the barrage is to compensate for the surges caused in water flow by the peak load operation of the Bős power station, to generate electric power, and to insure navigation above the barrage. It also assists in the maintenance of the groundwater level in the eastern end of the Szigetkős. The site selected was one of five sites studied. The selection was made on the basis of topographic, geologic and cost criteria. The barrage consists of seven 24 m wide gates, a powerhouse with six bulb turbines and generators, each with a rated output of 26.4 MW, and each discharging at design head 466 m^3/sec. Two locks, each ith a chamber 34 m wide and 275 m long, and guide piers up and downstream, provide for navigation. Maximum water elevation under all conditions on the upstream face will be 107.8 meters above msl. Downstream water elevation will vary with flow between 98.4 and 107.1 during the 0.01% probability flood. Present bank elevation, 109.3 m, is above flood level at the site. The roadway elevation of the bridge that is part of the structure will be 118.2 meters. Dikes with heights of up to 5 m are generally constructed at the sites of existing flood control dikes, topping the existing ones by 1.5 to 2.5 m. At the site of the present relocated stream bed, two lagoons for recreation are planned.[10] A monitoring network will parallel the river on both sides.

At the present state of construction, the river has been relocated into a sharp bend near the right edge of the valley. This relocation seems to have narrowed the bed and increased the velocity of the flow. The material excavated for this relocation, which included the blasting of rock outcrops, was used in building a cofferdam anchored on the left bank that encloses the entire construction site .or the Nagymaros barrage. The cofferdam, riprapped to protect it from erosion, is built to withstand a three-year flood. Inside the cofferdam, gravel and rock excavation for the foundation of the gate structure, the powerhouse and the navigation locks, is in progress and will soon be to full depth. In addition to a concrete batching plant, a temporary railroad siding and a group of permanent houses for workers, are under construction. The houses will be sold for local use after completion of the job. On the right bank an overlook and visitor area are also under construction. It is estimated that between 15 and 20 % of the investment at Nagymaros is now in place.

Four major concerns have been expressed relating to this reach. These are

(1) the surges created by peak operation of the Bős station;
(2) the safety of areas, like Esztergom, where water levels are permanently higher than the surrounding ground;
(3) the water quality in the reservoir;
(4) the damage to the important cultural, historic, archaeological and landscape values of the Danube bends.

During peaking operation at Bős, water levels at the powerhouse will vary up to 5 m. However, by the time the flows reach the end of the outlet canal and join the existing Danube bed, the differences will be not more than about one meter.[11] Further reduction in these variations can only be produced by changes in the operation of Bős, i.e. the total or partial elimination of peak power production. The variation in flow rate will also reduce the deposit of sediments by moving them downstream during the power cycle.
The second concern can be addressed only through the quality of construction and maintenance of the dike system. Competent and periodic inspection and immediate repair of any deficiency discovered is the guarantee of safety for the low-lying areas. Serious damage from a sudden failure of the barrage by war or sabotage is unlikely. The low height of the dams and the relatively small amount of water stored would create a flood wave not greater than a natural flood.

Water quality problems will exist downstream from the mouth of the Moson Danube. The major inflows are the discharges from Győr, for which a treatment plant with a capacity of 120,000 m^3/day is planned.[12] The short retention time of flows in the reservoir and the flushing of the reservoir during floods are likely to maintain the water quality at the present level. It again must be pointed out that construction of treatment plants on both sides of the river should proceed at maximum possible speed. Continuous monitoring of groundwater levels and water quality will give early warnings of problems that might make changes in operation necessary.

Changes in the landscape and effects on elements of historical, cultural and archaeological significance will occur when and if the Nagymaros barrage is built. Some mitigation is possible through changes in the operation at Bos to longer and lower peaks. Only the removal of the Nagymaros barrage from the entire system, with the changes in power output and possible effects on navigation, would remove all concerns in this region. Such removal must include restoration of site conditions at Nagymaros. There appear two options if work is not completed on this barrage. Both will require careful studies including modeling to insure proper hydraulic characteristics. One would require to fill the present cofferdam area and stabilize the cofferdam and the filled surface to protect it from erosion during flood events. Such a course of action is likely to cost at least as much as construction costs on the site to date, create a navigation bottleneck, increase flood heights upstream, and leave a landscape that is not likely to be pleasing. The second option, full restoration to pre-project condition would probably cost as much as completion of the barrage, and interrupt river traffic for a considerable time, as much as a whole season.

Abandoning the construction of the Nagymaros barrage, and leaving the site in its present condition, would likely have catastrophic consequences following a major flood. The cofferdam would be destroyed, a large turbulent area created over the present excavation, and debris scattered in the reach below. All these would be a very serious hazard to navigation and require costly corrections to make the river properly navigable.

The Nagymaros-Budapest Reach

No further work is contemplated in this reach as part of the barrage system. Problems in the bank-filtered wells through the increase in nitrates apear to be due to inflow from the background area rather than from the Danube.[13] Continuous monitoring, especially in areas where gravel is mined from the river, would be a prudent investment.

Output of the Project

Electric Power. The two power plants of this system--located at Bős and Nagymaros--are expected to produce an average of 3675 GWh/year, with Czechoslovakia and Hungary sharing equally in this output. Installed capacity at Bős is 720 MW and at Nagymaros, 158.4 MW. The Bős plant is expected to be operated in a peaking mode. Using only the top one meter of the reservoir, Bős can operate at full output for about 3 hours each day at mean low water, for about 5 hours at mean flow, and for a full 24 hours at mean high water, in addition to discharging about 500 m^3/sec into the Old Danube bed. Nagymaros can operate at one-third load for 24 hours at lean low water, at full load for about 20 hours at annual mean flow, and at full load continuously at mean high water. Some peaking is also possible here depending on the degree of fluctuation acceptable downstream toward Budapest. The bulk of the power received by Hungary is power delivered during peak load periods. Thus, it is much more valuable than the base load power Hungary will deliver to Austria. Increases in water released into the existing Danube bed at Dunakiliti for maintenance of the ecology of the Szigetkőz will reduce power output at Bos in proportion to the releases. Removal of Nagymaros from the system requires a change of operation at Bős from peaking to run-of-the-river.

Alternative modes of operation are possible. For example, run-of-the-river operation is feasible at Bős. The total output would be about the same, but electricity would be produced following not a load-controlled schedule, but as water is available. Other generating facilities would have to be used to maintain output in accordance with demand.

Navigation. Navigation is presently restricted, especially in the Bratislava to Komarov region, by shifting sandbanks. Low water in the late summer and fall further limits ship passgae. The Bős-Nagymaros project will create a 3.5 m deep channel throughout its reach and extend, it is claimed, increase annual 193 navigation time by 40 to 50 percent. The value of this to Hungary, however, will depend on the development of a Hungarian shipping industry, new Hungarian ports, and development of Hungarian trade with the West. The eventual opening of the Rhine-Maine-Danube canal and the Elbe-Oder-Danube canal would open barge traffic from Budapest to Amsterdam and to the Baltic.

Flood Control. Most areas throughout the reach of this project are presently protected by a system of dikes. However, the continuous build-up of the Danube bed by silt deposition reduces the safety of the existing dike system. The new dikes built as part of the project, with a 2 m freeboard, will greatly increase flood protection.

Summary

The project as presently desgined is sound from an engineering viewpoint. All the studies customarily associated with such a project appeared to have been made. The design appears efficient for power and navigation, and is, at the same time, as compatible to the landscape as possible. Construction is proceeding at a rapid pace and also apears well-organized and carried out in a highly professional manner. This, however, does not invalidate concerns raised against the project, concerns that are based on different values and objectives than those used by the engineers and designers.

Three possible mitigation actions can reduce concerns raised by the Bos-Nagymaros project. Physically, the easiest changes would be in the operation of the Dunakiliti and Bös portions of the project, delivering more water to the existing downriver areas and reducing power production. More difficult and costly will be the essential improvements for industrial and municipal sewage treatment in Austria, Czechosolvakia, and Hungary upstream and within the project area. The most costly would be the abandonment of the Nagymaros barrage, combined with changes at Bös to a run-of-the- river operation, and the very costly restoration of reasonable pre-project conditions at Nagymaros.

Endnotes

1. Regional Zusammenarbeit der Donaulander, *Die Donau und ihr Einzugsgebeit*, 1986.

2. Personal communication, VITUKI, Budapest, April, 1989.

3. Nagy, L. and Ö. Starosolszky. *Environmental Impacts of the Bös-Nagymaros River Dam Project.* VITUKI, Budapest, 1989.

4. OVIBER. *The Bös-Nagymaros River Barrage System.* National Investment Enterprise for Hydraulic Projects, Budapest.

5. Nagy and Starosolszky. *Environmental Impacts.*

6. OVIBER. *Bös-Nagymaros River Barrage.*

7. Flows shown are estimated based on information provided by OVIBER and VITUKI.

8. Nagy and Starosolszky. *Environmental Impacts.*

9. Nagy and Starosolszky. *Environmental Impacts.*

10. OVIBER. *Bös-Nagymaros River Barrage.*

11. Personal communication from OVIBER.

12. Nagy and Starosolszky. *Environmental Impacts.*

13. Nagy and Starosolszky. *Environmental Impacts.*

Annex 27

(Extracts)

Bechtel report, February 1990

Section 1

INTRODUCTION

1.1 PURPOSE

Bechtel has independently reviewed the Gabcikovo (Bös)-Nagymaros Barrage (GNB) Project in terms of potential environmental impacts, operational considerations, and currently planned mitigation measures. We have examined the project from the standpoint of its stated goals of integrating and optimizing multiwater resources for the purposes of power production, navigation, flood control, regional development, water supply and water quality, agriculture and forestry, natural biological values (including fishery and wildlife), recreation, visual enhancement, and preservation of archaeological values.

Our approach to the environmental review was a multidisciplinary effort, which focused on:

- Defining significant impacts associated with the project that warrant evaluation and mitigation
- Determining additional baseline data needed for impact definition
- Reviewing planned mitigations to reduce impacts to insignificant levels or to enhance project benefits
- Identifying additional investigation measures that could reduce impacts further
- Assessing effectiveness of the monitoring program by defining preoperational environmental conditions and operational conditions

Where possible, the significance of potential project-related impacts were qualitatively defined in the context of construction and operation activities, and the expected duration of the impacts. Impact discussions in this evaluation reflect the amount of data and analyses available for the environmental review. For example, the hydrologic regime of the project area has been thoroughly studied and potentially significant impacts have been identified by VIZITERV and associated experts and Bechtel concurs with this assessment. More limited data and analyses are available regarding project-related impacts on biological resources. Therefore, a more detailed impact analysis was made for biology than that provided by VIZITERV. Our impact analysis considered the potential effects the project could have on the environment's social benefits to man, such as agriculture and regional development, and the impact of the project on the intrinsic values of environmental resources such as biology. Additional data collection and modeling is recommended where needed for either additional impact definition or determination of the adequacy of the proposed mitigation and monitoring program.

We have approached the environmental evaluation with the philosophy that impacts must be identified, appropriate mitigations must be in place prior to project operation, and the project monitoring program will be used to ensure the effectiveness of these mitigations.

1.2 BACKGROUND INFORMATION

Information used in the review of environmental effects related to the GNB project are based upon:

- A 3-day site visit to the project area
- Summary documents provided by VIZITERV (see Appendix 1 for detailed list)
- Selected publications and
- Interviews with VIZITERV professionals and other experts

The site visit included a review of construction sites at Dunakiliti weir, Gabcikovo power plant and navigation canal, Nagymaros barrage site, and selected intercept channels and sidearms in the Szigetköz. In addition, a general reconnaissance was conducted along accessible areas on the right side of the Danube River from Visegrád to Süttö and on the left side of the Danube River from Nagymaros to Szob. All impact evaluations in Section 2 are based

The project has used a sound technical and scientific basis to identify impacts and appropriate mitigations. However, several areas should be considered for additional studies or mitigations. These include ensuring that (1) water quality is maintained along the Danube by completion of wastewater treatment plants; (2) archaeological resources that are affected by the project are thoroughly investigated; (3) additional studies are conducted to define biological baseline conditions and appropriate mitigations; and (4) sufficient flow releases into the old Danube River channel in the Szigetköz will maintain planned ground water levels.

Several benefits will come from the project, including increased archaeological research, creation of a new riverbank park, improved water quality in the Mosoni Danube, better flood protection, improved navigation, and the generation of electric power.

1.4.2 Conclusions

Our review has shown that potentially adverse impacts in hydrology, land use, visual resources, and recreation have received close attention by VIZITERV. Based on the data available, these impacts will be mitigated to minimize them sufficiently. However, potential impacts to biological and archaeological resources may be significant, and planned mitigations may not be sufficient to reduce impacts to an insignificant level. While the artificial recharge plan in the Szigetköz is well conceived and will be effective in protecting and enhancing forestry and agriculture in the Szigetköz, conflicts may be present with protecting biological resources. Additional baseline data and biologic modeling are needed to better define impacts to biological resources and plan effective mitigations. Additional data needed include information on the seasonal occurrence and habitat use of important wildlife species such as waterfowl and protected species in the Szigetköz area. Modeling of dissolved oxygen (DO) levels in the reservoirs is also recommended to quantify potential impacts to surface water quality and fisheries. Additional flows to the old Danube River channel and side arms may be necessary, to augment the benefits of the artificial recharge system and mitigate impacts to biological resources, but until more biological baseline conditions are established, this cannot be clearly determined.

The recommended studies for water quality and biology may result in identification of the need to modify the project's operational strategies. In addition to mitigation measures outlined by VIZITERV, alternate operational modes for the Gabcikovo power plant should be closely reviewed. Presently, alternate operational modes (including seasonal variations) are being studied to revise the original KET operation plan. Modified peaking schedules could help reduce potential significant impacts to biological and recreation resources caused by downstream fluctuations. Increased flow releases from the Hrusov-Dunakiliti reservoir to the main channel should be considered as a way of reducing signficant impacts expected downstream.

In comparison with U.S. hydropower monitoring systems, the proposed GNB monitoring system is unique because it monitors more parameters than the Columbia River Basin, Ohio River Basin, or Tennessee Valley Authority (TVA). Hydropower facilities on these rivers monitor water quality and/or minimum streamflows for fish and recreation, but do not monitor the array of environmental parameters sampled in the GNB monitoring system. With a few additions, this system will represent a state-of-the-art monitoring program for integrating environmental considerations with operations.

The monitoring program developed for the GNB project will assess changes in environmental resources affected by project operations and the effectiveness of project mitigation measures. Our review has identified aspects of the planned monitoring program that can be reduced, and recommended additional monitoring that would enhance the overall effectiveness of the program. However, mitigation measures should be in place (or clearly established, in the case of operational rules) prior to startups at either the Gabcikovo or Nagymaros power stations.

Benefits of the project as well as impacts and mitigations proposed by the project, or recommended by Bechtel are summarized below. Detailed discussions regarding impacts and mitigations measures are contained in Sections 2 and 3.

Hydrologic Regime. GNB surface and ground water conditions have been thoroughly studied by VIZITERV and other experts. The project's planned releases to the Mosoni Danube and the Szigetköz side arms will improve water quality in these surface waters. Project mitigations to minimize adverse impacts on the hydrologic regime have been incorporated into project design, including the artificial recharge system in the Szigetköz, and interceptor channel system at Dunakiliti reservoir, Esztergom, and Pilismarót. Potential problems that we believe require additional studies to quantify impacts and effectively develop mitigations are the water quality and water level fluctuations downstream of the Gabcikovo barrage. Revisions to the KET operation criteria are currently being studied. Reduction in water level fluctuations downstream of the Gabcikovo barrage will mitigate many of the impacts discussed below. Specifically:

- Water quality in both reservoirs could be possibly reduced below historical levels (DO below 6.0 mg/l) during summer months due to detention times, increased temperature, nutrient loads, and associated algal blooms

- Water quality during the summer months should be estimated using available computer models which simulate reservoir/ powerhouse operations and changes in DO and water temperature

- If undesirable water quality is identified, alternative mitigation measures should be evaluated to determine the most cost-effective means to maintain the water quality at or above historic levels. Possible mitigation measures include continuous release through the Gabcikovo power plant to reduce detention time and releases over the Dunakiliti weir to promote more aeration

- Concern has been expressed by others that heavy metals accumulated in deposited sediments might be remobilized under anaerobic conditions and migrate into the ground water. The circumstances required to alter the bottom sediments are highly unlikely to occur, especially since the DO level will be tracked in the reservoirs and operational measures will be initiated to keep DO above minimum levels. However, it is recommended that sediment buildup be monitored, especially over ground water recharge areas, and heavy metal concentrations in these sediments be regularly measured. Should undesirable amounts of heavy metals accumulate over sensitive areas, this material can be removed. Alternatively, methods for controlling the reservoir bed DO levels should be investigated and implemented if found cost effective

- The original KET plan anticipated peaking operations at Gabcikovo for a minimum of 5 hours per day. The KET project operation would produce significant water level fluctuations at the upstream end of the Nagymaros reservoir. For example during summer months, peak power operations would produce 1.3 to 4.7 m^3/min rate of rise in water level and a 2.5 to 3.5 m change in water level over 24 hours. This is greater than current practices on the Columbia River in the U.S., where similar hydroelectric/navigation lock projects are operated. During the summer, the allowed water level changes on the Columbia River are 0.75 cm/min and 1.5 m over 24 hours. It is recommended that evaluation of modified Gabcikovo peaking operations be continued to assess possible reductions to project impacts associated with the large water level changes

Ground Water. The extensive mitigation measures planned by the project to control the impacts on ground water conditions appear adequate. To verify whether or not the mitigations are effective, the network of monitoring wells will provide a good measure, and allow modifications to be made to correct any deficiencies. To avoid the situation where unexpected conditions occur in sensitive areas, and because of the time required to make necessary corrections, vegetation and wildlife may be adversely affected and may not be able to recover, the following recommendations are suggested.

1. Detailed studies of critical areas in the Szigetköz should be conducted to determine if additional control measures are needed to mitigate impacts on the recharge of ground water. For example, the heron habitat area near Ásványráró may require close control of ground water fluctuations to maintain the proper environment for the breeding and feeding habitat. The hydrogeologic characteristics of a specific area will most likely differ from the homogeneous, isotropic conditions assigned in the analog modeling studies of the total area. Detailed studies of the critical areas can determine if the variations are significant, and the need for modifications in the general mitigation measures can be anticipated.

2. Mitigation measures to prevent waterlogging in the three major lowland areas adjacent to the Nagymaros reservoir have been provided. Within the intervening hill areas, where high natural banks are present, the raised ground water levels are expected to remain well below the ground surface. However, with the rise in base level, some seepage may occur in low areas not presently considered to be wetlands. Although such occurrences may not be widespread in the highlands, they could cause undesirable wet ground in

program and, if warranted, operational controls to mitigate DO decreases should be evaluated (e.g., alternating modes, spill flows, mechanical aeration).

Loss of migratory fish access to spawning grounds in the side channel system will result from blocking the outlets to the Danube and installating the weir at Ásványráró to maintain the water levels in the side arms. This is expected to result in a regionally significant, long-term impact on some fish species inhabiting the Danube. The ability to operate the Gabcikovo facilities while maintaining adequate flow to the main channel above Gönyü should be evaluated. Use of a control gate to allow fish passage at Ásványráró also should be considered in conjunction with baseline information on fish spawning migrations.

Entrainment and turbine-induced mortality of fish and lower order organisms will occur at the Gabcikovo and Nagymaros power stations. The significance of these effects should be assessed once baseline fish surveys have been conducted and, if warranted, an appropriate fish protection system should be developed.

The project has incorporated fish locks at Dunakiliti and Nagymaros to mitigate impacts on spawning fish due to blocked fish migration.

Land Use. The project impacts on land use in the project area were evaluated based upon anticipated changes in crop and forestry production and recompensation of losses of land or buildings.

The project will provide several benefits to agriculture and forestry production in the Szigetköz with installation of the artificial recharge system. These benefits include increases in arable land with more control of ground water levels and floods, as well as a more stabilized water supply for irrigation.

Development in the Danube bend area is currently limited by the lack of adequate sewage treatment and floodplain restrictions. The project will provide new sewage capacity and eliminate the need to restrict construction in the floodplain. This, coupled with planned improved roadway access, will foster regional growth. Growth in this area could be beneficial to local economies, but adverse impacts could occur if not properly regulated.

The need for electrical power in Hungary is increasing due to economic development. The possibilities of exploitating fossil fuels are limited and imported electrical energy is expensive and undependable. The project provides a clean, non-exhaustible source of energy, and does not rely on imported energy resources.

The implementation of the project is of international importance for Danube navigation. Anticipated improvement resulting from the project include: extended navigation time from 250 to 330 days annually; permanent nighttime navigation; increased freighter fleet cargo capacity of at least 20 percent; and decreased probability of navigation accidents. These benefits will be shared by the Danube countries, as well as other countries involved in navigation along this international waterway. It is anticipated that due to project construction, the tonnage of cargo shipped in the Danube will double in 10 years.

The project will provide protection against the 10,000-year flood in the region upstream of Palkovicovo/Szap. Along the downstream reaches, levees will provide protection against the 1,000-year flood. Over the life of the project, this should result in a significant protection to Danube River landowners and residents, who could experience agricultural and sylvicultural loss, structural damage to buildings, and even loss of life during large floods.

1.5 SUMMARY OF RECOMMENDATIONS

Detailed discussions of recommended mitigations and additions and changes to the monitoring program are included in Sections 2 and 3. Recommended mitigations are summarized below.

1.5.1 Mitigation Recommendations

1. VIZITERV should continue evaluating the peak operations (including seasonal changes) of the Gabcikovo plants with gradual load buildup. Variations in river levels due to peaking modes can significantly impact downstream resources including recreation and natural habitats.

2. Additional preoperational data are needed to define impacts to biological resources, especially fisheries, and develop effective mitigations. Additional data should include seasonal surveys for waterfowl, fish, other wildlife species, and four protected birds to determine distribution, abundance, and seasonal habitat use. Surveys should focus on the old Danube channel and side arm/oxbows in the Szigetköz. Consideration should be given to increasing the flow rates to the main channel. A system-wide DO modeling program should be conducted. Based on the modeling results, appropriate mitigation (e.g., spill flows, mechanical aeration, alternating operational modes) should be developed if warranted. The effectiveness of a control gate to allow fish passage at Ásványráró, to allow spawning fish access to the side channel system, should be evaluated. If warranted by a preproject fish survey, appropriate fish protection and guidance systems at the barrages should be developed.

3. Revegetation programs using native species should be considered for areas along the Danube. Restoration of area adjacent to existing remnant forests along the Mosoni Danube should also be considered. This would also meet goals of the Szigetköz Landscape Protection Area policy.

4. Modeling is needed to assess the possibility of reduced DO in the two reservoirs, and to develop any necessary water quality mitigation measures.

5. One of the most effective ways of improving the quality of both surface and ground water and its attendant effects on ecological conditions is to clean up the sources of the pollution. It is not the intent of this report to discuss such concerns, but some of the more critical areas of concern are the sewage discharge into the Mosoni at Györ; the leaching of bauxite red muds, and the asbestos cement plant, near Komárom; and the

excessive amounts of farm fertilizers seeping into the ground water in the Szigetköz and along the lower reaches of the project. We understand that construction of sewage treatment facilities at Györ has started and evaluation of industrial effluent treatment is under way. These and other effluent treatment plans should be pursued.

6. It is strongly recommended that sewage treatment facilities at Györ be operational before the Nagymaros reservoir is filled.

7. Local authorities should develop recreation and land use plans to enhance benefits of new tourism opportunities while limiting adverse impacts to existing land use and sensitive biological areas.

1.5.2 Monitoring Recommendations

Recommendations regarding the GNB project monitoring program are summarized as follows. Detailed discussions are presented in Section 3.

1. The project has expended substantial efforts to develop data to be used to implement mitigation of project-related environmental impacts. A program to educate the public about these efforts would do much to develop support for the project and to answer criticism developed by the opposition.

2. After project startup, the approximately 50 stream flow measuring stations (existing or planned) can be reduced for project operation purposes to about 10 stations, located at all project input sources. All measuring stations should be monitored until project operating rules for all ranges of input conditions (streamflow, sediment load, and pollutant load) have been verified.

3. After surface water levels versus ground water level correlations have been verified, the surface water level measuring stations can be reduced to those at headworks and tailraces of project structures, two locations along the old Danube River channel, and control structures for the seepage interception channels.

in the upstream portion of the reservoir where the inflows first encounter the reduced velocity regime. Deposition will also occur along the areas adjacent to the reservoir dikes. Sediment accumulation could fill the dead storage volume in the reservoir in about 60 years. However, during major floods, the gates at Dunakiliti weir will be lowered to allow safe passage of the flood flows. At these times some flushing of deposited sediments can be expected and therefore filling of the dead storage area will take more than 60 years.

Sediment accumulation in the upstream portion of the reservoir will have to be monitored to ensure that safe navigation depths are maintained. Periodic dredging of this area may be required. Sediment accumulation in the downstream portion of the reservoir will build up a less permeable bottom layer which will help reduce reservoir seepage.

Surface Water Quality. The impoundment of Danube River flows in the Hrusov-Dunakiliti reservoir will affect the quality of surface waters. Settlement of 70 percent of the suspended solids will clarify the water. The water surface area will be increased about four times. This larger surface area will increase oxygen gas absorption, and thereby improve the DO content of the water. The longer detention time will allow the natural biological process to reduce the organic load under favorable DO and temperature conditions. These three factors will improve the water quality. However, during the summer months, the clarified water depth will increase, allowing deeper light penetration. This, together with the already high nutrient load, will promote increased algae production. When the extra organic load from algae growth is mixed with the incoming organic load, a reduction in DO supply will occur. When DO is significantly reduced, the biological breakdown of the organic load will also be reduced. Reduction of the DO level below 6 mg/L, the limit for Class I water, would constitute an adverse impact. With a DO level at or above 6 mg/L, the Danube waters would maintain the project aerobic environment. Thus, there should be no significant impact to aquatic life or to downstream potable water works due to the GNB project.

To determine if there is a water quality impact due to the GNB project, a quantitative evaluation is recommended. This evaluation should first establish what conditions - organic load, water temperature, nutrient load, etc. - might produce undesirable water quality. If such conditions can be expected - even if they have a low probability of occurrence - then possible mitigation measures should be quantitatively assessed to determine the most likely cost-effective mitigation. Such analysis could be accomplished using existing water quality computer programs and the existing project database. The U.S. Environmental Protection Agency (EPA) computer program QUAL2E (see Appendix 2) can be used for this analysis.

If DO levels fall below acceptable levels, a proposed project mitigation measure is to temporarily pass flows over the Dunakiliti weir to reduce the detention period and thereby minimize oxygen depletion. This action would be initiated based on reduced DO levels detected by the project monitoring program. Other possible mitigation measures which could be considered would be to temporarily change the Gabcikovo power plant operation to a run-of-river plant, thereby reducing detention time and mechanical aeration (example is shown in Appendix 3).

A second potential water quality problem has been identified concerning heavy metals. Heavy metals tend to be adsorbed on suspended sediments. While Danube sediment sampling for heavy metals is limited, varying concentrations of Hg, As, Cd, Fe, Zn, and Mn have all been measured. Under GNB project conditions, the suspended sediments will be deposited in the reservoir as previously described. Deposited sediments with adsorbed heavy metals can remain in a stable state indefinitely. However, if the reservoir bed environment were to become anaerobic, either due to stratified conditions in the reservoir (which is unlikely), or deposition of organic material with the sediments, the heavy metals can be dissolved. For example, the insoluable ferric and manganic salts will be transformed to soluable ferrous and manganous form under anaerobic conditions. In the soluable state, the metals could pass into the underlying ground water regime adding an unwanted pollution load to the ground water.

There are measures which can be implemented to control this problem. The most positive measure is treatment of industrial effluent for removal of heavy metals. Industrial effluent is the major source of heavy metal load in the Danube. The second measure is to monitor reservoir deposition and to sample the sediments. Should sediments with undesirable metal concentrations be detected near ground water recharge areas, these sediments can be removed by dredging. The buildup of sediments is a slow process and remedial dredging could probably be accomplished at 3- to 5-year intervals. A third measure would be to monitor the reservoir bed environment to check that the adsorbed heavy metal state has not been altered. This will require testing representative sediment samples to determine what conditions will cause the metals to dissolve. Should an undesirable reservoir bed environment be detected, sediment removal by dredging can be initiated, or the anaerobic condition can be alleviated by forced vertical mixing using pumps or mechanical aerators.

Szigetköz. Reducing the flow in the old Danube River channel reach (about 30 km long) from the historic 2,000 m^3/s average to 100 m^3/s will significantly impact the adjacent environment. With the planned 100 m^3/s continuously released at Dunakiliti weir, the average depth of flow in the upstream reach of the old Danube River channel will be reduced from 6 to 2 m.

The water level at the confluence with the power tailrace canal and the old Danube River channel will be controlled by Nagymaros reservoir impoundment and will be near the prior GNB project average water surface level. However, the downstream portion of the old Danube River channel water levels will fluctuate daily according to the power releases at the Gabcikovo powerhouse. For the Joint Convention (KET) operation case with a 1,500 m^3/s average inflow into the upper reservoir and 700 MW peak power, the daily fluctuations will be $\pm$ 2.0 m, at the tailrace confluence and $\pm$ 1.0 m 10 km upstream of the tailrace confluence. These daily water level changes will require riverbank stabilization to control erosion. Such erosion control measures are planned for the GNB project. The operation of Gabcikovo powerhouse and the resulting downstream water level fluctuations are being evaluated. We understand that VIZITERV is evaluating alternate operation modes and that a modified operation plan will eventually be adopted which will yield smaller water level changes.

The water level in the side arms of the Szigetköz is currently controlled by the water level in the old Danube River channel up to 2,500 m^3/s as backwater effects. Beyond this flow rate the side arm dikes are overtopped and water flows directly into the side channels. Therefore, without additional water level controls, the water level depth in these side arms would be reduced up to 4 m, with flow diverted from the old Danube River channel. However, mitigation measures to control surface waters in the right bank side arms are planned to maintain the historical water levels in the Szigetköz area. Mitigation measures include improving the existing system of dikes which channelize the side arms waters and planned flow releases of approximately 50 m^3/s (more if needed) at the side arm headwaters. A rockfilled drop structure will be placed near the downstream end of the side arm channels. The purpose of this structure will be to maintain the desired upstream backwater level in the side arms and, most importantly, to keep this backwater level above the daily water level changes in the old Danube River channel induced by the Gabcikovo powerhouse operation.

The southern border of the Szigetköz is delineated by the Mosoni Danube. This arm will also receive releases from the Hrusov-Dunakiliti reservoir. The forecasted release to the Mosoni is 20 m^3/s which will be a benefit of the project. This release is greater than the previous average flow in the upstream reach of the Mosoni. The previous 20-year average has been 5 to 15 m^3/s depending on the stage of the Danube River at Rajka.

Sedimentation. The sediment load in the releases to the old Danube River channel and the side arms will be reduced due to sediment deposition in the upstream reservoir. Further, the flow velocities will generally be equal to or greater than the prior GNB project flow velocities in the same channels. Therefore, sediment deposition in the old Danube River channel and the Szigetköz area will be significantly reduced from historic levels. The amount of sediment deposition in the areas with the GNB project has not been estimated but is not anticipated to be a problem.

Water Quality. The old Danube River channel and the side arms will receive flows from the upstream reservoir. As previously discussed, the water quality in the Hrusov-Dunakiliti reservoir will be improved, except for possible seasonal degradation problems. Concerning flows released over the Dunakiliti weir, the water quality will be improved because of the aeration induced when the flow tumbles over the concrete energy dissipation blocks.

Water quality in the side arms will be improved. The currently stagnated side arms waters will be replaced by the steady 50 m^3/s or more flow released from the upstream reservoir.

The water quality in the Mosoni will be equal to or better than the past water quality, except for the downstream reach just above the confluence with the Danube. Here the daily water levels will fluctuate by $\pm$ 1.5 m, according to the KET operation plan. These fluctuations will alter backwater up to the city of Györ. At present there are a number of raw sewage water discharges into the Mosoni Danube at Györ. Except when major flows (greater than 3,000 m^3/s) occur in the Danube once or twice a year, the sewage effluent is passed into the Mosoni Danube and diluted. However, under GNB project conditions, the fluctuating backwater at Györ will hinder mixing of the raw sewage. We understand that a sewage collection and treatment plant for Györ is under construction and will be operational in 1993. It is strongly recommended that this treatment plant be in operation prior to impounding water in Nagymaros reservoir. This would eliminate what otherwise would become a health hazard if the current once- or twice-year sewage mixing problem were to be transformed into a daily problem.

Nagymaros Reservoir. The Nagymaros barrage will develop a 120 km long reservoir with a normal water surface elevation of 108 m. This impoundment will provide a 9 m elevation drop for power generation, and sufficient depth to pass navigation up to the Gabcikovo shiplock. The reservoir will also act as an equalization pond by receiving the generation flows from Gabcikovo (about 4,000 m^3/s for 5 hours) and releasing these flows at an uniform rate to the natural flowing river downstream. Further, the Nagymaros weir, with the radial gates lowered, will safely pass the 1,000-year flood event.

flow of 2,000 m^3/s in this channel reach will be reduced to 100 m^3/s. The net change to the aquifer ground water supply due to the altered recharge regime will be minimal - possibly increasing or decreasing slightly.

Measurable impacts will occur, however, to the ground water levels adjacent to the reservoir and the old Danube River channel. Where land surface areas adjacent to the reservoir are below the normal reservoir impoundment level, seepage from the reservoir will raise the water table - possibly inundating local depressions. To manage this problem, seepage interception channels have been constructed parallel to the reservoir dikes as part of the project. These interception channels will transport the reservoir seepage to the Szigetköz side arm channels and will maintain the local ground water level near historic levels. No additional mitigation is recommended.

The planned project release to the old Danube River channel is significantly less than the historic average river flow. This reduced flow rate will lower the water level in the old Danube River channel by 5 m at the Dunakiliti weir and to no change at the old Danube River channel/power tailrace canal confluence. The ground water table in the adjacent Szigetköz area will be lowered because the Danube is the major recharge source.

To keep Szigetköz ground water levels near historic levels, an artificial ground water recharge plan has been adopted for the GNB project. The plan is to release water from the seepage interception channels and the reservoir into headwaters of the selected side arm channels and the Mosoni Danube. The extra flows in the side arm channels will provide a new ground water recharge source. Analog model studies of the Szigetköz ground water basin were conducted to help design the new side channel recharge system. These studies have indicated that the average water table level can be maintained within 50 cm of the preproject level of 80 to 90 percent of the Szigetköz, and the historic level fluctuations will be reduced. However, the analog model study included the assumption of a homogenous but unisotropic gravel aquifer is homogeneous and isotropic. For the area-wide plan, this assumption is justified and supportable. However, the Szigetköz subsurface does vary from place to place in composition and characteristics. Therefore, we suggest

Along reaches of Nagymaros where the mean project water level would be above the land side ground level, seepage interception channels will be constructed parallel to the reservoir dike. As previously discussed, these interception channels will control seepage from the reservoir and maintain the local ground water level near the historic average level. This measure is appropriate and workable and no further mitigations are recommended.

In the hill areas, where natural high banks exceed the highest flood levels, the raised ground water will generally remain deep and have insignificant impact on the area. Protective measures are planned for some industrial plants and community facilities near the river. However, seepage may occur in areas not previously expected. It is doubtful that such occurrences would cause seriously detrimental effects, but it could result in undesirable developments, such as marshy, wet ground. It is recommended that the occurrence of ground water in those areas be reviewed to identify potential areas where unwanted seepage might occur. Ground water level measuring stations should be added to the monitoring system as necessary to allow surveillance of these local seepage areas during project operation.

The Nagymaros reservoir will impact the bank filter wells by affecting the capacities of the wells and the quality of the extracted water. With regard to the capacity of the wells, the increased river level and the reduction of seasonal fluctuation will provide a higher, and more constant driving force, or head, to induce infiltration. This will increase the potential capacity and dependability of the wells. On the other hand, sediment deposited on the reservoir bank will tend to reduce the capacity of the wells because it will develop a low-permeability layer that could restrict infiltration.

To monitor inflow to the bank filter wells, many of the wells are provided with observation wells between the river and the extraction well. The purpose has been to detect reduction in well efficiency. Monitoring these wells in conjunction with the reservoir level will also provide an indication of whether or not sediment deposition in the reservoir is affecting well capacity. Should it be proven that inflow into some wells is significantly reduced due to reservoir side sediment deposition, the sediments should be removed by dredging.

Quality of the water extracted by the bank-filtered wells will depend primarily on the quality of the river water. The filtering characteristics of the sand and gravel materials will not be affected by the reservoir. Because the water level of the reservoir will be higher than the existing water level, the wells will draw a lower percentage of ground water from adjacent areas, which are the present sources of poor quality water. Should an undesirable dissolved constituent be introduced into the Danube River, the filter characteristics will not prevent that constituent from eventually reaching the filter wells except to the extent of the adsorption capacity of the filter material.

The same concern for heavy metal accumulation exists for the Nagymaros reservoir as for the Hrusov-Dunakiliti reservoir. As previously discussed, representative sediment samples should be tested to determine the particular circumstances necessary to turn the stable adsorbed metals to the soluble state. The monitoring of bottom sediments should then track the local environment and if unfavorable conditions are observed, corrective measures already identified can be initiated.

Downstream of Nagymaros. The planned operation of the project will not significantly alter the flow characteristics or hydrology of the river downstream of Nagymaros. Some dredging has been done to improve the channel for navigation. Concern has been expressed that these efforts, or operation of the project, could disturb or affect the bank-filter wells present in the area.

The dredging work has been terminated, so that is no longer a factor. Because the project will not alter the flow of the river in this area, the project can not have a measurable impact on the performance of the wells. From a water quality standpoint, as discussed in the section on surface water, the project operation might result in an improved water quality except for a few months during the summer. The question of lower quality water occurring during the summer months should be evaluated as previously recommended. The bank filter wells located downstream from Nagymaros will yield water with the same water quality as found in Nagymaros reservoir. The occurrence and movement of ground water downstream of Nagymaros will not be affected by project operation.

Loss of willow thicket and willow-poplar gallery forest vegetation due to clearing for the Dunakiliti reservoir and lowering of the ground water table in the zone along 25 km of the Danube will measurably reduce the number of these natural habitats in the Szigetköz area. This loss of vegetation will be a long-term impact of the project. Vegetation cleared for the Dunakiliti reservoir is permanently lost, and alternation of willow thicket and willow-poplar forest vegetation to associations requiring less water is also expected to be permanent.

These habitats already have been reduced in the Szigetköz, and the additional reductions resulting from the project will include a considerable portion of the remaining natural vegetation. Additionally, these natural vegetation types are ecologically important because they support a greater diversity and abundance of bird species than do the planted poplar stands in the floodplain of the Danube. Because of the importance of this natural vegetation, the extent of the area to be affected, and the long-term nature of the effect, this is considered to be a long-term, regionally significant impact.

Mitigation Measures. Three types of mitigation are possible for this impact on natural vegetation. First and preferably, the impact could be reduced by increasing the flow released continuously to the main channel of the Danube. The degree of mitigation would depend on the increase in flow and associated ground water levels.

Second, this impact could be reduced somewhat by developing and implementing a revegetation plan to reestablish natural vegetation in the Szigetköz. To facilitate reestablishment of natural vegetation, riparian areas around the Dunakiliti reservoir could be planted with suitable native species. For example, the possibility of sprigging with unrooted Salix species should be considered. Riparian vegetation, however, is expected to establish naturally around the reservoir. This mitigation measure would expedite replacing lost habitat, but would not fully offset the acreage lost permanently to the project.

Third, a revegetation plan also could be developed to begin implementation of the planned, but currently unfunded, expansion of the remnants of native forest along the Mosoni Danube, which is one of the objectives of the Szigetköz Landscape Protection Area policy. For example, acreage immediately adjacent to the remnant oak hardwood forest at the Hédervár forest monitoring station could be obtained, cleared, and planted with appropriate species. Reestablishment of this type of natural, high-diversity vegetation which supports a more diverse fauna could offset the adverse impact of the loss of natural vegetation in the floodplain. The minimum mitigation recommended for the project includes increasing the flow releases to the main channel and reestablishment of expanded acreage of the remnant hardwood forests along the Mosoni Danube. Facilitating reestablishment of riparian vegetation at the Dunakiliti reservoir also should be included but is not considered as important as the other two mitigations.

Other Impacts. Other potential impacts on vegetation identified in the Szigetköz-Gönyü reach were evaluated and considered to be insignificant. No significant impacts are expected on the old forest vegetation (e.g., Hédervár, Feketeerdö) and associated protected plant species (e.g., *Lilium bulbiferum*, *Ophrys spp.* and *Iris sibirica*) along the Mosoni Danube because the flow of the Mosoni will be maintained (i.e., slightly increased) during project operations, and ground water levels in the adjacent areas are not expected to change (Section 2.2). Additionally, the project will not alter any land within these "strictly protected areas" of the Szigetköz.

Natural vegetation occurring in the vicinity of the Danube side channel/oxbows is not expected to experience significant adverse impacts. Reeds, willow-poplar gallery, willow thicket, and other natural vegetation comprise approximately 20 percent of the total vegetation and exist in areas not suitable for silviculture (e.g., abandoned borrow pits). This type of vegetation will be supported by maintaining the water level in the side channels. Although some localized changes in species composition are expected in response to alteration of ground water levels (e.g., decreased ground water levels toward the center of larger islands in side arms), these changes are not expected to result in significant impacts on the natural wetland and riparian vegetation.

Effects on fringe forest and other riparian vegetation are expected to be long term or permanent. This reach appears to have proportionally less natural vegetation remaining along the Danube, due to more settlements and industrial development. A substantial portion (approximiately 300 ha) of the natural fringe forest along this reach is expected to be lost or altered. This is considered to be a significant impact.

The most effective mitigation for these impacts on vegetation would be to operate the Gabcikovo (Bös) power station in the continuous mode. This would eliminate the periodic increase in the water depth, the daily water level fluctuations and associated slope stabilization measures (i.e., riprap), and the resultant impacts on natural vegetation.

Alternatively, a revegetation program could be developed to replace the natural vegetation lost to project development. A revegetation program plan could be developed by a multidisciplinary team including project engineers and biological experts - such as the ELTE staff who are performing the biological monitoring and are familiar with the natural vegetation of the Danube floodplain. Such a program should consider slope stability, erosion control, appropriate vegetation, and visual considerations.

First, to maintain the structural integrity of the dike system, areas where it is undesirable to reestablish trees or understory vegetation, such as tops of dikes or steep banks, should be identified. For revegetation, consideration should be given to using native species of grasses or non-native species that provide both suitable erosion control (e.g., rapid establishment of adequate cover) and habitat value to wildlife. Using native grasses adapted to the local area and site-specific conditions is advantageous because native species will establish permanent cover that does not require periodic maintenance treatments (such as reseeding), and provide better wildlife habitat.

Reestablishment of native shrubs or forest to replace a portion of that lost to project development should be considered. Where possible, topsoil should be spread over fill material to provide a substrate conducive to supporting recommendations and mitigation developed were described under the Szigetköz-Gönyü reach. Potential disruption of fish migration due to the barrage has been mitigated by the use of a fish lock as described for the Gabcikovo barrage/power station. (Impacts on migratory fish inhabitating this reach, but spawning in the Szigetköz side arm system were discussed under the Szigetköz-Gönyü reach.)

Nagymaros-Budapest - Vegetation. Natural vegetation along the reach from Nagymaros to Budapest, downstream of the project facilities associated with the Nagymaros barrage system, is not expected to be affected by the project. Because the system will be operated in the continuous, run-of-the-river mode, no changes in water levels and associated bank or flood protection measures are planned. Consequently, no vegetation will be cleared.

Nagymaros-Budapest - Wildlife. No baseline surveys were conducted to characterize wildlife use of this reach. Limited data on birds observed at Szentendre Island (biological monitoring station) were available. Because the Nagymaros barrage is a run-of-the-river system, it will not significantly alter the downstream flow of the Danube or the recharge of Szentendre Island. No significant impacts on wildlife are expected.

Nagymaros-Budapest - Fish. The only impact on fish identified for this reach is potential for DO deficiency effects downstream of the Nagymaros barrage and power station. Reduction in DO concentration below this power station would be cumulative from the two barrage systems. Mitigation for such impacts could be developed (as described for the Szigetköz-Dunakiliti reach) if warranted by the system-wide DO modeling effort. (Impacts on migratory fish species inhabitating this reach as adults, but spawning in the Szigetköz side arm/oxbow system were discussed in the section on the Szigetköz-Gönyü reach.)

Without mitigation measures, potential impacts associated with the project in the Szigetköz area would have included reduced productivity of crops and forests due to changes in ground water levels. However, this potential impact will be mitigated by the implementation of the artificial recharge system.

The recharge system is designed to maintain existing ground water levels and flooding regimes in the side channels during operation of the project. Plans call for the system to be augmented by a monitoring program to determine changes needed during operations to maintain ground water levels. Without the artificial recharge system, timber productivity would be reduced by one-third, and one-fourth of the current value would be lost.

With the artificial recharge system in place, approximately 300 of 7,803 ha of forest land will be adversely affected by changes in the ground water levels along a 250-300 m strip adjacent to the Danube River. This area represents approximately 3 percent of total forest area. Mitigation to reduce this impact focuses on substituting more xeric tree species for more water intensive poplars. Shift to the more xeric species would constitute a loss in timber value of approximately one-third of present production, along this stretch of the Danube. This future loss in timber value was compensated. No significant impact on forest production is anticipated.

The transportation costs of timber harvested in the Szigetköz area would increase due to the diking of the side arms of the Danube. Harvested timber is currently transported by barge along those side arms. The dikes which are part of the artificial recharge system will make barge traffic impossible and alternate means of transportation are necessary. Compensation has been made through funding for new road construction, to provide alternate transportation means. While this will likely increase transportation costs, the increase cannot be quantified.

Approximately 1,100 ha of forest stands in the Dunakiliti reservoir area have been cleared. While the area was previously forest intermixed with meadow/pasture, no net loss in production has occurred since the Rajka farm cooperative was compensated for the loss with other land.

The GNB project provides an inexhaustible, clean source of energy, does not require imported goods, and relies on a new and as yet unused resource. Although the power to be generated by the river barrage system will provide only a small portion of the nation's total power production, it could play a significant role due to the peak-energy generation possibilities of the daily hydraulic storage scheme.

International Navigation. Maintaining and developing the Danube River as an international waterway are the tasks of the riparian countries, as formulated by the proposals of the Danube Commission. One of the main objectives of the GNB project is improved navigation. The Bratislava/Pozsony-Nagymaros river reach is the narrowest part of the Danube, in terms of navigational requirements, and is a significant obstacle to the development of international shipping transportation. This reach is impeded by 20-25 shallow crossings to such an extent that the average annual navigation time is restricted to 250 days. Navigation obstacles have been gradually eliminated in both the upper and lower Danube reaches. Consequently, the reach between Bratislava and Budapest has now become a bottleneck to international navigation.

Understandably, the implementation of the river barrage project is of international importance. Anticipated improvements resulting from construction of the river barrage system are as follows:

- Navigation time would be increased to 330 days annually
- Nighttime navigation would become permanent
- The efficient use of freighter fleet cargo capacity would be increased by at least 20 percent
- The probability navigation accidents would decrease

These benefits would be shared by the Danube countries, as well as other countries involved in navigation along the waterway. It is anticipated that project construction will double the tonnage of cargo shipped on the Danube in 10 years.

Annex 28

(Extracts)

HQI report, December 1990

2.0 PRÉVISIONS DES VARIATIONS ET DE LA CONTAMINATION DE LA NAPPE.

2.1 Introduction.

2.1.1 Rappel du mandat.

Dans le cadre de l'étude d'opinion d'HQI, deux aspects des impacts potentiels du projet sur la nappe ont fait l'objet d'une étude particulière. Ce sont, d'une part, la méthodologie de prédiction des impacts du projet sur les niveaux de la nappe d'eau souterraine et d'autre part, la méthodologie de prévision des variations de la qualité de l'eau souterraine. Dans ce dernier aspect, nous nous prononcerons de façon préliminaire et qualitative sur les impacts appréhendés du projet.

2.1.2 Contexte social

En abordant la question des impacts appréhendés du projet sur les eaux souterraines, il importe de présenter brièvement certains éléments de la situation sociale concernant les eaux souterraines. En effet, le projet est construit sur un important aquifère qui fournit l'eau de consommation à une partie importante de la Slovaquie et en particulier à Bratislava. Dans cette région, des événements passés ont rendu la population très sensible aux risques éventuels ou appréhendés de détérioration de la qualité des eaux souterraines. Dans ce contexte, et en sachant que le projet aura un impact indéniable sur la nappe, des craintes spécifiques ont été formulées face au projet. C'est afin de répondre à ces craintes que plusieurs études ont été entreprises dans le cadre du projet et c'est aussi dans ce contexte que certains objectifs de la mission d'HQI visent à donner une opinion extérieure et impartiale sur les résultats des études et sur les effets appréhendés du projet.

2.3.2 Impacts des effets présumés

2.3.2.1 Impacts des changements de niveaux

La plaine de débordement située entre le barrage de Dunakiliti et la restitution à Palkovicovo sera drainée et il en résultera une modification majeure de l'équilibre biologique de cette région.

Le rabattement de la nappe à l'aval du projet pourra être bénéfique pour l'agriculture dans cette région où le drainage est requis. Cependant, dans le cadre de l'aménagement de Nagymaros, des coupures étanches ont été construites tout le long du Danube et de ses affluents. Ces aménagements provoqueront le rehaussement de la nappe dans ces endroits, et pourront ainsi nuire à l'agriculture à moins de mesures correctrices.

Dans un premier temps, il est prévu que le réservoir permettra une augmentation substantielle du volume d'eau exploitable dans les alluvions de Zitny Ostrov. On prévoit même presque doubler le volume exploitable de la nappe et un projet de captage majeur est ainsi prévu à Dobrohost [VSTB, SKPZP]. Avec le temps, si aucune mesure correctrice n'est entreprise, on prévoit que le colmatage du réservoir provoquera une diminution du volume d'eau disponible dans la nappe de Zitny Ostrov.

2.3.2.2 Impacts potentiels sur la qualité de l'eau souterraine

Voies de contamination actuelles

Rappelons que l'infiltration d'eau du Danube fournit la majeure partie de l'alimentation de la nappe, mais une partie moindre de l'alimentation provient des précipitations hivernales, des infiltrations d'eau du Maly Dunaj (en aval de Bratislava) et des eaux d'irrigation dans le Zitny Ostrov.

ces phénomènes doivent être simulés simultanément dans le domaine du temps.

Jusqu'à maintenant, seul le code d'écoulement du modèle a été écrit. La partie géochimique n'a pas encore été élaborée.

2.5 OPINION

2.5.1 Prédictions hydrauliques

L'étude de la variation future du niveau de la nappe comprend plusieurs aspects qui méritent chacun une discussion sommaire.

En premier lieu, la définition des paramètres hydrauliques a été effectuée à travers un série de travaux menés par divers organismes impliqués soit dans les études d'approvisionnement en eau, soit dans les études associées au projet Gabcikovo. Le genre d'essais effectués (pompages, essais de perméabilité, suivi de la piézométrie et des régimes des crues) et leur nombre de même que leur interprétation ont été faits d'une façon très acceptable selon les standards internationaux. Nous devons même signaler de nombreux cas où les hydrogéologues consultés ont fait preuve d'ingéniosité.

En second lieu, afin de définir un régime stationnaire pour une nappe continuellement en changement, une étude mathématique des variations piézométriques a été faite à VSTB. C'est là une approche originale que nous n'avons pas évaluée dans ses détails, mais qui nous apparaît fondée dans ses principes.

En troisième lieu, la simulation de la nappe a été faite sur un modèle analogique de résistances électriques à Brno . Ce genre de modèle est maintenant peu utilisé, mais avec la disponibilité des ordinateurs de l'époque (étude terminée en 1975), c'était une méthode appropriée. Dans l'approche de la modélisation, on a d'abord procédé

En troisième lieu, le programme de contrôle de qualité de la nappe semble moins bien élaboré que le contrôle piézométrique dont la première fonction est la sécurité des ouvrages. Les efforts de suivi semblent dispersés entre divers organismes dont la coordination n'est pas évidente.

2.5.3 Général

Une observation se dégage de l'ensemble des entrevues et des documents consultés : les techniciens et les travaux font généralement preuve d'une compétence et d'un souci du détail élevés. Cependant, on observe un manque de communication entre les divers organismes impliqués de même qu'une subdivision poussée des tâches. Un tel état, si la 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.

2.5.4 Risque de contamination suite à la submersion d'hydrocarbures

Certains ont exprimé des craintes concernant la submersion de sédiments contaminés dans le futur réservoir Hrusov. Les substances craintes sont des hydrocarbures (non spécifiés) qui se seraient accumulés dans les sédiments déposés dans les bras morts lors des crues. Si de telles accumulations ont eu lieu, il parait peu probable qu'elles soit effectivement demeurées en place. En effet, les sédiments en question sont peu profonds et exposés à l'air, l'activité biologique dans ces sédiments est élevée et la température moyenne annuelle est relativement élevée; tous ces facteurs font que les processus de biodégradation sont favorisés dans cet

2.5.6 Évaluation qualitative du risque de contamination

Dans les sections précédentes, nous avons décrit sommairement les conditions physiques de la nappe de Zitny Ostrov dans la zone du projet de même que la qualité de l'eau et les modes de contamination possibles. Nous avons aussi revu et discuté divers aspects du projet de même que les processus géochimiques susceptibles d'affecter la qualité de l'eau.

Suite à cette analyse sommaire, il nous apparait que les risques de déterioration de la qualité de l'eau sont faibles. Les principaux arguments en faveur de cette opinion sont les suivants:

- l'eau infiltrée du Danube sur de courtes distances est de bonne qualité (voir captages de Bratislava)
- la mobilisation éventuelle des métaux dans les sédiments sera contrecarrée par la baisse de perméabilité des sédiments et l'apport d'eau rapide et massif dans l'aquifère à partir des fouilles au fond du réservoir.
- aucune évidence d'hydrocarbures mobiles n'a été décellée dans la zone du réservoir
- les nappes alluviales comparables montrent peu de cas de contamination dans ces conditions.

Le seul phénomène susceptible de détériorer la qualité serait la mobilisation du fer et manganèse et cette éventualité peut n'être que lointaine en raison de l'apport rapide d'eau au fond des fouilles d'infiltration. Dans la pire des éventualités, le fer et le manganèse sont faciles à retirer de l'eau et ne posent pas de risque pour la santé.

Du point de vue sismique, les catalogues de sismicité historique établis en 1975-1978 permettent de fournir une description extrêmement détaillée de localisation des séismes et leurs effets sur la période s'étendant de l'an 1 400 à nos jours. Les données associées à la région montrent que, sur cette période d'observation, les épicentres susceptibles d'influencer le projet se situent soit dans la région des Alpes de l'Est et des Petites Carpates à proximité de Bratislava soit dans la région de Komarno, (fig.6) vraisemblablement en liaison avec les zones de remontée du socle rocheux, bien qu'il ne nous ait pas été présenté de cartographie mettant ou cherchant à mettre une relation entre la séismicité et la tectonique. Les catalogues de séisme montrent une certaine rythmicité dans l'activité, suivant des périodes de 100 à 200 ans. Des contours d'iso-intensité ne montrent pas d'amplification des signaux au droit de la structure de graben (toute épaisseur de matériaux meubles), intéressant les ouvrages. Ainsi le séisme destructeur qui a secoué la région de Komarno en 1763, bien que ressenti très loin, n'aurait fait des dommages, dont certains pouvaient être attribués à la liquéfaction des alluvions de surface, que dans la zone épicentrale où le socle se situe à faible profondeur.

Sur la base de ces données, les intensités maximales envisagées pour la conception du projet étaient de 6 M.C.S.(*) sur la zone du projet et de 7 M.C.S. en voisinage de Bratislava et Kormarno aux deux extrémités. La corrélation entre les intensités en échelle M.C.S. et les accélérations maximales utilisées en 1965 pour la conception amenait à envisager des accélérations maximales de 0,010 g pour une intensité de 6 M.C.S. et de 0,025 g pour une intensité de 7 M.C.S. Une révision de la carte de zonage des intensités maximales suivant les échelles M.S.K.(*) (qui constituent une norme européenne), préparée en 1987 par M. Broucek, pour les fins de l'établissement d'un code de la construction, indique des intensités de VI pour la zone du projet et VII pour les zones voisines de Bratislava et Komarno (fig.6). La corrélation des accélérations avec les intensités maximales, recommandées par M. Broucek, conduit à des valeurs de 0,035 g pour l'intensité VI M.S.K. et de 0,075 g pour l'intensité VII M.S.K. Ces valeurs sont sensiblement plus élevées que celles envisagées lors de la conception et sont en accord avec les valeurs utilisées ailleurs.

* Note: Échelles d'intensité: M.C.S. = Mercalli-Cancanni-Sieberg
M.S.K. - Medvedev-Sponhener-Karnik

3.2.2. Reconnaissance au droit des ouvrages

Des investigations géologiques, dont deux principales campagnes en 1965 et 1975, ont été effectuées suivant un même principe au droit des digues de retenue du bassin Hrusov et du canal d'amenée, du canal de fuite de Gabcikovo et sur les digues existantes:

- reconnaissance à l'aide de puits et de tarières à main de la couche de surface recouvrant les alluvions graveleuses suivant un maillage approximatif de 100 x 50 m. Au cours de ces travaux les échantillons étaient prélevés aux fins d'essais en laboratoire : identification, granulométrie, compressibilité, résistance et perméabilité. Ces essais en laboratoire étaient complétés par des essais in situ dans les puits à l'aide d'essais de perméabilité, de déformation à la plaque, de cisaillement sur les alluvions graveleuses.

- reconnaissance à l'aide de forages de 30 m de profondeur en 1965 espacés de 500 mètres environ (en 1975 ces forages avaient entre 10 et 20 m de profondeur). Ces forages, qui ont permis un échantillonnage plus profond de la couche de surface, étaient poursuivis dans les graviers à l'abri d'un tubager de gros diamètre permettant le prélèvement en épaisseur. Notons qu'en amont, près de Petrzalka, des écrans en paroi moulée ont été utilisés en raison de la proximité du substratum étanche et de l'espace disponible qui était insuffisant pour le creusement du contre-canal.

La conception de ces ouvrages a été optimisée à partir des calculs de déformation et de stabilité classique pour vérifier les coefficients de sécurité normalement prévus pour ce type d'ouvrage. Une attention particulière a été apportée pour simuler les conditions d'écoulement suivant différentes combinaisons de perméabilité et d'épaisseur pour une série de matériaux imperméables, suivis de sable limoneux, puis de graviers très perméables recouvrant une couche profonde de graviers moins perméables munis de coefficient d'anisotropie moyen. Les simulations ont cherché à vérifier si les gradients locaux étaient dans des limites admissibles. Les calculs ont pris en compte les valeurs mesurées en forage et celles provenant de relevés plus globaux d'écoulement, ce qui a conduit à des valeurs de perméabilité légèrement plus faibles que les valeurs les plus fortes mesurées par forages. Ces résultats ont été confrontés avec l'expérience acquise dans les niveaux graveleux, en particulier lors de la crue de 1965. Cette crue a été extrêmement bien documentée en ce qui concerne la fréquence des phénomènes de renard en fonction de la distance du pied de la digue alors que des charges de l'ordre de 2 mètres pouvaient être appliquées (fig.7). Les variations toujours possibles de conditions géologiques justifiaient l'important système d'auscultation prévu dans la conception, qui sera en mesure de noter les anomalies de comportement. Lorsque le concept de tranchées d'infiltration, situé à l'intérieur du réservoir, a été développé, des distances minimum de 200 à 500 mètres ont été respectées vis-à-vis de l'extrémité amont du tapis.

De plus, en 1982, des vérifications de stabilité des digues sous la sollicitation de secousses sismiques ont été effectuées au niveau de la liquéfaction possible des sables silteux. Ces calculs ont été basés sur des densités relatives estimées à partir des essais de pénétrations dynamiques suivant plusieurs méthodes, dont la méthode simplifiée de Seed et Idriss qui est la méthode généralement utilisée en Amérique du Nord pour ce type de problème. À partir de ces calculs, l'accélération maximale susceptible de provoquer ce type de phénomènes était évaluée. Cette valeur lorsque comparée aux accélérations envisagées alors, à partir des intensités M.S.C. (même en les majorant d'une unité) montrait que ces phénomènes n'étaient pas à craindre, comme l'indiquaient les données historiques. Les dernières valeurs d'accélération envisagées à partir des intensités M.K.S. montrent que l'on ne disposerait pas du degré de sécurité envisagé comme indiqué plus haut. Notons qu'en raison de certains doutes lors de l'interprétation des essais de pénétration dynamique des valeurs pessimistes de densité ont été envisagées.

3.3.2 Construction

Les travaux de construction ont été menés à partir de plans adaptés à la conception envisagée, en particulier pour la construction du tapis, conçu pour s'adapter à des conditions de terrain assez variables. Un profil longitudinal était établi à partir des résultats des campagnes de reconnaissance. Des profils transversaux étaient établis tous les 50 mètres affichant les données de sondage obtenues lors des reconnaissances ainsi que les épaisseurs de tapis variables et tout traitement particulier des fondations. Ces plans étaient accompagnés de spécifications techniques qui faisaient appel aux normes standard existantes ou définissant de façon plus précise les travaux spéciaux lorsque requis. Les critères de fuseaux granulométriques et les paramètres de compactage y étaient spécifiés.

Le contrôle des travaux était effectué de façon permanente par un représentant du concepteur. Lorsque des modifications aux

La mise en exploitation du projet de Gabcikovo entraînera par rapport à l'état naturel une réduction des niveaux d'eau d'environ 1 mètre lors des crues centennales. Ceci implique une amélioration des conditions de stabilité par un facteur de 1,5 indépendemment des renforcements cités plus haut. La partie des crues exceptionnelles (du type déci-millennale) véhiculées par le lit existant du Danube impliquerait alors des conditions moins défavorables que celles connues lors de la crue de 1965. Il y aura lieu de s'assurer que les endiguements envisagés pour le relèvement des eaux lors de l'assèchement ne diminuent pas sensiblement le degré de sécurité, en particulier dans les zones protégeant les villages situés entre les levées et le canal de dérivation.

Lors des travaux d'exécution de la centrale de Gabcikovo un dispositif de drainage par puits de relâche a été installé au pied des levées voisines et a montré son efficacité à la période des crues.

3.7 Opinion

La revue des infrastructures de retenue présentée plus haut, permet de constater qu'à l'état actuel le projet de Gabcikovo offre déja une protection accrue contre les crues.En exploitation, bien que ces ouvrages aient été conçus pour la crue millénale,la revanche prévue devrait permettre, moyennant certaines vérifications ou ajustements mineurs, de se protéger des crues plus élevées de l'ordre du décimillénale en accord avec le dimensionnement des ouvrages hydrauliques.La protection contre les crues exceptionelles est ainsi en accord avec les règles généralement utilisées pour des évacuateurs de crue. Le projet assurera donc un niveau de protection nettement amélioré vis-à-vis de la période avant 1965, niveau que l'on devra s'efforcer de conserver lors des modifications éventuelles, en particulier lors de l'aménagement de l'ancien lit du Danube envisagé dans les travaux de mitigation.

Les principes de conception des ouvrages ont pris en compte la complexité de fonctionnement du projet et les difficiles conditions de fondation des ouvrages de retenue.Leur application a nécessité une optimisation très poussée entre l'économie du projet et la sécurité des ouvrages, particulièrement en ce qui a trait à la susceptibilité à l'érosion interne des fondations alluvionnaires. Ainsi, lorsque les charges hydrauliques dépassaient des valeurs de l'ordre de 8 à 10 mètres, on a cherché à assurer une étanchéité complète du fond de la retenue. Pour des têtes d'eau inférieures, on a pris des mesures importantes pour limiter les gradients d'écoulement qui sont la cause première des phénomènes d'érosion interne. Ces mesures, appliquées suite à une analyse approfondie de ces phénomènes dans les conditions du site,sont accompagnées de/ façon cohérente d'un dispositif d'auscultation important adapté à un ouvrage de grande longueur, où il existe toujours une possibilité de rencontrer localement une conjuguaison de conditions défavorables. Les données présentées telles que décrites plus haut indiquent que les réparations éventuelles seront d'ampleur limitée et devraient avoir peu d'impact sur le projet.

Les plans et devis ,leur application et le controle de qualité correspondent en général aux standards appliqués pour ce type d'ouvrages.

Le remplissage contrôlé et la possibilité de vidange totale des ouvrages, fournissent le degré de sécurité requis, à travers les possibilités de réparations que l'on pourra toujours effectuer à temps en raison de l'auscultation prévue. Notons qu'il s'agit d'une précaution normale dans le cas de fondations difficiles en l'absence de coupure totale ou lorsque l'on a recours à des matériaux synthétiques de faible épaisseur plus vulnérables que des matériaux naturels aux défauts d'exécution ou au vieillissement.

Pour la surveillance lors de la mise en eau, les moyens nécessaires nécessaires au suivi du comportement sont prévus pour pallier aux particulièrement important pour les digues de retenue du bassin Hrusov. Advenant un problème éventuel,il sera nécessaire d'évaluer immédiatement les solutions les mieux adaptées sous la forme la plus définitive possible et d'apprécier par voie de corrélation les zones sensibles où le même type de comportement pourra être rencontré.

En terminant rappelons que les délais encourus par le projet sont préoccupants et ne sont pas favorables du point de vue de la sécurité des ouvrages:

. Le maintien prolongé hors de l'eau des parties conçues pour un fonctionnement submergé risque d'en diminuer la durée de vie et d'augmenter les risques de dégradation.Dans ce sens, une mise en eau anticipée du canal d'amenée parait une disposition à considérer fortement.

. La mise en eau des ouvrages doit faire l'objet d'une concertation importante avec la partie hongroise et devrait être conduite de façon à éviter toute opération précipitée.Le délai d'un an disponible avant la mise en eau prévue au plus tôt au cours de l'hiver 1991-1992, devrait être mis à profit pour suivre le passage de la prochaine crue et préparer les dossiers, tel que recommandé plus haut.

4.2 Description sommaire du milieu

En sus de ce qui a été dit en détail plus haut, concernant le milieu naturel, il faut ajouter que ce milieu traversé par le Danube est mixte et para-urbain. On y pratique l'agriculture de façon intensive de même que l'exploitation forestière. La région comprise entre le Danube (Dunaj), le Petit Danube (Maly Dunaj) et le Vah se dénomme "Ile de Blé" (Zitny Ostrov) , et on considère ses sols à l'échelle nationale comme étant les plus fertiles pour des fins agricoles.

Bien que l'urbanisation ne soit extensive qu'à Bratislava, on retrouve une quinzaine de villes et villages dans la portion tchécoslovaque des rives du Danube, pour une population de plus d'un demi-million d'habitants, en incluant la ville de Bratislava.

Le fleuve Danube et ses rives, majoritairement colonisées par la forêt alluviale, sont également utilisés pour la pêche et la chasse. La zone des méandres est particulièrement reconnue pour sa richesse et sa diversité en termes végétal et faunique; cette zone revêt de plus un caractère d'unicité et de rareté au plan biologique, non seulement en Tchéco-Slovaquie, mais dans toute l'Europe.

Pour fins de navigation internationale, un chenal dragué a été aménagé sur le Danube dans la région du projet. Les trains de péniches y transportent des volumes importants de cargo annuellement.

4.3 Études existantes

4.3.1 Historique des études

En 1975, le groupe URBION (Institut d'urbanisme et d'aménagement du territoire de Bratislava) et l'Académie Slovaque des Sciences se voyaient confier le mandat d'analyser le projet Gabcikovo-Nagymaros du point de vue environnemental.

- la construction de quatre seuils dans le lit du Danube pour le maintien du niveau du fleuve et de la nappe phréatique des méandres avoisinants;

- une passe à poissons adjacente à l'écluse de l'ouvrage de Dunakiliti; le même projet proposé pour la centrale de Gabcikovo a été abandonné du fait que les poissons pourraient emprunter l'écluse pour remonter le canal et accéder au réservoir Hrusov;

- la construction d'un ouvrage régulateur dans le canal de Gabcikovo pouvant déverser un minimum garanti en tout temps de 20 à 50 m^3/s dans la partie amont des méandres. Ce débit sera révisé selon le colmatage du sol qui sera suivi en phase exploitation du projet. Il pourrait être élevé à 140 ou à un maximum de 234 m^3/s plusieurs fois par année, durant la saison de croissance de la végétation, de façon à optimiser la production piscicole et forestière. A noter que normalement, ces méandres ne sont inondés complètement qu'environ une fois à tous les deux ans. Selon l'avis des experts consultés, cette gestion procurerait des conditions d'écoulement améliorées par rapport aux conditions actuelles, en évitant entre autres la stagnation de l'eau dans certains méandres et l'assèchement d'autres portions de ceux-ci;

- une digue surmontée d'une route d'accès le long de l'ancien lit du Danube pour contenir l'eau déversée par l'ouvrage régulateur dans les méandres, et pour limiter les inondations liées aux fortes crues. Cette digue possèderait des seuils abaissés permettant le passage des poissons du lit du Danube vers les méandres lorsque le débit évacué dans ce fleuve atteint 1300 m3/s, soit en l'occurence une fois par semaine en pratique courante;

- construction de six seuils dans les méandres pour conserver un niveau adéquat de la nappe phréatique selon les besoins. Ces seuils sont émergés avec une partie plus basse permettant le passage des poissons, et comprennent des ouvertures pour le contrôle du niveau d'eau;

4.5 Opinion

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. A cet égard, des études environnementales ont été entreprises parallèlement à la construction des ouvrages du complexe, soit vers l'année 1975. La solution technique étant déjà choisie, ces études ne portaient donc pas sur une comparaison de variantes, mais bien 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, sur le territoire de la Baie James par exemple.

De façon générale, les principaux enjeux environnementaux considérés dans ces études ont trait surtout à la qualité et la propagation de la nappe d'eau souterraine liée à l'agriculture, l'exploitation forestière, l'industrie et l'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, l'identification des sources d'impacts ainsi que les impacts eux-mêmes ne se retrouvent pas de façon systématique et explicite dans les différents rapports de synthèse consultés. Les impacts se retrouvent plutôt dans la définition de la zone d'étude et dans les mesures proposées. Ces mesures proposées relèvent plus d'un objectif 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'aménagement du territoire, alors que d'autres identifient des études complémentaires ou encore demeurent très générales.

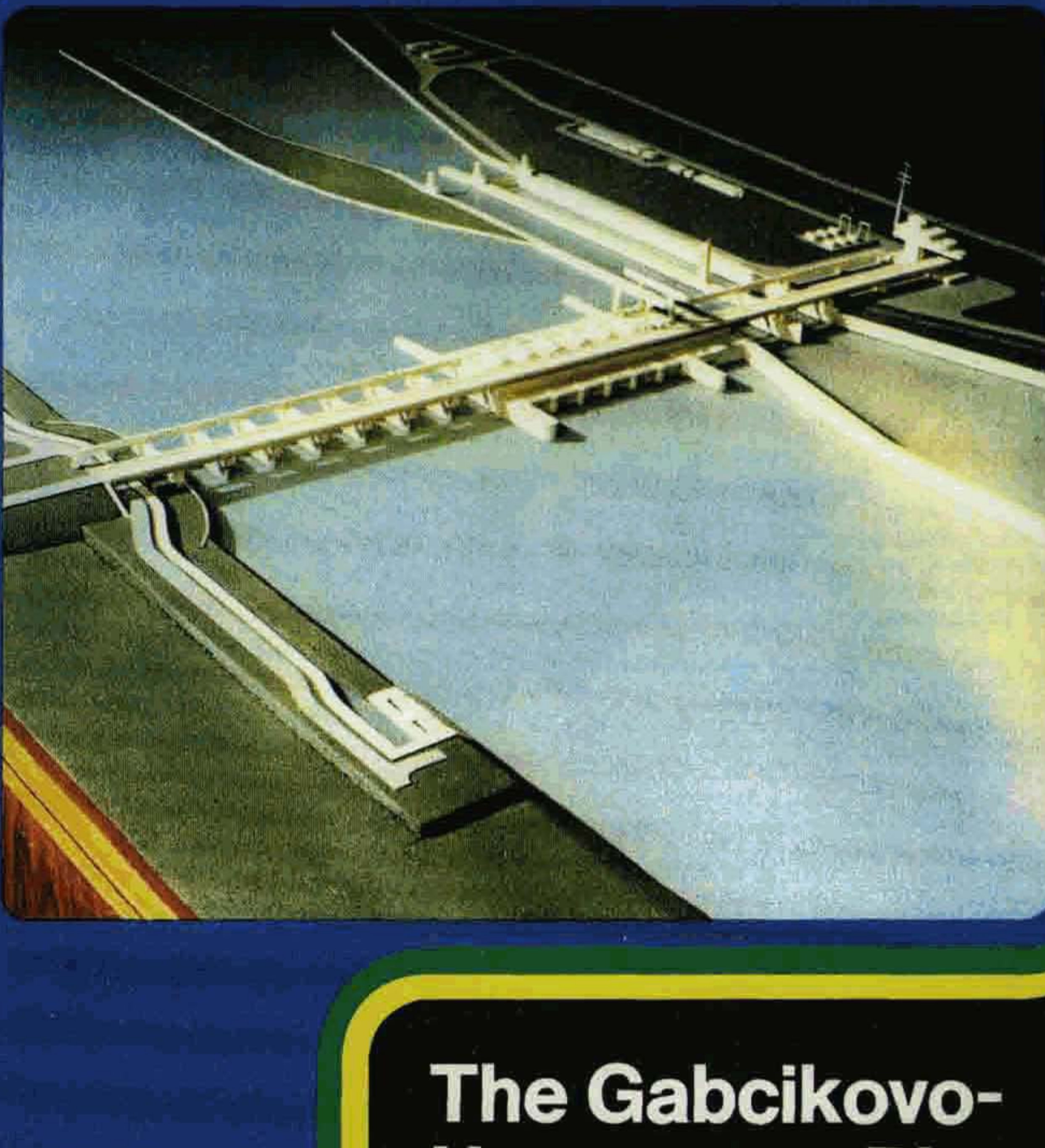
Annex 29

The Gabčíkovo-Nagymaros River Barrage System, OVIBER

OVIBER

ORSZÁGOS VIZÜGYI
BERUHÁZÁSI VÁLLALAT

OVIBER



The Gabcikovo-Nagymaros River Barrage System

Watershed area of Danube

International significance of Danube

Danube and its tributaries have always played an important role in the social-economic development of this area of Europe, in forming the living conditions and history of the peoples living here. Settlements were established along the rivers and the roads on the rivers linked the developing settlements and the riverside areas like arteries.
At present it is one of the common bases for the economic development of the peoples living along the banks of Danube and it is a common source of utilization by the navigation, power generation, supply of water and recreation. The most effective technical-economic exploitation of possibilities gained by the nature, and at the same time, the effective prevention of damages – as the flood-prevention, the preservation and improvement of the quality of water – link the neighbouring countries by these common interests, and induce them to realize these economic developments – aiming the above targets – on the basis of an extensive plan, favourable to each party concerned.
The source of Danube is at a distance of 2,900 km from the mouth of the river, as it is the second longest river in Europe. Danube flows across eight countries, and 76 million inhabitants live on its catchment area of 817 thousand square kilometres. In the economy of the countries the role of the river can be characterized by the proportion of the watershed area of each country and of the number of inhabitants living on this territory.

Country	Catchment area of Danube and its proportion to the total territory of the country.		Population of the catchment area and its proportion to the total population of the country.	
	thousand km^2	%	million inhabitants	%
GFR	54	22	10	17
Austria	83	99	7	100
Czechoslovakia	73	57	7	50
Hungary	93	100	10	100
Yugoslavia	185	71	18	68
Rumania	234	93	19	100
Bulgaria	50	45	4	50
USSR	42	0.2	1	0.4

In the last century the planned and large scale exploitation of Danube began by navigation. Traffic and significance of the navigable water have been gradually increased and the Canal Danube-Main-Rhein, to be finished by the eighties – will open a new stage in this development. So a water-way of 3,500 km across Europe will be set up, from Sulina to Rotterdam, linking the Black Sea to the North Sea.
In the first part of this century the utilization of water power commenced. River barrages, generating plants were set up, first on the upper reaches – where the fall was bigger, then on

the lower reaches the Djerdjap River Barrage was set up as Yugoslavian-Rumanian joint project and was put in operation in 1972. Among the planned 27 generating plants on Danube 20 are already in operation and according to the plans others are under construction. In the same time utilization of the middle course of the river also becomes timely. The fall of the river between Bratislava and Komárom considerably declines, the bed of the river becomes shoaly and forms impediments, and when there is low-water period, it frequently paralyses the continuous navigation. The involved Hungarian and Czechoslovakian state organs decided by ceasing the impediments to set up a common river barrage system in order to gain a continuous and trouble-free international navigable water on this reach of the river as well as to utilize the energy of water. In addition to the above projects the river barrage system provides further exploitation and development possibilities to other branches of the watersupply, and national economy.

The function of the Gabcikovo-Nagymaros River Barrage System

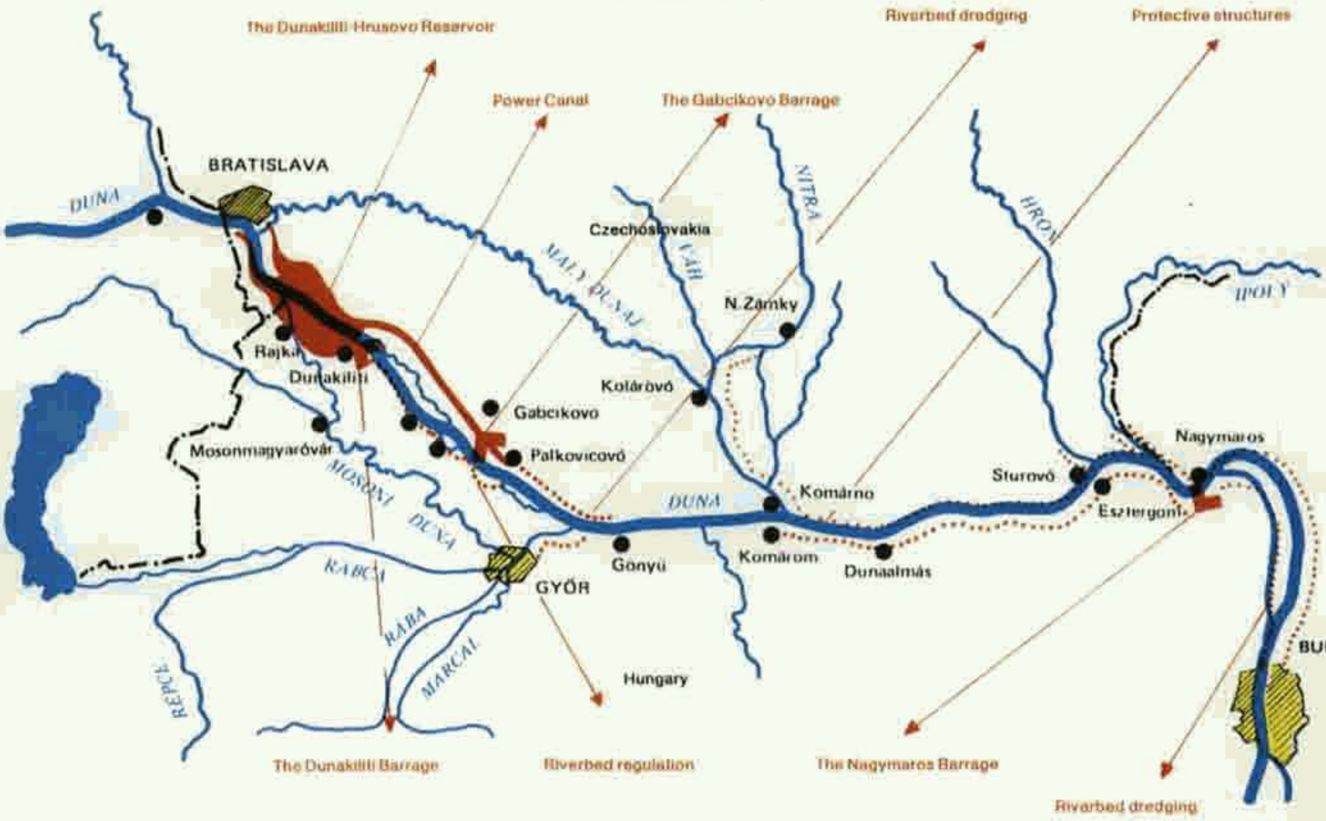
The river barrage system regulates and makes use of the 220 km long reach between Budapest and Bratislava.
The system consists of:
- the power canal type Gabcikovo barrage and
- the Nagymaros river barrage,

functioning in common working order, forming a joint technical-economical unit, with the accessory establishment belonging to them.
On the reach in question Danube forms the border between the two countries, therefore according to the agreement Czechoslovakia and Hungary share the benefit by 50-50 per cent and bear the costs of the river barrage system in the same proportion. On the basis of a technological-economic preparation of several years, on the 16th September 1977 the Prime Ministers of the two countries signed the interstate treaty relevant the common realization of the river barrage system.
Results of the complex utilization of the river barrage system to be observed in the following branches:

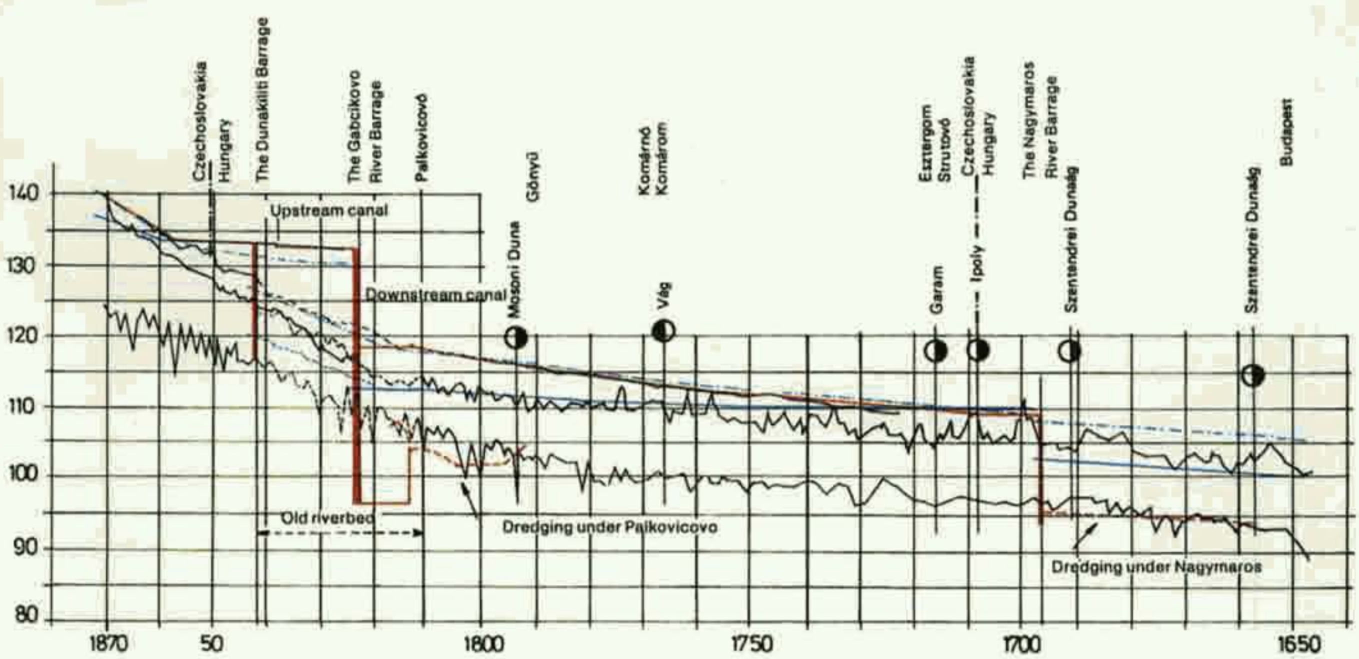
a) Production of electric energy

The river barrage system produces an electric energy amounting to 3,675 GWh per year on the average, replacing 3.8 million tons of brown coal or 1.0 million tons of petroleum by that. The value of the produced energy is raised by making use of the possibilities of the daily storage, a peak energy of 1,510 GWh can be produced at an average per year, from which Gabcikovo hydro-electric power station will produce 92 per cent and Nagymaros 8 per cent. In addition to this, Gabcikovo power station can contribute to regulating frequency too. Gabcikovo hydro-electric power station will join the Hungarian and Czechoslovakian network by the branching of the 400 kV transmission line between Győr and Pod. Biskupice. On the Czechoslovakian side further 110 kV terminals will be set up. The Nagymaros hydro-electric power station is to be connected to the Hungarian network at Dorog, with 120 kV, and to the Czechoslovakian network at Sturovo, on 110 kV.

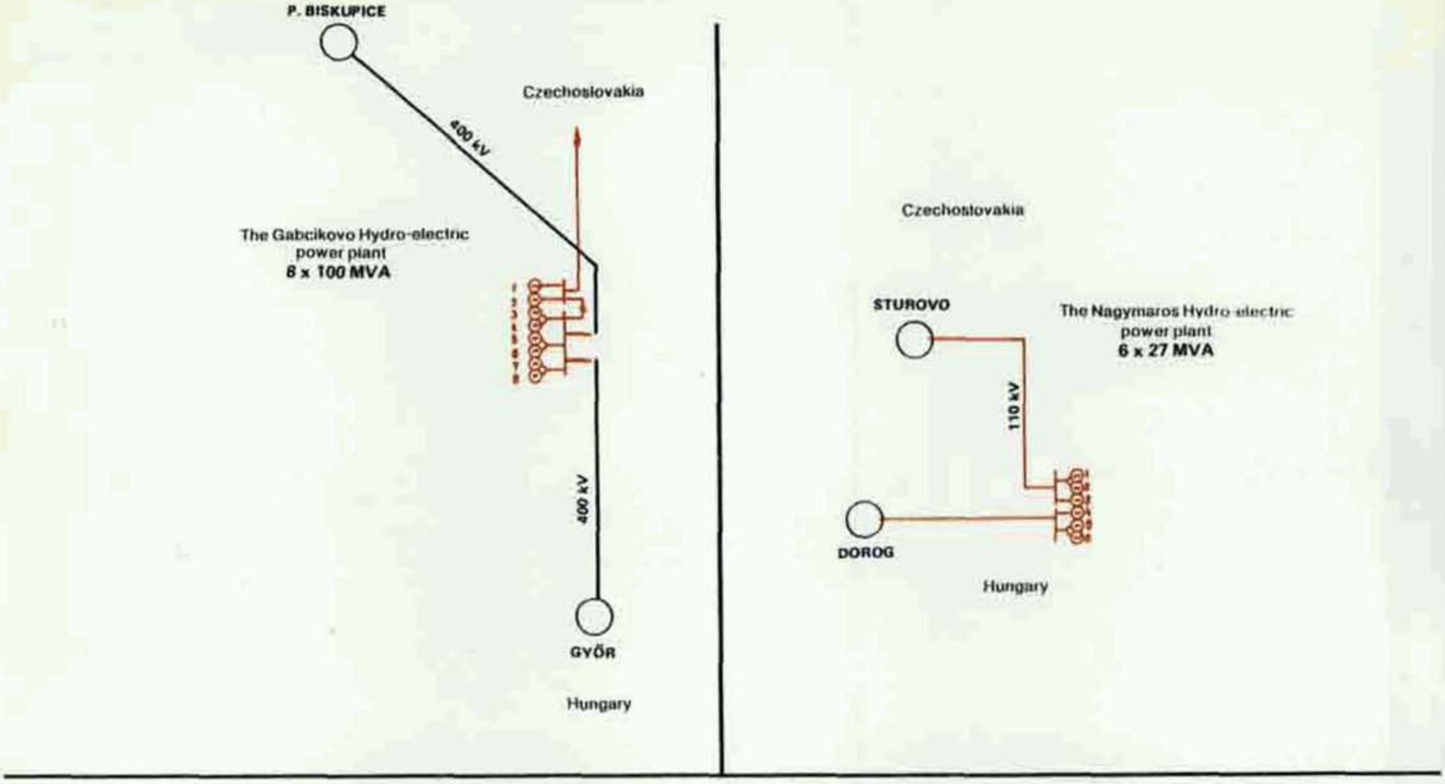
Layout Plan of Gabcikovo–Nagymaros River Barrage System



Longitudinal-section of the Danube between Budapest and Bratislava



Energetic scheme of the Gabcikovo and Nagymaros hydro-electric power stations

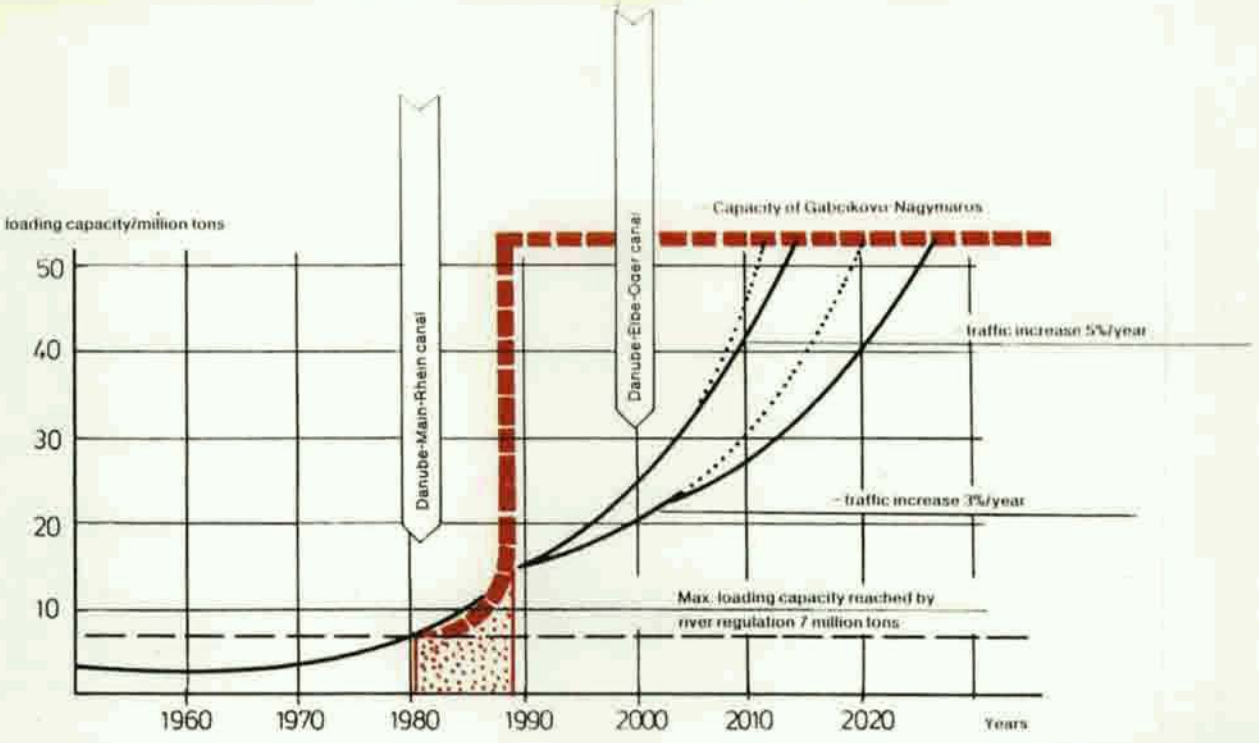


b) International navigation

On the middle-course of the Danube the narrowest cross-section is of 70 km between Bratislava and Gönyü, and the parameters and fundamentals regarding traffic of this navigable water can be no longer improved by river regulation. On the lower course, impediments, disturbing navigation, were mostly ceased. By the construction of Djerdjap River Barrage, navigation became safe on the most dangerous reach of Danube and at the mouth significant regulation was done. On the Austrian course river barrages are continously set up. On the middle course regulation and the construction of river regulating projects will shortly be completed, so from the mid-eighties conditions for the undisturbed navigation will be created. The last impediment of the continuous navigation, depending on the waterlevel will also be eliminated by constructing Gabcikovo-Nagymaros River Barrage System, forming the conditions for navigation on this course of the river, prescribed by the requirements of the Danube Commission and which will comply with the expectable longrange demands. The minimal depth of the navigable waterway will be of 3.6–4.0 m, the minimal width will be of 180 m, the smallest radius of curvature 1,000 m and the average speed of water 1.6 m/s.

According to the data, navigation traffic of the reach between Bratislava and Budapest is increasing year by year and its rate of development will be presumably accelerated by joining the European waterways. This possibility will be created by the characteristics of the river barrage system.
Navigation will have further advantages by the construction of the river barrage system, the navigation time basis will increase by 40 per cent, the exploitation of the loading capacity of the fleet will increase by 20 per cent, and the driving capacity demand per one ton of the consignment reduced from 0.37 kW to 0.15 kW, and in addition to the above, modern navigation system could be applied.

Increase of consignment of goods on the Danube reach Bratislava–Budapest



c) Flood-control

The dikes built along the Danube and its tributaries protect more than 200,000 ha flood area on the Czechoslovakian side, and about 40,000 ha flood area on the Hungarian side. On the reach of the planned river barrage system, and especially on the upper part of it, the situation of the flood-prevention becomes worse year by year, the stream deposit raises the bottom of the river-bed, and so the water level becomes higher as well. Therefore the security of the protecting lines reduces. In the 1954 flood, banks were washed out on the Hungarian side and on the Czechoslovakian side in 1965. The preservation and the continued development of the safety of prevention demands a lot of work and also great expenses.

The construction of the river barrage system ceases the danger of inundation and makes safe the run off of the floods. Sizes of the reservoir dikes give complete security, and the deepening of the river-bed under the river barrages ameliorates the run-off conditions. In the case of the Gabcikovo River Barrage, conditions improve by the fact, that the run off of the flood is divided between the power canal and the old Danube river-bed.

d) Regulation of riverways

Danube reaches under Bratislava the flat territory of the Small Plain, here the course of the river is reduced, it deposits and forms a continually changing formation. On this course of 70 km up to Gönyü the navigable waterway has to be preserved by continuous regulation and dredging and deformation of the riverbed must be improved. When it is low-water peroid, demands of undisturbed navigation cannot be assured despite of application of the above methods. Having realized the river barrage system the run-off conditions become advantageous, there will be no longer deformations in the river-bed, and a safe navigable waterway will be formed with the requested characteristics.

e) Development of the area

The river barrage system changes the run-off regime of the river and has a transforming effect to the surrounding areas. The planned work will not compensate only the infavourable effects of the above changes, but will achieve a higher scale of the development. Exploitation of the favourable effects provides potential opportunity to the development of the area in question.

- On the backwater area effected by the Nagymaros River Barrage protecting work of eight caverns catchments on the Czechoslovakian side, and seven catchments of the Hungarian side develop the flood protection, the land drainage, the traffic and telecommunication network.
- In the river barrage territory the water supply for the population and for the industry, the irrigation of agricultural territories will be developed.
- The big water-surface of the storages and their well-arranged surroundings, the regulation of the old Danube bed, the protection of its area promote the development of recreation, water-sports and tourism and form a favourable microclimate.
- The advantageous possibilities given by the river barrage system promote the general economical development of the area.

Natural and environmental conditions

Topography

Danube, crossing the mountain range of the Small Carpats enters the Small Plain, its speed of flow decreases, under Bratislava it divides to several branches. In the North is an important branch the Small Danube (Maly Dunaj), while there in the South it is Mosoni Danube surrounding the fertile Csallóköz (Zitny ostrov), resp. Szigetköz. Downwards from Gönyü the river bed is mostly homogenous, steady. Lower down Danube reaches Gerecse hills, then between Börzsöny and Pilis, after passing the narrow valley of natural beauty after Nagymaros, it enters the Pest-flatland. Its bigger tributaries are in the North: Vág, Nyitra, Garam, Ipoly.

Geological conditions

The most part of the Danubian regions are basin-like formations, bordered by mountains. Its a basement consists of earthen, sandy earthen and sand formations from the earlier Neogene on which there are deposits – gravel, sand – from the Pleistocene and Holocene. The layer of gravel is thickest at the central part of the basin, it reaches the 600 m, at the two ends of the basin the gravel layer becomes thin, it is of 12–15 m depth at the upper part and 8–30 m at the lower part.

Hydrology

Calculations concerning the river barrage system are based on the estimations of the Bratislava and Nagymaros Danube water gauges.

	Bratislava	Nagymaros
Main data of water-gauges:		
distance from the mouth (km)	1,868.8	1,694.6
extention of the catchment area (km^2)	131,300	183,530
beginning of the observation (year)	1823	1872
Characteristic water discharges (m^3/s):		
smallest estimated rate of flow	570 (28. 12. 1948)	590 (4. 11. 1947)
biggest estimated rate of flow	10,400 (15. 7. 1954)	8,180 (17. 6. 1965)
95 per cent rate of flow durability	882	1,124
50 per cent rate of flow durability	1,810	2,248
10 per cent rate of flow durability	3,298	3,837
Different incidence probability of floods (m^3/s):		
0.01 per cent	15,000	11,100
0.1 per cent	13,000	10,000
1 per cent	10,600	8,700
5 per cent	8,750	7,650

Main projects of the river barrage system

Gabcikovo river barrage system

It extends to the Danube reach of 70 km between Bratislava and Győr, upto the inlet of the Mosoni Danube and consists of 7 main projects.

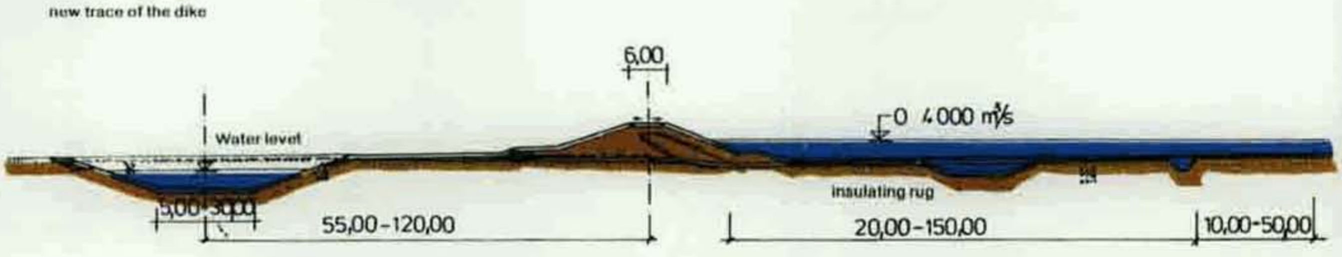
Layout of Gabcikovo river barrage

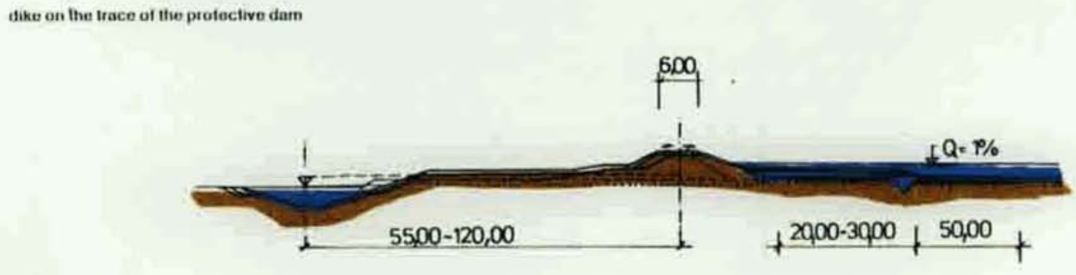
Hrusov-Dunakiliti reservoir

The storage retains the water dammed by the Dunakiliti barrage up to 131.20 mB level.
It is mainly situated on the flood area and extends to Bratislava. Its working volume, in case of one meter of water-level decrease measured at the branching of the power canal is 49 million m^3, its total volume is 200 million m^3. It makes possible the daily equalizing of water discharge of the Danube. Its protective dams are constructed of gravel with clay insulation. The bank slop near the water is protected by concrete cover. In front of the dam a coat of 20–150 m width, built of impermeable soil cover impedes the considerable leakage. Behind the dams the reduced leaking water is gathered by drainage canal respectively by outlet wells. The expectable leakage water of 40 m^3/s is led to the drainage canal of the forbay at the left bank, and to the branches of the river bank of the Old Danube on the right bank, under the barrage of Dunakiliti.

Water-level of the drainage canals are controlled by sluices. The top of the dam is provided by a stabilized way of the width of 5 metres. Ridges are erected starting from the Dunakiliti barrage on the left side of the storage to make the flow of ice easier.

Sections of the dam of the Hrusov-Dunakiliti storage

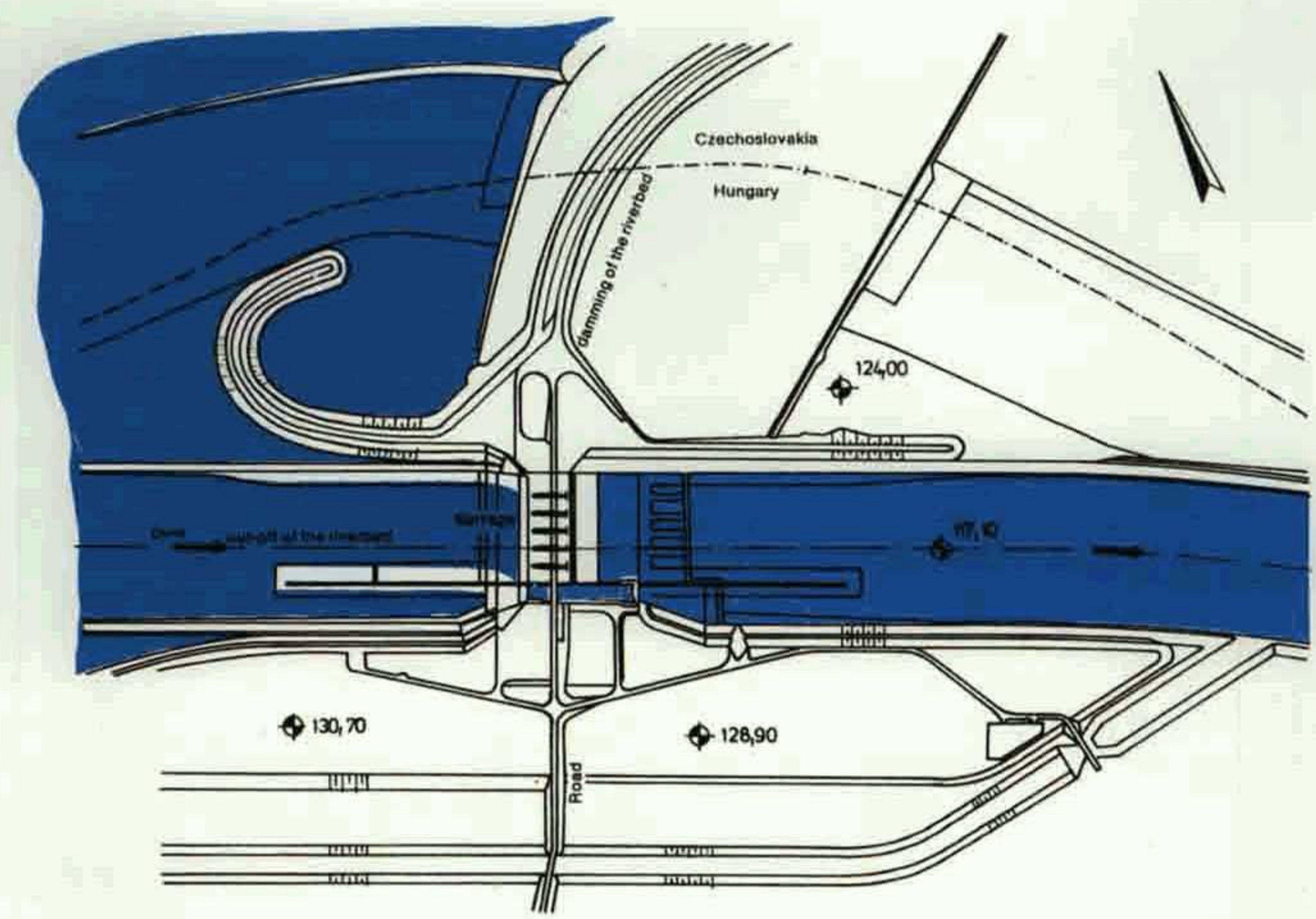




Dunakiliti barrage

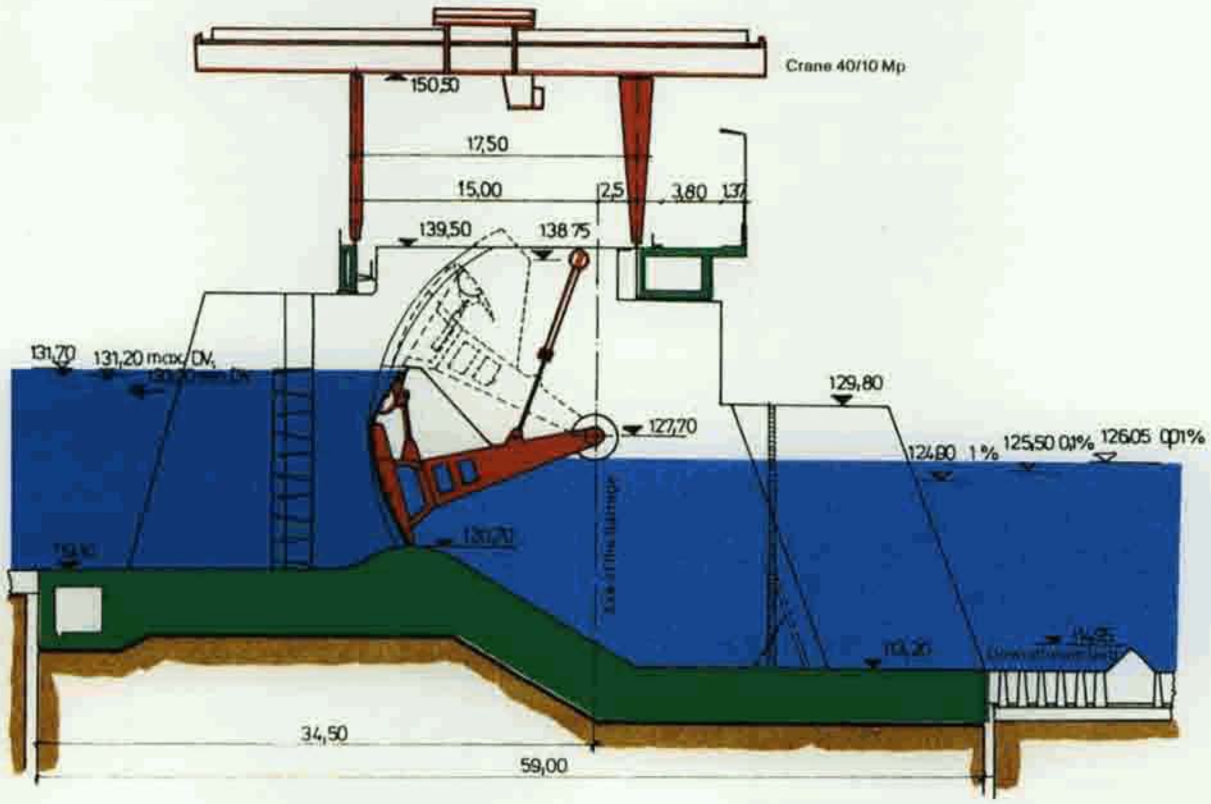
The project will be constructed at the 1,842 river km section of the Danube, in a right bank cut-off. Its task is to create a damming of 131.20 mB level, and to discharge that part of the floods which cannot flow through the Gabcikovo hydro-electric power plant. That rate of flow is 6,360 m^3/s at a flood having a 1% probability of occurance, 3,110 m^3/s at 0.1% and 9,730 m^3/s at 0.01% probability value. The barrage consists of seven 24 m wide openings, the closing system is oil-hydraulic operated tilting gates.
For the provisonal shut off steel stop logs in the upstream and so called Schön type shutter weir system are used downstream. Reinforced concrete upstream floor of 15 m length and reinforced concrete downstream bed are connected to the base plate which is followed by a base protection having concrete stones of 40 m length and rock filling of 45 + 50 m length. Service bridge and crane track are running through the barrage provided with two frame cranes which are used for locating the provisional shut off as well as for the erection and maintenance operation.
The right bank opening of the barrage plays also the role of the auxiliary ship lock in the peroid of putting into operation. Useful dimensions of the chamber are: 24.0 x 125.0 m. The left side lock operated by paddles is located in the right side pier of the ship lock.

Layout of the Dunakiliti Barrage



A bulb turbine with a discharge capacity of 30 m^3/s will be built into the left side pier of the barrage, to utilize the energy of the water-flow coming to the old river bed for maintenance. The barrage will be erected on a homogenous work site, protected by circular dam, in excavation pit provided with injected diaphragm wall construction, the area dewatered.
Additional projects are: winter harbour, service building, housing estate, and the road leading to the village.

Main section of the Dunakiliti Barrage

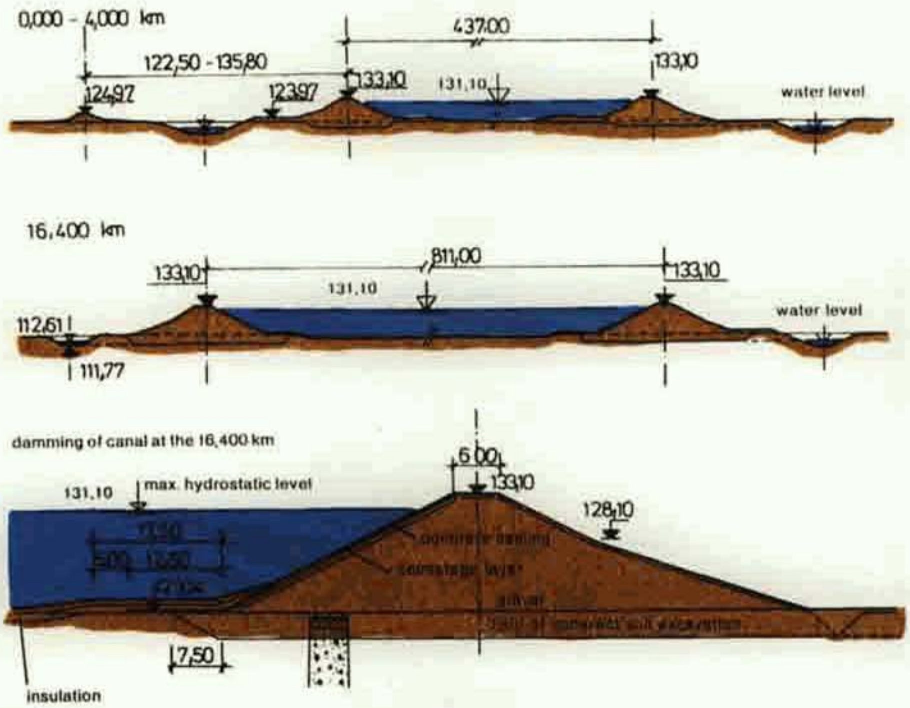


Diversion canal

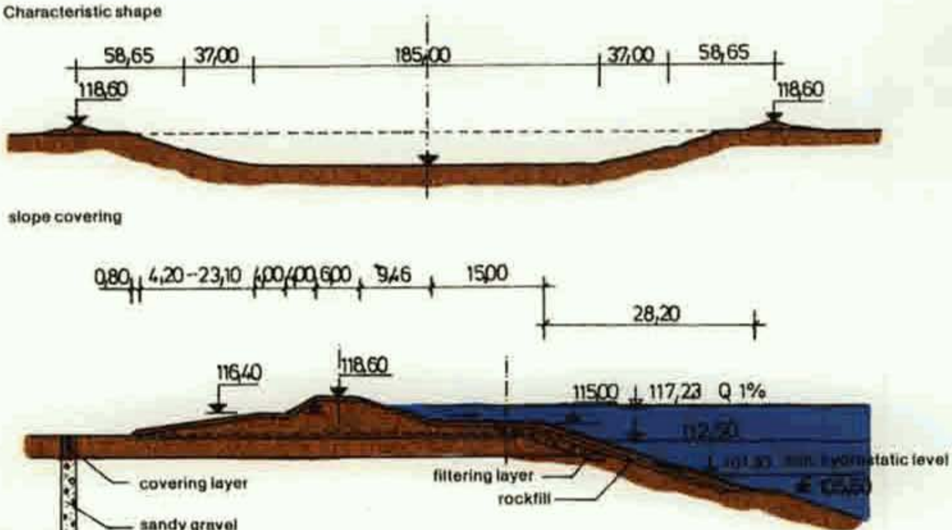
It is of 25.2 km length and serves as ship and discharge canal in case of floods of these reaches of the river in addition to supplying water for the power plant. The canal is to deliver a 4,000 m^3 water per sec. at a mean velocity of 1.0 m/s and this average velocity does not exceed the 1.3 m/s value even at peak load requirement. This canal is split by the Gabcikovo power plant into two sections: head- and tail sections.

Upstream canal starts from the storage located above the Dunakiliti barrage. Its length is 17.0 km. Bottom width is varying in proportion with the increasing depth of water, it is contracted from 542.5 m to 267.5 m, then it is reamed up to 730 m in front of the power plant along a 5 km section. This solution ensures to decrease the wave occured during peak-load operation at the required level. The dams emerge to a max. of 18.0 m above the site keeping a safety margin of 2.0 m, above the static water level. Material of the dam is sandy gravel, the slope on the water side is protected by an insulated concrete pavement of 20 cm depth, which is containing on the bottom having a width of 12.5 m. Insulation of the bottom was performed by compacting and tighting the existing clay loam which is followed by a gravel

Cross-section of the upstream canal

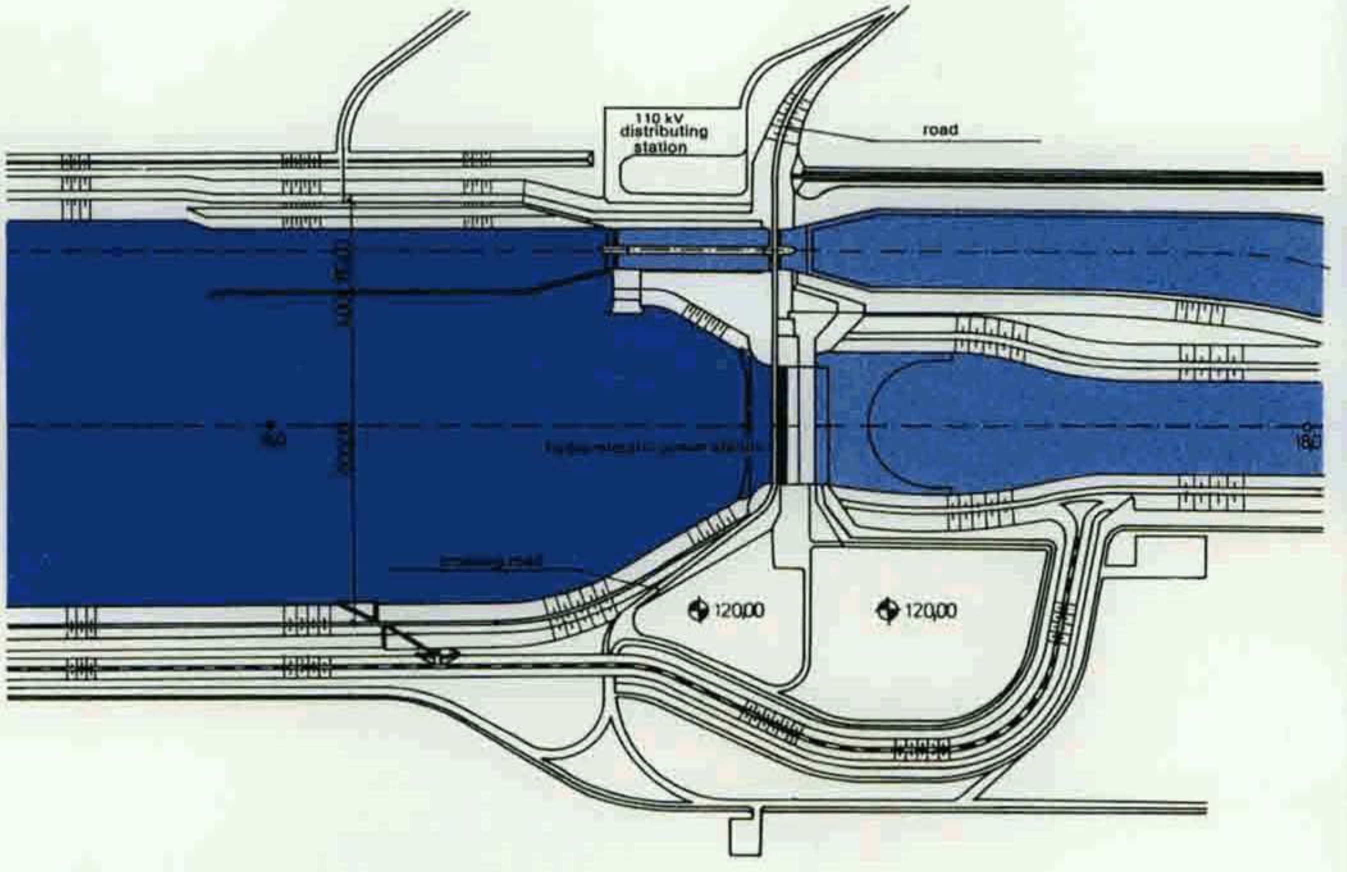


Cross-section of the downstream canal



layer of 50 cm, not to cause the weather conditions damage to the insulation during anchoring in emergency cases and in the erection period. The gravel layer is protected against drag by sprinkled asphalt. Water leaking through the layers is collected in drainage wells and canals. *Downstream canal* having a length of 8.2 km starts under the Gabcikovo power plant and reaches the Danube at Palkovicsovo. Its bottom level is situated under the land surface by 18 m. Dams are erected on both banks. Section of the canal has a shape of cup, its bottom width: 185 m. It will be protected by slope against the fluctuations of waterlevel. This protection consists of a 70 cm depth rockfill with a 50 cm filter layer under it. In addition a sandy gravel filter is located on the coherent soil overlying stratum. Construction of the downstream canal will take place in parallel with the head water canal, disintered sandy gravel will be built into the dams of the headwater canal.

Layout of the Gabcikovo power station and navigation lock



The Gabcikovo hydro-electric power station and ship-lock

It will be erected at a section situated at a distance of 17.0 km along the headwater canal i.e. at the 1,821.0 river-kilometer of the Danube. The power station is to utilize the waterfall available here, and the lock serves as by-pass to ensure a continuous navigable canal.

The hydro-electric power station is located on the right side, the double navigation lock is on the left side. The machine-house of the power plant, the 400 kV switchgear, the office and auxiliary buildings can be found between the two sides. A highway-bridge with 10 m width runs across the barrage. The underlying soil on the site of the project is sandy gravel of great water permeability, therefore the foundation work is performed by means of injected bottom-layer and trenches insulated by earthen-concrete partition-walls. Separate trenches are arranged for the erection of the hydro-electric power plant and for the navigation locks.

The machine house of the power station consists of four double blocks for the 8 units located inside.

Main characteristics of the turbines

number of pieces	8
type of the turbines	Kaplan system
diameter of the impeller	9,200 mm
rated speed	68.2
runaway speed	188 rpm
max. output	90 MW
working range of fall	23.40–16.00 m
range of utilized waterflow	420–651 m^3/s
min. value of fall to be utilized	11.81 m

Main characteristics of the hydro-generators

number of pieces	8
rated output (apparent)	100 MVA
rated output (useful)	90 MW
rated working power factor	0,9
rated voltage	15.75 kV $\pm$5%
rated frequency	50 cps
rated speed	68.2 rpm

Rated (apparent) output of the auxiliary generator serves as the exciter of the main generator is 1,700 kVA. Its voltage is 380 V $\pm$5%, working power factor is: 0.4. Connection diagram of the hydro-electric power station fits to the energy system of both countries;

- 6 generators are connected to the common electrical switchgear in twin-units arrangement through a three-winding transformer and feed the Hungarian-Czechoslovakian 400 kV overhead line between Podunajské Biskupice and Győr.
- 2 generators are connected to the 110 kV Czechoslovakian switchgear;
- the 110 and 400 kV switchgears are interconnected by means of booster-transformer.

The hydro-electric power plant is operated fully automatically and controlled by computer.

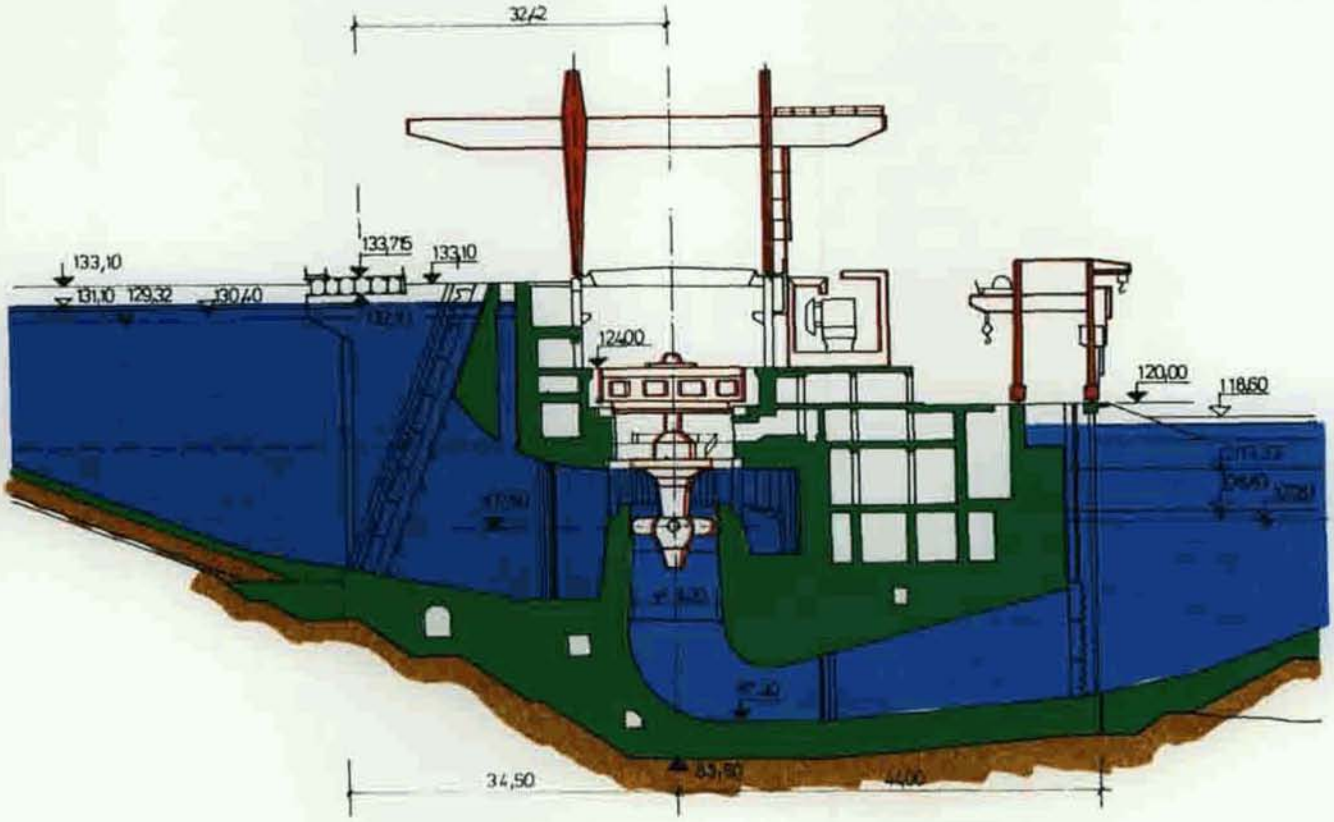
Two portal cranes serve for lifting the heavy pieces during maintenance of the equipment, the loading capacity of each is 275/50 Mp, for the smaller pieces two travelling cranes are to be used with a loading capacity of 32/8 Mp each.

The two navigation locks will be located on the left side of the headwater canal right next to each other. Effective length of both lock-chambers is 275 m, the effective breadth of it is 34, the minimum value of the depth above the sill is 4.50 m. 3 channels run lengthwise in the lock floor for ensuring the filling and emptying of the lock chambers. These are connected to the resp. structures situated outside the mooring. The lock chambers are interconnected and can be operated as a twin-type navigation lock.

The locking structure of the upper lock head is of segment construction which sinks under the sill when opening the lock. Cheek gates are built into the lower lock head. Upper and lower forebays and mooring spaces are connected to the lock chambers which have a breadth of 160 m and extended to 797 m in the headwater resp. to 1,072 m in the tailwater. Quaypiers and guide structures constitute integral parts of the ship-lock as well, erected on both sides along the up- and downstream.

Navigation guidance takes place from the control tower located near to the lower lock head.

Main section of the Gabcikovo power station



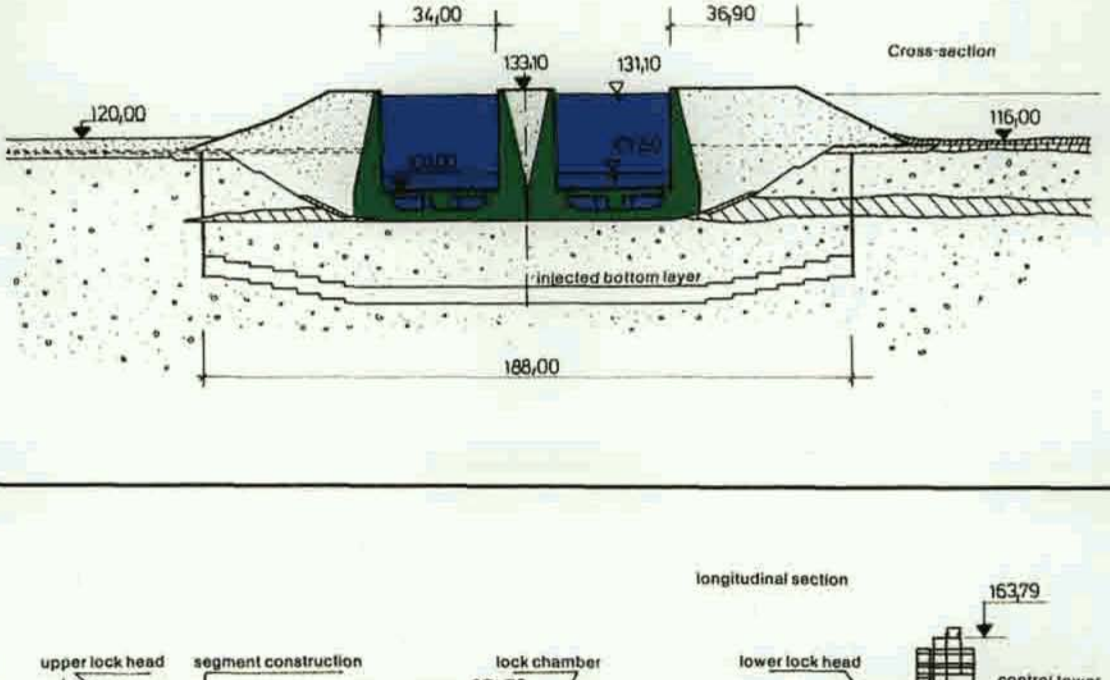
Dredge of the bed of the Danube under Palkovicsovo

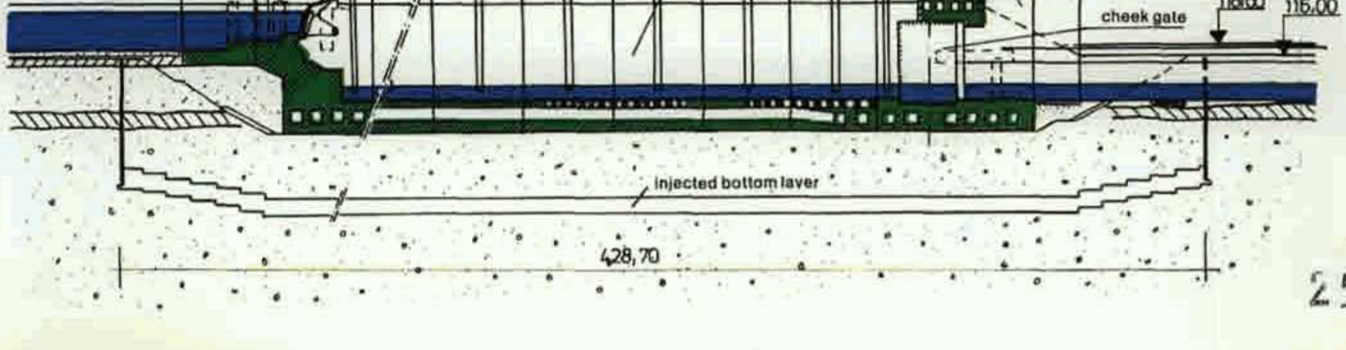
Dredge of the bed was foreseen under the mouth of the downstream canal to increase the head of water for the hydro-electric power station and to ensure the necessary depth for navigation along a 20 km section. Breadth of the dredged bed is 250–280 m, quantity of the scraped sandygravel is amounted to 20.5 mil. m^3.

Regulation of the old Danube bed

The old Danube bed under the Dunakiliti barrage which routing up to the mouth of the service-water channel will play an important role also in the future. It will take part in draining of the floods as well as the ice and alluvial deposit from the storage. The aim is not to effect the natural conditions and to maintain the water-carrying capacity, and rigidity. Therefore refining water let flow through the channel. The bed and the canal branches are to be regulated. Regular mending will be needed in the future to preserve the natural conditions.

Main sections of the Gabcikovo navigation lock





The Nagymaros barrage

The course of Danube influenced by the barrage is extended from Győr to Budapest. An increased protection of the sheltered land and reint bank will be attained in the area above the barrage, effected by the damming. Flood control, regulation, inland drainage and other preventive work was performed in eight connection creeks in Czechoslovakia resp. seven in Hungary, and these works promote also the future developments. Under the barrage up to the boundary of Budapest dredging will take place to increase the water fall of the barrage and to ensure safe navigation depth of water. The quantity to be dredged is 6.5 million m^3 sandy gravel.

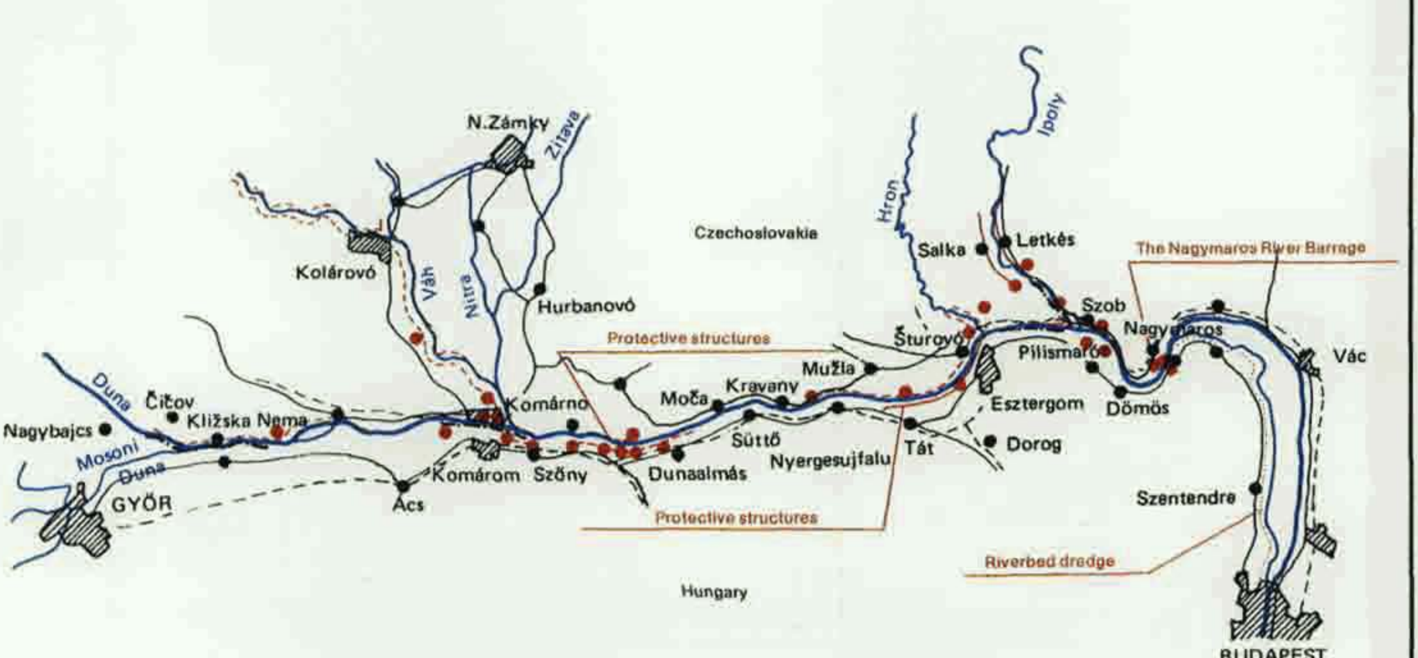
Task to be performed by the Barrage:

- To compensate the waterflow at a peak-load operation of the Gabcikovo hydro-electric power plant and to keep the minimal water level necessary for the operation of the turbine.
- To generate electric power.
- To comply with the requirements of navigation.

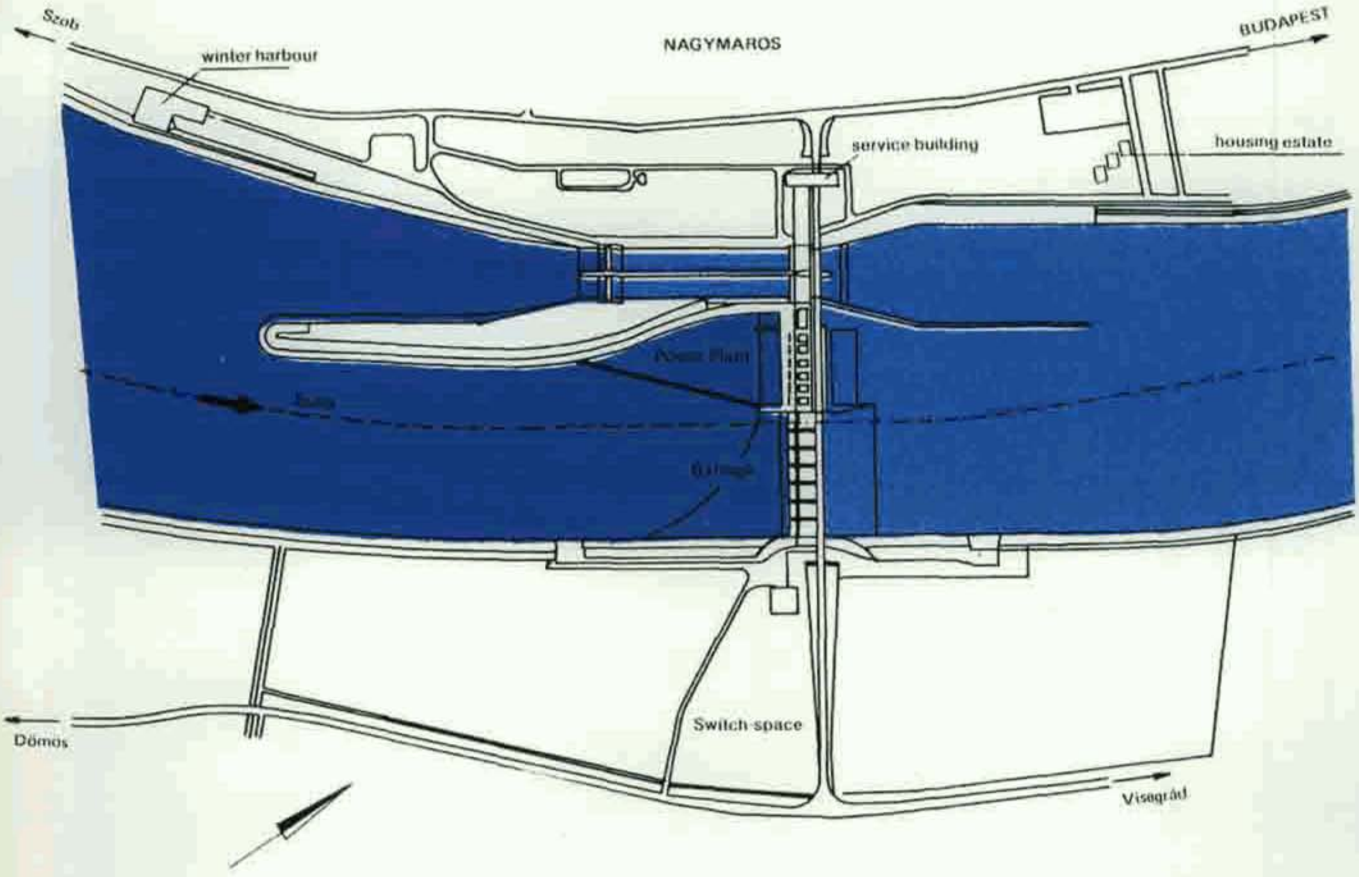
The barrage is erected at the 1,696 river km of the Danube. It is built on the bed of the river, on stone undersoil, applying plane foundation, dewatering the working pit. Protective round shaped dam built in the bed is connected to the left bank. To the flood-flow during erection, the bed ensure was expanded provisionally at the right bank.

Main projects of the barrage connected to each other from the right bank are the following: dam, power plant, and the twin type ship lock. A double-track road-bridge crosses above the barrage.

General layout plan of the Nagymaros Barrage



Layout of the Nagymaros barrage



›arrage

is connected to the right bank, its 7 x 24 m open-
ıg is closed by wickets of the segment-shaped
uice driven by oil-hydraulic moving gear.
readth of the pillars is 4.0 m, the total width of
ıe barrage is 200.0 m. Length of the base-plate
51.90 m, that of the tailrace is 85.0 m, which is
ollowed by the prepared bed. Provisional
ɔcking at the up-and downstream will take place
y means of bulkheads having box girder steel
tructure. They are put into their places applying
vo frame cranes with a capacity of 2 x 125 Mp
ach, running along the barrage. The cranes are
lso used during the erection and maintenance
eriods as well as during the operation of the
ower plant and the barrage.

Hydro-electric power station

It is located in the middle, consisting of 3 x 2 pcs of pipe-turbines and internal erection bay. Distance between axes of the machines is 20.0 m, the breadth of the erection bay is 41.0 m, the total breadth of the barrage power station is 170.0 m. Quick closing of the head water can be performed at two machines simultaneously, each of the sluice boards are delivered by 450 Mp capacity semi-portal cranes and moved by electro-oil-hydraulic operated cylinders. A separate pair of 100/5 Mp capacity frame cranes serve for lifting the sluice boards in the tail water. There are two 35/5 Mp capacity bridge cranes inside the machine house. Heavy pieces are transported through the openings above each of the turbine units by means of travelling crane outside the machine house.

Technical data of the units:

Turbines

number of pieces	6
type	pipe turbine having four blades
diameter of the impeller	7,500 mm
speed	62.5 rpm
runaway speed	145 rpm
max. output	27.4 MW
design fall	6.8 m
wheel discharge at design fall	466 m^3/s
operating fall range	9.43–3.04 m

The 158 MW installed capacity in an average year can be utilized during 180 days in the 5 hour peak-load period.

Generators

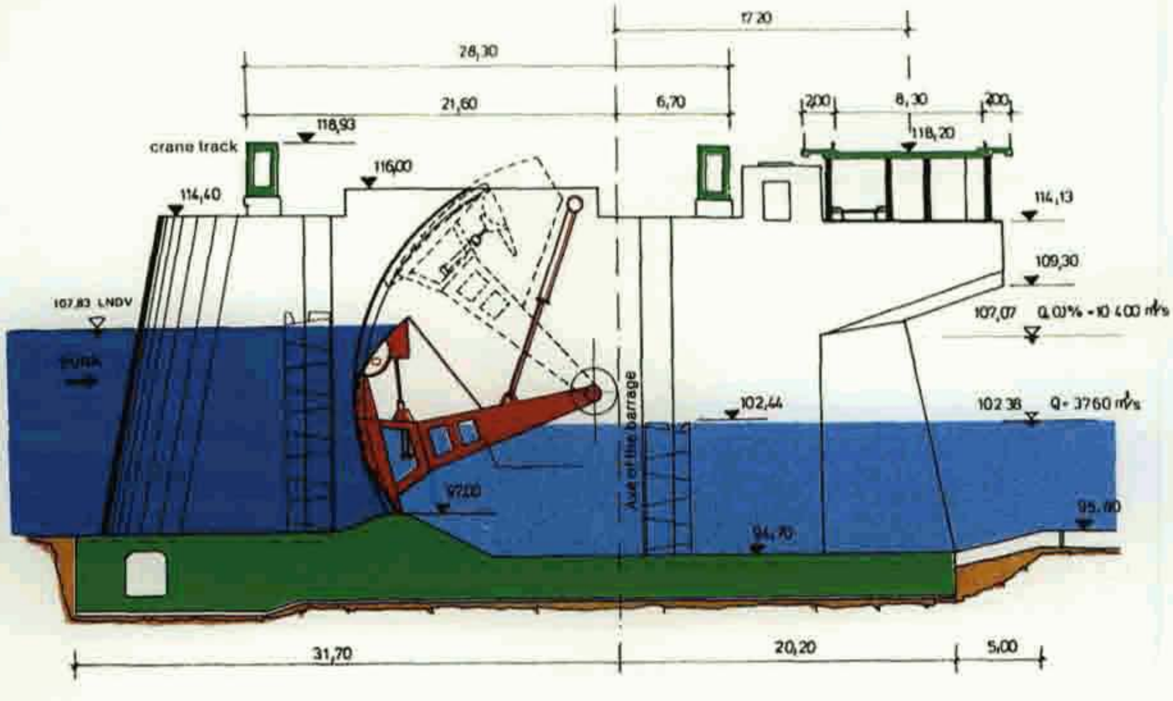
number of pieces	6
rated apparent capacity	27 MVA
power factor	0.98
rated useful capacity	26.4 MW
rated voltage	6.3 $\pm$5 per cent kV
rated frequency	50 cps

2–2 pieces of the generators feed the three-winding 63 MVA transformers, 1–1 generators are operated through the 31.5 MVA two-winding transformers with a voltage ratio of 115 kV $\pm$5%/6.3 kV.

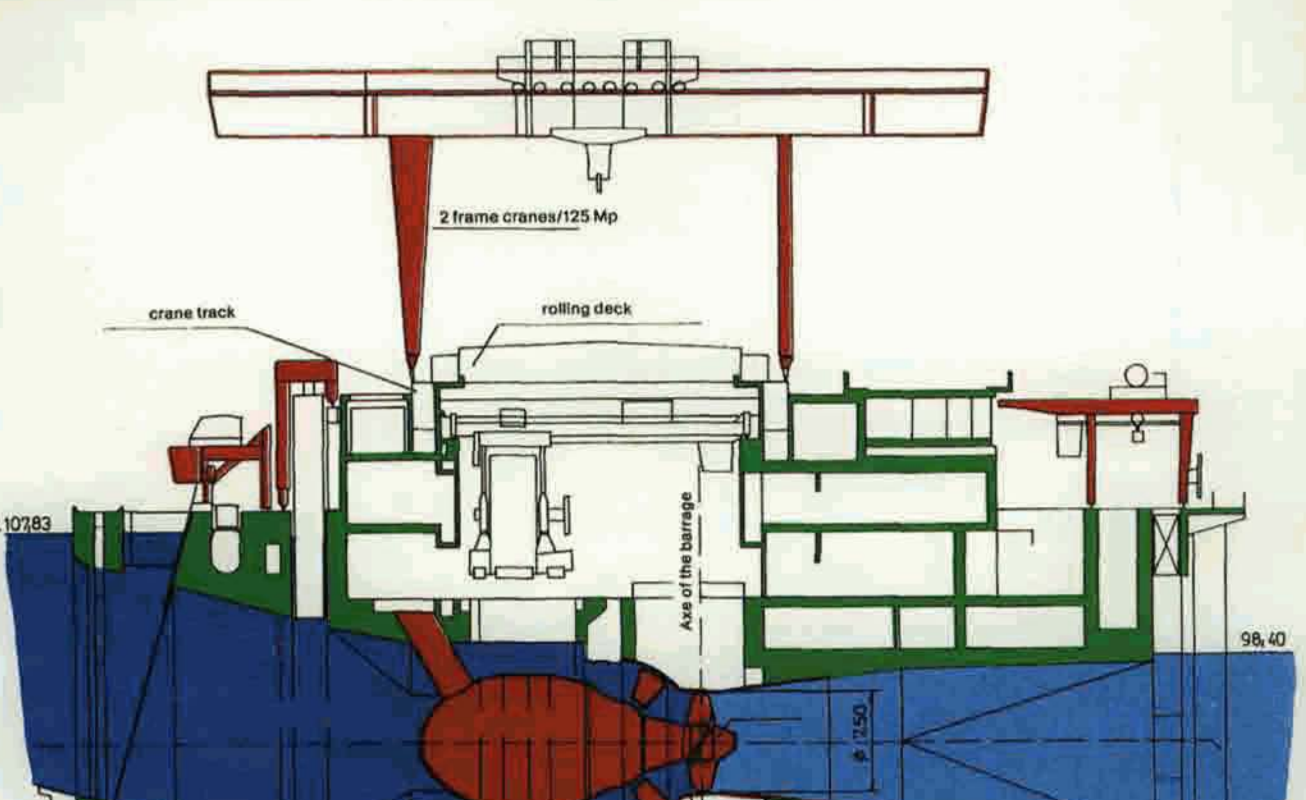
The outdoor switchgear on the right bank is connected to the Hungarian grid through two 120 kV transmission lines, that on the left bank to the Czechoslovakian grid through two 110 kV transmission lines.

The plant is operated by automatic control equipment, when the automatic operation is switched off, the plant can be operated from the control room.

Main section of the Nagymaros Barrage



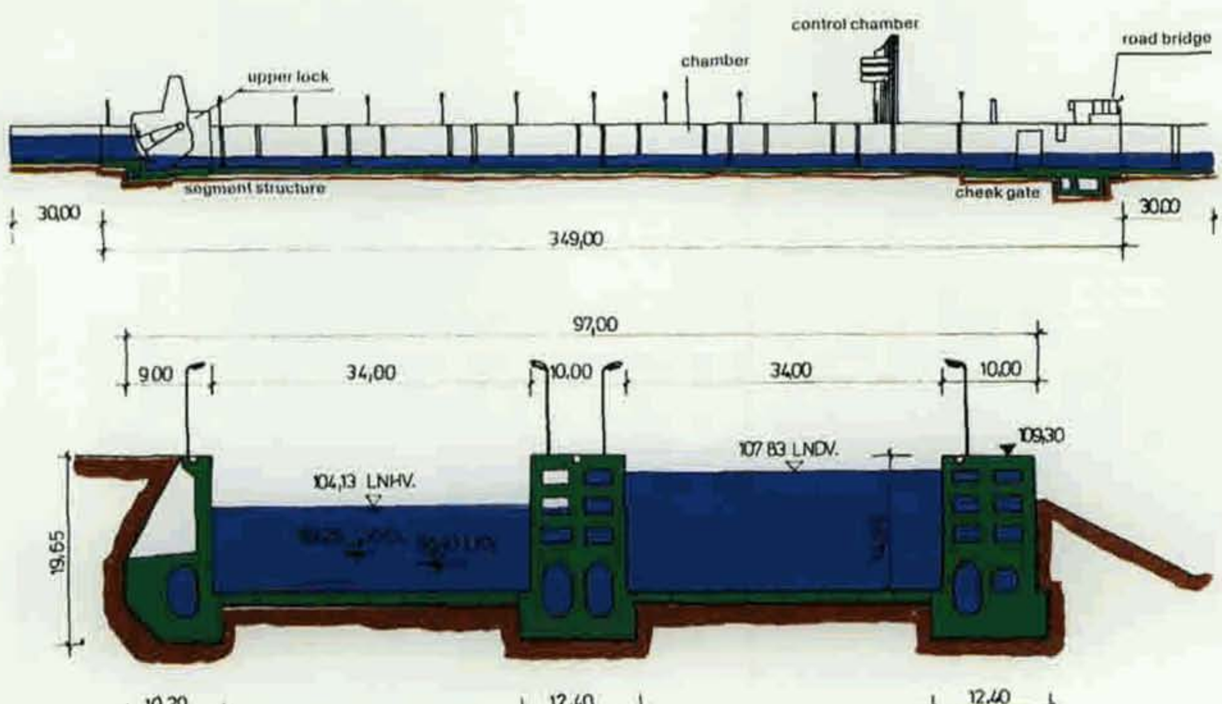
Main section of the Nagymaros hydro-electric power station

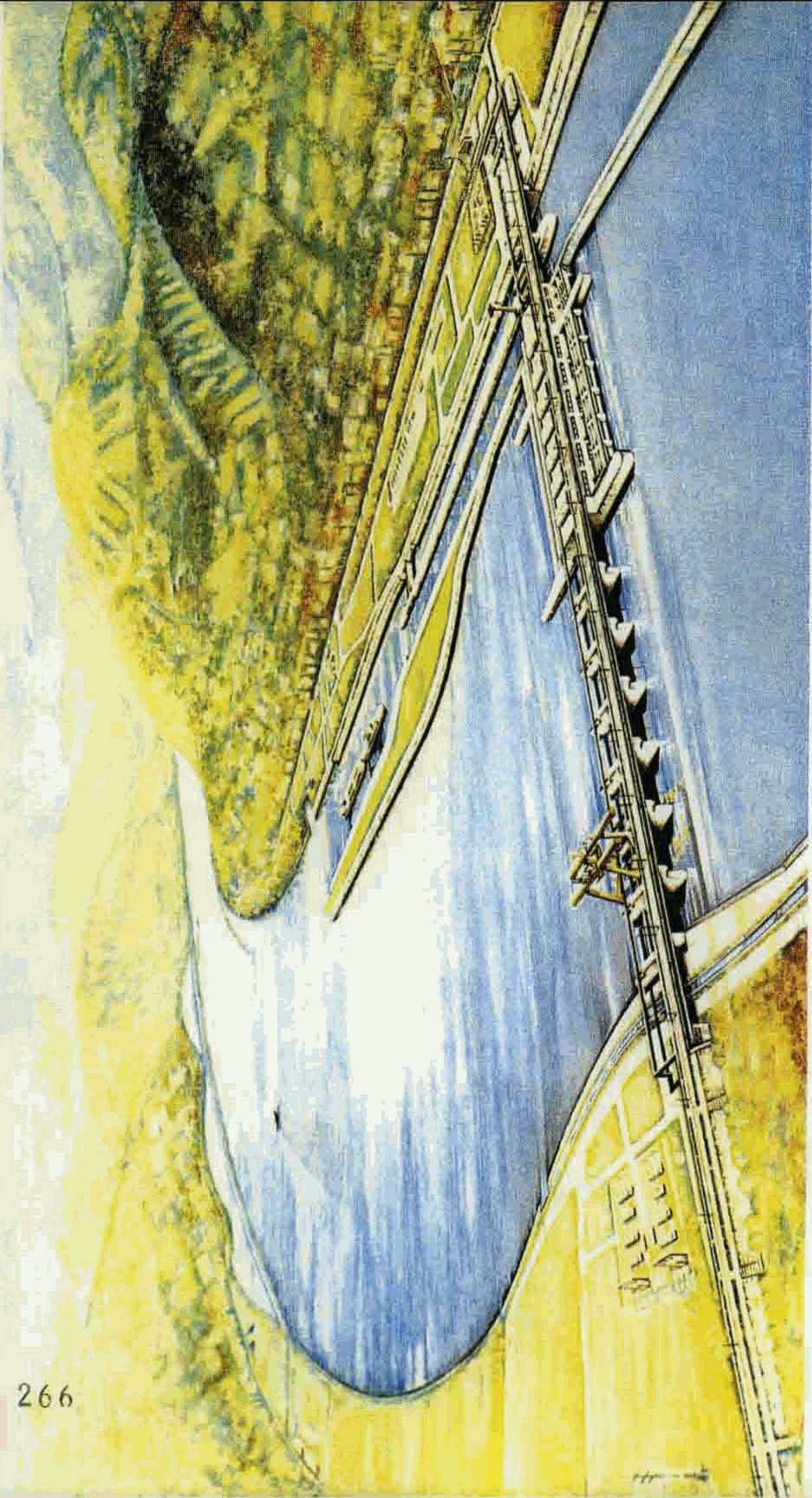


Shiplocks

The two locks having a useful breadth of 34 m and a length of 275 m are located in the upstream water connecting to the left bank. In the lock chamber a ship-train consisting of 9 pcs 1,500 t two barges and tugs can be sluiced.
Locking structure of the upper lock-head is oil-hydraulic operated sluice board which can be lifted, the lower lock head is closed by mitering gate. Min. value of the water depth above the sill is 4.50 m. The filling-draining system of the lock chamber is of longitudinal – channel type routing in the side walls of the chambers. Vertical boards supported by floated beams are used for the provisional closing of the upper lock head. These boards can be located by means of floating crane. At the lower lock head, the vertical closing boards supported by the upper beam are located by means of frame crane. Guide structure and quay piers of 450 m length in the forebay and 432 m in the afterbay are also belonging to the barrage. Min. breadth of the moving space is 155 m.
Office and service buildings are situated on the bank of the river.

Main section of the Nagymaros lock





Important stages of work to be performed during the erection of the barrage system

Dunakiliti-Hrusov storage

Construction of dam with clay core insulation	22,250 thousand m^3
Sandy gravel filter layer	745 thousand m^3
Projects made of concrete, reinforced concrete	50 thousand m^3
Slope pitching, made of concrete	417 thousand m^3
Bank protection stones	243 thousand m^3

Dunakiliti barrage

Earth work	16,470 thousand m^3
Injected bed	400 thousand m^3
Bulkhead closure	82 thousand m^3
Projects made of concrete, reinforced concrete	232 thousand m^3
Stone work	910 thousand m^3

Upstream channel

Construction of dam	29,500 thousand m^3
Slope pitching, made of concrete	1,460 thousand m^2
Filter layer	853 thousand m^3
Clay insulation of the bed	5,630 thousand m^3
Gravel layer for bed protection	4,380 thousand m^3
Projects made of concrete	55 thousand m^3
Core walls	119 thousand m^2

Downstream channel

Excavation	42,210 thousand m^3
Construction of flood protection dike	1,810 thousand m^3
Filter layer	425 thousand m^3
Stone work for pitching protection	568 thousand m^3

Gabcikovo barrage

Earth work	13,480 thousand m^3
Injected bed	1,080 thousand m^3
Insulation bulkhead closure	140 thousand m^2
Projects made of concrete, reinforced concrete	1,260 thousand m^3
Technological equipment	33 thousand Mp

Nagymaros barrage

Earth work	12,030 thousand m^3
Rock work	588 thousand m^3
Construction of dam	9,640 thousand m^3
Projects made of concrete, reinforced concrete	616 thousand m^3
Stone work	963 thousand m^3
Technological equipment	28 thousand Mp

Flood control work on the area above Nagymaros

Earth work	15,630 thousand m^3
Construction of dam	10,200 thousand m^3
Sandy gravel filter layer	1,100 thousand m^3
Projects made of concrete, reinforced concrete	200 thousand m^3
Concrete closure	640 thousand m^2
Stone work	690 thousand m^3

Main characteristics of the Barrage System

Typical water discharge (m^3/s)	Gabcikovo Barrage	Nagymaros
0,1% probability	13,000	10,000
1% probability	10,600	8,700
5% probability	8,750	7,650
smallest (1901–1960)	570	590
highest (1901–1960)	10,400	8,180
90% durability	1,010	1,286
50% durability	1,810	2,248
10% durability	3,298	3,837

Typical water levels

Maximal operation upstream water level (mB)	131.20	107.83
Maximal head (m)	23.27	9.43

Storage characteristics

Max. breadth of the storage (km)	4.5	2.0
Surface of the storage (km^2)	60.1	68.0
Total capacity of the storage (million m^3)	200.0	170.0
Useful capacity of the storage (million m^3)	49.0	25.0

Characteristics of power generation

Installed capacity (MW)	720.0	165.0
Power generation during peakload operation (GWh/year) in average year	2,650.0	1,025.0
Average utilization per year (hours)	3,775.0	6,740.0

Navigation characteristics

Depth of water below the navigation low water level (m)	3.6–4.0
Minimal breadth of the navigation way (m)	180
Minimal radius of curvature (m)	1,000
Depth of still under the navigation low water level (m)	4.5
Clearance height above the navigation flood level (m)	10.0
Average filling and draining time of the barrages (minutes)	12–14

Annex 30

The Binational Gabčíkovo-Nagymaros Project, November 1986
V. Lokvenc and M. Szántó

The binational Gabčíkovo-Nagymaros project

By V. Lokvenc and M. Szántó, Czechoslovak Government-Delegate* and General Manager**

The joint Czechoslovak-Hungarian Gabčíkovo-Nagymaros hydro scheme, exploiting the waters of the Danube from Bratislava (the capital of Slovakia) and Budapest (the capital of Hungary) is now under construction in Central Europe. The project is designed for flood protection of adjacent areas, providing electric energy and navigation on the common Czechoslovak-Hungarian sector of the river. Water management and water resources development problems have to be solved to improve conditions over extensive areas on both sides of the river.

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The Danube enters Czechoslovakian territory at the Devín Gate (Fig. 1), at point km 1880.2. It then forms a common border between Czechoslovakia and Austria along a stretch of 7.5 km. Between points km 1872.7 and 1850.2 the river passes through Czechoslovak territory along a stretch of 22.5 km. Between points km 1850.2 and 1708.2 it creates a 142 km-long border between Czechoslovakia and Hungary. Further downstream it flows exclusively through Hungarian territory.

This geographical information is included to show that any technical interference in the water management of this area is a common problem for at least two countries. The Danube breaks at the Devín Gate and then runs into flatlands. Down to km 1790 (Kližská Nemá-Gönyü) it has the character of a wild river with a gradient of 35-40 cm/km. It then passes (with a

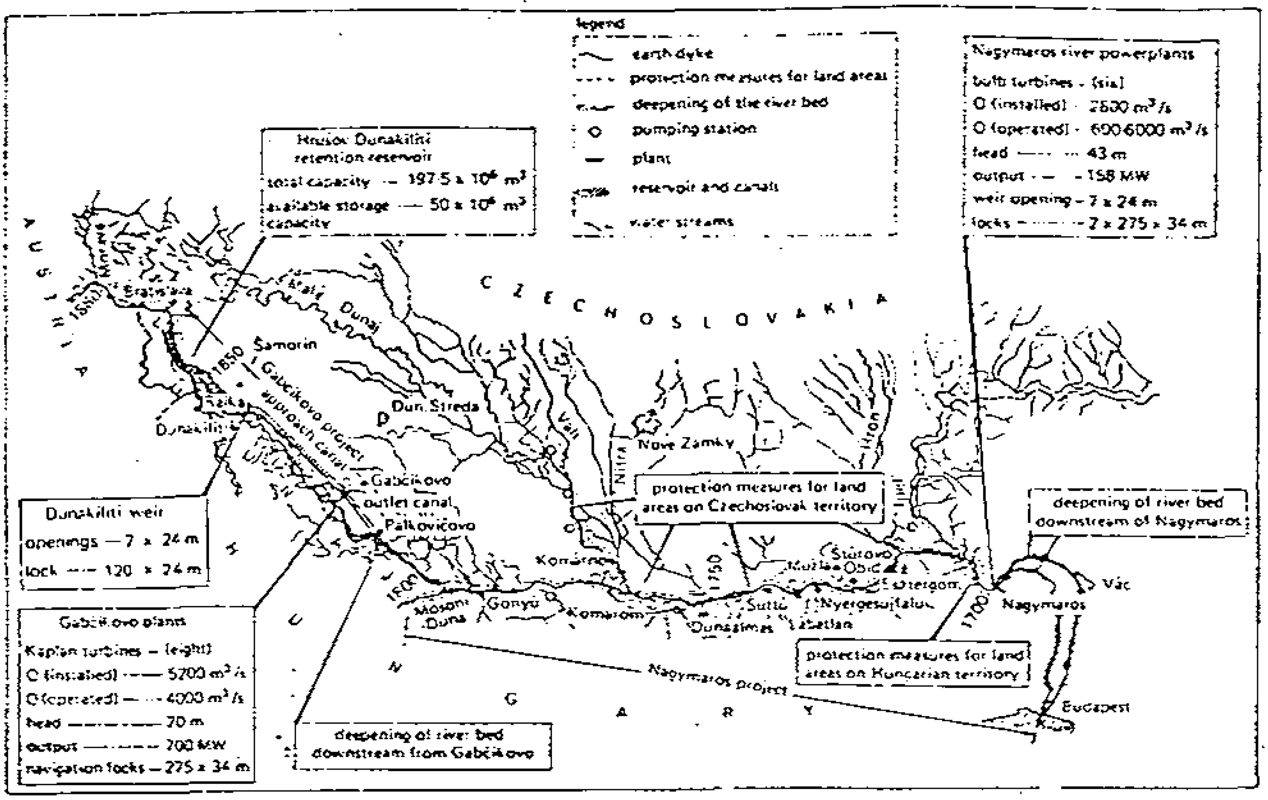

Fig. 1. General layout of the Gabčíkovo-Nagymaros scheme.

gradient of 8-6 cm/km) into the strait of Chlaba, using the narrow valley between the Börzsöny and Pilis Mountains. The valley widens downstream of Nagymaros and the river enters the plains of Pest.

This abrupt decline of the course gradient at Kližská Nemá-Gönyű reduces the bedload transport capacity of the stream, creating the characteristic features of the wide flatlands and plains. The suspended and rolled sediment load, carried easily by the river in its upper reaches, has been deposited in these areas over the centuries. At this point the river has braided into multiple streams, the courses of which frequently migrate.

Immediately downstream of Bratislava (on the Czechoslovak territory) the Little Danube branches from the main river channel, returning into the main course at Komárno and forming a large island (called the Danube Island), covering an area of 160 000 ha. On the other side a branch called the Mosoni-Danube forms the island of Szigetköz with an area of 33 000 ha. From Bratislava downstream to Palkovičovo, along the main river channel, the braided system undergoes continuous alterations.

At Bratislava the river carries a bedload of about 600 000 m³ of rolling sediment per year. Because of the steep gradients upstream, the sediment is kept in motion even at low discharges. At Nagymaros, however, the volume of observed sediment is only 14 000 m³/year. Therefore, the majority of the sediment is deposited in the area of slope break at Kližská Nemá-Gönyű.

Maintenance of navigation routes required extensive works over this stretch of the river, especially in the so-called ford section. Navigation depths recommended by the Danube Commission cannot be provided by traditional regulation structures. Today, it is the Danube's most difficult waterway section to manage.

Adjacent areas cannot, at present, be protected with sufficient safety against extreme river or ice floods, despite the fact that along the Danube, and its tributaries, an expensive dyke system has been constructed (parts of which have been destroyed several times). During long-term high water periods the undersoil beneath the dykes was washed out and the dykes collapsed. In 1954 there were three dam failures in the Hungarian territory with subsequent inundation of the entire area of Szigetköz.

In 1956 two dams collapsed on the Czechoslovak side causing inundation of 100 000 ha of land. At that time 3900 houses were damaged, 54 000 people had to be relocated and the costs of the damage amounted to several billion Czechoslovak crowns.

Today, the area around this Danube stretch is densely populated and heavily exploited by agriculture. Its drawback to continued development is its non-regulated state with regard to water management. It is permanently endangered by flooding despite the fact that approximately 1300 km of drainage channels have been built in this area, with the necessary number of pumping stations.

Ironically the area often suffers from droughts: the average yearly precipitation is 560-620 mm. In short, out of three years two are dry, despite the Danube carrying sufficient water volumes during the growing period.

Underneath the flatland areas there are (under the clayey 1-4 m-deep top soil) Quarternary sedimentary strata, chiefly alluvial systems, consisting of gravel and sand. Adjacent to Bratislava they are 13-20 m thick. In the downstream direction their thickness increases to about 400 m, with a filtration rate of 3×10^{-3} m/s. From the water level break at Kližská Nemá down to Štúrovo and Esztergom this layer thins again to 8-15 m.

The area is quite seismically active. Seismicity at Komárno has been recorded at 8.5 ±0.5° on the Mercalli scale. Therefore seismic zones were determined along the Danube, and their appropriate values established. These are used in designing as follows:

Table I—Delineation of seismic zones

Location	Intensity (Mercalli scale)	Acceleration
km 1861-1823 (downstream of Bratislava)	6	0.01 g
km 1823-1808 (Gabčikovo)	7	0.025 g
km 1808-1797	8	0.05 g
km 1779-1764 (Komárno)	9	0.10 g
km 1764-1740	8	0.05 g
km 1740-1720	7	0.025 g
km 1720 and lower (Esztergom-Nagymaros)	6	0.01 g

It is evident from the Tables, when constructing on the water-bearing sandy-gravel layers it is impossible to avoid extensive foundation works in the seismic areas.

Hydrological characteristics of the area are given in Table II.

The maximum discharges used in the project with their probability of occurrence expressed in per cent and computed by extrapolation, are shown in Table III.

Along the stretch of the river which has been described, various tributaries enter the Danube: from the left, the Váh with the Nitra, the Hron, the Ipel; and, from the right, the Rába. There are well known and very dangerous ice floods in winter. The probability of a continuous ice cover is 40 per cent. The ice usually lasts for about 28 days in the year (and up to a maximum of 92 days). Ice usually accumulates upstream, and melting and ice runs occur downstream. Planners have had to take into consideration all these natural phenomena and technical constraints as well as many other factors. Technically and economically feasible solutions have been elaborated by a number of design organisations, and by committees appointed by the two governments. The best design options have now been approved by the government delegations.

Table II—Average monthly flows at Bratislava and Nagymaros

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bratislava	1567	1585	1957	2358	2700	2785	2633	2271	1954	1568	1480	1441
Nagymaros	1845	1970	2334	2772	2900	2980	2673	2394	1937	1701	1680	1668

Table III—Maximum discharges at Bratislava and Nagymaros

	Bratislava	Nagymaros
$Q_{0.01}$ per cent	15 000 m³/s	—
$Q_{0.1}$ per cent	13 000 m³/s	10 000 m³/s
$Q_{1.0}$ per cent	10 600 m³/s	8 700 m³/s

Not only are the natural conditions extraordinarily complicated, allowing for several possible solutions, but also the scheme required the co-operation of experts in three countries; this made the final solution of the problems more difficult.

The companies Hydroconsult of Bratislava and Viziterv of Budapest started conducting studies as early as 1951.

In 1952 an agreement was reached between Czechoslovakia and Hungary at government level. In accordance with this, the lower common section of the system will be used for the hydropower project at Visegrád, while the upper common section will be used for another power station on a diversion canal. During the Czechoslovak-Austrian negotiations between 1955 and 1959, it was agreed that these countries would construct a joint Czechoslovak-Austrian hydro project at km 1873.3.

A number of options had been studied for the common Czechoslovak-Hungarian stretch. Between 1952 and 1966 about 100 different solutions were analyzed, compared by both sides and documented. Each plan resulted from the combined effort of a number of organizations, including surveyors, geologists, designers, research workers, as well as construction and equipment enterprises.

It is felt that such an extensive series of studies has resulted in the selection of the best option from the technical, ecological, and economical point of view.

In addition to the basic plan for the location and layout of the barrages, powerplants, and so on, a number of supplementary plans had to be evolved for the various turbine capacities and canal dimensions.

A substantial amount of work has been achieved in studying the effects of the system on adjacent areas, for example forecasting groundwater motion and changes in ice conditions.

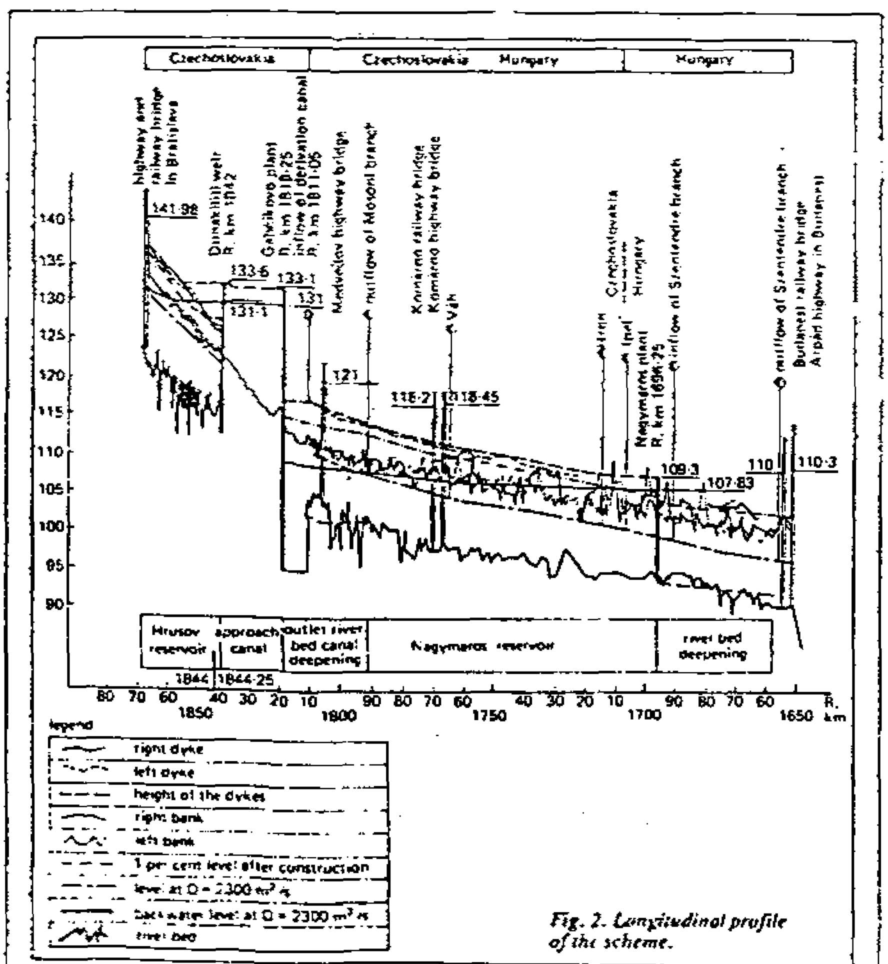

Fig. 2. Longitudinal profile of the scheme.

The final design

The two water schemes, one at Gabčikovo and the other at Nagymaros, will create a unified, inseparable operation system bound hydraulically together by the interconnected water levels and by the method of power-production (Figs. 1 and 2).

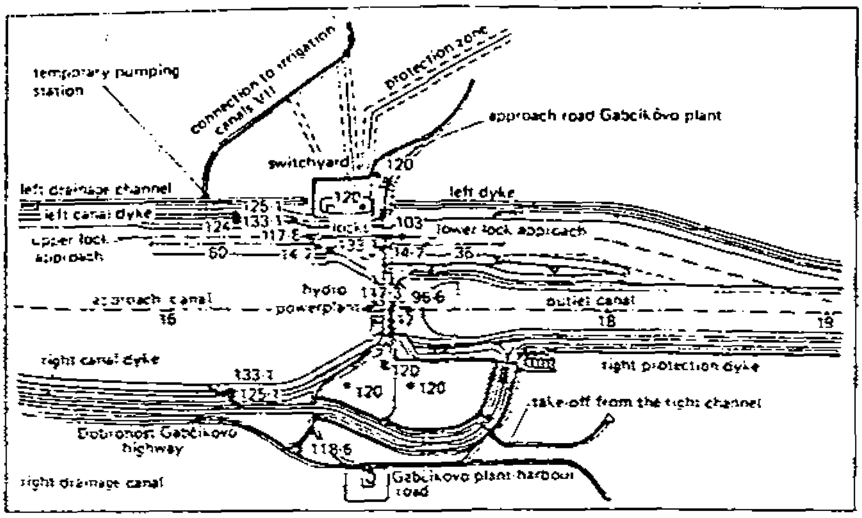

Fig. 3. Layout of the Gabčíkovo structures.

The 200 km stretch of the Danube between Bratislava and Budapest will be favourable for energy production, since the water required for peak-operation can be stored in the upper reservoir, created downstream of Bratislava, while the (already compensated) discharges will be released from the second reservoir at Nagymaros.

This scheme provides sufficient water for navigation and other water uses, and also enables peak-operation and energy production from a system that is more reliable than any other hydro powerplant in both countries.

The review of main operation parameters of the powerplants is presented in Table IV.

Gabčíkovo project

This plant, constructed on the diversion canal, will exploit the difference in water level of the Danube between Bratislava and Kližská Nemá. Its main pupose will be to meet the peak demand. It consists of following main components.

The reservoir at Hrušov-Duna-kiliti

This is downstream of Bratislava, between dykes built mainly on Czechoslovak and partially on Hungarian territory. Maximum damming is planned to el.131.1*. The reservoir volume is 243×10^6 m³; its useful volume is 60×10^6 m³ at water level fluctuations of 1 m in the reservoirs and in the diversion canal upstream of the barrage. The reservoir is 6000 ha. The 6 m-wide crest of the dykes will be at 2.5 m above the backwater level at the discharge of 4000 m³/s. In areas endangered by major flood levels an extra elevation of 1.5 m above the flood-level of Q_1 per cent is provided, which will be sufficient to protect against the 1000-year flood ($Q_{0.1}$) with the elevation of 0.5 m.

The reservoir dykes will mostly be of the same design as the present flood dykes, and will be embankments filled with gravel-sand material obtained by excavation and dredging of the infiltration channels. They will be sealed with clayey materials. The slopes on the water face will be fortified by concrete plates against waves (from el.129.1 to the crest). If adequate sealing material is not available, asphalt insulation may be used. For the dykes on Hungarian territory, a 4 m-long wave-breaker will be built to protect against waves induced by wind.

The water level at the downstream end of the reservoir will be 6.5 m above the present ground surface. At its upper section, water will remain in the river bed, overflowing only during periods of flood.

*Metres above Baltic sea level

Water will pass through the dykes and below them into the infiltration channel on both sides of the reservoir. Water in those channels is regulated as required by impounding structures. This water will be used to regulate the groundwater level, and to help restore the original Danube riverbed parallel to the stretch of the diversion canal; it will be a clean and valuable water resource.

About 3500-4500 m³/s of water will be discharged from the reservoir into the diversion canal, to secure the required volumes for the Little Danube, Mosoni-Danube and old Danube river bed. Floodwaters exceeding the amount required for the powerplant, and the ice-runs in winter will be discharged through the weir into the old Danube river bed.

Dunakiliti weir

This is planned to be located on Hungarian territory in the cut-off of the river bend at km 1842. The cut-off width will be 245 m. The weir will have seven openings each 24 m wide. It will be capable of passing a discharge of 15 000 m³/s ($Q_{0.01}$ per cent) at el. 129.76, in other words, the 10 000 year flood can be passed in such a way that the diversion canal will convey 5270 m³/s.

The extreme right opening of the weir will serve as a temporary lock during impounding of the reservoir and diversion canal. The pillars of this opening will be elongated

Table IV—Main parameters of the system

Parameter		Gabčíkovo	Nagymaros	Total
Max. turbines absorption	(m³/s)	5200	2800	—
Installed capacity	(MW)	720	158	878
Output of the powerplant at 90 per cent discharge	(MW)	700	146	846
Power production at continuous operation in an average year	(GWh)	2980	1040	4020
Power production at peak-operation in a humid year	(GWh)	3660	960	4620
Power production at peak-operation in a dry year	(GWh)	1775	925	2700
Power production at peak-operation in an average year	(GWh)	2650	1025	3675
of which: peak energy	(GWh)	1470	55	1525
semi-peak energy	(GWh)	810	—	810
base energy	(GWh)	370	970	1340
Peak-operation at 90 per cent discharge	(h)	5	5	—
Installed output utilization at peak operation in an average year	(h/year)	3790	6500	—
Head	(m)	16.0-21.5	3.04-9.43	—

and at their lower end the gate will be constructed, thus forming a lock with an inner available capacity of 24 × 125 mm.

In the central pillar close to the lock, an opening has been designed for a bulb-turbine to be installed with a discharge capacity of 30 and 50 m^3/s; this will discharge into the old river bed, supplying it with a supplementary volume.

Gates of the weir will comprise segments and valves, making it possible to construct narrower pillars. The closing height of the segments is 8 m; valves will dam the remaining 3.3 m.

At the construction site a 200 m-thick gravel-sand layer exists below groundwater level. The foundations will be excavated in an open pit, protected on the periphery by 27 m-deep sealing screens. A firm base will be formed by injecting gravel-sands under the 5 m-thick bottom of the construction pit. Its lower edge will be 32 m below the ground surface. Towards the edge the bottom of the base gradually increases.

Approach canal

The approach canal is a continuation of the reservoir, and joins it on the left bank, where the former has a tapered construction. The upstream approach canal is designed to be 17 km long, and will be entirely on Czechoslovak territory together with the Gabčíkovo hydro plant and locks and the outlet canal. The canals are inside the area at present protected by flood control dykes. The water depth in the approach canal is 7.3 m at the end. The bottom of the canal coincides with the level of the terrain.

Because of the changing topography in the canal, the water depth will vary. The canal designs were worked out on the basis of hydraulic model experiments and computer-aided calculations, with the aim of reducing wave propagation induced by peak-operation, frequency regulation, and in particular by a total shutdown of the hydropower station. Therefore the bottom width along the canal will vary.

For a discharge of 4000 m^3/s the average flow rate is 1 m/s. During peak-operation, discharges from the powerplant will vary between 3300 and 4550 m^3/s, and if the water level is lowered after the peak operation, even in the narrowest part of the canal flow velocities will not exceed 1.3 m/s. This means that the canal will be stable against scouring and erosion.

The average velocity allowed at flood events of Q_1 per cent is 1.5 m/s. Thus, in case of reduced operational water levels and simultaneous floods of $Q_{0.1}$ per cent discharges of 4890 m^3/s may be passed through in the cross-section at 0.0 km of the canal at el. 129.34. In case of a flood event of $Q_{0.01}$ per cent, the discharge will be 5270 m^3/s at a reduced water level of 129.76. It is not assumed that complete evacuation of the canal would ever be necessary.

The crest of the dykes along the approach canal is horizontal at el. 133.1, so that there is a 2 m safety margin above the static water level. The earthen canal dykes will be constructed of gravel and sand gained from the outlet canal and from borrow pits. Compressible layers of soil must be removed from under the dykes and replaced with compacted gravel sand. The crest width of the dykes will be 6 m. On the protected side, their upper slope will be 1:2 and the lower slope 1:3. Canal-facing surfaces with a slope 1:2 will be protected by an elastic asphalt layer. Subsidence of the dykes was calculated as 26 cm for maximum dyke heights, which will occur simultaneously in the course of construction and impounding. After filling the canal, the wetted side of the dyke will subside by about 10 cm, and the bottom of the canal by 19-36 cm, the latter being a function of the thickness and of the physical characteristics of the top soil layers in question. The subsidence will be areal and uniform, causing no difficulties in the dyke construction.

Stability of the dykes was investigated at seismicities of 7 and 8° on the Mercalli scale and for the most unfavourable loads, totally broken sealing or lining, and sudden total evacuation with simultaneous earthquake. The lowest safety factor was obtained at the downstream face, namely 1.4. For the canal-facing side, values of 2.01-81.1 were considered sufficient. It can be seen therefore that the dykes will be safe even in cases of a very strong earthquake.

The bottom of the canal is constructed as follows: after levelling, a continuous plastic lining is laid down between two 40 cm-thick clayey-sand layers and protected by a 30 cm-thick sand-gravel layer. On both sides of the canal, there are drainage channels at groundwater level. During construction the groundwater level along the axis of the canal will be 2 m below the ground surface in the case of average flows, and even during floods with a frequency of one year. Thus higher Danube water stages will not jeopardize the construction.

In the cross-section at 4 km, a culvert is to be constructed underneath the canal with a capacity of 60 m^3/s which will convey excess seepage waters originating from the protected area on the left side into the lateral branches of the Danube stream.

Gabčíkovo structures

These will consist of two main elements, the hydropower station and navigation locks, see Fig. 3.

Eight turbines will be installed in the power station, in two blocks. They will be vertical Kaplan turbines coupled directly to three-phase vertical synchronous generators. Total capacity of the station will be 720 MW. The contractor for these installations is the Skoda Concern Plzeň.

The main technical details of the turbines are shown in Table V.

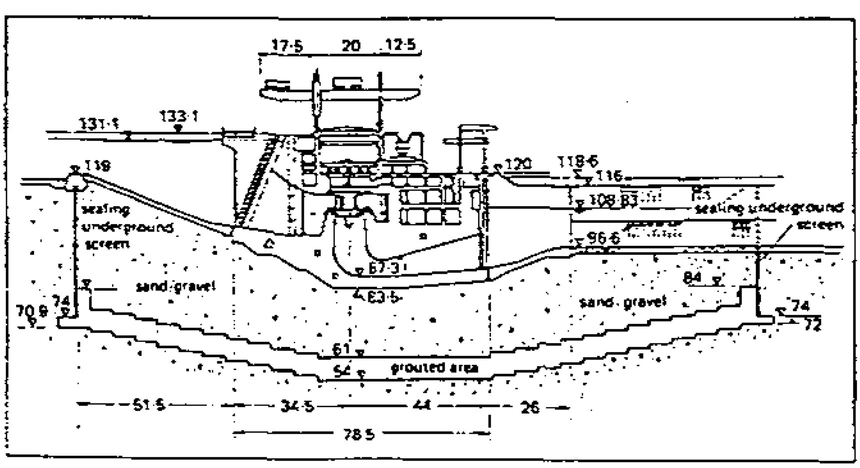

Fig. 4. Cross section of the foundation of the Gabčíkovo plant.

If a failure in the power station occurs, water can be discharged, at least for a short time period, through turbines in a free-running mode, so that the wave conditions in the canal will be similar to those under normal operation.

After the construction is completed the difference in hydrostatic water level between the upstream and downstream canal will be 23.3 m. River craft will have access to twin navigation locks, 275 m long and, 34 m wide, on the left-hand side of the station. They will be filled by a system in front of the power station and emptied by the same system below the station. The time needed for filling up is 14 minutes. The size of the locks will permit a tug and nine barges, with a capacity of 1600 tonne each, to pass through them.

Table V—Details of the Gabčíkovo turbines	
Type	PL 20-V-930
Diameter of the rotor (mm)	9300
Speed (rev/min)	68.2
Runaway speed (rev/min)	193
Maximum capacity (MW)	91
Guaranteed head range (m)	16-23.4
Operational discharge range (m^3/s)	421.7-632.2
Minimum operational head (m)	11.8

Table VI—Main parameters of the generators	
Type	SV 3595/150-88
Real nominal capacity (MVA)	100
Active nominal capacity (MW)	90
Nominal efficiency (cosϕ)	0.90
Nominal voltage (kV)	15.75
Nominal frequency (Hz)	50

The upper gate of the locks is a segment-gate which can be lowered below the entrance threshold. Lower gates are check-gates supported by the thresholds from below and by overbridgings from above.

The power station (Fig. 4) and navigation locks are founded on water-bearing gravel-sand layers similar to that of the Danakiliti weir. These layers have a thickness of 300–400 m.

The power station and navigation locks will be constructed in separate open pits protected by the sealing vats.

The sizes of the pits are:

	Power station	Locks
at the bottom	236 × 53 m	248 × 100 m
on the ground surface	374 × 214 m	429 × 188 m

The pits will be protected by 60 m-thick underground sealing screen-walls made of a self-solidifying suspension and reaching a depth of 42 m and 37 m underneath the power station and the locks, respectively. The bottom will be 7 m thick for the station and 5 m for the locks and will be built by underwater injection of gravel-sand. The upper level of this base is at a depth of 22.5 m below the foundation level of the power station (19 m below the foundation level of the locks) and will ascend stepwise to the peripheral sealing walls. The lowest point of the base is 60 m below the terrain (46 m in case of locks).

The area of each foundation pit is 80 000 m^2, enough to accommodate ten football fields.

Outlet canal

This will be 8.2 km long, with a capacity of 4000 m^3/s and an average flow velocity of 1 m/s. Water depth at this velocity is about 16 m. Even during peak operations the flow velocity will never exceed 1.2 m/s.

The outlet canal is entirely cut into the terrain. Its cross-section is bowl-shaped, with a bottom width of 185 m. Its slopes are 1:5 up to a height of 5 m, then 1:3 up to a height of 9.1 m. At this height, a 3 m-wide bench will be built and from there the slope will again be 1:3 to the shore line, that is, 18.5 m above the bottom. Protection against floods is by dykes 50 m from the shore line.

During peak operations, significant and rapid fluctuations of water level are expected. For this reason the canal slopes are covered by thick riprap, 70 cm above a 50 cm thick filtration layer.

Deepening the bed

Deepening of the original Danube bed is planned for the section which starts at the point where the outlet canal meets the Danube downstream of Palkovičovo, and ends at Gönyü. Because of this the head of the power station will be increased by 1.7 m at operational discharges 4000 m^3/s. The width of this excavated section of river bed is 250-280 m at the bottom, the slopes being 1:5.

Upsteam from the point where this excavated section joins the old untouched riverbed, a 6 km-long transitional stretch will be built to prevent erosion of the old Danube riverbed upstream of Palkovičovo.

The Nagymaros project

This will be constructed to exploit the water levels between Gönyü and Budapest. Its reservoir will hold water released at Gabčíkovo during peak-operation, and release it through the power station into the Danube downstream from Nagymaros. It will create the same discharge conditions as existed before the construction of the whole project.

If the discharge in the Danube reaches 6000 m^3/s, the weir of the barrage will be completely opened and higher flows will be let through without any energy extraction.

Power station

This is constructed at km 1696.25 in Hungary, because of the favourable morphological and geological conditions there. Protective dykes for the reservoir of the Nagymaros project are partially in Czechoslovakia and partially in Hungary, the Danube marking the border. There the project consists of a weir, power station and navigation locks (See Fig. 5).

The weir will be placed on the right-hand side and, like the weir at Dunakiliti, it will be provided with seven openings, each 24 m wide. Closing structures will consist of segment gates up to 8 m, and of 3.3 m-diameter valves. The station will consist of three blocks each containing 2 bulb turbines with horizontal axes (Fig. 6). The distance between the individual axes is 20 m, and the width of the assembling area 41 m. The total width of the powerhouse will be 170 m, and the total installed capacity will be 158 MW.

Two locks, 34 m × 275 m, will be built upstream of the barrage on the left bank. A 450 m-long and 155 m-wide upper outer lock area will be constructed. The lower roadstead of locks will have a similar width but will be only 432 m long.

The upper gates of the locks are closed by segment gates. In a similar way as at Gabčíkovo these can be lowered below the threshold, giving a 4.5 m draught for navigation. The lower end is closed by gates. Lock filling is through a canal system built into the walls. Operation of this system is carried from the blocks beside the power station.

Table VII—The main parameters of the turbines at Nagymaros	
Runner diameter (mm)	7500
Speed (rev/min)	62.5
Runaway speed revolutions (rev/min)	145
Maximum capacity (MW)	27.4
Recommended operational head (m)	6.8
Discharge at recommended operational head (m^3/s)	466

Table VIII—Main parameters of the generators at Nagymaros	
Real nominal capacity (MW)	27
Active nominal capacity (MW)	26.3
Nominal efficiency (cosϕ)	0.98
Nominal voltage (kV)	6.3
Nominal frequency (Hz)	50

Table X. [illegible] volumes

Type of work	Built by	Gabčíkovo	Nagymaros	Total
Dredging including [illegible] (10^3 m^3)	ČSSR	24 457	8 208	32 663
	MLR Hung	36 369	15 715	52 084
	Total	62 826	23 921	106 747
Dredging by floating dredgers (10^3 m^3)	ČSSR	—	—	—
	MLR Hung	51 721	11 396	63 117
	Total	51 721	11 396	63 117
Compacted [illegible] (10^3 m^3)	ČSSR	22 592	3 327	25 918
	Hungary	16 228	13 542	29 780
	Total	38 820	17 869	[illegible]
Rock [illegible] (10^3 m^3)	ČSSR	—	—	—
	Hungary	—	652	652
	Total	—	652	652
Sealing screens (10^3 m^2)	ČSSR	300	1072	1372
	Hungary	119	218	337
	Total	419	1290	1709
Injection of foundations (10^3 m^3)	ČSSR	1292	—	1292
	MLR Hung	400	—	400
	Total	1692	—	1692
Concrete and reinforced concrete (10^3 m^3)	ČSSR	1321	115	1436
	Hungary	297	734	1031
	Total	1618	849	2467
Concrete and asphalt linings and facings (10^3 m^2)	ČSSR	1712	366	2078
	Hungary	546	448	994
	Total	2258	814	3072
Stone protective facings (10^3 m^3)	ČSSR	32	9	41
	Hungary	12	84	96
	Total	44	93	137
Equipment (t)	ČSSR	34.5	0.7	35.2
	Hungary	4.4	32.2	36.6
	Total	38.9	32.9	71.8
Gravel-sand for structures (10^3 m^3)	ČSSR	3870	301	4171
	Hungary	1437	1227	2664
	Total	5307	1528	6835
Cement (10^3 t)	ČSSR	640	208	848
	Hungary	180	355	535
	Total	820	563	[illegible]
Reinforcing bars (10^3 t)	ČSSR	52.4	4.6	57
	Hungary	17.4	45.5	63
	Total	69	50.1	120
Timber (10^3 m^3)	ČSSR	45	3.8	48.8
	Hungary	11.2	26.2	37.4
	Total	56.2	30	86.2
Clay bentonite for sealing screens (10^3 t)	ČSSR	96.8	81	177.8
	Hungary	16.8	6	22.8
	Total	113.6	87	200.6
Stone (10^3 m^3)	ČSSR	347	235	582
	Hungary	2162	1594	3756
	Total	2509	1829	4338
Larssen sheet-piles (10^3 t)	ČSSR	0.3	—	0.3
	Hungary	3.4	4.4	7.8
	Total	3.7	4.4	8.1

Hungary, also belongs to Czechoslovakia. It was also agreed that both countries would share the construction work equally. To keep the work load divided equally it will be necessary for some structures to be built by Hungarian contractors on Czechoslovak territory.

According to the agreement, structures to be built by Czechoslovakia on the Czechoslovak territory are as follows:

- the left-bank protection dykes for the Hrušov reservoir;

(Continued on page 55.)

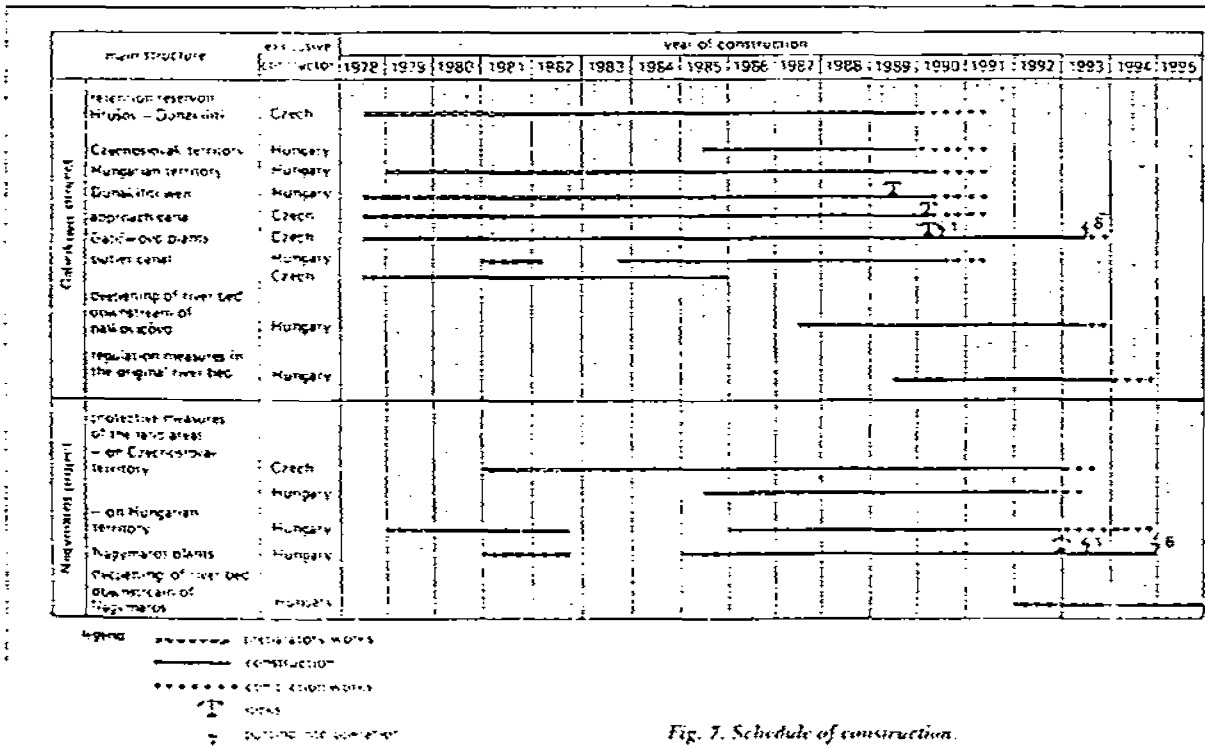

Fig. 7. Schedule of construction.

Geological conditions will enable the structure to be founded in an open pit excavated within the andesite subsoil, and protected with circular dykes made of stones and gravel. The circular dykes are made watertight by Larsen sheet piles driven down into the bedrock. Because the free passage of floods and navigation must be ensured during construction, a temporary riverbed will be cut out on the right bank and refilled later.

Riverbed deepening downstream of Nagymaros

The river bed downstream of Nagymaros will be deepened to increase the head at the power station and facilitate navigation. At a discharge of 3000 m³/s, the head will increase by 0.8 m. Excavation and dredging will be carried out from Nagymaros down to Budapest. Both branches around the Szentendre island will be involved in that operation. The width of the main branch is planned to be 180-300 m, and that of the small branch 80 m. Dredged materials will be deposited.

Reservoir fluctuation

The dam at Nagymaros will permanently impound the Danube. Levels will fluctuate between els. 107.15 and 107.83 m. Added to these more or less static water levels, 3500 to 4500 m³/s discharges from Gabčikovo must also be stored, causing additional fluctuations of the levels. As a result the level will be 2 m above the present average water surface in the middle of the backwater line. Consequently, the dykes, which earlier provided temporary protection, will become reservoir dykes permanently loaded. Therefore, they must be strengthened and must incorporate elements such as underground screen-walls, sealing aprons, and wells in seepage channels to prevent piping.

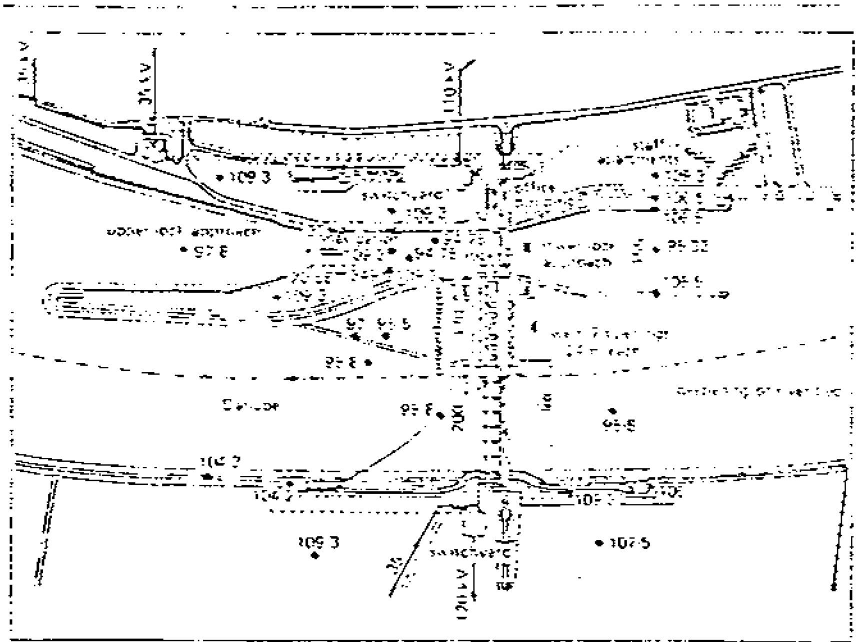

Fig. 5. Layout of the Nagymaros structures.

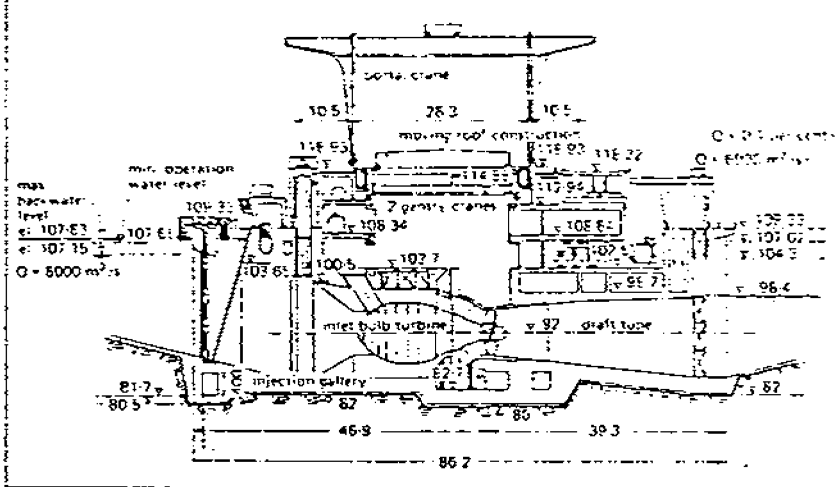

Fig. 6. Cross-section of the Nagymaros powerhouse.

The same applies to the dykes on the tributaries. Simultaneously, the drainage of infiltration and internal waters has to be arranged. For this purpose, additional drainage channels will be built in which the water level will be maintained by pumping stations, thus providing for agricultural use. A full description of all protective measures would be time-consuming, and therefore a typical 100 km long-stretch is detailed in Table IX.

Table IX—Protection measures at Nagymaros

Territory	New dykes (km)	Reconstructed dykes (km)	Screen-walls (km)	Sealing apron (km)	Infiltration channels (km)	Drainage channels (km)	Wells series (km)	Pumping stations (km)	Roads (km)	Bank protection (km)
ČSSR	14.3	137.7	103.4	48.5	135.1	58.6	66.4	75.3	23.1	4
Hungary	42.5	6.3	31.8	7.1	13.8	16	15.7	38	26.2	47.8
Total	56.8	144	135.2	55.6	148.9	74.6	82.1	113.3	49.3	51.8

Review of main construction works

The main construction works and the most important construction materials are shown in Tables X and XI with the tasks equally divided between Czechoslovakia and Hungary.

Up to the present 50 × 10⁶ m³ has been excavated, of which 22 × 10⁶ m³ was incorporated into the dykes, representing approximately 50 per cent of the dyke filling.

Distribution of work and project ownership

The two countries decided, in a bilateral agreement signed on 16 September 1977, that construction, ownership and maintenance of project would be treated as a common investment. Management and supervision during construction and operation would be executed by delegates from the two governments.

This means in practice that the Gabčikovo project in

(Continued from page 40)

- the approach canal;
- the structures at Gabčíkovo; and.
- protective measures for the Nagymaros reservoir, except for protective measures along the Dolný Hron and Ipel' rivers (which are to be constructed by Hungary).

Structures to be built by Hungary are:

- the right-bank dykes of the Hrušov reservoir both on Hungarian and Czechoslovak territory;
- the Dunakiliti weir in Hungary;
- the outlet canal in Czechoslovakia;
- deepening of the riverbed downstream of Palkovičovo on both Czechoslovak and Hungarian territory;
- river regulation of the old riverbed in both countries;
- protective measures for the Nagymaros reservoir in Hungary, and in the region of the Dolný Hron-Ipel in Czechoslovakia;
- structures associated with the Nagymaros powerplant in Hungary
- deepening of the riverbed downstream of Nagymaros.

In addition to these main projects, each country will carry out various supplementary national schemes.

In accordance with the agreement of the governments of Czechoslovakia and Hungary, preparatory works began as early as May 1978. On the Czechoslovak side, the main projects are under construction. In Hungary the construction of the *Dunakiliti* weir has been started and preparatory works initiated at the site of the Nagymaros barrage.

A difficult economic situation subsequently called for a reduction in investment. In October 1983 the two partners agreed on a new schedule of construction (Fig. 7). The project is now in an active stage of construction. The dykes of the approach canal have been filled with material obtained from the outlet canal and from borrow pits. The protective trench for the hydropower station has been constructed and the excavations for the power station has been completed. The foundations are now under construction. The downstream canal has been dredged (by the Hungarians) and its material has been transported for use in the dykes of the upstream canal.

Preparatory works for the construction of the Dunakiliti weir are in progress. Filling in of the working area and the downstream end of the river bed cutting are completed as well as 3 km long reservoir dykes. Several research institutes are conducting further research with a view to reducing the negative impacts of the scheme on the environment.

Annex 31

Union Ouest-Européenne des Chambres de Commerce et d'Industrie des régions rhénane, rhonadienne et danubienne

Réunion du Conseil d'Administration

Résolution, Luxembourg, le 16 février 1990

Union Ouest-Européenne des
Chambres de Commerce et
d'Industrie des régions
rhénane, rhonadienne et
danubienne

Luxembourg,
Le 16 février 1990

Réunion du Conseil d'Administration

Résolution

Les travaux d'aménagement du Danube en Autriche et en Hongrie sont à reprendre. L'Union des Chambres de Commerce Ouest-Européennes se prononce pour une reprise immédiate des travaux.

Au cours de sa séance du 16 février 1990 au Luxembourg, l'Union Ouest-Européenne des Chambres de Commerce et d'Industrie des régions rhénane, rhodanienne et danubienne, dont font partie 90 chambres de 7 pays, a exigé la reprise de la planification des travaux d'aménagement du Danube afin d'améliorer les conditions de la navigation en Autriche entre Greifenstein en amont de Vienne et la frontière austro-tchécoslovaque, ainsi que la reprise des travaux de construction du projet commun tchécoslovaco-hongrois Gabcikovo-Nagymaros. Fin 1992 le canal Main-Danube sera mis en exploitation. De cette façon sera réalisé le trafic ininterrompu entre le Main et la région danubienne. L'efficacité et l'effet de rentabilité d'un trafic continuel seront sensiblement limités par la présence de plusieurs passages étroits sur le Danube. En dépit des décisions prises à l'unanimité par la Commission du Danube en 1962, visant l'élargissement du secteur international du Danube de 2,40 m en amont de Vienne et de 3,50 m en aval de Vienne, auprès de l'étiage navigable, et de régularisation, après la mise en oeuvre du canal Main-Danube, rien n'a été réalisé jusqu'à présent des projets importants. Pour le secteur autrichien du Danube il n'existe toujours pas de plan obligatoire.

L'Union exprime ses regrets, d'autant plus qu'une grande artère navigable, celle de la liaison Rhin-Main-Danube, pourrait jouer un rôle décisif dans le problème de l'ouverture vers une coopération économique plus intensive entre les états membres du CAEM et ceux de la Communauté européenne. L'achèvement de la formation du marché intérieur de la Communauté européenne coïncide quant aux délais avec l'ouverture du canal Main-Danube. Qui plus est, le transport par voie navigable est le plus avantageux du point de vue de l'écologie. Une telle voie pourrait contribuer d'une façon importante au déchargement du trafic routier en Europe. L'infrastructure des voies de transport des états danubiens n'est encore développée qu'en partie et quant au réseau des états rhénans il se trouve surchargé.

L'Union prie le gouvernement fédéral de l'Autriche, ainsi que les "Länder" Fédérés de Vienne et de la Basse-Autriche, d'accélérer la réalisation d'une conception concernant l'aménagement du Danube entre Greifenstein et la frontière. Elle fait en même temps appel au gouvernement de la République de Hongrie afin de reprendre en commun et en accord avec le gouvernement tchécoslovaque les travaux de construction sur le secteur de Nagymaros. La situation actuelle, à la suite de laquelle le barrage tchécoslovaque Gabcikovo, qui est terminé, ne peut pas être mis en oeuvre de par l'absence de la partie Nagymaros du barrage ne saurait de toute évidence être satisfaisante. Les conditions de la navigation sur ce secteur du Danube sont à l'heure actuelle pires qu'avant le commencement des travaux de construction de ce projet commun.

Le Danube et le canal Main-Danube sont une porte entre l'Europe du Sud-Est et l'Europe du Nord-Ouest. Si cette porte est largement ouverte pour le trafic et le commerce extérieur, cela sera un signal important quant à l'intégration économique et politique de l'Europe.

Annex 32

(Extract)

State of the Hungarian Environment, 1990, the Hungarian Academy of Sciences, the Ministry for Environment and Water Management and the Hungarian Central Statistical Office

Chapter 2. Freshwater Resources and Water Quality by Béla Hock and Láslo Somlyódy

Chapter 2. Freshwater Resources and Water Quality

By: Béla Hock and László Somlyódy

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Water managers in Hungary joke that there are really only two kinds of water in the country: too little, or too much (and usually at the wrong time of the year or in the wrong place). As in much humor, there is a large chunk of reality in this statement. Hungary's total water resources average about 120 cubic kilometers a year, but only 60 cubic kilometers of this generous amount, 50 percent, is due to direct precipitation. The bulk of the country's water—94 percent—comes from within the international water basin. What this means is that the availability and quality of water in Hungary is determined, to a large extent, by the country's neighbours. Water resources within the country are also very unevenly distributed. As a result, Hungary was forced to develop intensive nationwide water management programs. Indeed, Hungary's water managers have been coping with this situation since the 19th Century, building countless kilometers of flood protection dam, canals, channels, and irrigation systems.

Section 1. WATER RESOURCES AND DEMANDS

1. Surface Water

The total amount of water resources available in Hungary amounts to roughly 20 billion cubic meters a year; with 67 percent of this supplied by surface water and 33 percent by groundwater. Annual water use amounts to about 20 percent of the total resources available (see Table 2.10).

For practical purposes, the surface water resources available in August (within an 80% probability), are used in water management planning (see Table 2.11). The reasoning behind this is simple: better to base water use on the amount available during driest

Table 2.11 Surface Water Resources in August (within 80% Probability) (Source: KSH, Central Office for Statistics, 1986)

River Basin	*Inflow from abroad (m^3/s)*	*On Hungarian territory (m^3/s)*	*Total (m^3/s)*
Danube	2,076.3	49.7	2,126.0
Tisza River	163.9	96.1	260.0
Total	2,240.2	145.8	2,386.0

Table 2.10 Total Water Availability and Use (Source: KSH, Central Office for Statistics, 1986)

	Water use (millions of m^3/yr.)	*Uncommitted resources available (millions of m^3/yr.)*	*Total (millions of m^3/yr.)*
Surface water	2,788	10,481	13,269
Groundwater	1,095	5,409	6,504
Total	3,883	15,890	19,773

month of the year. Considering that 98 percent of the Danube's river system along with 63 percent of the Tisza's—the two largest rivers in the country—lie outside of Hungary, this policy makes good sense.

2. Groundwater Resources

Bank-filtered waters comprise the predominate volume of available groundwater resources, followed by artesian waters, unconfined groundwaters, and karstic waters (Table 2.12). The most important bank-filtered groundwater is stored in alluvial formations along the Danube and Tisza Rivers. Taking exploitable resources into account, theoretical supplies of groundwater from this one source are estimated to be around 7.5 million cubic meters per day; with 87 percent coming from the Danube's catchment area and 13 percent from the Tisza's.

Hungary's famed geothermal waters, used mainly for recreational and medicinal purposes, amount to 419 million cubic meters a year, of which 33 percent are warmer than 60 degrees Centigrade.

Table 2.12 Groundwater Resources in Hungary
(Source: KSH, Central Office for Statistics, 1986)

Type of resource	*Amount (km^3/year)*	%
Bank filtered	2.74	40.6
Artesian	1.21	17.9
Unconfined groundwater	2.41	35.7
Karstic water	0.39	5.8
Total	**6.75**	**100.0**

3. Water Use

Water use in Hungary has increased sharply over the last several decades. The growth of water demand by industry, agriculture and municipalities is illustrated in Figure 2.8 (for the period 1970—84). As can be seen, in terms of water use, the most important sector of the economy is industry (accounting for 73%), followed by agriculture (about 13%), and finally municipalities (8%).

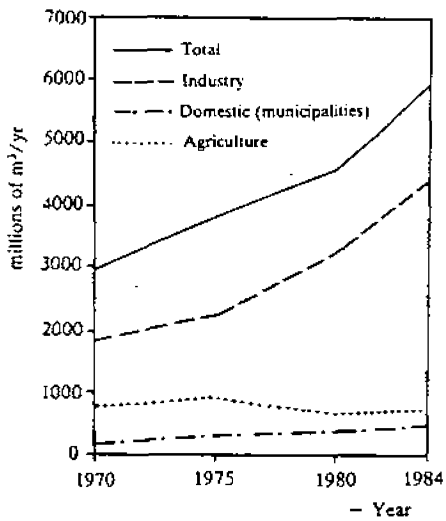

Figure 2.8 Water Use in the National Economy, 1970—1984
(Source: Central Office for Statistics, 1986)

The energy sector—most notably electricity generating plants—account for most of the water used by industry. The total amount of water used, including total freshwater demand—with projections to the year 2000—is illustrated in Figure 2.9.

Water use by agriculture varies considerably from year to year, depending on the amount needed for irrigation purposes. However, in :

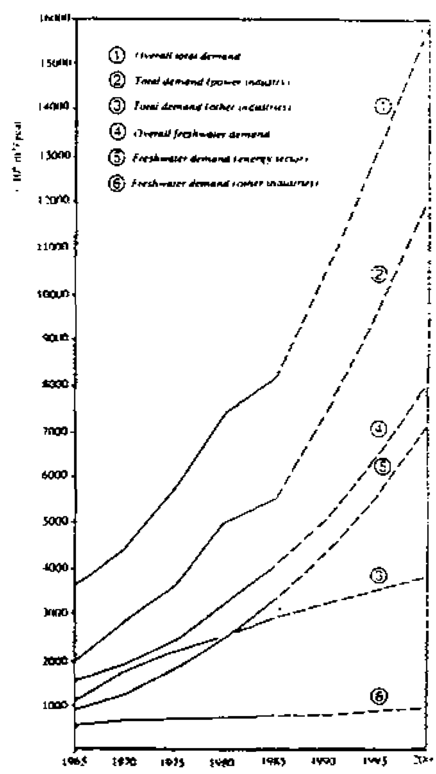

Figure 2.9 The Total and Freshwater Demand in Industry, 1965—2000
(Source: State Office for Technical Development, 1980 and 1988; and the Central Office for Statistics, 1986)

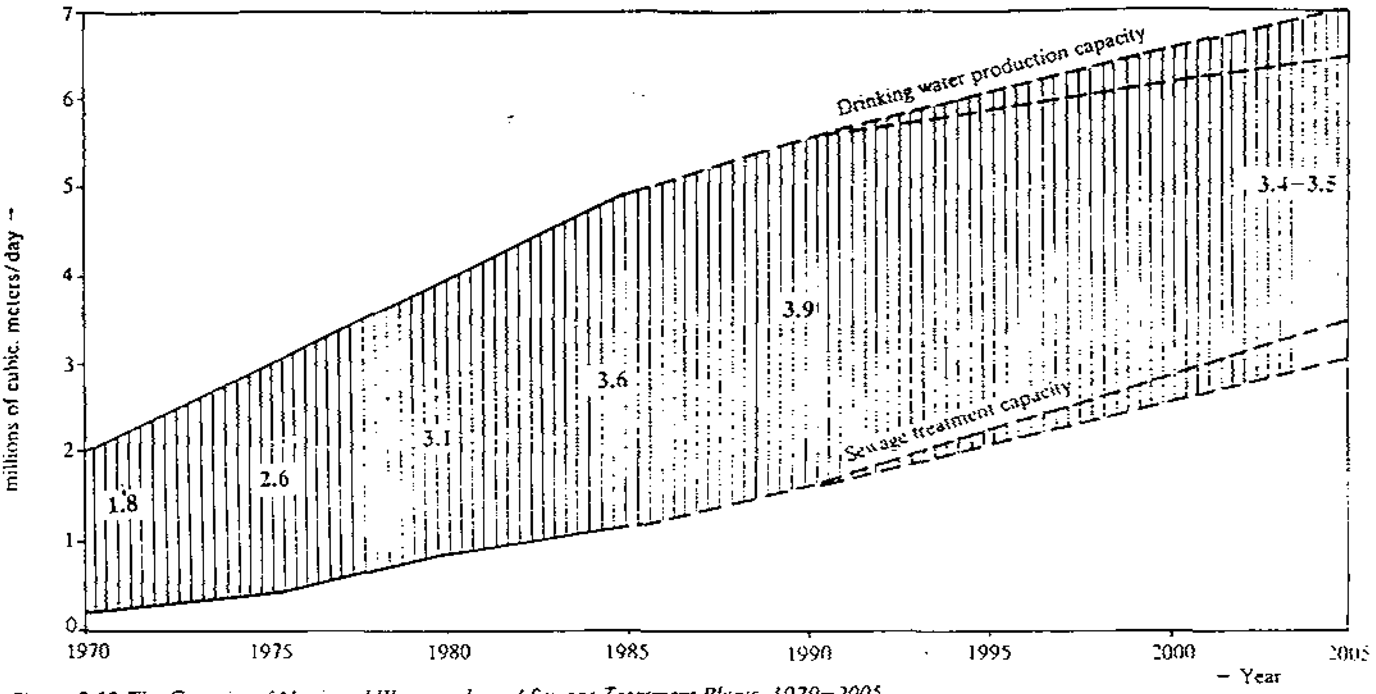

Figure 2.10 The Capacity of Municipal Waterworks and Sewage Treatment Plants, 1970–2005 (Source: Hungarian National Water Authority, 1984, 1987)

normal year, irrigation and aquaculture account for 76 percent of the water used in the agricultural sector.

Domestic, or municipal, water demands have increased steadily as well (see Figure 2.10). The supplies needed to meet this rising demand come from bank-filtered water (46%), artesian and karstic waters (44%), and from surface water (10%).

A simple comparison of aggregate water demand and availability gives the impression of a huge untapped surplus. The reality is slightly more complicated. When taking into account future demand for water resources by the industrial and agricultural sectors—not to mention the rapid growth of urban areas—several factors conspire to „pull the plug" on Hungary's reserves:

– Comparing water use with availability by months reveals a less favorable picture;

– Since Hungary is essentially a downstream country with respect to its surface waters, it is safe to assume that as upstream countries increase their water use and consumption, less will be available for Hungary. The Tisza River's flow is expected to decline due to the construction of large reservoirs by upstream countries;

– In drought years, irrigation needs may rise precipitously;

– The geographical distribution of water resources and water demands are far from uniform. Take the Danube and the Tisza Rivers, for example. The percentage of available, but so far uncommitted, water resources (after subtracting the base flow in the river bed) is 85 percent for the Danube, but only 15 percent for the Tisza, which flows through Hungary's mercurial Great Plain. Hence, during periods of drought, water shortages can be expected during the growing season.

In the future it will be necessary to set realistic prices for water. In the absence of water pricing policies, all the water available, cheaply, will be used.

There will be enough water available to meet Hungary's future demands up to the turn of the century. However, difficulties may arise in allocating water use along the Tisza River system and perhaps in other „water-short" areas. Because of this potential shortfall in water availability, authorities will have to implement a carefully worked out water management policy for the country.

Section 2. WATER POLLUTION

Not surprisingly, since industry is the largest water user, it is also the largest source of water pollution. Despite the fact that untreated industrial effluents discharged into Hungary's surface waters have been reduced significantly over the past two decades—due mainly to the construction of treatment plants and the reuse of waste waters—some 84 million cubic meters of untreated industrial waste water still ends up in Hungary's rivers and lakes every year. Consequently, the discharge of organic pollutants, heavy metals, oil and its derivatives, and dissolved salts has increased accordingly.

Because of the importance of the Danube as a source of both municipal and industrial water supply, the major COD loads (Chemical Oxygen Demand) to the river have been illustrated in Figure 2.11. It is noteworthy that the overwhelming majority of COD inputs come from Budapest; all the other sources combined amount to only two-thirds of the communal and industrial load from the capital.

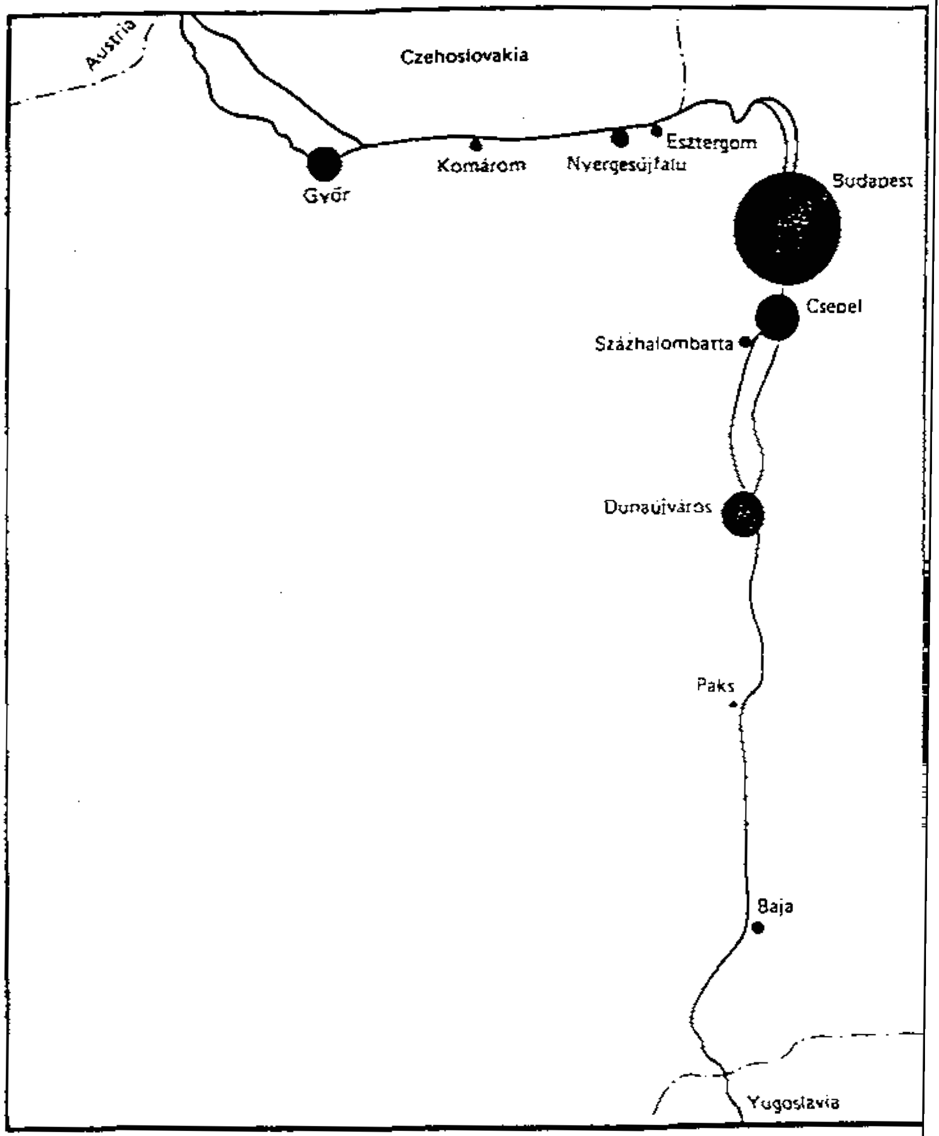

Figure 2.11 Major COD Loads in the Danube (Source: Hock, 1981)

Wastewater and effluent emissions from the country's thousands of farming operations are insignificant when compared to emissions from industry. Most of the water harnessed for agricultural purposes is used to irrigate crops and supply aquaculture ponds. Large-scale, „industrialized" farming operations produce liquid manure at the rate of 48 million cubic meters a year, of which 55 percent is accounted for by specialized animal farms. Of the total volumen produced, 42 percent was spread on fields for fertilizer, 40 percent was discharged into designated areas, 12 percent was pumped into rivers and streams, while no satisfactory disposal method was found for 6 percent.

Drinking Water and Sanitation Services

The number and percentage of people served by communal water supplies and sewage treatment plants are shown in Table 2.13, while the growth of these services over time is illustrated in Figures 2.10 and 2.12. As can be seen, precedence has been given to supplying the population with communal, piped water systems, rather than sewage treatment plants. As a consequence of this policy, there is a marked „utility gap" between the percentage of the population served with communal water supplies and those connected to sewage treatment plants. Moreover, the gap continues to widen. One result of this dichotomy in services is that the country's communal water supplies are becoming more polluted, mostly with untreated sewage. In the absence of sufficient sewage treatment capacity, some 1.3 billion cubic meters of untreated sewage is discharged into the country's surface waters every year. Over the last few years, some of this untreated sewage is also showing up in goundwater aquifers.

Table 2.14 Wastewater Treatment in Hungary, by Methods of Treatment (in percent. source: KSH. Central Office for Statistics, 1986)

	Mechanical treatment	*Biological treatment*	*Chemical treatment*	*Total*
Industry	22.0	4.6	5.9	32.5
Waterworks and sewage treatment	44.3	20.5	1.6	66.4
Other sectors of economy	0.8	0.3	0.0	1.1
Total	67.1	25.4	7.5	100.0

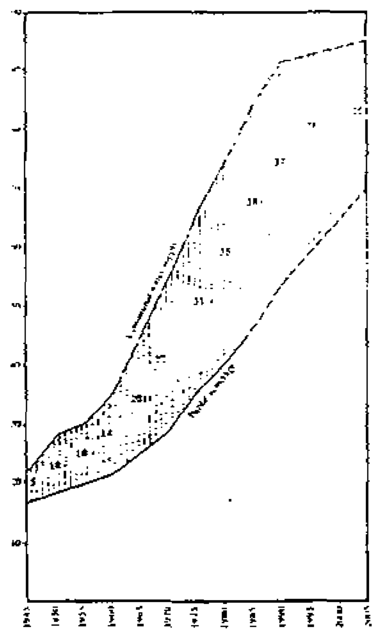

Figure 2.12 Percentage of Population Living in Areas Served by Communal Water Supply and Public Sewers, 1945–2005
(Source: Hungarian National Water Authority, 1984, 1986)

The situation, however is worse than the statistics imply. As can be seen from Table 2.14, over 44 percent of the sewage treatment plants in the country are equipped only for mechanical treatment of effluents. In total, two-thirds of Hungary's wastewaters are discharged directly into water courses after mechanical treatment only.

Table 2.13 Main Indices of Communal Water Supply and Sewerage (Source: Hungarian National Water Authority, 1986)

	Unit	*Communal water supply*	*Communal sewerage*
No. of communities	3,064	1,822	305
Population	10,640,000	8,952,000	4,902,000
Percentage population	%	84	46
No. of homes	3,846,000	2,498,000	1,482,000
Homes, percentage	%	65	39

Section 3. WATER QUALITY

Naturally, the quality of both surface- and ground-waters in Hungary is determined, in part, by the quantity and type of pollutants discharged into them. In order to check water quality on a regular basis, a network of monitoring stations was established in the early 1960s, and subsequently upgraded. The number of sampling locations and sampling frequencies for Hungary's two largest river systems are shown in Table 2.15.

1. Surface Water

The quality of Hungary's surface waters is illustrated in Figure 2.13 (for 1986). The map is updated annually on the basis of a criteria and classification system that incorporates 25 chemical water quality indicators. Water of Class I, shown in light grey on the map, represents clean water of high quality, requiring little if any treatment to meet consumer demands and ecological needs. Middle grey denotes the slightly pollutes waters of Class II, which require some form of treat-

Table 2.15 Sampling Sites on Surface Water Grouped according to River System and Sampling Frequency (Source: Hock and Schneider, 1986)

River system	Sampling frequency			Total
	52 (weekly)	24–26 (bi-weekly) (sample/year)	11–12 (monthly)	
Danube	16	99	54	169
Tisza	23	52	6	81
Total	39	151	60	250

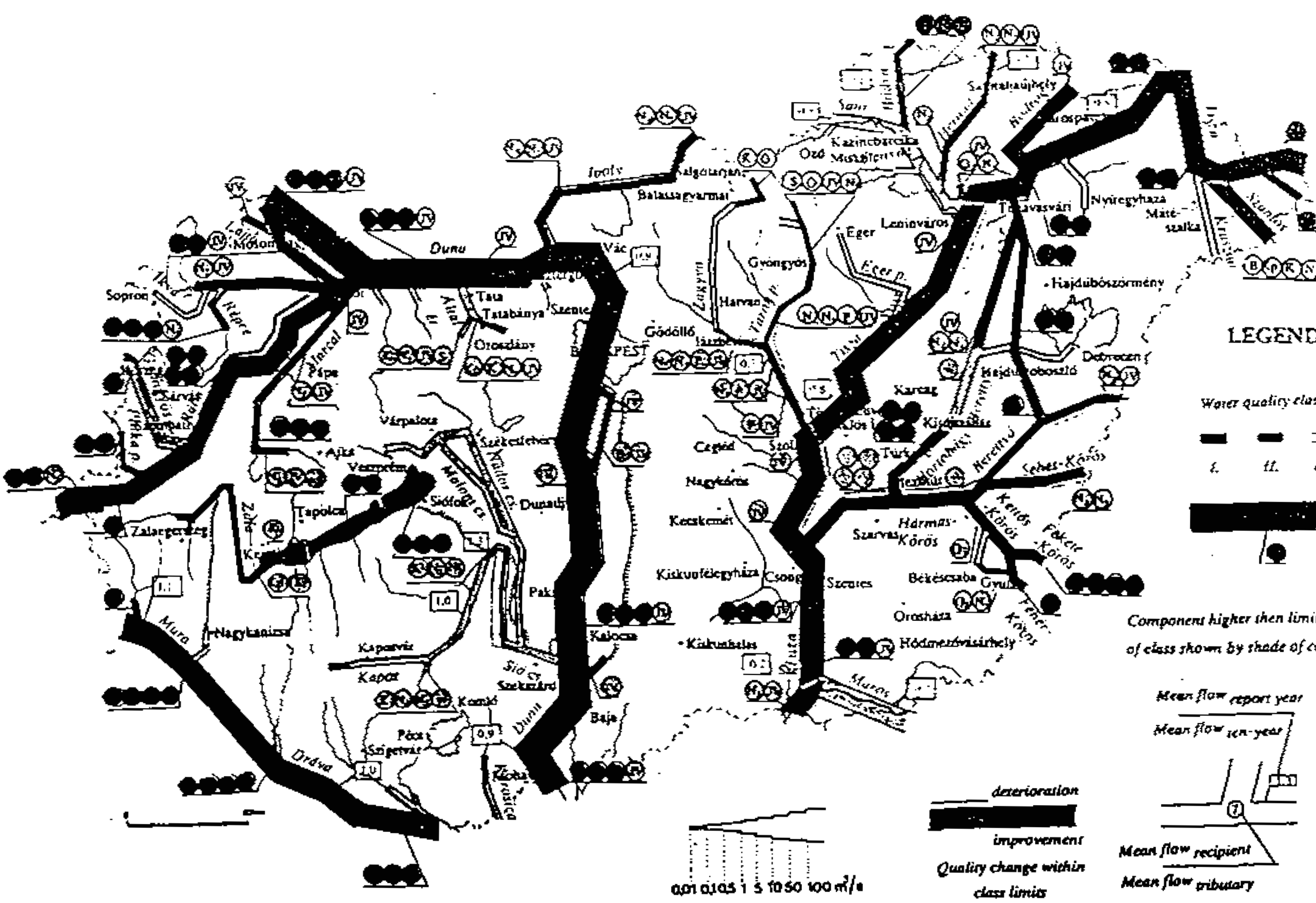

Figure 2.13 Quality of Surface Waters (Based on the sectorial standard specifications of water management MSZ–10 172/1–83 and the Guidelines MI–10 172/3–85)

nent before the water is suitable for use by cosumers. Such pollution, however, is not considered detrimental to the ecological health of th system. Dark grey (Class III) indicates those lakes and rivers so polluted with industrial, minicipal, and agricultural effluents, that the water quality cannot be restores by acceptable treatment methods. This also means that pollution is considered detrimental to the ecosystem itselft.

The integrated classification scheme displayed on the map was arrived at as follows:

— In terms of a particular quality component, the water is considered Class I if at least 80 percent of the analytical data remains below the upper limit specified for Class I, and at least 95 percent remains below that specified for Class II water.

— The water is of Class II quality if at least 80 percent of the analytical data on a particular component is considered within Classes I and II.

— The water is considered Class III if it fails to meet the specifications for Class II.

The integrated classes indicated shades of color in Figure 2.13 are

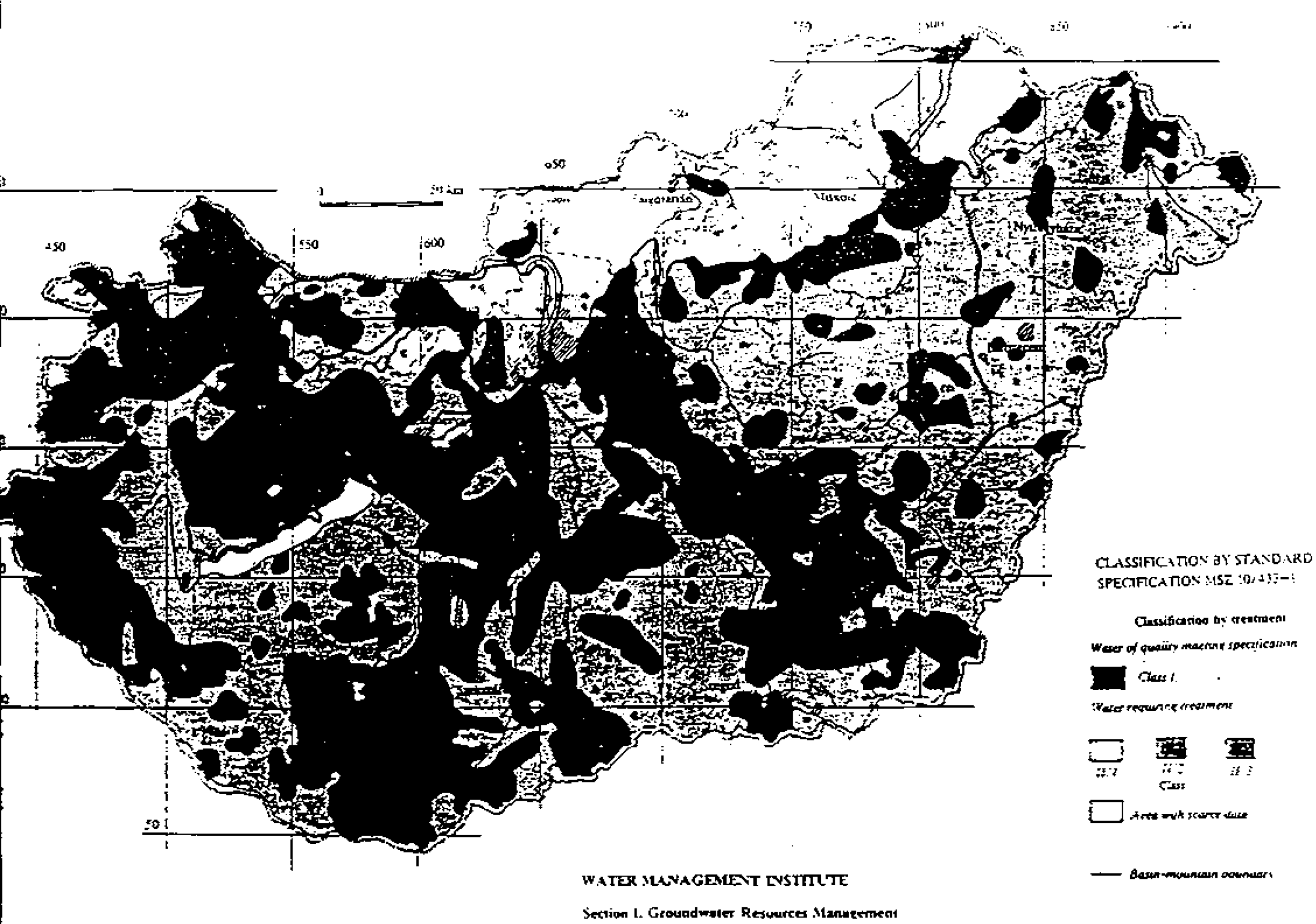

Figure 2.14 Quality Classification of Groundwaters (50—600 m depth range)

determined, subsequently, from component classes. The quality of a sample belongs to a certain class (say Class I) if at least 80 percent of the components belong to the same class. Pollutants exceeding the limit value of the class denoted, are also shown on the map.

2. Groundwater

The quality of groundwater, situated between 50 and 600 meters in depth, is illustrated in Figure 2.14. The waters belonging to various quality categories are indicated in differenc shades of grey color. The map denotes sites (in light grey) where water of Class I quality—needing no treatment—can be obtained. Regions colored with different tints middle grey indicate the various technologies needed to provide potable water: Class II/1—de-gassing, acid extraction, iron and manganese removal; Class II/2—ammonia stripping, removal of arsenic, organic materials, and nitrate; and Class II/3—softening, desalination, hardening, scale control, and cooling.

3. Overall Water Quality

For a brief overview, seven water quality indicators were evaluated for the most important cross-sections (totally 43) in Hungarian rivers over the period 1976—85. The components involved include the following: COD, BOD_5, dissolved oxygen (DO), ammonium, nitrate, orthophosphate, and total dissolved solids. The results, summarized in Table 2.16 indicate three categories of water quality:

— Water quality has improved:
— Water quality is of Class I status; and
— Quality of the water is poor (associated with a deterioration greater than three percent a year).

Table 2.17 gives details of the investigations performed to deter-

Table 2.16 Water Quality in Hungary, 1981—1985 (Source: Hock, 1986)

Componenet (indicator)	*Quality improvement (%)*	*Class I quality (%)*	*Especially poor (deterioration noted) (%)*
COD_4	37	41	17
BOD_5	41	20	15
Dissolved O_2	35	65	15
Ammonium ion	35	28	30
Nitrate ion	13	89	7
Orthophosphate ion	22	20	57
Total dissolved solids	**15**	**63**	**0**

Table 2.17 Combined Evaluation of Actual Water Quality and Changes Based on Measurements of Nitrate Ion (Source: Hock, 1986)

Actual mg/l	*Change*	*Change in annual mean (1976—1985)*								*Total*
		Improvement (%/year)				*Deterioration (%/year)*				
		< −15.0	*−15.0 −7.0*	*−7.0 −3.0*	*>−3.0*	*< 3.0*	*3.0—7.0*	*7.0—15.0*	*> 15.0*	
Water quality situtaiton 1981–1985	< 20	–	–	3	3	20	12	3	–	41
	20—40	–	–	–	–	1	2	1	–	4
80 % duration	> 40	–	–	–	–	1	–	–	–	1
Total		–	–	3	3	22	14	4	–	46

mine the extent of nitrate pollution. The extent of the nitrate problem is clear: in 87 percent of the cross sections studied, a deterioration of the water quality was noted.

The drawback to the foregoing analysis is that the cross section of the rivers analyzed—of widely diverging orders of magnitude and importance—have been assessed together. In order to compensate for this, the water quality in five rivers—the Kapos, Zala, Zagyva, Danube (border sections), and Tisza (border sections)—has been analyzed and compared over a 15 year period (see Figure 2.13). The catchment areas of the first three rivers are situated entirely on Hungarian territory, so the pollution loads are all produced in the country. For the Danube and the Tisza Rivers, measurements were taken at the borders so that the quality of the water entering and leaving Hungary could be appropriately assessed in both cases. The water quality parameters are virtually identical with those used before, and are presented according to their five-year mean values. In this way, the water quality (on average) of these rivers could be compared over the course of three successive five-year plans (1971—75, 1976—80, and 1981—85).

From the final studies it was concluded that the water quality in these five rivers has deteriorated continuously over the past 15 years. The Kapos River has deteriorated in every category except for nitrate; the Zala River has no improvements except for BOD_5, dissolved O_2, and ammonium; and the Zagyva River is worse off except for BOD_5. Furthermore, the rate of deterioration showed an increasing trend for orthophosphate, but a levelling off for total dissolved solids.

The quality of the Danube's water, as it enters the country, has consistently deteriorated in terms of nitrate and total dissolved solids. As the water leaves Hungary it is worse off only in relation to ammonium, nitrate, and total dissolved solids. The other components registered improvements.

By contrast, the rate of deterioration of the Tisza River is one of the highest for any water body in Hungary. As it enters the country, the Tisza has shown a consistent downward trend for ammonium, nitrate, and total dissolved solids, while at its outflow measurement point, all components—except for orthophosphate and BOD_5—indicate poorer water quality. Whereas the Danube's waters show some improvement over time, the water quality in the Tisza

Table 2.18 Mean Values of Nitrate-and Orthophosphate Ions during the IVth, Vth and VIth Five-year Plan Periods (1976—1980, 1981—1985, 1986—1990) (Source: Hock, 1987 and Hock and Somlyódy, 1988)

Stream	*Nitrate ion mg/l*			*Ortohophosphate ion mg/l*		
	IV	*V*	*VI*	*IV*	*V*	*VI*
Kapos	4.9	6.4	7.1	1.19	1.60	3.24
Zala	5.8	6.8	8.4	0.50	0.74	1.07
Zagyva	13.1	14.9	15.1	0.86	1.00	2.28
Danube (entrance)	7.1	8.6	9.5	0.59	0.62	0.58
Danube (outflow)	6.9	8.7	8.8	0.39	0.47	0.44
Tisza (entrance)	2.7	4.0	5.2	0.13	0.15	0.08
Tisza (outflow)	6.2	8.1	12.1	0.14	0.26	0.25

deterioration (thick arrow)

improvement (thin arrow)

River has consistently deteriorated for all seven components over the three periods considered.

The detailed results obtained in these studies for both nitrate and orthophosphate are shown in Table 2.18 (thin arrows indicate water quality improvement, while full arrows connote deterioration).

This body of data, when compared to studies carried out 30 y ars ago, reveal a startling deterior: tion in water quality. Consider tl following:

— The relevant water quality pa: ameters reflect a much poorer pi ture today, when compared to 3 years ago; the number of sectior measured with Class I quality w: ter has decreased substantially;

— The rate of deterioration in w: ter quality has actually declined some instances, and a number rivers (eg. the Danube) ha shown some improvements;

— Over the past 30 years, th number of streams registering po water quality (and increasing det rioration) has increased signif cantly. This development is con spicuous in the Tisza River systen

The importance of the Danub River as a source of bank-filtere water has prompted a study of po lution levels in the river's bottor sediments (see Figure 2.15). It interesting to note the maximur values recorded for iron and zinc for instance, exceed maximur concentrations set for soils growin food crops.

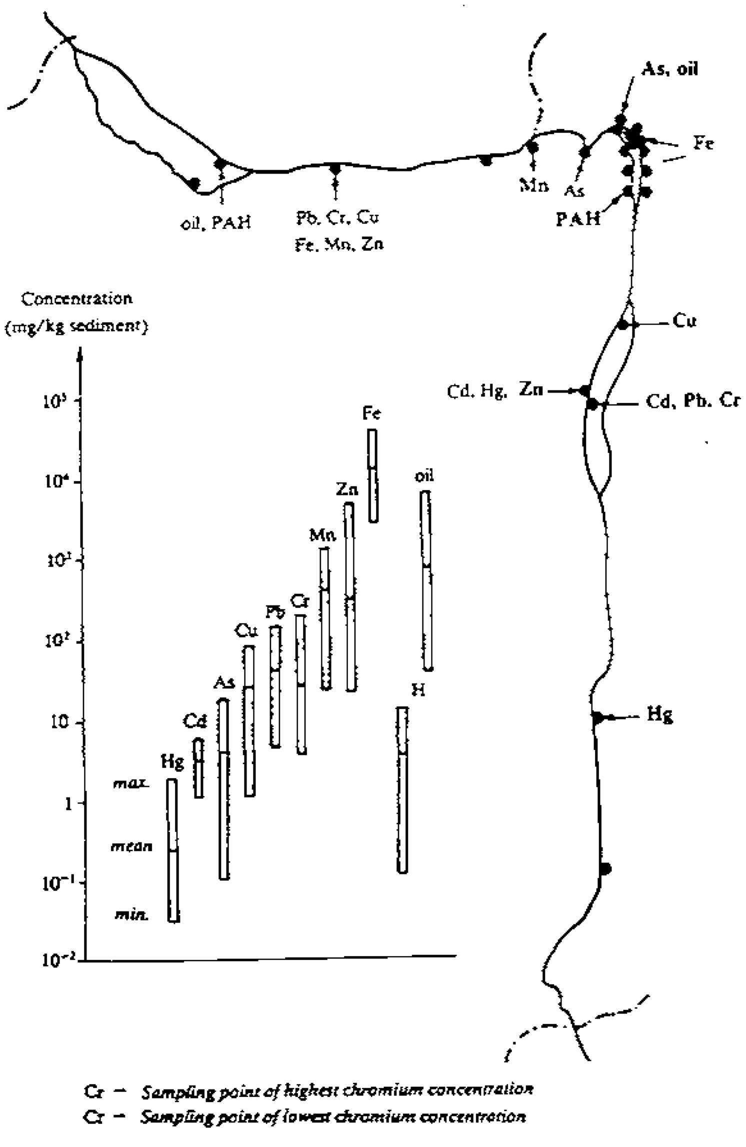

Figure 2.15 Bottom Sediment Pollution of the Hungarian Stretch of the Danube River (Source: László, 1985)

4. Accidental Pollution

In 1986 there were a total of 25 accidental discharges of pollutan into Hungarian waters; domest sources were responsible for 214 them, with foreign sources ac counting for 37 of the accident: Petroleum and its derivatives ac counted for the lion's share of thi pollution (45 percent). Because c its heavy barge traffic and concer tration of industries, the Danube River suffered 25 percent of all accidental discharges. Moreover, between 1978 and 1986, such accidents were increasing at the rate of 3.6 percent a year.

Section 4. IMPACTS OF BUDAPEST ON WATER QUALITY IN THE DANUBE

Budapest, the capital, depends on the bank-filtered groundwater resources along the Danube for its water supply. Besides the Vág River, discharging polluted waters from Czechoslovakia, Budapest is the most important source of pollution along the Hungarian stretch of the Danube.

In terms of the normal chemical components measured, there is little detectable difference upstream or downstream from Budapest (see Figure 2.13), due mainly to the high dilution rates (1:250) under average flow conditions. Budapest's impact on the Danube is felt primarily by its input of heavy metals and high bacteriological parameters.

Nevertheless, data for nitrate levels go back over 100 years, so it is possible to reconstruct the increase in nitrate levels since 1870 (despite the differences in measurement techniques). Figure 2.16 shows the consistent upward trend in nitrate concentrations in the Danube.

Minimum, mean, and maximum values for some heavy metals have been compiled in Table 2.19, based on samples taken upstream and downstream from Budapest. From the data, the following conclusions can be drawn:

— Except for manganese, the concentrations of heavy metals have values belonging to water quality Classes II and III; and

— The pollution from Budapest is reflected mainly in the high mean and maximum values of mercury and lead.

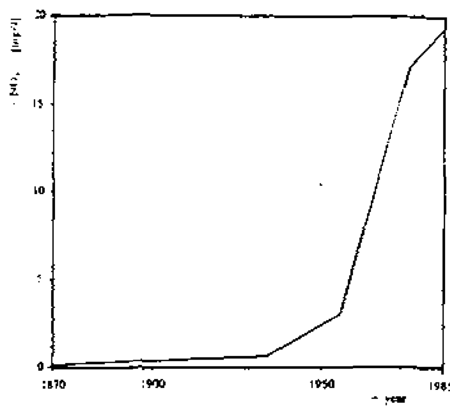

Figure 2.16 Nitrate-ion Concentrations in the Danube, downstream from Budapest, 1870–1985
(Source: Balló, 1875; Lesenyei, 1975; Hock, 1987)

Heavy metals, bound to suspended solids, tend to accumulate in the river's bottom sediments (see Table 2.20). The high concentrations of mercury, lead, chromium, copper, manganese, and iron downstream from Budapest reflect the pollution loads to the Danube from wastewaters discharged from the capital.

Some of the heavy metals deposited in the bottom sediments are transported further downstream by flood flows, others are remobilized into dissolved form, and still others penetrate deeper into the sediment. Table 2.21 demonstrates the variations in heavy metal content—mercury, cadmium, lead, iron, and manganese—along vertical profiles of the bottom sediment downstream from Budapest. It is interesting to note that significant reductions in mercury and lead oc-

Table 2.19 Heavy Metals in the Danube, upstream (R. St. 1659 km) and downstream (R. St. 1631 km) of Budapest, based on the 1982–1983 records (Source: László, 1985)

Components	*Location*	*Minimum*	*Mean*	*Maximum*
Mercury (μg/l)	Budapest upstr.	<0.1	1.0	4.7
	Budapest downstr.	<0.1	1.2	18.1
Lead (μg/l)	Budapest upstr.	<1.0	2.4	11.0
	Budapest downstr.	<1.0	4.2	55.0
Cadmium (μg/l)	Budapest upstr.	<0.1	0.6	29.0
	Budapest downstr.	<0.1	0.4	4.0
Iron (μg/l)	Budapest upstr.	0.23	0.87	3.5
	Budapest downstr.	<0.05	0.81	10.7
Manganese (mg/l)	Budapest upstr.	0.04	0.07	0.28
	Budapest downstr.	<0.02	0.08	0.50

Table 2.20 Bottom Sediment Analyses in the Danube (Source: László, 1985)

Sampling site	*Hg mg/kg*	*Pb mg/kg*	*Cr mg/kg*	*Cu mg/kg*	*Fe mg/kg*	*Mn mg/kg*
R.St. 1688 km	0.30	50	30	22	12,000	350
R.St. 1675 km	0.39	71	38	39	22,000	710
R.St. 1663 km	3.30	33	14	9	9,400	320
R.St. 1635 km	0.87	190	90	230	28,000	400

Table 2.21 Vertical Distribution of Heavy Metals in the Bottom Sediments of the Danube, downstream from Budapest (R. St. 1629 km) (Source: László, 1985)

Depth below sediment surface (m)	*Concentration of heavy metals (mg/kg)*				
	Hg	*Cd*	*Pb*	*Fe*	*Mn*
1.0	0.38	1	95	6,400	210
2.0	0.20	0.5	25	7,600	250
3.0	0.01	1	10	5,400	160
6.0	0.07	0.5	10	6,000	130
8.0	0.12	0.5	10	5,800	145

cur only below 2 meters in depth.

The toxicity of Danube water has been studied since 1978, with germ-, alga- and Daphnia-tests being performed on a regular basis. The water quality is classified according to five categories: non-, slightly-, tolerably-, highly-, and very highly-toxic.

Based on these studies, the following conclusions were drawn:

— The overwhelming majority of the tests performed on upstream and downstream water from Budapest (95.6 percent and 90.6 percent, respectively) were non-toxic;
— Only a small percentage of the samples taken upstream and downstream from the capital were slightly toxic (4.3 percent and 8.8 percent, respectively); and
— A negligible percentage of the samples taken showed tolerable toxicity (0.1 percent and 0.6 percent, respectively).

A comprehensive sampling program, launched in 1968, has accumulated a wealth of data on the levels of pollution in the Danube as measured by mean germ, coliform and streptococcus counts. At one measuring point in the Danube (R. St. 1659 km) downstream from Budapest, these values were analyzed for the year 1985, with the following results:

— In terms of the bacteriological components, the quality of Danube water is poorer upstream than downstream from Budapest;
— The coliform and streptococcus counts downstream from Budapest are five and ten times higher, respectively, than upstream values;
— The annual mean values for coi iform and streptococcus count upstream from Budapest excee the norms specified for bathin waters. This means that sections o the Danube both upstream an downstream from the capital ar unsuitable for bathing. The water upstream from Budapest are i Classes II–III, while those downstream are entirely in Class III.

The differences observed in th quality of Danube water, as measured by bacterial and chemic components, are striking. The average bacterial counts (coliforn and streptocuccus) along th stretch of the Danube that flow through Budapest are shown i Table 2.22. Dividing the coliform and streptocuccus-counts in wastewater discharged into the Danube by the river's backgroun pollution, ratios of 544 and 1867 respectively, are common. By contrast, the ratio for COD is no mor than 31; an order of magnitud smaller.

In light of these findings, th high diluting capacity of the Danube can no longer be used as a excuse to delay expanding the sewage treatment capacity of Budapest, a city which now contain over 20 percent of the entire population of the country.

Section 5. GROUNDWATER POLLUTION

Bank-filtered groundwater is th main source of supply for the com munities situated along the D

Table 2.22 Comparison of Mean Bacterial Pollution in the Danube from Budapest and in the Communal Effluent Discharges (Source: Némedi, 1980)

Sampling site	*Coliform count 100 ml*	*Streptococci count 100 ml*
Budapest, upstream (bank and main current)	8,600	300
Municipal Sewer Utility Co. (21 discharge points)	4,600,000	560,000
Budapest, downstream (bank and main current)	85,000	2,800

nube River. Indeed, Budapest alone withdraws some 312 million cubic meters of bank-filtered water every year for municipal use.

The quality of bank-filtered water is dependent upon the quality of water in the Danube. As the quality of the Danube's water has deteriorated, so too has the bank-filtered groundwater along its shore. The level of groundwater pollution is illustrated in Figure 2.17 for Csepel Island. From this map, it is evident that:

– The groundwater is highly polluted under a major part of the island for each of the four components considered—nitrate, organic carbon, iron, and manganese; and

– Nitrate pollution is reaching dangerously high levels. Over half the island, nitrate levels are 40 mg/l, while 5 percent of the area has nitrate values of 200 mg/l. The standard for nitrate in drinking water is set at 20 mg/l, with tolerable values not exceeding 40 mg/l.

In another series of studies, a filter-well supplying drinking water on Csepel Island was evaluated for a variety of contaminants. The mean values for the well were the compared with mean values for the Danube (see Figure 2.18). Although the data obtained for this well cannot be generalized, it is interesting to note that in the case of the Ráckeve branch of the Danube—which has excellent oxygen supply—the oxygen content of the water was reduced by 84 percent due to the filtration process; creating near anaerobic conditions. Consequently, this oxygen poor environment resulted in higher iron, manganese and ammonia contents in the groundwater.

In order to better assess the general state of groundwater pollution along the Danube, researchers selected 103 wells, comprising seven groups, in the northern well field (north of Budapest), along with 63 wells, constituting five groups, in the southern well field. The results, once again, attested to the capital's

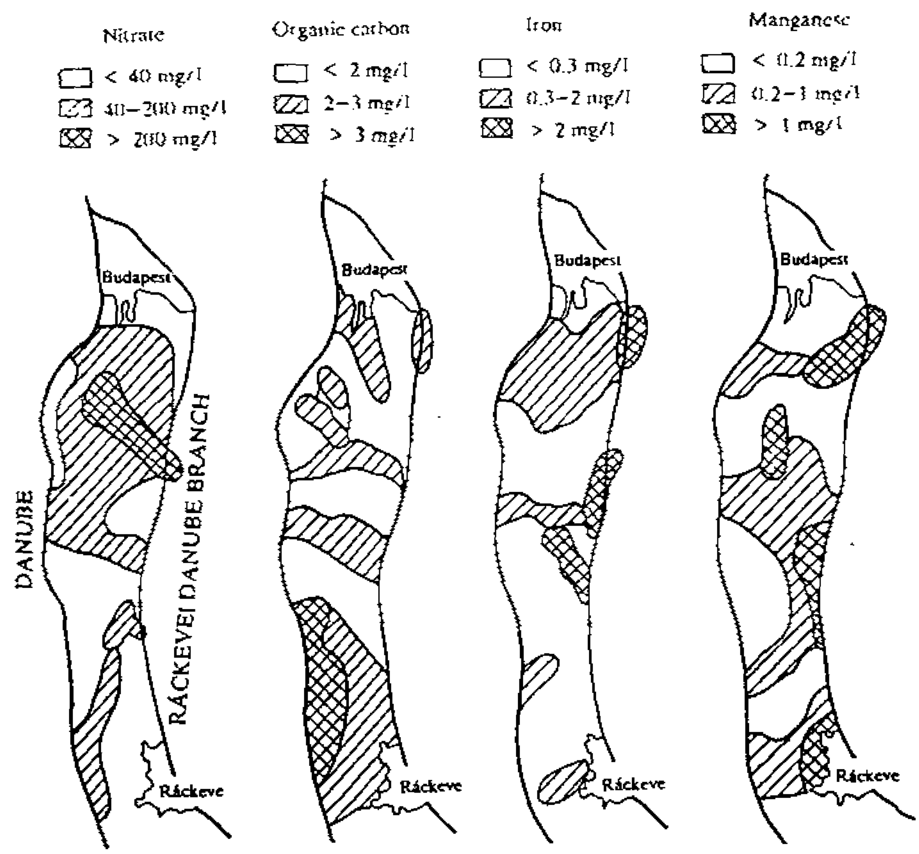

Figure 2.17 Groundwater Pollution on Csepel Island (Source: László, 1985)

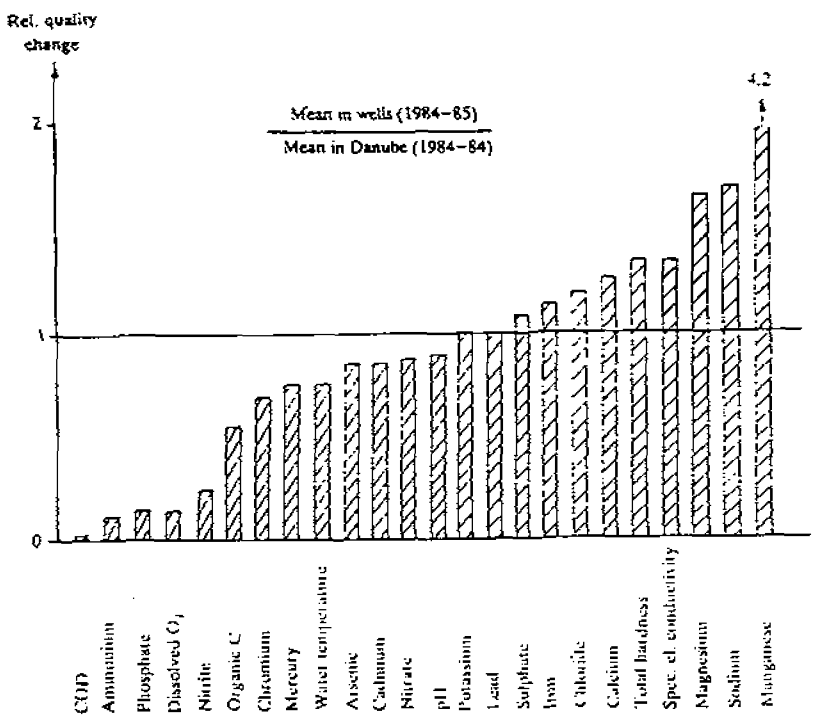

Figure 2.18 Relative Change in Water Quality and its Effects on Bank Filtration (Source: László, 1985)

negative impact on water quality: both surface- and ground-waters.

Generally, the only problems encountered in the northern well fields were elevated levels on manganese and ammonia and only in two horizontal filter wells. By contrast, the quality of water withdrawn from the southern fields was substantially poorer, with elevated levels of ammonia, manganese, iron and nitrate. What was considered exceptionally poor quality water in the northern well fields, had become the norm south of the capital.

The water quality in northern and southern well fields has been compared in Table 2.23, based on studies performed in 1985. As can be seen, the percentage of consistenly poor quality well water was only 8.7 for the northern fields, but soared to nearly 47 percent in the southern well fields.

It should be noted that the percentages tabulated as „objectionable" are based exclusively on chemical parameteres. If biological indicators were also included, the situation would be even worse.

In order to get a more precise picture of groundwater quality upstream from Budapest, the variations in water quality from fields situated along both banks of the Danube (at the Danube Bend) were evaluated between 1968 and 1978. On the right-hand bank 37 wells from 8 different waterworks were studied, while on the left-hand bank, 68 wells from 6 waterworks were included in the analysis. The data were averaged for COD, ammonium, nitrate, and total iron and manganese. The results, plotted in Figures 2.19 and 2.20 clearly illustrate the deteriorating quality of well water along the Danube.

The following considerations should be kept in mind:

— The trend towards poorer quality groundwater is an unbroken one, but this does not apply to each individual well. Mean values have been used;

— 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. But the trend is not an unbroken one;

Table 2.23 Well Waters with Objectionable Chemical Parameters (Source: Homonnay, 1986)

Site	*No. of wells*	*Invariably objectionable*	
		no.	*%*
Szentendre (northern) well fields	103	9	9
Southern well fields	63	29	46

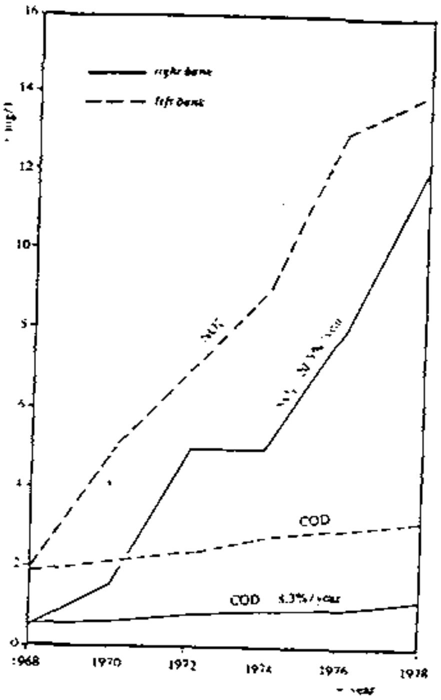

Figure 2.19 Changes in Average Water Quality in the Right Bank and Left Bank Well Fields, North of Budapest at the Danube Bend. Evaluated for COD and NO_3^-
(Source: Hock, 1984)

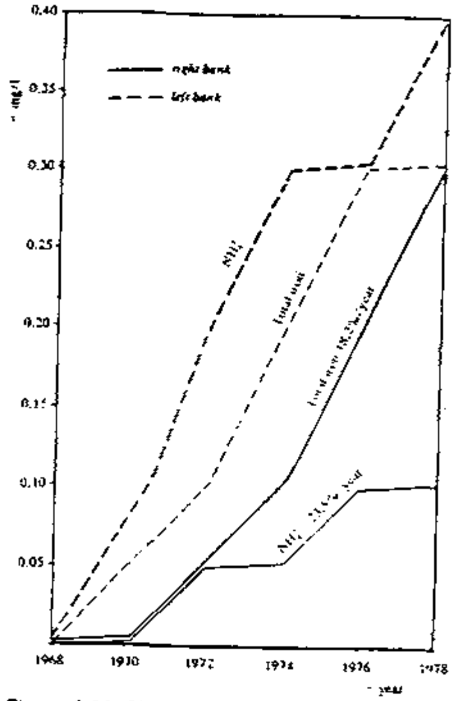

Figure 2.20 Changes in Average Water Quality in the Right Bank and Left Bank Well Fields at the Danube Bank. Evaluated for NH_4^+, Total Iron
(Source: Hock, 1984)

— 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.

1. North and South of Budapest

Despite the deteriorating quality of well water in the northern fields, the trend is not nearly so severe as in the southern fields. The quality of well water south of Budapest has deteriorated drastically since 1963.

This continuing crisis is due fundamentally to the untreated wastewater discharged into the Danube from sewer outlets in Budapest. And the situation is not expected to improve for at least 5–10 years. At present only 21 percent of the wastewaters discharged into the Danube at Budapest are treated biologically. To date, water from fields north of Budapest is still distributed to consumers virtually without any treatment. In stark contrast, water pumped from the southern fields—over 100,000 cubic meters per day—require advanced ozone treatment before it is suitable for use.

2. Groundwater Quality in Other Areas

The quality of groundwater stored in deep aquifers has remained more or less unchanged over the past decades. However, pollutants are beginning to turn up in the karst- and unconfined- groundwaters accessible from the surface by infiltration.

The central part of the Hungarian Great Plain is characterized by a high salt content in the groundwater. But this is not considered a serious problem.

The chemical contaminant of greatest concern in Hungary (as elsewhere) is nitrate. In those areas of the Great Plain where domestic water is supplied by deep weels, nitrate pollution has not yet appeared. Unfortunately, because of the growing acidification of soils in Hungary as well as increased use of fertilizers and pesticides, nitrate pollution is on the increase across wide areas of the country. Of Hungary's 3000 towns and cities, around 700, containing some 300,000 inhabitants, now rely on bottled water brought in by tank trucks or water piped in from neighboring communities for their domestic needs.

Of the traditional chemical components found in water, iron is often the most objectionable. In the Great Plain region, high iron content in drinking water is the most frequent cause of complaints. Since iron represents no health hazard (at normal levels) de-ironing is not a normal function performed by the local waterworks. Hence, as more iron accumulates in water pipes and mains, the iron becomes a source of secondary pollution. Because of this phenomenon, the water delivered to consumers is often or poorer quality that when it is pumped from wells.

It should be pointed out, however, that the overwhelming majority of groundwater used for domestic or municipal purposes is distributed to consumers virtually without any treatment whatsoever (except for occasional disinfection). De-ironing and de-manganizing is being provided for 19 percent, while other forms of treatment—coagulation, sedimentation, acid extraction, and so on—is performed on 7 percent of the groundwater extracted.

Table 2.24 summarizes the percentage of drinking water found objectionable in both waterworks and private wells throughout the country. Private wells relying on unconfined groundwaters are the most polluted in each category.

Table 2.24 Percentage of Drinking Water Samples with Objectionable Parameter (Source: KSH, Central Office for Statistics, 1986)

	Waterworks	*Private wells*	
		dug (unconfined)	*drilled (artesian)*
Bacteriological	25.4	42.4	18.8
Chemical	26.4	58.9	36.9
Biological	17.4	26.8	10.3

Section 6. CHANGES IN WATER QUALITY AND PROSPECTS FOR THE NEXT CENTURY

The changes noted in the quality of Hungary's surface- and ground - waters is due to the rapid urbanization of the country along with a tremendous increase in industrial and agricultural activities.

The „utility gap" mentioned earlier, will no doubt continue to widen as urban and industrial growth continue. Nearly 95 percent of the entire population is now connected to a communal water supply and more waterworks are expected to come on-stream by the turn of the century. Unfortunately, sewage treatment lags far behind the provision of piped water, and will likely continue to do so for the forseeable future.

Meanwhile, Hungary's water consumption continues to rise: by the year 2000, if current trends continue, the per capita consumption of water will increase four-fold over 1960 levels—from 50 litres per day to 200 litres per day.

At the same time that water use is increasing, both surface and groundwaters are becoming more polluted. This „scissors effect" on water resources will have to be confronted by water managers. If current trends in water use and treatment continue unchanged, then the country's water resources will be squeezed between rapidly rising demands and deteriorating quality; prompting increased costs to consumers and utilities.

As Hungary's agricultural sector continues to expand production, more chemicals in the form fertilizers and pesticides will be used. In this context, the amount of fertilizers used in Hungary from 1921, with projections to 2005, have been plotted to a logarithmic scale against time (see Figure 2.21). It should be noted that of those fertilizers used, the greatest loss—about 10 percent—occurs with nitrogen-based fertilizers. And since nitrogen often penetrates beyond the root zones of crops, and does not break down easily, it is a source of increasing pollution to both surface- and ground-waters. It is possible to modify the adverse effects of fertilizer use by installing better storage facilities and by improving the methods of application.

Given the state of Hungary's waters, it is evident that future changes in water quality—both surface- and ground-water—will be dictated by the same factors which influence present water quality. Improvements will depend, to a great extent, on the amount of mo-

Annex 33

(Extracts)

Commission of the European Communities, Republic of Hungary, Slovak Republic

Working group of Monitoring and Water Management Experts for the Gabčíkovo System of Locks, Report of 1 December 1993 on Temporary Water Management Regime

COMMISSION OF THE EUROPEAN COMMUNITIES
REPUBLIC OF HUNGARY
SLOVAK REPUBLIC

WORKING GROUP OF MONITORING AND WATER MANAGEMENT EXPERTS
FOR THE GABCIKOVO SYSTEM OF LOCKS

REPORT ON TEMPORARY WATER MANAGEMENT REGIME

Bratislava
December 1, 1993

5. ELABORATION OF SCENARIO 1

Scenario 1 has the same discharge regime in the Old Danube as presently existing but has improved water supply to the inundation area on the Hungarian side.

In addition to the impacts described in this chapter reference is made to Section 3.3, where environmental impacts common to all five scenarios are described.

5.1 Characterization of the Scenario

This scenario is characterized by the following discharge regime:

* In average 400 m^3/s into the Old Danube consisting of a base discharge of 250 - 300 m^3/s supplemented with more discharge during some flood events.
* 30-140 m^3/s into the side channels on the left side flood plain with an average value of 50 m^3/s.
* 30-70 m^3/s into the side channels on the right side flood plain with an average value of 50 m^3/s.
* 1-3 floods of more than 3500 m^3/s per year into the Old Danube (to the extent hydrologically possible).

Remedial measures (structures) will be implemented for the following purposes:

* Obtaining increased water supply into the side channels on the right side.
* Ensuring some migration of wetland species between the main river and the side branches.

All the remedial measures are technically reversible.

In addition improved operation rules for the day-to-day operation of the water management within the above given discharges will be implemented in order to obtain as good environmental conditions as possible.

5.2 Technical and Water Management Aspects

5.2.1 Additional remedial measures

The following technical measures are considered under this scenario:

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Inundation area on the left side

* Construction of 7 fish passes connecting the main Danube to the side branches.
* Construction of fish passes within the inundation area.

These fish passes can be constructed in three months and is estimated to cost 0.54 mill ECU.

Inundation area on the right side

In order to achieve sufficient flow velocities in the channels on the Hungarian side it is estimated that the present 10 m^3/s have to be increased to the same level as the one presently existing on the Slovakian side, i.e. up to 70 m^3/s with average values in the order of 50 m^3/s. Such discharges will most likely result in sufficiently high flow velocities to ensure removal of mud from a substantial part of the river bottom.

The supply of these up to 70 m^3/s can be achieved by four technically alternative solutions:

(a) Construction of a supply canal from the inundation weir to the first side branch. This work can be completed within three months and is estimated to cost 2.4 mill ECU. In addition, the reconstruction work on the spillway of the bypass weir is neccecary and is expected to be completed in May 1994.

(b) Construction of an underwater weir between RKM 1843 and 1847. Previously such a project has already been designed. Implementation of a new project, including fullfilment of all legal procedures, is expected to be possible within a year and to cost 1.5 mill ECU.

(c) Using the supply canal and additional construction of syphons between the reservoir and the first side branch. The syphons, which need to have a total capacity of about 50 m^3/s, have to cross the river. Taking into account a length of 450 m and a 7 m difference in level, a water pipe of 1 m diameter enables transmission of 0.6 m^3/s. Hence about 80 syphons are required for transmitting 50 m^3/s. The best technical way of crossing the Danube is put the pipes in a trench below the river bottom. The cost of the syphon system is estimated to be in the order of 5 mill ECU.

(d) Increase of the capacity of the supply canal from 25 m^3/s to 70 m^3/s. This can be implemented within six months and is estimated to cost 5 mill ECU.

From a technical and economical point of view, the simplest alternative is the underwater weir (b). This solutions also provides the best water management possibilities and the minimum risk of damage during floods. From an implementation point of view alternatives (a) and (d) can with more certainty be implemented within six months.

In addition to the water supply fish passes between the main Danube and the side branches should be constructed. These works have not been designed but can according to designs on the Slovakian side be estimated to cost 0.5 mill ECU.

5.2.2 Water management regime

The water management regime will be characterized by the average annual discharge values shown in Table 5.1.

Table 5.1 Annual average discharge values in Scenario 1.

	Average annual discharge (m^3/s)
Danube, Bratislava	2.025
Inflow to Little Danube, Bratislava	30
Inflow to Mosoni Danube, Cunovo	25
Seepage canal, right side	2
Seepage canal, left side	5
Seepage from reservoir to Danube	20
Seepage to ground water	30
Intake to Slovakian river branches, Dobrohost	40
Intake to Hungarian river branches, Danube	50
Bypass weir plus inundation weir, Cunovo	380
Ship locks, Gabcikovo	25
Turbines, Gabcikovo	1.418

5.3 Possible Time Schedule for Implementation

This scenario can be implemented by May 1994, provided that fulfilment of possibly neccessary legal procedures does not take more than three months.

5.4 Impacts on Discharges, Water Levels and Flow Velocities

The impacts on discharges and water levels, as already measured are described in ref /2/, and shown in Table 5.1. They can be characterized as follows:

* The discharges in the Old Danube will in average be about 20% as compared to pre-dam condition.

* The water levels in the upstream part of the Old Danube will be reduced by 2-4 m as compared to pre-

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dam conditions.

* The characteristic dynamics of water level and discharge fluctuations in the Old Danube will continue to be significantly reduced as compared to pre-dam conditions. This could be influenced by implementation of improved operational rules for day-to-day water management.

* Water level variations on the Slovakian inundation area will vary by 1.8 m at a difference in water supply from the intake canal at Dobrohost from 0 to 140 m^3/s.

* The difference in water levels between the main river and the side branches will generally be so large that water flows from the main river to the side branches will only be possible under the flooding conditions expected to occur 1-2 times per year.

The split of the discharges can in a year with average discharge be described by the figures given in Table 5.1

The flow velocities have been estimated to be as described in Table 5.2. From the table it appears that the cross-sectional velocities at minimum discharge in the main river are 0.6 - 0.8 m/s corresponding to velocities near the bottom of 0.4 - 0.5 m/s.

5.5 Impacts on Erosion/Sedimentation

The impacts on erosion and sedimentation as already measured are described in ref /2/. Due to lack of specific measurements there is some uncertainty with regard to the development over the coming years. The best estimate is as follows:

* No major net erosion and sedimentation in the Old Danube. During some events sedimentation of fine material will take place. This fine material may be washed away during flood events.

* The river bed in the main branches on the Slovakian side will continue to be sufficiently free from mud, so that good infiltration conditions exist.

* The river bed in the main branches on the Hungarian side will become sufficiently free from mud, so that good infiltration conditions will exist.

5.6 Impacts on Surface Water Quality

The impacts on the surface water quality are expected to be insignificant.

Table 5.2 Estimated discharge and flow velocity values in the main river and in the side branches under Scenario 1.

Location	Discharge characteristic	Discharge (m^3/s)	Cross-sectional average velocity (m/s)
Main river, Rajka	Minimum	200	0.60
	Average	400	0.88
	Typical annual maximum	3500	2.04
Main river, Dunaremete	Minimum	200	0.77
	Average	400	1.12
	Typical annual maximum	3500	2.00
Left side branch, main channel	Typical minimum	0	0
	Typical average	40	0.05 - 0.25
	Typical annual maximum	70	0.07 - 0.35
Right side branch, main channel	Typical minimum	0	0
	Typical average	10	0.05 - 0.09
	Typical annual maximum	15	0.06 - 0.10
Connection between main river and side branches	Flow from inundation area into main river		365 days/year
	Flow from main river into a few river arms		5-10 days/year
	Flow from main river into almost all river arms		< 5-10 days/year

5.7 Impacts on Ground Water Regime

The estimated impacts on the ground water regime are:

* Ground water levels on the Slovakian territory will be higher than or equal to the pre-dam conditions.
* Ground water levels on the Hungarian territory are expected to be not lower than in the pre-dam conditions.
* Reestablishing the dynamics of ground water level fluctuations will to large extent be possible downstream the reservoir.

5.8 Impacts on Ground Water Quality

The impacts on the ground water quality are in general expected to be insignificant. However, some local changes are expected in areas close to the reservoir in certain parameters, such as total dissolved solids, nitrate, etc due to changes in flow pattern. These changes are not expected to lead to a worsening in the ground water quality.

5.9 Impacts on Flora and Fauna

The impacts on flora and fauna as already observed are described in ref /2/. However, if the present situation continues for some years an increased effect will result with regard to changes in alluvial ecosystems as follows:

* On the Hungarian inundation area the reduction of deposition of fine material (nutrients!) by floods in the alluvial forests makes their growing conditions worse.

* On the Slovakian inundation area the decrease of water level changes due to flooding from the main river can be compensated for management of discharge intake from the navigation canal at Dobrohost. The net effect of this combination is not yet proven in pratise.

* On the Slovakian inundation area the reduction of deposition of fine material (nutrients!) by floods will be counteracted by deposition of smaller concentrations originating from artificial flooding by discharge from the navigation canal. The net effect of this combination is not yet certain.

* Reduction of discharges in the Old Danube leads to reduction of the water body, the flow velocity and to sedimentation of fine material. This will cause the loss of species typical for streams, of *rheophile* organisms, especially of fish species spawning on gravel ground.

* The flow velocities in the main river are not large enough to provide adequate living conditions for the species requiring the higher flow velocity, for example fish species like Streber (0.6 m/s 7 cm above ground).

5.10 Impacts on Agriculture and Forestry

Due to the increase of ground water tables on both the Slovakian and Hungarian territory an increase in the capillary water supply for as well agricultural as forestry areas can be expected.

5.11 Impacts on Electricity Production

In a year with average discharges as outlined in Table 5.1 the electricity production can be estimated to about 1,930 GWh/year.

5.12 Cost Estimate for Remedial Measures

The remedial measures already implemented in addition to Scenario 0 are estimated to cost as follows:

* Fish passes on the Hungarian flood plain: 0.54 mill ECU
* Water supply plus fish passes on the Hungarian flood plain: 2.0 mill ECU.

APPENDIX A: Terms of References for the Working Group

COMMISSION OF THE EUROPEAN COMMUNITIES
DIRECTORATE-GENERAL
EXTERNAL ECONOMIC RELATIONS

Brussels, 26 August 1993
Service/L-3/hcs

Establishment of a Group of Monitoring
and Water Management Experts for
the Gabcicovo system of locks

1. Introduction

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 (Group of Experts).

The Group of Experts shall consist of one expert appointed by Hungary and one expert appointed by Slovakia. Three independent experts appointed by the Commission of the European Communities will participate in the Group. The meetings will be chaired by one of the EC experts. The EC experts will have expertise in hydrology, including monitoring of hydrological data, ecological issues and water based constructions. The Slovak andd Hungarian experts can be supported by associate experts if necessary.

The monitoring will cover the whole area surrounding the Gabcikovo system of locks, and monitoring and measuring systems will be established both at Slovak and Hungarian territory.

No recommendations or activities arising from the establishment of the Group of Experts or its operation will effect, or reflect upon, any of the issues of legal liability which, in accordance with the Special Agreement, must be determinated by the International Court of Justice.

The Group of Experts will submit reports and recommendations based on consensus between the experts. In cases of disputes in the Group of Experts the Slovak and Hungarian experts as well as the EC experts can submit separate reports and recommendations.

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2. Objectives

The Group of Experts will:

I. Collect and assess data on all relevant aspects and effects of the current water discharge including the effects of the various remedial measures already put in place. The data to be collected will be defined by the Group of Experts within three days after its formal establishment. The methodology to be applied in the subsequent data analysis will be defined by the Group of Experts in connection with its first report 17 days after its formal establishment. The data to be collected will at least include:

* water discharge at all relevant places;

* surface water level and quality including sedimentation at all relevant places.

* ground water level and quality;

* impact on flora and fauna in the region;

* impact on agriculture and forestry;

* electricity production

* other possible essential aspects.

The data collection will be based on the existing data currently at the disposal of both sides as a result of regular measuring made jointly or separately by each side. Further the Group of Experts will decide on new or harmonised monitoring procedures and identify possible need for additional monitoring to be carried out in the future.

II. On the basis of the data collection (I) prepare recommendations for submission to the two Governments on the following aspects, with a view to safeguard the environment and the ecological conditions in the region:

A. A Temporary Water Management Regime including a detailed manual with specifications for the day-to-day operation and different water discharge situations:

B. The necessary water discharge and water level in the old riverbed and in the adjacent area and remedial measures to be taken.

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c. The establishment of a Water Management and Monitoring Committee for the operation of the Temporary Water Management Regime. The main task of the Water Management and Monitoring Committee would be to:

- propose modifications in the Temporary Water Management Regime or new remedial measures to be taken on the basis of the operational experience and continued monitoring,

- initiate and supervise additional studies, measurements and research required; and

- prepare recommendations for urgent measures to be taken in case of emergency situations.

3. Activity and time schedule

The Group of Experts will work in accordance with the annexed time and activity schedule.

4. Mode and place of operation

A detailed activity and meeting plan will be prepred at the first meeting in the Group of Experts. Place of meetings will alternate between Slovakia and Hungary and secretarial support will be provided by the host country.

5. General

All proceedings, data collected by and recommendations from the Group of Experts will be confidential until the two Governments and the Commission decide otherwise. The Experts will make no public statements on the work of the Group.

DATE	ACTIVITY
September 8, 1993	First meeting to develop a detailed action and meeting plan.
September 13,1993	Report by the EC Experts on the need for clarification or adjustments in the Working Document
September 30,1993	Report on the assessment of existing data, the preliminary findings from analysing the data and the recommendations regarding modifications to the present monitoring practice. The report will be submitted to the two Governments and the Commission.
November 19, 1993	Final report, including recommendations for: 1. Temporary Water Management Regime, including a detailed manual with specifications for the day-to-day operations and different water discharge situations; 2. The necessary water discharge and water level in the old river bed and in the adjacent area and remedial measures to be taken; 3. The establishment of a Water Management and Monitoring Committee re. item 2.II.C.

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Annex 34

(Translation)

Kuryr,
Extract of 14 October 1991, Dr. Vagas

KURYR, October 14, 1991

A bomb is peeping

Professsor's opinion: God save Szigetköz

Q. - Mr. professor, you are not afraid?

A. - Why should I be afraid? Don't think that I am the only person for the construction of the G/N Project - this is the decisive answer of Dr. István Vágás, hydrologist, a nominated university professor.

Q.- Everbody knows two things about you that you are an encyclopaedia of water management on two legs and that you believe in the operation of the G/N Project.

A.- I am not led by political interests, but by water management. I can mention one recent argument. Those who observed the flood of August 1991, were stroken by the fact that the measured water levels at Vienna and Bratislava were 120 cm lower than the maximum level in 1954 flood, even in Budapest the level was by 50 cm lower than in 1965 flood. On the contrary, the water level at Dunamerete was of 30 cm higher than the maximum levels measured in the 1954 flood. The time bomb is peeping!

It means that the section of the Danube near Dunaremeete has been gathering and gathers the gravel-sand and this process has been known for hundred years. Zoltán Károlyi has predicted already in 1955 further raise of the Danube river bottom and all numbers which he predicted became unfortunately a reality. This raise of bottom means 100 cm during 25 years. It was useless to raise protection dykes because the danger of a flood at Dunamerete has not be lowering, but increasing. In the following ten years, a lower backwater of the Danube can cause a big flood catastrophe. A headwater canal was completed at Szigetköz which will protect Szigetkôz against floods. Czecho-Slovakia will never dismantle this headwater canal for this reason. If Hungary does not allow that a part of the Danube water is drained to this canal in the event of a flood, thus, it can cause the break of the protection dyke because if gathered suspended load will reach its peak I can say only God save Szigetkôz.

Q. - This is the opinion of water management lobby, isn't it?
A.. -I would say that this is the opinion of experts - hydrologists. But this is also the opinion of the Commission of water management of the Hungarian Academy of Sciences, the honorable president of which is Emil Mosonyi, professor of Karlsruhe who can be considered at last the father of the G/N Project. The Hungarian Academy has never asked for the opinion of this Commission, even if its competence is indisputable. The Hungarian press rejects regularly our opinions, I am curious, why? It is not known that the government commissioner György Sámsondi Kiss has chosen the universities and persons which participated in the advertismenent for dismantling the coffer dam in Nagymaros. Thus, the professor Gábor Karádi from the Milwaukee University, who is generally known that he is the only research engineer who got a national Hoffman prize for research work on hydroelectric power plants, was also asked for his opinion. He explains in his answer that the American experts who are specialists in these issues, consider the suspension of work for a wrong decision. He wrote also that the moderate financial means should be used for reduction of pollution of atmosphere abd for construction of wastewater treatment plants. He mentions also that the campaign against atmosphere pollution "would be too expensive, but it would bring only a moderate political result, therefore it is highly probable that in your programme of environment protection, the campaign against pollution of atmosphere does not belong to the particular tasks."

In the opinion of Gábor Karádi, the Hungarians should be asked for their opinion and it would be necessary to explain the arguments of both sides to the Hungarian nation. He writes in his letter that he is rather disappointed that the decision of the G/N Project had originally political causes. In his opinion, these interests played greater role by the suspension of work when the economic, technical and ecological reasons were not taken into account.

Q. - Doctor Vágás, how do you see the future of water?
A. - We think that Czechoslovakia solves the issue of waterwork for its benefit. In the event of the completion, Hungary would

get 50% of produced electrical energy and it would be possible to use this gain for construction of ecological structures, as well as for the wastewater treatment plants. Even maintenance work could be performed for the protection of environment. But the most important reason is generally known that the only obstacle of intercontinental navigation way Danube-Rhine-Main is a low water level in the upper section of the Danube which cannot be used without backwater. The time of provisional solutions is over.

Annex 35

Further details on the sub-variants of Variants "C" and "D"

Variant "C" - 3 sub-variants:

(i) Sub-variant "C1" assumed regulation measures in the old channel and water supply into the old channel and branch system in accordance with the 1977 Treaty (50 m^3/s).

(ii) Sub-variant "C2" assumed construction of submerged weirs in the riverbed and a permanent discharge of 350 m^3/s of water into the old channel.

(iii) Sub-variant "C3" assumed water supply into the old Danube channel and branch system according to variant C2, but it envisaged that the submerged weirs in the riverbed would consist of movable structures.

Variant "D" - 6 sub-variants:

(i) Sub-variant "D.a.1." envisaged impoundment at Dunakiliti weir up to 129.00 m, supply of the old Danube channel without power utilisation and water regulation measures within the branch system.

(ii) Sub-variant "D.a.2." was identical to sub-variant D.a.1, although water supply into the old channel would amount to 350 m^3/s, and at the Dunakiliti weir power production would occur. Measures in the branch system would be identical with those in sub-variant "D.a.1." and submerged weirs would be constructed in the old Danube channel.

(iii-iv) Sub-variants "D.b.1." and "D.b.2." assumed impoundment at Dunakiliti weir up to 131.10 m but were otherwise identical to sub-variants "D.a.1.", or "D.a.2.".

(v) Sub-variant "D.c.1." consisted of construction of an inlet canal along the left-side dyke of the reservoir in the section rkm 1842-1858 and its connection to a new weir at Rusovce (rkm 1856.6) with an impoundment 130.80 m, and power production at Gabcikovo. Water supply into the old Danube channel would be 50 m^3/s, and remedial measures in the branch system would be realised.

(vi) Sub-variant "D.c.2." envisaged water supply into the old channel amounting to 350 m^3/s, power production at a weir at Rusovce, with water regulation in the branch system and construction of submerged weirs in the old riverbed.

Annex 36

List of Studies, Research Tasks and Experts' Accounts elaborated for putting the hydroelectric power project Gabčíkovo into operation by means of the Temporary Solution, Variant "C", 1991-1993

LIST OF STUDIES, RESEARCH TASKS AND EXPERTS'S ACCOUNTS ELABORATED FOR PUTTING THE HYDROELECTRIC POWER PROJECT GABČÍKOVO INTO OPERATION BY MEANS OF THE TEMPORARY SOLUTION - VARIANT C - OVER THE YEARS 1991 - 1993

1/ "The Danube - proposal of manipulation within the branch systems"
Water Research Institute, /VÚVH/, Bratislava, Szologay J., March 1990
The aim of the task was elaboration of the proposal of manipulation on respective barriers at maximum water saving. The water is supplied into the branch system through the intake structure in the connecting dyke. Based on the computations of various alternatives the basic discharge Q = 28,2 m3.s-1 was recommended, and the flood discharge Qz = 140 m3.s-1. The data were used for processing of execution designs and of the proposal of manipulation within the branch system.

2/"Study of the discharge and water level regime of the left-side Danube branch system on a physical model, rkm 1820-1840"
VÚVH, Bratislava, Slota R., Sikora A., October 1992
The project of left-side branch system irrigation in rkm 1820-1840 by means of the intake structure in the connecting dyke of the reservoir was studied on a physical model in the scale 1/250/50. The physical model was developed on the basis of the request of the Slovak Environmental Commission in March 1992. The functioning of the proposed branch system solution was verified on the physical model.

3/ "Data for elaboration of the operating regulations for the provisional solution of the Hydroelectric power project Gabčíkovo" /Gabčíkovo Project/.
VÚVH, Bratislava, Lindtner J., Koštál R., Šoltész A., 1993
The report deals with the assessment of the water level regime of groundwaters within the Danube flood plain, considering two feasibilities of its regulation:
- variant, assuming cascade-like arrangement of the old Danube bed by means of constructions of barriers,
- variant assuming supplying of groundwaters by means of the branch system.
The results proved, that when 500 m3.s-1 discharge in the old Danube bed will be provided, and the branch system will be supplied by 28,2 m3.s-1, no separation of the groundwater from the cover layers will occur and the groundwater level within the flood plain will be ensured at the same level, as at the discharge of 1300 m3.s-1 in the old Danube channel, without supplying of the branch system. The results were used for drawing up the provisional working regulations.

4/"Data for drawing up the operating regulations for the temporary solution of the Gabčíkovo Project, for discharge and water level regime in the left-side Danube branch system in the rkm 1805 - 1842.
VÚVH, Bratislava, Sumbal J., Brezinová E., Lahoda R., Topoľská J., March 1992
As continuation of the works on a physical model calculations were executed on a mathematical model, which, in addition to problems of water supplying to the branch system through the intake structure dealt also with following:
- potential maintaining of the admissible water level regime within the branch system through increasing of the constant discharge in the old Danube channel,
- irrigation wave into the old Danube channel.
The model study proved explicitly, that the designed system is well functioning and creates for the ecology of the inland delta more favourable conditions than existed before the Danube stream transposition. The results were used for the realization of works within the branch system and for drawing up the provisional working regulations.

5/ "Gabčíkovo-Nagymaros Project, training in the old Danube channel, Study of regulation structures",
VÚVH, Bratislava, Capeková Z., Szolgay J. March 1991.
The study was worked out on the basis of a new approach with regard to ecology in solving the problems of the old Danube channel. Water-level courses for two eco-discharges have been computed, namely 350 m3.s-1 and 1300 m3.s-1, under assumption that 5 barriers in the old Danube bed will be constructed. The results revealed, that significant gradient differences occurred at the barriers with regard to groundwater flow under those structures, therefore a modified solution was designed, 7+1 barriers in the concerned Danube area. The designed solution affords environmentally more favourable conditions for the reclamation of the old Danube bed section, as well as of the riparian zone, than the solution, planned in the JCP. It will be used for elaboration of further stages of project documentation.

6/ Project of antierosion and landscape forming measures on the territory, affected by the operation of the Gabčíkovo Project by temporary solution,
Forest Research Institute, Zvolen, Valtýni, October 1992
Analysis of the wind erosion within the concerned territory /total area about 27 200 ha/, as well as anti-erosion measures and issues of ecological stability of the territory. Potential increasing of ecological stability by means of landscaping, i.e. developing of grass cover and planting of anti-erosion plants and trees. Results have been used for the realization of works within the branch system and for landscaping of the concerned territory.

7/ Water management-ecological conceptual solution of the old Danube channel as well as of the branch system,
VÚVH, Bratislava, Szolgay J., Holubová K., Capeková V. June, 1991.
The study has been worked out on the basis of a new approach to the solution of the old Danube channel and of the branch system. Within the scope of the study following was investigated:

- the extent, in which ecological, or other demands may be implemented, connected with the existence and development conditions of the old Danube channel and of the branch system, and how it may be executed,
- alternative conceptual modifications were designed for changing hydrologic, hydraulic and morphologic parameters of the old channel and for starting autoregulation water regime, and consequently also of the branch system,
- a system of regulable regime within the old channel was established, realized by means of a weir, or weirs, and in the branch system by means of a combined system of sluices and solid spillways.

Results were used for drawing up further project documentation.

8/ Analysis of the hitherto morphological development of the old Danube channel and prognosis of changes due to long-term operation of the Gabčíkovo Project ,
VÚVH Bratislava, Stančíková A., Bačík M. June 1991
Two basic issues have been dealt with:

- analysis of the hitherto development of the old river bed,
- prognosis of the progressing development of the old river bed, as influenced by the Gabčíkovo Project operation

Research results were used for further tasks, dealing with the issues of the old river bed, which is one of the main factors, influencing the effect of the Gabčíkovo Project on the environment.

9/ Design and hydraulic research of weirs in the old Danube channel, VÚVH, Bratislava, Komora J., June 1991.
The aim of the task was to revise the solution, taking into account ecological and water resources development aspects and the decreasing at minimum of unfavourable impacts of the construction of the Gabčíkovo Project on the environment. The resulting design includes construction on the environment. The resulting design includes construction of two weirs in the old channel situated in rkm 1828 and 1817,9, and construction of barriers within the branch system.
By means of this design following will be achieved:

- stabilization of the groundwater levels regime
- safe passing of flood discharges
- ensuring of navigation conditions in case of failure and fall-out of the Gabčíkovo hydroelectric power plant
- providing of conditions for substitute navigation in the old Danube channel.

The designed weirs have the solid part, which will be overflown only during flood discharges, and the gated part, making possible water level regulation within the retentions. Research results have been used for elaboration of further stages of the project documentation.

10/ Determination of the water level courses within the old Danube channel, considering the distribution of the effect of the branch systems.
VÚVH, Bratislava, Bačík M., Lukáč M., Szolgay J., Topoľská J. June, 1991.
The task was solved within the scope of requirements for minimalization of unfavourable effects of the construction of the Gabčíkovo Project on the environment. The task presents water level courses in the old channel at discharges Q 500 m3/s, 1000 m3/s, and 1500 m3/s, water level courses in the old Danube channel at various discharges distribution between the old Danube channel and the Hydroelectric power plant Gabčíkovo, and water level courses at flood events.
The water level courses computation was executed for two basic situations:
- the old river channel is in original state, without any hydraulic modifications or interventions
- there are two bottom sills in the old channel according to the Hungarian documentation in the JCP.
Computation results have been applied in working out the project documentation.

11/ Model study of transversal structures in the old Danube bed, VÚVH, Bratislava, Sikora A. June 1991
As to provide stabilization of the groundwater regime of the Danube Island, protection of floodplain forest ecosystems on the left-side branch system, and preservation of ecologic conditions in the area of the old Danube channel, it is of topmost importance to increase the water levels in the old river channel, i.e. higher than at the sanitary discharge Q 50 m3/s according to the design of the JCP. It is required to construct in the old Danube channel /length 41 km from the Danube damming up at Čuňovo, downstream to Palkovičovo/ transversal structures - barriers, which will ensure this requirement.
The aim of this research task was construction of barriers made of rock-fill, at the water level regime over the barriers corresponding to the constant discharge in the old channel of Q 350 m3/s, occasional flushing discharge Q 1300 m3/s, and to flood discharges higher than Q 1300 m3/s.
The research results have been used for the preparation of the project documentation.

12/ Testing the feasibility to correct groundwater level for forest ecosystems on the left-side of the headwater canal on the Danube Island by means of manipulation on damming up structures of seepage canals.
Water-Engineering Construction, State Enterprise, Sept. 1991
The aim of the task was to test the impact of the Gabčíkovo Project on forest ecosystems, occurring on the left-side of the bypass canal on an area of about 633 ha, and simultaneously to verify the effects of the manipulation of existing hydraulic equipment of the seepage canal on those forest growths. The results were applied for processing the project documentation of afforestation works and for drawing up the working regulation of the hydroelectric power project and its structures.

13/ Assessment of the effect of passing biological discharges on the energetic utilization of the hydroelectric power project Gabčíkovo, Hydroenergia, Bratislava, Indúšek J., October 1992
The research task assessed the effect of various values of biological discharges on the hydroelectric power plants Gabčíkovo, Čuňovo, Mošoň, Dobrohošť and SVII. Results of various variant solutions enable to compute decreasing of electric power and energetic outputs at various combinations of discharges.

14/ Socio-economical prognosis of the impact of the hydroelectric power project Gabčíkovo on the adjacent territory.
Geographic Institute SAV, Bratislava, Manot J., February 1991
The work consists of two parts:
1. physical-geographical characteristics of the hinterland of the Gabčíkovo Project has been dealt with,
2. socio-economic system in the hinterland of Gabčíkovo Project.

On the basis of evaluation of those two stages the proper prognosis of the impact of the Gabčíkovo Project on the socio-economic development of the adjacent territory has been processed.

15/ Considering the feasibilities to provide navigation conditions in the Danube in case of the failure in the hydroelectric power plant Gabčíkovo, VÚVH, Bratislava, Sumbal J. June 1991
The conclusions of the research task were applied for manipulation and were incorporated into the provisional operating regulations of the Gabčíkovo Project.

16/ Unsteady flow through the hydroelectric power project Gabčíkovo under provisional solution on the Slovak territory, VÚVH, Bratislava, Sumbal J. March 1993
Conclusions of the research task have been incorporated into the First updating of the provisional operating regulations.

17/ Computation of velocities in the inlet funnel at abrupt increases of the Danube discharge during the construction, VÚVH, Bratislava, Sumbal J. March 1992
Computation of discharges of average cross-sectional velocities within the inlet funnel of the headwater canal in case of sudden discharge increase in the Danube over a certain stage of construction. Applied for operation and construction.

18/ Assessment of speed in the tapering parts of the reservoir according to the Variant C.
VÚVH, Bratislava, Topoľská, March 1992
The aim of the task was to specify the water levels and velocities in the narrowing parts of the reservoir in various stages of construction, and thus to solve the issues of the determination of the critical grain-size in those parts of the reservoir, which are tapered as compared with other parts, i.e. the velocities are higher. Consequently the fortification was designed. Applied as information for the project.

19/ Cooperation in the construction-technological large-scale experiment of the Danube damming up in rkm 1851,750 and in its estimation,
VÚVH, Bratislava, Sumbal J., Hrazdílek I. September 1992
Design of the process of damming up, considering the results of all research works and of the large-scale experiment. Applied for the projet and working process.

20/ Specification with more precision of the construction during damming up of the Danube channel.
VÚVH, Bratislava, Dumbal J., Hrazdílek I. April 1992
The construction process of the Danube channel damming up has been verified by means of a hydraulic model study, /rkm 1851,750/, taking into account the practical feasibilities of the contractor. Applied for the project.

21/ Investigation of the chute stability, situated in the left-side cut-off below the weir in rkm 1851,750
VÚVH, Bratislava, Komora J., Topoľská, 1992
The study was aimed at the providing of the stability of a boulder chute. Applied for the project.

22/ Solution of filtration stability of the reservoir structures in spatial conditions
HALVPEX, Hálek, June 1992
Estimation of the filtration stability of the righ-side dyke and design of horizontal and vertical sealing elements. Applied for the project.

23/ Possibilities of more economic construction of the structures - A study. Volanský, January 1992
Estimation of the more economic construction of the wier structurs, of the hydroelectric power plant, and navigation lock. Applied for the project.

24/ Exploitation and storage of sediments from the Hrušov reservoir under temporary solution - a study.
The Danube River Office, State Enterprise, Minárik, Fašiang, May, 1992
Design of the solution of the exploitation, transport and defining sites for storage of extracted sediments. Applied for operation.

25/ Model study of the Danube channel damming up at the variant solution of ramps from the river banks.
VÚVH, Bratislava, Sumbal J., Hrazdílek I. July 1992
Investigation of the possiblity to organize the process of the Danube damming up - tapering of the channel profile by construction of groynes on both sides. Applied for the project.

26/ Unsteady flow in the hydroelectric power project at temporary solution. VÚVH, Bratislava, Sumbal, J. Kĺučovská, July 1992
Solution of the impact of emergency failure of the hydroelectric power plant Gabčíkovo on the navigation under temporary solution on the Slovak territory. Applied for operation.

27/ Model study of the area close to the stilling basin in the right-side flood plain
VÚVH, Bratislava, Kališ, Hrazdílek, Olmer, 1993
Estimation of the stilling basin - boulder chute. Applied for the project.

28/ Study of the ice regime during operation of the Ist stage of the temporary solution
Hydroconsult Trenčín, Uhlár, February 1993
Estimation of problems occuring during the winter regime in January 1993. Applied for operation.

29/ Intake structure into the Mosoni branch, variant with idle outlets
VÚVH, Bratislava, Pavelčák, Slota, September 1991.
The hydraulic problem of the intake structure into the Mosoni Danube branch has been solved in two stages:
I. hydraulic computations /weir capacity, scour in the area close to the stilling basin, stilling basin/
II. model study, testing the function of the structure.

30/ Hydraulic investigation of the reservoir and functional structures, VÚVH, Bratislava, Kališ, Olmer, January 1993
Testing the designed solution and its modification, so that its function would be ensured during the construction of a new large weir. Applied for the project.

31/ Hydraulic study of the restoration of the area close to the stilling basin in the right-side flood plain after the flood event in November 1992.
VÚVH, Bratislava, Kališ, Topoľský, Olmer, April, 1993
Investigation of the restoration of the weir structure within the flood plain - protection of the area close to the stilling basin /chute/. Applied for the supplement to the project, and operation.

32/ Sedimentation of the reservoir with bedload and suspended load. VÚVH, Bratislava, Bačík, Kališ. Kĺúčovská, Květoň, Topoľská, December 1991,
The interception effect of the modified retention reservoir /variant C/ has been studied. Applied for operation and maintenace of the reservoir.

33/ Water level course in the area affected by the Gabčíkovo Project, VÚVH, Bratislava, Topoľská, Bačík, December 1991
Research results aimed at the determination of water level course-discharge within the reservoir and in the headwater canal of the Gabčíkovo Project - temporary solution, Ist and IInd stage of construction
VÚVH, Bratislava, Komora J. December 1991
Solution of hydraulic problems by means of a three-dimensional model. Applied for the project.

34/ Hydraulic investigation of the overflow dyke
VÚVH, Bratislava, Hrazdílek, December 1991
By means of measurements on sectional model of the overflow weir capacitance curves of the spillway for 3 alternatives were identified, as well as coefficients of overfall and flooding, the stilling basin efficiency was verified, and possibilities of scour formation behind the structures considered.
Data were applied in the project.

35/ Hydraulic investigation of the intake structures into the Mosoni branch,
VÚVH, Bratislava, Pavelčák, Slota, September 1991
The report dealt with the hydraulic problem of the solution of the intake structure into the Mosoni branch:
a/ computation of water overfall over a low weir, scour extent in the area close to the stilling basin, design of the stilling basin
b/ verification of the weir capacity on a three-dimensional model, determination of the consumption curve of the tailrace canal, bottom deformation assesment in the area close to stilling basin-design of measurees for bottom stabilization. The work was used in the project.

36/ Hydraulic investigation of the weir realized within the Ist stage of construction
VÚVH, Bratislava, Komora J. 1991
Hydraulic problems of the weir on the bypass have been dealt with. Modifications of the stilling basin and rough chute have been solved on a model in hydraulic flume. Applied in the project.

37/ Hydraulic study of the Danbue channel damming up
VÚVH, Sumbal J., Majzún, October, 1991
Verification and more precise specification of construction processes, recommended in this task by the hydraulic model study. Application in the project and large-scale experiment.

38/ Winter regime - provisional solution
VÚVH, Sikora A., Brezinová, December 1991
Design of the winter regime and adaptation on the structure navigation cunette. Applied for operation and project.

39/ Model study of the weir in the right-side flood plain with vacuum construction.
VÚVH, Bratislva, Hrazdílek, 1991
The work deals with hydraulic data on the sectional model. Applied for the project.

40/ Effect of guiding structures in the lower part of the Hrušov reservoir on stream flow and sedimentation.
VÚVH, Bratislava, Kališ, Kľúčovská, March 1992
The effect of both guiding structures, constructed in the reservoir, was investigated. Applied for the project.

41/ Determination of water level and of velocities in various stages of construction
VÚVH, Bratislava, Sumbal J., March 1992
Computation of water level differences at the right-side dyke of the reservoir of the temporary solution, in the section of the Danube channel damming up to the connection to the reservoir dyke for respective construction stages.
Application: data for
a/ operation of the hydroelectric power project during the construction of the temporary solution
b/ construction process

42/ Hydraulic study of the weir and of the hydroelectric power plant, situated in the right-side cut-off in rkm 1851,750, on a sectional model.
VÚVH, Bratislava, Komora J. Topoľská, May 1992
The work deals with more precision the design of the weir and of the hydroelectric plant from the hydraulic point of view. Applied for the project.

43/ Report from the supplementing study on the model - effect of the construction of the 1st cut-off in stages /rkm 1851,750/ on the development of bottom deformation.
VÚVH, Bratislava, Komora J., Topoľaký, September 1992
Experimental study on reduced model in the scale M 1:70 of the development of the boulder chute in stages, and its effect on cut-off bottom deformation. Applied for the construction of the boulder chute and of the bypass.

44/ Hydraulic investigation of the navigation lock on the weir
VÚVH, Bratislava, Krčmárik, February 1992
Testing of navigation lock hydraulic parameters and determination of the lock gates manipulation during filling and emptying of the navigation lock on the model. Applied for the project and operation.

45/ Estimation of variant solutions of the hydroelectric power project on the Danube
VUT, Hálek V. September 1991
Comparison of designed alternatives of the technical solution of

the Gabčíkovo Project. As most favourable is considered the original alternative, designed in the JCP.

46/ Exploitation of gravelsand from the Hrušov reservoir during the operation of the Gabčíkovo Project at temporary solution - proposal of infiltration pits for the material.
VÚT, Hálek V. November 1992
The necessity of gravel-sand exploitation due to reservoir sedimenatation and colmatage. Localities were proposed for storage of regulated gravel-sand extraction from the reservoir with the aim to increase infiltration into existing water resources.

47/ Prognosis of groundwater levels of the Danube Island with regard to the colmatage of the Hrušov reservoir bottom when Gabčíkovo Project will be in operation.
VÚT, Hálek V., July, 1992
The task dealt with the prognosis of groundwater levels with regard to the reservoir colmatage at alternative B. On the basis of forecasted stages of colmatage, for increasing of the supplying reservoir capacity with regard to existing water resources it is suggested to realize regulated extraction of gravel-sands in the reservoir.

48/ Arrangements in the Hrušov reservoir with respect to flow within the reservoir and to groundwater flow
VÚVH, Bratislava, Lindtner and al., 1992
The effect of arrangements within the Hrušov reservoir on flowing and sedimentation in the reservoir and on groundwaters in the adjacent area has been estimated. Obtained results were incorporated for the project of guiding structures in the reservoir.

49/ Data for drawing up operating regulations for the temporary solution of Gabčíkovo Project.
VÚVH Bratislava, Lindtner, 1992
Submitted hydraulic data were used for drawing up the provisional operating regulations.

50/ Study aimed at the solution of sediment storage from the Hrušov reservoir at temporary solution on the territory of ČSFR
VÚVH, Bratislava, Kľúčovská, April, 1992
The storage of sediments, exploited from the Hrušov reservoir has been designed. The study is a basis for operation.

51/ Hydroelectric power project Gabčíkovo on the Czechoslovak territory
VÚVH, Bratislava, Brachtl I. Kališ, November 1989
The task dealt with the water level regime during flood discharges, winter operation regime, hydraulic conditions within the navigable way, and conditions of flood discharges passing in

the right-side flood plain downstream of the weir. Results were applied for the project and operation of water schemes.

52/ Study of assumed water treatment after filling the Hrušov reservoir
Bratislava, HYDROCONSULT, Štibraný, July, 1992
Measures designed for the protection of water resources. Protection by sealing, hydraulic, sorbtion and oxidation screens was proposed, as well as technical measures. Applied for the project.

53/ Complex study of water resources protection in Rusovce, Kalinkovo and Šamorín
VÚVH, Bratislava, Holubec and al. May 1992
Measures, aimed at prolongation of the route and time of water retention in the underground are proposed, as well as methods of testing these measures. Data for the project.

54/ Results and interpretation of model solutions for the study of foundation of the hydroelectric power plant, PLK and weir at Čuňovo
GEOHYCO Bratislava, May 1993
The task presents the identified tables of values of situation velocities and gradients within the network of points in the subsoil of structures and their close vicinity, in the stage under construction and after the construction of the structure.

55/ Prognosis of groundwater levels on the Danube Island under Gabčíkovo Project operation according to the variant C.
The task has dealt with the prognosis of groundwater levels on the Danube Island in the course of the realization of the variant C. Subsequently arrangements in the reservoir were recommended.

56/ Technical solutions of the reservoir on the Slovak territory, study of the technical solution of the protection of the construction pit and of the bottom sealing for foundation of structures.
Vyskoč, April, 1993
The protection of the common construction pit for realization of the structures of the IInd stage - hydroelectric power plant, weir and PK has been solved in the study under given and more precise conditions. The study will be used for project preparation.

57/ Technical solution of the reservoir on the Slovak territory - study of the technical solution of the weir and auxiliary navigation lock
Vyskoč, March, 1993
The study deals with the foundation of the weir and auxiliary navigation lock under newly specified hydraulic conditions. Applied for the project.

58/ Data for the draft of principles for operating regulations of the structures in the left-side and right-side bypass, rkm 1851,750
VÚVH, Bratislava, Komora J., Topoľský, November 1992
The conception of simplified weir solution on the bypass with a chute, aimed at more speedy execution of works.
The task is applied for the supplement of the project.

59/ The flow conditions in the Hrušov reservoir as influenced by the regulation arrangements.
VÚVH, Bratislava, Kališ, Kľúčovská, May 1992
Assessment of the interception effect of the reservoir on transported suspended load, design of regulation arrangements, and division of the discharges between PK and the old channel.
Applied as basis for the project and operation.

60/ Alternative solution of the utilization of the System of hydroelectric power projects Gabčíkovo-Nagymaros /Gabčíkovo-Nagymaros Project/
HYCO, November, 1990
The study dealt with the solution of 7 alternative technical utilizations of the Gabčíkovo-Nagymaros Project /namely A - F/.
It was used for decision making on further construction process of G/N Project.

61/ Prognosis of the Hrušov reservoir sedimentation with suspended load
VÚVH, Bratislava, Kališ and al., June 1991
The work presents results of the study of reservoir sedimentation with suspended load according to the original solution.
Distribution of velocity and discharge-travel time within the reservoir were also assessed and served as basis for the computation of sedimentation and estimation of water quality changes within the reservoir.

62/Estimation of chemical characteristics of sediments and suspended load in the Danube and in the branch systems VÚVH, Bratislava, Bíliková A., Szolgay J. June 1991
Stress was put chiefly on organic sediments in the Danube branches, where the highest content of organic micropollutants could have been expected. However, as far as the covered area is concerned, they represent only a slight percentage of the area of the reservoir bottom /infiltration area/. The results of analyses were not processes statistically. Random occurence of pollutant concentrations exceeding the admissible limits was misused by some "experts" for their disastrous prognosis of the impact of the Project on the groundwater quality. For evaluation of the effect of the variant C, the results of this work were processed in details in the report by R. Rodák, in September 1992.

63/ Prognosis of the groundwater levels under new operation conditions at the Gabčíkovo Project.
VUT Brno, Hálek, V. June 1991
Prognoses were elaborated for the Gabčíkovo Project, without the Nagymaros Project /alternative B/. Results of numeric modelling are presented in the form of maps of groundwater-table contours for various stages of colmatage of the reservoir bottom. This report is supplemented by the report by V. Hálek of July 1992

64/ Study of selfpurification processes with regard to the Gabčíkovo Project - water resources Kalinkovo - Šamorín - Dobrohošť - Gabčíkovo
VÚVH, Bratislva, Holubec and al. June 1991
The first attempt to simulate on numerical model the processes of qualitative water parameters transformation, from infiltration to the pumping wells within water resources. Results presented in the report by A. Bíliková, and J. Szolgay of June 1991 were used as input data, as well as prognoses of the water quality development in the reservoir under conditions of variant B. For conditions of variant C new prognoses were drawn up in the report by Holubec and al., 1991 and 1992

65/ Analysis of the impact of sedimentation in the Hrušov-Dunakiliti reservoir on infiltration, taking into account the quantity and quality of water.
VÚVH Bratislva, Hucko P, Mišút B. June 1991
Results of colmatage experimets performed on colmatators have been evaluated. Results were used in the report by Hálek, of July 1992

66/ Hydroelectric power project Gabčíkovo: Occurence of carcinogenic, mutagenic, teratogenic and petroleum substances in rocky formations of the Danube riparian zone.
Vodné zdroje /Water Resources/, June 1991
The survey had been carried out simultaneously with the study of A. Bíliková and J. Szolgay. In addition to sediment analyses also groundwater analyes under the branches, or in close vicinity /effect of seepage through organic sediments/, were performed. Tests of mutagenity were performed with 25 water samples using highly sensitive Salmonella strains. Neither of the tests showed positive reaction. Results were processed in the report by D. Rodák September 1992.

67/ Estimation of the water regime dynamics in the flood plain forest ecosystems
VÚV, Bratislava, Lindtner J. June 1991
Results of groundwater regime monitoring in the area of flood plain forest ecosystems are processed in the report in relation to the water level regime in the Danube channel.
The work was used for designing measures in the branch system.

68/ Study aimed at groundwater treatment, originating from the water resources Šamorín, Kalinkovo, Rusovce.
VÚVH, Bratislava, Valko et al., December 1991
Methods and technologies of groundwater treatment from the mentioned resources, with regard to forecasted water quality development. Due to favourable development of the water quality within the water resources it was not necessary to realize designed measures.

69/Study of the chemical composition and soil contamination in the Hrušov reservoir region
Research Institute of Soil Fertility /VÚPÚ/, Čurlík, December 1991
The work was oriented to obtain more data on chemical composition of soils in the reservoir bottom before the water resources. The results were used in the comprehensive report by D. Rodák, Septmeber 1992

70/ Gabčíkovo-Nagymaros Project: Feasibilities of artificial reoxidation of groundwaters in the large-scale water resources Šamorín, Kalinkovo, Gabčíkovo
Šimonič M. June, 1991
Possibilities to remove iron and manganese from groundwaters using the method of reoxidation "in situ" /system Viredox/ were studied. This method has been used in the water resource Rusovce - Ostrovné Lúčky, without taking into account the VD. Concerning the water resources Šamorín, Kalinkovo and Gabčíkovo, according to hitherto monitoring of the Gabčíkovo Project effect, this measure was not necessary.

71/ Evaluation of the Danube sediments with regard to the content and migration of contaminants in groundwaters
UK /Comenius University, Dept. of natural sciencies-groundwater/ D. Rodák, September 1992
Statistical processing of hitherto performed investigations of chemical characteristics of sedimets in the reservoir bottom, with spatial and areal evaluation. By means of the mathematical model the potential migration of contaminants into groundwaters was estimated. The results show, that the fears of hazardous speedy groundwater contamination, surpassing admissible limits, is not substantiated and justified. Results were applied for the design of optimization measures in the Hrušov reservoir.

72/ The role of the canal network of the Danube Island in contamination transfer and regulation of the groundwater level regime, UHH, Kosorín K. December 1992
The work presents the development and verification of the numeric model of pollution propagation within the canal network, and the interaction of surface and groundwater. The results will be used for optimum solution of the canal network utilization on the Danube Island.

73/ Prognosis of groundwater level decreasing on the Danube Island due to the Danube bed decreasing, according to the situation in 1990.
VUT, Hálek V. November 1991
As result of mathematic modelling, forecasting maps of groundwater-table countours on the Danube Island were worked out, at discharges in the old Danube channel of 600 and 1300 m3/s, taking into consideration the results of last measurements in 1990 and ensuing water levels in the river channel.
The maps of groundwater-table countours were used for the prognosis of the impact of Gabčíkovo Project on agricultural production and on forest ecosystems. The positive influence of branch system filling in the flood plain forest ecosystems on groundwater level increasing was not considered in these works.

74/ Estimation of the effect of Project on the Danube on water resources in the upper part of the Danube Island
VÚT Brno, Hálek, V., August 1991
The author proves, on the basis of model solution of hydrodynamic conditions of water streaming from the reservoir to the wells of water resources, that in case of deep water extractions from the wells /below 40 m/ there is no danger of groundwater quality deterioration in the adjacent water resources. The filling of reservoir will even increase the yields of those sources.

75/ Specification and estimation of basic criteria of the Gabčíkovo Project influence on the environment
STU, Etirs, Kališ, J. et al. 1992
The basic criteria of the impact of Gabčíkovo Project on the ambient and environment have been estimated by means of the point value according to positive or negative effect. A complex evaluation of the effect of the hydroelectric power project on the natural environment ensued from this estimation and analysis, and it was found as positive.

76/ Effect of industrial wastewaters from the concern ISTROCHEM on other wastewaters prior putting into operation the wastewater treatment plant.
Hydroconsult, Bratislava, Marek, P. et al. June 1992
The study dealt with the effect of decisive producers of sewage and industrial wastewaters of the agglomeration Bratislava on the Malý Danube water, with regard to irrigation, and on the Danube water and consequently the water quality in the Hrušov reservoir. The study was used for the design of final wastewater treatment from ISTROCHEM in the biological unit of the wastewater treatment plant in SLOVNAFT.

77/ Prognosis of groundwater quality after filling of the Hrušov reservoir - Variant C
VÚVH, Bratislava, Holubec et. al., November 1991
In solving this task the results of solutions for the variant B were accepted, including the applied methodic processes. Simultaneously the results of water quality monitoring over the summer water level increase in the Danube were incorporated into

the solution. In addition, also results of works achieved at colmatators were included into the solution, contributing to the more precise computations or the processes of water quality changes. The results were applied for the design of optimization measures within the reservoir and for design of water quality monitoring.

78/ Influence of the flood of August 1991 on the groundwater quality within the riparian zone of the Danube.
SKOV, Klaučo, S.,1992
The expert's account has been revaluating the effect of higher water stages in the Danube on the content of so called oxidation-reduction sensitive components and characteristics of the groundwater in the area of Dobrohošť. The work confirmed the existence of the natural chemically instable zone within the riparian plains of the Danube also without the existence of the hydroelectric power project. The study has also confirmed the opinion, that potential construction of a large-scale water resource on this territory would require in any case treatment of water /nitrates, manganese, iron/, also if no hydroelectric power project would be constructed.

79/ Changes of pedagenetic processes and their impact on soil development and on plant production in the region of the Project.
PEDON NItra - J. Hraško at all., May 1992
By means of available information, existing prognosis and on the basis of realized experiments the justification of objections against further construction of the G/N Project has been confronted and feasible methods of problems solution are devised in case, when the equilibrium state of soil water regime would be disturbed. The results are used for monitoring of the effect of the Gabčíkovo Project on soil moisture regime and on agricultural production.

80/ Re-evaluation of the effect of Gabčíkovo Project on forests according to the prognosis of groundwater level at the discharge in the old Danube channel 600 m3/s and 1300 m3/s
VÚLH, July 1991
Research tasks worked out for the variant B, dealing with the influence of forecasted groundwater levels at discharges 600 and 1300 m3/s in the old Danube channel, on the ecology and production capacity of the flood plain forest ecosystems. The results of this study were applied for designing measures for achieving optimization of the water level regime in the area of the branch system and in designing monitoring of forest ecosystems.

81/ Gabčíkovo-Nagymaros Project: Putting into operation the Gabčíkovo Project by means of temporary solution. Re-evaluation of research tasks, solved within the scope of "Measures of the Ministry of Forestry and Water Management of the Slovak Republic" /MLVH SR/
Hálek V. May 1992
Evaluation of the applicability of research tasks, solved within

the scope of "Measures MLVH SR aimed at the minimalization of the effect of Gabčíkovo Project on the environment" /variant B/, for the designing of the "Temporary solution ..." /Variant C/. The work was used for complementing studies and design works for the Variant C.

82/ Final Report A17: Assessment of groundwater supplies on Žitný Ostrov /Danube Island/, utilizable for drinking water supply, amounting to about 18,0 m3/s, under Gabčíkovo Project operation. It was proved, that due to the Danube bottom degradation the infiltration of water from the Danube Island decreased, and utilizable groundwater stores were reduced by about 2,5 m3/s, as compared with the 1970. After the Gabčíkovo reservoir filling, it is possible to achieve increasing of stores to the stage, considered in the last definition of the commission for classification of stores /KKZ/.
The results of the report were an impulse to the Ministry of Environment of the Slovak Republic to re-evaluate the groundwater stores on the Danube Island /without the effect of the Gabčíkovo Project/. The re-evaluation was carried out by authors: Šubová, Mucha, Klaučo, however the report was not approved yet, and the results were not published.

83/ Effect of the optimization of the Hrušov reservoir on the groundwater quality of water resources Rusovce, Kalinkovo and Šamorín
VÚVH, Bratislva, Holubec et al. November 1992
Brief review and critical evaluation of hitherto works dealing with prognosis of the Gabčíkovo Project impact on groundwater quality, statistical assessment of the hitherto groundwater quality development in the area Dobrohošť on the basis of data of the Water Research Institute, including data of the summer 1991. Emphasis was given to the prognosis of groundwatr quality changes in used water resources close to the Hrušov reservoir, considering the optimization measures. Realized measures within the reservoir have brought a partial shift of expected values of water quality parameters towards lower values.

84/ Groundwater quality development in the area of the water resource Gabčíkovo
SKOV, Klaučo S., March 1993
Increased content of sulphates was identified in the gorundwater close to the Gabčíkovo water resource. Some"experts" tried to blame the effect of sealing vat grouting during the foundation of the hydroelectric power plant. By means of processing a data base of results of long-term observations in the surrounding of the hydroelectric power plant and of the water resource it was identified, that the suphate contamination originated from a long-term abandonned, wild dumping site of agrochemicals, the effect of which was demonstrated on the south-west margin of Gabčíkovo already prior to the construction of the hydroelectric power plant and of the water resource /during survey works for construction of an accomodation centre in 1976 a sulphate content of about 800 - 1000 mgl-1 was identified in groundwaters/.

85/ Analysis and methods of verification of gorundwater quality prognoses with regard to oxidation-reduction processed UK-Dept.of Natural Sciences-groundwater, Mucha, I. February, 1993
Draft of the methodology for evaluation of the development of groundwater quality by means of monitoring the trend of development prior to, and after the reservoir filling. The work will be used for evaluation of the results of monitoring of groundwater quality in the ambient of the Project.

86/ Methodological proceeding of a pilot-plant experiment aimed at completion of the water treatment technology in the water resource Rusovce-Ostrovné Lúčky
VÚVH, Bratislva, Valko M., May 1993
Methodology for realization of a pilot-plant experiment for removal of specific organic substances from water of the water resource Rusovce-Ostrovné Lúčky by means of ozonization and filtration on active carbo. It was not possible to realize the experiment, since after reservoir filling conditions for its realization in groundwaters of the mentionned water resource were not availbale /no constant or excessive occurence of substances, which should have been removed during the experiment, was identified/.

87/ System of hydroelectric power projects Gabčíkovo-Nagymaros: Study of assumed water treatment after the reservoir filling
VÚVH, Bratislava, Štibraný
Due to the construction of the Hrušov reservoir, and operation of the hydroelectric power plant Gabčíkovo /variant C/ the surface water infiltration line, occuring from the Danube into the Danube Island, got closer to existing water resources Šamorín, Kalinkovo, Rusovce. Measures for protection of those water resources are proposed. The results of monitoring show a positive development of groundwater quality in these water resources. The study serves as basis for potential need to realize the designed protection measures.

88/ The course of water levels within the impact of the Gabčíkovo Project
VÚVH, December 1991
Results of the model study concerning water level course within the reservoir for the Ist and IInd stage of construction of the variant C, taking into consideration the distribution of discharges between the Little Danube, Mosoni Danube, and the old river channel. The results were used for designing the variant C and also for drawing up of operating regulations.

89/ Verification /testing/ of the measures in situ and of the sorbtion screens
VÚVH, Bratislava, Holubec, January 1993
Preparatory measures for protection of water resources developed in the regions of the impact of the Gabčíkovo Project. Two basic measures were designed as perspective solutions:
- protection by means of oxidation screens for respective wells
- protection by means of sorbtion screens. The large-scale field experiment has not been realized, since conditions for its executing did occur neither at the water resource Pod.Biskupice, nor at Kalinkovo.

Annex 37

G/N Project, The Temporary Solution on the Territory of the CSFR - Slovakia

Gabčíkovo – Nagymaros Project

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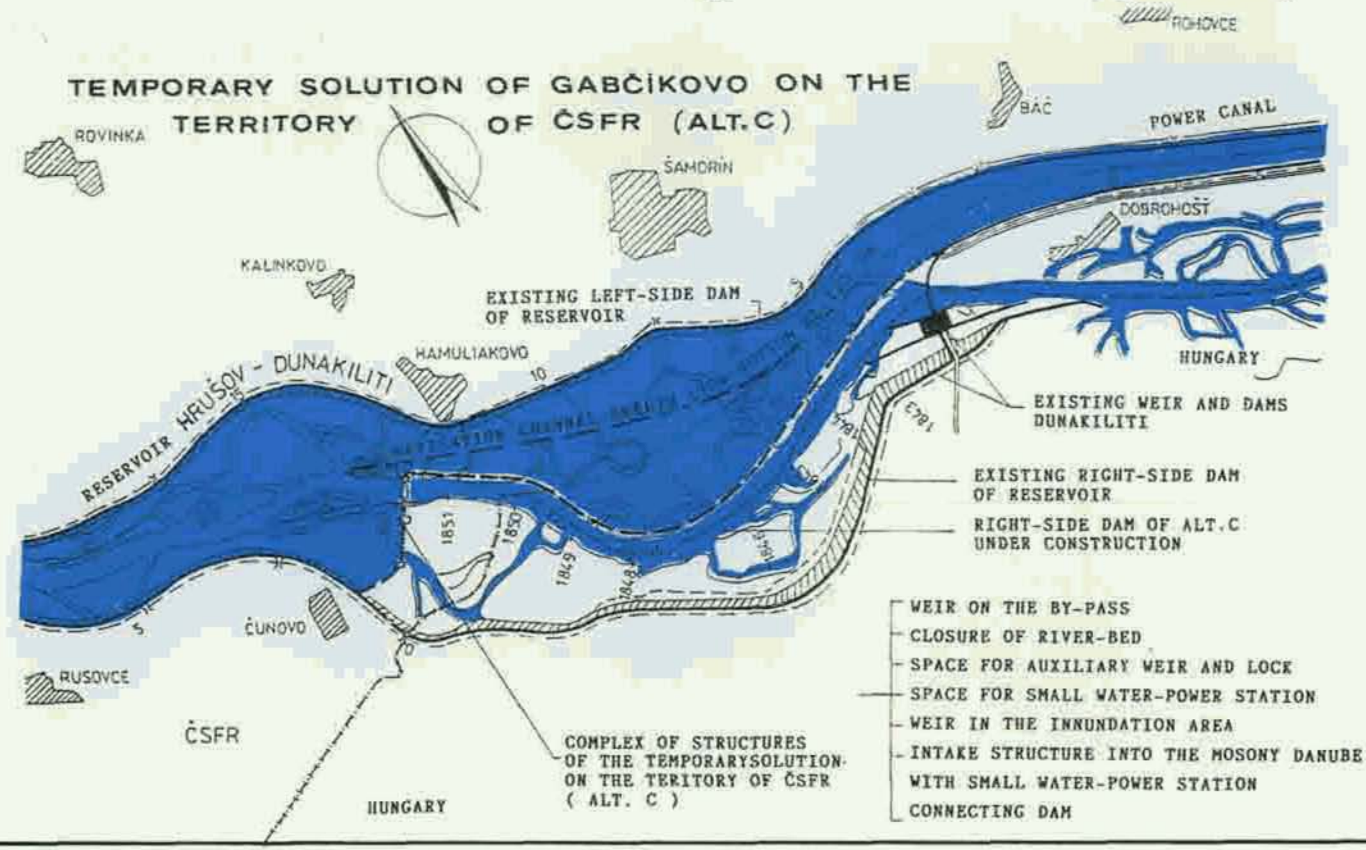
THE TEMPORARY SOLUTION ON THE TERRITORY OF THE ČSFR – SLOVAKIA

Lay-out of the Reservoir in the Original and Temporary Solutions



Reasons for the Necessity to Complete Gabčíkovo

Damage Caused by Postponing of Operation: In the initial phase of implementation of the investment, the event of its abandonment means only the loss of the wasted financial resources, especially if there exists the possibility, to secure the aim of the investment in another suitable way. At an advanced stage of construction, the national economy counts on the gain of appropriate capacities and benefits, while the possibility of implementation of appropriate equivalent alternative solutions is not only practically limited by technical and time considerations, but is is also economically handicapped, because of the costs already spent in the implemention of the original solution.

The effectiveness of completing the Project increases in the course of construction, and just before it is put into operation is many times higher, than the originally determined effectiveness of the whole investment. The damage from stopping construction at this stage is therefore given by the value of the lost profit, increased by the resulting extra costs. In the given case, the value of the electricity not gained, in the quantity of about 2,000 million kWh per year (from this, a half is of peak-quality), alone represents a loss of about 6,000 million Kčs per year. This damage can be reduced to about a third of the amount mentioned, by bringing at least the Gabčíkovo stage into operation. The total economic damages in the case of abandonment of the GNP and implementation of alternative solutions, would reach over 100,000 million Austrian schillings (that represents 10,000 million USD) on the side of ČSFR alone. This damage is estimated as the present value of the stream of costs involveded by this decision, but practically no benefits. It is unquestionable, that such a solution is absolutely unacceptable for Czecho-Slovakia.

Possibility of Reaching a Common Solution Acceptable to Both Sides: The offer of a common completion of Gabčíkovo, officially submitted by the Hungarian side in December 1989, was promptly withdrawn in January 1990, after the study work on the temporary solution in the ČSFR was stopped. In an attempt to preserve good neighbourly relations, the ČSFR used every opportunity for negotiations with the aim to work and reviewed on its side the potential environmental impacts of the GNP. On the other hand, the party violating the Treaty (the validity of which it did not dispute) interrupted the activity in the Joint Expert Group, so that communication on the professional level was completely stopped and there was no possibility of jointly checking unfounded accusations and solving the disputed problems. The offer of a joint request to the European Community for help in the frame of the PHARE programme, to study the most serious of the possible impacts on stocks of underground water, was rejected by the Hungarian side in October, 1990. On the basis of all the evaluations carried out SOFAR, and taking into account all possibilities, including the proposed abandonment of the Project, the governments of the ČSFR and the Slovak Republic decided to continue the preparation of the temporary solution within the territory of the ČSFR, in January 1991.

The government delegations met after long delay in April 1991, nearly two years after the unilateral abandonment of work. After violating the obligation to notify and to consult before every unilateral step, the Hungarian side also twice broke the „obligation to negotiate with the aim of reaching a solution to the dispute", which is prescribed by the international customary law:

- by a resolution of ist parliament, the Hungarian government was authorized only to negotiate the abrogation of the Treaty, and the restoration of the „original state of the territory",

- by binding negotiating experts to completely predetermined ultimatum like condition, to stop works on fulfillment of the Treaty also on the side of the ČSFR as well.

Under these limitations, the second negotiation between government delegations in July 1991 could contribute nothing and indeed it did contribute nothing to the solving of the dispute. Therefore, at the end of July, the governments of the Slovak Republic and the ČSFR decided to implement the temporary solution, the construction of which started in November 1991.

Possibilities of Defence Against Non-fulfillment of the Treaty by One Party: The party fulfilling an international treaty has the following possibilities of defence:

- to also interrupt fulfillment of the Treaty itself, but this would only fulfill the aim of the partner;
- to appeal to international arbitration, which is in the given case impossible, without the cooperation of the partner, while the partner gave abundant evidence of its unwillingness to cooperate;
- retaliatory provision in other economic or political areas, which would only sever good neighbourly relations, without lowering the damages;
- to undertake defensive counter-measures, which can also overreach the framework of the valid Treaty, if their purpose is the reduction of the resulting damage, by at least partial fulfillment of the aims of the Treaty. Since the counter-measures have also to perform pressure on the partner to fulfill its obli gations, or to provide full compensation of the damages, they must have a temporary character. At the same time, they must not have the character of punishment, i.e. they must not cause significant harm to the partner's citizens or environment, or violate the principles of humanity.

Evaluation of the Admissibility of the Temporary Solution: The Hungarian side did not allow the use of the Dunakiliti weir and the peripheral reservoir dams on the territory of Hungary, and was not willing to complete its share of work on the Gabčíkovo part of Project. The basis of the temporary alternative solution is, to realise structures entirely on the territory of the ČSFR, which would reduce the surface of the reservoir by one third and limit it to the territory of the ČSFR, and replace the function of the Dunakiliti weir, allowing the filling of the reservoir and the power canal constructed, thus enabling completion and operation of the Gabčíkovo part of the Project.

The Czecho-Slovak side was willing to abandon the implementation of the temporary solution, if the Hungarian side appeared willing to fulfill its obligations, at least for the Gabčíkovo part, and secure the damming of the Danube channel in autumn 1991. At present, with the first stage of works on the temporary solution practically completed, the temporary solution can be withdrawn from operation, as soon as the partner returns to fulfillment of the Treaty conditions. Full compensation for damages would – in the given case – require fulfillment of the aims of the Treaty, which cannot be achieved in another way.

Environmental Effects of the Temporary Solution to the Operation of Gabčíkovo: The environmental effects of the original solution of Gabčíkovo influence the Czecho-Slovak side to an essentially higher degree than the Hungarian side, since two thirds of the area of the reservoir are on the territory of the ČSFR, and especially because the whole canal is situated on the protected, agriculturally exploited land. The territory occupied by the GNP can no longer be returned to its original productive state. There is no place, to dispose of millions of cubic metres of construction waste without further damage to the environment, the natural material to fill up the canal is lacking, and also top-soil needed to fertilize the reclaimed land is no longer available.

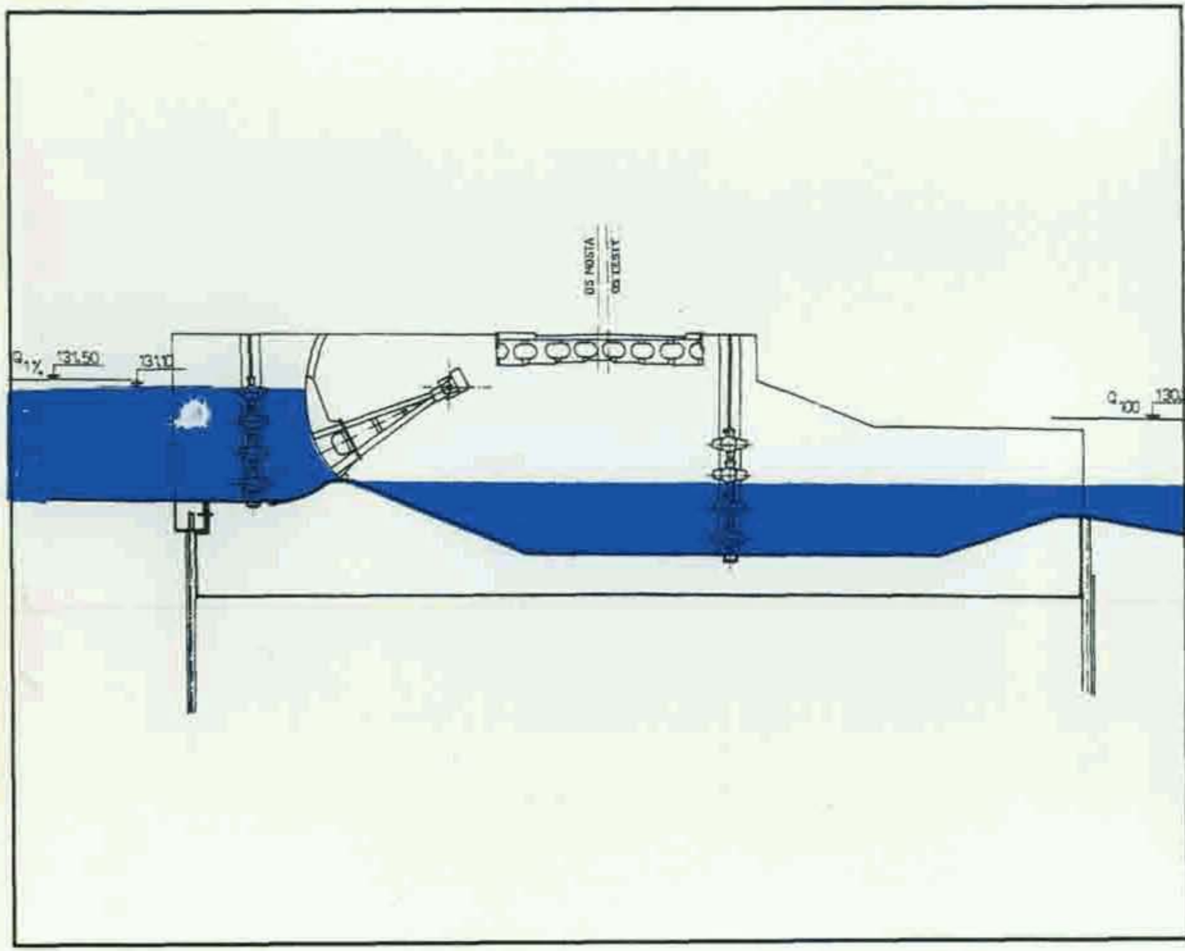
The side effects of the temporary solution will be either equal to those in the original Treaty solution and in this case it is necessary to consider them as mutually agreed-on in the framework of the 1977 Treaty, or they have more moderate effects on the Hungarian side, so that they cannot be considered as a significant harm, in the sense of international law, or a violation of humanitarian principles in any way.

Since the Hungarian unilateral act, declaring the annulment of the 1977 Treaty has not been accepted by the ČSFR, it is legally inactive and the Treaty 1977 is still fully valid.

The environmental effects of the temporary solution may therefore be recapitulated as follows:

- The diversion of the navigational channel of the Danube onto the territory of the ČSFR is in harmony with the Treaty, and in the sense of its article 22, does not change the state boundary, neither does it interfere with the territorial integrity of Hungary in any way.
- The transfer of water from the Danube is agreed in the Treaty, it is carried out to mutual advantage, although the share of the costs and of the energy produced have changed as a result of the decision of the Hungarian side.
- All provisions of the Treaty for the operation of the Project and for the allocation of the Danube flow will be respected, or even exceeded in favour of the natural environment.
- By the impoundment of the water-level, the harmful process of systematic erosion of the bed of the Danube and deepening of the surface of the underground water will be definitively stopped.
- At the same time, it will secure the supply of water to the Mosony branch of the Danube, improving significantly the present state of nature on Hungarian territory.
- The impoundment of water in the reservoir will increase the feeding of underground water by seepage from the reservoir. Taking into account the hydrogeological configuration of the underground layers, the deeper aquifers will be fed by seepage from the more distant upstream part of the reservoir near Bratislava, while seepage from the lower part of the reservoir will feed and dilute the upper, at present very polluted layer of undeground water.
- The constructed intake structures will enable the optimal distribution of water to the old channel and the system of dead branches, and – if necessary – also the creation of artificial floods.
- Before and during operation, systematic monitoring is being done, by means of a sofisticated system of observation structures to evaluate the level and the quality of the underground water and many other values are being measured and evaluated around all structures. Any aberration will be detected in time, and if necessary, appropriate measures will be taken.

As a result of the facts mentioned, putting Gabčíkovo into operation not only secures the fulfillment of the aims of the investment, to the advantage of both sides, but the side effects will have mainly positive influence on the environment of both Czecho-Slovak and Hungarian territory. Therefore, these counter-measures have to be considered as appropriate and at the same time also environmentally desirable.



Section of the Bypass Weir

List of Structures of the Temporary Solution:

1 – Leteral dam, length: 11 km
2 – Bypass weir: 4 bays 18.0 × 5.1 m
3 – Dammed channel of the Danube
Temporary protection for additional structures of the 2nd stage:
4 – * Dam – 3 bays
5 – * Auxilliary ship-lock
6 – * Hydro electric power station
7 – Dam in the inundation: 20 bays 24.0 × 3.6 m
8 – Intake structure to the Mosony branch
9 – Connecting dam
10 – Navigational canal from the Danube into the power canal

View of the Structures of the Temporary Solution

Section of the weir in the inundation

Quantity of the main structural works:

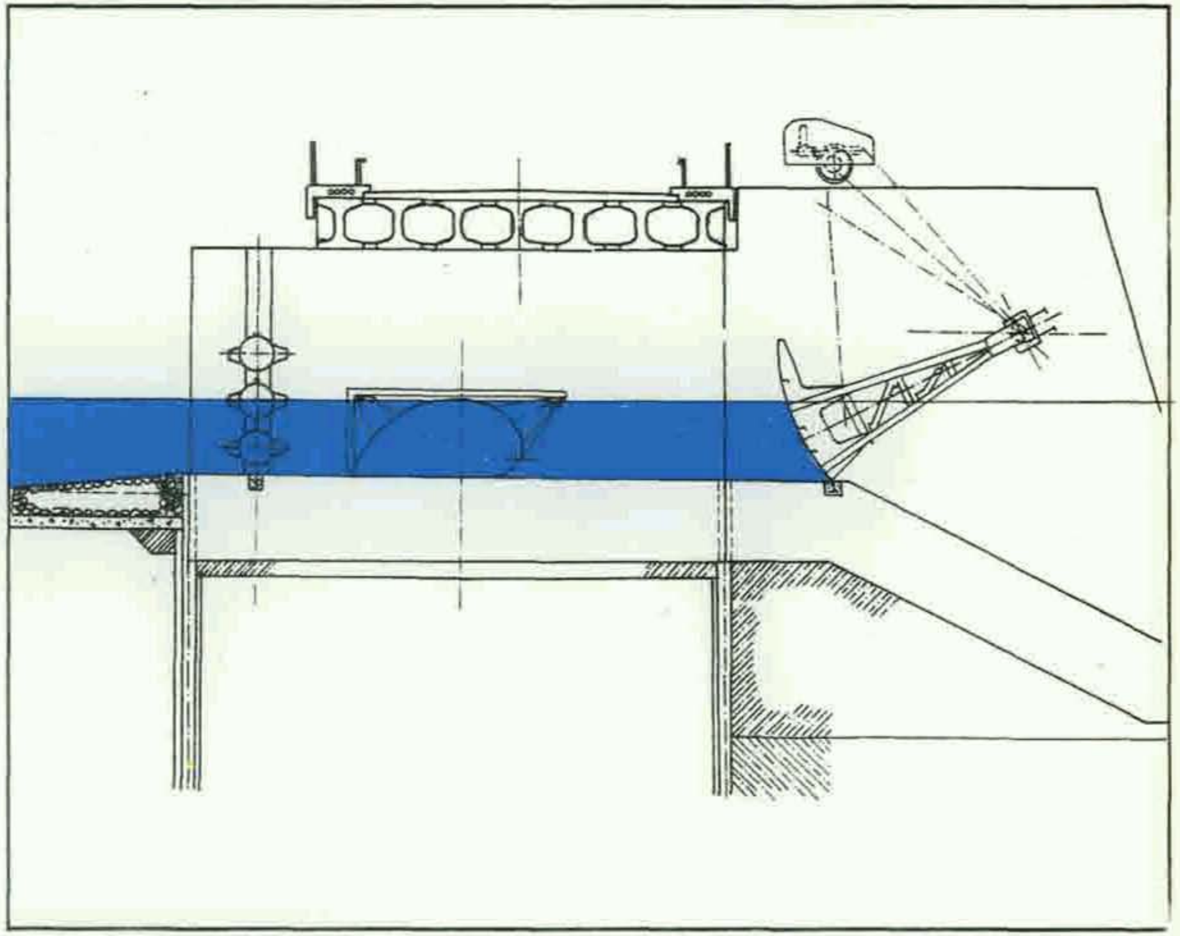
Excavation (incl. soil)	11,2 mil. m^3
Compacted fill	9,5 mil. m^3
Foild and geotextiles	3,1 mil. m^2
Concrete, incl. reinforced	0,17 mil. m^3
Underground walls	0,19 mil. m^3

Dates:

Beginning of work	Nov. 1991
Diversion of channel (1st stage)	Nov. 1992
Operation at maximum level	Dec. 1993
End of construction	1995

Costs – benefits (billions of Kčs):

Cost of the 1st stage	3,5
Cost of the 2nd stage	5,0
Value of annual production of energy	4,0–6,0



Proposal for a Definitive Solution of the Old Channel of the Danube:

The 1977 Treaty supposed the discharge of a biological flow of 50 m^3s^{-1} into the old channel. The empty strongly deepened channel (almost 2 m deeper than in 1977) would produce a harmful drainage effect. During periods of low flow in the Danube, the underground water-level in the surrounding areas would beunfavourably lowered. Therefore the possibility was studied of reducing this effect by construction of low dams/weirs in the old channel, which would maintain a level corresponding to the natural flow of about 1350 m^3s^{-1}, by a biological flow raised for example to 350 m^3s^{-1}. According to recommendations of biologists the weirs would be completed with bypasses allowing the migration of fish. However, even the increased water-level would still not reach the interface between the underlying gravel and the soil layer of the meadow forests. Therefore, it previewed that with periodical raising of the biological flow to about 1300 m^3s^{-1}, the accumulated sediments on the bottom would be washed away, the root systems of trees would be reached, and the water-level in the channel would be joined with the system of interconnected water-levels of the dead branches.

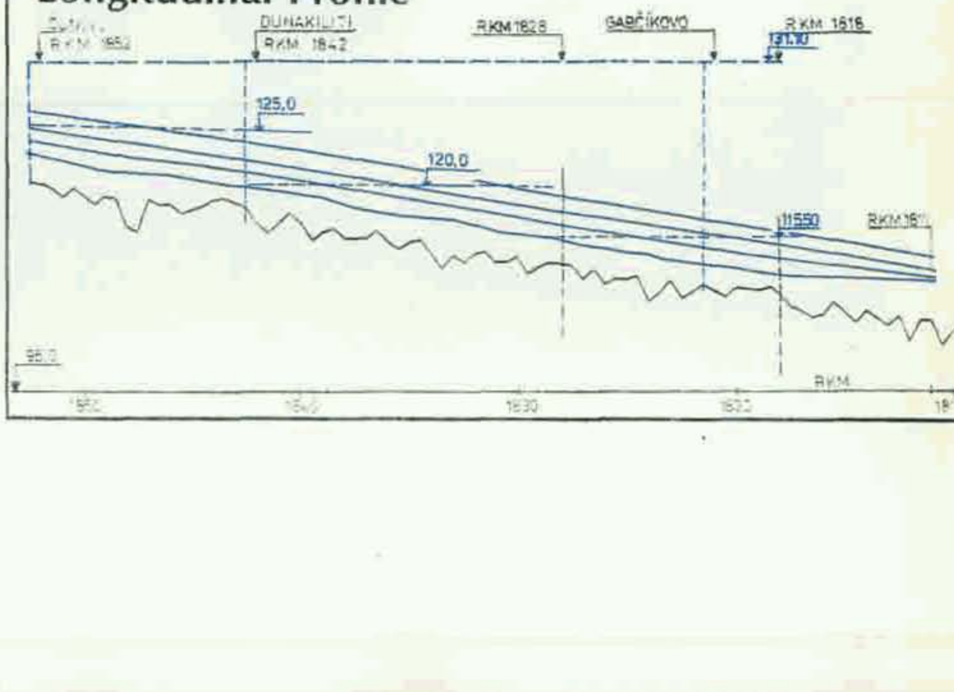
The latest results of research, carried out in cooperation with Danish and Dutch companies (in the frame of the PHARE program), shows the considerable importance of a pulsation of the water-level in the old channel, favourably influencing the quality of the neighbouring underground water. In such a solution the number of dams is lower, they are completed with weirs, while the heads created may be used for the production of electric energy.

The construction of low dams in the old channel is desirable in the interests of creating optimal conditions for the ecosystem of the inland delta on both sides of the Danube and it should be carried out only on the basis of bilateral agreements. One of the possible solutions considers the use of the Dunakiliti weir and previews the construction of two further dams/weirs, about in river kilometres 1821 and 1831. The impounded water-levels would secure the watering of the root systems of the meadow forests and connection of the old channel with the system of dead branches. Variation of the water-level, possible in the period of low flows and the periodical washing out may be secured by occasional release of these small reservoirs.

Situation

Independant areas of the flood-plain with adjustable water-level, with water-supply from they reservoir thtough the intake-structure Dobrohošť.

Longitudinal Profile



The Gabčíkovo – Nagymaros Project

Publisher – contact address: Vodohospodárska výstavba – M. Liška MSc (Eng.), PhD(Econ.), Nám. SNP 13, 812 63 Bratislava, tel.: 07/552 40, 575 35, fax: 07/507 89

Part GABČÍKOVO

Solution according to the 1977 treaty

Lay-out of the GNP According to the 1977 Treaty

Purpose of the Project
Flood Protection

Aim: To prevent flood-catastrophes as of the years 1954 and 1965.
Means: In the section of the canal: to reduce the peak-flow in the old channel and the hydraulic charge on the existing 2 levees and their subsoil by the forking of flood peaks. Downstream of Palkovičovo: to raise the flow capacity by deepening the channel. In the area of the Nagymaros reservoir: to increase security by reconstruction of embankments and by sealing their relatively shallow subsoil with underground walls. Securing the disposal of excess by pumping stations.

Improving the Navigational Parameters of the Danube Water Way

Aim: To secure the parameters of the Danube water way recommended by the Danube Commission – a navigable channel 180 m wide and 3.5 m deep.
Means: To transfer the navigable channel into the canal in the Gabčíkovo section (gravel fords). To flood the gravel fords and stone thesholds in the Nagymaros section by impounding the water-level. To deepen the channel in the transition section, downstream of Palkovičovo as well.

Utilisation of the Renewable Hydraulic Energy of the Danube for Environmentally Friendly Production of Electricity

Aim: To gain for the benefit of both countries a permanent source of clean electricity by utilisation of the hydro-energetic potential of the Danube and to double the utilisation of hydraulic energy resources of Slovakia.
Means: Construction of two hydroelectric power stations – Gabčíkovo HPS with an installed capacity of 720 MW, and an annual production of about 3,0 billion KWh (two thirds of peak quality), and Nagymaros HSP with an installed capacity of 158 MW and an annual production of about 1,0 billion KWh. Together with the existing HSP, coverage of about 20 % of the consumption of the Slovak Republic will be secured from domestic, renewableble and environmentally friendly sources.

Creation of Conditions for Conservation of the Ecosystem of the Inland Delta of the Danube

Aim: The conservation of river-side forests and side-arms of the Danube and their protection before drying-out. To prevent further harmful effects of the constant and accelerating deepening of the Danube river-bed – as the decline of the water-level of low flows and of the adjacent ground water-level.
Means: Prevention of the process of erosion of the bed by impounding the water-level and slowing-down the current. Construction of small electric power stations watering the old channel of the Danube and its branches and intake structures allowing the creation of artificial floods of the inland delta of the Danube in the case of need. Slowing down the runoff from the old river-channel by construction of low dams.

Side Effects of the GNP

On stocks of Underground water: The increased amount of water seeping from the end of the reservoir, downstream of Bratislava into the deeper aquifers used for fresh-water supply, and from the middle and lower parts of the reservoir into the upper, at present very polluted layer of ground-water, diluting it whith clean, naturally filtrated water. The penetration of seepage-water directly to the deeper aquifers and the displacement of organic matter from the fresh sediments is highly improbable, taking into account the local conditions (permeability of the layers is ten times greater in a horizontal, than in a vertical direction, etc.).

On the Level of the Underground water: In the section of the Gabčíkovo reservoir, there will be a favourable increase of the very low surface of the underground waters, an increase in the inclination of their surface, an in the dynamics of their movement and renewal. In the section of the power canal, it is also possible to influence the level of the underground water, by regulation of the water level in the seepage canals. In the section of the tailrace canal, there will be a decline of the level of the underground water, the influence of which may be balanced by the dense network of irrigation canals. In the given climatic conditions, irrigation is a condition of the intensification of agricultural production on surfaces not influenced by the GNP. In the Nagymaros section, the seepage canals and pumping stations exclude an unfavourable raising of the underground water-level near to the surface and they create conditions for the desalination of soils and irrigation.

On Water Ways and Ports: The gravel fords on the Rajka – Gönüyi section, as the greatest obstacles to navigation, are bypassed by the canal. The creation of the Gabčíkovo reservoir allows access and use of the Bratislava harbour throughout the year and will stop erosion processes endangering the navigation. The Nagymaros reservoir secures good conditions for navigation on the Danube upstream of the dam and deep into its tributaries.

On Nature and the Ecosystem of the Inland Delta of the Danube: The decline of the underground water-level will be stopped and the possibility of supplying irrigation-water in the required quantity will be secured throughout the whole year. As a definitive solution, construction of barrages or low dams is considered, in the old channel of the Danube, to secure together with increased biological flow, also permanently raised water-levels, as well as the possibility of their cyclic variation. The permanent addition of water to the drying Mosony branch will enable gradual renaturalisation of its channel and the surroundings.

On Agricultural Production: The occupation of 3900 hectares of agricultural land, especially for the canal, is outweighed by the protection of 2000 hectares of land excluded from the inundated area, and by the reclamation of a further 3000 hectares of unproductive land using the topsoil teken from the occupied arable land. In the whole area, favourable conditions will be created for the intensification of agricultural production with the help of regulation of the underground water level and by supplying pure water for additional irrigation.

On Forestry and Wildlife: The occupation of 3400 hectares of forest land and its clearance is a price, which had to be paid for the many important benefits and side effects of the GNP. Optimum conditions will be created for river-side forests on a 32 km long stretch of the Danube along the canal, which are at present threatened by gradual drying-out. Recommendations for improving the living conditions of wildlife will be fully respected.

On Fisheries and Sport-fishing: The water regime in the reservoir and canals will be changed. Therefore, new fish-ponds were constructed from the budget of the Project. Optimal conditions, better than at present, will be created in the old channel, the dead branches and the Mosony branch of the Danube. The required possibility for the migration of fish between the dead branches and the Danube, or along the old channel, will be be secured after the construction of small dams and/or weirs.

On the Population: During the construction, up to 5,000, mostly local people found well payed employment, what led to a modernisation of villages in the region. The construction of two recreational and sports centres with a capacity for about 100,000 daily visitors is planned. At least 5,000 permanent jobs, and the possibility of selling domestic products will thus be created. These recreational centres, with the possibility of cultivating cycling and water sports are extraordinarily necessary in the surroundings of Bratislava, and will also serve a wider region, as well as foreign tourists. The GNP with its apurtenent structures also represent the basic conditions for future economic development of the region, because it includes definitive protection against floods by both external and internal (rain and seepage) waters.

Section of the Hydro-electric Power Station

Parameters of Main Structures:

Canal:

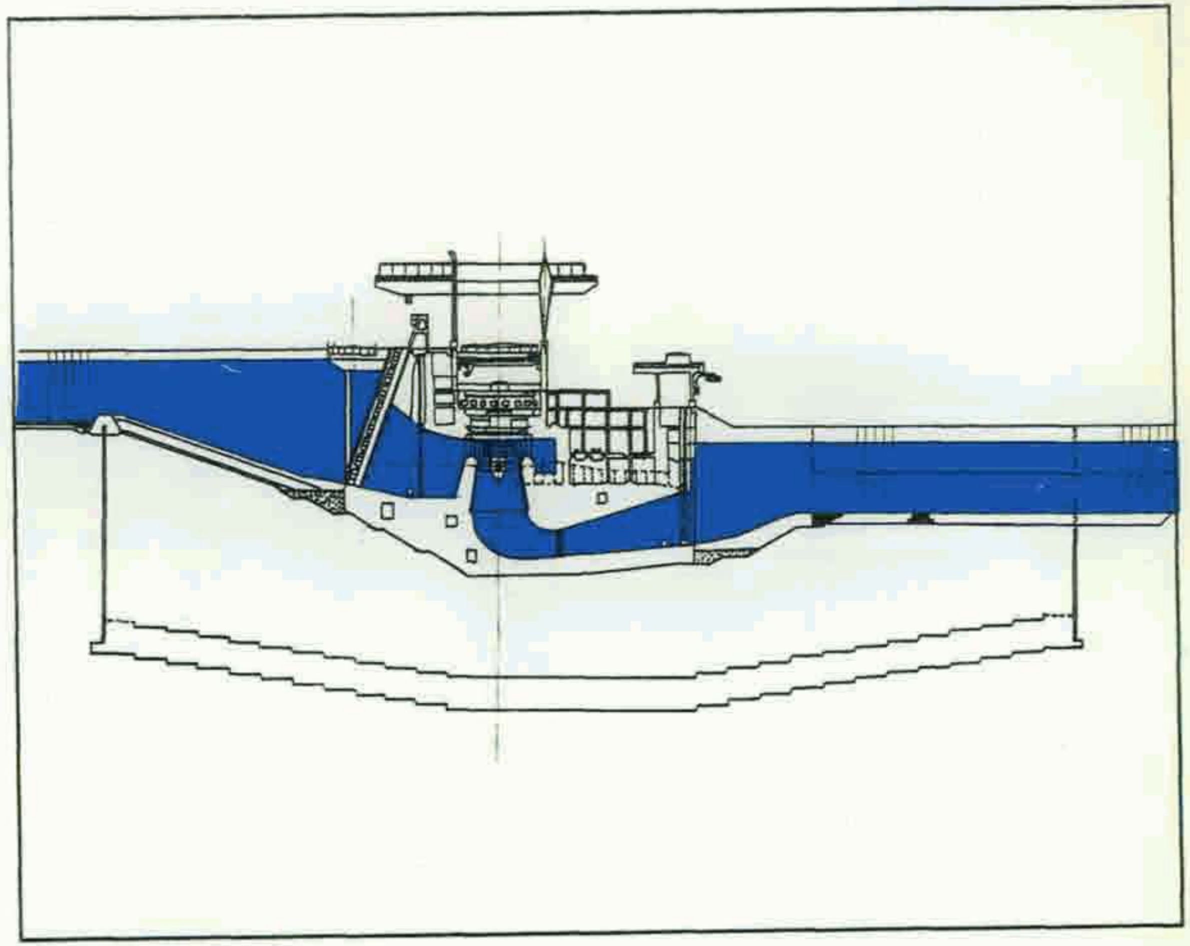
Length:	17 + 8 = 25 km
Width of power canal:	280 to 750 m
Width of tailrace canal:	250 to 280 m
Depth of the power canal:	6 to 13 m
Capacity of the canal:	5,300 m^3s^{-1}

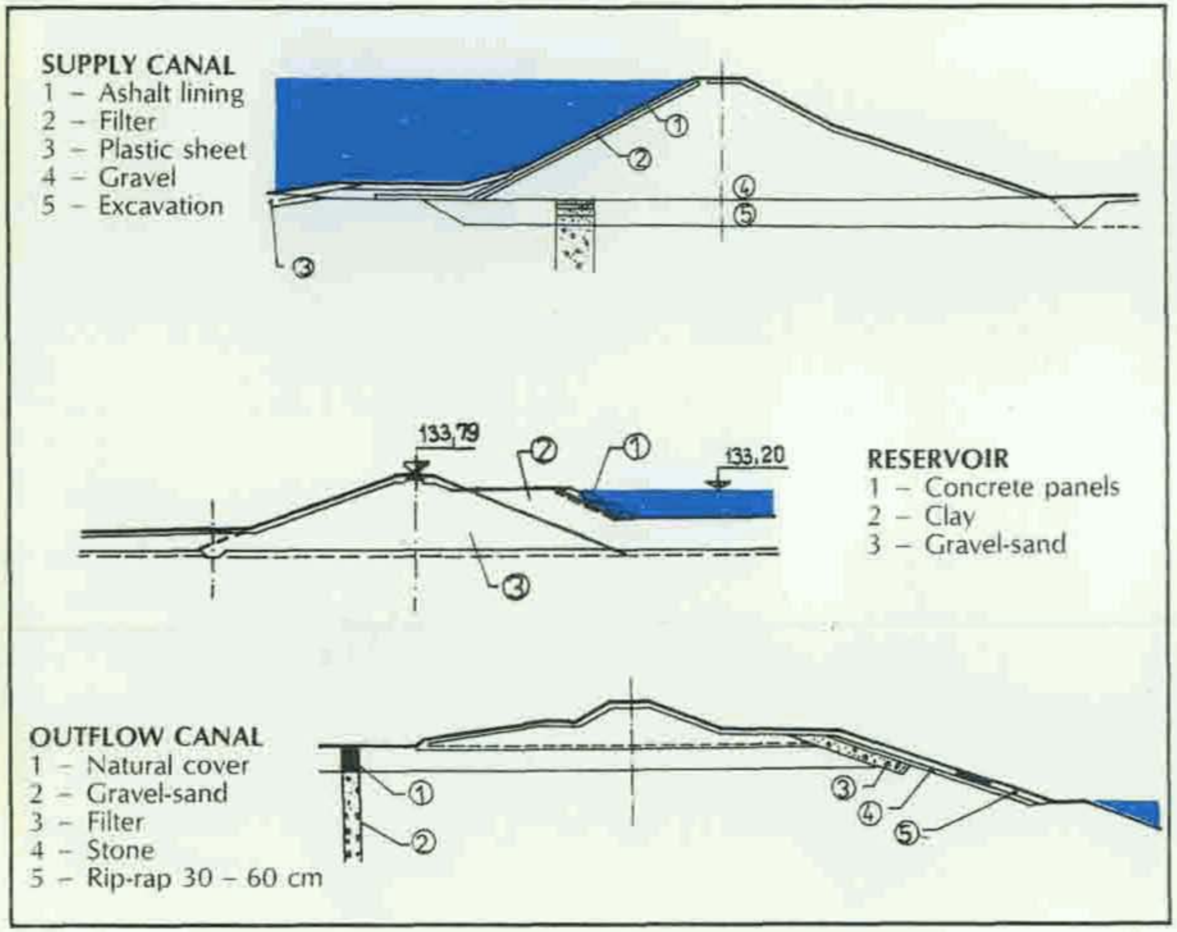
Two navigation locks:

Length:	275 m
Width:	34 m
Time of emptying or filling:	15 min.

Gabčíkovo Hydro-electric Power Station:

Gross head:	16.0–21.5 m
Capacity:	4000–5200 m^3s^{-1}
8 Kaplan turbines:	9200 mm
Installed capacity:	720 MW





Typical Sections of Embankments – or Dams Reservoir:

Power canal:

Quantity of Main Structural Works (ČSFR and Hungary):

Excavation (inc. soil)	46.5 mill. m^3
Excavation by dredging	51.7 mill. m^3
Compacted embankments	54.8 mill. m^3
Concrete and reinforced concr.	1.6 mill. m^3
Concrete/asphalt lining	3.1 mill. m^2

Tailrace canal:

Dates of Implementation:

Signing of the Treaty:	1977
Beginning works at Gabčíkovo:	1978
Beginning constr. at Dunakiliti:	1986
Beginning constr. at Nagymaros:	1988
Beginning of operation (planned):	July '90
Beginning of operation (actual):	Nov. '92

Economic Characteristics of the Project:

It was decided in the Treaty of 1977, that in spite of the natural allocation of primary hydro-energetic potential by 55:45 percent in favour of Czecho-Slovakia, the investment costs would be divided in the proportion of 50:50 percent, and the produced electric energy in the same proportions. Further benefits were considered as „national" in character, without any compensation of differencies. Responsibility for the environmental consequences is common. Common obligation to minimize the ainevitable negative impacts is also anchored in the treaty. Originally, the elaboration of a common economic evaluation was supposed, and methodology for it was already prepared. However, the implementation of this intention was abandoned, therefore the compensation for different intercalar interest charges in the course of construction, caused by considerable differences in the times of implementation of structures allocated between the treaty-partners, was not taken into account.

The last complete evaluation of the economic effectiveness of the Czecho-Slovak parts of the investment was elaborated in 1980. At an average price of mostly peak energy of about 340 Kčs/MWh, the income for electricity production made 639 million Kčs per year, what represented about 38 % of the total benefits, estimated at 1688 million Kčs per year. At investment cost of 13,800 million Kčs, or including interest (8 %) 18,700 million Kčs and operating costs of 120 million Kčs/y, the internal rate of return of the investment was IRR = 6.3 % at a repayment time of about 12 years.

In 1980, the price of energy used, was derived from the subsidized price of fuel, incompletely calculated costs for safety and pollution control of the coal-fired thermal and nuclear power stations. Therefore, in this assessment, the share of benefits accruing from energy production was significantly underestimated. The price of energy did not cover the total annual costs including the annuity of the investment reaching about 537 Kčs/MWh. Since 1980 the cost of structural works significantly increased, which was also reflected in the value of the non-energetic benefits (accruing from flood-protection of the territory, from improving navigational conditions, from supplies of water and gravel, from recreational and sporting use, from improvement of the local infrastructure and from the development influence on the region). Nevertheless, the price of electric energy, following the prices on the European market, has grown considerably higher. Since the majority of the investment cost have already been spent during the preceeding lower price levels, the effectiveness of the Project grew, in spite of the the expected reduction of the amount of produced electric energy (as a result of the proposed increase of the sanitary flow).

For example, at 1989 price level, the total investment cost increased to 18,400 million Kčs, or including interest to 25,000 million Kčs, and the operation costs to 160 million Kčs per year. At an energy price of 1500 Kčs/MWh, the contribution from production of energy would be 2,814 million Kčs per year, what represents about 67 % from the total benefits reaching 4,228 million Kčs per year. The internal rate of return of the investment has doubled and the reimbursment time has shortened by half. Indeed, the higher cost of energy and the higher proportion of benefits from electric energy production caused an increase of the totale annual costs to about 1200 Kčs/MWh, but these represent only 80 % of the price of energy. In 1989, the benefits from the electric energy production alone would have secured the return of the whole investment in a period shorter than 10 years. As a result of the present impossibility of completing the construction of Nagymaros, a new evaluation of the whole GNP was no more done.

When evaluating Gabčíkovo alone, without Nagymaros, the equal division of the electricity produced does not apply any more. The natural allocation of primary hydroenergetic potential in this section is about 62:38 percent in favour of Czecho-Slovakia. In the case of the common completion of the Gabčíkovo part, the share of the Hungarian side would reach only 35 %, which would also determine the claim for the allocation of the electricity produced. At 1989 price levels, at investment costs of 15,400 million Kčs (including interest 21,300 million Kčs), operation costs 144 million Kčs per year, and at a price of energy of 1500 Kčs/MWh, the benefits from the production of electricity reach 2,658 million Kčs per year, the IRR would reach about 12 % and the reimbursment time of the respective part of the investment would be about 6 years.

Annex 38

Slovak Proposal for the Temporary Water Management Regime of the Gabčíkovo System of Locks, 8 February 1994

Accompanying letter to Mr. Pablo Benavides, Director General for External Economic Relations, Commission of the European Communities, 8 February 1994

P r o p o s a l

for the temporary water management regime of the Gabčíkovo system of locks

The proposal for the temporary water management regime of the Gabčíkovo system of locks (hereinafter TWMR) submitted by the Government of the Slovak Republic is based on following reports of the Working Group of Independent Experts of the Commission of the European Communities, the Hungarian Republic and the Slovak Republic on monitoring and TWMR :

1. DATA REPORT - Assessment of Impacts of Gabčíkovo Project and Recommendations for Strengthening of Monitoring System, Budapest, November 2, 1993.
2. Report on Temporary Water Management Regime, Bratislava, December 1, 1993.

The evaluation of the results of monitoring proves that putting the Gabčíkovo system of locks into operation by means of a temporary solution has not caused significant ecological damages, nor any ecological catastrophe or emergency situation. On the contrary, the results show convincingly that a lot of long term negative trends characterising the pre-dam situation have been stopped and that the environmental, agricultural and forestry conditions, flood protection and navigation have been improved considerably in many respects. There is also a clear economic and ecological benefit drawn from the production of nearly 2 000 GWH/year of electrical energy.

The positive impacts of the Gabčíkovo system of locks clearly prevail over the negative impacts which are consequences of the fact that the Gabčíkovo part of the Project could not have been realized in the whole extent according to the original Joint Treaty Project and some measures could not have been realized without the Hungarian side.

Some negative impacts of the present operation of Gabčíkovo system of locks could be minimized by mutual cooperation of both sides. The Slovak Republic sincerely wishes that the operation of waterwork Gabčíkovo has the same positive impacts on the Hungarian territory as it has on the Slovak side.

According to the conclusions of the 2nd report of the Working Group of Independent Expert the TWMR should be based on the combination of elements from several scenarios. The scenarios have one common aim - to provide Hungarian river branches with sufficient discharge of water in order to ensure the same beneficial conditions as they already exist in the Slovak branch system since May 1993. Different technical solutions for providing Hungarian river branches with water are described in different scenarios. Nevertheless, as to the substance it seems that an agreement is emerging.

The Slovak side proposes therefore to proceed in two stages to reach progress in negotiations on TWMR.

- in the first stage, to agree and realize the filling of the Hungarian branch system with water and all related technical measures, while maintaining the present discharge in the old river bed of the Danube,
- in the second stage to solve the question of discharge and eventual measures in the old river bed of the Danube.

I. stage

It is necessary to guarantee the discharge of water 40 m^3/s into the Hungarian branch system. This aim can be reached by one of the mentioned means or their combination.

a) The most advantageous solution would be the realization of the underwater weir in the old river bed of the Danube. The Slovak and Hungarian authorities have already once issued the legal authorisation for the construction of such an underwater weir in the rkm 1843.

The construction of a low underwater weir is the simplest alternative from the technical and economic viewpoint. "This solution provides the best water management possibilities and the minimum risk of damage during floods." (Report on TWMR, page 35). Under optimum conditions it is possible to construct this underwater weir in very short time.

b) It would be also possible to improve the water regime in the Hungarian inundation area by providing higher discharge (30-40 m^3/s) into the Hungarian river branch system through the intake structure into the Mosoni Danube.

c) It would be also possible to construct the underwater weir on the Slovak territory, in order to enable the interconnection between the old river bed of the Danube and the Hungarian branch system and thus to fill Hungarian branch system directly from the Slovak territory.

In case of an agreement on the implementation of any of these measures it would be necessary that Hungarian side adopts such measures on its territory that the mentioned water discharge could be effectively utilized.

All works proposed with the aim to fill Hungarian branch system with water are reversible and in comparison with existing closures of the Danube branches (inlets and outlets) easily removable.

<u>II. stage</u>

After filling the right side branch system with water, the impact on water regime will be evaluated on the basis of continued monitoring and the question of discharge in the old river bed of the Danube will be considered in order to ensure the manipulation regime with regard to:

- level of groundwaters in left and rightside inundation,
- sufficient velocity of water flow in the old river bed of the Danube,
- water quality in the lower part of reservoir and power canal.

Without regard to these stages and provided that the hydrological conditions make it possible there will be up to three floodings of the inundation area a year with discharge higher than 3500 m^3/s.

The objectives of this proposal are as follows:

- water levels and velocity in the branch system on the Slovak and Hungarian territory must be much better as compared to pre-dam conditions, they must at least approximately respond to the state before closing the branch system realized in the past for navigation purposes,
- groundwater level must be substantially higher as compared to the pre-dam conditions when it was long-term negatively influenced,

- water quality not only in the reservoir and in the old river bed of the Danube but also in the branch system on both sides must be the best possible,
- water velocity in the old river bed cannot be comparable to the pre-dam situation when the whole discharge was concentrated into one river bed still deepened in navigation line, but to more natural conditions. This is the question of number, level and form of underwater weirs, the question of river bed and progressive natural degradation of artificial embankments, not only of the water discharge,
- it is necessary to construct fish passes on the Slovak and Hungarian side (a part of the measures has already been realized on the Slovak side),
- within discharges set up with regard to mentioned objectives the maximum production of electrical energy should be given.

February 8, 1994

Bratislava, February 8 , 1994

Dear Mr. Benavides,

with reference to your letter 25715 of January 16, I would like to inform you that the government of the Slovak Republic has carefully studied the results of the work of the Working group of monitoring and water management experts for the Gabčíkovo system of locks as well as the proposal of the EU experts concerning the Temporary Water Management Regime. It took into account that the Working group had not succeeded to elaborate a common proposal for the TWMR which would have been supported by the EU experts, as well as by the Slovak and Hungarian experts.

The government of the Slovak Republic highly appreciates that with the help of the EU experts it was possible, in some respects, to bring nearer the standpoints of the Slovak and Hungarian sides.

The government is of the view that the measures the realization of which is still the object of different opinions of both sides, should be further discussed. The negotiations would be facilitated by further monitoring which can bring new information and thus promote an agreement in still opened questions.

Mr. Pablo B e n a v i d e s
Director General
for External Economic Relations
Commission of the European Union
<u>B r u s s e l s</u>

Concerning the above mentioned proposal for the TWMR submitted by three EU experts, the Slovak government is of the view that it contains many valuable elements which could be implemented in a short time and at a relatively low cost. Their implementation could have an immediate positive impact on the environment and should not be further postponed.

On the other hand, the volume of the average discharge into the old river bed which has very important economic implications should be further considered.

The above mentioned measures aimed at improving hydrological conditions in the right side inundation area, contained in the proposal of three EU experts, served therefore as a basis for a new proposal of the Slovak government which is enclosed to this letter.

The central idea of this proposal is the realization of further negotiations on the TWMR and its implementation in two stages. This should enable to put into effect first those measures which hopefully can already provide a basis for an agreement. The Slovak government does not consider it appropriate to wait with these measures until all questions are solved.

The Slovak government would like to stress that it considers it very important that the monitoring, exchange of information and systematical evaluation thereof continue. On the basis of continuously collected data it would be possible to conclude the negotiations on the appropriate discharge and possible measures in the old Danube river bed.

I hope that the proposal of the Slovak Republic will meet with understanding of the European Union and first practical results will be reached in a near future.

In making this proposal the Government of the Slovak Republic would like to emphasize that it relates to a temporary water management régime. It is nor a reflection of the Government's view of its obligations under the 1977 Treaty with Hungary. On the contrary, it is a régime necessitated by Hungary's failure to perform that Treaty. It therefore follows that the temporary régime will lose its raison d'etre when full performance of the Treaty is resumed.

Sincerely yours,

Annex 39

(Translation) (Extracts)

Protocol of the 17th Session of the Czechoslovak - Hungarian Committee for Economic and Scientific-Technical Cooperation.

The 17th Session of the Czechoslovak - Hungarian Committee for Economic and Scientific Technical Cooperation (hereinafter Committee) was held on February 24-26 1981 in Prague.

Czechoslovak delegation was lead by Rudolf Rohlíček, Deputy Prime Minister, Chairman of the Czechoslovak Part of the Committee who was also the Chairman of the Committee Session.

Hungarian delegation was lead by József Marjai, Deputy Chairman of the Council of Ministers of the Hungarian People's Republic and the Chairman of the Hungarian Part of the Committee.

Ambassador of Czechoslovakia to Hungary Václav Moravec and Ambassador of Hungary to Czechoslovakia Mr. Béla Kovács were also present.

Other participants are listed in the Annex. The Session considered the following agenda items:

1. Implementation of tasks from the 16th Session and activity of the standing bodies of the Committee.

2. Coordination of national economic plans for the period 1981 - 1985 and the situation in the preparation of the long-term plan of economic cooperation after 1985.

3. Cooperation in the foreign trade in the years 1976 - 1980 and the Long-Term Agreement on the Exchange of Goods and Payments for the years 1981 - 1985.

4. Further development of the production cooperation in the period 1981 - 1985.

5. Scientific-technical cooperation and the Programme of cooperation for the period 1981 - 1985.

6. Development of the cooperation of the border regions and the programme of cooperation for the period 1981 - 1985.

7. Joint construction of the Gabčíkovo-Nagymaros Project.

8. Preliminary date of the 18th Session of the Committee.

On the basis of the submitted information and after consideration the Committee adopted these conclusions concerning separate items of the agenda:

In respect of item 7: The joint construction of the Gabčíkovo-Nagymaros Project.

7.1 To note that:

- in the years 1978 - 1980 the construction of Gabčíkovo-Nagymaros Project was fulfilled in accordance with the inter-state Treaty and the Agreement on Mutual Assistance in the Construction;

- the works were started at all main objects of the Project;

7.2 To entrust Deputy Chairmen of both parts of the Committee, in cooperation with the Government Plenipotentiaries of both parties, to consider and specify a schedule of work of the Gabčíkovo-Nagymaros Project for the period after the year 1981 and to submit a report with pertinent proposal to the Chairmen of both parts of the Committee to discuss it at the next Session.

Annex 40

(Translation)

Memorandum of negotiations of vice-chairmen, of the Czechoslovak-Hungarian Committee for Economic and Scientific-Technical Cooperation, 10 September 1981

MEMORANDUM

OF THE NEGOTIATIONS OF THE VICE-PRESIDENTS OF THE CZECHOSLOVAK-HUNGARIAN COMMITTEE FOR THE ECONOMIC, SCIENTIFIC AND TECHNICAL COOPERATION AND THE DEPUTIES OF THE PRESIDENTS OF THE CENTRAL PLANNING ORGANS OF THE CZECHOSLOVAK SOCIALIST REPUBLIC AND THE HUNGARIAN PEOPLE'S REPUBLIC, ING. H. ÚJHÁZY AND DR. GYULA KOVÁCS HELD ON SEPTEMBER 10, 1981, IN BUDAPEST.

(Translation)

The following items were on the agenda for negotiation:

1) Continuation of the common construction of the waterworks system on the Danube.
2) Topical questions of mutual economic cooperation.
3) Questions concerning the organization of further work of the committee in the area of industry.
4) Preparation for the meeting of the presidents of both parts of the committee.
5) Selected items concerning the cooperation of the central planning organs

ITEM 1/

1. The vice-president of the Hungarian party of the committee informed the Czechoslovak party of a new assessment of the investment project for the planning period 1981-1985 by the Hungarian party. With regard to the results of the research, the Hungarian party decided to continue the suspension of the work of the common construction of the Gabčíkovo-Nagymaros project by 1990. Within this period conservation works on the objects under construction, the riverbed and dams on the Danube would be performed only. The Hungarian party stresses that such a standpoint follows from a multilateral reassessment of the expected sources of Hungarian investment construction.

2. The vice-president of the Czechoslovak party of the committee spoke of the measures taken by the Czechoslovak party since the previous talks of the vice-presidents of the committee:

a) A state expertise was completed. It solved not only the basic technical problems but, also, the budget and cost set out in the G/N project construction timetable. In conclusion, the state expertise seeks to solve the construction timetable so that the first turbine of the Gabčíkovo power station could be put into operation in 1989 (i.e. 2 years later).

b) With regard to this as well as the current state of talks with the Hungarian party, the Czechoslovak party suggests:
- in order to reach a compromise on the construction time-table with Hungary, to slow down the construction so that the fires aggregate of the Gabčíkovo power station could be put into operation in 1989.
- to take into account the fact that, in accordance with division of structures of the project, each party will perform its part of the construction work. If the Hungarian party demands other assistance in the sphere of the construction work /excavating of the bypass canal/ such a help will be provided under the condition that the referred - to works are practicable as to technical prerequisites, and, that the Hungarian party will compensate the works by equivalent supplies of construction works in the same value and time extent.

In case the Hungarian party suggested a longer postponement of the construction, for example by 3 years, the Czechoslovak party will apply the respective provisions of the interstate Treaty, particularly the chapter XI, article 26, paragraphs 1 a and 2 c.

The calculation of the damage by the Czechoslovak party could include:
- Supplies of the electrical power by Hungary at least in the quantity that would, according to the agreement, for mutual cooperation in the construction of the G/N project, belong to the Czechoslovak party within the first years of operation.
- the compensation for damage by the longer temporary occupation of the farming land on the Czechoslovak side.
- higher interest of the investment on the Czechoslovak side during the considered postponement as suggested by the Hungarian party, etc.

ITEM 2/

1. The vice-president of the Czechoslovak party of the committee announced, that the Czechoslovak party would not take the delivery of 200 000 tons of briquettes from Hungary in 1981 and was obliged to reduce equivalently the exportation of the coal for the production of coke to Hungary by 155 000 tons under the condition that the other supplies of this part of cooperation would be realized.

At this occasion, the Czechoslovak party underlines the urgent necessity to settle the briquettes supplies for 1982 and asks the Hungarian party to create conditions in the annual plan in preparing annual protocol for 1982.

2. The Czechoslovak party demands to consider the coordination of plans for increasing the forint limits according to the agreed principle that the Czechoslovak passive balance of the tourism would be compensated by the Czechoslovak active transit saldo. At the same time, it calls attention of the fact, that if the Hungarian party insists on its suggestions to raise the forint limit for Czechoslovak tourism, the Czechoslovak party will be forced to open the matter of equivalent reciprocal supplies for the active balance of the Czechoslovak party of the transit.

As to the standpoint of the Czechoslovak party to the item 2/ the vice-president of the Hungarian part of the committee will inform the Hungarian president of the committee.

He displayes his regret, that the Hungarian proposal on the solution of the compensation for undelivered briquettes, was not accepted by the Czechoslovak party. He calls attention of the fact, the in the course of the coordination of the plans, the parties reached agreement on the compensation of the balance of the non commercial payments.

ITEM 3/

As to the submitted Hungarian working proposal concerning the organization of further work of the committee in the section of industry, the Czechoslovak party demands to reassess the possibility to guarantee the administration of the Hungarian parts of important permanent working bodies of the committee in the same way as it is on the Czechoslovak side.

It further recommends organizing cooperation in the section of machinery on the level of the members of the committee - the vice-ministers of both parties in the future, too.

ITEM 4/

The Hungarian side announced that the president of the Hungarian part of the committee, the vice-minister of the Council of Ministers of Hungary, Mr. J. Marjai, would take part in the inauguration of the exposition "Days of economy and technique of Hungary" in Prague, on September 21, 1981, and he agrees with the proposal of the vice-president of the Czechoslovak part of the committee, the vice prime minister of Czechoslovakia, Mr. R. Rohlíček, to held negotiations of the presidents of the committee in the course of this event.

The vice-presidents of the committee suggest the following meeting agenda:

1. Progression of the realization of task set up by the meeting of the vice-prime-ministers of the Czechoslovakia and Hungary of June 1-2,1981.
2. Further progression of the construction of the G/N Project
3. Topical items of the cooperation /foreign trade and tourism/
4. The state of the productive cooperation and the conclusion of "The Agreement on cooperation in production of mutual supplies of junctions and final products of the car industry, construction and farming machines for 1989-1990".
5. The preparation of the XVIII. session of the committee.

ITEM 5/

Based on mutual information concerning the state of preparation of the work on the perspective programme of the economic, scientific and technical cooperation between Czechoslovakia and Hungary after 1985 it was agreed to speed up the referred-to works.

The summary working group of the central planning organs will evaluate the CS draft programme in the second half of October this year.

The Memorandum was done in Bratislava on September 10, 1981, in two copies, in the Hungarian and Slovak languages, both texts being equally authentic.

For the Czechoslovak party:
The vice-chairman of the CS part of the Committee for the Economic and scientific-technical cooperation

Ing. K. UJHÁZY
the deputy-chairman of
the State Planning commission
of the CSSR

For the Hungarian part:
The vice-chairman of the Hungarian part of the Comittee for ESTC

Dr. GYULA KOVÁCS
the deputy-chairman
of the SPC of the HPR

Annex 41

(Translation)

Memorandum of meeting of chairmen, of the Czechoslovak-Hungarian Committee for Economic and Scientific-Technical Cooperation, 21 September 1981

MEMORANDUM

ON THE TALKS OF THE CHAIRMEN OF BOTH PARTS OF THE CZECHOSLOVAK-HUNGARIAN COMMITTEE FOR ECONOMIC, SCIENTIFIC AND TECHNICAL COOPERATION

(Translation)

On September 21, 1981, in Prague, a negotiation of the chairmen of both parts of the Czechoslovak-Hungarian Committee for the Economic, Scientific and Technical Cooperation (hereinafter Committee only) was held. The vice-prime-minister of the CSSR Mr. Rudolf Rohlíček and the vice-chairman of the Council of the Ministers of the Hungarian People's Republic Mr. József Marjai took part as well as the Ambassador of the Hungarian People's Republic to the CSSR Mr. Béla Kovács.

The agenda of the items which were to be negotiated is as follows:

I. Progress of the realization of the tasks set up by the meeting of the prime-ministers of the CSSR and HPR of July 12, 1981.

II. Further progress on the common construction of the G/N Project.

III. Topical matters of the cooperation (briquettes supplies, coal, coke, tourism)

IV. XVII. session of the committee

It was stressed at the negotiation of the chairmen of the governments of the CSSR and HPR on July 1-2, 1981, in Budapest, that mutual economic relations were on a good level, and in the coordination of the plans, as well as in the perspective trade agreement for 1981 - 1985 are ....

....

informed each other of the standpoint of their governments and further development of the construction of the G/N Project.

The Hungarian government with regard to the present state of the realization of the interstate Treaty, owing to the changes that arose as to the conditions and circumstances since the conclusion of the Treaty, suggests to the government of the CSSR to suspend work on the G/N project construction by 1990 on the basis of a common agreement.

The Czechoslovak party announced that in could not accept the Hungarian suggestion on the suspension of construction by 1990 to the considerable amount of work which had been performed on all structures of the G/N project on the Czechoslovak territory and for other economic reasons (the occupation of the farming land, use of mechanic means, technological character of performed works, temporary solution of the anti-flood protection, etc) and because of the political significance of the project for both countries and the respective territory and that it could accept a contingent proposal to slow down the pace of the work by 3 years.

The chairmen agreed on the continuation of the talks. They agreed that they would inform their party and governmental organs of respective positions. They decided that the experts would mutually evaluate the proposals of both parties in order to submit data for the determination of further concrete step by the end of 1981.

III.

The chairmen of the committee were given information supplied by the vice-chairmen of the Committee on several topical matters of mutual cooperation.

With regard to the fact that the Hungarian party had not delivered the briquettes, the Czechoslovak party repeatedly stated that it could not accept the Hungarian proposal on the compensatory solution and announced, that, in 1981, ...

Annex 42

(Translation)

Letter of 26 April 1982 from Hungarian Vice-Prime Minister (József Marjai) to Czechoslovak Deputy Prime-Minister (Rudolf Rohliček)

Dear comrade Rohlíček,

In response to your letter of April 19, this year, which was delivered to me in Moscow, first of all, I am forced to comment on your assertion according to which the Czechoslovak party regards as the violation of the interstate treaty our, in the last year, in advance, submitted proposal to carry out only the maintenance works in 1982 in order to reach a common agreement on further measures at the construction of the G/N Project.

As you know, the Hungarian party desires to amend the treaty by a common agreement so that work on both sides could be suspended by 1990. The Hungarian party has not violated the treaty, has not caused damage to the Czechoslovak party and either after declaration it did not put obstacles to your activity, that, by the way, so far has not been carried out in accordance with the timetable set out in our agreement.

I believe that the Czechoslovak party seeks, as early as possible, common agreement particularly in order to avoid damage and to find a solution that would satisfy the needs of both parties.

In your letter, you have proposed that the vice-chairmen of both parts of the intergovernmental committee judge, by the end of April, the progression of the negotiations on the G/N Project and to determine the agenda of the further talks. Since the negotiation can help to find a solution or alternative solutions that could be a basis for a common agreement, I agree to the proposal to hold this urgent negotiation. I agree, too, with the proposal, referred to in your letter, to centre the expert talks on the preparation of the data necessary for the common agreement.

Having determined a method of addressing the problems, on which the common position would be based, the expert commission can elaborate the details of the solution adopted by both parties and submit proposals on the treaty amendment. Thus, it is necessary to prepare the respective data immediately for the preparation of the position of the intergovernmental committee at the conference of the vice-chairmen of both parts of the Committee.

With regard to my desire to reach a common agreement quickly, I suggest participants in the negotiation to seek a compromise solution at the meeting for these very distant positions, respecting the possibilities and endeavour of both parties. At the same time, it would be possible to discuss the suggestions referred to in your last letter with which we could not familiarize ourselves completely.

I believe that the talks will help us to make the VIII. session of the Committee a success. The vice-chairman of the Hungarian part of the Committee obtained my directive according to which he shall, as early possible, reach an agreement on the date of the talks with the vice-chairman of the Czechoslovak part.

Budapest, on April 26, 1982

(Signed) József Marjai

Annex 43

(Translation) (Extracts)

Protocol of the 18th Session of the Czechoslovak - Hungarian Committee for Economic and Scientific-Technical Cooperation.

The 18th Session of the Czechoslovak - Hungarian Committee for the Economic and Scientific-Technical Cooperation (hereinafter Committee) was held on May 31 - June 1, 1982, in Budapest.

Czechoslovak delegation was lead by Rudolf Rohlíček, Deputy Prime Minister, Chairman of the Czechoslovak Part of the Committee.

Hungarian delegation was lead by József Marjai, Deputy Chairman of the Council of Ministers of the Hungarian People's Republic and the Chairman of the Hungarian Part of the Committee, who was also Chairman of the Committee Session.

Ambassador of Czechoslovakia to Hungary Andrej Barcák and Ambassador of Hungary to Czechoslovakia Mr. Béla Kovács were also present.

Other participants are listed in the Annex.

The Session considered the following agenda items:

1. Implementation of tasks from the Meeting of the Prime Ministers of Czechoslovakia and Hungary and of the 17th Session of the Committee; the long term Programme of economic and scientific and technological coöperation.

2. The review of cooperation in selected branches of the industry; preparation of production cooperation.

3. Cooperation in the foreign trade.

4. Scientific-technical cooperation.

5. Further construction of the Gabčíkovo-Nagymaros Project.

On the basis of the submitted information and after consideration the Committee came to these conclusions concerning separate items of the agenda:

In respect of item 5: Further construction of the Gabčíkovo-Nagymaros Project

5.1 To take note that on the basis of negotiations and exchange of letters between Chairmen of the Committee, the Vice-Chairmen of the Committee and the Government Plenipotentiaries made progress at searching for possibilities to solve problems arising at the construction of the Gabčíkovo-Nagymaros Project and the group experts of both sides under the leadership of Government Plenipotentiaries elaborated the joint report with a proposal for further action to be considered at the 18th Session of the Committee.

5.2 To note that both sides abide by the basic principles of the interstate Treaty in force.

5.3 To assign the Vice-Chairmen of the Committee to continue, in cooperation with Government Plenipotentiaries of both countries, in their work and in the interest of a comprehensive agreement:

5.3.1 to elaborate a plan for organisation of the construction of the Gabčíkovo-Nagymaros Project in order to:

- make operational the first turbine/generator unit of the Gabčíkovo hydroelectric power plant in 1990,

- begin the construction of the Nagymaros hydroelectric power plant in 1989-1990,

5.3.2 to make operational the first turbine/generator unit of the Nagymaros hydroelectric power plant as soon as possible, if possible by 1993.

5.3.3 in view of the new situation, to agree on a new schedule of construction for the Gabčíkovo Project and to agree, in 1985, a schedule of construction for the Nagymaros Project.

5.3.4 to specify conditions and method of settlement of labour and supplies, which would be carried out by the Czechoslovak side instead of the Hungarian side at the Gabčíkovo Project under the item 5.3.1.

5.3.5 after the fulfilment of tasks under the items 5.3.1, 5.3.2, 5.3.3 and 5.3.4 by September 20, 1982, to prepare a proposal for an Inter-Government agreement by the end of 1982.

5.4 The Hungarian side will deliver to the Czechoslovak side the results of studies on technical solution and of environmental impact and, in the interest of taking necessary joint measures, requests the Czechoslovak side to consider jointly the proposals for modification which will be sufficiently justified.

The Czechoslovak side is willing to study and consider new proposals of the Hungarian side. But this consideration must not change the concept of the Project agreed to in the interstate Treaty. Necessary modifications, as the case may be, can only be made on the basis of a mutual agreement if permitted by the progress in construction work.

5.5 Government Plenipotentiaries shall continue in the negotiations in July 1982.

Annex 44

(Translation)

Letter of 3 May 1983 from the Czechoslovak Prime Minister (Lubomir Strougal) to the Prime Minister of Hungary (Gyorgy Lazar)

Unnoficial Translation

Prime Minister of the Czechoslovak Socialist Republic

Prague, May 3, 1983

Dear Comrade Lazar,

I was informed on current negotiations about our futher joint progress at construction of the Gabcikovo-Nagyamaros System of Locks.

During the negotiations of our Deputy Prime Ministers in Komarno on March 22. 1983 the Czechoslovak party brought up new proposals in an attempt to narrow views and approaches about the joint construction. As the Hungarian party was not ready to discuss these proposals, it was agreed that, both parties would mutually exchange their oppinions for futher judgement.

On basis of the preliminary consideration of the proposals of the Hungarian side, which we received on April 18, 1993 we came to the conclusion, that they repeat approaches which were already discribed by the Czechoslovak side as unacceptable.

As I informed you as early as in October 1981, Czechoslovak side can not interrupt works at the construction of the Gabcikovo System of Locks, because we would cause considerable damages, which in their consequences would have been borne by both sides.

Your Deputy Prime Minister, comrade J.Marjai had an opportunity to see by even greater stage of building activity at at the construction site in March of this year. This considerable building activity on the Czechoslovak side and the fact, that many objects which, according to the Interstate Treaty, were to be built by Hungarian side and which are not finished yet are causing serious complications during the construction and creates another damages and delays of construction beyond four year period as it was agreed by our sides. In this situation and also in accordance with the joint viewpoint of comrade G.Husak, General Secretary of the Communist Party of Czechoslovakia and comrade J. Kadar, the First Secretary of the Central Committee of the Hungarian Socialist Workers Party which was reached at the joint working meeting last year in Budapest. They agreed not to cause udesirable damages to either side in connection with the construction of the System of Locks. In this connection I am asking you that after the evaluation of the current situation the Hungarian side will take up measures to fulfill its obligations of the Hungarian side which were fixed in the Interstate Treaty which we signed jointly in September 1977.

With comradly greetings.

To: Comrade Gyorgy Lazar
Chairman of the Council of Ministers of the Hungarian People s Republic, Budapest

Annex 45

(Translation)

Reply of Hungarian Prime Minister (Gyorgy Lazar) of 23 May 1983 to 3 May letter of Czechoslovak Prime Minister (Lubomir Strougal)

Unnoficial Translation

Chairman of the Council of Ministers of the Hungarian People s Republic

Comrade Lubomir Strougal
Prime Minister of the Czechoslovak
Socialist Republic
Prague

Dear Comrade Strougal,

I received your letter of May 3, regarding a construction of the System of Locks on the Danube.

The Government of the Hungarian People s republic even under more difficult conditions than earlier carries on the systematic and significant steps to fulfill the concluded Interstate Treaty on the Construction and Operation of the Gabcikovo-Nagymaros System of Locks to bring the benefit to both states.

Our representatives on every occassion were ready in this respect to bilateral negotiations, and tried that in order at realistic evaluation of facts, it would be possible to find joint constructive solutions of current questions. This effort was expressed also at discussions of chairmen of both parts of the Czechoslovak-Hungarian Committee for cooperation in the field of economy, science and technology cooperation on March 22, this year.

The partial stopping of the operations of Hungarian side did not cause any hindrance to continuity of work of the Czechoslovak side which were carried on with regard to the delay in comparison to the original working schedule of planned operations.

At the above mentioned Session of chairmen of the Committee, the Czechoslovak side delivered at its introductory address such new proposals, which were not mentioned during earlier negotiations on further joint construction of the System of Locks and that is why our specialists could inquire into these proposals only after studying them. Until now the studying of the above mentioned new proposals shows, that in the question importanat for the Hungarian side, the Czechoslovak proposals did not mean the real rapprochement and not even to the Hungarian position, which was several times modified in the intention of reaching the agrement.

Rapprochement of positions is made difficult by the fact that the Czechoslovak side by its proposals demands to use procedures, which are different from the methods used in similar cases in practise of the CMEA.

In the proposal sent by the Hungarian side on April 18, 1983, which is base on the framework of the previous negotiations, we came to the limits of our possibilities.

At the same time, the Czechoslovak side at variance with the agreement between the Deputy Prime Ministers, which was at the meeting laid down in an "aide memoire", did not send neither its position, nor data, which could explain in detail the Czechoslovak proposals, and that is why they could not be jointly discussed.

Allow me to inform you, Dear Comrade Prime Minister, that party and state organs of the HPR concerned, in accordance with standpoint adopted at a meeting of Gustav Husak, General Secretary of the CPCz and Janos Kadar, First Secretary of the Hungarian Socialist Workers Party last year, I think it is very urgent to continue in negotiations to reach mutually acceptable agreement. Our deputies received relevant full powers and delegations.

Allow me, Dear Comrade Strougal, to express at this occassion my highest consideration.

Budapest, May 23, 1983

Sincerely,

Lazar Gyorgy

Annex 46

(Translation)

Memorandum of meeting of chairmen, of the Czechoslovak-Hungarian Committee for Economic and Scientific-Technical Cooperation, 9 July 1983

MEMORANDUM

ON THE TALKS OF THE CHAIRMEN OF THE CZECHOSLOVAK-HUNGARIAN COMMITTEE FOR THE ECONOMIC, SCIENTIFIC AND TECHNICAL COOPERATION

(Translation)

On July 9, 1983, in Komárom, a negotiation of the chairmen of the Czechoslovak-Hungarian Committee for the Economic, Scientific and Technical Cooperation /hereinafter Committee only/, comrade R. Rohlíček, the vice-prime-minister of the Czechoslovak Socialist Republic and comrade József Marjai, the vice-chairman of the council of the ministers of the Hungarian People's Republic was held in order to discuss the topical issues of further progress of the joint construction of the G/N Project.

The Ambassador of the CSSR, comrade Andrej Barčák, and the Ambassador of the HPR, Comrade Béla Kovács, took part in the talks.

The list of other participants is enclosed.

1. The parties stated, that the verification performed according to the conclusion, on the top level on the taking over of separate works by the Czechoslovak party instead of the Hungarian party, was not finished with success. With regard to this fact and to the achieved level of the performed works on the Czechoslovak territory, the parties have agreed to continue construction of the G/N Project according to the apportionment of works and supplies contained in the Treaty concerning the construction and operation of the G/N Project and the Agreement on mutual assistance at the construction of 1977, respecting the terms approved at the XVIII. session of the Committee.

2. The chairmen of the committee charged the governmental delegates with

- immediate preparation of the common time-table of the works and supplies that will be in accordance with terms of the introduction of the aggregates into operation as it was approved at the XVIII. session of the Committee, so that, the first aggregate of the Gabčíkovo waterworks will be put into operation in 1990 and at the Nagymaros waterworks in 1993.
- elaboration and agreement on a common time-table of works and supplies so that the necessary data about quality of works and

supplies for 1984-85 could be at the disposal of the central planning organs for the preparation of the proposed 1984 plan.

- elaboration of the necessary legal texts inevitable for the amendment of the terms of the Treaty on the construction of the Project and the Agreement on the mutual assistance so that these texts could be submitted to the chairmen of the Committee for approval by the end of September 1983.

3. The Committee chairmen state that the interstate Treaty and the common contractual project took into consideration, with regard to the then knowledge level, the measures concerning the environment protection and nature protection. Both parties, however, consider it necessary to continue to search for a reasonable solution of contingent infavourable phenomena in the course of the realization of the construction and to find ways which will lead to improvement of the environment. With regard to this, it will be necessary to modify the technical projects for this purpose and to create conditions for effective cooperation.

This memorandum was done in two copies, in the Czech and Hungarian languages, both texts being equally authentic.

Komarom, July 9, 1983

(Signed) Rudolf Rohlíček *(Signed)* Marjai József

ANNEX

The list of the other participants of the talks

Karol Ujházy
Vladimír Lokvenc
Rudolf Kaplán
Jaroslav Prokeš
Juraj Jirásek
Ladislav Derian
Jozef Obložinský
Ján Koša
Miroslav Šándor
Mária Császárová

Gyula Kovács
Péter Havas
Gyorgy Gilyán
Zoltán Vezér
Lászlo Nagy
Miklós Szántó
Vadász Gáborné

Annex 47

(Translation) (Extracts)

Protocol of the 19th Session of the Czechoslovak-Hungarian Committee for Economic and Scientific-Technical Cooperation (hereinafter "Committee") The 19th Session of the Czechoslovak Hungarian Committe for Economic and Scientific-Technical Cooperation was held on February 20-22, 1984 in Prague.

Czechoslovak delegation was lead by the Deputy Prime Minister and Chairman of the Czechoslovak part of the Committee, Mr. Rudolf Rohlíček, who also chaired the Committee's Session.

Hungarian delegation was lead by the Deputy Chairman of the Council of Ministers of the Hungarian People's Republic and Chairman of the Hungarian part of the Committee, Mr József Marjai. Ambassador of Hungary to Czechoslovakia, Mr. Béla Kovács, took part in the Session.

Other participants are listed in Annex No. 1.

The Session considered the following agenda items:

1. The development of tasks arising from the meeting of the Secretary General of the Central Committee of the Communist Party of Czechoslovakia and the First Secretary of the Central Committee of the Hungarian Socialist Workers Party on November 10, 1983, and from the meeting of the Prime-Ministers, held on October 10-11, 1983.

2. The implementation of tasks from the Protocol of the 18th Session of the Committee.

3. The cooperation and specialization in production
   - the analysis of the present situation,

- new proposals and ideas for the development of the specialization and cooperation.

4. Selected issues concerning the commercial exchange of goods
   - protocol on the goods exchange and payments in 1984,
   - information from the price negotiations on the goods exchange in 1984.
   - information from the negotiations on prices in the branch of specialised and operative production processes and products.

5. The information on the finalization of work on the document regarding the main projects of the long-term economic and scientific-technical cooperation between Czechoslovakia and Hungary.

6. The information on the course of consultation on the coordination of the national economic plans for the period 1986-1990.

On the basis of the submitted information and after consideration, the Committee came to these conclusions concerning the separate items of the agenda.

In respect of item 2: Implementation of tasks from the protocol of the 18th Session of the Committee,

2.1 It is established that

- the resolution of the 18th Session of the Committee, ensured by respective members and working organs of the Committee, have been fulfilled or are being implemented.

- Government Plenipoteniaries for the construction and operation of the Gabčíkovo-Nagymaros Project have elaborated the over-all schedule for the construction in accordance with the instructions of the Chairman of both parties of the Committee of July 9, 1983, in Komárom;

- in Prague, on October 10, 1983, the protocols on modifications of the dates of the Treaty on the Construction and Operation of the G/N System of Locks and the Agreement on Mutual Assistance at the construction were signed. According to these protocols the first turbine/generator unit of the Gabčíkovo hydroelectric power plant will be put into operation in 1990 and that of the Nagymaros hydroelectric power plant in 1993, respectively;

- the construction of the Gabčíkovo-Nagymaros Project continues at present in accordance with the apportionment of labour and supplies determined by the Treaty on the Construction and Operation of the Gabčíkovo-Nagymaros System of Locks and the Agreement on Mutual Cooperation in the Construction and in accordance with the protocols on the modifications of the construction dates.

- the Government Plenipotentiaries for the construction of the Gabčíkovo-Nagymaros Project have determined, on both sides, the volume of work and supplies within the period 1984-85 and submitted that to the central planning authorities.

2.2 It is requested that:

2.2.1 the Government Plenipotentiaries for the construction of the Gabčíkovo-Nagymaros Project;

- continue in organizing the construction of the Project in accordance with the schedule set out in the Protocols of amendment of the Treaty and the Agreement;

- submit a joint report on the progress of construction of the Project to the 20th Session of the Committee.

* * *

Annex No. 2

Main directions of the long-term economic and scientific-technical cooperation between Czechoslovakia and Hungary

1. Competent ministries and state administration authorities of Czechoslovakia with federal, republic and territorial Jurisdiction and competent ministries and state

administration authorities of Hungary with republic and local jurisdiction (hereinafter state authorities) will further the development of cooperation between both states by joint solving of these tasks.

* * *

G. Investment:

Coordination of investment plans which will considerably influence the further extension of mutual economic cooperation and cooperation in "third markets" and will avoid the construction of parallel facililties. Particular attention will be paid to the joint construction of the Gabčíkovo-Nagymaros Project.

* * *

Annex No. 2/a

Main subjects of the long-term economic and scientific-technical cooperation

X. Water Management Economy

1. Comprehensive utilization of water and water protection against pollution.

2. New water treatment technologies including processing and utilization of ooze.

3. Development of measuring, regulatory and automation technical means for water management.

4. Water management economy.

5. Realization of the joint construction of the Gabčíkovo-Nagymaros Project in accordance with the concluded treaties and agreements.

Annex 48

(Translation) (Extracts)

Protocol of the 20th Session of the Czechoslovak - Hungarian Committee for Economic and Scientific-Technical Cooperation.

The 20th Session of the Czechoslovak - Hungarian Committee for Economic and Scientific-Technical Cooperation (hereinafter Committee) was held on April 10-12, 1985, in Budapest.

Czechoslovak delegation was lead by Rudolf Rohlíček, Deputy Prime Minister, Chairman of the Czechoslovak Part of the Committee.

Hungarian delegation was lead by József Marjai, Deputy Chairman of the Council of Ministers of the Hungarian People's Republic and the Chairman of the Hungarian Part of the Committee, who was also Chairman of the Committee Session.

Ambassador of Czechoslovakia to Hungary, Ondrej Ďurej and Ambassador of Hungary to Czechoslovakia, Mr. Béla Kovács were also present.

Other participants are listed in the Annex No 1.

The Session considered the following agenda items:

1. The implementation of tasks from the Protocol of the 19th Session of the Committee.

2. Possibilities for the development of specialisation and cooperation in production.

3. Current issues of cooperation in agriculture and food industry.

4. Coordination of national economic plans for the period 1986 - 1990.

5. Development of foreign trade relations.

6. Construction of the Gabčíkovo-Nagymaros Project.

At the Session of the Committee it was stressed that it is necessary to abide by the resolutions of the Economic Summit of Member States of the Council of Mutual Economic Assistance held in June 1984 in Moscow which have primary importance for the development of economic and scientific-technical cooperation between Czechoslovakia and Hungary.

On the basis of the submitted information and after consideration the Committee came to these conclusions:

In respect of item 6: The construction of the Gabčíkovo-Nagymaros Project

6.1 To take note that the Hungarian side is adopting necessary measures for acceleration of the beginning of the construction of the sealing tank of the Dunakiliti weir so to be finished in terms according to the Intergovernment agreement.

6.2 To impose upon the Government Plenipotentiaries.

6.2.1 To coordinate further the construction of the Project in order that the terms of the construction agreed in the Protocols of amendments of the Treaty and the Agreement are abided by.

6.2.2 To submit a joint report on the progress of construction of the Project for the 21st Session of the Committee.

Annex 49

(Translation) (Extracts)

Protocol of the 21st Session of the Czechoslovak-Hungarian Committee for Economic and Scientific - Technical Cooperation.

The 21st Session of the Czechoslovak-Hungarian Committee for Economic and Scientific-Technical Cooperation (hereinafter Committee) was held on May 19, 1986 in Prague.

Czechoslovak delegation was lead by Rudolf Rohlíček, Deputy Prime Minister, Chairman of the Czechoslovak Part of the Committee, who was also Chairman of the Committee Session.

Hungarian delegation was lead by József Marjai, Deputy Chairman of the Council of Ministers of the Hungarian People's Republic and Chairman of the Hungarian Part of the Committee.

Ambassador of Czechoslovakia to Hungary Mr. Ondrej Ďurej and Ambassador of Hungary to Czechoslovakia Mr. Béla Kovács were also present.

Other participants are listed in Annex No. 1.

The following agenda items were discussed:

1. Implementation of tasks from the 20th Session of the Committee.

2. Specialization and cooperation in production and its contract basis in the period 1986-1990.

3. Selected issues concerning mutual exchange of goods and foreign trade relations.

4. Preparation of the long-term programme of economic and scientific-technical cooperation between Czechoslovakia and Hungary up to year 2000.

5. Cooperation during the implementation of the comprehensive programme of scientific and technical progress of member-states of the council of Mutual Economic Assistance up to year 2000.

On the basis of the submitted information and after consideration the Committee came to the following conclusions concerning separate items of the agenda:

In respect of item 1: Implementation of tasks from the 20th Session of the Committee.

1.1 It is established that

- Government Plenipotentiaries prepared in March 1986 the joint report on the progress of construction of the Gabčíkovo-Nagymaros Project.

1.2 To take note that

- Government Plenipotentiaries worked out conditions for the acceleration of the construction of the Nagymaros Project by 15 months and acceleration of putting individual turbine/generator units into operation in two months period instead of three months period. They suggested that the turbine/generator units of the Gabčíkovo hydroelectric power plant be put into operation in three months period instead of five months period. They determined the amount of the electric energy which will be produced by this acceleration.

PROPOSAL OF THE HUNGARIAN SIDE:

The date of February 1, 1993 is the deadline for the putting of the last turbine/generator unit of the Nagymaros hydroelectric power plant into operation to protect the environment and the surrounding countryside. On August 19, 1985, this date was officially announced by the Hungarian side at the meeting of the Committee Co-Chairmen, as requested by the resolution of the Government of Hungary.

In this connection, it is also necessary to shorten the time intervals of putting the turbine/generator units of the Gabčíkovo hydroelectric power plant into operation, which will increase the production of the electric power in both states in the years 1990-1995 and at the same time make the whole investment more effective.

Therefore the Hungarian side considers necessary to adopt adequate work schedule, which is a possibility already discussed by the Government Plenipotentiaries.

PROPOSAL OF THE CZECHOSLOVAK SIDE:

The Czechoslovak side considers that it will be reasonable to accelerate the construction, but because of construction capacities the Czechoslovak side will be able to take final position only by the end of the first half of the year 1987.

The Czechoslovak side is prepared to discuss together with the Hungarian side the possibilities and conditions of the assistance of Hungary at the construction of flood-control works of the Nagymaros reservoir on Czechoslovak territory, or to seek another solution. Czechoslovak side can provide plan and investment preparation for flood-control works of the reservoir on the Czechoslovak territory, production, supplies and assembling of pumping stations if they are ordered in appropriate time in advance.

- schedule of assembling of measuring and monitoring devices in the Project's framework and its connection to the existing system of monitoring of adjacent countryside, which, starting in 1987, will function under the newest scientific requirements;

- under instructions of the Government Plenipotentiaries, project organizations, in cooperation with scientists and specialists of both parties, started updating of technical solution for the bed of the Danube river in accordance with environmental requirements.

1.3 To impose upon the Government Plenipotentiaries for the construction of the Gabčíkovo-Nagymaros Project.

PROPOSAL OF THE HUNGARIAN SIDE

1.3.1 To prepare within a month, a protocol amending the Agreement on Mutual Assistance to be signed by Chairman of both parts of the Committee.

According to this Protocol, the first turbine/generator unit of the Nagymaros Project, would be put into operation on April 1, 1992 and other turbine/generator units would be put into operation successively every two months. If the first turbine/generator unit of the Gabčíkovo Project is put into service on the agreed date then to put other turbine/generator units into operation every successively three months.

PROPOSAL OF THE CZECHOSLOVAK SIDE:

To organize the construction of the Project in such way that the dates of the construction agreed to in the Protocol amending the Treaty and the Agreement would be observed. To prepare a draft protocol amending the Agreement on the Mutual Assistance after a decision is taken on acceleration of the construction of flood-control works of the Nagymaros reservoir on Czechoslovak territory.

1.3.2 To submit to the 22nd Session of the Committee a joint report on the progress of construction of the Project and on updating of technical solution of the old bed of the Danube river.

Annex 50

(Translation) (Extract)

Protocol of the 22nd Session of the Czechoslovak - Hungarian Committee for Economic and Scientific-Technical Cooperation.

The 22nd Session of the Czechoslovak - Hungarian Committee for Economic and Scientific-Technical Cooperation (hereinafter Committee) was held on July 6-8, 1987, in Budapest.

Czechoslovak delegation was lead by Pavel Hrivnák, Deputy Prime Minister, Chairman of the Czechoslovak Part of the Committee.

Hungarian delegation was lead by József Marjai, Deputy Chairman of the Council of Ministers of the Hungarian People's Republic, Chairman of the Hungarian Part of the Committee who was also Chairman of the 22nd Session.

Ambassador of Czechoslovakia to Hungary Ondrej Ďurej and Ambassador of Hungary to Czechoslovakia Béla Kovács were also present.

Other participants are listed in the Annex No. 1.

Following agenda items were discussed:

1. Implementation of tasks from the 21st Session of the Committee.

2. Status of development of cooperation in production for the period 1986 - 1990.

3. Issues of exchange of goods and foreign trade relations.

4. Joint plan of measures aimed at implementation of the Programme of long-term economic and scientific-technical cooperation between Czechoslovakia and Hungary up to year 2000.

5. State of the preparation of framework Intergovernment agreements on establishing joint-ventures and entering into direct economic relations.

On the basis of the submitted information and after consideration the Committee adopted these conclusions:

In respect of Item 1. <u>Implementation of tasks from the 21st Session of the Committee</u>

1.3 To take note that the central planning authorities, following the 21st Session of the Committee, applied the principles of the continuous coordination of plans and focused their mutual consultations on development and investments on problems of economic and scientific-technical cooperation and unification of structural changes in the national economy. Better participation of the working bodies of the Committee is anticipated in the process of coordination of planning, particularly in the development of specialisation and cooperation of the production, and in establishment of direct cooperation between enterprises, industrial and research organisations.

1.4 To state that in connection with the acceleration of putting the Nagymaros Project into operation, the Czechoslovak side is intensively studying the conditions for acceleration of the construction of the whole Project. Its position will be announced shortly.

1.5 To impose upon the Government Plenipotentiaries;

1.5.1. to elaborate the joint schedule of work and supplies which will be in accordance with the new terms for putting the turbine/generator units of the Gabčíkovo-Nagymaros hydroelectric power plants into operation;

1.5.2 to arrange for the elaboration of necessary amendments to the Protocol amending the Agreement on Mutual Assistance in the construction of the Gabčíkovo-Nagymaros Project so as the text could be submitted to the Chairmen of both parts of the Committee by the end of 1987;

1.5.3 to submit to the 23rd Session of the Committee a joint report on the progress of construction of the Gabčíkovo-Nagymaros Project.

Annex 51

(Translation)

Protocol of meeting of Government Delegates of Czechoslovakia and Hungary on Cooperation in the Construction of the G/N Project, 1 - 3 February 1989

P R O T O C O L

of the negotiations of the governmental delegates of Czechoslovak Socialist Republic and the Hungarian People's Republic concerning the further cooperation in the construction of the G/N Project held at Budapest on February 1-3, 1989.

The governmental delegates agreed that the following items would be negotiated:

1. Fulfilment of construction work in 1988
2. Plan of tasks for 1989
3. Time-schedule of putting the structures of Gabčíkovo part of the Project into operation
4. Solution of output of the hydroelectric power plant Nagymaros
5. Compensation for higher cost of the extension of 400 kV distribution equipment of the hydroelectric power plant Gabčíkovo
6. Report on the activity of the Joint Operative Group
7. Modifications of the technical solution of the Joint Contractual Project approved in 1988
8. Operation and calculation of operational costs
9. Miscellaneous

1. Fulfilment of construction work in 1988

The government delegates take due note of the report of the heads of the Joint Operative Group about the fulfilment of construction work in 1988 in accordance with Annex 2 to this protocol.

2. Plan of tasks for 1989

The government delegates take due note of the report of the heads of the Joint Operative Group regarding the plan of construction work in 1989 in accordance with Annex 3 to this protocol.

3. Time-schedule of putting the structures of Gabčíkovo part of the Project into operation

The government delegates discussed the report of the heads of the Joint Operative Group regarding the time-schedule of putting the structures of Gabčíkovo part into operation.

protocol.

The report is enclosed in Annex 4 to this protocol.

With regard to the date of putting the first turbine of the Gabčíkovo hydroelectric power plant into the test operation o n July 2, 1990 and with aim of shortening the restrictions of international navigation, the governmental delegates agreed on following basic terms:

a/ beginning of damming up at the Szigeti Duna	01.08.1989
b/ beginning of damming up the Danube river bed	20.10.1989
c/ beginning of filling the reservoir	04.12.1989
d/ beginning of filling the headwater canal	18.12.1989
e/ transfer of navigation into bypass canal	19.03.1990 to 02.04.1990

....

....

b/ the next negotiations of the governmental delegates will be held on the Czechoslovak territory in April 1989.

This protocol was done in two copies, in the Slovak and Hungarian languages, both texts being equally authentic.
Budapest, February 3, 1989

(Signed)
Vladimír Lokvenc

(Signed)
Péter Havas

Annex 52

(Translation) (Extracts)

Protocol of the 23rd Session of the Czechoslovak-Hungarian Committee for Economic and Scientific-Technical Cooperation.

The 23rd Session of the Czechoslovak-Hungarian Committee for Economic and Scientific-Technical Cooperation (hereinafter Committee) was held on March 2-3, 1989 in Praque.

Czechoslovak delegation was lead by Pavel-Hrivnak, First Deputy Prime Minister, Chairman of the State Commission for Scientific-Technical and Investment Development and Chairman of the Czechoslovak Part of the Committee. He also chaired Session.

Hungarian delegation was lead by Péter Medgyessy, Deputy Chairman of the Council of Ministers of the Hungarian People's Republic and Chairman of the Hungarian Part of the Committee.

Ambassador of Hungary to Czechoslovakia Mr. Miklós Barity was also present.

Other participants are listed in Annex No. 1.

The Session considered the following agenda items:

1. Implementation of tasks from the meeting of Secretaries-General, Prime Ministers and Deputy Prime Ministers of Czechoslovakia and Hungary and from the 22nd Session of the Committee.

2. The topical issues of mutual exchange of goods and foreign trade relations.

3. The report on cooperation in agriculture, food industry and proposals for the next period.

4. Information on coordination of economic plans between the Czechoslovakia and Hungary for the period 1991-1995

On the basis of submitted information and after consideration the Committee came to these conclusions:

In respect of item 1 - Implementation of tasks from the meetings of Secretaries-General, Prime Ministers and Deputy Prime Ministers of Czechoslovakia and Hungary and from the 22nd Session of the Committee.

1.1 To note that,

1.1.1 Plenipotentiaries of the Governments of Czechoslovakia and Hungary for the construction and the operation of the Gabčíkovo-Nagymaros Project.

- worked out a joint overall schedule for the construction of the Gabčíkovo-Nagymaros Project, which takes into account new terms for the construction of the Gabčíkovo and Nagymaros hydroelectric power plants.

- worked out a joint report on the progress of construction of the Gabčíkovo-Nagymaros System of Locks in 1987 and 1988. The work and the deliveries were carried out in accordance with the contractual plan and in accordance with the new schedule of construction which was adopted by both sides.

1.1.2 On behalf of their respective governments, the Chairmen of both parts of the Committee signed on February 2, 1989, the Protocol amending the Agreement between the Government of Czechoslovakia and Government of Hungary on Mutual Assistance at the Construction of the Gabčíkovo-Nagymaros System of Locks of September 16, 1977 which takes into an account new terms for putting of the Gabčíkovo and Nagymaros hydroelectric power plants into operation.

1.2 Requested Plenipotentiaries of the Government of Czechoslovakia and of the Government of Hungary for the Gabčíkovo -Nagymaros Project

1.2.1 to submit to the Chairmen of both parts of the Committee a joint report on the progress of work relative to schedule of putting the Gabčíkovo Project into operation a report on the status of preparation of the contracting parties for the joint operation, a report on taking over of the objects to the joint ownership, a report on accounting of costs of the joint operation by the end of 1989 at the latest, and at the same time to examine possibilities of establishing a joint venture.

1.2.2 to submit to the 24th Session of the Committee a joint report on the progress of construction of the Gabčíkovo-Nagymaros Project and on the status of preparation of economic management rules for and operational regime of the Gabčíkovo Project.

1.3 The Parties agreed that the operation of the Gabčíkovo-Nagymaros Project must not deteriorate the environment, basic requirement being that the quality of the Danube water must not deteriorate.

To request

The Minister of Forestry and Timber Industry of Slovakia and the Minister of Environment and Water Management of Hungary in cooperation with Plenipotentiaries for the construction and operation of the Gabčíkovo-Nagymaros Project to elaborate and submit, by April 15, 1989, to the Chairmen of both part of the Committee a concrete proposal for achieving the above-mentioned goals.

Chairmen of both parts of the Committee will discuss this proposal by the end of April 1989 and they will decide upon further procedure.

Annex 53

Joint Boundary Waters Commission Documents - March 1985 : Information on Completed and Scheduled Measures for Protection of the Danube Water

Record from the Extraordinary Negotiations of the Working Group for Protection of Water Purity of Border Rivers of the Czechoslovak-Hungarian Commission for Economy and Science, 20-24 February 1989

Protocol on the 48th session of the Working Group for Protection of Water Purity in Boundary Rivers of the Czechoslovak-Hungarian Commission for Economy and Science, October 31 - November 4, 1988

(Translation)

I N F O R M A T I O N

ON COMPLETED AND SCHEDULED MEASURES FOR PROTECTION OF THE DANUBE WATER

Czechoslovak-Hungarian commission for boundary waters
Working group for protection of water purity

March 1985

2.2 Number of operational wastewater treatment plants (WWTP).

In accordance with technical-economic possibilities and with regard to the interim legal system, attention is payed to construction of wastewater treatment plants in Czechoslovakia and Hungary. The project of construction of wastewater treatment plants is a part of the economic and social development. With regard to the refered to principles, there are at present 620 WWTP in operation on the territory of the CSSR, 90 of them being municipal and 530 being industrial. The number of WWTP in separate basins is as follows:

Basin	Municipal	Industrial	Total
Danube-CSSR	14	14	28
Váh	59	269	328
Hron	11	152	163
Ipeĺ-ČSSR	6	95	101
Total	90	530	620

According to respective authorities, there are 806 sources of pollution, registered in the CSSR. Wastewater from them is released directly to recipients. That means that 77% of sources already disposes of conpleted wastewater treatment plants.

In the Hungarian part of the Danube basin, 273 sources of pollution are registered, wastewater of which is released directly to recipients. Up to now 213 WWTP have been built, 90 of them being municipal and 123 being industrial. That means that 78% of sources already disposes of conpleted wastewater treatment plants.

The total number of WWTP on the Danube and its tributaries from Hungary is as follows:

Basin	Municipal	Industrial	Total
Danube-HPR	6	8	14
Mosoni-Duna	51	54	105
Cuhai-Bákony-Ér	2	3	5
Concó	3	6	9
Által-Ér	12	32	44
Kenyérmezeipatak	10	14	24
Ipeĭ-Hungary	6	6	12
Total:	90	123	213

2.3 SURVEY OF WWTP FROM POLLUTION SOURCES AFFECTING THE DANUBE DIRECTLY

On the territory of the Hungarian People's Republic:

Construction site in installation, Dunakiliti

A biological treatment plant with the capacity of 115 cubic m per day was built as an investment connected with the G/N Project

Oil industry plant Komarom, works Szony

Mechanical treatment plant for cleaning of wastewater polluted with oil products, capacity of 20 000 cubic m per day. In 1983 it produced cca 10 000 cubic m per day of clean waste water, containing 51 T of crude oil every year. In 1984, oil processing was suspended.

Bauxite works, Almásfüzito

Mechanical WWTP with capacity of 9 500 cubic m per day. Quantity of released pollution in $CHSK_{cr}$ is 160 T per year.

Oil industry Komárom, works Almásfuzito

Mechanical-chemical WWTP with capacity of 22 000 cubic m per day 9 000 cubic m is cleaned everyday. The amount of released organic pollution in $CHSK_{cr}$ is 240 T per year.

Paper mill, Lábatlan

In the factory 1, there is floating treatment equipment with the capacity of 2 000 cubic m per day. A biological WWTP for wastewater from lavatories has been built with capacity of 200 cubic m per day. Wastewater production is 20 000 cubic m per day and its $CHSK_{cr}$ of their water is 20 T per year.

Municipality of Lábatlan

A mechanical WWTP has been built for the village itself and surrounding factories. The capacity is 470 cubic m per day. Waste water after cleaning has the $CHSK_{cr}$ 180 T per year.

Hungarian works Viscosa, Nyergesújfalu

Wastewater from lavatories and a part of industrial waste water /polyamide, pan/ are being treated by a complete oxidation treatment plant with the capacity of 4 200 cubic m per day. 1 600 T of organic substances (in the $CHSK_{cr}$) per year is released from the plant to the recipient.

On the Czechoslovak territory

The town of Komárno

Every year 5,5 milion cubic m of waste water is produced by the town. The water is being treated mechanically. The pollution released is cca 400 T per year (in BSK_5).

South Slovakian pulp and paper mills, Štúrovo

The enterprise disposes of mechanical-chemical-biological WWTP with 95% efficiency. Rest of pollution in BSK_5 reaches annually 4 100 T.

2.4 NUMBER OF WWTP UNDER CONSTRUCTION

31 WWTP, 13 of them municipal, were under construction in the referred-to basins in Czechoslovakia by Dec. 31, 1984.

WWTP under construction in separated basins are categorized as follows:

Basin	Municipal	Industrial	Total
Danube CSSR	4	6	10
Váh	6	6	12
Hron	2	5	7
Ipeľ-CSSR	1	1	2
Total	13	18	31

The WWTP will be put into operation gradually in 1985 and later according to the term of completion of construction. At expected average efficiency as to BSK_5 90%, the remaining pollution released to recipients will be 2 600 T per year.

On the territory of Hungary, 8 WWTP, 5 municipal and 3 industrial, were under construction in the evaluated period.

WWTP under construction in separate basins are categorized as follows:

Basin	Municipal	Industrial	Total
Mosoni Duna	4	-	4
Cuhai-Bakony-ér	-	-	-
Concó	-	1	1
Által-ér	-	2	2
Kenyérmezei patak	-	-	-
Ipeĺ-Hungary	1	-	1
Total	5	3	8

After the WWTP are put into operation, the rest of pollution released to recipients will be 2 000 T per year ($CHSK_{cr}$).

2.5 WWTP UNDER CONSTRUCTION AT THE POLLUTION SOURCES ON THE DANUBE

On the Czechoslovak territory at the end of 1984, the following WWTP were under construction:

Slovnaft Bratislava

Mechanical-chemical-biological WWTP will treat cca 10,5 milion cubic m of wastewater per year. At present operation trials, outstanding efficiency proved by the fact that instead of 480 T only 7 T of oil products will get into the Danube per year.

Chemical works of J.D.Bratislava

A new mechanical-chemical WWTP is under construction which will neutralize 15,7 milion cubic m of wastewater per year.

On the territory of Hungary in 1984, no WWTP were being in the construction.

Bratislava/Budapest, March 1985

(Translation)

RECORD

FROM THE EXTRAORDINARY NEGOTIATIONS OF THE WORKING GROUP FOR PROTECTION OF WATER PURITY OF BORDER RIVERS OF THE CZECHOSLOVAK-HUNGARIAN COMMISSION FOR ECONOMY AND SCIENCE.
PALÁRIKOVO, FEB. 20-24, 1989

The negotiations were held following the meeting of the Minister for forestry, water management and wood processing industry of the Slovak Socialist Republic, Mr. Margetin, and, the Minister of environment protection and water economy of the Hungarian People's Republic, Mr. Maróthy, held on Jan. 19-21, 1989 in Bratislava.

The list of participants - Annex 1.

The agenda of negotiation

1. Final solution of disputable questions related to the determination of the area affected by the G/N Project operation.
2. Specification of number of indicators of water quality.
3. Specification of the wastewater treatment plants programme.
4. Discussion on methodology of analytical procedures concerning some of the water quality indicators .
5. Determination of further work related to protection of water purity in the operation of the G/N Project.
6. Information of the Czechoslovak party on accidents of tankers on the Danube in January 1989.

Ref.1

Among the unsolved issues, upon which we did not reach agreement at the extraordinary session at Tiszafüred, held on Jan. 9-13, 1989, was the determination of the area affected by the G/N Project from the point of view of water quality. The affected area from a water quality viewpoint is defined by the area covered by backwater of the G/N Project and the area adjacent to the original river bed of the Danube. This water area should be protected against pollution and be under inspection to monitor possible changes of water quality. (The water area formed by backwater is defined by the Joint Contractual Project).

The main sources of pollution which have serious impact on the quality of water shall be defined separately by each party. The construction of wastewater treatment plants will be checked by the common working group for the protection of the water purity in the booundary waters.

The control of the impact of pollution sources on the affected area will be carried out directly at estuary or in control profiles at the tributary estuaries.

The Hungarian part of the working group believes it necessary to develop an endeavour aimed at reducing release of pollutants into the Danube and in its tributaries also before the affected area.

Ref.2

The Hungarian part of the working group confirmed, that in 1989 it would follow the water quality to the extent mentioned in the Annex 3 - the record of the extraordinary session of the working group for the protection of water purity of border rivers of the Czechoslovak-Hungarian Commission for economy and science, held on Jan. 9-13, 1989, at Tiszafüred.

In discussing this issue, the Czechoslovak part of the working group informed that it would, during 1989, monitor four times the parameters quoted in the numbers 32, 33, 35 and 44-46 in the profile of Bratislava - the bridge of SNP, Komárno - the road bridge, Szob -the bridge (in the middle of the river).

The parameter 10 - Ligninsulfone acid, will be monitored by the Hungarian part only.

The joint working group believes that it is inevitable that the instantaneous discharge will be required to be measured at agreed profiles for purposes of separate samples of water quality evaluation.

Ref.3

The Czechoslovak-Hungarian Commission for boundary waters attended and will permanently attend to the protection of water quality. In 1984, the government plenipotentiaries charged the working group concerned with the protection of water purity of border rivers to elaborate an information on realized and planned measures centered on the protection of the water quality in the Danube especially pertaining to the G/N Project construction. This basic document was approved by the government plenipotentiaries in Sept.1985. Every year, it is reassessed and modified.

The information provides a survey of realized protective measures on the territory of both states in the river basin on both sides of the Danube since 1984.

In the respective basins on the Czechoslovak territory, 620 wastewater treatment plants have been constructed to this point. Already in that period, 77% of pollution sources disposed of wastewater treatment plants. In the Hungarian part of the Danube basin, 213 wastewater treatment plants were in operation by the end of 1984. Thus 78% of pollution sources were equipped with wastewater treatment plants.

The information also contains measures, which are to be realized in the area of interest by the end of 1990, with a perspective till 1995.

On the basis of the measures which have been completed, a programme of the development of water quality has been worked up. It concerns the Danube and its tributaries till 1995 as compared to 1983.

The above mentioned data prove the care of both states protecting water purity in the Danube even in the past.

The completed and planned measures are a basis for elaboration of a project of wastewater treatment stations necessary for the improvement of the water quality. Annex 2 contains data on investment, measures that were to be carried out in Czechoslovakia in connection with the operation of the Project in 1990, 1992 as weell as measures which are to be completed by 1997. The proposed measures should be used as a basis for the preparation of an intergovernmental agreement on the construction of wastewater treatment plants. Annex 3 contains those wastewater treatment plants that were built by Hungary in 1985 - 1988 and that are scheduled to be built from 1989 to 1993.

The completion of the proposed measures on the Czechoslovak territory will reduce the quantity of released organic pollution by 6 286 tonnes every year as expressed in (BSK_5) and on the

Hungarian territory by 25 730 tonnes every year as expressed in CHSK.

The Czechoslovak part of the working group notes that the wastewater treatment plants have been put into operation on the Danube as follows:

1. Mechanical-chemical-biological plant at Slovnaft Bratislava (reduction of crude oil substances by 473 T per year, or 1,3 tonnes a day).
2. Mechnical-chemical-biological station at CHZJD Bratislava (neutralization of wastewater - 15,7 milion cubic meters per year).
3. The central wastewater treatment plant in Bratislava - left river side (reduction of organic pollution by 7 790 tonnes per year, or 21,3 tonnes a day). Additionally, 8 plants have been completed in the affected basins in 1986-87.

The Czechoslovak part of the working group furhter noted the completion of construction of 37 plants in accordance with the plan for 1986-1990 for the protection of the water purity on the Czechoslovak territory. They will be put into operation gradually by 1995.

The Hungarian part of the working group requests that the Czechoslovak part submits by the next session, a precise list of 37 stations with the data quoted in the table 2, the construction of which will start in 1986-1990 and that will become operational gradually by 1995.

Ref. 4

Most indicators of water quality will be set up in accordance with methods previously agreed upon in the framework of bilateral cooperation or in the framework of the Declaration on the Danube. For this reason it would be necessary to clarify the methods of monitoring of transparency, chlorophyll, some parameters of organic micropollution and heavy metals. By specifying the methods, it was agreed as follows:

- Rating of transparency will be carried out in a lab with use of a glass cylinder. The result will be expressed in centimeters of water layer
- The principles of rating of indicators of organic micropollution (determined in points 32 - 36 of the list of

indicators - Annex 3 to the record of Jan.9-13,1989). It has been agreed, that the rating would be carried out according to methods of EPA (601, 608, 610 of 1984). Concrete selection of evaluated compounds will be done on the basis of a common analysis at the beginning of monitoring.

- Methods of primary preparation of samples for heavy metals rating have been agreed upon.
  For the analysis centered on heavy metals a filtered sample will be used (0,45 mm filter), the sample will be collected in a plastic sample container. The analysis of heavy metals contained in alluvia will be done from an extract after a slight acidification.
- The rating of chlorophyll will be carried out from acetone by spectrophotometrical measuring at the wavelength of 663 NM, after subtraction of the value of turbidity measured at the wavelength of 750 NM, without the correction of the values of chlorophyll b and chlorophyll c.
- In order to compare practically the results and, if necessary, to modify methods, a session of representatives of the cooperating labs will be held in Bratislava, in May 1989.

Ref. 5

The working group has judged another set of tasks in the sphere of water protection, in the construction of the G/N Project, that must be done not later than in 1989. These tasks must be completed in order to accomplish the objectives set out in the documents

a/ adopted by the government plenipotentiaries of Czechoslovakia and Hungary for the boundary waters (Topolčianky, Dec.8, 1988) or

b/ by respective ministers of the Slovak and Hungarian governments (Bratislava, Jan. 21, 1989).

From the discussions, the working group concluded the tasks to be completed in 1989:

- Determination of extension of water quality monitoring in the agreed area in 1990 - 1992 (control profiles, frequency and methods of extraction of samples, extension of indicators). These tasks must be worked up in close cooperation with authorities responsible for the G/N Project construction.

- Determination of methods and procedures for processing of basic data in determining primary quality of water and the way of mathematic assessment of changes. With regard to the character and content of the task, it will be necessary for experts in the field of programming of mathematic models to take part in the preparation of respective models.
- Elaboration of the proposal on organization and technical solution and reduction of negative impact of accident pollution in the area of the G/N Project.

With regard to the character of the tasks above mentioned, the working group proposes to the gov. plenipotentiaries that they organize an extraordinary session of experts in which the heads of the common working group for the protection of water purity participate. Terms and place of the session will be agreed upon later.

This protocol has been written in Slovak language in 4 copies, each party having received two copies.

Palárikovo, Feb. 24, 1989

(Signed) Kazimír Šárnik	*(Signed)* György Simonfai
Head of the CS	Head of the Hungarian
part of the working group	part of the working group

Annex 1

LIST OF PARTICIPANTS

The Czechoslovak part of the working group:

Kazimír Šárnik - the head of the CS part of the working group - Ministry of forestry, water economy and wood processing industry
František Dohnalík - Ministry of forestry, water economy and wood processing industry Bratislava, (Partial participation)
Ivan Závadský - Ministry of forestry, water economy and wood processing industry Bratislava
Ján Ardó - VÚVH Bratislava
Ján Šesták - PBH, Košice
Ľuba Draková - VÚVH Bratislava (partial participation)
Igor Líška - VÚVH Bratislava
Blažena Tarandová - ŠF VH Bratislava

The Hungarian part of the working group
György Simonfai - the head of the Hungarian part of the working group, KVM Budapest
Emil Katona - KVM Budapest
László Balázs - KVM Budapest
Margit Ábrahám - Kovizio Györ
Pál Varga - Kovizig Györ
Sámuel Papp - Interpreter

LIST OF WASTE WATER TREAT MENT PLANTS (WWTP) CONSTRUCTED AND SCHEDULED ON THE AREA AFFECTED BY THE G/P PROJECT

Source of polut ion	Recipient River	Quantity of wastewater Thous.m3/year)	BSK 5 T per year	Other pollutants T per year	Investment measures	Budget mio Kčs	Compl. of construction year	Share on the reduction of polut.	Present way of treatment
2	3	4	5	6	7	8	9	10	11
ar 1990					Mechanical step WWTP Petržalka				
ar 1992									
Danube Bratislava-Petržalka	Danube	19 229	3 520		Construction of WWTP mechanical step whole construction	333,3	1990 1992	3 100	No treatment MB WWTP
JCP Štúrovo	Danube	28 500	7 435	8 122 NL	Final construction of primary treatment equipment	15,0	1992	700 NL	
Váh VK Kolárovo	Canal Aszód-Čergov	673	35		Construction of MB WWTP	15,0	1992	20	Mechanical WWTP
After 1992									
Danube VK Šamorín	Danube reservoir	1 250	77		Expansion of WWTP	55,0	1994	9	MB WWTP

2	3	4	5	6	7	8	9	[illegible]	[illegible]
- VK Gabčíkovo	Danube tailwat. canal	246	7		Expansion of WWTS	[illegible]	[illegible]	-	[illegible]
- Bratislava-left side estuary at Karl.Ves-Bridge ČA	Danube	6518	991		Reconstruction of A-collector, winter port-Lafranconi I.constr. II.constr.	100,0 85,0	1993 1995	726 265	No treatment
- CHZDJ Bratislava	Danube	11 000	2 310	Solub. substan. 331	Segregation of wastewater and Biol.WWTP	90	1995	500	Mech.a.chemical WWTP
- VK Štúrovo	Danube	1 860	620		Construction of mech.a.biol.WWTP	70	1997	526	No treatment
- Váh ZVL Kolárovo	Váh	60	3	Solubl. substanc.	WWTP from plating plant	22,0	1993		Neutral.station
- VK Komárno	Váh	5 933	501		Construction of WWTP, Komárno-East	62,0	1994	306	Mech.WWTP
- Meat industry Komárno	Váh	65	104		Jonction to a new WWTP Komárno-East	10,0	1994	104	Mechan.WWTP
Sugar reffinery Šurany	Stará Nitra	1 524	427	120-NL	Construction WWTP	105,0	1995	350 100-NL	No treatment 100 days
- Hron Sugar Reffinery Pohronský Ruskov	Hron	1 555	476	670-NL	Construction of WWTP and recycling of wastewater	80	1997	380 500-NL	No treatment 100 days
Total						1052,3		6286	

	Source of polution	Recipient River	Quantity of wastewater (m3/day)	CHSK kg/day	Other pollutants kg/day	Investment	Capacity WWTP m3/day)	Budget Mio Ft.	Compl. of construction year	reduction of CHSK kg/day)	Actual state of wastewater treatment	Note
1	2	3	4	5	6	7	8	9	10	11	12	13

SURVEY OF WASTE WATER TREATEMENT PLANTS (WWTP) AND OTHER MEASURES REALIZED IN THE PERIOD 1985 - 1988

	Source of polution	Recipient River	Quantity of wastewater (m3/day)	CHSK kg/day	Other pollutants kg/day	Investment	Capacity WWTP m3/day)	Budget Mio Ft.	Compl. of construction year	reduction of CHSK kg/day)	Actual state of wastewater treatment	Note
	Local											
1.	Szob	Danube	500	200		Biological WWTP	1 000	40,0	1987	150		
2.	Nagymaros-Verőcemaros	Danube	1 000	400		Connection to WWTP Vác	-	120,0	1988	400		WWTP Vác
3.	Mosonmagyaróvár	Mosoni Danube	4 000	1 000		Biological WWTP	6 000	49,0	1988	600	Mechanical WWTP	
4.	Csorna	Keszeg-ér (basin of Mos.Danube)	1 700	800		Expansion of biological WWTP	2 000	34,0	1986	600	BWWTP	
5.	Kapuvár	Kis Rába (basin of Mos.Danube)	2 300	1 200		expansion of biological WWTP	1 200	51,0	1986	900	BWWTP	
6.	Sopron	Ikva (basin of Mos. Danube)	15 500	5 800		expansion of biological WWTP	15 000	81,0	1987	3 550	mechanical WWTP	
7.	Szentgotthárd	Rába (basin of Mos.Danube)	1 000	400		Connection on WWTP		20,0	1988	300		WWTP in Austria
8.	Babolna	Cuha Bakonyér	600	240		Biol.WWTP	600	40,0	1987	180		
9.	Zirc	Cuha Bakonyér	1 000	400		Biol. WWTP	1 000	20,0	1986	300		
10.	Kisbér	Cuha Bakonyér	400	160		Biol. WWTP	400	12,0	1987	120		
11.	Balassagyarmat	Ipel	3 000	1 200		Biol. WWTP	3 000	20,0	1988	1 000		
	Industrial:											
12.	Csorna-milk industry	municipal sewer system	100	400		primary cleaning	100	14,0	1988	300		
13.	Csornai Volán	municipal sewer system	40			primary cleaning	40	4,0	1988			

1	2	3	4	5	6	7	8	9	10	11	12	13
14.	Győr - Freezing plant	municipal sewer system	400			primary cleaning	40	1,0	1986			
15.	Mosonmagyaróvár Machinery plant	Mosoni Danube	300		metals-3	reconstruction of chem. WWTP	300	40,0	1987	metals-3	chem. WWTP	Cu, Zn, Cr, Ni
16.	Petőház Sugar Refinery	Ikva (basin, Mosoni Danube)	3 000	2 100		expansion of chem. WWTP	3 000	40,0	1988	800	mech. WWTS	
17.	Oroszlányi Volán	municipal sewer system	50			primary cleaning	50	4,0	1988			
18.	Bokod - heating plant	Által ér	2 000			water recycling	2 000	10,0	1988			
19.	Tatabanya - coal mines	Által ér	3 500	2 250		mechanical treatment sedimentation tanks	3 500	140,0	1988	1 900		
20.	Tatabanya Mikrolin	municipal sewer system	380			primary cleaning	400	3,5	1987			
21.	Dorog - Kőgyo	Kenyérmezei patak	2 000	14 400		biol. WWTP	2 000	140,0	1988	5 000		
	TOTAL		42 770	30 950			41 630	944,5		16 050		

	Source of pollution	River Recipient	Quantity of sewage water (m^3/day)	CHSK (kg/day)	Other pollutants (kg/day)	Investment	Capacity STP (m^3/day)	Budget Mil.FT.	Compl. of constr. year	reduction of CHSK (kg/day)	Actual state of sewage treatment	Note
1	2	3	4	5	6	7	8	9	10	11	12	13
	Survey of sewage treatment plants (STP) and other measures to improve the water quality and realized in the period of 1989-93											
	Local											
1.	Komárom	Dunaj	4 200	1 900		BSTP	6 000	550,0	1992	1 500		
2.	Almásfüzitő	Dunaj	450	150		linking to STP x		30,0	1993	100		x STP Komárom
3.	Esztergom	Dunaj	7 000	2 400		BSTP	12 000	689,0	1992	1 800		
4.	Dömös	Dunaj	200	80		linking to STP x		200,0	1992	80		x STP, Vác
5.	Pilismarót	Dunaj	100	40		linking to STP x		200,0	1992	40		x STP Vác
6.	Szob	Dunaj				expansion of BSTP	1 000	50,0	1993		BSTP	
7.	Zebegény	Dunaj	200	80		linking to STP x		30,0	1989	40		x STP Szob
8.	Győr	Moš. Dunaj	80 000	50 000		BSTP	80 000	3 028,0	1993	42 000		
9.	Oroszlány	Által ér	6 600	1 000		expansion of BSTP III. step	4 000	350,0	1990	900	BSTP	
10.	Tatabánya	Által ér	26 300	4 000		expansion of BSTP III. step	6 000	220,0	1990	2 700	BSTP	
11.	Szécsény	Ipel	500	200		BSTP	500	15,0	1992	150	mechanical STP	

1	2	3	4	5	6	7	8	9	10	11	12	13
	Industrial											
12.	Almásfüzitő - hliníkáreň	Dunaj	9 000	400		expansion of water recirculation	9 000	40,0	1992		mechanical STP	
13.	KKV Szony, závod B 12	Dunaj	6 700	5 000		BSTP	1 000	100,0	1992	4 500	mechanical STP	
14.	Lábatlan - papiereň	Dunaj	17 400	5 400		change of technology		50,0	1992	2 000		
15.	Nyergesujfalui Viscosa	Dunaj	14 000	4 600		expansion of BSTP	4 000	200,0	1992	2 000	BSTP	
16.	Nyergesujfalui Eternitgyár	Dunaj	2 140	120	2 000 NL	expansion of mech. STP	2 000	50,0	1992	1 860 NL		
17.	Győri Szeszipari Vállalat	Mos. Dunaj	16 000	9 200		dept. of cooling waters, linking to ver. canalization		60,0	1992	1 600	evaporating unit	
18.	Kapuvári AHV	Kis Rába	1 600	4 000		expansion of BSTP	1 200	80,0	1992	2 000		
19.	Sárvári ATEV	Rába	380	200		expansion of STP		40,0	1992	100	BSTP	
20.	Sárvár, cukrovar	Rába	8 000	2 200		change of technology		90,0	1991	1 200	mechanical STP	
21.	Ászár, škrobáreň	povodie Concó	1 400	2 200		irrigation with sewage water		24,0	1989	2 000		
22.	Szolnok, galvanizovňa "Új élet"	Kenyérmezei patak	25		metals 2,5	expansion of CHSTP	25	25,0	1992	kovy 2,5 1,5	CHSTP	
23.	Sárisápi Alugrafika	Kenyérmezei patak	620		copper 12	CHSTP	620	17,0	1989	copper 3,2		
	TOTAL:		202 815	93 170			127 345	6 138,0		70 510		

Annex 4

Annexes of the session of the Czechoslovak-Hungarian working group for the protection of quality water, held on Jan. 9-13, 1989, at Tiszafured

PLACE OF SAMPLE TAKING

River	Place of taking sample	Profil	Charakter of sample	
Danube	Bratislava	road bridge	1871 rkm	RML
	Rajka		1848 rkm	RL
	Medveďov	road bridge	1806 km	M
	Komárno	road bridge	1770 km	RML
	Szob		1710 km	RML
	Visegrád		1690 km	RML
Mosoni Danube	Vének			M
Concó	ÁCS	road bridge		M
p.Kenyérmezo	Dorog	road bridge Táti		M
Váh	Komárno	road bridge		M
Hron	Kamenice n/H	road bridge		M
Ipeĺ	Letkés-Salka	road bridge		M

Remarks:
RML - right side, middle, left side
M - middle
R - right side
L - left side

Water samples taking from the Danube will be carried out by both parties together, only, besides the profile in Visegrad, where the Czechoslovak part of the working group will be asked to execute two common control takings. Methods of samples will be agreed upon by cooperating labs.

Collecting samples on tributaries will be done by each party separately. Both parties are entitled to demand that the other party executes a common control taking sample twice.

Water samples analysis will be done by each party separately in its labs. In 1989, sediment samples will be taken 3 times near the river side at Bratislava, Komárno and Szob. On the basis of them, both parties will assess:
- total iron
- manganese
- zinc
- copper
- chrome
- lead

The Hungarian party will carry out complementary assessment of the parameters as follows:
- mercury
- nickel
- arsenic
- oil products
- polycyclis aromatic carbohydrates
- PCB
- AOX
- radiochemical analyses

Water quality parameters

Physical-chemical parameters

1. - water temperature

2. - transparency
3. - insoluble substances
4. - pH
5. - insoluble oxygene
6. - oxidability ($KMnO_4$)
7. + oxidability (K_2, Cr_2, O_7)
8. - BSK_5
9. + dissolved organic carbon (DOC)
10. - ligninesulfonic ACID
11. 0 specific electrical conductance
12. - dissolved substances
13. 0 alkalinity
14. 0 hardness
15. 0 chlorides
16. 0 sulphates
17. 0 hydrogene carbonates
18. 0 calcium
19. 0 magnesium
20. 0 potassium
21 0 natrium

<u>Parameteres of utilization</u>
22. - ammonia
23. - nitrites
24. - nitrates
25. + nitrogen totally
26. - orthophosphates
27. - phosphorus totally
<u>Organic micropollution</u>
28. - phenols
29. - anioactive detergents
30. - oil products - UV spectizoforometrically
31. - adsorbed chlorinated organic sompounds
32. + organic chlorinated pesticides
33. + triazine pestcides
34. + volatible chlorinated carbohydrates
35. + PAH
36. - PBC
<u>Anorganic micropollution</u>
37. - iron
38. + manganese
39. - zinc
40. - copper
41. - chrome (VI)
42. - lead
43. - cadmium
44. + mercury
45. + nickel
46. + arsenic
<u>Biological parameters</u>
47. - saprobe index
48. - chlorophyll
49. - total number of algae
50. + list of species of algae
<u>Microbiological parameters</u>
51. - coliform germs
52. - mezofile and psychrofile germs/20 and 30°C

53. + excrement coliform germs
54. + excrement streptococcus
55. + clostridium
<u>Toxicological parameters</u>
56. + dafnie magna-toxicity
<u>Radioactive parameters</u>
57. - total beta activity
58. - + gama specter
59. + tritium
60. + stroncium
<u>Mass specter</u>
61. + identification of mass specter

Remarks:

- indicators monitored together in 1989

+ indicators that will be monitored in 1989 by the Hungarian party, only

0 indicators, that will be taken from previous monitoring

(Translation)

P R O T O C O L

ON THE 48-TH SESSION OF THE WORKING GROUP FOR PROTECTION OF WATER PURITY IN BOUNDARY RIVERS OF THE CZECHOSLOVAK-HUNGARIAN COMMISSION FOR ECONOMY AND SCIENCE, HELD IN TATR.ŠTRBA ON OCT.31-NOV.4,1988

The session was held in accordance with the time table for 1988, completed by the decision of the XLIX.Session of the CS-Hungarian Commission for economy and science /Pécs, June 14-17, 1988/

The agenda of the session:

1. Mutual information on results of monitoring of Beta-activity of the Danube water in 1988 and unification of methods of analysis and assessment of samples.
2. Discussion on methods of evaluation of the quality of the Danube water in the period after the G/N Project is completed and put into operation.
3. Information of the Czechoslovak part of the working group on measures aimed at reduction of pollution in the river of Slaná, emanating from the papermill at Gemerská Hôrka.
4. Discussion on the problems connected with the influence of drinking water supplies in the basin of Bodva on the border profile of Bodva on the Czechoslovak territory.
5. Negotiation regarding problems of radioactivity of water profiles creating border, that could be influenced by planned nuclear plants and nuclear plants in construction.
6. Miscellaneous.

Ref. 1/

The working group states that the cooperating labs (VÚVH Bratislava and VITUKI Budapest) carry out the monitoring of Beta-activity in the way and extent, adopted by the 46th session of the working group for the protection of water purity of border waters.

With regard to the discussion, the working group stated that the adopted methods were acceptable and made possible to assess the level of Beta-activity in the Danube. The results of the assessment will be incorporated into the general analysis of the water quality in the Danube since 1988. The analysis will be based on COMECON norms.

Unified results, including physical-chemical, microbiological and biological, will be handed over to the Romanian authorities in accordance with the declaration which was signed in Bucharest.

Ref.2/

In the course of discussions, the delegates clarified their positions concerning the problems of monitoring and assessment of the Danube water quality after the construction of the G/N Project is completed. With regard to the principles of the common contractual G/N project, the Hungarian part of the working group, submitted in writing the proposal on monitoring of the water quality in the Danube after the completion of the G/N Project.

The Czechoslovak part of the working group shall discuss the proposal with competent Czechoslovak authorities and submits its standpoint not later than at the 50th session of the working group.

The working group concluded that a solution to the above mentioned problems was a priority and in accordance with the Agreement on cooperation at boundary waters between Czechoslovakia and Hungary and with the principles approved by the interstate treaty between the Czechoslovak Socialist Republic and Hungarian People's Republic concerning the construction and operation of the G/N Project. In that this problem is very complex, the working group proposes an extraordinary session in 1989, with participation of the working group and the delegates responsible for the construction and operation of the G/N Project. The session will be held after approval of the government plenipotentiaries for border rivers.

In Tatranská Štrba, November 4, 1988

(Signed) Kazimír Šárnik *(Signed)* György Simonfai

Annex 54

Record of negotiations between the Czechoslovak and Hungarian Plenipotentiaries for Border Waters, 7-8 April 1989

(Translation)

R E C O R D

OF NEGOTIATIONS BETWEEN ING.VLADIMÍR MARGETIN, THE PLENIPOTENTIARY OF THE CZECHOSLOVAK GOVERNMENT FOR BORDER WATERS AND DR. MIKLÓS VARGA, THE PLENIPOTENIARY OF THE HUNGARIAN GOVERNMENT FOR BORDER WATERS, HELD AT BUDAPEST ON APRIL 7-8, 1989.

Other participants of the negotiation:

Czechoslovak party:

Karol Ujházy	CS Embassy
Kazimír Šárnik	Ministry of forestry, water managem. and wood processing industry
František Dohnalík	Ministry of forestry, water managem. and wood processing industry
Emília Oravcová	Ministry of forestry, water managem. and wood processing industry
Jozef Fury	Danube Basin

Hungarian party:

Zorkóczy Zoltán	KVM
Katova Emil	KVM
Papp Kálmán	KVM
Halász István	KVM
Réti Sadorné	OVIBER

In the course of negotiations the plenipotentiaries discussed problems of water quality and water treatment connected with the construction of the G/N Project.

The plenipotentiaries discussed further the content of the record of the extraordinary session of the working group for the protection of quality of water purity of border flows, held in Palárikovo on Feb. 20-24, 1989, adopted with the modifications as follows:

1. In connection with the last section of the point 1 of the record, the delegates took the position that both parties regard as necessary the reduction of pollution of the Danube water and its tributaries also before the area affected by the construction of the G/N Project.

2. In connection with the last section of the point 3 of the record, the plenipotentiaries agreed, that in order to monitor the process of construction of WWTP, the Czechoslovak party would provide information on chosen WWTP, as it results from the scheme 2 of the record from Palárikovo, that would be put into operation by the end of 1993.

3. The plenipotentiaries agreed, that the CS party would gradually provide data on scheduled and realized WWTP on the Czechoslovak territory in the Morava river basin.

The plenipotentiaries informed each other that they had ordered the launching the common project of water quality monitoring according to the adopted extend and methods for the area affected by the construction of the G/N Project apart from April 1, 1989.

They accepted the term of the subsequent session of the working group for the protection of water quality of border flows, that would be held on April 10-14, 1989, in Siofok. They charged the heads of working groups to fulfil the tasks resulting from this record.

This record has been written in two copies, in Slovak and Hungarian languages, both of them being equally authentic.

At Budapest, April 8, 1989.

(Signed) Vladimír Margetin
CS government plenipotentiary

(Signed) Miklós Varga
Hungarian government
plenipotentiary

Annex 55

(Translation)

Draft Protocol of negotiations of the heads of the Czechoslavak-Hungarian Committee for Economic and Scientific-Technical Cooperation, 3 May 1989

Report for the Czechoslovak-Hungarian Committee for Economic and Scientific-Technical Cooperation on Measures in the Sphere of Environmental Protection in connection with the Construction and Operation of the G/N Project, 8 April 1989

(Translation)

DRAFT PROTOCOL (RECORD)

OF NEGOTIATIONS OF THE HEADS OF THE CZECHOSLOVAK-HUNGARIAN COMMITTEE FOR ECONOMIC, SCIENTIFIC AND TECHNICAL COOPERATION OF MAY 3, 1989

The heads of the Czechoslovak-Hunarian Committee for economic, scientific and technical cooperation (further committee only) met on May 3, 1989, and examined, the construction of the Gabčíkovo Project on the Czechoslovak side. They were informed of the development of work and stated, that work was carried out in accordance with the common contractual project.

The list of participants of the session and construction site examination is enclosed.

The heads of both parts of the committee discussed the fulfiment of objectives concerning environment protection in relation to the G/N Project, as per the requirements of point 1.3 of the protocol of the XXIII. session of the committee, held in Prague on March 2-3, 1989.

1. The heads of both parts of the committee regard the report by the Slovak minister of forestry, water management and wood processing industry and the report by the Hungarian minister of environment protection and water management as the basis for the next steps toward fulfillment of the objectives.
2. The heads of both parts of the committee confirmed their previous agreement resulting from the treaty between Czechoslovakia and Hungary, to prevent the deterioration of water quality as a result of operation of the G/N Project.
3. The heads of both parts of the committee, on the basis of the proposal of ministers and with regard to the importance of enviroment protection in both states, agreed, that a separate agreement should be concluded in order to protect the Danube water in particular. The agreement must be in accordance with the interstate treaty on the construction and operation of the Project.

The heads of the committee concluded that the intergovernmental agreement should be based on the following principles as follows:

a) Protection of water quality

- the contractual parties agreed that monitoring and evaluation of water quality in the Danube on the elevation area of the G/N Project in the original river bed will be done to the extent and in the manner determined by the governmental delegates for boundary rivers and according to the agenda prepared for 1990-1993
- respective organs of the contractual parties will define limit values of separate indicators of water quality on the basis of several year monitoring of water quality in the Danube. This data will be regarded as a basis for analyses of water quality.

b) Operation of the Project

- the contractual parties will agree on a programme for the construction of wastewater treatment plants on the affected area. Fulfilment of the programme will be verified every year by the government plenipotentiaries for boundary rivers.

c) Nature and environment protection

- respective authorities of the contractual parties will, with a particular emphasis on the original river bed of the Danube, take care of the Danube bed, so that , besides water flow regulation and conditions suitable for the operation of the Project, it will be possible to consider also demands on conservation of environment.

d) Information

- The contractual party will accept obligation concerning the information of the public about the development of ecological conditions with a particular respect on water quality

4. The heads of both parts of the committee will charge the minister of forestry, water management and wood processing industry of Slovakia and the minister of the environment protection and water management of Hungary and the government delegates for the G/N Project with the preparation of a draft on intergovernmental agreement:

a) that will specify problems of water purity according to this text.

b) which will be prepared by the end of June 1989.

This record was done on May 3, 1989 in Slovak and Hungarian languages, both copies being equally authentic.

(SIgned) Pavel Hrivnák *(Signed)* Péter Medgyessy

(Translation)

R E P O R T

FOR THE HEADS OF THE CZECHOSLOVAK - HUNGARIAN COMMISSION FOR ECONOMIC, SCIENTIFIC AND TECHNICAL COOPERATION ON MEASURES IN THE SPHERE OF ENVIRONMENT PROTECTION IN CONNECTION WITH THE CONSTRUCTION AND OPERATION OF THE G/N PROJECT.

Minister of forestry, water management
and wood processing industry of the Slovak
Socialist Republic

Minister of enviroment protection and
water management of the Hungarian People's
Republic

Bratislava, Budapest, April 1989

At the XIII. Session of the Czechoslovak-Hungarian committee for economic, scientific and technical cooperation, held at Prague on March 2-3, 1989, point 1.3. of the protocol was stated:

The parties agreed on the fact, that the operation of the G/N Project cannot negatively influence the environment adjacent to it, as the basic prerequisite must be the conservation of the water quality in the Danube.

The parties charged the minister of forestry, water management and wood processing industry of Slovakia and the minister of the environment protection and water management of Hungary in cooperation with the delegates for the construction and operation of the G/N Project, to work up and submit to the heads of both parts of the committee a concrete proposal of methods which will guarantee the above mentioned prerequisite by April 15, 1989.

The heads of both parties will discuss this proposal by the end of April 1989 and determine further steps.

PROPOSAL ON NEGOTIATION BETWEEN HEADS OF THE CS-HUNGARIAN COMMITTEE FOR ECONOMIC, SCIENTIFIC AND TECHNICAL COOPERATION, TO BE HELD IN APRIL 1989

The ministers approved the results of the negotiations of the delegates of the governments for boundary waters of April 7-8, 1989 according to which:

- They agreed upon the extraordinary project of water quality monitoring for 1989, in which, they would apply a system of monitoring and assessment of water quality which has been adopted with regard to the agreement on boundary waters completed with other parameters.
- They will examine the state of water quality of the Danube before filling the reservoirs.
- with regard to the principles adopted in the framework of the agreement on the boundary waters, they will carry out current monitoring according to unified methods as part of a common or coordinated project. Results of monitoring will be analyzed and registered. In case the results are unfavourable

they will take necessary measures after a mutual consultation.

With regard to extraordinary important and essential role of environment protection, with particular emphasis on the protection of water quality of the Danube, the ministers suggest a particular intergovernmental agreement uto be concluded to ensure that the construction of the G/N Project will be carried out in accordance with the interstate agreement and to it related governmental agreements.

The proposed intergovernmental agreement should be based on the principles as follows:

- The contractual parties will be required to monitor and analyze the state of the Danube water quality on the territory affected by the construction of the G/N Project to the extent and in the manner approved by governmental delegates for boundary waters on April 7-8, 1989 and in accordance with the programme for 1990-1993.
- Respective authorities of the contractual parties will determine limit values of separate water quality indicators on the basis of long-termed common monitoring of water quality in the Danube and the values gained by detail monitoring before the filling up of the reservoir at Hrušov-Dunakiliti in 1989. These values will be used as a basis for the assessment of deviations as to water quality and the operation of the G/N Project will be adjusted accordingly.
- The contractual parties will agree that peak operation may begin as late as the completion of the construction of installations necessary for the protection of water purity. The operational rules of the Project must take into consideration the conditions.
- In order to guarantee the above mentioned objectives, the parties will agree on a project of construction of necessary WWTP on the territory of both countries no later than before the commencement of the peak operation. The fulfilment of the agreed project will be verified every year by the governmental plenipotentiaries for boundary waters.
- The contractual parties will mutually accept the obligation of informing the public about the development of ecological conditions with a particular emphasis on water quality.

The schedule of works envisages establishment of a common working group of experts from both parties who will prepare draft agreement by the end of June 1989.

This report was done in two copies, in Slovak and Hungarian languages, both of them being equally authentic.

At Budapest, on April 8, 1989

(Signed) Vladimír Margetin	*(Signed)* László Márothy
Minister of Forestry, water management and wood processing industry of Slovakia	Minister of environment protection and water management of Hungary

Annex 56

(Translation)

Letter 19 March 1984 from Vice-Prime Minister (József Marjai) to the Chairman, Hungarian Academy of Sciences (Dr. János Szentágothai)

CONFIDENTIAL

Council of Ministers
of the Hungarian People's Republic

Ma-004/50-1-1984

Comrade
Dr. János Szentágothai
chairman
of the Hungarian Academy of Sciences
B u d a p e s t

Dear comrade Szentágothai,

The Prime Minister has submitted to me and, thus I had the possibility to study, the standpoint of the Presidium of the Hungarian Academy of Sciences concerning scientifically disputable questions related with the G/N System of water works.

I consider this standpoint for very important because, the Presidium of the Academy is the highest forum of our science and the construction of the System of water works is a matter of such an importance that the decisions of the Government should be taken with greatest carefulness.

I consider it my duty, dear comrade, to inform you repeatedly about the steps undertaken by the Government and to recall those demands which we had addressed to the Academy of sciences with the aim to rely in our decisions, on the work of scientific institutions directed by the Academy because we want to do so also in next stages of the construction of water works.

After decades of preparation works, the Government signed in 1977 the Treaty concerning the construction of the System of water works. It is without doubt that prognosis concerning our economic sources, investment possibilities were not adequate to the situation which arose later, but we have evaluated it in such a way that these difficulties would be only temporary. Therefore we signed an additional Agreement with Czechoslovakia the substance of which was that they would perform works also instead 471 of us and we would begin our investments only at the beginning of 80-ties.

With regard to difficulties caused by our economic situation which showed up to be permanent, we tried, at the beginning of 1981, to push for suspension of the investments up to 1990 and the negotiations referring on this subject with Czechoslovakia were started in February 1981. The reasons were first of all of economic character, but we wanted to refer as well to the need of further research of environmental impacts. Therefore comrade Borbándi addressed you already in March 1981 and demanded such a help of the Hungarian Academy of Sciences which would strengthen our positions during the negotiations.

The Commission of the Academy of Sciences, established on the demand of comrade Borbándi, did not provide such a help. This comes out from your letters of December 1981 with which you sent to me the report of Petrasovics and objections of the director of the Botanic research institute of Academy of Sciences against this report. In January 1982 I called on you referring to these written materials and our personal discussions and I asked you to accomplish further researches and elaborate a number of materials which would make possible real and practical consideration of ecological impacts in the Government decision making. I could not do otherwise but to set up, in this letter, a short term for accomplishment of these works because negotiations with Czechoslovakia already demanded it. Unfortunately the Hungarian Academy of Sciences gave us no utilizable material for interstate negotiations. This fact and its negative consequences for us were stated on 26.5.1982 by the Economic Committee which requested the cooperation of the Scientific-Political Committee.

I don't want to recall further our previous correspondence and I don't want to preoccupy you in recalling now all studies and standpoints elaborated before by the research institutes and different commissions of the Academy. These studies have in general confirmed that the concept and projects concerning the System of water works represent the most mature solution based on the actual scientific knowledge. It is true and possible that some more or less important worries can arise which were not sufficient for concrete measures or project modifications, we have nevertheless approached them with greatest cautiousness.

I recall to you that from comments and proposals of the Polinszki Commission (Academy commission) of April 1982 - even if they reflected different views - I had to pick up those which were promising to be utilizable during the ongoing negotiations with Czechoslovakia as arguments to support the need of postponement. The water balance of Szigetkôz and the change of designed navigation locks were such subjects. The government plenipotentiary convened for these questions the scientists representing the relevant scientific branches who participated in the work of the commission as well as experts with the aim to elaborate such qualified arguments which would make it possible to ask for the change of the Project an thus support our goal to postpone the works. In both cases it became evident that such arguments don't exist, they confirmed the existing valid concept and well-thought-out character of projects.

On the basis of the report of the Under Secretary General of the Academy, the Scientific-Political Committee in September and November 1982, and later, in summer 1983, the Council for environmental protection adopted such resolutions which started further research to find out eventual ecological damages, ways to eliminate them and to form the most favourable conditions.

Summarizing all this, I must state that the scientific workshops of the country participated in the large extent in the creation of the concept of the G/N System of water works and its projects. The Government relied, rely and will rely also in the future on the opinion of the commissions of the Academy of Sciences and on scientific researches of the Academy institutions which help the practice.

The Government did not reach its goal to stop the construction of the System of water works. It was not possible because in Czechoslovakia, according to the agreements of that time, the works not only started in 1977 but they progressed substantially. The suspension of works would have caused such damages that we could not even think to compensate them. But we have achieved that the term of completion of construction of water works was postponed by 4 years without any claim for compensation. It made possible that our costs expenses up to 1985 would be minimal in this investment. We succeeded to save 12 billions Forints in this critical period. We agreed with our Czechoslovak partners that both sides would be prepared to take into account all those justified and realistic demands which would arise during following stages of construction in the interest of the environmental protection. Both sides also considered that the close cooperation of both Academies is needed.

I hope, comrade president, that you agree with me that in view of available knowledge and possibilities the Government proceeded with great cautiousness and that it is willing to guarantee the political, economic and ecological and regional development interests of the country.

I would like to inform you, comrade President, that in coordination with Water Management Office all works envisaged by the resolution of the Council for protection of the environment and nature of 21.6.1983 the reference to which is made in the standpoint of the Presidium of Academy, are being performed.

I cannot avoid to comment on some specific statements contained in the Standpoint. First I would like to point out in general that the standpoint of the Presidium requests - besides the formulation of general demands - priority start of such researches which, in my opinion, had to be done logically before signing the interstate Treaty, but in any case at latest after the letter of comrade Borbándi of March 1981.

The Presidium elaborated his Standpoint among other things, on the basis of the fact that "the general threat to the environment, worsening of the quality of groundwater and surface water, farm land indicates worse tendency than it was prognosed." I must state that I am not informed about prognoses indicating the worse tendency. Such prognosis could be done only on the basis of researches accomplished by the institutes of the Academy of Sciences. Except studies done previously there are no newer studies which would confirm it. I don't consider it decisive but the latest analyses of our and foreign experience confirm that in such water works the quality of the discharged water is better that the quality of water entering the retention area.

As far the substance of point 2 of the Standpoint is concerned, the costs for elimination of ecological damages should be shared by both sides because investments cannot be left only with the party on the territory of which the measures should be realized.

The agreements indicate as joint investment only constructions directly related with the System of water works. Their considerable part cannot be separated from the environmental protection (protection structures, fortification of banks, seepage network etc.) but majority of these investments is qualified as so-called national investments. For example, the most important national investment of such character on our territory is the seepage network serving for regulation of groundwater of Szigetköz and region water work supplying the drinking water. The costs of these investments and other smaller structures not mentioned here are indicated in the complete investment budget.

Similarly oriented national investments are necessary also on the territory of Slovakia (regulation of water balance of the Danube Lowlands). According to the common analysis, their national investments are much more higher that ours. On both sides these investments contain also investments for prevention of damages and for development of infrastructure. Taking into account also this fact, we can assert with certitude that we have no substantiated claims against Czechoslovakia.

The necessary extra investments are considered in the Standpoint in a very large sense and it is considered as a fault that the investment tasks of the G/N System of water works does not contain them. The costs which are necessary for the construction of lacking infrastructure, for potential development of agriculture and forestry, for better utilization of recreation possibilities are not included in it. They are, certainly, connected with the construction of the System of water works, but they represent only partially additional possibilities, and partially independent investments.

The proposals for realization of such investments are mentioned in the point 2 of the Standpoint. I agree with them in general and we want to realize them within our material possibilities.

I want to mention two proposals:

- You propose that "waste waters on the adjacent territory must be treated up also biologically before the reservoir Dunakiliti-Hrušov is put into operation". I agree that the treatment of sewage waters in the whole country is very undeveloped and that the major part of them should be treated biologically. But I cannot agree that we would be able, in such a short period, to solve the problem of the biological treatment of sewage waters in the whole adjacent territory and neither that it is needed. Both countries committed themselves that the treatment of sewage water in this region will be solved in such an extent that the pollution of the Danube should not increase, but the water quality should even be improved considerably. We are informed that Czechoslovakia is constructing in the affected region a number of sewage plants. We also envisage to construct a sewage plant in Győr what was already discussed for a long time. But I must say repeatedly that it was not soundly proved by the research that the construction of the G/N System of water works would lead to the deterioration of the water quality and in particular that the supply of Budapest with drinking water would be threatened. Therefore without putting into doubts the need to enlarge the waste water treatment - I don't consider substantiated the demand for realization of investments of such an extent and in such a short time.

The same point of the Standpoint considers it necessary to create by means of regulation of the Old Danube "conditions for permanent functioning of realistically planned navigation route." The fulfilment of this demand is impossible. Due to the construction of the navigation canal, it is not possible to ensure such constant discharge of water in the old river bed which could enable the navigation. It is well-known that even now in case of small discharges it is possible to guarantee navigation in this section only by constant dredging. It is also not possible to justify the need for permanent navigation. There is no such important agglomeration, nor economic activities in the affected section which would demand permanent navigability. Occasional navigation will be possible in the old river bed. This is nevertheless limited to such a case when the navigation canal could not be utilized, because of an accident. In such a case, the navigation would be possible through 24 m wide navigation lock constructed at Dunakiliti weir and due to the specially increased discharge. The navigation of small ships will of course be always possible - thanks to the adaptation of the river-bed - any time.

The points 7 and 8 of the Standpoint deal with economic questions of the System of water works. The research of this question took place in the stage of investment preparation. Obviously, it cannot be stated - as in the case of any important investment - that the repeated research of effectiveness is not necessary, even in that case if changes are not possible any more. It is proved to these decisions that constructions already completed or near to be completed should be considered as a specific issue. The only real way is that constructions in progress or those already completed or their operation will be adapted to existing but different conditions.

In the future, the Government intends to undertake such measures which are possible under given economic conditions which could ensure that despite existing problems the system of water works under construction would not damage, or would intrude in minimum extent, the realization of our political and economic aims. I don't want to assert that the construction of the System of water works is in our opinion uneconomical, but it is sure that if we had to take decision concerning the construction today, with our modest investment possibilities we would probably decide to postpone the investment. (We would certainly do it also with some already realized investments or right now being realized if it had not caused greater damages than the completion or their operation. As it is known, the Government does not fear to take - after careful consideration - decision on termination of already started investment. The example is the power plant in Bicske, copper exploration in Becsk, water work Csongrád).

The main direction of the economic policy of the government is similar with the objectives stated in the Standpoint. The increase of economic export capacities, reasonable replacement of import, development of manufacturing industry and its structural change in desired extent, are those objectives we will support by all means. Since many years the government does not start such big investments the return of which is very slow. Nevertheless we must be conscious of the fact that the conditions of our country do not allow us not to utilize our natural sources- and among them also the energy sources. We must increase even the production of basic materials just for the reason that our industry should not depend on always more and more expensive import. By all this I wanted to point out that "one third of century of development politics" could really be criticised because of spending a lot of our sources for production of materials and energy, but under existing conditions, the construction of the System of water works, even if it is a burden, will not shock our economy in such an extent as it was described in the Standpoint.

I have mentioned the issues of the Nagymaros hydropower plant in my last letter of 2.3.1984 addressed to you, there is no reason to repeat it.

The Standpoint of the Presidium of Academy supposes as justified the long-term postponement of the investment or rather its suspension. On the basis of already mentioned arguments I don't think that it would be possible or justified. The Presidium should take into account the existing situation as well as the fact that its arguments rely in great extent only on presumptions, due to the lack of scientific research required earlier several times by the government. Behind majority of objections there are mostly contradicting scientific or expert opinions, the confrontation, comparison and scientific evaluation of which - at least on the existing level of knowledge - was not yet done. I consider it obvious that the government will do everything for justified changes - if they will be proposed. For this I call for effective support of institutions of the Hungarian Academy of Sciences.

Dear comrade President, I would like to assure you that also in future the government will require in every important question the opinion of representatives of science and it would implement them at maximum extent in its decisions.

Budapest, March 19, 1984

József Marjai