Document of
The World Bank

Report No: ICR00002415

IMPLEMENTATION COMPLETION AND RESULTS REPORT
(TF-55978)

ON A

GLOBAL ENVIRONMENT FACILITY TRUST FUND

IN THE AMOUNT OF US$ 12.5 MILLION

TO

HUNGARY

FOR A

NUTRIENT REDUCTION PROJECT

June 18, 2012

Sustainable Development Department
Central Europe and the Baltic Countries Country Unit
Europe and Central Asia Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective May 2012)

Currency Unit = Hungarian Forint
1.00 HUF = US$ 0.0042
US$ 1.00 = 240 HUF

FISCAL YEAR 13

ABBREVIATIONS AND ACRONYMS

BMSC	Budapest Municipal Sewerage Company
BOD	Biochemical Oxygen Demand
CAS	Country Assistance Strategy
COD	Chemical Oxygen Demand
DDNPD	Duna-Dráva National Park Directorate
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EU	European Union
ERR	Economic Rate of Return
FM	Financial Management
FMR	Financial Management Report
FMS	Financial Management System
GBK	Gemenc and Béda-Karapancsa wetlands
GEF	Global Environment Facility
GoH	Government of Hungary
HMWP	Hungary - Municipal Wastewater Project (Loan 4512-HU)
HUF	Hungarian Forint
ICPDR	International Commission for the Protection of the Danube River
ICR	Implementation Completion and Results Report
ISR	Implementation Status Report
IW:LEARN	International Waters Learning Exchange And Resource Network
JAP	Joint Action Plan
LME	Large Marine Ecosystem
M&E	Monitoring and Evaluation
MOB	Municipality of Budapest
MOEW	Ministry of Environment and Water
MOF	Ministry o f Finance
MoRD	Ministry of Rural Development
MWP	Municipal Wastewater Project (Loan 45 12-HU)
MWWTP	Municipal Wastewater Treatment Plant
N	Nitrogen
NBWWTP	North Budapest Wastewater Treatment Plant
NGOs	Non-Governmental Organizations

P	Phosphorous
PIU	Project Implementation Unit
PMRs	Project Management Reports
PMU	Project Management Unit
PSC	Project Steering Committee
QAG	Quality Assurance Group of the World Bank
SA	Special Account
SS	Suspended Solids
UNDP	United Nations Development Programme
US$	United States Dollar
WD	South-Transdanubian Environment Protection and Water Management Directorate
WWTP	Wastewater Treatment Plant

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HUNGARY
NUTRIENT REDUCTION PROJECT
IMPLEMENTATION COMPLETION AND RESULTS REPORT

CONTENTS

A. Basic Information			
Country:	Hungary	Project Name:	Nutrient Reduction Project
Project ID:	P074971	L/C/TF Number(s):	TF-55978
ICR Date:	05/23/2012	ICR Type:	Core ICR
Lending Instrument:	SIL	Borrower:	REPUBLIC OF HUNGARY
Original Total Commitment:	US$ 12.50M	Disbursed Amount:	US$ 12.32M
Revised Amount:	US$N/A		
Environmental Category: B		**Global Focal Area: I**	
Implementing Agencies: Ministry of Rural Development[1], Municipality of Budapest, South-Transdanubian Environment Protection and Water Management Directorate (or Water Directorate)			
Cofinanciers and Other External Partners: N/A			

B. Key Dates				
Process	**Date**	**Process**	**Original Date**	**Revised / Actual Date(s)**
Concept Review:	12/08/2004	Effectiveness:	08/11/2006	08/11/2006
Appraisal:	10/12/2005	Restructuring(s):	03/25/2011	
Approval:	04/18/2006	Mid-term Review:	12/15/2007	11/09/2009
		Closing:	12/31/2011	12/31/2011

C. Ratings Summary	
C.1 Performance Rating by ICR	
Outcomes:	Satisfactory
Risk to Global Environment Outcome	Low
Bank Performance:	Moderately Satisfactory
Borrower Performance:	Moderately Satisfactory

[1] The Ministry of Rural Development succeeded the Ministry of Environment and Water in 2010. The changes in implementing agencies were reflected through a second order restructuring in March 2010.

C.2 Detailed Ratings of Bank and Borrower Performance			
Bank	**Ratings**	**Borrower**	**Ratings**
Quality at Entry:	Satisfactory	Government:	Moderately Satisfactory
Quality of Supervision:	Moderately Satisfactory	Implementing Agency/Agencies:	Satisfactory
Overall Bank Performance:	Moderately Satisfactory	**Overall Borrower Performance:**	Moderately Satisfactory

C.3 Quality at Entry and Implementation Performance Indicators			
Implementation Performance	**Indicators**	**QAG Assessments (if any)**	**Rating**
Potential Problem Project at any time (Yes/No):	No	Quality at Entry (QEA):	None
Problem Project at any time (Yes/No):	No	Quality of Supervision (QSA):	None
GEO rating before Closing/Inactive status	Satisfactory		

D. Sector and Theme Codes		
	Original	**Actual**
Sector Code (as % of total Bank financing)		
Flood protection	12	12
General agriculture, fishing and forestry sector	12	12
Irrigation and drainage	76	76

Theme Code (as % of total Bank financing)		
Biodiversity	33	33
Other environment and natural resources management	17	17
Pollution management and environmental health	33	33
Water resource management	17	17

E. Bank Staff		
Positions	**At ICR**	**At Approval**
Vice President:	Philippe H. Le Houerou	Shigeo Katsu
Country Director:	Peter C. Harrold	Daniela Gressani
Sector Manager:	Sumila Gulyani	Sumter Lee Travers

Project Team Leader:	Sanyu Lutalo	Xavier Chauvot de Beuchene
ICR Team Leader:	Sanyu Lutalo	
ICR Primary Author:	Anthony J. Hooten	

F. Results Framework Analysis

Global Environment Objectives (GEO) and Key Indicators(as approved)

The key development objectives of the Project are: (i) to reduce Budapest's discharge of nutrients (nitrogen and phosphorus) into the Danube River, and consequently into the Black Sea; (ii) to enhance the nutrient trapping capacity of Gemenc and Beda-Karapancsa wetlands situated in the lower Hungarian part of the Danube River; and (iii) to serve as a model for similar nutrient reduction initiatives in Hungary and other Danube basin countries. The project outcome indicator for the GEO as approved was: *Overall reduction of the nutrient flow into the Danube River and Black Sea in tons/annum.* Other key indicators, identified in the Results Framework as intermediate outcome indicators, are presented in the Table below.

Revised Global Environment Objectives (as approved by original approving authority) and Key Indicators and reasons/justifications

Not applicable[2].

(a) GEO Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	Overall reduction of the nutrient flow into the Danube River and the Black Sea (from component A and component B) (tons / annum).			
Value (quantitative or Qualitative)	0	4000	N/A	3720[3]
Date achieved	02/16/2006	12/31/2011		
Comments (incl. %	Reduction in discharge of N and P represents substantial achievement of the target as measurements were taken while the WWTP was operating below			

[2] There were some changes made, in collaboration with the Borrower, in June 2008, to improve the capture of results in the Results Framework during implementation. The resulting indicators were used to monitor project progress during implementation. However, because the changes were not formalized through a formal amendment of the legal document or restructuring of the project, the ICR is required to use the original indicators in its assessment.

[3] The capacity of the North Budapest Wastewater Treatment Plant is 200,000m3/day but it was not yet operating at full capacity when measurements were taken. Daily loads tend to vary, and with them the nutrient removal rates; current load at the time of measurement was around 118,525m3/day, but the expectation is that once operating at full capacity the target would be potentially met and exceeded. Component B nutrient removal excludes removal by plant uptake considered at appraisal, and varies with water levels in wetland. Efficacy of results would be improved if measured over several years, particularly for the wetlands component.

achievement)	capacity; it is expected that when the Plant is operating at full capacity the target would be met and/or exceeded. This target is therefore considered fully achieved.

(b) Intermediate Outcome Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	Component A: Quantity of nutrients discharged from the NBWWTP (in Kg/day).			
Value (quantitative or Qualitative)	BOD: 20,586; Nitrogen (N): 9,230; Phosphorus (P): 775	BOD: 3,200; N: 2,945; P: 310	N/A	BOD: 1,185 N: 1604 P: 195
Date achieved	02/16/2006	12/31/2011		12/31/2011
Comments (incl. % achievement)	The targets were exceeded for all the parameters.			
Indicator 2 :	Component B: Number of hectares of wetlands rehabilitated in the DDNP (ha)			
Value (quantitative or Qualitative)	0	10,000	N/A (see comment below)	4300 (see comment below)
Date achieved	02/16/2006	12/31/2011	11/20/2009	12/31/2011
Comments (incl. % achievement)	The target was revised to 4300 during MTR, when actual costs based on detailed designs turned out higher than expected. However, since revisions to the target were not formalized, the ICR considers the original targets, hence achievement is measured as 43% based on the original target.			
Indicator 3 :	Component A: Average operational cost of the nutrient removal facilities at the NBWWTP			
Value (quantitative or Qualitative)	0 US$/m3	0.03-0.05 US$/m3	N/A	1.78-2.15 US$/m3
Date achieved	02/16/2006	12/31/2011		12/31/2011
Comments (incl. % achievement)	Average operational cost of the nutrient reduction process in the NBWWTP was estimated at between 1.78 US$/kg to 2.15 US$/kg. This target was therefore not met.			
Indicator 4 :	Component B: Annual Water flow in the wetlands of DDNP (m3/ha/a)			
Value (quantitative or Qualitative)	37,000 m3/ha/a	43,000 m3/ha/a	N/A	11,860 - 99,534 m3/ha/a
Date achieved	02/16/2006	12/31/2011		12/31/2011
Comments (incl. % achievement)	The results from monitoring show a range based on variations in water levels, but the target is within the desired range and is considered met.			
Indicator 5 :	Component B: Average operational cost of the nutrient reduction process in the DDNP wetlands			
Value	No baseline was	No targets were	N/A	Estimated at 0.54

(quantitative or Qualitative)	provided.	provided.		USD/kg
Date achieved	02/16/2006	12/31/2011		12/31/2011
Comments (incl. % achievement)	Since no targets were provided, the achievement of this indicator is not assessed.			
Indicator 6 :	Cost-benefit analysis of nutrient reduction of wetland restoration compared to WWTP tertiary treatment.			
Value (quantitative or Qualitative)	No	Yes	N/A	Yes
Date achieved	02/16/2006	12/31/2011		12/31/2011
Comments (incl. % achievement)	The target was achieved. The cost-benefit analysis of nutrient reduction of wetland restoration compared to WWTP tertiary treatment was conducted.			
Indicator 7 :	Project experience and impact evaluation studies disseminated according to communication strategy.			
Value (quantitative or Qualitative)	No	Yes	N/A	Yes
Date achieved	02/16/2006	12/31/2011		12/31/2011
Comments (incl. % achievement)	The target was achieved. The cost-benefit analysis study was completed and discussed in the workshop involving stakeholders from different countries. It was captured and disseminated through the IW:Learn facility in line with the project requirements.			

G. Ratings of Project Performance in ISRs

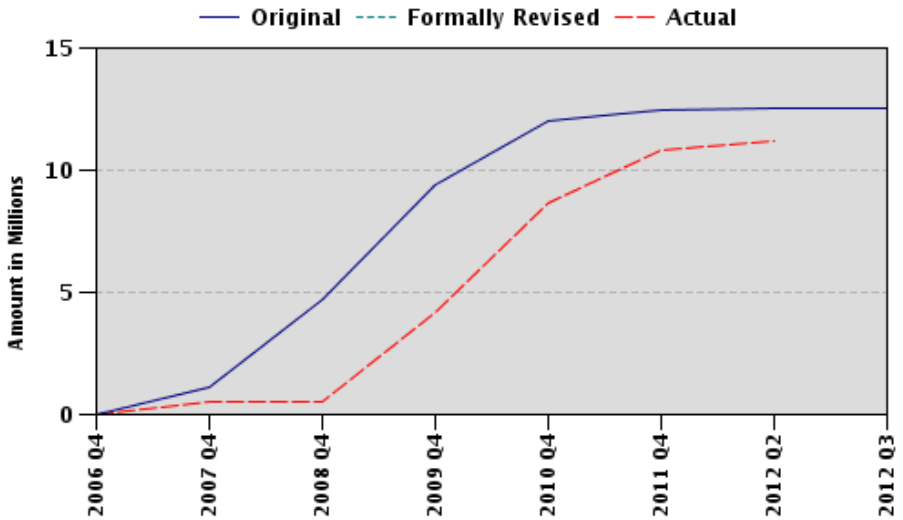
No.	Date ISR Archived	GEO	IP	Actual Disbursements (US$ millions)
1	06/20/2006	Satisfactory	Satisfactory	0.00
2	03/29/2007	Satisfactory	Satisfactory	0.50
3	11/30/2007	Satisfactory	Satisfactory	0.50
4	07/10/2008	Moderately Satisfactory	Moderately Satisfactory	0.53
5	11/21/2008	Moderately Satisfactory	Moderately Satisfactory	1.02
6	06/11/2009	Satisfactory	Moderately Satisfactory	2.89
7	12/23/2009	Satisfactory	Moderately Satisfactory	8.69
8	05/24/2010	Satisfactory	Moderately Satisfactory	8.69
9	12/08/2010	Moderately Satisfactory	Moderately Satisfactory	8.78
10	07/05/2011	Moderately Satisfactory	Moderately Satisfactory	10.82
11	12/25/2011	Satisfactory	Satisfactory	11.16

H. Restructuring

The project was officially restructured in March, 2011 to address the reorganization of Hungary's Ministries pursuant to Government resolution 2097/2006 (V9). As a result, the Ministry of Environment and Water (MOEW[4]) was assimilated under the Ministry of Rural Development. Duties that resided with the Ministry of Finance were transferred to the Ministry of National Economy. As mentioned earlier, some revisions to indicators were made in June 2008, but not formally revised through restructuring. The changes were made prior to the new Investment Lending guidelines, released in October 2009, requiring formal restructuring for changes in the Results Framework.

[4] For purposes of the ICR the MOEW will be referred to as the Ministry of Rural Development (MoRD), its legal successor after the 2011 restructuring)

I. Disbursement Profile



Section 1. Project Context, Global Environmental Objectives and Design

1.1 Context at Appraisal

Over the past century, the Danube River has become one of the most significant contributors of nutrient loading to the Black Sea Region. Nitrogen (N) and Phosphorous (P) are essential elements for plant growth and biological metabolism, but they have also reached concentrations—as a result of the mismanagement and resource transformation from land, riparian and coastal development—that cause significant transboundary pollution and undesirable biological and ecological change. Negative consequences to both riparian and coastal waters, and living aquatic resources, include impacts to water quality, dissolved oxygen concentrations, ecological imbalances to regionally important fisheries, aquatic biodiversity and habitat. These negative effects have a direct bearing on the maintenance and sustainability of ecosystem services that support human well being throughout the region.

The improved management of excessive nutrients is one of the most significant interventions that can be undertaken to improve regional environmental quality. Ten countries border and drain the Danube River Basin, and the Republic of Hungary represents about 11% of the river's drainage area. This project was designed to specifically reduce nutrient pollution entering into the Danube River and the Black Sea Large Marine Ecosystem from the Republic of Hungary, to significantly improve transboundary water resources and environmental management. The project was also designed to assist national and local authorities in Hungary with the implementation of top priority investments in the wastewater sector and to support the Government's commitments under the Danube Conventions and other international agreements for the protection of the Danube River and the Black Sea.

Prior to and at the time of project appraisal, increased cooperation was underway to better protect the Danube River and the Black Sea through the Bucharest (1985) and Sofia (1994) Conventions. These conventions were signed by eleven member countries, including Hungary, and the European Union, leading to the creation of the International Commission for the Protection of the Danube River (ICPDR). Hungary joined the EU in May 2004 and began to align the country's regulatory framework with EU standards, including those related to water quality. The ICPDR enacted a Joint Action Plan (JAP) calling for the reduction of municipal discharges of wastewater, including concentrations of N and P, from major urban centers. In addition, the JAP called for enhancing the capacity of wetlands to serve as traps for both N and P. Over the course of decades, the Danube River within Hungary's borders has developed a number of flow-constrained tributaries and meanders from the river's main stem (also referred to as 'oxbows') where improved flows could significantly restore and enhance the role of wetlands in both trapping and assimilating higher quantities of N and P. The Project was prepared and implemented to support the UNDP/GEF Strategic Partnership for the Protection of the Danube River and the Black Sea. The World Bank, as a key development player in the Region, was instrumental in the development of this Partnership.

Rationale for Bank Involvement

The 2002 Country Assistance Strategy for Hungary specifically identified nutrient reduction as an objective for Bank investment and co-financing. At the time of project approval, N and P concentrations flowing down the Danube and into the Black Sea annually were estimated to be 690,000 tons (N) and 70,000 tons (P), respectively. To support actions under the UNDP/GEF Strategic Partnership for the Protection of the Danube River and the Black Sea, GEF created an investment fund administered by the Bank, which provided grant financing for the project. Moreover, during the time that the project was under development, the Bank had earlier established a Specific Investment Loan for a Municipal Wastewater Project (1999-2006) to assist Hungary in reducing the nutrient pollution load in the Danube River, to help strengthen Hungary's wastewater utilities and to strengthen compliance with EU environmental standards. Budapest was already targeted to install tertiary treatment initially at the South Budapest Wastewater Treatment Plant. This project focused on the North Pest Wastewater Treatment Plant (which serves a population of approximately 600,000 from 23 districts), and built upon the Municipal Wastewater Project.

Financing from the GEF grant was complemented by counterpart funding involving a reallocation from World Bank Loan 4512-HU to the MOB in the amount of EUR5.9 million (US$7.7 million equivalent), using savings from the Municipal Wastewater Project. Additional counterpart funding was also provided from the MOB (about US$10.4 million), and US$1.4 million from the Ministry of Rural Development.

Of particular interest by both the Bank and the GoH was a critical examination of the role of floodplains and wetlands, such as those existing within the DDNPD, in assimilating N and P thereby reducing concentrations of these nutrients in the Danube and ultimately the Black Sea through the services provided by wetland ecosystems. If properly documented, the potential efficiency of nutrient reduction could serve as a cost effective alternative to the more cost and technologically intensive conventional wastewater treatment plant (WWTP) model. While conventional nutrient removal technologies are well understood and increasingly utilized, they are more costly in terms of capital investment, operation and maintenance.

Wetlands can serve as nutrient traps from both point and non-point sources of pollution and presumably at a significantly lower capital investment; however, this has continued to be poorly quantified compared to WWTPs in general. Furthermore, wetland rehabilitation can improve habitat condition and support the maintenance of biological diversity. This project was seen as an opportunity to quantify and further examine such cost and benefit between actively engineered (i.e.WWTPs) and more passively engineered (i.e. sluices and weirs) natural systems. The resulting information can be used to share knowledge with other countries in the Region so that they may consider implementing similar environmental management interventions.

1.2 Global Environmental Objectives (GEO) and Key Indicators (as approved)

The Global Environmental Objectives and the Project Development Objectives were as follows:

(i) to reduce Budapest's discharge of nitrogen and phosphorus into the Danube River, and consequently into the Black Sea;

(ii) to enhance the trapping capacity of these two nutrients in the Gemenc and Béda-Karapancsa wetlands situated in the lower Hungarian part of the Danube River; and

(iii) to serve as a model for similar nutrient reduction initiatives in Hungary and other Danube basin countries.

The GEO/PDO is clear and has generally served as an achievable objective within the project time frame. Budapest was identified as a major conduit for, and a principal source of, nutrient enrichment into the Danube River and ultimately, the Black Sea. If properly executed, the GEO/PDO would have significant local and regional environmental benefits and benefits for knowledge sharing among riparian countries.

The only Outcome Indicator identified at approval was *Overall reduction of the nutrient flow into the Danube River and the Black Sea.* This indicator captured the first and second Global Environmental Objectives. Other performance indicators defined at project approval as Intermediate Outcome Indicators [5] were:

- Quantity of nutrient discharges from the North Budapest Wastewater Treatment Plant (NBWWTP) (N and P reported in kg/year)
- Average operation cost of the nutrient reduction process in the NBWWTP (US$/kg of nutrient reduced)
- Number of hectares of wetlands rehabilitated in the DDNPD
- Annual water flow and quantity of nutrients retained by the DDNPD wetlands (N and P kg/year)
- Average operation cost of the wetland management procedures in the DDNPD, in terms of its nutrient reduction capacity (US$/kg of nutrient reduced)
- Cost benefit analysis of nutrient reduction of wetland restoration compared to WWTP tertiary treatment; and
- Project experience and impact evaluation studies disseminated.

[5] The text of the PAD does not distinguish between the Outcome Indicators and the Intermediate Outcome Indicators, hence these are based on the original Results Framework.

1.3 Revised GEO/PDO and Key Indicators (if applicable), and Reasons/Justifications

There were no revisions to the GEO. Changes, which incidentally were not formalized [6], were however made, during the Supervision mission in June 2008, to some indicators, to improve project results monitoring. They included addition of two project outcome indicators, one each for Components B and C, and revision of intermediate outcomes and corresponding indicators in line with the planned project activities to better track project progress and achievements. Since the changes were not reflected through a formal restructuring of the project, the ICR does not consider them as formal changes even though it acknowledges that they have helped to better assess the project's achievements.

1.4 Main Beneficiaries

Project beneficiaries were at multiple levels; global or regional, national, and local. The global-level benefits discussed in the PAD identified regional environmental improvements to the Danube River and Black Sea Large Marine Ecosystem (LME) through net reduction of N and P entering into these ecosystems. The downstream riparian countries should see improved environmental quality resulting from meeting the project objectives. Forecasted nutrient reductions of approximately 9% for N and 4% for P could be considered as significant, especially in light of the percent of riparian coverage of the Danube River within Hungarian borders (approximately 11%). At the national level, Hungary benefitted from progress towards compliance with EU Directives, in particular in regard to wetland management aspects of the Water Framework. Directive (WFD), and increased capacity of the existing central, regional and local institutions concerned to protect and manage wetlands, floodplains and aquatic ecosystems. Similarly, the Municipality of Budapest and its clients benefitted from the project's support to tertiary treatment of the wastewater from the NBWWTP, resulting in a higher level of treatment and better quality effluents, which contribute overall to a cleaner river. Beneficiaries also included the local Gemenc Forestry and Gaming Company and hunters operating in the Duna Drava National Park (DDNPD) who are economically dependent on the game and other biodiversity in the national park. Benefits to these parties include habitat enhancements within the DDNPD, and forage and habitat use by other wildlife, especially water fowl and other migratory, riparian-dependent birds. Tourism activities such as bird-watching in the DDNPD could also be boosted by the habitat enhancements. Other beneficiaries include people in riparian communities and townships who would benefit from the improved fishing habitats and consequent productivity. The wetland works planned to enhance water flow and nutrient retention over time in specific locations also present the opportunity to demonstrate to other countries in the region that such interventions can be used region-wide to improve water quality conditions,

[6] While mentioned revisions to the indicators, for purposes of the ICR, have been considered not formal since the project was not formally restructured to reflect them, it is noted that the changes were made in June 2008 while official changes to Bank Investment Lending policy only came into effect in October 2009.

potentially obviating the need for higher-cost technical solutions, such as tertiary wastewater treatment in smaller community locations with lower population densities. The knowledge and learning generated from the project will finally benefit local academia and institutions responsible for environmental management in the region.

1.5 Original Components

The project objectives were undertaken through three main components:

(i) **Component A: Development of tertiary treatment at the North Budapest Wastewater Treatment Plant (NBWWTP)**, also referred to as 'Part A' of the project in the Grant Agreement); 5.9 million Euro of an original 27.6 million Euro loan from the World Bank were reallocated from an IBRD loan dedicated to municipal wastewater treatment in Budapest to finance part of the facilities for tertiary treatment (i.e. the removal of Nitrogen and Phosphorous from the effluent) at the North Budapest Wastewater Treatment plant (NBWWTP) to provide the necessary parallel financing to the GEF project for Nutrient Reduction.

(ii) **Component B: Wetland Restoration in the Duna-Dráva National Park** (also referred to as 'Part B' of the project in the Grant Agreement) involved the rehabilitation of wetlands in the Gemenc and Béda-Karapancsa areas of the DDNPD (refer to the detailed map in Annex 8). A major intent of this component was to create interventions through specific wetland works and use long term (i.e. several years) monitoring data to help compare the role of wetland uptake of N and P and its cost-effectiveness to that of an active engineered system, such as a tertiary WWTP.

(iii) **Component C: Dissemination and Replication** (also referred to as 'Part C' of the project in the Grant Agreement). This involved the establishment of a comprehensive Monitoring and Evaluation System for water quality and environmental health, measurement of nutrient reduction, as well as communication and dissemination activities to foster replication in Hungary and other Danube River basin countries.

1.6 Revised Components

No revisions were made to the original components. Please see discussion below however concerning relevant indicators.

1.7 Other significant changes

(i) Revisions to the Results Framework: The Results Framework was revised in collaboration with the Borrower in June 2008, and later 'confirmed' with the Government during the mid-term review to include the following additional project outcome indicators for Components B and C: Component B: *Overall improvement to the water*

regime in Gemenc and Beda Karapancsa wetlands; and Component C: *Dissemination of a comprehensive project impact evaluation study.* The target for achievement of component B, based on the intermediate outcome indicator concerning the number of hectares of wetland rehabilitated, was also reduced from 10,000 hectares to 4,300 ha in the DDNPD beginning in 2010 after the mid-term review. This, as mentioned above, was largely due to the inability to secure additional counterpart funding after actual costs based on detailed designs for the dredging works for eleven originally identified water systems proved to be higher than had been envisaged. The number of dredging works was reduced to occur at five sites. Additionally, these refinements resulted in the capability to better measure and assess project outcomes, provided the monitoring program could be implemented for a sufficient period of time. The above changes, while useful in assessing project implementation progress and overall impacts, are not considered in the ICR as formal since the process was not formalized through restructuring or amendment of legal documents[7].

(ii) Restructuring of GoH Ministries: The project was formerly restructured in March, 2011 to reflect reorganization of Hungary's line Ministries pursuant to Government resolution 2097/2006 (V9). The Ministry of Environment and Water (MOEW) was assimilated under the Ministry of Rural Development and duties that resided with the Ministry of Finance were transferred to the Ministry of National Economy. This change did not have a major impact on implementation.

2. Key Factors Affecting Project Implementation and Outcomes

2.1 Project Preparation, Design and Quality at Entry

Preparation: The project was consistent with the World Bank's Country Assistance Strategy as stated in the World Bank document 23609-HU (April, 2002) and with the Republic of Hungary's regulatory framework to meet EU environmental standards. Interviews with early Task Team Leaders of the project emphasized that the length of preparation time was essential for stakeholder consultation in the DDNPD region and in performing the necessary EIA and other studies to appropriately prepare for the interventions and environmental monitoring.

Project Design: The project was generally well designed and should be commended for its novelty in seeking to test important environmental and economic comparisons between an actively engineered system (i.e. NBWWTP) against the role that natural systems, such as wetlands, can play in wastewater treatment and natural processing, and in supporting ecosystem services and human well being. Because of its existing investment with WWT infrastructure and the significant border with the Danube River, the GoH presented an opportunity to test a project with regional-level environmental and

[7] In the ECA Region, the Results Framework is part of a Supplemental Letter to the Legal Agreement and is therefore legally binding.

development implications within a single national government jurisdiction. As mentioned earlier, the project was designed within the context of the UNDP/GEF Strategic Partnership for the Protection of the Danube River and the Black Sea. It was a thoughtful choice in working with Hungary as a single national government, while testing and comparing innovative approaches that could have regional impact, yet reducing the transaction costs that otherwise would have likely been much higher had multiple countries been involved[8].

Quality at Entry: A QAG quality-at-entry assessment was not undertaken for this project; however, the ICR rates quality at entry as satisfactory, because it adequately took due consideration of important design aspects such as strategic relevance of the project based on prevailing priorities in Hungary and the Black Sea Danube basin at large, as well as the technical, environmental, institutional, financial and economic considerations. Bank inputs and processes were also adequate. The GoH committed adequate staff time and resources in preparing the project. Project preparation funds were made available by the GEF and financed detailed consultant services for the preparation of economic and financial analysis, environmental impact assessments, stakeholder consultations, environmental management plans, pre-feasibility studies and preliminary designs (i.e. for the DDNPD component). The roles and responsibilities of each of the project partners were well defined during preparation and included in the PAD and the Grant Agreement. The implementation structure was clear as to reporting to the Bank and with each of the Project Partners, and the lines of responsibility and funding flow for each of the Components were clear and transparently executed. Project partners were appropriately identified to support the MOEW for Components A and B and represented a mix of skills to address key issues, although initially expertise was weighted more toward technical experience than scientific. Where additional technical or scientific expertise was required, the WD engaged a panel of experts representing a range of technical, biological (including forestry), and ecological expertise to provide guidance and advice throughout the project life. The one shortcoming with respect to quality at entry related to design of the monitoring and evaluation (M&E) aspects, which eventually necessitated the earlier mentioned need for revision of the results framework (See relevant discussion in M&E section below).

Project Risks: The risks identified at appraisal were adequately assessed. The ICR comments on key risks as identified at appraisal below.

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[8] Ironically, within the Hungarian government, 33 separate authorities/ local jurisdictions eventually claimed some regulatory oversight, approval or no-objection requirements from their respective councils or governing bodies related to the wetland rehabilitation works in and around the DDNPD over the course of project implementation. This increased government transaction costs and partially contributed to slowing the pace of the project's time line for Component B in securing the necessary permits, even following extensive public consultations during preparation. Based on discussions with WD project staff, this was an unanticipated externality for the Water Directorate in implementing Component B.

- *Lack of continuing commitment from the Government - Negligible*. The commitment and continuity of project staff for all of the components remained strong and consistent throughout the project.

- *Consumers unwilling/unable to pay required tariff levels (Component A) - Negligible*. Studies performed during preparation showed that any new tariffs should be affordable to most of the population (less than 4% of the average household monthly income) or provided a form of financial relief for Budapest's low income citizens. The fact that the NBWWTP uses biogas to service more than 90% of its energy requirements reduces capital costs to consumers.

- *Institutional capacity to handle preparation and implementation - Negligible for Component A based on previous experience (i.e. similar work financed by Loan 4512-HU), Modest for Component B due to limited experience in dealing with Bank-financed projects*. This did have some impact at the early stages of project implementation and there is evidence for a constrained start of project activities in the first two years. However, the PMU for Component B demonstrated the ability to engage expertise as needed (i.e. through contracting specialists and the convening of an Experts panel to assist with biological and water quality monitoring) to address institutional gaps in capacity.

- *Capital investments at the NBWWTP are higher than estimated* (Component A) - *Modest*, owing to a risk of higher than expected prices for the contracted works. However, the MOB used counterpart funding to ensure completion of the NBWWTP and successfully completed this Component of the project to a highly satisfactory degree. Incidentally, this issue also affected Component B and prices escalated above the original estimates due to exchange rate fluctuations and inflation. The works were therefore scaled down for Component B as earlier mentioned.

- *Slow decision-making during implementation - Significant*. The government bureaucracy in Hungary was known to be complex and this factor did play into project delays. A Grant implementation agreement between the MoRD, the MOB, the WD and the DDNPDD defined the roles and responsibilities of each partner during implementation to reduce risk; however, Component B did experience formal objections and appeals of decisions by the Gemenc Forest and Gaming Company in the DDNPD region of the project, which delayed the physical works for wetland rehabilitation to a considerable extent and the long term monitoring that was to follow. This situation, combined with unexpected weather leading to excessive flooding of the Danube River in 2010, compounded implementation delays.

- *Safeguards policies.* Modest. Refer to Section 2.4 for details.

The project applied lessons learned from earlier World Bank project experience effectively. The project attempted to engage stakeholders as comprehensively and as early

as possible and performed respectably in communicating with local communities about its benefits, especially regarding the wetland interventions. However, one stakeholders group, the Gemenc Forestry and Gaming Company's opposition to the rehabilitation works in certain parts of the DDNPD under Component B, caused/contributed to delays in project implementation. With a significant stake in hunting red deer (*Cervus elaphus*) adjacent to the DDNPD and a desire to maintain upland habitat from perceived risk of flooding, this stakeholder group's objections delayed project operation and progress by intervening under Government regulations at critical times and filing appeals of decisions related to the works, allowing misinformation about the project to spread among locals and local media, and filing appeals of decisions related to the wetland rehabilitation to delay progress. According to ICR interviews, while the potential with this particular stakeholder group was identified early in the consultation process as a potential risk, the complexity of the relationship between the Gemenc Forestry and Gaming Company and the DDNPD was underestimated and it was not specifically identified in the PAD.

In hindsight, the communication element of Component C arguably could have focused much sooner on perceptions by local stakeholders in the region where Component B was being implemented. Such effort could have dispelled misinformation spread about the benefits and risks of project works. Regardless, the public, and especially the townships and communities closest to the proposed works, were generally supportive of the project's objectives and recognized the values to the environmental quality of the Danube River and the Black Sea, and to fisheries and wildlife.

2.2 Implementation Stage

Mid-term Review: The project mid-term review reaffirmed that no changes were necessary to the GEO/PDO; however, a series of critical issues were identified in the review under Component B to ensure that the project would complete the agreed-upon activities within the designated time-frame. In particular, the pace of completing the wetland rehabilitation works in the DDNPD, and to provide for sufficient time to monitor the capacity of the modified works to enhance nutrient trapping was to receive the highest priority. The Results Framework was revised to include two additional project outcome indicators for Components B and C (see section 1.7). Also, the number of hectares of wetlands targeted for intervention under Component B was reduced from 10,000 to about 4,500. This was due to the inability of the project partners to secure the necessary co-financing for wetland rehabilitation that had been expected during project preparation.

Seasonal constraints: In 2010 higher-than-expected rainfall and consequent Danube River flooding played a significant role in impeding implementation of activities related to Component B, resulting in unexpected but continued delays of construction works associated with the Component.

Delays in obtaining licensing: The project's 'at risk' status was affected, as evidenced by ISRs from July, 2008 to June, 2011, by the slower-than-expected implementation and disbursements in first two years, and by continual delays in obtaining the necessary permits and licenses for the wetland rehabilitation works and subsequent monitoring. The

ratings were adequately flagged by the TTLs in the ISRs and Aide Memoires, and noted by senior management in reviewing the ISRs and appropriate responses and plans were implemented to address the risks as they were identified.

Restructuring of GoH Ministries: As mentioned, the project was formerly restructured in March, 2011 to reorganize Hungary's Ministries pursuant to Government resolution 2097/2006 (V9). The Ministry of Environment and Water (MOEW) was assimilated under the Ministry of Rural Development while duties that resided with the Ministry of Finance were transferred to the Ministry of National Economy. This change did not have a major impact on implementation.

2.3 Monitoring and Evaluation (M&E) Design, Implementation and Utilization

Design: The MoRD designed and was responsible for an overall Monitoring and Evaluation process for project outputs and outcomes from each of the project partners. A M&E process was developed during project preparation. However, the spatial and timing differences between Components A, B and C segregated the M&E responsibilities and tasks. In the case of Component A, the BMSC provided M&E for the MOB, while the DDNPDWD performed M&E activities related to Component B. The latter also included a detailed biological monitoring program with the original intent to inform and track the uptake of nutrients within DDNPD wetlands. The process was relatively complex and required highly specialized experts from the Budapest University of Technology and Economics to implement it throughout the life of the project. It was initiated in 2009 and initial sampling informed the model development for the Cost-Benefit Analysis carried out at the end of the project. The main shortcoming of the M&E design was the failure to identify sufficient outcome indicators to measure achievement of the third project GEO. The one outcome indicator at approval captured the first two objectives. Some of the targets also needed to be better defined. The ICR acknowledges that during preparation reliable data on baselines and consequently on targets may be difficult to confirm, hence during implementation of projects it may be found necessary, as happened in this case, to refine some of the indicators or targets based on actual conditions on the ground. The revisions should however have been formalized.

Implementation and Utilization: The PIUs for each of the three components adequately monitored and reported their progress to the PMU with respect to the process of project implementation, and these M&E arrangements proceeded in a generally *satisfactory manner*. The MOB/BMSC established routine chemical and biological monitoring and has been highly effective in measuring N and P sequestration. The Bank and the Government and implementing agencies discussed relevant M&E issues to improve the M&E design by refining the results framework, although as mentioned they were not formally captured through a restructuring or amendment of the legal agreement.

The water quality monitoring program for Component B, which was planned for execution as early as possible during implementation, was subject to the construction of the wetland rehabilitation works as a prerequisite (to successfully measure before-and-after environmental conditions). While initial monitoring was undertaken (in 2009),

repeated measures of the monitoring program were delayed together with the associated works, due to the above mentioned permitting issues until September, 2011. The DDNPD will continue some aspects of monitoring (especially for wildlife), but will not have the same technical capacity to continue routine monitoring of N and P dynamics in the DDNPD area. This activity was carried out by highly specialized technical consultants and the DDNPD has neither the skills nor other resources to continue with this monitoring after the project closing. With hindsight, arrangements to ensure continuation of the monitoring should have been considered during design or earlier in implementation.

Technical and financial aspects were satisfactorily reported in PMRs prepared by the Borrower. In addition, the World Bank project supervision and monitoring reports, including ISRs served as useful M&E tools to help measure progress, and to support and help the project adjust to both anticipated and unanticipated challenges. It should be noted that there were some discrepancies in some of the results provided for nutrient reduction directly by the client during the course of project supervision and some of the numbers utilized by the consultants carrying out the Cost Benefit Analysis. This is partly attributed to the fact that the latter was conducted in a highly scientific manner, including specific assumptions and limitations not necessarily considered in the regular monitoring of results.

2.4 Safeguard and Fiduciary Compliance

Safeguards

Of the ten Safeguard Policies adopted by the Bank, four were relevant and triggered during the life of the project. These were:

Environmental Assessment (OP 4.01): The EIA and other studies carried out during preparation indicate that no significant negative impact on the environment was expected as a result of project implementation. The environmental assessment and other technical reporting were generally of high technical quality. For Component A, potential impacts were exclusively limited to those that could occur during the construction phase (for example, noise) which was adequately controlled. For Component B, the EIA identified potential environmental negative impacts associated with dredging, changes in local hydrology, disposal of dredged materials, and increased flow of other pollutants (such as organics or heavy metals) into wetlands. However, these potential impacts were not determined to be significant, and the wetland rehabilitation as planned provides greater benefit than risk in ecological functioning of those areas where rehabilitation occurred, combined with secondary positive effects of increases in biodiversity and productivity, as habitats will be either renewed or new ones created. In particular, positive impacts for a number of migratory bird species of global significance are expected for Hungary, which is part of the African-Eurasian Flyway.

Natural Habitats (OP 4.04): The project EIA was developed and satisfactorily conducted as part of project preparation and the project was determined not to have significant loss or degradation of natural habitats, particularly in the DDNPD. As a result of the completed project works there will be an increase in water retention from regular, period

flooding by the Danube River, and expand some areas of permanent wetlands. However, these were determined to not have unintended negative or lasting consequences on the existing habitats. Specific provisions have been included in the EMP, also developed during preparation, to ensure that the wetland rehabilitations works were properly executed to avoid disturbing migratory species or reduce biodiversity. Populations of selected endangered species were monitored as part of the DDNPD program during the project, with plans to continue monitoring following specific EU biological and DDNPD protocols beyond the Project life as part of the monitoring system established.

Safety of Dams (OP/BP 4.37). Dam Safety was also adequately addressed during project preparation. No dams higher than 15 meters are located within the Project area and no upstream dam infrastructure failure could impact the planned investments. The sluices and weirs constructed for this project were small structures but were engineered to retain flood waters to maximize N and P retention, while permitting anomalous flooding events to wash over the structures to accommodate excessive flows.

Project on International Waterways (OP 7.50): During preparation, the project was determined as triggering the Bank policy concerning Projects on International Waterways given its link to the Danube River and Black Sea. The project was determined to have a net positive impact as a result of improvements in water quality. Notification to the riparian countries as part of OP7.50 was waived via a memorandum from the Bank's Europe and Central Asia Regional Vice President dated March 18, 2005. Nonetheless, the neighboring riparian countries, which are signatory members of the Danube convention, were informed of the project within the scope of the Danube Commission through the Commission's priority list of the Joint Action Program. Moreover, as a result of the project's study tours and partner communications with counterparts in neighboring riparian countries, i.e. those that are also part of the Danube River and the Black Sea, and which are signatory members of the ICPDR, partners were briefed and discussed the project within the scope of the Danube Commission.

Fiduciary Issues

Financial Management: Fiscal oversight of the project is rated as *satisfactory*, as evidenced by the structure of funding flow to each of the component's lead agencies and project partners, which was clear and consistent throughout the project life. The Quarterly Financial Management reporting from the MoRD to the Bank, as well as internal reporting on each of the Component accounts, were well documented, clear and transparent. The Bank received acceptable audit reports for each of the project years from 2006 through 2011, and the MoRD and partners were consistent in taking action to address audit recommendations.

Disbursement, relative to initial plans, though not clearly reflected in the ratings, was slow in the first two years of implementation (2006-2008; see page 8, paragraph G - Ratings of Project Performance in ISRs), which may have been partially attributable to a cautious management style of the personnel within the Ministry, coupled with a limited capacity within the MoRD to address specific environmental and technical challenges

associated with Component B, especially in the early stages of implementation. However, implementation partners (i.e. the WD) within Component B engaged the services of highly qualified technical consultants to conduct the needed environmental analysis and other background studies to a *satisfactory* degree.

Procurement: The PIU consistently followed the World Bank guidelines for procurement of goods and works and for selection and employment of consultants, and sought review, advice and no objections from the Bank as required. The PIU and its partner agencies for each of the three components (MOB, WD and DDNPD) were systematic and accurately reported the procurement of all goods and works and in developing contracts and consultant TORs, baseline studies and licensing reports, and modifying relevant parts of the procurement plan when warranted. The 'turn-key' contract for the NBWWTP plant was successfully procured under the International Competitive Bidding (ICB) method, and used Bank standards. The quarterly Project Management Reports prepared by the PIU and partners were comprehensive and accurate in reflecting procurement aspects. The procurement plan was updated following World Bank Supervision Missions in 2008 and at the Mid-term Review, during which project procurement was rated as moderately satisfactory. This was largely attributed to the delays associated with Component B at the time; however, by the final Supervision mission (October 2011), procurement for the project was essentially completed and is rated as *satisfactory*.

3. Achievement of Objectives and Outcomes

3.1 Relevance of Objectives, Design and Implementation:

Rating: High

The project objectives, design, and implementation were highly relevant to the GoH and to the region, given the high priority given to reducing the impact of pollution to water quality of the Danube River and the Black Sea LME, and they remain relevant in keeping with EU environmental directives, of which Hungary is party. The project design presents a model for learning for other countries in the Region as well as globally for parties, including not just countries, but academia and other institutions interested in assessing the relative benefits of wastewater treatment through conventional systems compared with natural systems. This is evidenced through the interest in the project's results and findings discussed through various conferences and other forums, including the GEF Biannual International Water Workshop and the Project Closing workshop, both attended by people from the region and beyond. The key results and findings are also continuing to be disseminated through the GEF financed IW:Learn website.

3.2 Achievement of Project Development Objectives:

Rating: Satisfactory

(i) Objective 1: <u>Reducing Budapest's discharge of nitrogen and phosphorus into the Danube River, and consequently into the Black Sea</u>

Overall, the project has provided a significant contribution towards reduction of nutrient concentrations to the Danube River from the NBWWTP. The first PDO has been met as demonstrated by significant reductions of N and P concentrations from the NBWWTP[9] (Refer to results in Section F of the ICR Datasheet). Achievement of this objective is assessed to be 100 percent, based not only on the project outcome indicator, which combined nutrient reduction from the WWTP and the wetlands, but also based on the achievement of the target for the intermediate outcome indicator concerning the quantity of nutrients discharged from the NBWWTP.

(ii) Objective 2: Enhancement of the trapping capacity of these two nutrients in the Gemenc and Béda-Karapancsa wetlands situated in the lower Hungarian part of the Danube River

There was no separate formal outcome indicator for this objective in the Results Framework at approval; the outcome indicator defined at approval captured the combined impact of nutrient reduction from the NBWWTP and the wetland rehabilitation and was considered achieved. The ICR additionally infers achievement this objective on the basis of the relevant outcome indicator added to the Results Framework (though it was not formalized). Relevant intermediate outcome indicators and the envisaged impact of relevant project features/investments are also considered to a lesser extent. Given the highly scientific and experimental nature of the activities related to this GEO i.e. nutrient removal by natural wetlands, baseline and target parameters were estimated at appraisal, and the design included installation of pilot monitoring sites to collect some preliminary data early in implementation.

From the 'informal' project outcome indicator for this GEO: *Overall improvement to the water regime in Gemenc and Béda-Karapancsa wetlands*, which had a baseline of "*No monitoring system in place and no interventions undertaken*" and a final target of "*Monitoring system fully installed and 5 interventions undertaken*", the target was fully achieved. Additionally, the ICR considers the intermediate outcome indicator for "number of hectares rehabilitated", which had been originally envisaged to cover about 10,000 ha, though only 4300 ha (full achievement of the informal revised target) which would appear to be about 43 percent achievement of the original target, was ultimately covered as explained earlier. Considering however, that the removal process is not linear and additional factors such as the nature of project features which contribute to improved water flow and retention within the wetland, climatic factors, etc., contribute to the nutrient removal, the ICR concludes that the nutrient trapping capacity of the Gemenc and Béda-Karapancsa Wetlands would be enhanced by more than just the 43 percent through the project. From numbers provided in the final supervision missions and results

[9] The Cost-Benefit analysis notes that the absolute decrease of the pollutant loads in the Danube from the NBWWTP cannot be solely attributed to the plant's operation, but that there could also be confounding factors from other interventions, climatic variability and nutrient dynamics that could affect the results to some degree. However, it remains clear that the project has had a significant positive effect on the reduction of nutrient concentrations reentering the Danube River following waste water treatment.

measurement, the wetland rehabilitation works within the Gemenc and Béda-Karapancsa wetlands were expected to actively contribute to nutrient reduction of approximately 720[10] tons/annum. Based on the above considerations, the ICR concludes that the nutrient trapping capacity of the Gemenc and Béda-Karapancsa Wetlands was enhanced through the project, and this objective is assessed to be achieved.

(iii) Objective 3: Serving as a model for similar nutrient reduction initiatives in Hungary and other Danube basin countries

There was no formal outcome indicator for this GEO. The ICR again infers achievement this objective on the basis of the relevant outcome indicator added to the Results Framework (though not formalized) and relevant intermediate outcome indicators. The informal outcome indicator was "dissemination of a comprehensive project impact evaluation study", and the intermediate outcome indicators related to completion of the cost-benefit analysis of nutrient reduction of wetland restoration compared to WWTP tertiary treatment, and project experience and impact evaluation study disseminated. The project was able to achieve the above objective through successful dissemination of lessons and results from the project, including a Cost-benefit and Impact Evaluation Study shared through the final workshop attended by representatives from Hungary as well as from the broader Danube region. It was further achieved through the study tours and the dissemination of information to various stakeholders through the various outputs under the communication strategy as well as the connection to IW:LEARN, contributing to the knowledge base for the region through the ICPDR. Three additional wetland systems along the Danube River, Kerülő-Duna, Veránka, and Cserta-Duna have received EU funding resulting from this project and can be considered as catalytic outcomes from the project as the GEF project provided the initial pre-feasibility, monitoring, environmental assessment and detailed technical design work. The results of the monitoring and the cost/benefit analysis and impact evaluation conducted under the project provide an improved understanding of the role of nutrient reduction technology and the role of wetlands in performing similar services for this region than previously known, and appropriately identifies the technical and environmental difficulties encountered in conducting and interpreting consistent, repeated measurements of nutrient dynamics along the Danube River.

[10] There are differences in the values provided during supervision, and those used in the cost-benefit analysis, although they all confirm an increase in the wetlands' nutrient trapping capacity. According to the report of the consultants who carried out the Cost-benefit and Impact Evaluation studies, the methodology and some of the assumptions used for assessing the measurements used for their analysis, differed from that used in background analysis carried out by separate consultants during preparation. The latter formed the basis for some of the baseline and targets during preparation, and the results were compared on the basis of the same measurements.

3.3 Efficiency
Rating: Satisfactory

The efficiency of the project is assessed as Satisfactory on the basis of results of an economic analysis carried out at the end of the project as part of a Cost-Benefit and Impact Evaluation Study conducted independently under Component C, compared with the results of the assessment conducted at appraisal. The economic assessment at appraisal considered the project's contribution to global benefits, primarily linked to reduction in nutrient discharges into the Danube and consequently into the Black Sea; and its cost-effectiveness. That analysis was qualified in the PAD, which indicated that the unit cost for abatement for the wetland component had been roughly estimated based on information available during project preparation, because the impact of wetlands on nutrient reduction had not been systematically documented and was to be better assessed through the project. The Analysis at the end of the project estimated the economic net present value (ENPV), the economic rate of return (ERR) and the benefit-cost ratio of the investments. The relative cost-effectiveness of the investments was also assessed.

Economic Estimate of Environmental Benefits
At appraisal the ERR for NBWWTP was estimated at 22% while that for the Wetland component was cautiously[11] estimated at 72%. As shown in Table 3.1 the ERR for the NBWWTP and the Wetland Components, based on the economic analysis at the end of the project were 12.7% and 13.21% respectively, which although lower than expected, were still satisfactory. The benefits clearly outweighed the costs.

Table 3.1 Summary of Economic Performance Indicators.

Component	Economic Net Present Value (1000 US$)	Economic rate of return (ERR %)	Economic rate of return (ERR %, at appraisal)	Benefit-cost ratio
A- NBWWTP	14, 998	12.7	22	1.31
B – DDNPD Wetland Rehabilitation	3,251	13.21	72	1.86

Global benefits: The key global benefits achieved as a result of the project were the following: (i) a significant reduction in nutrient discharges in the Danube River basin and the Black Sea; (ii) improvement in the quality of the Danube River providing benefits to downstream areas; (iii) restoration of high priority wetlands with benefits for biodiversity of the ecosystems; and (iv) demonstration effects for other potential investors in Hungary as well as other countries in the region.

[11] The PAD acknowledged that the high ERR should be viewed with caution given the relative lack of quantitative evaluations of the impacts of wetlands at the time.

The ecosystems of the DDNP benefitted directly from the Project, as well. These included the Gemenc and Béda-Karapancsa areas, which are two areas of international importance (Ramsar sites) and nesting places for a number of migratory birds and other species of global importance. At the national level, Hungary benefitted from progress towards compliance with EU Directives, in particular in regard to wetland management aspects of the Water Framework. Directive (WFD), and increased capacity of the existing central, regional and local institutions concerned to protect and manage wetlands, floodplains and aquatic ecosystems. The Project also had a demonstration effect in Hungary and in the region, as it resulted in a replicable model for the treatment of non-point sources of nutrient pollution, using wetland and floodplains, and the development of a methodology of impact evaluation.

Cost-Effectiveness Assessment: In terms of cost effectiveness, the unit cost of abatement (estimated as the present value of the relevant annual capital and O&M costs) was estimated at US$ 2230/ton for the NBWWTP component and US$ 2623/ton for the DDNP component. Based on the estimated quantity of nutrients removed as calculated in the Impact evaluation, and the capital and operation costs, as calculated in the Cost Benefit Analysis, the nutrient removal of Component A is slightly more cost-effective than Component B. The unit cost of nutrient Removal of Component A is 15 % lower than that of Component B. It should be noted, however, that in the case of NBWWTP it is easier to determine the quantity of nutrients removed than for the wetlands and floodplains. In both cases, the unit costs of nutrient removal calculated in the final economic assessment were higher than those at appraisal. Moreover, based on the results of the assessment conducted at the end of the project, the nutrient removal of Component A is slightly more cost-effective (about 15%) than Component B. Nevertheless, it is clear that wetlands can be shown to have significant potential to be cost-effective in removing and sequestering N and P.

Table 3.2: Cost-effectiveness of Component A and Component B

Description	**Present value of the total capital and O&M costs**	**Unit cost of nutrient removal (Final Assessment)**	**Unit cost of nutrient removal (Appraisal estimate)**
	1000 US$	US$/t	US$/t
Development of tertiary treatment at NBWWTP	47 853	2230	1060
Rehabilitation of DDNP	4 059	2623	240
Project total	51 912	2256	

Project design and implementation efficiency was also considered generally adequate and the project was implemented within time and budget. Final project costs were also kept generally in line with the appraisal estimates.

3.4 Justification of Overall Outcome Rating

The overall outcome rating of the project is *satisfactory* as a composite of high relevance, *satisfactory* achievement of the three-part GEO/PDO and *satisfactory* efficiency. In many respects, this regional project was pioneering by attempting to contrast the cost-benefit of WWTPs with the role of wetlands and their potential to assimilate nutrients in a cost-effective manner for water quality maintenance. The upgrading of the NBWWTP to a tertiary level of treatment is a significant accomplishment and has helped to meet EU goals for water quality. Furthermore, significant advancements in knowledge and understanding of the nutrient dynamics for both Components A and B, their highly significant variability related to water volume and flow, and the methods developed to model and assess such variability under changing flow regimes in the Danube River is a first for the region. This improvement in understanding is a direct result of the project and has provided useful information that can be applied in future project design and implementation. The lower than envisaged efficiency, though still in the satisfactory range, is linked to the higher costs and the higher ERRs that had been anticipated, especially for the Wetland Component, given the limited data available on the subject at appraisal.

4. Assessment of Risk to Development Outcome

Rating: Low

The risk to development outcome is rated low on the basis of likely threats to the project's outcomes discussed below, and the subsequent likelihood of sustainability of the investments and associated impacts.

Technical: The likelihood of risk to development outcome associated with Component A is *low*. Waste water treatment remains a high priority for the GoH in line with its need to comply with EU wastewater treatment standards and regulations. The MoB is committed to the success of the NBWWTP and its 90% self sufficiency in energy usage is a significant advantage in continuing service to the City. Sustainability is likely for Component A by the strong commitment of the Hungarian Government to comply with EU water and wastewater regulations and to support its MWWTP infrastructure, as well as the capacity of the MOB to operate its WWTP systems. The Treatment Plant's is highly efficient due in large part to its ability to generate part of its energy needs from biogas captured as part of the tertiary process. The NBWWTP is generating 90% of its energy requirements from biogas, which is a significant achievement in its technical design and operation. The Plant successfully operated under a one year Defects liability and trial period, ending in April, 2011.

The technical stability of the completed wetland works in Component B in the GBK wetlands will also ensure that nutrient sequestration will occur at least over the next 25 years of operation. The sustainability of Component B is likely because the role that the hydraulic structures will play in facilitating sediment removal (and thus phosphorous

bound to sediment) over the next 25 years—combined with the uptake of N from biological processes—cannot be discounted and will represent some active and sustained nutrient reduction functions along this section of the Danube River until around 2040. However, risk associated with the ability to effectively measure nutrient dynamics to a high degree of precision stemming from the monitoring program is considered *moderate* given the current limited technical capacity of DDNPD personnel and costs to sustain a sophisticated water quality monitoring program in the medium- to long-term. This suggests that little quantitative information will be forthcoming to adequately assess the dynamics and uptake of N and P and thus the efficacy of specifically how the wetland works will perform in reducing nutrients and their actual effectiveness over time. DDNPD has acknowledged the reduced technical capacity and lack of resources to perform the level of technical monitoring needed to adequately maintain long term data on wetland nutrient dynamics; however, the DDNPD monitoring program is capable of measuring general ecological conditions for which correlations of benefits to species (and thus effects to biodiversity) resulting from the wetland rehabilitation may be useful. This supports the argument that even though consistent quantitative monitoring may not be realized over time, the life of the hydraulic structures does and will continue to support a *likelihood* of sustained nutrient uptake and sequestration from the Danube River. Communication on the project results, findings and experiences has been captured and will continue through maintenance of the project website, linked to the IW:LEARN site.

Financial: Financial risk is considered *low* in the short to medium term based upon the financial projections and analysis established under the PAD assessments. Other factors contributing to the low risk include, the forecasted revenues generated for the City of Budapest from wastewater tariffs for the NBWWTP, the significant energy self-sufficiency from biogas generation for plant operation and maintenance, the general passive stability of the wetland rehabilitation works established under Component B resulting in relatively low maintenance costs for the latter, and the evidence of prior financial commitment by the GoH and its partners during project implementation.

Political and Economic: The current economic uncertainty in Hungary, its evolving economic and political disposition internally adds uncertainty to development outcomes over the long term and as such it would be irresponsible to not acknowledge this most recent turn of events. However, the current political and economic situation in Hungary is beyond the scope of this evaluation. As a result of the project's general success and commitment by the government, its partners and project staff, risk is generally considered to remain *low*. Wastewater treatment services and environmental quality remain as nonpartisan issues, but could be affected by future political changes should they impact funding to support and maintain such services.

Social: The social risk to development outcome is considered *low*. During project preparation a social assessment was determined to not be needed given that engagement with local stakeholders was comprehensive and deemed satisfactory. The communication aspects launched under Component C successfully created a successful identity and raised awareness of the program. The consultation meetings held during project preparation and implementation demonstrated clear awareness by the public on its

dependence upon the value of the Danube River, the GBK wetlands and their natural resources.

5. Assessment of Bank and Borrower Performance

5.1 Bank

(a) Bank Performance in Ensuring Quality at Entry:

Bank performance during project identification and preparation was *Satisfactory.* Time and careful attention were given to the preparation activities to reach out to stakeholders and to prepare the necessary assessments and studies, which included policy, economic and financial analyses, institutional analyses of the various project partners, financial results and projections, technical design studies, social, environmental and safeguard studies, and Environmental Impact Assessment and Environmental Management Plans, to properly design project activities. Bank staff and consultants who helped prepare and supervise the project represented a diverse range of technical, development and management expertise which included economics, legal, financial, sanitary engineering, water management and operations specialties. However, the project could have also benefited from engaging a riparian, aquatic or wetland ecologist with expertise on the fate and effects of chemicals in the environment to have helped guide early planning and design for long term environmental monitoring associated with Component B. The main shortcoming at entry related to design of the M&E/Results Framework, in particular with respect to design of the project's outcome indicators.

(b) Quality of Supervision:

The Bank's supervision performance is rated as *Moderately Satisfactory.* Bank supervision missions were regularly conducted by technical teams to provide detailed advice and recommendations on relevant project management issues, financial management, procurement, improved communication, technical improvement and advice on the adjustment of project plans to better link activities with the PDO and expected outcomes. The team however failed to formally restructure the project to reflect the additions/changes to the project outcome indicator and to targets for one of the intermediate outcome indicators. The timing of the changes, in June 2008, before the new investment lending guidelines for restructuring appears to have played a role in this requirement being overlooked. The high rate of turnover among Task Team Leaders was (six different TTLs over the project's life) a concern among the borrower and a number of the partners. This was in evidence during the interviews conducted in developing the ICR. Nevertheless, the quality of the ISRs showed that each of the TTLs were well versed in the project's issues and progress, and the Bank's Sector Manager and Country Director demonstrated a strong managerial awareness and effectiveness in follow-up recommendations to the TTLs over the course of project implementation.

(c) Overall Bank performance:

The overall Bank performance is rated *Moderately Satisfactory* based on the ratings assigned to Quality-at-Entry and Supervision.

5.2 Borrower

(a) Government implementation performance:

Rating: Moderately Satisfactory

The MoF[12] and MoRD were generally committed to the project and managed the financial aspects of the project to a *satisfactory* degree. During project preparation the MoRD collaborated with Bank staff to establish a new financial system within the Ministry to address financial aspects pertaining to funds transfer, establishment of accounts for each of the Components and reporting. The management structure and flow of funds, and the reporting and transparency, were all well managed and documented. Government was unable to raise additional counterpart funds when rehabilitation works under Component B turned out to be more expensive than originally estimated. Moreover, the delay in permitting and licensing to conduct the wetland works—even though successfully identified as a risk during preparation—did have a significant effect on project implementation and arguably could have been addressed more aggressively within the government. Nonetheless overall assessment of Government performance is rated *Moderately Satisfactory.*

(b) Implementing Agency and Partner Performance:

Rating: Satisfactory.

Implementing Agency and Partners were committed to the project and performed their tasks in general accordance with plans. Project personnel remained consistent throughout the project life with virtually no turnover. The Municipality of Budapest had adequate experience from previous projects with the World Bank and was especially well positioned to support the implementation of Component A. The Municipality was able to provide additional funds to cover the financing gap for its component. The MoRD on the other hand did not possess initial technical capacity to adequately cover all of the project issues during the first two years of implementation. Staff's expertise was weighted more toward financial management than technical which led to some delay in seeking the proper technical assistance for other components of the program. The MoRD team capacity was however strengthened through hiring of consultants to support activities like procurement. The WD and the DDNPD were also less experienced with International projects of this type, and so capacity enhancement was needed and did occur during project preparation and into the early stages of implementation. Nevertheless, the WD displayed an early understanding of its limitations with technical capacity within its institution and sought early assistance from qualified academic and technical consultants and experts, who provided timely expert knowledge and support. The "Expert Panel", comprised of specialists in water management, forestry, gaming, ecology, nutrient flows and conservation, played a key role in providing technical guidance to the project partners and implementing agencies during implementation. Consequently, a rating of *Satisfactory* is assigned for overall Partner Performance.

[12] MOF later became the Ministry of National Economy.

(c) Justification of Rating for Overall Borrower performance:

Rating: Moderately Satisfactory
Justification of overall borrower performance is based on the composite of the ratings of Moderately Satisfactory and Satisfactory for Government and implementing Agency performance, respectively. Despite the various delays in the project over the course of implementation, the continuity of the same staff members working on the project from the very beginning, and their commitment and dedication to seeing the project meet its objectives, even if slightly adjusted due to manifested risks and unforeseen circumstances, is noteworthy. This was acknowledged repeatedly by Bank staff in several of the ISRs. Even in light of the unfortunate delays associated with permitting the wetland works and the monitoring associated with Component B, the GoH (including the project partners) generally performed *satisfactorily* in implementing each of the project components and associated activities. Component A is considered as highly successful in meeting its objectives. The drive to complete the wetland rehabilitation activities under Component B was strong and the continuity of the partner personnel remained consistent throughout the project's life. This played a significant role in completing the project milestones, even if some were reduced in scope (i.e. the number of hectares of wetlands addressed) or delayed (i.e. permitting for wetland rehabilitation and long term monitoring).

6. Lessons Learned

a) Regional approaches remain crucial in managing transboundary environmental challenges. The continued importance of World Bank interventions using regional, transboundary efforts cannot be overstated and deserve continued support in demonstrating economic benefits and environmental services to development. Projects that have regional impacts continue to show significant positive results in proving such concepts and in transferring knowledge among neighboring countries so that future environmental and development management strategies and capital investments can be more effective. Even with the project's challenges, there has been a good demonstration of the importance of nutrient reduction and the economic and environmental benefits in both local and regional contexts for the Danube River and Black Sea LME which can be transferred to other regions. Three additional wetland systems along the Danube River, Kerülő-Duna, Vernaka, and Cserta-Danube have received EU funding resulting from this project and can be considered as catalytic outcomes from the project as the GEF project provided the initial pre-feasibility, monitoring, environmental assessment and detailed technical design work.

b) Strategic use of managed wetlands can be effective in reducing nutrient concentrations and, based on model runs, can be cost-competitive with constructed waste water treatment systems. Operational and maintenance costs can be size-dependent as well as subject to significant fluctuations in raw material costs. Additionally, variation can occur in natural systems that affect efficiency of nutrient uptake. This project demonstrated that wetland systems, through the use of hydraulic structures designed to facilitate sediment retention (and thus concentrations of Phosphorus) as well as

increasing the scope for biological uptake and utilization of Nitrogen, can be effective over an extended period of time. This provided a learning opportunity for, and potential application by other riparian countries along the Danube River.

c) Considerations for future Bank projects involving environmental monitoring should be clearly developed during preparation and tested prior to project approval. The complexities and non-linear dynamics of natural systems cannot be underestimated when attempting to measure cause-and-effect relationships related to development, and this can clearly be seen in the range variation of nutrient uptake between the different systems. Effective environmental monitoring remains a critical component to assess environmental services and economic costs and benefits, to support better decisions and adaptive management regarding sustainable development. Considerations for future Bank projects involving environmental monitoring should be clearly developed during preparation and tested prior to project approval. Also, an exit strategy and support plan should be crafted prior to approval to ensure sustainability of appropriate (i.e. technically adequate) monitoring beyond the project life. The relatively short duration of projects (e.g. 3-5 years) makes this especially challenging, but no less important, given the tendency for these types of programs to cease when project funding ends.

d) Future projects should carefully examine the importance of continuity in World Bank personnel routinely interacting with the borrower. The high turnover in the number of Task Team Leaders for the project contributed to a feeling of discontinuity and had an impact on the morale of the borrower and partners. During interviews, even though the project staff stated that they adapted to the changes with the high rotation of different TTLs (there were six different individuals serving as TTL over the project's life), it was felt that there was a constant re-visiting (and even local re-orientation of TTLs and re-statement of issues was required). While it is apparent that the ISR process keeps TTLs and Senior Bank Management well informed, future projects should emphasize continuity in World Bank personnel routinely interacting with the borrower.

Annex 1. Project Costs and Financing

(a) Project Cost

Components	Appraisal Estimate	Latest Estimate	Appraisal Estimate	Latest Estimate	Percent of Appraisal[13]
	US$ 000		EUR 000		
Component A: Development of tertiary treatment at the NBWWTP (Budapest)	**23.40**	**26.8**	**19.45**	**18.88**[14]	**115**
omponent B: Wetland Restoration in the Duna-Drava National Park	**6.08**	**6.5**	**5.05**	**5.0**	**107**
Component C: Dissemination and Replication	**0.41**	**0.5**	**0.34**	**0.39**	**122**
Contingencies	**2.09**		**1.7**		
Total Financing	**31.97**	**33.8**	**26.54**	**24.27**	**106**

(b)Project Financing

Source of Funds	Appraisal Estimate	Latest Estimate	Percent of Appraisal
	US$ 000, 000		
Global Environment Facility	**12.50**	**12.32**	**98.6**
IBRD (Loan No. 4512HU)	**7.7**	**7.7**	**100**
Local Financing	**11.77**	**13.78**[15]	**117**
Total Financing	**31.97**	**33.8**	**106**

[13] Percentages are based on the US$ comparisons at appraisal and actuals.

[14] This shows a lower estimate than the one appraisal, but is higher in US$ due to differences in exchange rate from US$ to Euro at the time the estimate was made. The US$ amounts are however considered since at appraisal and for most contracts costs were in US$.

[15] The local financing amount is also based on a final estimate given that the amounts were in Hungarian Forints and the exchange rates fluctuated during the course of the project implementation.

Annex 2. Outputs by Component

Key outputs from the three Project components are described below.

Component A: Upgrade of the NBWWTP for tertiary level treatment

Component A was managed by the Municipality of Budapest and there was only one activity and one contract under this component, related to the upgrade of the NBWWTP for tertiary level treatment or nutrient removal. The aim of the project was to decrease the concentration of the nitrogen and phosphorous in the effluent water. During the extension works, which involved converting the existent aeration tanks and building new tanks, a nitrogen removal technology using activated sludge was installed. The phosphorous removal process was introduced by addition of chemicals.

The North Budapest Wastewater Treatment Plant was upgraded and commissioned in April 2011, and now provides tertiary wastewater treatment, resulting in significant a reduction in the discharge of total Nitrogen and Phosphorous from the Plant into the Danube River by as much as 72 and 75 percent[16], respectively. Ammonium-nitrogen discharge was reduced by 91 %. Other wastewater discharge parameters from the Plant such as removal of BOD have also been significantly improved (92%). Approximately 90% of the plant's energy requirements are satisfied by biogas generation as a result of the tertiary treatment process. This project has served as a pioneering effort, and fortunately, the other EU regulations are further strengthening the removal of both N&P from treated sewage effluent entering the Danube River, further reducing N and P loading. The other two-thirds of the Budapest municipality are also coming on-line with tertiary treatment systems, which is part of the EU regulatory requirements.

Installed structures and technical process
No changes were carried out in the pre-mechanical and the mechanical treatment sections of the NBWWTP during the installation of the nutrient removal phase. The new and the existing tanks were both connected to the pipe at the end of the primary sedimentation tank. At this point the wastewater is distributed by a driving-gear-moved sluice gate controlled by an inductive flow-meter. The volume of the existing activated sludge tanks and the secondary sedimentation was not changed. To form the denitrification tanks, the first part of the aeration tanks was separated with walls and mixers were installed. The water with high nitrate content is led back to the denitrification zones by inner recirculation pumps. The new Plant section comprises 4 race track aeration tanks with pre-denitrification and 8 final sedimentation tanks. The necessary concentration of dissolved oxygen in the aeration tanks is ensured by fine bubble aeration system. Within the framework of the project a recirculation sludge station, a surplus sludge station and a new blower house were built.

[16] These measurements were based on June 2011 supervision mission.

The phosphorous is removed by precipitation: ferric chloride is added after the water leaves the primary sedimentation tanks. Treated water from the secondary clarifiers of both lines is led into the chlorinating channel through perforated pipes, and then into the Danube through a final shaft.

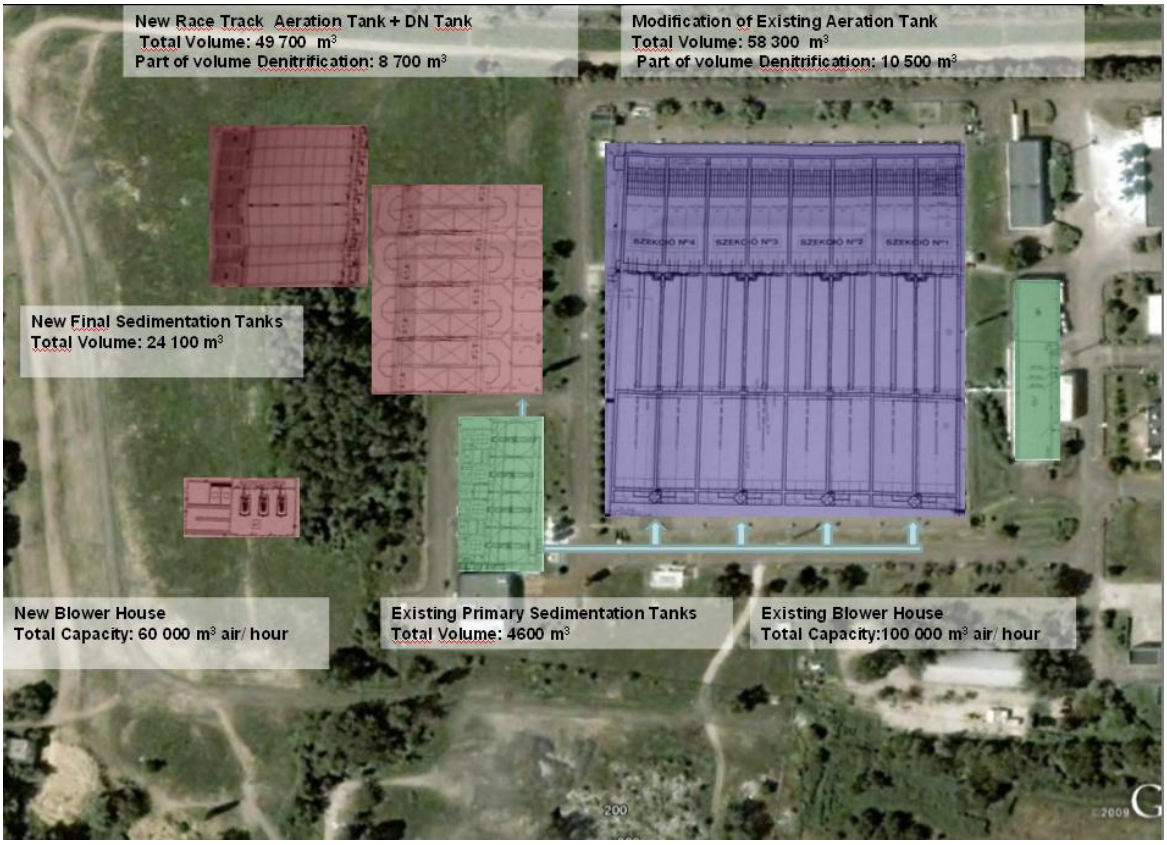


Figure A2-1: Technology development investments at the North Budapest WWTP

Component B Outputs

This component financed the rehabilitation of about 4,300 hectares of wetlands to develop their nutrient trapping capacity within two identified areas, Gemenc and Béda-Karapancsa, located within the DDNPD, directly along the course o f the Danube River. The DDNPD is located downstream from Budapest, which discharges a proportion of its wastewater into the Danube River without any treatment. The surrounding areas upstream from the Park are cultivated areas, and also represent a source of non-point pollution of nutrients. This component financed development of a comprehensive M&E system to measure the reduction of nutrients resulting from the interventions. Parameters to be included in the M&E system were determined on the basis of a baseline survey carried out at the beginning of implementation.

The number of hectares and works to be implemented under Component B was reduced from eleven to five riverine areas based on the inability to provide additional cofinancing associated with final detailed designs. The combined total area of the revised Gemenc-Béda-Karapancsa wetlands to be rehabilitated was about 4300 hectares to improve nutrient (N&P) trapping capacity. The selections were chosen based on a combination of optimal specific costs per nutrient and specific cost for volume, where specific costs refer to 25 years of depreciated operation and maintenance at 4%/year. The works involved sixty two separate actions at five sites and included the following locations (also refer to maps and numbered locations in Annex 8):

Water System	**Area (ha)**	**Flood Volume** (K m^3 /yr)
1. Moeskos Duna (near #1, see Annex 8)	544	499,818
2. Kerűlö Duna (#5)	696	501,432
3. Bátai Duna (#7)	1,723	5,544,064
4. Grébec (Fekete Erdö) (#6)	780	1,462,235
5. Báli (#3)	620	37,118
Total/Average	4,363	8,044,667

Summary of the works under Component B

Moeskos-Duna: There was an existing culvert of two meters diameter which did not adequately prevent water flow. A small sluice was constructed, using a technical design similar to the one built for the Fekete Erdö site (below).

Kerűlö Duna The determining element of water regime in the area is the artificially created bed with the name, Kerűlo-Duna". It is 8 kilometers long. During flood events, it can represent a wetland of *9* hectares in area. Approximately 2,200 m^3 (for sections between Cserta and Duna) and 964 m^3 (Kapostas and Duna) were dredged at this site.

Bátai Duna: The system is named after the *6 km* long dead branch of 96 hectares in surface area. The island between the branch and the Danube River bed is an area of high ecological diversity, partially covered by forest, which is frequently flooded. Works in this area included 26,550 m^3 of dredging in a channel adjacent to a row of houses next to the town of Bata (population 2500). Works also included dyke construction, two sluices, one large double-sluice (built between two unused railway pillars), and another board-locking sluice built to protect a privately-owned forest from flooding.

Grébec (Fekete Erdő): The area is an island bordered by the main bed and the side branch "Grébec-Duna". It was-created in the 19th century, by cutting across a bend. The side-branch has 66 hectares surface area. Its length is 4 km, and is connected to the main bed only by its confluent end. It had become heavily silted, and significantly eutrophic (i.e. nutrient rich). Approximately 34,000 m^3 of dredging was performed along a 500 meter upper inlet of Grébec and a locking sluice with a gate was constructed to slow the rate of sedimentation. The pumping of sludge was transferred into two (one small and one large) excavated reservoirs, topped with geotextile material and stabilized with

grasses to serve as a 'game rescue hill' for wildlife refuge during high flood periods of the Danube River.

Báli: The central part of the area is occupied by a heavily eutrophic and silted inner lake. The surface area of the lake is approximately 15 hectares. Its water supply is regulated by the canal connecting it to the "Ven-Duna" (Old-Danube), the neighboring hydrological unit, which has already been revitalized. Works in this area included approximately 2200 m^3 of dredging of the entire stretch of Bali-fok and the bottom of Bali-to to ensure a more frequent and prevalent flooding of the lake. It also included dyke construction, placement of three culverts and two fords. The culverts were reconstructed at a slightly lower elevation to remove bottlenecks to improve more frequent flooding to facilitate a more persistent and active wetland environment. Three shallow lakes play a crucial role for fisheries and bird migration habitat.

M&E System: A system for monitoring the nutrient reduction capacity of the wetland system in the project area was developed and implemented in 2009 and results from this system informed the model runs for the Cost-Benefit Analysis. Twenty five monitoring wells were licensed and constructed to support monitoring for these works.

Component C Outputs

This component financed consultant services to (a) implement a Communications Strategy for the project and (b) to carry out a comprehensive end-of-project impact evaluation and results analysis study o f the two interventions (tertiary treatment and wetlands restoration), including a cost-benefit analysis.

a) *Communications Strategy:* The Project Communication Strategy targeted three main groups, 1) North-Pest, 2) Gemenc, Béda-Karapancsa (GBK) areas and 3) Sixty two municipalities between the two locations; however, only the first of the three target groups were effectively addressed because of resource limitations for the contract. Nevertheless, outputs resulting from the Component C included the following:

- A 26 week training was held to enhance English Language, communication and integrated skills related to water management, environmental and nature (wildlife) protection
- A professionally developed film was produced to highlight the project, titled "The Danube – Naturally!" Website(s): http://www.ddkovizig.hu/angol/kezdolap
- A permanent display of the project was established in the museum in Budapest.
- A project website was developed and managed (http://www.gef.ddkovizig.hu/)
- Highlights of the project were shown in 41 separate cases and journalists were invited to participate in each of the events. A press tour was conducted for national and local television stations.

- Study Tours were undertaken in Germany, France and Romania to discuss nutrient reduction and other aspects of environmental impact assessment.

- An end-of-project workshop and learning exchange, titled: *Nutrient Pollution Reduction in Wastewater Treatment and Wetlands Remediation: Lessons from Hungary Nutrient Reduction Project* was held in Budapest November 14-16, 2011. One open forum (including students) was held, and a separate forum for professionals to facilitate knowledge exchange was undertaken.

b) Cost-Benefit and Impact Evaluation Analysis: The analysis was conducted and a report was produced that included an impact evaluation for Component A, an impact evaluation and methodology for Component B, and an analysis of conventional treatment of the NBWWTP contrasted against nutrient uptake and sequestration by natural wetlands in the GBK areas. The Project used a multi-focal approach to assist the Government of Hungary (GoH) in developing advanced wastewater treatment of domestic discharges and to restore high priority wetlands to work as nutrient traps, while increasing their internationally recognized ecological values. It enabled comparison of two different forms of intervention to reduce discharges of nutrients from point and non-point sources, and evaluation of their impacts in terms of global benefits in relation to their respective investment and operation costs. It had an important demonstration role in Hungary and within the region to help develop technically and financially sound solutions, allowing for best use of scarce resources. Furthermore, the Project strengthened the institutions involved, built capacity of local staff in efficient development and operation of wetlands for nutrient trapping, and raised awareness of the ecological benefits of wetland rehabilitation and their impacts on biodiversity

Annex 3. Economic and Financial Analysis

The Government initiated a number of wastewater treatment related investments in the early to mid 2000's. For Budapest, these included the expansion and upgrading of the North Budapest and South Pest WWTPs, and were financed in part by the Bank through Loan 4512-HU. The South Pest WWTP was expanded from a capacity of 72,000 m^3/day to 120,000 m^3/day, and upgraded to provide nitrogen and phosphorus removal, and biogas recovery. The NBWWTP was expanded to a capacity o f 200,000 m^3/day and included secondary treatment. Nutrient removal facilities were left for implementation in the future (i.e. this project) to add more high-rate primary sedimentation tanks, fixed-bed filters, and chemical dosing for phosphorus removal). The estimated total cost of the investment was about US$ 80 million of which US$ 31 million was for the South Pest WWTP, US$27 million for the NBWWTP, and US$22 million for complementary investments. This was assumed as the Baseline for the proposed Project.

This GEF Project financed additional investments of about US$32 million, of which GEF provided US$12.5 million, with the local contribution to the Project estimated to be US$11.8 million, of which US$10.4 million came from the Municipality of Budapest and US$1.4 million from the Government. An amount of US$7.7 million equivalent (Euro5.9 million) was made available from the reallocation of loan savings and uncommitted funds under the Bank's Loan 4512-HU (for the MWP). The GEF leverage ratio was determined to be 1:7.96 (US$12.5 million provided by GEF and US$99.5 million provided as baseline investments and counterpart contributions).

Table 1. Economic Project Costs

	At real price of 2011 US$			
Development of tertiary treatment at NBWWTP	**2009**	**2010**	**2011**	**Total**
1. Works	**965 519**	**8 766 538**	**915 524**	**10 647 582**
1.1 Structures	965 519	7 602 515	915 524	9 483 559
- aeration basins	386 208	3 041 006	366 210	3 793 424
- settling basins	434 484	3 421 131	411 986	4 267 601
- machine house	144 828	1 140 377	137 329	1 422 534
1.2 Roads and utilities	0	1 164 023		1 164 023
2. Goods	**1 043 158**	**9 240 569**	**0**	**10 283 727**
2.1 Machines, equipment	938 842	8 316 512		9 255 354
2.2 Control techniques	104 316	924 057		1 028 373
4. Net investment costs	**2 008 677**	**18 007 107**	**915 524**	**20 931 309**

Wetland restoration in DDNPD	2008	2009	2010	2011	Total
1. Works	0	42 422	162 315	988 448	1 193 186
2. Goods	0	76 730	75 527	2 642	154 898
3. Services	7 121	16 761	587 434	2 336 016	2 947 333
4. Total investment costs	**7 121**	**135 913**	**825 277**	**3 327 106**	**4 295 418**

Source: Cost-Benefit Analysis, MoRD/ VTK Innosystem Ltd. 2012

Environmental Benefits: The main benefit of the Project is the reduced nutrient load to the Danube River and the Black Sea. Although the Danube River is not declared as a sensitive water body, the GoH chose to include tertiary treatment in the North Budapest Waste Water Treatment Plant (NBWWTP) to meet the GoH's commitment of reduced nutrient discharges into the Danube River and the Black Sea. The following figures demonstrate the benefits resulting from tertiary treatment of the NBWWTP and the reductions in N (Fig. 1) and P (Fig. 2) concentrations re-entering the Danube River following treatment.

Figure 1. Discharged Tons/yr of Nitrogen against influent at NBWWTP.

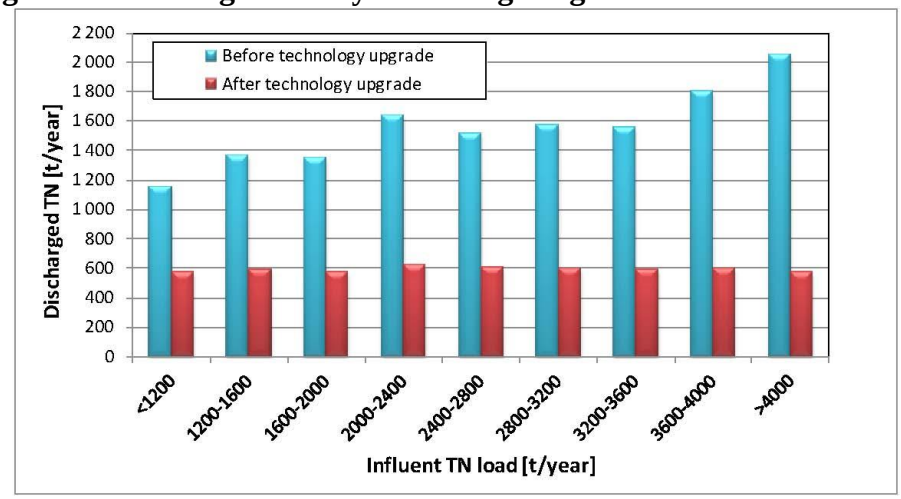
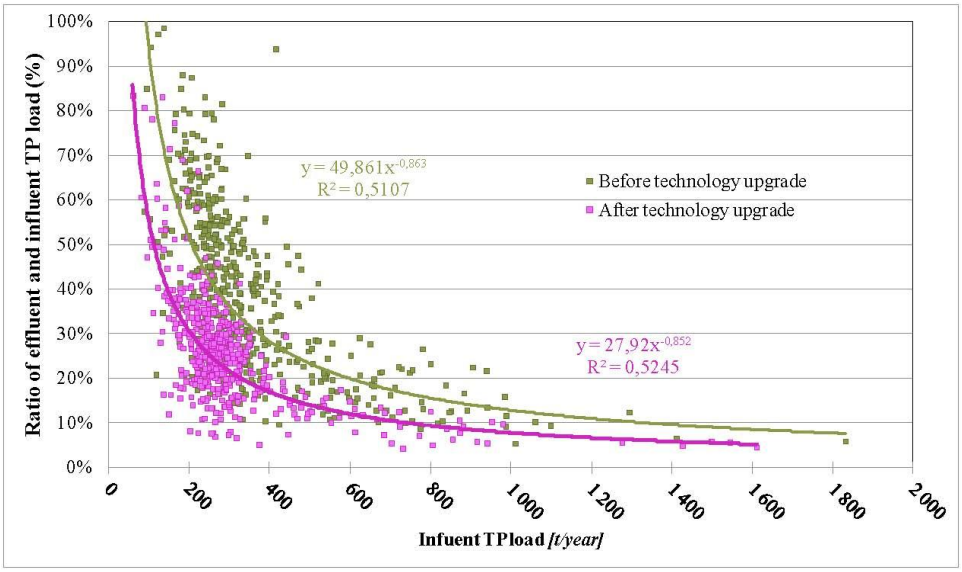


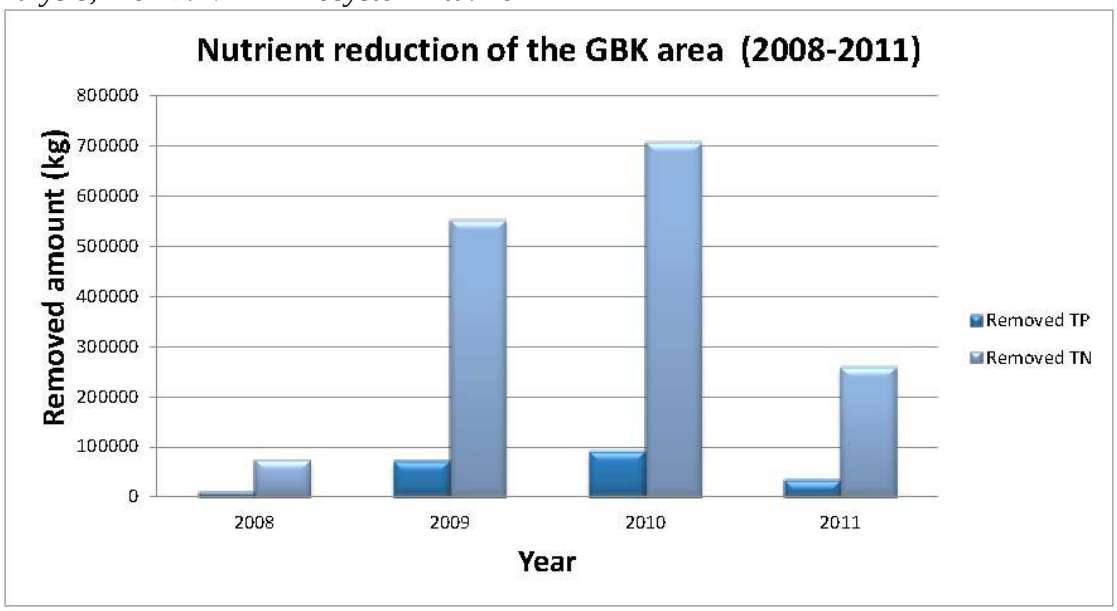
Figure 2. NBWWTP ratio of effluent and influent loads of phosphorous in tons/yr.



Source: Cost-Benefit Analysis, MoRD/ VTK Innosystem Ltd. 2012

To reduce costs, the Project also placed emphasis on alternative solutions to reduce nutrients, namely through the restoration of wetlands and particular floodplains connected to the Danube River Complex (Fig. 3). As part of Project Component C an Economic Cost-Benefit Analysis was conducted to examine the differences between the NBWWTP and the capacity of wetlands as nutrient filters downstream in the Béda-Karapancsa wetlands of DDNPD.

Figure 3. shows the volume of total nitrogen and total phosphorus removed by the reviewed side arms on the basis of model runs and calculations. *Source: Cost-Benefit Analysis, MoRD/ VTK Innosystem Ltd. 2012*



Operational Costs

Incremental benefits of the project during Appraisal were valued at US$ 5 per kg of nutrient reduction, with incremental capital and operations and maintenance costs being net of taxes. Under the contractual agreement between the MOB and the BMSC, a tariff formula was used to estimate incremental operating expenses resulting from the investment, and was based on cost-recovery.

For Component A, the upgrading to tertiary treatment was estimated during appraisal to involve an incremental cash expense (HUF 6.5/m^3 for O&M and HUF 1.5/m^3 for debt service) of about HUF 8/m^3 of wastewater invoiced. The required tariff increase was estimated to be about 4.5% over the baseline level of the average wastewater tariff and was determined to remain affordable to most of the population concerned at the time of Appraisal, with schemes for financial relief for the poorest of the population. This resulted in an adjusted tariff of 24.9 HUF/m^3 at project completion.

Table 2. Calculation of wastewater fee for NBWWTP. *Source: Cost-Benefit Analysis, MoRD/ VTK Innosystem Ltd. 2012*

WASTEWATER FEE IN BUDAPEST		**Net fee**	**Water loading fee**	**Net total**	**VAT**	**Total fee**
Fee at present	HUF	306.73	18.57	325.30	81.33	406.63
Fee in 2010	HUF	248.70	23.73	272.43	68.11	340.54
Fee at present	US$	1.3942	0.0844	1.4786	0.3697	1.8483
Fee in 2010	US$	1.1305	0.1079	1.2383	0.3096	1.5479

Table 3. Operation and Maintenance Costs for Component A for selected current and forecasted years up to 2030. *Source: Cost-Benefit Analysis, MoRD/ VTK Innosystem Ltd. 2012*

With project	**2011**	**2012**	**2013**	**2014**	**2015**	**2020**	**2025**	**2030**
Total variable costs	**22150**	**22220**	**22290**	**22361**	**22433**	**22803**	**23192**	**23601**
Total fix costs	**2196**	**2256**	**2277**	**2298**	**2320**	**2430**	**2546**	**2668**
WWTP total direct costs	24346	24476	24567	24659	24753	25233	25738	26269
Overheads	4869	4895	4913	4932	4951	5047	5148	5254
Total O&M costs	**29215**	**29371**	**29480**	**29591**	**29703**	**30280**	**30886**	**31522**
Without project								
Total variable costs	**20968**	**21029**	**21090**	**21152**	**21215**	**21537**	**21876**	**22232**
Total fix costs	**2000**	**2020**	**2040**	**2061**	**2081**	**2187**	**2299**	**2416**
WWTP total direct costs	**22968**	**23049**	**23131**	**23213**	**23296**	**23724**	**24175**	**24648**
Overheads	4594	4610	4626	4643	4659	4745	4835	4930
Total O&M costs	**27562**	**27659**	**27757**	**27855**	**27955**	**28469**	**29010**	**29578**
Incremental O&M costs	**1 653**	**1 712**	**1 724**	**1 736**	**1 748**	**1 810**	**1 876**	**1 945**

For Component B, an increase in O&M expenses was estimated at appraisal by about HUF 135 million per year (US$ 634,000), or an estimated 26% of the 2005 DDNPD annual budget (HUF 529 million, US$2.7 million equivalent). The 2012 economic analysis estimated operational costs (i.e. monitoring costs) of DDNPD project to be about US$40,000 annually (Table 4).

Table 4. Operation and Maintenance Costs for Component B for selected current and forecasted years up to 2030. *Source: Cost-Benefit Analysis, MoRD/ VTK Innosystem Ltd. 2012*

With project	**2012**	**2013**	**2014**	**2015**	**2020**	**2025**	**2030**
Grébec	10	10	10	10	10	10	10
Cserta	10	10	10	10	10	10	10
Mocskos	10	10	10	10	10	10	10
Báta	10	10	10	10	10	10	10
Total O&M costs	**40**	**40**	**40**	**40**	**40**	**40**	**40**

Economic Estimate of Environmental Benefits

The projection period for the project was based on 25 years (2006-2030), and on this basis, the economic rate of return (ERR) was estimated at 22% for the Budapest component and 72% for the DDNPD component. However, during Appraisal the high ERR for the DDNPD component was viewed with caution given the relative lack of quantitative evaluations of impacts for wetlands. At the time of the PAD, estimates for nutrient reduction ranged from US$2/kg to about US$9/kg for N and up to US$22/kg for P.

Table 5. Economic net present value (ENPV), the economic rate of return (ERR) and the benefit-cost ratio of the investment.

	Component A	Component B
Economic internal rate of return of investment (ERR), %	12.7%	14.0 %
Economic net present value of investment (ENPV) , 1000 US$	14 998	3 229
Benefit-cost ratio (BCR)	1.31	1.80

Source: Cost-Benefit Analysis, MoRD/ VTK Innosystem Ltd. 2012

Sensitivity analysis conducted during Project Appraisal indicated that, at the lower end value of US$ 2/kg, the ERR for the NBWWTP would be negative while that for the

DDNPD component would drop to 33%. At the upper end values of US$ 9/kg for N and US$ 22/kg for P, the ERRs for the two components were estimated at 51 % and 111% respectively.

For Component A (NBWWTP), the break-even point (NPV=O) was determined at an economic value of nutrient reduction of about US$3.5/kg. For Component B (the GBK wetlands), given the relative uncertainty about the amount of reductions to be achieved, sensitivity analysis indicates that the ERR would remain above 40 % even if the amount of reduction (in tons) turned out to be lower than expected by up to 50%.

Table 6. Results of the Sensitivity Analysis. ***Source: Cost-Benefit Analysis, MoRD/ VTK Innosystem Ltd. 2012***

Component A (NBWWTP)		ENPV	ERR	Changes of ENPV		Changes of ERR	
Base case		14998	12.72%	-			
Economic benefits	1%	15591	12.98%	3.95%	Critical	2.09%	Critical
	-1%	14406	12.45%	-3.95%	Critical	-2.10%	Critical
Economic O&M costs	1%	14789	12.62%	-1.39%	Critical	-0.74%	Not critical
	-1%	15207	12.81%	1.39%	Critical	0.74%	Not critical
Component B (GBK Wetlands)		ENPV	ERR	Changes of ENPV		Changes of ERR	
Base case		3229	13.96%	-			
Economic benefits	1%	3301	14.13%	2.25%	Critical	1.21%	Critical
-1%		3156	13.79%	-2.25%	Critical	-1.21%	Critical
Economic O&M costs	1%	3225	13.95%	-0.12%	Not critical	-0.07%	Not critical
-1%		3233	13.97%	0.12%	Not critical	0.07%	Not critical

Two main points are evident as a result of the analysis:

1. Economic benefits and economic O&M costs are critical variables for Component A (NWWTP)

2. Only economic benefits are critical variables for Component B (DDNPD).

According to the impact evaluation of Component A, the Nitrogen load of the Danube is reduced by 890 t annually, on average, due to the GEF technology development. For P this amounts to 43 tonnes. According to the impact evaluation of Component B (GBK wetlands), the average volume of N removed amounts to 28. t/year for N and 45.6 t/year for P. These analyses suggest that natural wetlands are, at least theoretically, comparable in cost-benefit when compared to engineered systems; however the operational and maintenance costs can and do vary significantly. Such variation depends upon environmental conditions and river levels and volume, but wetlands do appear to be competitive compared to specific costs of nutrient reduction associated with wastewater treatment plants. Specific operation and maintenance costs for treatment plants depend upon size and are sensitive to fluctuations in the prices of energy and raw materials. WWTTP appear to be more efficient and effective in the short term; however, wetlands can demonstrate cost-competitiveness for long term nutrient management (e.g. averaged over a 30 year period).

Cost-Effectiveness Assessment: The cost-effectiveness comparison was also considered as part of the economic analysis. Specific cost (USD) per each nutrient (N, P) and also per unit volume of water treated (m3) were analyzed as part of the assessment. In this case**,** benefits were expressed in volume of nutrients removed. The GEF supported technical developments at NBWWTP resulted in 890 t/year N, and 43 t/year P removal on annual average. The estimated total quantity of nutrient removal during the 25 year reference period considered in the analysis, amounted to 21,459 tonnes, out of which 20,470 tonnes for N and 989 tonnes for P. The GEF program contributed to the removal of 28.1 t/year of N, and 45.6 t/year of P in the Gemenc – Béda-Karapancsa region from the Danube. The total estimated nutrient removal was 1,548 tonnes, out of which 590 tonnes were for N and 958 tonnes for P during the reference period. In terms of cost effectiveness, the unit cost of abatement (estimated as the present value of the relevant annual capital and O&M costs) was estimated at US$ 2230/ton for the NBWWTP component and US$ 2623/ton for the DDNPD component. Based on the estimated quantity of nutrients removed as calculated in the Impact evaluation, and the capital and operation costs, as calculated in the Cost Benefit Analysis, the nutrient removal of Component A is slightly more cost-effective than Component B. The unit cost of nutrient Removal of Component A is 15 % lower than that of Component B. It should be noted, however, that in the case of NBWWTP it is easier to determine the quantity of nutrients removed than for the wetlands and floodplains.

Cost-effectiveness of Component A and Component B

	Quantity reduced over the period of 25 years	**Present value of the total capital and O&M costs**	**Unit cost of nutrient removal**
	Tonnes	1000 USD	USD/t
Development of tertiary treatment at NBWWTP	21 459	47 853	2230
Rehabilitation of DDNP	1 548	4 059	2623
Project total	**23 007**	**51 912**	**2256**

Based on the volume of nutrient removal calculated in the impact evaluation of the Cost-Benefit Analysis, combined with the capital and operational costs, the nutrient removal of Component A is slightly more cost-effective (about 15%) than Component B. Nevertheless, it is clear that wetlands can be shown to have significant potential to be cost-effective in removing and sequestering N and P. Project design and implementation efficiency was also considered generally adequate and the project was implemented within time and budget. Final project costs were also kept generally in line with the appraisal estimates.

Annex 4. Bank Lending and Implementation Support/Supervision Processes

Name	Title	Unit
Xavier Chauvot de Beauchêne	Senior Water & Sanitation Specialist, Task Team Leader (TTL)	ECSIE
Manuel Mariño	Lead Water & Sanitation Specialist, former co-TTL	ECSS6
Luiz Gabriel Azevedo	Lead Water Resources Specialist, TTL	
Shelly McMillan	Water Resources Specialist, TTL	
Michael Webster	Senior Water and Sanitation Specialist, TTL	ECSS6
Sanyu Lutalo	Senior Water and Sanitation Specialist, TTL	ECSS6
	Senior Environmental Specialist	ECSS6
Tracy Hart		MNSEN
Emilio Rodriguez	Consultant	LCOPR
David Sislen	Senior Infrastructure Economist	LCSFU
Iwona Warzecha	Senior Financial Management Specialist	ECSPS
Andreas Rohde	Senior Sanitary Engineer	ECSIE
Salim Benouniche	Senior Procurement Specialist	ECSPS
Ahmet Gokce	Senior Procurement Specialist	ECSPS
Suman Mehra	Country Program Coordinator	ECCU7
Christine Castillo	Operations Analyst	ECCU7
Claudia Pardiñas Ocaña	Senior Counsel	LEGEC
Rohit Mehta	Senior Finance Officer	LOAG1
Maria Teresa Lim	Program Assistant	ECSSD
Ama Esson	Program Assistant	ECSSD

Annex 5. Summary of Borrower's ICR and/or Comments on Draft ICR

The Borrower prepared an Implementation Completion Report following project closure. The following table summarizes the Borrower evaluation ratings of performance, which is contained to the assessment of Component B:

	Component B	
Relevance of Objectives, Design, and Implementation	Rating: Satisfactory	**Overall Performance: Satisfactory**
Achievement of Project Development Objective	Rating: Moderately satisfactory	**Overall Performance: Satisfactory**
Efficiency	Rating: Moderately Satisfactory	**Overall Performance: Satisfactory**
Assessment Of Risk To Development Outcome	Rating: Satisfactory	**Overall Performance: Satisfactory**
Bank Performance: 1) Quality at Entry 2) Quality of Supervision	1) Rating: Satisfactory 2) Rating: Satisfactory	**Overall Performance: Satisfactory**
Borrower Performance 1) Government Performance 2) Implementing Agency/Agencies' Performance	1) Rating: Satisfactory 2) Rating: Satisfactory	**Overall Performance: Satisfactory**

Implementation Completion and Results Report – Government of Hungary's Report

GEF Nutrient Reduction Project TF HU 55978

Results and Description of Component

SECTION 1: PROJECT/PROGRAM CONTEXT, GLOBAL ENVIRONMENTAL OBJECTIVES, AND DESIGN

Context at Appraisal

The MoEW coordinated the components of the project (A B C).

"A" Component: For the first stage the upgrade and extension of North-Budapest Wastewater Treatment Plant was completed in 2002. This phase was designed only for the removal of organic substrates; however, because the system was unable to remove the nutrient components from wastewater, the authority was obliged to perform a second phase of construction that included nutrient removal.

"B" Component: The Gemenc and Béda-Karapancsa wetlands region is situated in the lower Danube River section within Hungarian borders and entirely within the Duna-Dráva National Park (DDNPD). The aim of the project component was to increase the protection of the River Danube through the restoration of wetlands; whilst reducing the nutrient discharges of nitrogen (N) and phosphorous (P).

Component"B" had primarily an environmental focus; however, because nutrient removal can be achieved by directing water together with the nutrients from the main bed onto floodland areas, the project was also considered a water utilisation activity. Another important benefit of the project included the improvement of microclimate by expanding water surface areas and by stabilizing the groundwater balance within the DDNPD, which together would enhance wildlife habitat conditions. The environmental aims of the project also had several additional positive side-effects which deserve emphasis, including habitat improvement that was as equally significant as the nutrient reduction objectives, because nutrient trapping is reliant upon the long term functioning and quality of habitat.

Component"C"; The Accompanying List No. 2. of the Grant Agreement disposes of the content of "C" Component, the implementation of which belonged to the Ministry for Environment and Water (its successor is the Ministry of Rural Development). According to the Grant Agreement, the aim was to complete a comprehensive comparative study after the fulfilment of "A" Component and B for the preparation of the World Bank's evaluation that contains the impact analysis, evaluation of results, and cost-benefit analysis of the project.

The second priority was the dissemination of the results of the GEF project, monitoring of project activities, promoting the project locally and internationally. On the local level, the task was the information of the press, the preparation of publications and the presentation and promotion of the project. The main task of the international communication was to inform the Danube-basin countries – with special regard to the non EU member's experts –

about the preparation, implementation and experiences of the project.
Within the scope of Component "C", capacity building was also of primary importance (via participating in study tours, conferences, seminars and workshops).
The organisation of a professional workshop for national and international experts (towards the end of the project) was formulated as a further objective. The project audits were contracted out within the scope of the Component.

Original Global Environmental Objectives (GEO) and Key Indicators (as approved)

Component"A"

The key objective of The North Budapest Wastewater Treatment Plant Phase II. (Nutrient removal phase) was to significantly reduce nutrient rich, biologically treated wastewater discharged into the Danube River from the plant. After this improvement the plant is able to remove significant concentrations of nitrogen and phosphorus.

Component"B" objectives were to:

1. enhance the nutrient trapping capacity of wetlands through the rehabilitation of the Gemenc and Béda-Karapancsa areas, which in turn allows the reduction of nutrient in the Danube River and consequently the Black Sea;
2. Component"B" also served as a pilot--a model for nutrient reduction initiatives through the use of wetlands. A Monitoring and Evaluation (M&E) system was to be designed, installed and operated prior to and following the rehabilitation works.

Monitoring and performance indicators (target and baseline figures which were reviewed several times during project implementation included):

- Number of hectares of wetlands rehabilitated in the DDNPD;
- Annual amount of nutrients trapped by the wetlands (in terms of N and P kg/year);
- Average operation cost of the wetland management procedures in the DDNPD, in terms of its nutrient reduction capacity (i.e. US$ /kg of nutrient reduced).

Revised GEO and Key Indicators (if applicable), and Reasons/Justifications

Component"B": Key Indicators were not modified, but one additional project outcome indicator was included in the Results Framework in June 2008 as noted at the Midterm Review as well. In addition, the intermediate outcomes and corresponding intermediate outcome indicators were revised in line with the planned project activities to better track project progress and achievements.

Component: "C" established one indicator to create and then implement a communication strategy during the project.

Main Beneficiaries

The primary beneficiaries of the Project are downstream riparian countries and littoral states of the Black Sea.

Component"A": The close financial cooperation (loan and grant) over more than 10 years between the World Bank and the Municipality of Budapest made it possible to achieve substantial environmental developments within the City. The City of Budapest became

environmentally more aware; the sewage network was better developed and benefited the inhabitants of the City.

Component"B": In addition, secondary beneficiaries of Component"B" benefitted from the following the following project outcomes:

- overall, Duna-Dráva National Park Directorate (DDNPDD) has experienced improved conditions will help wildlife and maintenance of DDNPD areas;
- Gemenc Forestry and Gaming Co. (GFG Co.) and local fishing associations, and municipalities – also received benefits from improved habitat and environmental conditions for fish and wildlife

Through Component"C" the MEW coordinated the all components of the project (A B C).

Original Components

Component"A": The upgrade of the NBWWTP was co-financed by the World Bank Municipal Wastewater Project loan (4512-HU), and also from a non-refundable grant of US$ 6.5 million received from the Global Environmental Facility. The only additional resources for the project beyond those envisaged during preparation have come from the MOB to cover the shortfall of funding for the NBWWTP. Bids for the upgrade came in at about 70% (US$ 17,746,300 in Attachment 4. of the "Four-party Agreement" US$ 30,085,707 in PP amended on November 12, 2009) more than the Project had originally anticipated.

Contract Amount EUR 18,877,306

Loan EUR 6,065,435.36

Grant EUR 4,847,416.29 (US$ 6,500,000 + US$ 382,667 contingency)

MOB own funds EUR 7,964,454.35

Component"B": The total base cost for Component"B" was estimated at US$ 6,075,000 including US$ 1,215,000 counterpart funding provided by the Republic of Hungary. The estimated cost for each category within the component is shown in the table below:

Category	***Original Estimate (2005)***	***Expected estimate (2012)***
Consultant Services:	US$ 1,150,000	US$ 2,504,704
Goods:	US$ 62,500	US$ 185,200
Works:	US$ 4,862,500	US$ 3,795,827
Total:	***US$ 6,075,000***	***US$ 6,485,531***

Component"C": The estimated costs of Component"C" were US$ 506,250, of which US$ 84392 included Counterpart funding provided by the Republic of Hungary

Revised Components

Component"B": No project sub-components were revised, added or deleted during implementation. However, the technical details of the project design were revised to

include the following:

- Expert Panel (EP): US$ 50,000 was allocated from the unallocated funds to cover the expenses;
- Grouping of individual task items thus forming larger consultancy contracts;
- Revision of the timeline of the project (as opposed to the project description of the Project Appraisal Document (PAD): one pilot was established (not two); the site selected was a location where administrative burden was the least (some licenses were readily available).

Component"C": The corrected procurement plan was US$ 536,140. The audit was financed by the unallocated funds of the agreement.

Other Significant Changes

Component"B"

a. Reallocation of funds: US$ 6,075,000 to US$ 6,485,531 – adding part of the unallocated funds to the budget of Component"B";

b. Reduction of scope of component in the sense of implementation areas (envisaged to comprise 10,000ha and nine water systems) scaled down.

Component"C": As a result of fine tuning the tasks and responsibilities, the budgeted amount was revised to US$536,140.

SECTION 2: KEY FACTORS AFFECTING IMPLEMENTATION AND OUTCOMES

Component"A"

Key dates	*Original*	*Revised*
Contract signing:	July 2008	
Planned deadline of the completion:	January 2010	March 2010
End of trial period:	January 2011	March 2011

Component"B"

The implementation area and the DDNPD at large is owned by the Hungarian State, and the designated authority for administrative matters is the Hungarian State Holding Company (HSHC Co.) – which had to authorize the interventions in the form of an Owner's Permission (OP). The Final Beneficiary of the Component was the DDNPDD; yet forested areas are managed by the GFG Co., and their consent was also essential for project implementation. The GFG Co. repeatedly voiced its opposition from project design throughout implementation, but which ebbed shortly before project completion. The South-Transdanubian Environmental Protection and Water Management Directorate (WD) carefully handled all concerns raised, which most often included an assumption of negative impacts to forest management. However, such objections were disproved as a result of the impacts studies.

Further, in accordance with current Hungarian legislation, the following licenses had to be

obtained before works could commence: OP, Environmental License (EL), Water License (WL), Forestry Authority License (FAL) and Construction Permit (CP) for the game rescue hills. Due to the location of the implementations area, several institutions and authorities had jurisdiction over project implementation (as licensors, authorizers), and their organizational structure and jurisdiction even altered the times during the project could be implemented. As a result, documentation had to be submitted (in certain cases repeatedly) to these authorities to obtain all due licenses. Consequently, the transaction costs to the process were increased by the variations in the authorities' jurisdiction, jurisdictional boundaries and the differences regulated by national law and their individual policies.

In order to show why considerable delays were experienced at the start of the works and completion in some areas, the major dates of the licensing process are listed below:

The Environmental Impact Assessment (EIA) is carried out in a two-stage process, first as a Preliminary Assessment (PA), which is reviewed by the relevant authority/ies; then a detailed EIA is completed ending in a design which was licensed by the same authority/ies. Substantial delay was experienced in project implementation due to the objection raised by the GFG Co. against the EL:

- June 10, 2009: Submission of the PA to the Environmental Protection, Nature Conservation and Water Management Authority (EPNCWMA) of South-West;
- August 29, 2009: Decision issued by the EPNCWMA; instructions for EIA;
- December 15, 2009: submission of the EIA to EPNCWMA;
- April 26, 2010: issuing the EL (June 14, 2010: projected date of effectiveness);
- May 25, 2010: GFG Co. submit an appeal against EL;
- October 2010: GFG Co. withdrew its appeal;
- November 18, 2010: EL became effective.

Furthermore, as a result of bureaucratic slow-downs, the prompt acquirement of FAL was hindered:

- March 2010: Submission of documentation for Principal Permission (PP) for the requisition of the project area (to the Baranya County Forestry Directorate);
- May 26, 2010: PP issued;
- May 31, 2011: FAL issued by Baranya County;
- July 28, 2011: FAL Issued by Bács-Kiskun County;
- August 23, 2011: Supplementary FAL for temporary works (planks to be used for floating dredger) issued by Baranya County.

The acquirement of the WL pivoted on the issuance of the EL and FAL.

- December 7, 2009: Submission of the documentation for obtaining the water license;

- December 14, 2009: Licensing process suspended until closure of the EIA

procedure;

— February 18, 2011: WL issued by the EPNCWMA of South-West (Pécs);
— March 31, 2011: WL issued by the EPNCWMA of Lower-Tisza-Region (Baja)
— May 9, 2011: WL issued by the EPNCWMA of Mid-Danube-Valley Region (Székesfehérvár).

In addition, a CP for the game rescue hills (dredged materials used to elevate land to provide protection for wildlife during flooding events) had to be obtained and this also involved the consent of affected municipalities and setting aside forest areas (as such structures not considered as an integral part of the forest).

— July 2010: Submission of permitting documents;
— April 14, 2011: CP issued by Szekszárd;
— May 9, 2011: CP issued by Baja.

Due to the drawn-out process of the OP acquirement, the issue of all licenses suffered.

Component"C": Due to the delay in Component"B", the communication activity was also affected, but reached its greatest momentum in 2011. The cost-benefit analysis was also prepared at the end of 2011 because of this delay.

Project Preparation, Design and Quality at Entry

Component"B": Upon Project Appraisal, the various task items were determined, but the project design had to be revised in order to make the Component"B" more manageable and the task items better tailored to the Hungarian licensing framework. Thus, splintered task items such as geodesic measurements, preparation of final design, acquirement of water licenses and supervision of works were brought under one contract. Furthermore, a large scale M&E was to be implemented, and it prompted grouping the design, development and maintenance of the M&E (including the analyses and capacity building) as well as the development of impact evaluation methodology into one large consultancy contract. This included the compilation of a protected area management plan.

Implementation

Component"A": The main contractor was the consortium comprising the companies COLAS ALTERRA Építőipari Kft. from Hungary and Passavant-Roediger GmbH from Germany. During the extension a nitrogen removal technology using activated sludge was installed by converting the existent aeration tanks and building new tanks. The phosphorous removal was addressed by adding chemicals. The capacity of the extended plant has provided an average daily inflow of 182,000 m^3, with a maximum daily inflow of 200,000 m^3.

During wastewater treatment in activated sludge systems a part of the biodegradable

nitrogen form is removed with the sludge. But in order to remove nitrogen forms in an efficient way, a dedicated nitrogen removal phase is required.

The first step in this technology is converting the ammonium into nitrite then into nitrate by nitrifying autotrophic micro organisms. The specific growth rate of the nitrifying bacteria is significantly smaller than of the heterotrophic bacteria. Furthermore, the specific biomass yield of the nitrifying bacteria is only one third of the heterotrophic bacteria. Therefore, the sludge could oxidize the ammonium only when the autotrophic micro organisms can reproduce at an appropriate rate.

These two bacterical groups get balanced when the limitation of the organic matter content (decreasing the BOD5 load) is proportionate. To compensate the disadvantage of the nitrifying autotrophic micro organisms, higher sludge age and a decrease of the specific organic matter load are required.

In case of pre-denitrification technology the nitrate is led back to the anoxic tanks by inner recirculation. Here the denitrification, followed by the nitrification, is carried out by heterotrophic bacteria which oxidize organic matter. The lack of dissolved oxygen is very important because these bacteria prefer oxygen to nitrate.

Practically, denitrification is a kind of respiration of heterotrophic bacteria which uses the oxygen bounded in the nitrate instead of dissolved oxygen for an electron acceptor. So the nitrate turns into nitrogen gas (N2) through several stages of reduction:

$$NO3^- \rightarrow NO2^- \rightarrow NO \rightarrow N2O \rightarrow N2$$

The efficiency of denitrification is defined by the ratio of the organic matter content and the nitrogen content (TKN—or Total Kjeldahl Nitrogen) in the influent wastewater and the biodegradability of the organic matter.

No changes have been carried out in the pre-mechanical and the mechanical treatment section by the consortium during the installation of the nutrient removal phase.

The new and the existing tanks are both connected to the pipe at the end of the primary sedimentation tank. At this point the wastewater is distributed by a driving-gear-moved sluice gate controlled by an inductive flow-meter. The volume of the existing activated sludge tanks, and the following secondary sedimentation tanks, have not been changed. To form the denitrification tanks, the first part of the aeration tanks has been separated with walls, and mixers have been installed by the contractors. The water of nitrate content is led back to the denitrification zones by inner recirculation pumps.

The new plant part is made up by 4 race track aeration tanks with pre-denitrification and 8 final sedimentation tanks. The necessary concentration of dissolved oxygen in the aeration tanks is ensured by fine bubble aeration system. Within the framework of the project a recirculation sludge station, a surplus sludge station and a new blower house have been built. There are mixers in the aeration and the denitrification tanks as well (four mixers for each aeration tank and two mixers for each denitrification tank). The phosphorous removal is solved by precipitation: ferric chloride is added after the water left the primary sedimentation tanks. Treated water from the secondary clarifiers of both lines is led into the chlorinating channel through perforated pipes, and then into the Danube through a final shaft.

Component"B"

Consultant Services: The Project Implementation Unit (PIU) set up within the WD that could also rely on designated staff of the DDNPDD for expert advice and the "Expert Panel" (EP). The EP had five members—experts from the fields of water management, forestry and gaming, ecology, nutrient flows, and nature conservation. The WD selected consultants for the design, installation and operation of an extensive M&E system; had the final design developed, including Works and supervision; contracted out the EIA, and also engaged consultants for forest impact monitoring to mitigate issues with the GFG Co.

Goods: Goods were purchased to aid the work of the PIU and to be used as an integral part of the M&E.

Works: Early in the Implementation Phase, minor works were accomplished; renovation of building and sites, and establishment of a location that could be used as an on-site accommodation for consultants visiting the areas for several days.

The location of the pilot was set for Béda-Karapancsa, and dredging of the channel section was carried out in 2008. Re-cultivation of the agricultural field used as a silt deposit and was completed by the end of that year. Through the removal of some 3,000 cubic meters of sediments, water flow was restored and nutrient trapping processes were revived. The sludge was relocated in neighboring agricultural land in sludge deposits, which were later dismantled and the area was ploughed and re-cultivated.

A Priority Matrix (PM) was developed by the PIU, and with the involvement of the DDNPDD and the EP, in order to select which water systems would interventions take place. However, funds were insufficient to cover all areas as originally planned. As a result, individual water systems were ranked based on certain priorities: nutrient reduction capacity, nature conservation value and feasibility (such as costs, working conditions) and this process assigned weights to these factors depending on their order of importance. During the Midterm Review, it was emphasized that that prioritization criteria include expected amounts of nutrient reduction, (e.g. amount of nutrients estimated to be removed and/or cost of the intervention per kg of nutrient removed), which was in line with the original concept of the PM. This needed to be refined in order to take further factors into consideration (e.g. funds obtained by the DDNPDD from other sources dedicated to the rehabilitation of a water system that was otherwise ranking high).

The bulk of the works was procured in 2009, and Site Possession occurred on November 30, 2010; however, works could not actually commence until March 1, 2011, and for some sites the licenses were pending until summer. Supplementary works were procured in 2011, and works commenced on November 7, 2001. All works were completed according to contract terms and by December 30, 2011.

Component"C": The plans were implemented as follows:

A communication strategy plan was prepared, based on which publications, newspapers, press releases, and press visits were published and interviews were broadcast (on radio and on local television channels). The effects and results of the project were introduced to the public, to the youth within Budapest and to students.

At the end of the project, an international closing conference was held, where the project implementers reported the results of tasks and presented lectures and study findings.

A cost-benefit analysis was prepared about the project, its implementation, effects and results.

Monitoring and Evaluation (M&E) Design, Implementation, and Utilization

Component"A": Tertiary treatment installation at the North Budapest Waste Water Treatment Plant (NBWWTP) progressed as expected. Standard quality indicators (biological oxygen demand, nitrogen, phosphorus) were regularly monitored as part of operations functions for the waste water treatment plant. The test operation started on 23rd March, 2010, when the tanks were filled. During the first two months the activated sludge system was seeded and the adjustment of the plant was made by the main contractor. At the end of the adjustment period the Procurer was informed that the plant had been ready for the Trial Operation Period when the parameters of the effluent water and the functional guarantee had to be examined.

During the Trial Operation Period the installed establishment proved its ability to meet the water quality standards ordained in the building permit. According to the contract 95% of the samples should be within the end values during the trial operation, and during the trial operation period (between 01.06.2010 and 23.03.2011) the average effluent water quality parameters were as follows:

Water quality parameter	Effluent [mg/l]	Standard value [mg/l]
COD	37	125
BOD5	<10	25
Ammonium-nitrogen	2.3	10
Total nitrogen	11.5	30
Total phosphorous	1.1	2
Total suspended solids	7	35

During the trial operation the nitrogen removal technology has been changed: the designed pre-denitrification system has been completed by simultaneous denitrification due to the periodic aeration in the activated sludge tanks. This technical modification has significantly improved the efficiency of the nitrogen removal. The test operation was successful. The quality parameters of the effluent water were within the end values ordained in the building permit.

Component"B": Early 2009, an M&E system was developed and installed, which is fully operational. Data retrieved were evaluated by the Consultant consortium, and formed the

basis of an impact evaluation, and cost-benefit analysis.

As part of the establishment of the M&E system, 25 monitoring surveying points were established in 2009, the wells equipped with instruments collecting data about ground water conditions. Over the course of 2009, a pilot dredging was carried out, preceded by a baseline monitoring campaign. Measurements revealed that the sediments had high concentration of nutrients (N, P), and for this reason, the intervention was found appropriate for their removal.

As results from the M&E system show, by improving the water cycle in the flood area, flood intensity and frequency in the flood area, the load of eutrophication on the Black Sea is meant to be reduced, without having an influence on the flood prevention, and water regulation of the affected river section. By operating settling basins or traps and natural sedimentation niches in a well-designed way, the project component intended to reach this objective. This floodland rehabilitation – although in an artificial way – contributed to the revitalisation of former, favourable water movement conditions and by that means, is also for the benefit of local wildlife.

Safeguard and Fiduciary Compliance

Component"B"

Social Safeguards: The implementation area lies within the DDNPD which is a sparsely populated area. There are few settlements, and the interventions took place in prohibited, or strictly prohibited, parts of the park. Measures were taken to inform the locals about the intervention, and as an integral part of the EIA, the relevant municipalities held Public Consultations (PC) where concerns were voiced based on which mitigation measures could be devised (if deemed necessary). In addition, the WD requested Consultant firms to hold PCs to inform the public about their engagement, progress and the expected end results.

Environmental Safeguards: During Project Preparation, an environmental assessment was prepared for Component B, and an Environmental Management Plan was developed (that was revised in the course of 2010). These were reviewed by the Bank and found to be satisfactory.

In line with Hungarian legislative framework (which is fully compliant with the environmental legislation of the European Union), a PA and an EIA was carried out resulting in an EL. The code of law and review and feedback by the EPNCWMA ensured that the EIA was designed to include all relevant factors. Recommendations, measures to be taken and descriptions, were an integral part of the license issued, which was legally binding for the Client/Final beneficiary and the Works Supervisor and the Contractor engaged for the works. However, the project interventions related to Components "A" and "B" aim to increase water retention and maintain the wetland areas in the DDNPD. Significant negative impacts were not expected and improvements to the natural habitats are anticipated and natural habitats were only minimally disturbed and appropriate mitigation measures were taken by the Contractor. These were all considered to be positive impacts of the project.

Institutional/Procedural Issues: The WD PIU was lacking substantial experience in the Bank's operational rules; limited capacity built only as a result of the Preparation Phase. In

order to offset these shortcomings, a Project Launch Workshop was held in March, 2007 covering the Bank's relevant operational rules and Safeguard Policies. In addition, the Hungarian implementing agencies developed and signed a contract encompassing the Operational Manual for project implementation; namely, the standard procedures of project implementation (procurement, finance & accounting, project coordination, functions of steering committee, etc.). Past, current and future tasks were followed through in action plans, and procurement plans were revised prior to the missions, and also interim when necessary.

Component"C": The MEW, as the project coordinator, planned the coordination of financial processes among the components.

Post-completion Operation/Next Phase

Component"A": Further operation of the wastewater treatment plan in the case of Component"A". Standard quality indicators (biological oxygen demand, nitrogen, phosphorus) were regularly monitored as part of operations functions for the waste water treatment plant.

Component"B": Works were completed by December 30, 2011. Due to the fact that monitoring was carried out prior to the works, and a measurement campaign was, as expected, run simultaneously, months of delay in the project implementation meant that there was no time left for measuring the results of the full project implementation. For this reason, monitoring of the usual scale would need to be maintained for some years in order to determine the effectiveness of the interventions from the viewpoint of increased nutrient trapping capacity. However, the DDNPDD will continue operation of the manageable part (i.e. within park personnel and training capacity) of the M&E, retrieve data, and actively seek to secure financing for larger scale operations.

SECTION 3: ASSESSMENT OF OUTCOMES

Relevance of Objectives, Design, and Implementation

Component"B"

Rating: Satisfactory

The aim of the planning and implementation of Component"B" was to allow gravitational replenishment of water from the Danube into the intervention area. This aim was accomplished through methods that allow improved water replenishment (in frequency) and the duration of floods to be increased, such as dredging of channels, constructing sluices, fords, installing culverts and bottom weirs, as was done through the project. The intervention was therefore expected to lengthen periods when the given areas are covered in water, which in turn can also cause the ground water levels to increase.

Overall Performance: Satisfactory

Achievement of Global Environmental Objectives

Component"B" Rating: Moderately satisfactory

The global environmental objective was to increase the nutrient trapping capacity of wetlands, resulting in a reduced amount of nutrients back into the Danube River and thereby reducing nutrient loads into the Black Sea. This was achieved via the means of wetland rehabilitation and the development of nutrient trapping capacity in the Gemenc and Béda-Karapancsa regions of the DDNPD. Furthermore, an M&E system was established to measure nutrient reduction, improvement of water quality and impacts on ecology and biodiversity.

Overall Performance: Satisfactory

Efficiency

Component	Economic net present value (ENPV) 1000 US$	Economic rate of return, ERR(%)	Benefit-cost ratio
Component "A"	14,998	12.7	1.31
Component "B"	3,251	13.21	1.86

Justification of Overall Outcome Rating

Component"B" Rating: Moderately Satisfactory

Component"B" achieved its fundamental Project Development Objectives, but the scheduling of the works, prevalent water regimes and the time available towards the end of the implementation phase did not allow for the monitoring to be based on the actual results of the implementations. For this reason, simultaneous measurement campaigns, and data collected at other sites were synthesized.

Intermediate Outcome Indicators: Interventions were originally planned for nine water systems, and based on an area of a total of 10,000 ha; however, this had to be scaled down (resulting in intervention carried out on seven water systems) – as a result of inflation and exchange rate changes. The scope of works contracted (as adjusted to the amount of funds available) was completed in a timely manner. Delays and hindering factors/situations were dealt with promptly, and many events lay out of the power of the Implementing Agencies (e.g. opposition of the GFG Co., restructuring of licensing authorities).

Overall Performance: Satisfactory

SECTION 4: ASSESSMENT OF RISK TO DEVELOPMENT OUTCOME

Component"B" - Rating: Low

Works: Artifacts built (bottom weirs, fords, sluices) require low maintenance. Game rescue hills are designed and structured to withstand environmental effects, and were built in carefully selected locations. As part of the natural process, channels will gradually silt up, and effects of the dredging will slowly diminish (requiring repeated action).

M&E: the system contains elements that may be operated by DDNPDD staff (monitoring

wells in particular) and data may be retrieved, capacity building took place. Further, funding is sought to finance the continuation of the current monitoring activities (incl. data analysis and dissemination), as the full scale monitoring cannot be carried out by in-house staff.

SECTION 5: ASSESSMENT OF BANK AND BORROWER PERFORMANCE

Bank Performance

1) Bank Performance in Ensuring Quality at Entry — Rating: Satisfactory
2) Quality of Supervision — Rating: Satisfactory
3) Overall Performance — Rating: Satisfactory

The Bank showed flexibility when the necessary extension of the deadlines was needed. Supervision missions were held regularly, the World Bank staff followed through the project cycles and showed professionalism.

Borrower Performance

1) Government Performance — Rating: Satisfactory
2) Implementing Agency/Agencies' Performance — Rating: Satisfactory

From the management aspects of the project, certain activities and tasks can be emphasized as vital for the successful implementation of the Components: prompt performance of task items relating to procurement, finance and project administration; optimal scheduling of activities; warding off potential hindering and jeopardizing factors; coordination, liaising and mediation among parties involved.

Overall Performance: Satisfactory

SECTION 6: LESSONS LEARNED

Component"B"

Natural treatment of waters loaded with nutrients: Interventions carried out in the DDNPD, dredging of channels and installations of low maintenance artifacts may prove to be a viable, cost-efficient addition to conventional nutrient reduction measures (especially in cases where treatment plants are not an option, such as agricultural run-off).

Project design: Protected wetlands also pose a regulatory situation, where project preparation and licensing are more involved and significant, extra time has to be allowed for contingencies.

Institutional background: The area is owned by the Hungarian State, forest and game management is the responsibility of GFG Co, whilst the total area is managed by the DDNPDD. The DDNPDD and the GFG Co. have conflicting interests, which was further accentuated in consultations about project implementation. Ideally, these issues would have been resolved prior to project implementation.

Annex 6. Comments of Co-financiers and Other Partners/Stakeholders

A copy of the message from the representative of the Government Implementing Agency is presented below.

Dear Sanyu!

We have revised the draft Implementation Completion Report and we completely agree with the part of the report regarding Component A and C.
Nevertheless, we would like to raise your attention to some of the WD's remarks considering Component B, which are the followings:

1) There are several references to not realized or lacking own funds throughout the text which are colored. However, the report doesn't contain the reasoning of this remark. We would welcome a detailed reasoning for this problem in the text. Our reason for this on the one hand is that several years passed from the preparation of the original plans to the implementation which results that inflation and exchange rates have largely changed. On the other hand, the implementation costs couldn't have been calculated exactly during the planning.
2) The DDNPD succeeded and seeks in finding/involving other resources as well. The DDNPD accomplishes further elements of the original plan this year by involving EU funds, for example the culvert planned at a 4+943km section of the Cserta-Duna.
3) On page 15 a correction is marked, however, it is necessary to clarify whether the experts referred are those with whom a contract was signed by the WD or not.

We found in the text some inaccuracies, which we marked for correction. Please find attached this version of the draft ICR.

Thank you for considering our raised issues.

Best regards,

Roland Papp

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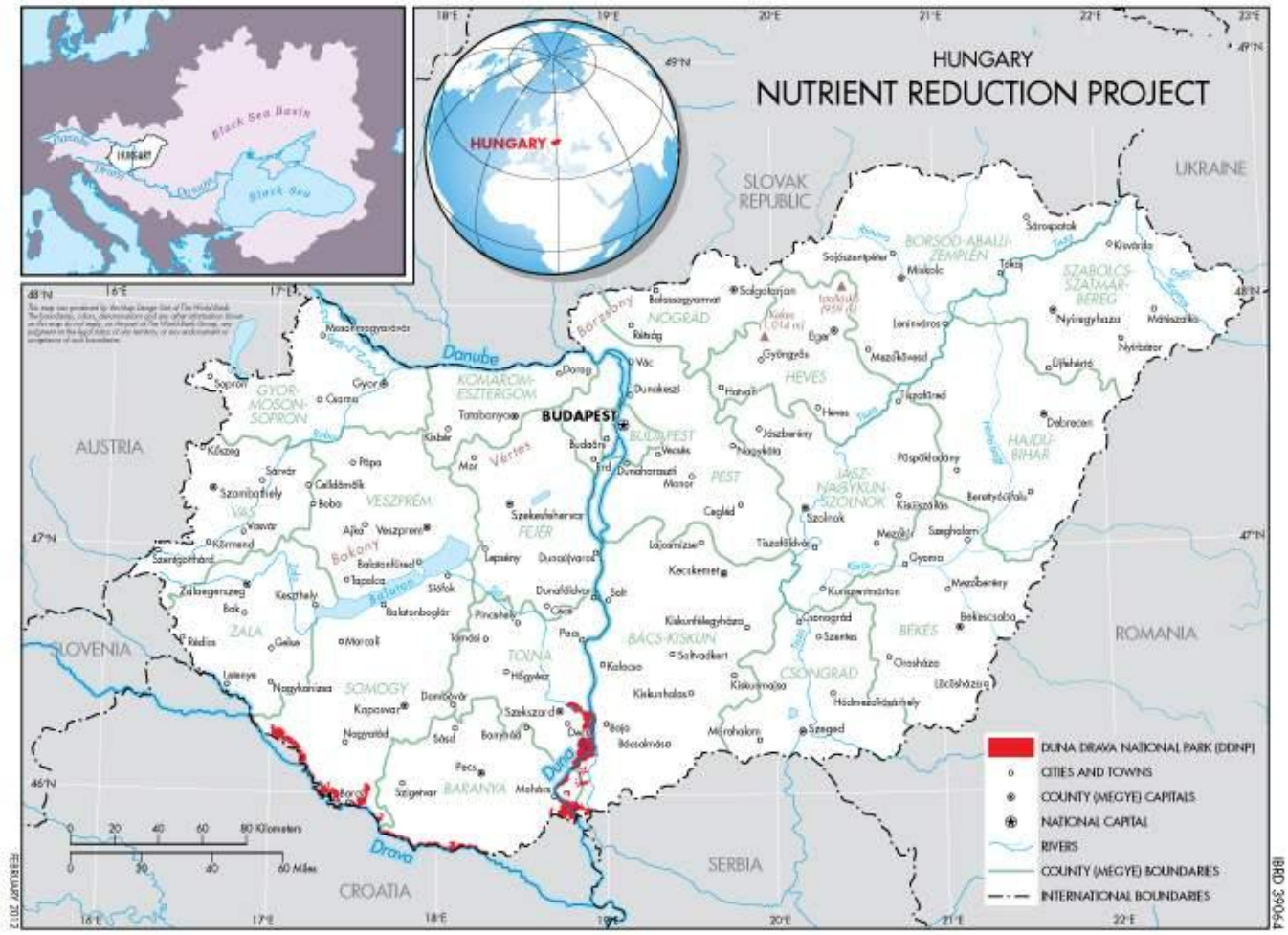
Annex 7. Supporting Documents

- Hungary - Nutrient Reduction Project (English) 2006/03/2832411 Project Appraisal Document
- World Bank Country Assistance Strategy Progress Report for the Republic of Hungary, April, 2002.
- Hungary - Black Sea Nutrients Reduction (GEF) Project (English) 2004/11/24AC814 Integrated Safeguards Data Sheet
- . Global Environment Facility, Trust Fund Grant Agreement (Nutrient Reduction Project) Between Republic Of Hungary and International Bank for Reconstruction and Development, May 15, 2006. GEF Trust Fund Grant Number TF 055978-HU.
- Aide Memoires, June 2005-2011
- Mid-term Review, Aide Memoire, November 9-13, 2009
- Implementation Status and Results Reports, 2006-2011
- Financial Monitoring Reports and various Audit Reports, 2006-2011
- Procurement Plans (various)
- Project and Consultant Progress and Workshop Reports (from GoH) 2008-2011
- Web links: film: http://www.youtube.com/watch?v=Mt6ibnYi-N4
    - Website: http://gef.ddkovizig.hu/angol/kezdolap
- Hungary - Black Sea Nutrient Reduction Project (English) 2004/11/22AB1088 Project Information Document
- Hungary - Nutrient Reduction Project: restructuring (Vol.1& 2), 2011
- Hungary - Nutrient Reduction Project: procurement plan (English) 2009/11/1351663 Procurement Plan
- International Waters Results Notes, December 9th, 2011 http://www.iwlearn.net/results
- EIA, Final Study and Workshop Reports, GEF - Nutrient Reduction Project, www.innosystem.hu
- Feasibility Studies and Consultant Reports (various)
- Cost-Benefit Analysis Of The Hungarian Nutrient Reduction Project Draft Report Part Ii - GEF No: TF 055 978. 135 pp.
- Borrower's ICR

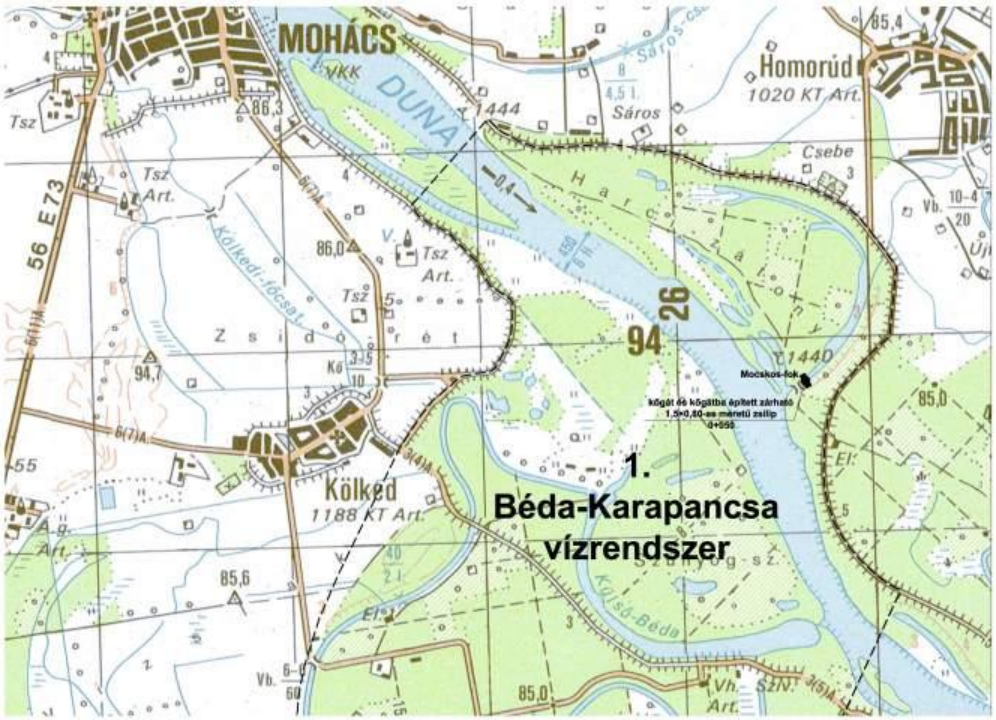
List of persons interviewed during the ICR Mission, December 6-10, 2011

Ministry of Rural Development	
Ms. Zsuzsanna Kámánné, Csán	Chief Counselor, Budget and Investment
Ms. Adrienn Petykó	Department Head
Municipality of Budapest	
Mr. Gábor Kárpáti	Head, Project Implementation unit
Janos Tobiás	Finance
Ms. Edina Kovács	Project Manager, Utilities Department
Budapest Municipal Sewerage Company, LTD.	
Mr. József Kováczvölgyi	Department Head, Engineering Services Department
Water Directorate	
Mr. Lásló Márk	Vice Director of Engineering
Mr. Jósef Schubert	Department Head
Ms. Britta Hadinger	Project Coordinator
Mr. Gábor Moliár	Finance
Mr. Gábor Makay	Legal
Duna-Dráva National Park Directorate	
Mr. Tibor Parrag	Head Department of Nature Conservation
Mr. Sándor Kőversi	Region Head, Gemenc area
Consultants and Teams	
Ms. Zsuzsanna S. Takács	Manager, Strategic Scope
Mr. Atilla Nyári	Strategic Scope
Dr. Ernő Fleit	CBA
Gergely Szalay	CBA
Géza Raskó	CBA
Mr. Jozsef Szücs	Contractor, Szekszárd-Paksi Ltd.
Mr. Péter Reisienger	Contractor, Szekszárd-Paksi Ltd.
Mr. Béla Kiss-Csontos	Works Supervisor, KevitervAkva Kft.
Ms. Vivien Gyuris	World Bank Consultant

Annex 8. Project Maps Overview of project area



Annex 8, continued. Additional Maps of the Component B area:



Dél-dunántúli Környezetvédelmi és Vízügyi Igazgatóság

GEMENC Konzorcium

KEVITERV AKVA Mérnöki Vállalkozási KFT.

EÖTVÖS JÓZSEF FŐISKOLA * BAJA

GEF-DDNP Tápanyagcsökkentési Projekt

GEF projekt száma: 055978

KEVITERV AKVA Mérnöki Vállalkozási KFT.

Ügyvezető igazgató: Décse Sándor — Témavezető: Kis-Csontos Béla

Tervező: KEVITERV AKVA MÉRNÖKI VÁLLALKOZÁSI KFT. — EN ISO 9001:2000 TANÚSÍTOTT CÉG

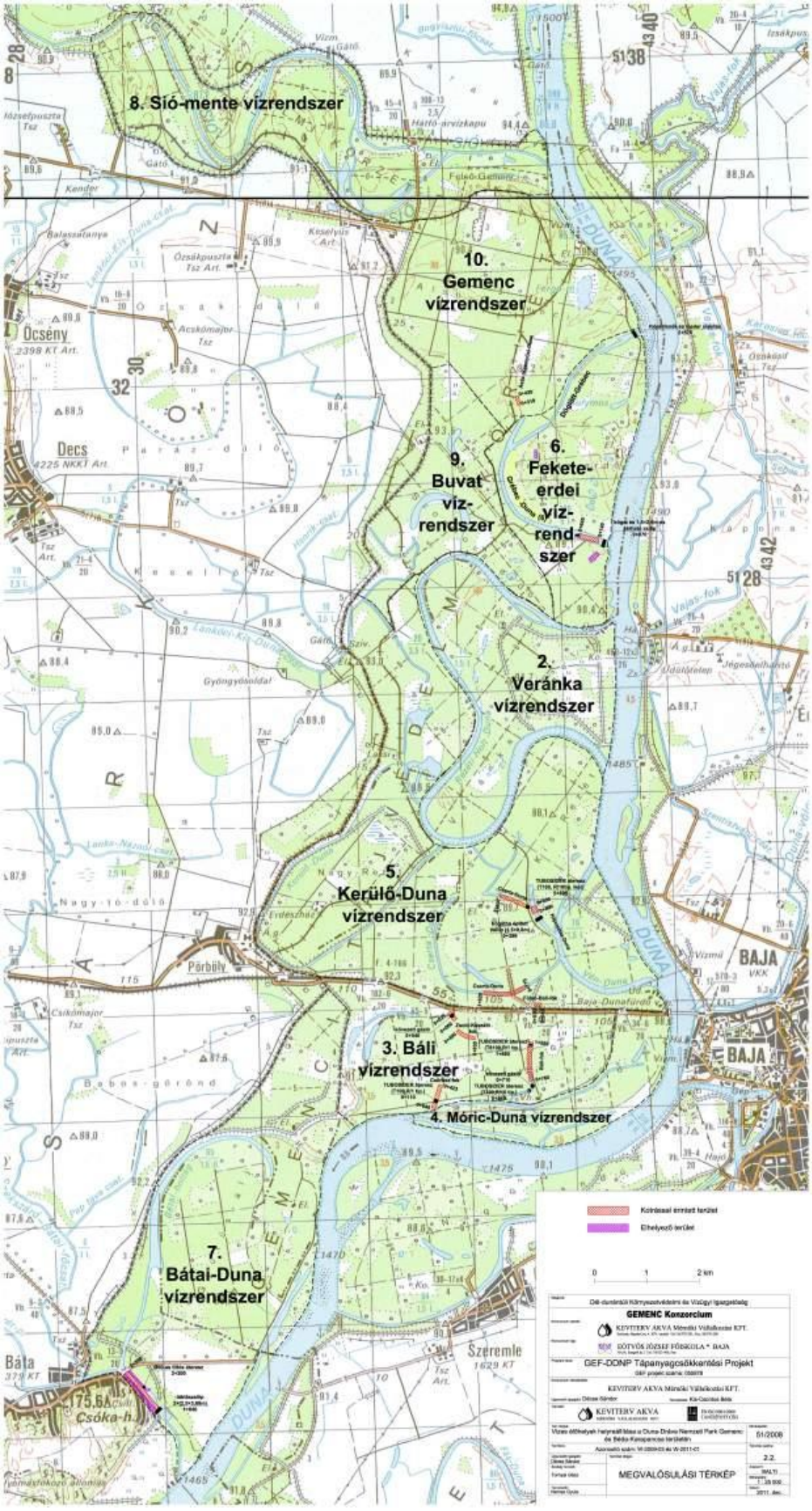
Terv tárgya: Vizes élőhelyek helyreállítása a Duna-Dráva Nemzeti Park Gemenc és Béda-Karapancsa területén — Munkaszám: 51/2008

Tervfázis: Azonosító szám: W-2009-03 és W-2011-01 — Tervlap száma: 2.1.

Ügyvezető igazgató: Décse Sándor — Tervlap tárgya: MEGVALÓSULÁSI TÉRKÉP — Alapadat: BALTI

Szakági tervező: Tornyai Géza — Méretarány: 1 : 25 000

Tervezők: Nemes Gyula — Dátum: 2011. dec.


8. Sió-mente vízrendszer
10. Gemenc vízrendszer
9. Buvat vízrendszer
6. Feketeerdei vízrendszer
2. Veránka vízrendszer
5. Kerülő-Duna vízrendszer
3. Báli vízrendszer
4. Móric-Duna vízrendszer
7. Bátai-Duna vízrendszer
Ócsény
Decs
Pörböly
BAJA
Bátaszék
Szeremle
Csóka-h.
Kotrással érintett terület
Elhelyező terület
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GEMENC Konzorcium
GEF-DDNP Tápanyagcsökkentési Projekt
MEGVALÓSULÁSI TÉRKÉP