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REPUBLIC OF KAZAKHSTAN
MINISTRY OF ENVIRONMENT AND WATER RESOURCES
COMMITTEE FOR WATER RESOURCES

Syrdarya Control and Northern Aral Sea Phase-II (SYNAS-II) Project

Feasibility Study

Report 3
Preliminary Environmental Impact Assessment (Book1)

PC «Institute Kazgiprovodkhoz»

Almaty, 2014

REPUBLIC OF KAZAKHSTAN
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Syrdarya Control and Northern Aral Sea,Phase-2 (SYNAS-2)

Feasibility Study

Report 3
Preliminary Environmental Impact Assessment (Pre-EIA) (Book 1)

Chairman of the Board **A.Ryabtsev**

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SYNAS II Report Organisation

General Explanatory Note
(Summary Report)

Thematic Reports:

Report 1: Water Management Information System

Report 2: Hydraulic Report

Report 3: Preliminary Environmental Impact Assessment Report (Book 1, Book 2) — Actual report

Report 4: Socio-economic Assessment Report

Technical Reports:

Volume 1 Project Package for Syrdarya River Basin Management

1. Flood protection dikes at Karmakchi an Kazalinsk districts of Kzylorda oblast
2. Syrdarya riverbed straightening at Korgansha and Turimbet sites in Zhalagash district of Kzylorda oblast (Book 1, Book 2)

Volume 2 A: Left-Bank Irrigation Offtake at Kzylorda Barrage (Book 1,Book 2)

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GLOSSARY / LIST OF ABBREVIATIONS

ACBK	Association for Conservation of Biodiversity of Kazakhstan
ASBP	Aral Sea Basin Programme
asl	above sea level (Baltic Sea)
km^3	Billion Cubic Meters (km^3)
BVI	Basin Water Inspection
CES	Consulting Engineers Salzgitter
CITES	Convention on the International Trade in Endangered Species
CWR	Committee on Water Resources under the MoEP
DANIDA	Danish Organization for International Development Assistance
DDT	Dichloro-Diphenyl-Trichloro-Ethane
EA	Environmental Assessment
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EMIS	Environmental Management Information System
EMP	Environmental Management Plan
ES	Environmental Screening
EU	European Union
g/l	grams/liter
GEF	Global Environmental Facility
GIS	Geographic Information System
GoK	Government of Kazakhstan
GPS	Global Positioning System
GTZ	Gesellschaft für Technische Zusammenarbeit (Organization for Technical Cooperation)
H&E	Health, Safety and Environment (Department)
HCCH	Hexa-Chloor-Cyclo-Hexane
HIID	Harvard Institute for International Development
HPS	Hydro-power Station
IBA	Important Bird Areas (according to classification criteria by BirdLife International)
IBRD	International Bank for Reconstruction and Development
ICWC	Interstate Commission on Water Coordination
IFAS	International Fund for the Aral Sea
JEP	Joint Environment Programme
JICA	Japanese International Cooperation Agency
Kazgidromet	Kazakh National Department for Hydro-Meteorology
KazNIIRKh	Kazakh Scientific Research Institute for Fishery
KDI	Kazgiprovodhoz Design Institute
KSB	Kazakhstan Syrdarya Basin
KZT	Kazakh Tenge (USD 1 = KZT 130)
LAS	Large Aral Sea
M&E	Monitoring and Evaluation

MoA	Ministry of Agriculture
MoEP	Ministry of Environmental Protection
MoH	Ministry of Health
NAS	Northern Aral Sea
NEAP/SD	National Environmental Action Plan for Sustainable Development
NEC/SD	National Environmental Centre for Sustainable Development
NGO	Non-governmental organization
OP	Operational Policy (of the World Bank)
PCB	Poly-Chlorinated Biphenyl
PPF	Project Preparation Facility
SCO	Shanghai Cooperation Organization
SYNAS	Syrdarya Control and Northern Aral Sea Project
TACIS	EU Technical Assistance Programme for the Commonwealth of Independent States
UNCED	United Nations Commission on Environment and Development
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Emergency Fund
USAID	United States Agency for International Development
USD	US Dollar
WARMAP	Water Resources Management and Agricultural Production Project

1 INTRODUCTION

1.1 General

This Environmental Appraisal at feasibility level prepared by Mott MacDonald Euroconsult of the Netherlands assesses the potential environmental impacts of the subprojects proposed for the second phase of the Syrdarya Control and Northern Aral Sea project. In the pre-feasibility study all considered subprojects have been studied at pre-feasibility level and two of them were selected for the feasibility study. The preparation of SYNAS-II is being undertaken by the Committee on Water Resources (CWR) of the Ministry of Agriculture representing the Government of Kazakhstan (GoK) in cooperation with the World Bank. Project preparation is done by the consortium Mott MacDonald – Euroconsult / Jacobs Babtie / Danish Hydraulic Institute with Kazgiprovodkhoz as main subcontractor.

Unfortunately, Synas II has been underbudgeted. Not all of the ten sub-projects developed during the pre-feasibility stage could be developed to fully fledged feasibility stage. While the World Bank would have approved the grant of loans on the pre-feasibility level of studies, the taking out of a loan by the Kazakh Government requires approval by the Ministry of Economy and Finance, which requires the passing of the stringent requirements of the state expertise on feasibility studies.

Initial time - consuming attempts at gaining approval from the state expertise failed, because the pre-feasibility level studies were not complete enough. Only in December 2007 the final decision was reached during a joint video-conference.

In the final selection of the sub-projects selected on SYNAS-2 project , not only the priority rating of the consultant played a role, but also the political decision of the Kazakh Government, the World bank and last but not least the availability of finance

According to results of meeting with the Ministry of Agriculture of the Republic of Kazakhstan dated June 22 , 2012 (minutes of meeting №04-6/138), the final selected sub-projects are :

- Left bank irrigation offtake at Kzylorda barrage
- Repair of the left bank irrigation offtake was planned during Synas -I and is long overdue. Failure of the intake structure is a high risk and would lead to large scale flooding of 60 000 ha of irrigable land, including loss of harvest and heavy damage to civil infrastructure;
- River bed straightening at Turumbet and Korgansha sections;
- Flood protection dikes in Kazalinsk and Karmakchi districts;

Plan to rehabilitate and strengthen 50 km of existing dikes, perform riverbed straightening at selected sites in the lower Syrdarya basin in order to pass winter floods in conjuction with already built Koksarai counter-regulator is a highly effective measure .

- Road bridge near Birlik settlement , Kazalinsk district;

This road bridge will replace existing low capacity pontoon. It will be the first in Kazalinsk district which markedly improves season-independent communication and economic parameters during freight handling by motor transport.

- Rehabilitation of Kamuishlibash and Akshatau lake systems in Aralsk district of Kzylorda oblast .

Rehabilitation of Kamuishlybash and Akshatau lake systems in Aralsk district of Kyzylorda region due to provision of guaranteed water abstraction to the lakes and maintenance of the required level regime there with the help of Amanotkel weir and other engineering structures increase water suplly of lake systems and create conditions for use of its biodiversity by the nature users and population.

- Reconstruction and extension of fishery ponds at Tastak site of Kamuishlibash fish hatchery in Aralsk district of Kzylorda oblast

Fish hatchery in Aralsk district of Kzylorda oblast provides an accelerated rehabilitation of fish capacity of NAS, delta lakes and Syrdarya river due to its artificial stocking by valuable fish species, breeded in fish hatchery at "Tastak" section , that would create the opportunity for the development of fish-breeding and improvement of conditions for the employment of local population

It is planned to finalize FS at the following sub-projects within the implementation of the first stage of SYNAS-2 project:

1. Reconstruction of North Aral Sea (two or one-level option);
2. Construction and equipping of operational center of water resources management in Kazakh Syrdarya Basin

It is proposed to include the following components into the second stage of SYNAS-2 project :

1. Reconstruction of North Aral Sea ;
2. Construction and equipping of operational center of water resources management in Kazakh Syrdarya Basin.

Moreover, taking into account that the procedure of review of second phase of SYNAS-2 project by World Bank and government bodies of the Republic of Kazakhstan delays the construction of sites up to 2017-2018 years (with this there is a possibility of coming of large volume of flood water to Shardara reservoir up to 2018, that threatens the safety of downstream settlements)- to exclude component "Construction of emergency water spillway on Shardara dam" and start its immediate implementation on account of budget in the established order.

During the discussion of the issue on preparation and financing of SYNAs-2 project with the World Bank, the Ministry of Agriculture took a decision on the two-stage approach with the use of special lending (credit) instrument of World Bank, known as "Adaptable Program Loan" (APL). Adaptable Program Loan allows to carry out the support on phased basis of long-term development program, including loan series. At that the subsequent loans in series are provided on the phased basis, subject to the achievement of the satisfactory progress in passing of certain phases towards the previous loan in series.

Two phased Adaptable Program Loan were used to implement SYNAS-2 project.
The first loan will be used :

- for the implementation of 6 sub-projects, included in the first stage of the project implementation ;

- for the development of Feasibility Study in order to take the final design solution by the conduction of careful analysis and evaluation, which will be financed on account of the funds of the second adaptable program loan.

Adaptable program loan-1 will be also used for capacity building of governmental authorities on river basin management, measures necessary for river modeling and procurement of the appropriate equipment for refit of the existing gauging stations and construction of new ones and monitoring conduction

Adaptable program loan -2 will be used for financing of two sub-projects on the basis of the results of Feasibility Study and decisions taken within Adaptable program loan-1

The environmental assessment is carried out in fulfillment of the World Bank's operational policies (Operational Policy OP 4.01 and related operational guidelines), so as to ensure that projects that require funding from the Bank are environmentally sound and sustainable. The environmental assessment is as well developed in accordance with the national legislation of the Republic of Kazakhstan

1.2 Strategic Context

Basin-wide international context

Starting 1992, ICWC in the framework of interstate coordination, developed a common strategy for trans-boundary water management for the Aral Sea Basin, determining water allocations and reservoir operations in the Amudarya and Syrdarya River basins. Declarations on water sharing were signed in 1995 (Nukus) and in 1997 (Almaty). In March 1998, a long-term water and energy agreement was signed between the three riparian countries, Kazakhstan, Uzbekistan and Kyrgyzstan, vis-à-vis sharing hydro-power benefits from Kyrgyzstan. In August 2007 on the Shanghai Cooperation Organization (SCO) summit the heads of several of the SCO member-states have proposed a new policy of utilization of hydroelectric energy resources. In this frame a new agreement on utilization of transboundary water resources is considered.

An International Fund for the Aral Sea (IFAS) was established in 1993 and an Interstate Council was created to coordinate and manage financial resources and programs in the field of ecological and socio-economic development in the Aral Sea Region.

In the Ashgabat declaration of April 1999, the five Heads of State expressed once more their concern on the quality of life in the Aral Sea region. They acknowledged the need for an integrated and joint regional strategy based on an ecosystem approach and integrated water management.

In spite of all these agreements, non resolved issues concern the operation of Toktogul reservoir in Kirgistan in hydropower regime, which provides a serious obstacle to the optimum river basin management in respect to irrigation water supply and winter flood prevention. Recently, the reduction of spilling opportunities from Chardara reservoir to Arnasai-Aydarkul depression has raised an important dam safety issue for Chardara dam.

The SYNAS project is part of a larger international program under the Aral Sea Basin Program, which has been prepared by World Bank in coordination with UNEP and UNDP, after diagnostic investigations made in 1992. Four main targets were recommended: (i) stabilization of the Sea environment; (ii) restoration of the ecology disaster zone around the Sea; (iii) integrated management of water resources; and (iv) creation of regional institutions for planning and implementation of the program. The Action Plan prepared for the improvement of the environmental situation in the Basin was approved by the Heads of State of the five basin countries in January 1994. The restoration of the NAS and the SYNAS project form part of Programme 4, which deals with environmental issues in and around the Aral Sea.

National context

To improve water management in Kazakhstan's Syrdarya Basin (KSB) and address problems caused due to degradation of the Aral Sea and the delta lakes, the Government of Kazakhstan (GOK) started preparation of a program for the development of the Syrdarya Basin. The long-term program for the Syrdarya basin includes: modifications in the Shardara dam to reduce spills to the Arnasay depression; the rehabilitation of weirs and the replacement of pontoon bridges with high-level bridges in order to increase the carrying capacity of the river; the rehabilitation of irrigation and drainage infrastructure; flood protection measures; improvement of hydraulic infrastructure in the Delta; and complementary measures which will be beneficial to the riparian communities and the environment. The present project will continue SYNAS-I as part of this program.

This report will be a part of the feasibility study for the subprojects to be realized as first steps during the second phase of SYNAS taking stock of the latest situation in the Basin, developments in the upstream countries as well as various interventions downstream under the SYNAS-I and other projects with an aim to prepare a program for improving water resources management in the Basin consisting of structural and non-structural measures. The feasibility studies for further subprojects identified as highest priority investments in the SYNAS-II project during the pre-feasibility study will be elaborated in time as funding will be allocated. The present environmental impact assessment however, already takes into consideration the context of the entire SYNAS-II project package instead of dealing with the selected first subprojects in an isolated way.

For the GoK, the SYNAS project is a priority project in the water resources sector. The project has been included in the first medium-term Public Investment Program. This program focuses on priority projects that have been selected for implementation by the national and local administrations. The CWR coordinates activities with the Syrdarya Basin Water Authority (BVO) and with the Interstate Commission on Water Coordination (ICWC) of the five Central Asian States. At regional level (oblast), the project is strongly supported by the regional authorities in Kzylorda Oblast and the local administration of the Rayons of Kazalinsk and Aralsk which are most affected by the environmental calamity. After the considerable success of SYNAS-I continuation and completion in form of a second phase is wished by the GoK.

The project fits into the National Environmental Action Plan for Sustainable Development (NEAP/SD, 1999), which identifies water resources conservation and improvement of the environmental situation in the Lower Syrdarya River as a priority action. Recently a "Concept for the Sustainable Development of the RoK for 2007-2024" has been approved by the government. This concept mentions the application of modern approaches for environmentally friendly water use and the rehabilitation of environmentally disastrous regions to which the Aral Sea region officially belongs.

The Government of Kazakhstan has also started rehabilitation of irrigation and drainage systems on the lands located on the Kazakhstan's Syrdarya Basin (KSB). The latest project under preparation, Irrigation and Drainage Improvement Phase-II (IDIP2) Project would cover some 200,000 ha primarily in KSB. Irrigation being the largest water user, a major objective of SBDP is to ensure adequate supplies to the irrigation systems. The SYNAS projects are designed to ensure water supplies for the irrigation systems at various locations on Syrdarya in addition to environmental, domestic and other uses.

1.3 Project Objectives

The entire SYNAS-II package is designed for further enhancement and completion of the impacts achieved in SYNAS-I. For SYNAS-II Project Objective and Project Area are defined by the ToR for the feasibility study: "The proposed Project would aim at:

a) continued environmental revival of the Northern Aral Sea (NAS) and delta area of the Syrdarya Basin and improved environmental/ecological conditions in the basin leading to enhanced human and animal health and biodiversity;

b) improving overall water use efficiency in the basin by improving operation and safety of the important water infrastructure and providing protection against flooding particularly during winter leading to improved agriculture and fish production and population safety; and

c) improving institutional capacity to manage basin water resources through better operation and management of the water management facilities in the basin.

The project area will consist of KSB including the Northern Aral Sea."

The following immediate interventions in water management are envisaged to fulfill the first two general project objectives stated in the terms of reference, which are a) Continued environmental revival and b) Improving overall water use efficiency:

- Establishment of new hydrological and hydraulic models, which will enable to operate the Shardara reservoir in such a way, that an optimum flow of the Syrdarya is achieved for flood control, hydropower, agriculture, fishery and environmental purposes.
- Development of proper operational procedures of Shardara reservoir so that it will be possible to reduce the need to spill water irretrievably into the Arnasay depression and to achieve a stabilization of the Arnasay water level in the interest of transboundary ecology, farming and flood control.
- Eliminate river water flow bottlenecks in winter on Syrdarya and avoid ice barrages and floods through constructive measures.
- Avoid flooding hazard in winter time in Kzylorda Oblast by applying reservoir operation rules obtained by modeling and by effective construction measures on the river.
- Regulate Syrdarya water flow in such a way as to avoid diverting winter flood water into desert depressions, without any specific agricultural, pasture, drainage, or environmental use.
- Provide a secure amount of water for the planned extent of irrigated agriculture, meadow and haymaking areas, in agreement with oblast authorities.
- Improve irrigation water use efficiency by rehabilitating canals, collectors and hydraulic structures.
- Install regulating structures for the adduction canals to the delta lakes to maintain fishery functions and secure the lake system as Important Bird Area.
- Fill the Northern Aral Sea with a yearly reliable amount of water for ecology and the economic revival of fisheries in the region. Excess water should be provided for maintaining the LAS downstream of Kokaral (Berg Strait) dike.

The project will also help to fulfill these aims by implementing a number of specific institutional flanking measures to reach the third main objective c) improving the institutional capacity in water management for the local, national and international transboundary level. Measures foreseen are:

- Provide the River Basin Operational Centers, with capacity to deal with national and international river basin management issues.
- Provide hydraulic Infrastructure Operation and Maintenance capacities.
- Provide monitoring capacity for the environment.
- Provide the installation of a financial management system.
- Create a capacity to implement and monitor projects.
- Provide telemetry and communication for hydrological and meteorological stations to establish contact with the Operational Centers.
- Install a Water Management Information System and capacity for hydrological and hydraulic modeling.

In the context of the environmental assessment especially the impacts of the construction measures and planned operation regimes of the hydraulic structures are to be assessed. At present a range of projects have been selected for elaboration of the detailed feasibility studies and accordingly for specific Environmental Assessment and Elaboration of the Environmental Management Plan.

1.4 Environmental Review Process

Requirements by World Bank

The World Bank requires EA for all projects proposed for Bank financing in order to ensure that they are environmentally sound and sustainable. The EA is an important tool for decision-making. In an EA, the projects' environmental risks and impacts in its area of influence, which is often larger than the project area itself, are evaluated. Project alternatives are studied; negative and positive environmental impacts are identified in relation to location, design, construction and operation of the project. Ways of preventing, reducing and compensating adverse impacts on the environment are worked out, as well as potential measures to enhance the positive impacts of the project. The EA further describes a monitoring system and includes an Environmental Management Plan (EMP).

The first step in the environmental review process is an Environmental Screening (ES) in order to determine the type of EA to be carried out. The SYNAS project was classified as Category A, which essentially comprises those projects that may have significant environmental impacts, which are sensitive, diverse or unprecedented in nature and may affect an area broader than the direct project sites. The SYNAS project would necessitate an EIA in view of the unprecedented nature of the crisis of the Aral Sea, the complex hydrological systems, the ongoing and degradation of wetlands and natural habitats, and the poor socio-economic and health situation in the area. In addition, an EIA is required as the project could have trans-boundary impacts on the LAS and Arnasay depression, which may have adverse environmental ramifications in Uzbekistan.

Category A projects have the widest scope of evaluation and require a full EA. Therefore, potential negative and positive impacts of the project are to be studied and compared with those from feasible alternatives including the "without project" situation. During the EA process, public consultations of project-affected groups and local non-government organizations (NGOs) have to be held.

Requirements of GoK

The environmental legislation of Kazakhstan has recently been changed by passing of the new Environmental code (December 2006). The Environmental code stipulates an environmental clearance by the responsible state organ of project proposals concerning nature resource use and state investment programs within a review period of 90 days. The SYNAS-II project belongs to category II (Special water use) for which the territorial organs of the MoEP (in the Oblasts Kzylorda and South Kazakhstan) are in charge of the environmental clearance. However, due to the inter-oblast, national and international importance of the project approval by the MoEP will likely be required.

With regard to the proposed SYNAS-II project, the pre-feasibility study did not require environmental clearance. The Environmental Assessment at feasibility level will be submitted to the responsible state agencies for obligatory environmental clearance.

Environmental Review in the frame of the feasibility study

The environmental review process in the frame of the elaboration of the feasibility study for SYNAS-II consists of the following stages:

<u>(I) Pre-feasibility studies</u>

At pre-feasibility level the entire project including all potential subprojects has been reviewed on the basis of available information (Materials from Kazgiprovodkhoz, EDIKO, SYNAS-I, IBA sites inventory of ACBK etc.). As the environmental appraisal was conducted parallel to the designing of subprojects the intensity of evaluation depends on the level at which the respective subprojects were advanced. In a limited scale additional field assessments have been carried out by environmental specialists (botanist, ornithologist). On this basis the presented short environmental appraisal of the expected subprojects positive and negative effect under normal operational conditions has been prepared. The detail level is considered sufficient to permit a semi-quantitative comparative environmental ranking of the subprojects.

(II) Feasibility studies

For the feasibility study priority subprojects have been selected as described above. For the entire project in general and for the selected subprojects in detail positive and negative environmental impacts during construction, operation, and if applicable, worst possible incident have been analyzed. The analysis builds on the evaluation of existing information on the project design and the environmental situation in the areas of influence. For filling information gaps field work has been carried out by the international environmental specialist and national consultants covering all envisaged sites of the subprojects as well as potential areas of influence. The net environmental effect was evaluated semi-quantitatively (by impact matrix) in a manner fit to be entered into a multi-criteria analysis.

(III) Environmental management plan

For the selected subprojects environmental management plans have been elaborated, which determine necessary measures for avoidance, minimizing, mitigation or compensation of adverse effects from the structures' construction, operation and worst possible incident. Based on the monitoring work for SYNAS-I, performed by Scott Wilson Company, an environmental monitoring plan for the project was devised, with particular consideration of the selected subprojects, naming items to be monitored, monitoring schedule and recommending organizations responsible for the task.

1.5 Project Baseline – SYNAS-I

The SYNAS-II Pre-feasibility study and feasibility study is conducted before the background of the SYNAS-I implementation. The following description of SYNAS-I objectives and outcomes is based on the Final Report of Scott Wilson on Syrdarya Control & Northern Aral Sea Phase I - Monitoring & Project Evaluation (Scott Wilson 2007). SYNAS-I implementation is still ongoing with a planned closing date 31 December 2008.

1.5.1 Project objectives and construction measures

The aims of the SYNAS-I Project are to increase the carrying capacity of the Syrdarya River and to optimize water management both in terms of allocation to various user groups as well as to allow a more reliable and better distribution in both spatial and temporal terms. In order to achieve these aims various structures have been constructed or rehabilitated on the Syrdarya River. In addition, a permanent dam (Kokaral dam or Bergs Strait dam) has recently been finalized that separates the Northern Aral Sea (NAS) from Large Aral Sea (LAS). Hydraulic structures on the Syrdarya River at Shardara Dam, Kzylorda Barrage, Aitek and Aklak have recently been or will soon be rehabilitated and additional flood protection measures will be installed. The expected increase in carrying capacity coupled with the focus on water management of the river flow will have the effect of allowing more water to enter the NAS; the dam separating NAS from LAS will enable the sea level to rise from 38 m to 42 m in the NAS. This level has recently been achieved (May 2007).

1.5.2 Project alternatives

The SYNAS-I project was designed following the consideration of all possible alternatives to address the problems of environmental degradation and improving water management in Kazakhstan's portion of the Syrdarya basin to the Aral Sea. After determining a broad strategy to address these issues, the selection of each intervention was based on obtaining optimal designs considering, costs, benefits, environmental and social impact and long-term sustainability. Major alternatives considered and reasons for rejection are described below:

Alternative 1: Rehabilitation of the Entire Aral Sea

The goal of restoring the entire Aral Sea to its historic levels is not achievable in the foreseeable future. The estimates are that about 75 km³ of water would be required annually over a period of 25-30 years to rehabilitate the whole Aral Sea. The total flow of the

Amudarya and Syrdarya Rivers is about 120 km^3 annually. With present water use being more than the total river flows as water is reused it is unrealistic to assume that more than half of the total flow of these two rivers could be allocated to the restoration of the Aral Sea in the near future. Furthermore, due to storage of water in reservoirs and water use in the basin upstream, the river capacity downstream has reduced to a level that water cannot be delivered to the Aral Sea even if it becomes available. To expand the river capacity downstream to deliver the required quantities of water would involve the reconstruction of bridges, diversion structures and embankments requiring huge investment. Finally, restoring the entire sea would require large losses of irrigated land; the present livelihoods of millions of people in the Amudarya basin in Tajikistan, Uzbekistan, and Turkmenistan. The impossibility of fully restoring the Aral Sea is currently well recognized by the countries participating in the ASBP. Kazakhstan and Uzbekistan are therefore now concentrating on finding their own local solutions.

Alternative 2: the "No Project" Alternative in Kazakhstan

Currently the Aral Sea has already split into the relatively small NAS and the much larger Large Aral Sea (LAS). If nothing is done the situation will worsen. The process of environmental degradation will continue and the NAS would further split into four water bodies, resulting in increased salinity. The river bed and bank erosion caused by lowering of the sea level would intensify, river bed erosion would move upstream and hydraulic and other infrastructure would become derelict. Also, as a result, fresh water flows to the delta lakes would cease, resulting in increased salinity and loss of fisheries. Water supply to irrigated areas would diminish. With the limited carrying capacity of the Syrdarya and the constraints in the operation of Shardara dam due to safety issues, increasing amounts of water would be spilled (and wasted) to desert areas and to the Arnasay depression resulting in property damage and loss of arable land in Uzbekistan. The cost of resettling the affected populations elsewhere would be extremely high. Furthermore, social assessment surveys conducted in 1998 of the residents of the area specifically indicated that they are not in favor of leaving the area despite the high rate of unemployment. Therefore, the "no project" alternative was considered not being a pragmatic approach.

Alternative 3: Rehabilitation of the NAS and Delta Areas.

Taking advantage of the topographic conditions and the location where the Syrdarya enters the NAS, the NAS could be (partially) restored and its further desiccation into small water bodies prevented. Water required for rehabilitation of the NAS is available from the Syrdarya basin and could be delivered to the NAS with some rehabilitation of the infrastructure along the river's course and in the delta area. The rehabilitation of the water conveyance infrastructure on the Syrdarya is also needed for irrigation, flood protection and fisheries. Rehabilitation of the NAS actually impacts a much larger area than the NAS itself. With higher water levels in the NAS and improved hydraulic control of the Syrdarya, the surrounding delta areas and fresh water bodies can also be rehabilitated. This alternative was adopted for the SYNAS-I project. Within this approach several design options were considered. In fact an optimal sizing exercise was carried out for each structural intervention proposing either replacement or rehabilitation under the project. The project implemented the most urgent measures. Other structures of lower priority or at this stage not possible to be financed have been left for a second project phase (SYNAS-II) which is currently in the stage of feasibility study.

1.5.3 Description of structures constructed or rehabilitated by SYNAS-I

The following projects were proposed and have been completed at the end of 2006 or were that time under construction (See figure 1-1 for their approximate locations).

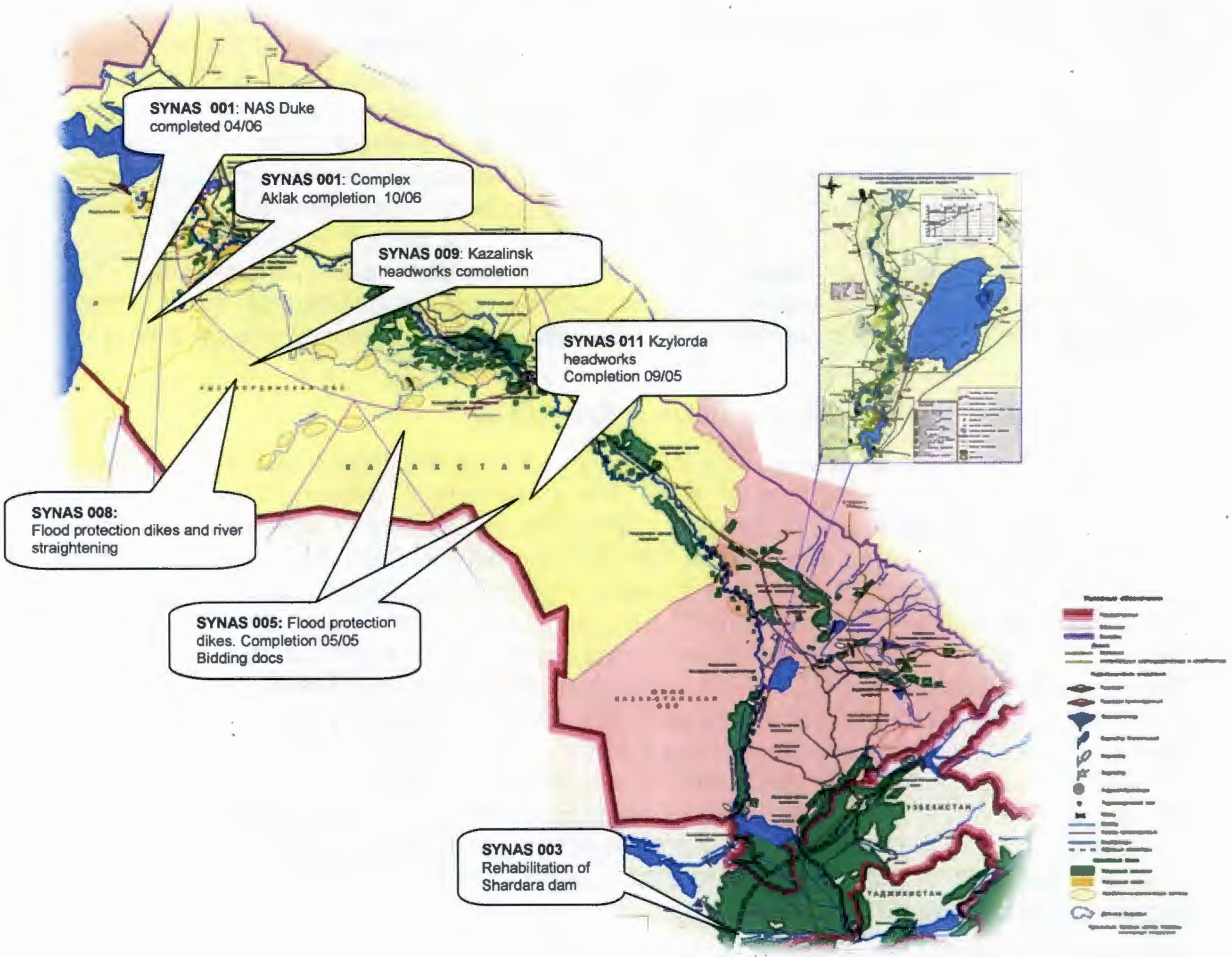


Fig. 1.1: Location Map of Construction Works under SYNAS-I (Source: Scott Wilson, Final Report, 2007)

Rehabilitation of Shardara Dam

The Shardara dam was found not to meet normal safety standards and it was considered to be 'at risk'. The major problems were that 'sinkholes' were forming at the crest of the dam, seepage rates were very high due to which there was a danger of internal erosion as the drainage system was ineffective, bottom outlets in the power station and spillway gates towards Syrdarya did not operate properly due to which the flows were limited to 40% of their normal capacity. The rehabilitation of Shardara Dam has covered priority works such as rehabilitation of the Kyzylkum irrigation outlet, the drainage system, spillway gates, and repairs of spillway outlets, chutes, stilling basins and related works, and installation of dam instrumentation. These works comprise the first phase of the program for the rehabilitation of Shardara dam in order to ensure its safety in the immediate future.

Details of the engineering works and operational capacities received from Mott MacDonald in October 2005 and March 2006. - Contract SYNAS 003 "Shardara Dam Reconstruction"

The main works at Shardara Dam are:

a) Construction work:

- reconstruction of drainage system of the dike, construction of the new water measuring structures;
- reconstruction of outlet and other structures on the discharge canal of the drainage system;
- construction of the new unload well
- Repair of junctures and concrete coating of the backslope
- Survey and compacting works in Kyzylkum canal water outlets, reconstruction of junctures of water outlets;
- Construction of the new vertical piezometers;
- Modification of the stilling basin of the bottom discharge on Shardara HPS, different surveys and experiments;
- Concrete works around the bottom discharges, reconstruction of ice profile and construction of intermediate walls;
- Mounting of the downstream face of Arnasay dike.

b) Mechanic and electric works

- Reconstruction of the gate (hoisting) apparatus;
- Reconstruction of the frame crane;
- Reconstruction of the stop beam;
- Installation of the new working gates;
- Installation of the steel lining under the floodgates;
- Installation of the new temporary floating caisson gate
- Replacement of the electric and technical equipment.

Works at Shardara are planned for completion by September 2007.

Moreover , taking into account the fact that the procedure of consideration of second phase of SYNAS-2 by World Bank and the Government Authorties of the Republic of Kazakhstan delays the construction of the objects up to 2017-2018 years, it was taken a decision to start the immediate implementation of the component " Construction of emergency spillway at Shardara dam" on account of budget funds in the established order, excluding it from SYNAS-2 project

Improving the Hydraulic Control of the Syrdarya

When completed, the rehabilitation and construction of hydraulic structures will contribute to regulating and improving water management, and controlling allocations to various water users, including an increased inflow for the NAS. Works under this component include: (i) reconstruction of Aklak weir (and related works) – included in SYNAS Contract 001 "Northern Aral Sea (NAS) Dam and Aklak hydrostructure" described below; (ii) reconstruction of the Aitek and Karaozek water control structures; (iii) rehabilitation and construction of low height dikes along the river to protect urban and rural areas from flooding and for increasing flow capacity of the river; and (iv) repairs of Kazalinsk headwork and Kzylorda barrage;

Details of the engineering works and operational capacities received from Mott MacDonald in October 2005 and March 2006. - Contract SYNAS 002 Aitek complex infrastructure

The Aitek complex infrastructure includes the following:

(i) The construction of a new structure with a capacity of 700 m^3/s in summer and 425 m^3/s in spring on Aitek hydro area.

(ii) Reconstruction of the headworks on Karaozek branch with a flow of 80 m^3/s.

(iii) Reconstruction of the headworks of Aitek, Sorkol, Eltai canals.

(iv) Construction of 4 apartment houses for servicing the facilities.

This project was completed in November 2004. The facilities have been put into operation.

Details of the engineering works and operational capacities received from Mott MacDonald in October 2005 and March 2006. - Contract SYNAS 005 "Protection dams on Syrdarya River".

In the framework of the contract the main contractor carried out the rehabilitation / construction of the protection dams within Karmakshy and Kazalinsk rayons and in Kzylorda City at the following sites listed in Table 1-1. The works were completed in May 2005.

***Fig. 1-2:** Insufficient (?) flood protection dike at Abay village. According to reports recently constructed under SYNAS-I*

Table 1-1: Constructed protection dikes

No	Items	Length, km	Earth work volume, m^3
1	Protection dam of Zhanazhol village.	4.0	85,192
2	Protection dam of Iirkol village.	4.8	248,254
3	Protection dam of the Pioneer camp	1.4	34,896
4	Protection dam of Zhusaly village.	1.3	9,871
	Total in Karmakshy rayon	11.5	378,213
5	Right bank protection dam	8.3	121,253
6	Protection dam of Abay village.[1]	3.0	45,315
7	Protection dam of Birlik village.	6.3	180,700
	Total in Kazalinsk rayon	17.6	347,268
8	Protection dam of Left bank main canal Kalgandarya	20.2	402,900
	Total in Kzylorda town	20.2	402,900
	In Kzylorda oblast	49.3	1128.381

Details of the engineering works and operational capacities received from Mott MacDonald in October 2005 and March 2006. - Contract SYNAS 006 a "Straightening of the Syrdarya River bed"

The site of the straightening of the Syrdarya River bed is located in the territory of Aksu farm of the Zhalagash rayon and consists of three sites with the length of 2805 m.

- The first site with the length - 1780 m., the volume of the excavation is 480,300 m^3;
- The second area with the length 763 m., the volume of the excavation – 221,300 m^3;
- The third area with the length – 262 m., the volume of the excavation – 86,900 m^3.

On 13 September 2005 the site has been passed to the Commission. See fig. 1-2. One of the riverbed straightening sites has by error again be included in the Pre-feasibility study (subproject 7, object 21).

Details of the engineering works and operational capacities received from Mott MacDonald in October 2005 and March 2006. - Contract SYNAS 009 "Reconstruction of Kazalinsk headworks"

The main works under this contract are:

- To provide reliability of power supply of the site, by replacing a high-voltage line of electric transmissions, transformer substation and installation of backup diesel electric power plant;
- Major repairs of the frame crane and other accessory equipment;

[1] During the field visit August 2007 the protection dike at Abay village looked insufficient for fulfilling the intended purpose and seemed to be decades old. (See fig. 1-2)

- Partial replacement and reconstruction of the reinforced concrete construction of the headworks, fastening of the slopes of the river and canals, entrance jetty and other structures;
- Construction of fish-pass at Aksay canal;
- Major repairs with the replacement of working parts of the segment gate of the headworks with cleaning and painting;
- Full replacement and reconstruction of the hydro-mechanic and electro-technical equipment and metal structures of the Right bank main canal (RBMC) and Left bank main canal (LBMC) and Aksay canal;
- Construction of the hydro-technical stations on the main bed of the Syrdarya River and on the canals of RBMC, LBMC and Aksay;
- Study of the conditions of the under water parts of the headworks;
- Planting trees and installation of light oConstn the headworks territory;

Works at Kazalinsk should have been completed by May 2006.

Several sites critical in terms of carrying floods still remain. The options for solving these problems have been assessed in the Pre-feasibility study of SYNAS-II and selected as one of the first two projects for which feasibility studies are to be elaborated.

Fig. 1-3: Google Earth image of completed riverbed straightening under SYNAS-I (Contract 006a)

<u>Details of the engineering works and operational capacities received from Mott MacDonald in October 2005 and March 2006. - SYNAS 011 "Reconstruction of Kzylorda headworks"</u>

On the Contract SYNAS 011 "Reconstruction of Kzylorda headworks" - concrete placement on the Right bank main canal (RBMC) and on hydro stations have been completed and mounting of the hydro mechanic equipment of the RBMC have also been completed. The main works completed by September 2005 are:

- To provide reliability of power supply on the site, changing of a high-voltage line of electric transmissions, transformer substation and installation of standby diesel electric power plant;
- Major repairs or replacement of the auxiliary equipment, electric components and others,
- Partial replacement and reconstruction of the reinforced concrete structures on the headworks and adjacent canals, fastening of the slopes, training wall and other structures

The outlet of the Kyzylorda left bank main canal is in deteriorating conditions and a possible failure of the structure would in a large extent threaten irrigated agriculture on some 60,000 ha of land. The options of rehabilitation of this hydraulic structure have been assessed in the Pre-feasibility study of SYNAS-II and selected as one of the first two projects for which feasibility studies are to be elaborated.

Construction of Northern Aral Sea Dam

A well engineered dam has been constructed across the Berg strait, a deep channel connecting NAS and LAS. The dam has a spillway for regular use, and an emergency spillway with an earthen fuse plug. These measures will, once the NAS has reached 42m asl, create a stable level of the NAS and allow for flushing to maintain salinity at an acceptable level and pass flows during periods of high inflow through the Berg Straights to the LAS.

2 POLICY, LEGAL AND ADMINISTRATIVE STRUCTURE

2.1 Policy

Governed by the resolutions of the World Summit in Johannesburg (2002), Kazakhstan carries out a consecutive policy for sustainable development. The Strategic Development Plan of the Republic of Kazakhstan till 2010, the Concept of Environmental Security for the period 2004-2015 speak in favor of a need to make the social and economic system more environmentally sensitive. The main goal is defined as ensuring the protection of natural systems, of the vital interests of the society and protection of human rights against threats resulting from adverse anthropogenic impacts on the environment.

Other national action programs and government plans determine the policy of environmental protection and sustainable resource use. Prominent examples are the National Environmental Action Plan for Sustainable Development (1998), the National Biodiversity Strategy and Action Plan and the National Action Plan on Combat Desertification (1998). A problem is that many of these programs and action plans have not been approved at the appropriate level and consequently are not much put into practice. Recently more attention is paid on mainstreaming of the environmental policy by direct inclusion in budget planning and appropriate government approval. This has been done e.g. with the National Program for Combating Desertification (2005-2015).

The environmental degradation of the Aral Sea region and the inefficient use of water resources are among the serious environmental threats affecting the social, environmental and economic wellbeing in the country. Accordingly the Government of Kazakhstan has adopted a number of important measures on mitigation of the immediate impacts of the Aral Sea disaster and the improvement of the water management in general and in the Aral Sea basin in particular.

The policy of the GoK is expressed by the participation in regional multi-country agreements concerning the water management and environmental rehabilitation in the Aral Sea basin (see. 2.3). In September 1995, the President of the Republic of Kazakhstan signed the joint declaration of five Central Asian Countries pertaining to stable development of the Aral Sea region. In 2003 a Sub-regional Action Plan on combating desertification was agreed by all five Central Asian Countries and since 2004 the countries have started a multi-country initiative for sustainable land management (CACILM) which is supported by a broad range of donor organizations.

2.2 National Legal and Administrative Setting

The present study complies with EIA regulations adopted by the World Bank. Requirements defined by the legislation of the Republic of Kazakhstan are considered in the level adequate for a pre-feasibility assessment. Environmental protection and the management of natural resources in Kazakhstan are regulated by the new Environmental code which passed in December 2006. This environmental code replaces a number of laws, among them the laws "On Environment Conservation in the Republic of Kazakhstan" (15.07.1997) and "On Ecological Expertise" (18.03.1997). The Environmental code defines the legal, economic and social basis for environmental conservation, the avoiding of negative effects on people's lives and on the environment that could result from administrative decisions, economic activities and other projects. In addition, the laws and regulations listed in Table 2-1 below are relevant to the present project.

Table 2-1. Relevant Legislation in Kazakhstan pertaining to Environmental Protection and Sustainable Natural Resource Use

Land Code (20 June 2003)
Water Code (9 July 2003)
Environmental Code (December 2006)
Law “On mineral resources and use of mineral resources” (27.01.1996)
Forest Code (08 July 2003)
Law “On social protection of citizens suffering from the environmental disaster in the Priaral region (30 June 1992)”
Law “On special protected natural territories” (7 July 2006)
Law ”On sanitary - epidemiological welfare of the people” (04 December 2002)
Law ”On conservation, reproduction and exploitation of the fauna” (1996)
Decree of Cabinet of Ministers “On the conservation of the environment and the rational exploitation of the natural resources”
Decree of Cabinet of Ministers “On ecological measures for restoration of the environment”
Decree of Cabinet of Ministers “On the conservation of the forests”
Order and approval of complex schemes for management and conservation of water resources
List of rare animal species in danger of extinction (Hunting and Fishing Regulation)
Regulation on approval and issue of special permits for water resources exploitation (29.12.1994)
Ordinance on the establishment of a State Water Survey (24.01.1995)
Decree on approval of State control of water resources exploitation and conservation (20.01.1995)
Decree on the payment procedure for water supply of irrigated lands (04.03.1997)
Ordinance on the estimation of natural losses caused by violation of environmental legislation (27.06.1995)
Decree on the approval of the Resolution ”On funds for environmental protection in Kazakhstan and payment procedures for pollution of the environment”
On protection and use of Historical and Cultural Heritage (1992)

These laws and resolutions form the legal basis for the management and conservation of water, soil and biological resources and for pollution control. Some of the more recent enactments also reflect provisions listed in international conventions that have been ratified by Kazakhstan, see Section 2.3. An important provision in these enactments is that technical designs of development projects must comply with international standards relating to environmental protection and monitoring.

The Environmental code makes an Environmental Impact Assessment mandatory for any type of economic or other activity which can have direct or indirect impacts on the environment and the health of the population. The results of the EIA are considered as integral part of the pre-project and project documentation, including feasibility studies. The documentation is subject to an Environmental clearance by the organ in charge of environmental protection, depending of the category of the planned object at the republic, oblast or local level.

The central agency in charge of all water management issues is the Committee on Water Resources (CWR) under the Ministry of Agriculture. The subordination, structure and functions of the CWR are defined by the Decree Nr. 310 of the GoK “On the approval of the Order about the Committee on Water Resources of the Ministry of Agriculture” (6 April 2005).

The Basin Water Authorities (BVUs) are subunits of the CWR, responsible for the management and utilization of the water resources in the area of Kazakhstan’s river basins. These river basins are administratively defined areas, determined under consideration of the natural watersheds. The areas covered by each BVU contain usually of two or more oblasts, in the case of the Syrdarya BVU the oblasts South Kazakhstan and Kzylorda. The BVUs legal basis is provided by the Water code of the RK, article 40, and relevant bylaws.

According to the Governmental Regulation of the Republic of Kazakhstan on February 28 2011, republican state enterprises and subsidiary state enterprises of the republican state enterprises of the Committee for Water Resources of the Ministry of Agriculture of the Republic of Kazakhstan were rearranged by the merging into Republican State enterprise on water management with the right of economic control "Kazvodhoz"

On the oblast level exist state enterprises, "Kazvodhoz" which are directly responsible for the allocation and delivery of irrigation water.

Hydrogeological-ameliorative expeditions are subordinated to the CWR and carry out monitoring of the ameliorative status of irrigated lands, of the quality of irrigation and drainage waters in the oblasts with significant irrigated arable lands. In the KSB the Kzylorda and South-Kazakhstan Hydrogeological-ameliorative expeditions are active.

The legislation on water and land use provides for the creation of rural water-users associations – voluntary associations of physical and (or) legal entities owning and using land lots on the irrigated territories for joint management of hydro-technical facilities and equipment. The main task of such associations is ensuring rights of equal access to water for all water users; protection of their interests; support of the regime of rational use of water and land resources and environmental protection. Until now the establishment of these associations is slowly advancing.

2.3 International Conventions

Kazakhstan has signed a number of international environmental conventions and agreements, including some that resulted from the UN Conference on Environmental Conservation and Economic Development (UNCED, Rio de Janeiro, 1992). In 1996, Kazakhstan became involved in a global network of environmental information exchange, under the aegis of the UNEP. Only recently, Kazakhstan has ratified the Convention on Wetlands of International Importance, also known as the RAMSAR Convention and the Convention on Migratory Species (Bonn Convention). Some wetland sites which form parts of the project area of SYNAS-II may qualify for inclusion in the RAMSAR list. Since 19 April 2000 the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is in force in Kazakhstan. International treaties and conventions pertaining to Environmental Protection and Natural and Cultural Heritage Preservation that have been signed and ratified by the GoK are listed in Table 2-2.

Table 2-2. International Conventions and Treaties pertaining to Environmental Protection and to Natural and Cultural Heritage Preservation, Signed or Ratified by Kazakhstan

Convention/Treaty	Date of Signing/Ratification
International Convention on Civil Liability for Oil Pollution Damage	05-06-1994
Convention on Safety of Sea-Living Organisms	07-06-1994
Convention on Protection of the World's Cultural and Natural Heritage	09-07-1994
Convention on Biological Diversity	06-09-1994
UN Framework Convention on Climate Change	17-05-1995
Convention on World Meteorological Organization	13-04-1993
Convention to Combat Desertification	09-07-1997
Vienna Convention on Protection of the Ozone Layer	26-08-1998
Montreal Protocol on Substances that Deplete the Ozone Layer	26-08-1998
Protocol on Energy Efficiency and Related Environmental Aspects	17-12-1994
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	19-04-2000
Convention on Migratory Species	01-05-2006
Convention on Wetlands of International Importance (Ramsar)	02-05-2007

In 1993, Kazakhstan, together with Uzbekistan, Turkmenistan, Kyrgyzstan and Tajikistan, concluded the "Agreement for Joint Actions Aimed at Solution of the Aral Sea Problem and Environmental Rehabilitation and Socio-Economic Development of the Aral Sea Region".

The Nukus Declaration (1995) among these five Central Asian countries acknowledged the formulation of the Aral Sea Basin Sustainable Development Conventions as a high priority. Following this convention, IFAS was established, as well as a Commission on Sustainable Development, and an Interstate Commission on Water Economy. A long-term water and energy agreement for the Syrdarya River Basin was signed in February 1998 between Kazakhstan, Uzbekistan and Kyrgyzstan (the Almaty Declaration). A new agreement is currently considered to be signed in the frame of the SCO. Also in 1998, an "Agreement for Cooperation in the field of Environment and Rational Use of Nature was signed by the Governments of the Central Asian countries. In the same year, these countries decided to set up a Regional Environmental Centre with a network of national branches.

2.4 World Bank Environmental Procedures

The World Bank defines the requirements for Environmental Assessments by the category to which projects are assigned. Category A: A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works. EA for a Category A project examines the project's potential negative and positive environmental impacts, compares them with those of feasible alternatives (including the "without project" situation), and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance. For a Category A project, the borrower is responsible for preparing a report, normally an EIA (or a suitably comprehensive regional or sectoral EA).

The SYNAS-I project was classified as a category A project. This classification can be as well applied to SYNAS-II as its extension, contributing to the same basic objectives and having principally the same character, temporal and spatial extent of environmental impact. In addition the transboundary impacts on the LAS and the Arnasay depression in Uzbekistan determine the requirements for the EIA.

Operational Policy 4.01 Environmental Assessment

The EA for SYNAS-II complies with the Bank's OP 4.01 and with the guidelines for EA laid down in the EA Source Books, Vol. 2 and 3. Its content is in accordance to the requirements for EIA. The EMP in accordance to this OP for the subprojects selected for priority financing is enclosed in the present EA report. Of particular significance to the present project, are the guidelines for irrigation and drainage projects and those pertaining to river regulatory works including small dam/weir constructions.

Operational Policy 4.04 Natural Habitats

The conservation of natural habitats, like other measures that protect and enhance the environment, is essential for long-term sustainable development. The Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions in its economic and sector work, project financing, and policy dialogue. The Bank does not support projects that, in the Bank's opinion, involve the significant conversion or degradation of critical natural habitats and if the environmental assessment indicates that a project would significantly convert or degrade natural habitats, the project includes mitigation measures acceptable to the Bank.

The SYNAS-II will likely have impact on significant areas of natural habitats and in some cases even critical natural habitats, according to the definitions provided in OP 4.04 Annex A. Natural habitats include water areas of the Syrdarya River, the Aral Sea, the Aydar-Arnasay lake system, the delta lakes and many other lakes, wetlands and terrestrial ecosystems, most notably semi-desert and desert ecosystems. Critical natural habitats include protected areas (in the zone of influence the Zapovednik Barsakelmes, Zapovednaya Zona Arys-Karaktau, planned Nuratau-Kyzylkum Biosphere Reserve in Uzbekistan), areas with known high suitability for biodiversity conservation; and sites that are critical for rare, vulnerable, migratory, or endangered species (e.g. assigned and potential Important Bird Areas and potential Ramsar sites). The Tugay forests in the

Syrdarya floodplain can also be considered as critical natural habitats as they represent an ecosystem type specific for Central Asian rivers, extremely in decline and inhabited by several endemic and vulnerable species. Such forests are found in especially valuable conditions in the region of the planned Koksaray Reservoir.

Operational Policy 4.11 Physical Cultural Resources

In the course of history, the Aral Sea and its periphery, and the Syrdarya River valley and adjacent plains, have been the scene of a succession of ancient civilizations. At present, a large number of sites of historical and cultural significance have been discovered and marked for preservation, both in the international and national context. For this reason, due note is taken of the Bank's OP 4.11 on Physical Cultural Resources, in order to guarantee that the proposed project interventions will in no way interfere with the nation's cultural property. This includes a check whether project interventions will interfere with existing cultural sites, structures, places of worship, graveyards, etc. and measures for avoiding, minimizing or mitigation of adverse impacts are proposed.

The Consultants studied the presence of cultural historical sites in and near the project area from existing documents and maps and paid special attention to those sites in the field surveys.

Operational Policy 4.12 Involuntary Resettlement

This OP is of relevance in case if

- resettlement is required in floodplain areas remaining under regular flooding or at risk in cases of exceptional high water (to be determined what flood level and frequency justifies resettlement).

While the project envisages the reinforcement of existing but insufficient dikes, there are houses in some areas which are located in the immediate floodplain. These houses have obviously been erected without consideration of the specific conditions in a natural floodplain and most likely in many cases without permission. Under the current flood regime some of these objects are under permanent threat of flood damage and often compensation is demanded for those damages. The protection of such houses by dikes may not always be the best solution from the cost-benefit ratio point of view and in terms of environmental impact. Instead of supporting inappropriate settlement forms by protection with public funds, resettlement might be the better option. In this case resettlement would not be caused by the project but may be supported by the project.

Operational Policy 4.36 Forests

This policy applies to the following types of Bank-financed investment projects that have or may have impacts on the health and quality of forests. Forest by the definition in Annex A is as an area of land of not less than 1.0 hectare with tree crown cover (or equivalent stocking level) of more than 10 percent that have trees with the potential to reach a minimum height of 2 meters at maturity in situ. It includes as well young stands which have yet to reach the crown density of 10 per cent and clear cut areas with the potential to revert to forest. In countries with low forest cover, the definition may be expanded to include areas covered by trees that fall below the 10 percent threshold for canopy density, but are considered forest under local conditions.

This OP is of relevance as the project will affect floodplain forests (tugay) by changing the river runoff and flood seasonality. The tugay forests can be considered as critical natural forests in accordance to the definition in the Annexes A of OP 4.04 and OP 4.36. One subproject (Koksaray Reservoir) potentially has direct impact on tugay forests by construction of diversion structures in the floodplain, flooding of floodplain areas (affected areas of existing and potentially rehabilitating forests) and reducing the flow in a river section with valuable tugay forest. The present report proposes variants which minimize these affects as required by the Bank for financing of projects.

The subproject on the flooding of the Saryshiganak Bay in NAS may affect woodlands. Raising of the water level in the Saryshiganak Bay can lead to degradation and destruction of secondary shrub lands with saxaul developed over the last decades on the dry seabed.

Operational Policy 4.37 Safety of Dams

The Bank distinguishes between small and large dams. Small dams are normally less than 15 meters in height. This category includes, for example, farm ponds, local silt retention dams, and low embankment tanks. Large dams are 15 meters or more in height. Dams that are between 10 and 15 meters in height are treated as large dams if they present special design complexities — for example, an unusually large flood-handling requirement, location in a zone of high seismic risk, foundations that are complex and difficult to prepare, or retention of toxic materials. Dams below 10 meters in height are treated as large dams if they are expected to become large dams during the operation of the facility.

OP 7.50 Projects on International Waterways

This policy applies to any river or body of surface water that flows through, two or more states, whether Bank members or not. It applies to projects that involve the use or potential pollution of international waterways as described above. The Bank attaches great importance to countries sharing international waterways making appropriate agreements or arrangements for these purposes for the entire waterway or any part thereof. The SYNAS-II project likely will have impact on two waterbodies of transboundary character – the Aral Sea and the system of Shardara reservoir and (Aydar-)Arnasay depression, both shared with the Republic of Uzbekistan.

Aral Sea and rehabilitation of Saryshiganak Bay

The Bank's OP 7.50 on Projects on International Waterways would, in principle, apply to planned interventions in the Aral Sea, which is bisected by the international boundary between Kazakhstan and Uzbekistan. The well-documented drying up of the Aral Sea and the construction of the Berg Strait dike have led to a separation of the NAS within Kazakhstan territory, from the southern LAS, shared between Kazakhstan and Uzbekistan. Consequently, the international waterway between Nukus and Aralsk has been disrupted and is no longer in use. The proposed rehabilitation of the Saryshiganak Bay by dam construction and water supply from the Syrdarya River will reduce the amount of water flowing via the spillway at the Berg Strait into the LAS by 1.5 km³ once for filling and about 0.5 km³ for covering evaporation and infiltration losses. These losses are due to the smaller surface area of the rehabilitated compared to the original Saryshiganak Bay below the level before the drying out of the bay. Impacts on the LAS water balance are, however, considered to be insignificant.

As to international water sharing policies pertaining to the waters of the Aral Sea, this is laid down in the Nukus Declaration of September 1995 and in the Almaty Declaration of February 1998 signed by the Central Asian states.

Shardara dam and Arnasay depression, Uzbekistan

The development of the present lake system in the Arnasay depression is related to the flow regulation of the Syrdarya River and in particular to the construction of the Shardara reservoir and the Toktogul reservoir, located at the Naryn River in Kyrgyzstan. In order to prevent disastrous floods at the Syrdarya river in 1969 and 1970 21.8 km³ of water from the Shardara reservoir were spilled through an emergency spillway into the Aydar basin. Afterwards, the lake level was at 239.4 m asl, the surface area amounted to 2300 km² and the water volume equaled 20 km³. Until the end of the seventies, the lake level sank by 4 m. The salt content was approximately 8-10 g/l. In the eighties, the sea level was kept at an artificial balance. Since 1990, the Toktugul reservoir is operated mainly on a power supply basis, which means that a large volume of water is discharged in winter and flows into Shardara (storage capacity limited to 4.2 km³) coinciding with the period when there is no demand for irrigation water. Then the carrying capacity of the river is minimal due to ice and the presence of a number of obstructions. Consequently, surplus water is spilled into the Arnasay depression in Uzbekistan. In wet years, the volume lost into the Arnasay depression could amount to 7.5 km³ or more. Thereby, the lake surface and its water volume increased considerably. In 1991 the lake covered an area of circa 2320 km². In June 1998) its water volume came up to 32.26 km² and the surface area amounts to 3067 km². Vast land area, mainly used for pasture, was lost due to the rising lake level. Furthermore, the increase of the lake causes problems with the release of drainage water (for both Uzbekistan and Kazakhstan farmers!), the destruction of dams, roads and of a railway line and aggravated conditions for fishery. The Government of Uzbekistan has requested GoK to halt releases into the depression.

The implementation of the SYNAS-I project has improved the situation by increasing the carrying capacity of the Syrdarya during the critical winter months. However, the original aim of avoiding water spills to Arnasay, as the entire flow of the Syrdarya could be regulated, has not been achieved due to remaining bottlenecks for the flow in the Syrdarya River and the failure to implement coordinated operations of the storage reservoirs in Kyrgyzstan (Toktogul reservoir), Tajikistan, Uzbekistan and Kazakhstan. The during the planning stage of SYNAS-I supposed reduction of releases in winter from the Toktugul reservoir has not been possible due to high demand for electric energy in Kyrgyzstan during the winter months.

In any case as a result of SYNAS-II the spillage into the Arnasay depression can be significantly reduced. As the water balance of the Aydar-Arnasay lake system is in its present extent naturally negative, options for future management of the water body, based on transboundary operations, are to be developed. The hydraulic modeling conducted under the pre-feasibility considers for different scenarios annual inflows of an average 68 or 94 Million m³ per annum respectively. The option preferred from an environmental point is the maintenance of the lake system at a level of about 1-1.5 m below the current maximum and as stable as possible, especially during the nesting period. The option preferred by Kazakhstan water managers is the stopping of any water discharge except in case of emergency which would lead to a significant reduction of the water body and salinization but the availability of a significant buffer capacity in case of extreme floods.

The recent construction of two low earth dams in Arnasai depression by Uzbekistan without prior transboundary consent from Kazakhstan, with a spillway capacity fo only 600 m3/sec has blocked the former opportunity to spill in an emergency up to 2300 m3/sec into Arnasai-Aydarkul depression. This capacity is necessary to allow for a Chardara dam safety of one in 10 000 years. Although this has helped Uzbekistan in preventing the flooding of additional territory in the vicinity of the Arnasai water bodies and provides opportunity for pumped irrigation in Golodnya steppe, the reduction of spilling opportunities from Chardara reservoir to Arnasai-Aydarkul depression has raised an important dam safety issue for Chardara dam.

2.5 Ongoing Environmental Programs

Over the last one and a half decade, the serious environmental degradation of the Aral Sea and its periphery has attracted quite some attention from donors. The International Bank for Reconstruction and Development (the World Bank) has provided financial support for the ASBP, i.e. in establishing a Regional Strategy on Water Resources Management. The World Bank is financing the SYNAS-I project with a loan of 64.5 Million US Dollars. The project is active since the 5 June 2001 and is the direct predecessor of the presented project. The Kazakhstan Forest Protection and Reforestation project, financed by the World Bank and the GEF, has started recently and will include a significant component for planting of perennial plants on the Dry Aral Seabed.

The Asian Development Bank (ADB) is financing the Technical Assistance «Improvement of Shared Water Resources Management in Central Asia» (ADB RETA 6163). The purpose of the TA is to help the CARs strengthen their cooperation in the management of shared water resources in the Aral Sea Basin and other transboundary basins. Among other tasks the TA will help the CARs to jointly move forward with concrete steps on selected high priority regional water policy issues and will strengthen the capacity of key regional water management institutions and their national affiliates.

In 1993, UNESCO in cooperation with GTZ (Germany) provided equipment for ecological monitoring of the Kazakhstan part of the Aral Sea. This equipment is currently in use by the Institute of Geography of the Academy of Science, and partly at the Aral Sea local research centre at Kazalinsk.

A NEAP/SD was prepared with support of donor organizations, including the World Bank, EU/TACIS, UNDP, the Harvard Institute for International Development (HIID), USAID, Germany, Italy, Austria and Japan. It includes rehabilitation programs for the Aral Sea, but few activities are operational.

UNDP, through its funding committed to "The Aral Seashore Capacity and Rehabilitation Programme", has provided financial support to strengthen the capacity and performance of local administrations and NGOs through training courses and supply of equipment. Focal points were health, environment, education and employment within the Kzylorda oblast. A small-scale project entitled "The Aral Sea Region Development and Humanitarian Assistance Programme" has been carried out under the aegis of UNDP, with contributions from IFAS and from the World Bank. Its main purpose is to assist the most affected riparian communities of the Aral Sea in capacity building and poverty alleviation.

UNDO is implementing the project "National Integrated Water Resources Management and Water Efficiency Plans for Kazakhstan" that supports the development of a National Integrated Water Resources (IWRM) and Water Efficiency (WE) Plan and the creation of river basin councils in each of the eight large river basins of Kazakhstan, among them the Aral-Syrdarya Basin Council.

The ongoing UNDP/GEF funded "Integrated Conservation of Globally Significant Migratory Bird Wetland Habitats" project supports the protection and management of three important wetland sites (Ural River Delta, Tengiz-Kurgaldzhin and Alakol/Sasykol Lakes) and sustainable development of peripheral communities. Experience from this project might used for achieving biodiversity benefits in SYNAS-II. The present SYNAS-II project is expected to have a positive effect on wetland restoration in the Syrdarya Delta and the Northern Aral Sea. Some of the Delta lakes would potentially qualify for inclusion on the RAMSAR list of wetlands of international significance.

The European Union (EU) support is channeled through its Tacis program. Tacis projects aim at solving environmental problems through improved (irrigation) water management. An allocation of USD 6.5 million was granted for the "Water Resources Management and Agricultural Production Project" (WARMAP). Since February 1996, seven subprojects of WARMAP have started. The TACIS financed project "Environmentally Friendly Development in Kzylorda Oblast (EDIKO)" has supported an improved water management in rice cultivation, the development of water users associations, modeling of the water balance in the Syrdarya, irrigation systems and natural wetlands. The outcomes of the project are of high relevance for the design of SYNAS-II.

The Committee on Forestry and Hunting of the Ministry of Agriculture has recently extended the strict nature reserve (zapovednik) Barsakelmes, originally located on an island in the LAS which suffered from the drying out of the sea and the increasing salinity level in the remaining water body. By the extension valuable habitats on areas at the former eastern coast and on the dry seabed have been included. The further extension and development of the protected area as a Biosphere Reserve in accordance to the UNESCO Man and Biosphere Program is considered. In this case the protected area would include zones of graded protection and nature use, promoting sustainable development of its area.

The Association for Conservation of Biodiversity of Kazakhstan (ACBK) is currently implementing a program for the identification and designation of Important Bird Areas (IBA) according to the criteria provided by BirdLife International. In the SYNAS project area several sites already have been identified and further potential sites are currently investigated. These sites should be considered as critical natural habitats in the sense of the World Bank's OP 4.04.

3 THE PROPOSED PROJECT

3.1 Development Options

The rural people in the Aral Sea region have long been seriously affected by the environmental crisis of the Aral Sea. Already since the 1980s this crisis has led to widespread out-migration especially of former fishermen who almost completely lost their basis for livelihood. The process was enforced by the deteriorating socio-economic conditions as a result of the collapse of the Soviet Union. Unemployment became rampant and living conditions deteriorated due to the high incidence of respiratory and parasitic diseases, frequent dust storms, absence of clean drinking water and poor sanitary and medical conditions. Although large-scale resettlement of population was proposed, massive translocation programs have not been executed due to local resistance. In 1998, over 75% of the people were not in favor leaving the area; despite the high rate of unemployment (over 80% of the households had in that year one or more unemployed members). Moreover, the cost of mass resettlement was considered to be prohibitive.

Since the beginning of the new millennium the economic situation in Kazakhstan is increasingly improving as reforms take effect and the growing oil prices provide significant incomes for the state budget and private incomes. The economic growth reaches step by step also the suffering rural areas of the Aral Sea basin. In addition development efforts by the government and donor funded projects have a positive impact. In the result during the last five years a significant improvement of the socio-economic situation can be observed especially in the coastal region of the Aral Sea. Employment opportunities in the frame of SYNAS-I without doubt contribute to this take-off and the sustainability of this positive trend in employment and income is not secure yet.

Restoration of the entire Aral Sea appears to be impossible, as this would require the reconstruction of the (pre-1960) water allocation regime of the Amudarya and Syrdarya Rivers with massive socio-economic consequences for the population living in the river basins and depending on water use for agriculture, power supply and industries. Alternative options of reallocating water from the Siberian rivers of the Irtysh System have been discussed in the 1980s but turned out being non-feasible due to unpredictable environmental risks and enormous economic costs.

During the design of the SYNAS project the no-action alternative was not considered as a feasible option, because that would eventually have led to a further decline in the sea water level and further salinization and drying out and break-up of the NAS into four separate lakes. The bed erosion of the Syrdarya River would have further progressed making the water supply of the remaining delta lakes impossible. This would certainly have led to declining water-tables, a strong increase in salinity and a further decline of the fisheries which is still an important source of income for a number of people.

The SYNAS project in total aimed to improve the hydraulic control of the river Syrdarya and to safeguard part of the original Aral Sea. Allowing more Syrdarya water to enter the NAS will raise the water level sufficiently to maintain one water body in the NAS and to improve the quality of the water as well as supplying the delta lakes with the amount of water needed for the maintenance of the lakes' surface area and water quality.

During SYNAS-I the most urgent and cost efficient measures for achieving this situation have been implemented. This included the rehabilitation of existing and erection of new hydraulic structures as described above (see 1.5.3). The most tangible result is the restoration of the NAS as one water body separated from the LAS by a dike with regulated spillway. The maximum water level of 42 m asl is achieved and surplus water is supplied to the LAS allowing a flushing of accumulated salts from the NAS and in future a salinity level between 4-17 g/l with spatial and temporal variations.

The measures, implemented in SYNAS-I, were intended as the phase of a long term development strategy for the Kazakhstan part of the Syrdarya basin. Several issues which seriously hamper the improvement of the environmental situation and economic development have not yet been addressed. These include:

- The operation regime of the Toktogul Cascade in Kyrgyzstan remains oriented on power production during the winter season. This leads to high water flow in the Syrdarya outside the natural high water season, vegetation period and time of irrigation water demand. Additionally, the surplus water in winter causes out of season flooding leading to environmental problems and damages to infrastructure and property.
- The level of 42 m leaves large parts of the Saryshiganak Bay dry and is insufficient for water to reach the harbor of Aralsk. For this to happen, a level of 46 m in the NAS is required. However, a further increase in the level of the NAS to 46 m would require considerable investments in the Berg Strait dike construction. Additionally a higher water discharge to the NAS of about 3 km^3 would be required.
- The water supply to the delta lakes is still insufficient and poorly regulated. During the dry season under the present water management conditions the Syrdarya does not reach the gauge needed for supplying the delta lakes. The canals supplying the lakes are regulated by earth plugs which are difficult to manage in a manner adaptive to the water availability and demand.

The solution of the identified problems can be divided into two main components:

I) Increasing water flow in the Syrdarya and prevention of winter floods

II) Rehabilitation and maintenance of water bodies additional to the currently existing NAS

The second component depends on the first one as increased water availability is the precondition of the rehabilitation of water bodies in the downstream areas.

The increasing of the water flow of the Syrdarya during the vegetation period and the prevention of winter floods can mainly be achieved by changing the operation regime of the Toktogul Cascade, by the construction of hydraulic structures which allow a storage of the surplus water in winter and its release during the appropriate season or a combination of elements of both. This would at the same time reduce the risk of flooding in winter season. Additionally this risk can be reduced by removing remaining artificial barriers in the river and by protection dikes for specific objects vulnerable to flooding.

The currently practiced emergency spillage of winter excess water to drainless depressions cannot be considered a viable alternative as this water cannot be returned to the river and is lost to evaporation without providing tangible environmental and economic benefits. Although some stakeholders propose to extend this practice in order to create new "ecological" water bodies, especially in Kzylorda Oblast, the option of spillage to drainless depression would thus not contribute to the major objectives of the SYNAS-II project of continued environmental revival of the NAS and delta area of the Syrdarya and improving overall water use efficiency in the basin. It is therefore no longer considered an option in the SYNAS-II project package.

The rehabilitation and maintenance of additional water bodies can potentially include the improvement of the hydrological conditions of existing water bodies, in particular in the Delta Lakes, the rehabilitation of the Saryshiganak Bay and the transformation of temporary water bodies in the Aksay-Kuandarya system, the Zhanadarya, in the Telikol and in other areas in permanent ones. The improvement of the conditions for fisheries and the rehabilitation and maintenance of ecosystems important for biodiversity would be the purposes of these subprojects. The options providing the best effects in these terms, combined with a good cost-benefit ratio and highest water use efficiency will be pursued.

3.2 Proposed Strategy

The SYNAS-II project will be the continuation of SYNAS-I as first phase in the frame of the strategy of an overall program for rehabilitation and development of the Aral Sea Basin. The long-term strategy is: increasing the carrying capacity of the Syrdarya and the water flows to the Aral Sea; and securing and sustaining the NAS level, through careful water allocation and water management and control of the river resources.

The strategy for improvement of water management and water allocation was originally planned to be implemented in three phases:

Phase 1:

- Improve operation and maintenance of existing irrigation infrastructure achieving an efficiency improvement of between 0.3-0.4;
- Limit irrigated areas to 300,000 ha, while abandoning saline lands (60,000 ha);
- Improve carrying capacity of Syrdarya in order to convey additional water to its Delta and NAS;
- Construct permanent dike in NAS to provide maximum level of 42 m asl.

Phase 2:

- Raise the efficiency in irrigation sector to 0.5 by technical means (canal lining, proper drainage collectors, field leveling, water pricing, etc.) and use saved water for raising water level of NAS.

Phase 3:

- Prepare multilateral agreement with riparian countries for use of additional run-off for inflow into NAS;
- Raise the NAS dike to achieve a water level as high as possible (e.g. 46 m asl).

The Phase 1 is currently under realization by SYNAS-I and completed and planned projects for rehabilitation of irrigation and drainage systems financed by the World Bank and the Asian Development Bank. The SYNAS-II will contribute to the full implementation of Phase 1.

SYNAS-II will contribute to the further rehabilitation of the NAS by the envisaged raising of the water level in the Saryshiganak Bay to 46 m asl.

In recent years, the area irrigated in the Kazakhstan part of the Syrdarya basin has strongly decreased. The irrigated area in Kzylorda oblast has dropped from a post Soviet Union high of 272 000 ha in 1992 and stabilized since 1997 to a figure around 150 000 hectares for all crops and from 93 500 ha to 57 000 ha below Chardara dam in South Kazakhstan oblast. Most of the area irrigated in South Kazakhstan oblast is supplied by Syrdarya River sections upstream from the Shardara reservoir and by tributaries of the rivers. Under the SYNAS project, it has been estimated that the total irrigated area between Shardara and the NAS will not exceed 300,000 ha. A recent study shows that the requirement for irrigation water in Kzylorda oblast is 3.23 km^3 per annum. This can be reduced to 2.51 km^3 per annum by implementing an improved production system with increased water efficiency (EDIKO, 2005: Technical note on Agricultural Production Systems). Similar improvements should be possible in South Kazakhstan oblast. These water use efficiency improvements will allow the required water supply for the maintenance of the NAS and the delta lakes even under the conditions of a recovery of the agricultural production. In the frame of the feasibility study for SYNAS-II modeling of the actual and potential water allocation is carried out.

3.3 Project Components / Subprojects

The proposed project consists of a number of construction measures which have been structured as 10 subprojects. These have been studied in the pre-feasibility study to a level permitting to analyze their effect on river basin management, on economy, socio–economy and environment, which then can be ranked by multi-criteria analysis. The analysis of the environmental aspects have been present in a thematic report on which the presented Environmental Assessment study builds on.

The subprojects for which the preliminary environmental appraisal had been conducted are presented in table 3-1. The short description, purpose and anticipated effects present the preliminary conclusions as studied and evaluated in the frame of the pre-feasibility study.

Table 3-1: Overview of subprojects

Sub-project Number and name	Short description, variants	Purpose
1Reconstruction of left bank irrigation offtake at Kzylorda barrage	Reconstruction of deteriorated left bank irrigation offtake	Prevention of total failure and maintenance of irrigation capabilities
2. Syrdarya river bed straightening at Korgansha and Turumbet sites in Zhalagash district of Kzylorda oblast	Construction of channels straightening the meanders along Syrdarya river	Flood control, increase of carrying capacity of river
3. Construction of flood protection dikes in Kazalinsk and Karmakchi districts of Kzylorda oblast	Flood protection dikes' raise	Irreversible discharge of water into the depressions in the desert in order to avoid flooding in the low reaches
4. Construction of bridge near Birlik settlement in Kazalinsk district of Kzylorda oblast	Bridge to replace pontoon	Improvement in traffic and avoidance of ice jams, floods in winter
5.Rehabilitation of Kamuishlibash and Akshatau lake systems in Aralsk district of Kzylorda oblast	Construction of Amanotkel -2 weir, regulation structures and canals for delta lakes	Improve water supply and water quality of the lakes by improving water exchange
6.Reconstruction and extension of fishery ponds at Tastak site of Kamuishlibash fish hatchery in Aralsk district of Kzylorda oblast	Construction of fish ponds, pumping station for water supply and other objects	Improvement of conditions of production and increasing of production yield (stocking material) for lake system of Syrdarya river delta

An additional project component will deal with institutional support to the river management structures. They consist of such items as the design of operational centers, the provision of a water management information system, provision for telemetry from selected hydrological posts, assistance to the CWR in pursuing implementation measures (tendering, evaluation, and construction supervision), monitoring and evaluation of project activities as well as environmental monitoring, and assistance in providing operation and maintenance of important hydraulic infrastructure.

In the pre-feasibility study a priority ranking has been done according to the joint appraisal of independently evaluated parameters, economy, socio-economy, ecology and safety. By definition, the most advantageous project package is the one in which the best synergies are achieved and the best cost-efficiency for a given investment achieved.

The Project should be composed of components which are mutually interelated and optimised and will make a contribution to the basic problem of the Syrdarya basin, in effect the river basin management. As mentioned several times, the World bank is looking for a comprehensive project that includes almost all activities that have been proposed.

Budget situation

The budget situation is well known and no improvement is foreseen in the near future. Sub-projects that can be realised thus are either small or must rely on available previous information.

Consultants proposal

In the consultants view, looking at the above situation with their sometimes diametrically opposed opinions they propose a project solution which we would be able to:

a) provide a coherent concept for the river basin management

b) provide dam safety and flood prevention

c) gain state expertise approval

d) fit within the available budget

e) provide a stable water balance situation for the realization of subsequent projects.

4 BASELINE SITUATION FOR THE PROJECT

4.1 Project Area and Area of Influence

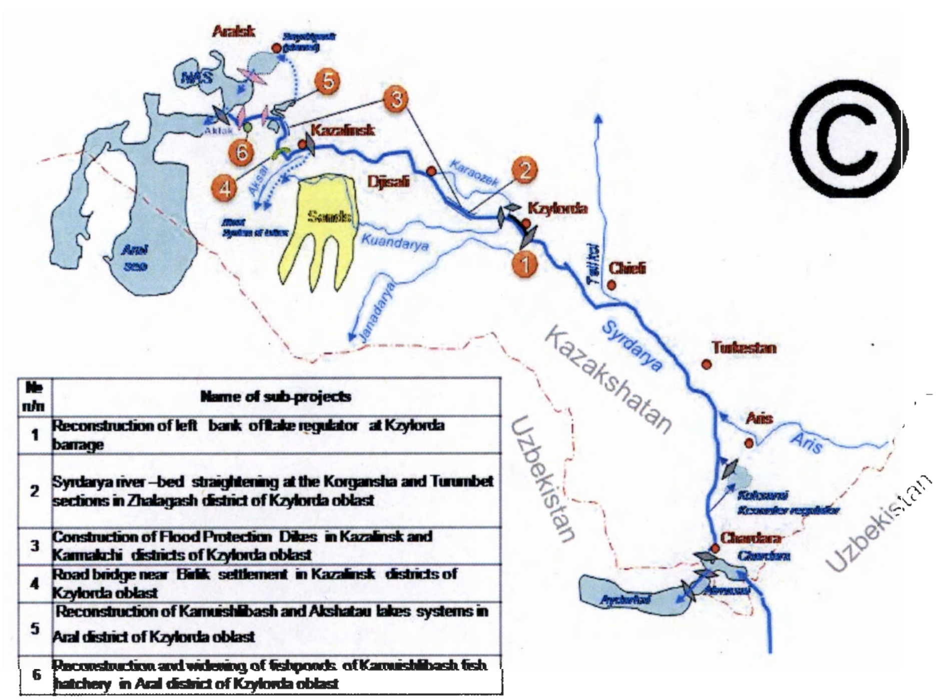
The overall project area of the SYNAS-II package as defined by the ToR for the consultancy includes:

- the floodplain of the Syrdarya between the Shardara reservoir and the Aral Sea including the Delta lakes;
- the NAS;
- Zhanadarya and Telikol systems;

The areas of influence include the LAS (Kazakhstan and Uzbekistan), the Arnasay depression (Uzbekistan).

The locations of subprojects are shown in figure 4-1.

KAZAKH SYRDARYABASIN



№ n/n	Name of sub-projects
1	Reconstruction of left bank offtake regulator at Kzylorda barrage
2	Syrdarya river –bed straightening at the Korgansha and Turumbet sections in Zhalagash district of Kzylorda oblast
3	Construction of Flood Protection Dikes in Kazalinsk and Karmakchi districts of Kzylorda oblast
4	Road bridge near Birlik settlement in Kazalinsk districts of Kzylorda oblast
5	Reconstruction of Kamuishlibash and Akshatau lakes systems in Aral district of Kzylorda oblast
6	Reconstruction and widening of fishponds of Kamuishlibash fish hatchery in Aral district of Kzylorda oblast

Fig. 4-1: ***Overview map of subproject sites***

4.2 Geo-Physical Profile

4.2.1 Climate

The project area lies within the arid continental climate zone characterized by hot, dry summers and cold, dry winters. About 20 years of climatic data are available from five meteorological stations (Shardara, Chieli, Kzylorda, Kazalinsk and Aral Sea). Rainfall data (summarized in Table 4-1) indicate increasingly drier climates from Shardara in the south-east to the mouth of the Syrdarya in the north-west of the project area. However, the Aral Sea station (at Aralsk), in the north-east corner of the Sea, receives consistently more precipitation than the lower Syrdarya valley (near Kazalinsk station). The mean annual precipitation varies from 258 mm at Shardara to 128.5 mm at Kazalinsk. The driest months are June-September. In the north of the Syrdarya basin the distribution of monthly rainfall over the year is more even than in the south with almost no rainfall during the dry season. There are great inter-annual fluctuations in the annual precipitation. In dry years, total annual rainfall in Kazalinsk can be as low as 37 mm, and in Kzylorda, 81mm. There is relatively little snowfall in the area. Average monthly climate data for Kazalinsk and Aralsk are given in Table 4-2.

Table 4-1 Average Annual Precipitation in the Project Area (1976-1996)

Station	Period of recording	Average annual mm	Maximum mm/year		Minimum mm/year	
Chardara	1978-1996	244	372	1,993	105	1,995
Chieli	1977-1996	116	354	1,981	67	1,995
Kzyl Orda	1969-1996	158	311	1,981	81	1,975
Kazalinsk	1969-1996	127	188	1,981	37	1,974
Aral Sea (Aralsk)	1969-1996*	141	270	1,981	67	1,984

* Data for the years 1971, 1972, and 1974-1977 are not available. Source: Meteorological Stations , RK.

The mean annual air temperature varies from 14°C in the south (Shardara) to 9°C at Kazalinsk. The cold period starts in November and ends in late March, with the lowest temperature averaging -25.4°C in the north and -6.1°C in the south. The frost-free period varies from 170 to 190 days (end of April to beginning of November). The warmest month is July, the coldest month is December.

Table 4-2 Average Monthly Values of Climatic Parameters at Kazalinsk and Aralsk (1969-1996)

	KAZALINSK				ARALSK				
	Ambient Air Temp. (°C)	Precipitation (mm)	Average Wind Velocity (m/s)	Relative Air Humidity (%)	Ambient Air Temp. (°C)	Precipitation (mm)	Wind velocity (m/s) Average	Wind velocity (m/s) Max.	Rel. Air Humidity (%)
Jan.	-8.4	11.2	2.0	80.0	-13.0	11	4.8	20	82
Feb.	-9.5	6.6	2.7	76.0	-12.0	10	5.2	25	81
Mar.	-2.1	15.2	2.5	74.0	3.5	13	5.3	20	78
Apr.	11.3	17.1	2.5	53.0	9.1	14	5.3	26	55
May	19.0	9.8	2.1	46.0	17.9	12	5.0	25	45
Jun.	25.0	5.4	1.8	41.0	23.5	10	5.0	24	38
Jul.	27.9	4.7	1.4	42.0	26.3	10	4.9	20	36
Aug.	24.6	7.4	1.4	44.0	24.4	9	4.6	20	37
Sep.	17.2	5.9	1.5	49.0	17.3	6	4.4	20	48
Oct.	8.0	13.1	1.5	62.0	7.9	17	4.8	24	59
Nov.	0.3	15.4	1.8	77.0	-1.2	12	4.7	20	76
Dec.	-5.3	15.2	2.0	81.0	-8.5	13	4.7	20	83
Year	9.0	128.5	1.9	60.4	7.4	137	4.9	22	59

Source: Meteorological Station Aralsk and Kazalinsk, RK.

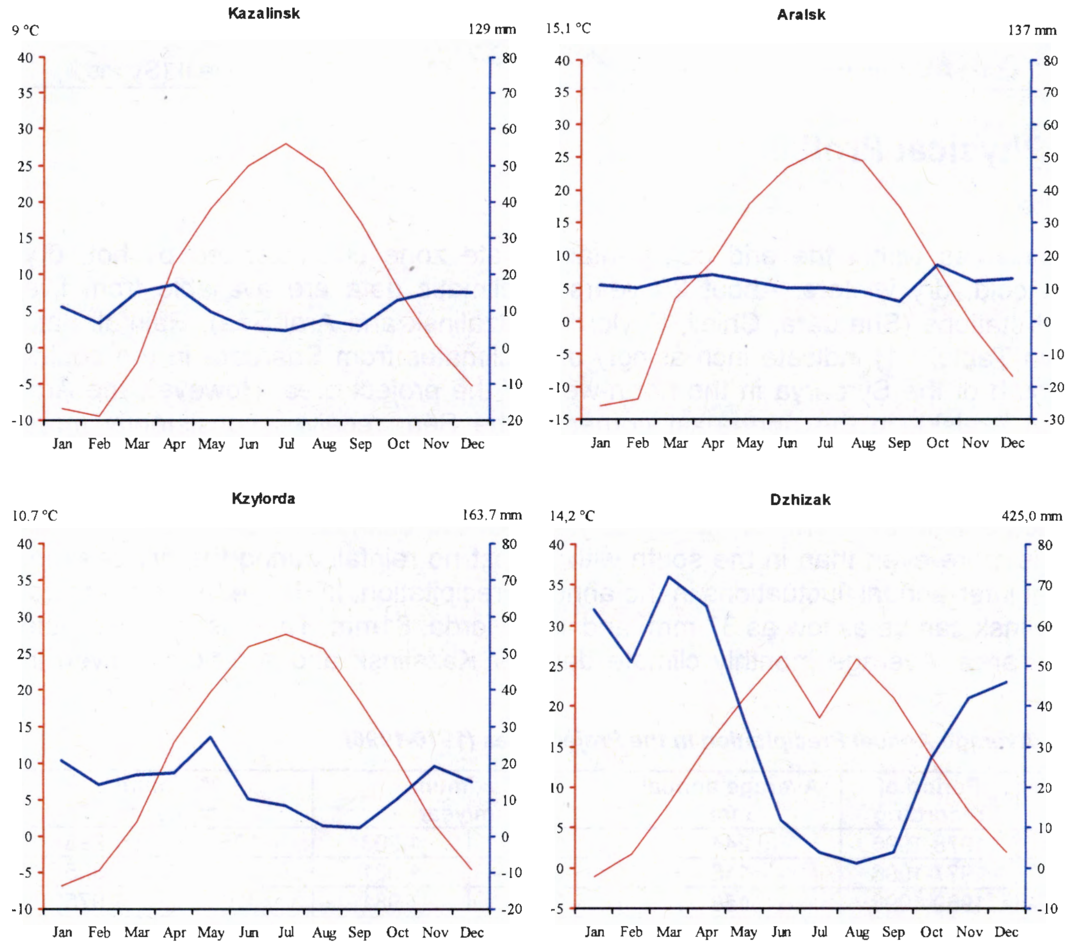


Fig. 4-2: ***Climate diagrams for the stations Kazalinsk, Aralsk(both based on Table 7), Kzylorda (1989-2003, source EDIKO project 2005) and Dzhizak (based on data from Uzhydromet, southeast of Shardara reservoir, in Uzbekistan)***

The relative humidity is about 60%. The potential annual evaporation ETpot varies between approx. 600 mm per year in the NAS area and 700 mm per year in the Shardara region. The reference evapotranspiration of a standard crop (i.e. 12 cm tall grass) is ET ref+ 1365 mm per year and ET ref+ 1441 mm per year respectively for the two regions (IWMI World Water & Climate Atlas). Water bodies are generally known to have an accumulated annual evaporation between 800 to 1100 mm. Within the project area the prevailing winds are from the north-east, north and north-west, with a velocity ranging from 1.4 to 2.7 m/s during the whole year. The number of sunshine hours ranges, on average, from 8.3-8.9 hours/day, while in summer it can reach 12.9-12.2 h/day, decreasing to 4.6-5.3 h/day during winter-time.

Specifics of the Aral Sea climate

The climatic conditions of the Aral Sea are defined by its inland location in the centre of the Eurasian continent. A determinant factor is the high solar radiation energy, which reaches a mean annual value of about 5,800 MJ/m². The mean annual rainfall at Aralsk is 137 mm/y, with a range of 110-150 mm/y; with highest recorded rainfall during spring and autumn. In July, the average air temperature over the Sea is 25-26°C, while in February it drops to -10°C to -13°C, with extreme temperatures reaching +44°C and -38°C recorded. The period with sub-zero temperatures lasts from 120 to 150 days a year. Air humidity ranges from 65-70%. The wind regime is mainly of an inland nature with predominant north-east direction. The average wind velocity is 5-6 m/s, with a maximum of 20-25 m/s.

Regional climate change

The Aral Sea creates a land-water interface, which is an important factor in regulating regional climatic conditions. It is assumed that the sea's influence upon the local climate extends up to a distance of 100-150 km from the sea. Understandably, the rapid reduction of the sea area and its water storage has led to a considerable decrease of its thermal storage, to changes in the thermal balance and in the precipitation and air humidity. As neither climate data nor new specific literature could be analyzed for this study the following facts are quoted from the EIA for SYNAS-I (ARCADIS, 2000).

The mean annual thermal storage of the Aral Sea has been decreased by 54%, as compared to the values estimated for the period before 1960. Especially the thermal storage in winter has greatly decreased (93%). Consequently, changes in heat and moisture exchange between the Sea and the atmosphere have affected the climate of the Aral Sea region. Notably, the difference between summer and winter temperatures has increased, and the mean annual relative air humidity declined by 10-15%. Also, the number of cloudy days and the frequency of strong winds have decreased. On average, annual rainfall has remained nearly the same, but over the last decade of the 20th century, the wettest month shifted from March to April, while the driest month shifted from September to July.

Dust storms with salt load are frequently menacing men and animals in the Aral Sea region, including the project area downstream from Kzylorda. Most of these storms originate on the exposed bottom of the Aral Sea. They carry particles of fine salt to distances of up to 400-500 km. Salt and dust transportation are one of the most serious negative consequences of the dramatic decline in Aral Sea surface elevation and size. These severe dust storms are considered one of the most serious health-threatening consequences of the drying up of the Aral Sea. However few proven evidence about the health impacts of the dust storms is available from scientific literature, at least for Karakalpakstan which is even more affected by the dust storms than the Kazakhstan part of the Aral Sea region (Große-Rüschkamp 2005). Since 1970, strong dust storms have been detected on satellite images from the Aral region. The increasing water surface area of the NAS and consequently the reduction of exposed dry seabed due to the construction of the Berg Strait Dike should have led to a significant reduction of dust storms originating from the dry bottom of the NAS. On the other hand it is possible that these positive effects are compensated by the increasing surface of exposed and highly erodible salt and silt substrates in the LAS. So far no monitoring data are available.

4.2.2 Geomorphology

The Syrdarya River Basin, between Shardara Reservoir and the NAS, slopes gently in a south-east - north-west direction (average gradient 0.1 m/km).

The major part of the project area is occupied by the floodplain of the Syrdarya River and the Aral Sea depression. The Syrdarya River in its Kazakhstan section is notable for its gentle inclination towards the Aral Sea, the average gradient is 0.1 m/km. Downstream of the Shardara reservoir, the river bank elevation is 236-239 m asl, and at its outlet in the NAS, a distance of 1,650 km, its elevation is 54 m asl. The river is a typical meandering lowland river and – due to natural processes and locally due to riverbed straightening - has often changed its course, leaving behind oxbow lakes and dry riverbed sections. The Syrdarya River within the South Kazakhstan oblast flows on the flat, plain territory. Between Shardara and Tyumen-Aryk railway stations, both river banks are barren. Here, the river cuts through quaternary deposits to a depth of 1-3 m. The riverbed width is 200-300 m with low terraces above the floodplain insignificantly sloped towards the river. The slopes of the territory towards the river stream are 15-20 cm per kilometer and towards the river itself – even less. The relief along the river banks is uniform, characterized by the absence of deep depressions. From Tyumen-Aryk to the river mouth in the Aral Sea, over long sections the river bed lies 1 m and more above the adjacent plains, which is the result of sedimentation. Thus, when the river overflows its banks, wide floodplain areas become inundated. The width of the floodplains in the central and lower reaches of the river varies from 5 -10 km; near the Delta, the plain widens up to 40 km.

During historic times the Syrdarya has changed significantly its river course, at one time also discharging its water along the present river course of the Zhanadarya into the Large Aral Sea. Satellite images reveal many variations of the river course, which has left many dry river terraces, and which at one time or another have left initially windswept dry salty plains which gradually have developed desert soils and vegetation. From the Syrdarya floodplain former river branches as the Torangylysay, Zhanadarya, Maylyozek, Kuandarya, and Karaozek lead into the Kyzylkum desert or the desert on the right bank and cut into plain areas. The old river branches are nowadays regulated and used as canals or collectors. The meandering lateral morphology, despite man made impoundment over significant lengths, and the nature-like geo-morphological dynamics make these waterways in some extent comparable to natural rivers.

The flow dynamics and sediment load of the Syrdarya River is heavily transformed by a number of dams, water diversion structures and the withdrawal of water for irrigation purposes. This affects the current morpho-dynamic processes of the river bed. However the geomorphologic structures are over large sections not directly modified and only at small river sections the riverbanks are artificially reinforced. The changes of the flow in quantity, timing and sediment load since the regulation in the 1960s have affected the geomorphology of the floodplain areas. The dynamics of the floodplain geomorphology in terms of erosion, sedimentation and development of new oxbow lakes and other structures came widely to a halt.

The geomorphologic processes in a river delta are generally characterized by sediment accumulation, seasonal flooding and the development of a net of river branches and islands. In the case of the Syrdarya River these typical delta structures are almost missing. Where the river enters the flat Delta, it meanders strongly into a widening floodplain with numerous lakes (Delta Lakes). In the Delta, a braided maze of old river channels, oxbows, lakes and depressions has developed. The river itself nowadays forms only one main branch which due to the dropping Aral Sea level has lowered its erosion basis and instead of accumulation is now characterized by backward erosion of the riverbed. Most of the lakes formed in natural depressions are now connected by canals and artificially supplied with water.

The depression of the Aral Sea is a drainless basin of 68,300 km². The relief of the Aral Sea shores shows considerable variation. The northern coast is basically high and steep, except for some small low places in the Saryshiganak, Butakov and Shevchenko Bays. At present, large areas of the shallow water gulfs of the NAS are dry. The Large and Small Barsuki Sands and Aral Karakums are adjacent to the NAS.

The western coast of the Aral Sea is high (up to190 m), being the steep edge of offshoots of the Ustyurt desert plateau. Near the western shore, the Sea is deepest, with slight unevenness. The (former) islands and peninsulas Barsakelmes, Vozrozhdeniya and Kokaral also have steep cliffs of some ten meters height. The eastern shores are gentle and sandy being in close proximity to the Kyzylkum Sands, and the former shoreline is in most areas only visible as a small terrace of one or few meters height. In the past, this low-lying but undulating coast had abounded with bays and sandy islands. At present, much of the foreshore has fallen dry due to declining sea levels, and the coastline has leveled off. The southern coast is low as it was formed by alluvial depositions from the Amu Darya River. This coast is unstable and some changes in the coastline have recently occurred.

The sea bed is subdivided into several depressions which in the course of the drying out of the sea led to the development of isolated lakes. In the NAS the raising of the sea level by the construction of the Berg Strait dike has avoided the division into four separate lakes. The geomorphology of the dry seabed is mostly determined by aeolian processes. These processes partly supported by specifically adapted sand fixating shrub vegetation form sand dune areas on the former seabed. The sand dunes are concentrated in the areas close to the former shore lines. The more central parts of the dry seabed are usually flat, but locally disrupted by small depressions and dunes.

Bordering formations of the project area include the south-western slopes of the Karatau Mountains. The foothills and piedmont plains of the Western Tienshan are gently sloping towards the Syrdarya floodplain. This region is the only place where the relief conditions allow for the construction of a reservoir from water management, economic and environmental points of view. Here the alluvial plain on the right bank of the river near the road bridge Arys – Shardara has been selected as most suitable potential construction site. The absolute elevations here vary within the range of 200-270 m. There is located a depression with gentle sloped edges, bordered from the south by the small plateau. The total area of this depression is about 400 km², the overall depth – up to 10 m, the mean depth – 6-7 m. The plain character of the surface in this area is disturbed by the depressions, gullies, hills. Besides, here the micro-relief is presented by small hillocks, closed micro-hollows and gullies. The relative difference in the heights of the micro-relief usually does not exceed one meter.

The Pre-Aral Karakum sands and the Malye Barsuki formations fringe the northern extent of the project area, while Kyzylkum and Zhuankum sands form the southern limit. The area is characterized by a flat relief and belongs to the vast Turanian Lowland.

4.2.3 Hydrology

River flow

The Syrdarya used to deliver formerly one third of the water inflow of the Aral Sea. The remaining inflow was discharged by the Amudarya which nowadays does not reach the Aral Sea with surface flow. The water resources of the Syrdarya catchment comprise some 376 km³. The main flow amount, constituting some 70%, is formed upstream of the Fergana valley. The right-bank tributaries (Ohangaron, Chirchik and Keles) upstream of the Shardara reservoir contribute some 23%, whereas the Arys River and the rivers originating from the Karatau mountains in Kazakhstan contribute the remaining 7%.

A critical characteristic of the Syrdarya River is its reduced flow capacity of its downstream sections in winter due to ice build-up in the natural river channel. This phenomenon also occurs in other river basins northern Kazakhstan and Russia, but in those northern basins the catchments are in generally also frozen during winter months, resulting in effectively zero winter runoff, which causes little problem in winter. However the situation is different for the Syrdarya, as its upper catchment is located in a more temperate climate, with a mean base flow (in winter) of approximately 500 m³/s, which increases (augmented by snow/glacier melt) to approximately 1500 m³/s in summer. In addition, winter flooding (from the upper more temperate catchment) also has occurred historically, that caused further large volumes of water to be discharged over an already frozen river, which in turn was forced out of the river channel into the flood plain, where the flood water would then freeze. It has also been known for further floods to occur during the same season, thus resulting in additional layers of ice to be built up and spread over a wide area.

Whereas up to 1961 the run-off of the Syrdarya has seen little change, after 1961 due to the construction of hydrological structures (construction of reservoirs and irrigation systems), the flow regime of the Syrdarya River has changed drastically. During the period 1961 - 1973, large irrigation schemes were constructed and the Shardara and Charvak reservoirs were built. The flood control policy was to limit downstream from Shardara releases to approximately 500 m³/s in winter and 1500 m³/s in summer. Any flood flows above that were discharged from the Shardara reservoir into the Arnasay depression. Since the construction of the Shardara reservoir the mean recorded discharge into the Arnasay depression has been in the order of 1.4 km³ per year, which represents a corresponding reduction of the net mean flow to the Aral Sea. During the period 1974 - 1991, the Toktugul reservoir was built which allowed the further expansion of irrigation by buffering of inter-annual flow fluctuations.

Till 1961, the annual inflow of Syrdarya water into the Aral Sea was some 4 to 5 km³, while during the period 1976-1990 it decreased to 0.85 km³. In the 1990s, a sequence of wet years coupled with the decrease in water consumption due to the crisis in the agricultural sector has given rise to large volumes of Syrdarya water reaching the delta. The actual average annual discharge from the Syrdarya River to the Aral Sea over the years 1991 - 2005 is about 5.6 km^3, varying between 3.56 and 8.4 km³. (Scott Wilson, Final Report 2007). In the frame of the project development of SYNAS-I the long-term average of the Syrdarya inflow into the Aral Sea was in the long term average 1.79 km³ (25 years). However the before mentioned measured data indicated that this estimate might be too conservative. The hydraulic modeling conducted under the present elaboration of SYNAS-II compared different scenarios based on naturalized flows of the years 1912-2005 and river abstraction records from 1976 – 2005. Scenario 1 considers the SYNAS-I up-rated river channel capacities, i.e. the present situation. In this scenario the total inflow into the Aral Sea would be 3.725 km³ per annum. Under Scenario 5 - SYNAS II (Mid-term report) uprated capacities with larger Koksaray the total annual inflow into the Aral Sea would be .4.185 km³. In this scenario the Aydar-Arnasay system would annually receive only 0.68 km³ an amount, even if the other desert spillages of 0.107 km³ would be reallocated, according to Uzgidromet by far insufficient for stabilizing the lake system. This shows the need for transboundary talks.

Table 4-3 ***Inflow into the Shardara Reservoir***

Operation mode	Period	Total annual inflow	November - March		April – October	
		Million m³	Million m³	%	Million m³	%
Irrigation	1969-1988	15,097	5,897	39	9,201	61
Mixed	1989-1991	15,033	7,580	50	7,453	50
Power generation	1992-1996	21,358	11,841	55	9,517	45
	1996-2003	18,380				

Source: CES/Sogreah/Kazgiprovodhoz, 1999, ARCADIS EUROCONSULT/AFC/MNT, 2005, Technical Note 11 (data 1996-2003)

Mainly as a result of construction of water regulatory works within Kzylorda Oblast the rivers' carrying capacity has decreased considerably.

Starting in 1992, the operation regime of the Toktugul reservoir changed from irrigation-oriented with summer releases into power-oriented with winter releases (see table 4-3). The main discharges under this condition are coinciding with the period when there is no demand for irrigation water. Additionally then the carrying capacity of the river is minimal due to ice. This was leading to emergency spillages from the Shardara reservoir (storage capacity limited to 4.2 km³) into the Arnasay depression. In wet years, the volume spilled in the Arnasay depression and finally lost to evaporation could amount to 7.5 km³ or more. The Government of Uzbekistan has requested GoK to halt releases into the depression.

The change of the flow regime from summer high water to winter high water is problematic both in terms of land-use and environment. The current situation causes shortages of irrigation water as well as insufficient flooding of tugai forests and lack of water supply of the Delta Lakes in spring and summer. On the other hand floods of tugai and inflow into the Delta Lakes during the winter are out of season and are thus of limited ecological value or have even negative impacts. For the long-term maintenance and regeneration of the floodplain vegetation, in particular of the critical tugai forests, the current extremely rare flooding during the late spring/ early summer is not sufficient.

Water consumption

The water management agencies record abstraction of water from the river for the following categories:

- irrigation abstractions (for arable lands)
- hayfield abstractions

- wetland and ecosystem abstractions
- fisheries abstractions
- industrial and communal abstractions

Up to 70% of available discharges below the Shardara reservoir have been used for irrigation. Table 4-4 shows the annual retrospective water balance of the project area and table 4-5 provides year-specific figures.

Table 4-4 Annual retrospective water balance of the project area

Probability of exceeding (%)	Average	Wet year 20%	Normal year 50%	Dry year 70%	Very dry year 90%
Inflow:					
Shardara inflow	14,486	18,800	12,750	10,900	8,800
Arys River	470	679	472	299	199
Return flow	756	847	763	746	671
Total	**15,712**	**20,326**	**13,985**	**11,945**	**9,670**
Consumption:					
Irrigation	6,365	6,876	6,493	6,139	5,506
Pastures	2,059	2,607	2,074	1,548	699
Delta	1,053	1,504	1,149	474	462
Fisheries	57	63	50	44	40
Industrial and Domestic	61	67	60	56	47
Inflow in NAS	1,785	2,700	675	368	0
Shardara losses	1,483	1,754	576	562	548
River losses	2,849	4,755	2,908	2,754	2,368
Total	**15,712**	**20,326**	**13,985**	**11,945**	**9,670**

Source: CES/Sogreah/Kazgiprovodhoz, 1999

Recent approximate river basin balances (ARCADIS EUROCONSULT/AFC/MNT, 2005, Technical Note 9) reveal the fact, that agriculture presently diverts on average only 37% (6 km^3) of the water resources discharged downstream from Shardara dam (16 km^3). Of the remaining only a small proportion (2 km^3) reaches the Northern Aral Sea, mainly in winter. Most losses can presently be attributed to the diversion of water from the main river stream for winter flood control purposes.

Table 4-5: Water flow and use data (ARCADIS EUROCONSULT/AFC/MNT, 2005, Technical Note 11)

	Average 1996-2003	2003 (wet year)
Inflow Shardara reservoir	18.38 km³	26.28 km³
Outflow Shardara reservoir	16.33 km³	20.49 km³
Losses reservoir and spillage to Arnasay	2.05 km³	5.79 km³
River flow hydro-post Kzylorda barrage	9.55 km³	12.38 km³
River flow hydro-post Kazalinsk		9.77 km³
River flow hydro-post Karateren (last post before Aral Sea)		9.18 km³
SYNAS-I calculation inflow Aral sea	1.79 km³ (long term average)	
SYNAS-I calculation need to cover evaporation loss in NAS	2.5 km³	
Irrigation use in South Kazakhstan oblast for 60 000 ha in 2003[2]		0.480 km³
Irrigation in Kzylorda Oblastv for 160 000 ha		3.27 km³
Water use for pastures and wetlands in Kzylorda oblast		1.08 km³

Thus at present in Kzylorda Oblast, water needs to be dumped during winter in quantities almost equaling yearly irrigation needs into the main irrigation canals and collectors in order to relieve downstream river sections. Apart from the strain put onto a deteriorated irrigation and drainage infrastructure, this water is led to drainage depressions and has created huge new wetlands and lakes of doubtful ecologic value, such as in the Telikol, in the Kuandarya, in the Aksay and the Zhanadarya systems, where water is irretrievably lost for irrigation purposes as well as for the Aral Sea. Thus, recent findings and modeling results reveal the curious fact that in this semi-desert climate of the Kazakh Syrdarya basin there presently not a water scarcity problem but a flood control problem.

Table 4-6: Bottlenecks on Syrdarya restricting through-flow, summer and winter (ARCADIS EUROCONSULT/AFC/MNT, 2005, Technical Note 11, adapted)

Maximum allowable flow	Summer flow	Winter flow	Remarks
	m³/s	m³/s	
Shardara outflow	1500	700	Determined by restrictions downstream
Kzylorda barrage	1200	600	
Aitek weir	700	450	
Karaozek old diversion	65	65	Until 2004
Karaozek new diversion	350	350	Operational since 2005
Railway bridge Karaozek			
Railway bridge Djusali			
Kazalinsk barrage	1000	450	
Aklak weir	515	400	New weir, operational since 2006

Irrigation infrastructure

The water management infrastructure for irrigation in Kzylorda Oblast consists of 19 principal canals branching off from Syrdarya with varying capacity, length and area connected. Some canals like Zhanadarya (also called Torangilsai) are old river courses, which have been converted to conveyors for irrigation water. In South Kazakhstan oblast the principal canals are the Kyzylkum canal, directly starting from the Shardara reservoir, the Arys canal and its extension, the Arys-Turkestan canal (supplied by the Arys river) and the Kirov and Southern Golodnostpeskiy canals, both diverted from the Syrdarya upstream from the Shardara reservoir. A number of smaller canals exist, feeding directly out of the river, but

[2] Water for irrigated area also obtained from other sources than the Syrdarya (tributaries - mountain rivers).

are not in regular use anymore. They are used to feed small lakes, pasture and haymaking. In addition the landscape is crisscrossed by remnants of large number of canals once used for former vegetable growing, temporary irrigation of reforestation schemes and windbreak plantings - most schemes resulting in failure.

Most canals are diverted directly from the Syrdarya, with a regulating structure, recessed further inland. The exceptions are the important Left Bank Main Canal (LMK) and Right Bank Main Canal (RMK), branching off directly from Kzylorda barrage and two corresponding canals branching off from the Kazalinsk barrage. Apart from the intake regulating structures, the big canals possess at regular intervals cross-regulators for providing high enough water level for the secondary or so called "inter-farm" canals. Canals at their end are transformed frequently without a special structure into collectors, which gather the drainage and un-controllable, not used irrigation water. Drainage waters from the irrigated farms are disposed off via the collectors and are led in most cases into distant drainage depressions, the most notable systems being the Telikol, the Zhanadarya, and the Kuandarya. In Kazalinsk the Aksay system also carries away drainage water from agricultural lands, although without a definite collector. Only in some special cases does drainage water flow back into the river. In effect, water from the Toguskenski area is drained by KP 17, in Chiili KP 18 and water from the Kzylorda RMK is discharged into the Karaosek branch (Koksu Collector, KP 24) of the Syrdarya.

Canals, collectors and structures have as a rule surpassed their service life and most are in the need of de-silting, weeding and structure rehabilitation if not complete reconstruction

Aral Sea

The Aral Sea is fed by two major river systems, the Amudarya (Oxus) River draining into the Sea at its southern limit, and the Syrdarya River entering the Sea from the north-east. Between 1911 and 1960, the mean water level of the Aral Sea was at 53 m asl and its surface extended over approximately 68,300 km², including 66,100 km² of water and 2,200 km² of land (islands). The water storage was 1,064 km³ and the average depth was 16.1 m, while the maximum depth reached 69 m. At that time, the NAS Sea covered approximately 6,000 km² and had a water volume of about 80 km³, which was 9.1% and 7.5% respectively of the total Aral Sea.

The very significant decline in river flow at its sea outlet since the 1960s as the result of large-scale diversions for irrigation development and retention of river water for hydro-power generation has led to a drastic decrease in sea water levels, and to a general increase in sea water salinity due to evaporation. By 1988, the Sea had reached the critical level of 40 m asl and the NAS became separated from the southern part, the LAS. With the lowering of the Sea, Kokaral Island, located between the northern and southern Seas became a peninsula and the NAS became disconnected when the narrow, shallow Berg Strait, west of Kokaral Island dried out. Only a small channel connected both Seas seasonally. Figure 4-2 shows the changes of the lake surface configuration over six decades.

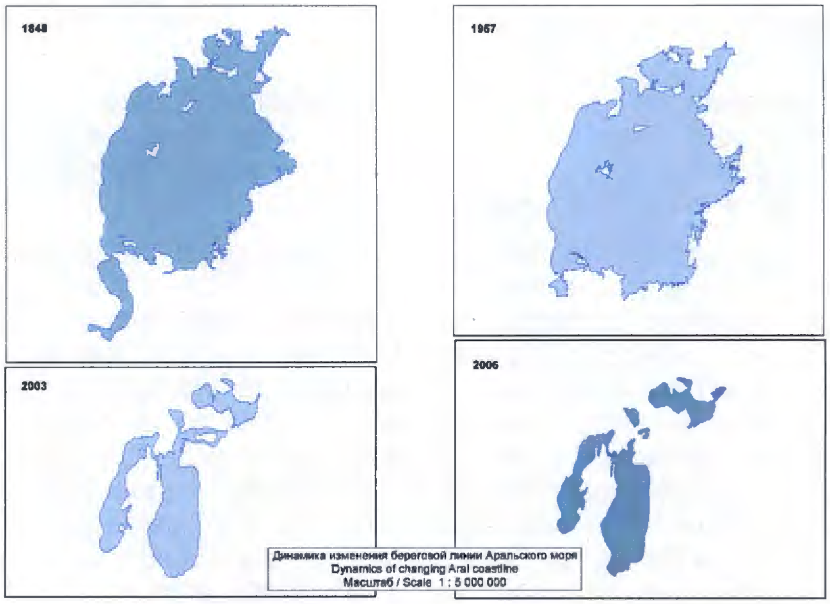


Fig. 4-3: ***Changing coast lines Areas of NAS and LAS (Source: Scott Wilson, Final Report 2007)***

From Table 4-7 it can be concluded that the Saryshiganak Bay is separated from the NAS at sea level below 40.5 m (this occurred in November 1997), while Butakov Gulf and Shevchenko Gulf will be isolated at 40.0 m and 38.0 m respectively. Thus, in order to keep the NAS as one contiguous water body, sea water levels should not drop below 41 m asl. This is currently achieved by the new Berg Strait dike which allows the maintenance of a water level of 42 m asl in the NAS. According to press statements this level has already been achieved, and has been confirmed by experts observation.

Table 4-7 ***Some Characteristics of the Sub-Water Bodies of the NAS (1998)***

Water areas	Depth (m asl)	Elevation of underwater thresholds (m asl)	Water surface at level of thresholds (km²)	Storage at threshold level (MCM)
1. Central part	24.5	Channel bottom to LAS 38.5	1,700	10,000
2. Shevchenko Gulf	26.5	38.0	812	6,740
3. Saryshiganak Bay	40.5	40.5	-	-
4. Butakov Gulf	37.5	40.0	89.6	130

Source: CES, Sogreah and Kaziprovodhoz, 1999

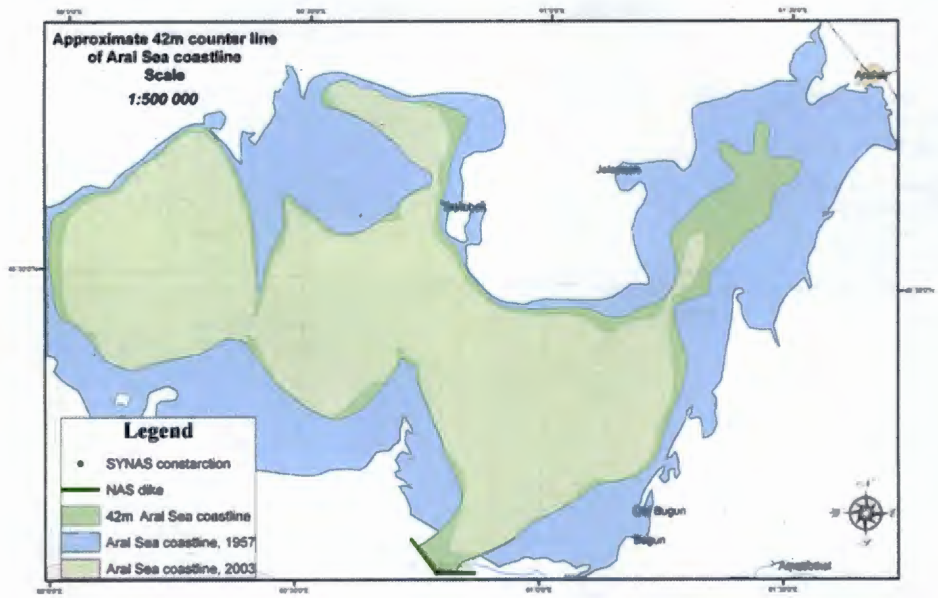


Fig. 4-4: North Aral Sea Comparative Coastline Changes (1957, 2003 and 42 m design level of NAS Dam) (Source: Scott Wilson, Final Report 2007)

Variation of Aral Sea surface area

Variations in sea water levels are typical for closed, "terminal" lakes such as the Aral Sea. Over the last few centuries, the Aral Sea level fluctuated considerably. During high water periods, sea water filled the Sarykamysh depression, which overflowed towards the Caspian Sea. Recent archaeological excavations showed that during the late middle age (13 century?) a city was located on the only recently again dried seabed, indicating a decades or even centuries long period of sea level below 45 m asl. Over the last 200 years (till 1960), sea levels fluctuated between 50.0 and 53.0 m asl. Since 1960, however, the Aral Sea level has dropped 15 m, i.e. an average rate of 45 cm/y over the period 1961-1997. See Figure 4-4.

Prior to 1960, seasonal sea water fluctuation was also limited to approximately 1 m. Since 1961, the difference between maximum and minimum levels during the year became less pronounced: 5-10 cm less difference; in some years, there was no difference. The time of maximum sea level shifted from July-August to April-May, and the period of the sea level rise shortened, while the period of receding sea levels became longer.

Variation of salinity in the Aral Sea

Until the split into the NAS and LAS the salinity level in both parts increased continuously from about 10-12 g/l TDS at the beginning of intensive irrigation schemes up to 32 g/l TDS at the time of splitting into the two separated parts. Since than, the salinity level in the LAS increased further (about 50 g/l TDS at the end of the last millennium). In the NAS the average salinity level dropped since the separation from the LAS due to an inflow of less saline river water exceeding the evaporation. NAS is now approaching historic average baseline of the Aral Sea prior to the 1960's pre-development mineralization of 10-12 g/l TDS. The most considerable reduction has naturally been achieved in the area between the Syrdarya River mouth and the spillways in the Berg Strait dike. Due to blending of the sea water and diffusion the salinity of the other parts is also dropping, significantly in the Central part, less noticeably in the more isolated bays with limited water exchange. So far no measurable impact is documented as result of the new Berg Strait dike and the raising of the water level. The relation of sea level and salinity is shown in figure 4-4. A map of salinity levels is provided in figure 4-5. (Both based on: Scott Wilson, Final Report 2007). The considerable difference between 2001 and 2002 might be caused by the contrast in precipitation. The year 2001 was a dry year, as it was 2000 as well. Consequently inflow of Syrdarya was lower (in total 3.56 km³) and salinity of the river water increased. The year 2002 was in contrast wet (6.14 km³ inflow) and river water was less mineralized.

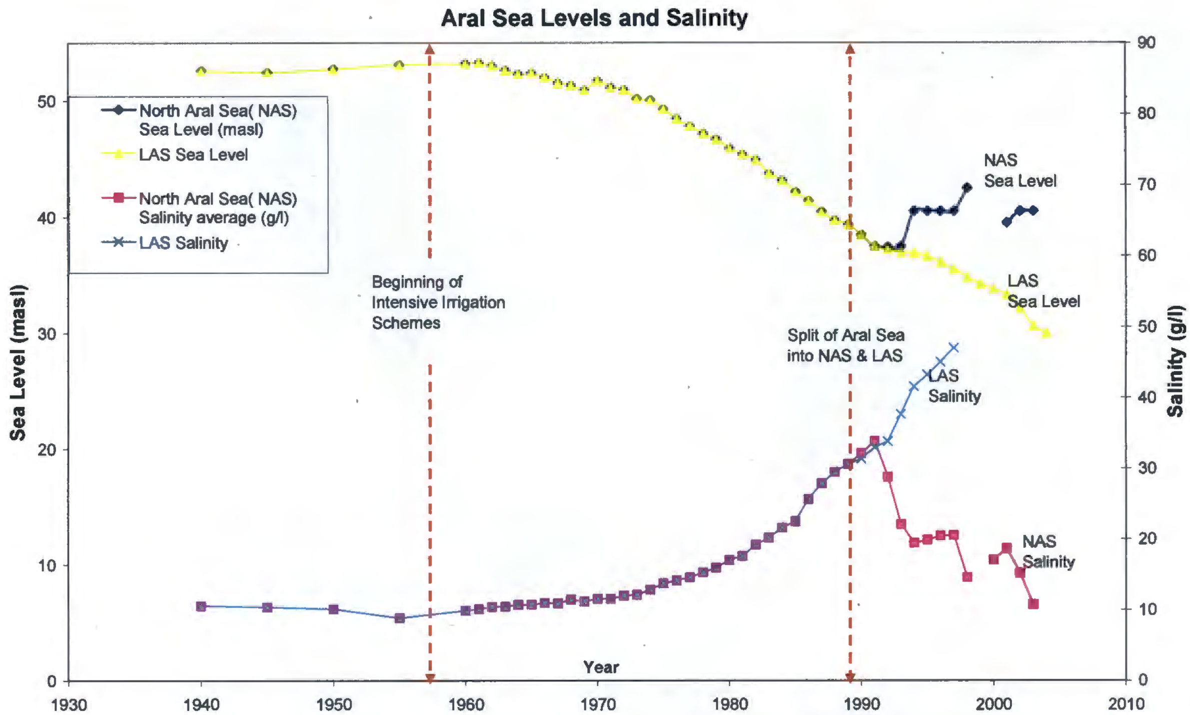


Fig. 4-5: Aral Sea Levels and Salinity Values (Source: Scott Wilson, Final Report 2007)

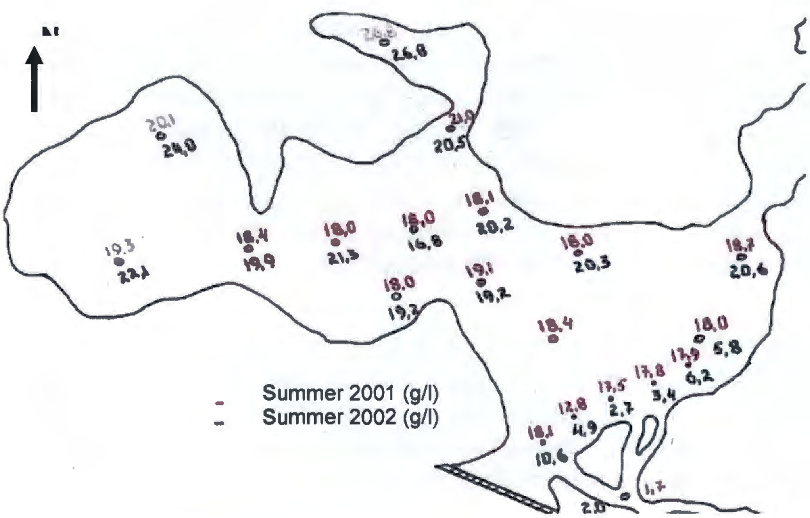


Fig. 4-6: NAS Mineralisation as TDS Values (g/l) (Source: Scott Wilson, Final Report 2007)

Syrdarya Delta lakes

The Delta lakes serve many functions: lake fisheries, livestock watering, hay and reed harvesting and wildlife habitat. In 1900, the total lake area was about 43,000 ha, grouped into four main clusters of lakes (see figure 4-6). However the comparison of satellite images taken in different seasons shows a high fluctuation of the lake surface areas from maximum to complete drying out (see also table 4-8). The lake surface area depends on the inflow from the Syrdarya River, the evaporation and the extent of flow back into the river during periods of low discharge. Under natural flow regime the discharge in the river was highest at the beginning of the dry season with maximum evaporation. Since the development of the large scale irrigation schemes these seasonal patterns changed dramatically making the water supply of the lakes without managed hydraulic structures insufficient.

- Kamyshlybash Lake System: on the right bank of the river, total area 22,700 ha, dominated by Lake Kamyshlybash (approx. 16,600 ha) and containing Laikol (2,000 ha), Kayazdy and Kuly (1,400 ha), Zhalanaskol (1,700 ha), and Raimkol (800 ha), as well as smaller ponds and wetlands. Surface elevation is about 56 m. It is supplied from the Syrdarya by two old canals, Sovetzharma (1920) and Taszharma (1940).

- Akshatau Lake System: on the river's left bank, total area 10,200 ha. Principal lakes are Akshatau (2,200 ha), Katankol (3,113 ha), Karakol (1,922 ha), Shomyshkol (642 ha) and Kolshikan (258 ha). Surface elevations are at 55-57 m. The system was fed by several canals from the old Amanotkel Weir.

- Aksay-Kuandarya System: on the left bank, south of Kazalinsk, once consisting of some 31,7150 ha of lakes and marshes, now reduced to about 4,500 ha with most of the open water now being of only seasonal character. The Aksay group of lakes consists of three subsystems: in the north, the Zhualy subsystem, now mainly consisting of grazing lands, is provided with water from the Kazalinsk Barrage via the Aksay Canal. It consists of the lakes Tamakol (565 ha), Utebas (938 ha), Zhuan-Sydyrbay (69,800 ha) and is drained by the Sagir Canal into the Lohaly subsystem (4.348 ha), the overflow of which passes directly into the Zhanay subsystem, consisting of Bolshoy (6,547 ha) and Malyy Zhanay (4,908 ha). At the request of the local government, the project is evaluating the establishment of three shallow fishing ponds – Lohaly, Bolshoy and Malyy Zhanay covering in total 20,000 ha of currently seasonally flooded hay making areas (limans). The Kuandarya group consists of the lakes Akkol (1,585 ha), Altynkol (1,927 ha), Karakol (543 ha) and Maryamkol (3,374 ha).

- Seaside Lakes System: the most downstream lakes on the right and left banks of the river. The largest and western-most lake was Karashalan, originally covering some 3,600 ha, but now reduced to about 525 ha. Tushibas Lake is now the largest (1,350 ha), but it has also been reduced in area. On the left bank is a cluster of smaller lakes that once totaled some 6,800 ha, now some 2,000 ha. It was fed by the Aklak structure.

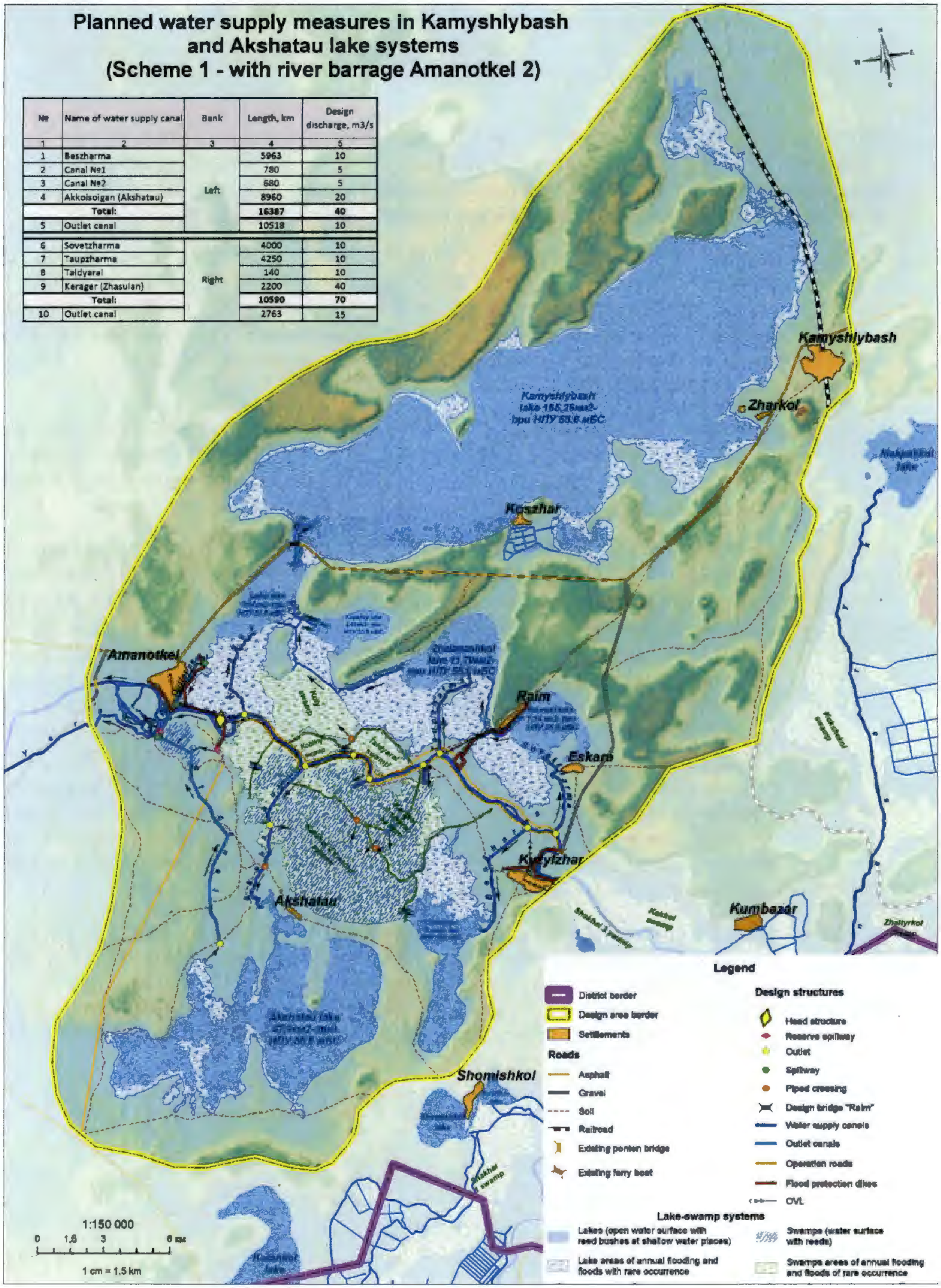
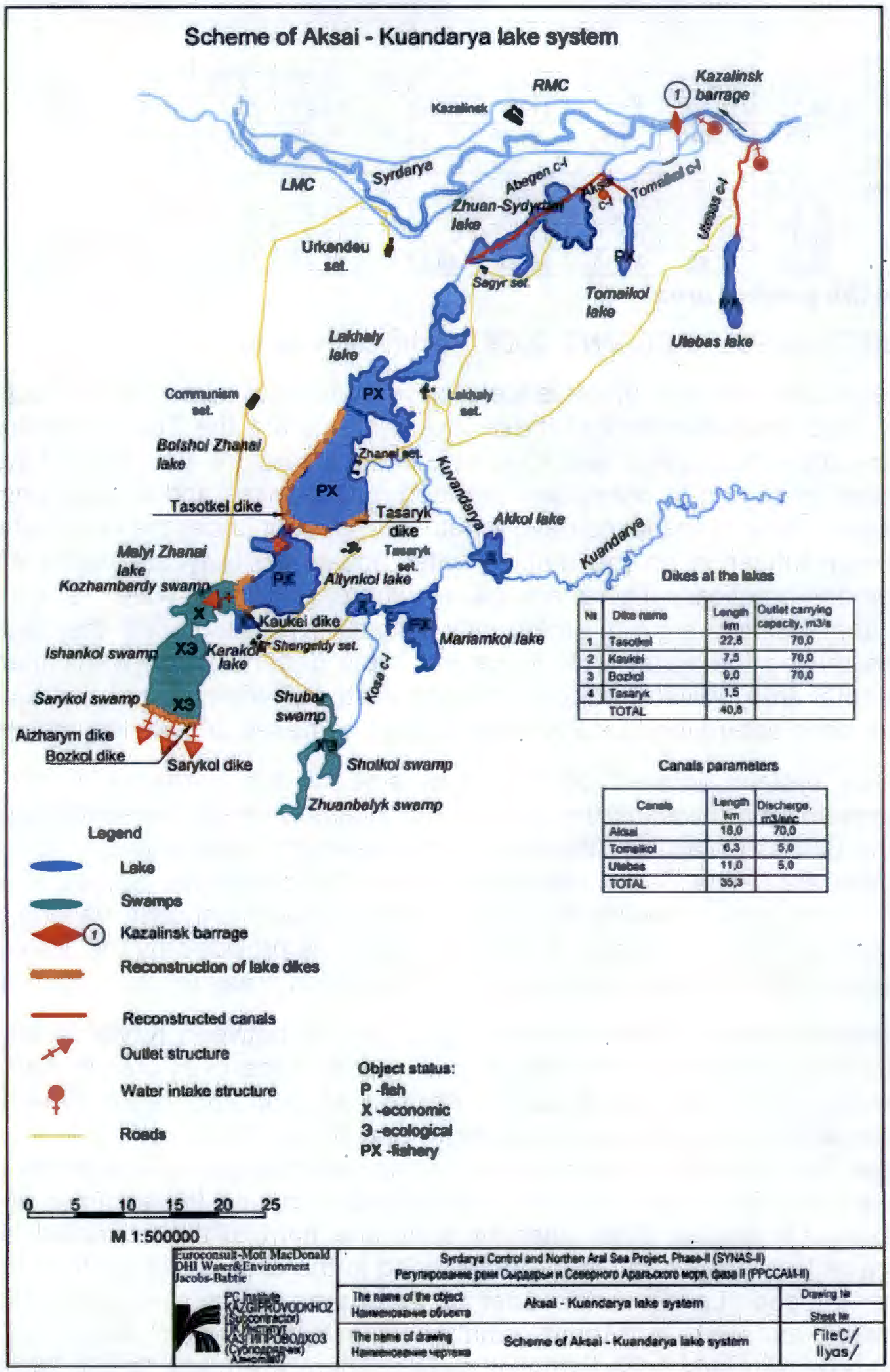


Fig. 4-7 Overview of the Delta Lake systems - Kamyshlybash and Akshatau lake systems, (Seaside and Aksay-Kuandarya lake systems not shown)



Dikes at the lakes

№	Dike name	Length km	Outlet carrying capacity, m3/s
1	Tasotkel	22,8	70,0
2	Kaukei	7,5	70,0
3	Bozkol	9,0	70,0
4	Tasaryk	1,5	
	TOTAL	40,8	

Canals parameters

Canals	Length km	Discharge, m3/sec
Aksai	18,0	70,0
Tomaikol	6,3	5,0
Utebas	11,0	5,0
TOTAL	35,3	

Fig. 4-8 Overview of the Delta Lake systems - Aksay-Kuandarya lake system

Table 4-8: ***Dynamics of wetland areas according to satellite images, areas in thousand ha (Source: Project INTAS Aral 2000, 2004)***

Year	1967	1981	1989	1997	Oct.99		Jul. 00		Mar. 03	
Name of the system	Lakes				other	lakes	other	lakes	other	lakes
Lower Delta right-side	14.71	6.12	1.4	7,1	9.4	5.56	5.73	3.53	6.58	2.74
Lower Delta left-side	9.61	4.67	0.55	4.43	14.23	8.37	2.14	0.77	4.62	1.26
Lower Delta total	**24.32**	**10.79**	**1.95**	**11.53**	**23.63**	**13.93**	**7.87**	**4.29**	**11.20**	**4.01**
Mid Delta Kamyshlybash	26.7	20.1	17.7	21.45	22.59	16.99	28.16	16.42	34.21	23.26
Mid Delta Akchatau	19.8	12.7	10.2	9.97	15.5	8.27	15.42	8.21	37.42	24.65
Mid Delta total	**46.5**	**32.8**	**27.9**	**31.42**	**38.09**	**25.26**	**43.58**	**24.64**	**71.63**	**47.91**
Aksay-Kuandarya	**37.3**	**29.4**	**8,7**	**12.7**	**27.35**	**12.22**	**21.28**	**9.13**	**64.49**	**43.87**
	99.12	**72.99**	**38.55**	**55.65**	**89.07**	**51.41**	**72.73**	**38.06**	**147.32**	**95.79**

Other lakes in the project area

(ARCADIS EUROCONSULT/AFC/MNT, 2005, Technical Note 3)

In the project area and the area of influence a large number of lakes can be found outside the floodplains. The most important of these lake systems are the Telikol, Karaozek (both right side), Zhandarya, Kuandarya and Aksay-Kuandarya systems (left side). To determine the origin of these lakes and to distinguish between natural lakes and artificial ones is often not easily possible. Many of the lakes have a natural origin but under the circumstances of a large scale human influence on the natural water household they are highly affected by water management practices. There are cases where additional water is supplied into naturally wet depressions, e.g. in emergency cases. In other cases the regulation of supplying rivers makes the water level in natural lakes dependent on water management decisions. The total area of water surface in these systems (without Kuandarya and Aksay Kuandarya) has been determined for 2004 with 22,551 ha based on satellite images.

- Telikol system: located on the right side of the Syrdarya in an enclosed depression, northwest of the Karatau mountains range at the south-western edge of the Betpak Dala. The lake system includes eight lakes between 40 and 130 ha surface area. The Telikol depression forms the end of the Sarysu River flowing from north and providing irregular, seasonally and annually varying flow. The major contribution of water to the lake system is provided by the Telikol canal, a collector (KP 23) draining water from the irrigation areas in Chiili rayon.
- Karaozek system: located on the right riverside between Kzylorda and Djusaly. Extended wetlands are spread on both sides of the river branch Karaozek and form such large lakes as Birkazan, Karaketken, and Zhamankol. The entire area is supplied by the Karaozek diverting a part of the Syrdarya flow in times of high water. This causes a seasonally changing water supply with a maximum during the winter months and only minimal discharge during the summer and autumn seasons. In August 2005 approximately one third of the observed lakes were more or less dried out. On the other hand in the area of Karaketken large areas were flooded. Lakes in the east of the Karaozek system (Lake Birkazan or Karakol as well as some smaller lakes) get water from the collector Baykadamskiy and linked smaller canals. There are plans to use large areas of the Karaozek as a water reservoir to buffer high waters in winter. Due to the undulating relief with poorly developed natural drainage and many small enclosed basins a high proportion of the water disposed to this area would be lost due to evaporation and infiltration.
- Zhanadarya system: located on the left bank of the Syrdarya and formed by an old river branch stretching from the Syrdarya near Tasboget into south western direction into the Kyzylkum desert. The upstream part is called Torangylysay. Along the river branch various lakes and wetlands are located. The Zhanadarya receives the main inflow from the Syrdarya, at the sluice Tasboget (Kyzylorda barrage). In 2003 the amount of 84.43 Mio m³ was diverted by the Zhanadarya for

"ecological use". Another part of the water is withdrawn from the Syrdarya east of Aydarli. The water delivered in 2003 amounted to 17.78 Mio m³ for "ecological use". Only a low amount of drainage water contributes to the water balance of the Zhandarya system. The Kzylorda oblast authorities consider the irreversible disposal of excess water into dry Inkardarya and the lower course of the Zhanadrya system a potential option for flood control in winter and alternative to the construction of the Koksaray reservoir. This would cause the waste of otherwise needed water resources and the flooding of desert ecosystems.

- Kuandarya system: an old river branch stretching from the Syrdarya through the Kyzylkum desert to the sand desert Zhuankum and swamps Bozkol in the southern part of the old delta of the Syrdarya (Aksay-Kuandarya system. The Kuandarya forms a riverbed meandering over hundreds of kilometers in the desert, partly filled with water, partly dry at the surface. The river branch is accompanied by a number of lakes and wetland areas, subject to seasonal and annual changes. The Kuandarya is supplied with water from the left side canal systems between Kyzylorda and Dzhalagash. The Kyzylorda Left Side canal provides 87.48 Mio m³ for "ecological use". Another 404.72 Mio m³ are considered as losses from this canal, a significant part discharged into the Kuandarya system. The origin of the water of Kuandarya in the irrigation areas suggests that a higher proportion of the water is drainage water, than in the Zhanadarya. Surplus water from irrigation is also contributing to the flow in the Kuandarya. During the last winters the Kuandarya system was also supplied with significant amounts of water prevent flooding.
- Aksay-Kuandarya System: see delta lake systems above!

The amount of water allocated for "ecological use" in Kzylorda oblast amounted in 2003 to 1.11 km³ or 16,847 m³ per ha. This is significantly more than according to the rayon data used for irrigation of pastures and hay meadows (in the average 10,520 m³). These numbers probably cover in significant proportion water loss from the principal canals and discharge to secondary wetlands, in particular to permanent and temporary lakes and reed areas.

Aydar-Arnasay lake system

The Aydar-Arnasay lake system (including Arnasay, Aydarkul and Tuzkan) in the north of the Nuratau Mountain range stretches about 180 km from east to the west and is one of the largest lakes in the Syrdarya Basin. The area today covered by the lake system has been a depression with salt swamps and small standing waters until 1968. At that time, the Tuzkan Lake was the largest one of the region. It was fed by the Kly River and it dried out every year. The water surface varied between 100 km² in spring and 40 km² in autumn. In the forties, salt was still won out of the dry lake basin. The soils of the then Aydar depression comprised Shory (salt content 3-8%) and Solonchaks (salt content 2 %).

The development of the present lake began with the development of irrigated agriculture in the Golodnaya Steppe when the area was used for disposal of drainage waters. From 1957 till 1968 the amount of drainage water spilled into the depression increased from 82 to 880 million m³ per year. In early spring 1969 heavy rainfall caused an emergency situation in the lower Syrdarya valley and a regulated overspill of 21.8 km³ from the newly constructed Shardara reservoir into the Arnasay depression, which initiated the creation of the Aydar-Arnasay lake system, with a level at 239.4 m asl and a surface area of 2300 km² at that time. Until the end of the seventies, the lake level dropped by 4 m. The salt content was approximately 8-10 g/l. In the eighties, the sea level was maintained at an artificial balance. A dam separated the Tuzkan Lake from the Aydarkul.

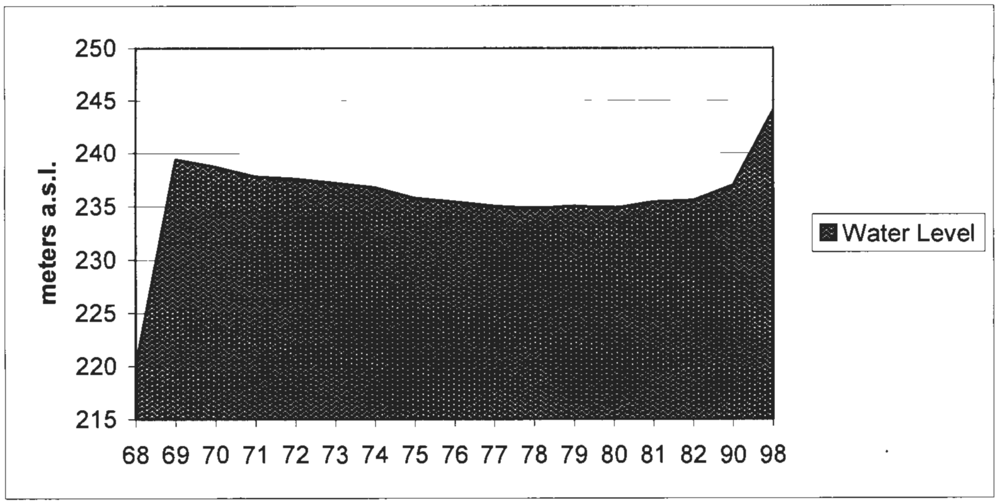


Fig. 4-9: ***Development of the water level of the Aydarkul.***

Since 1993 the water level was raised several times by excess water of the Shardara reservoir. From 1993 till 2003 more than 33.7 km³ have been disposed, the water level reached the gauge of 244 m asl and the surface area grew to 3106 km². An area some 1000 km² of land mainly used for pasture was lost. Furthermore, the increase of the lake causes problems with the release of drainage water, the destruction of dams, roads and of a railway line. As the result of freshwater inflow the salinity of the water was reduced and was in 2003 between 4.5 g/l in the southeastern part (Tuzkan), and 8.8-10.4 g/l in the western part.

Without artificial inflow, the long-term average of the water balance is negative. The sum of ground water inflow (0.04 km³ per year), precipitation (0.28 to 0.43 km³ per year) and inflow of collector water (between 1969 and 1982 1.72 km³ annually) exceeds the present evaporation. When stabilizing the lake system at the level of 2003 (244 km²) the annual evaporation losses of would be 3.41 km³ (calculated with 1100 mm* 3100 km²). According to information from Uzgidromet a regular inflow from Shardara of 1.5 to 2.0 km³ per year would allow the stabilization of the lake system at a level slightly below the maximum one. For an exact calculation of the water needs for stabilizing the lake system at the desired level in particular the amount of collector water spillage needs to be monitored.

4.2.4 Geology and soils

Syrdarya floodplain

Within the territory of Kazakhstan, the Syrdarya River has formed an alluvial plain with numerous oxbow lakes, ancient river beds, levees (mainly loams on top of sandy deposits) and basin-like depressions filled with silt or clay-like material.

Over the whole length of the river, from Shardara reservoir to the Aral Sea, the river bed is basically located in quaternary alluvial formations (except for some reaches), represented by sandy-loams of 3-5 m depth, underlain by fine-grained sands. The thickness of the sandy layer varies from 3-5 m to 120-200 m. The thickest sandy deposits can be found in the Arys-Turkestan depression (between Turkestan railway station and Kzylorda town). Near the towns of Leninsk and Kazalinsk, the quaternary deposits are only 3 to 10 m thick (occasionally 20 m), and underlain by clay-loams and gravel layers. The sandy layer is deposited over clay, which forms the water-confining stratum in the region.

In places along the right river bank 100 km downstream of the Shardara reservoir, from Tyuratam Station to Baikhozhi Station, and also near the original Aral Sea coastline, the river bed has cut into Neogene-Paleogene terraces consisting of clays, while between Leninsk and the Zhiirma natural boundary, it has cut into Turon Cretaceous deposits, represented by clay-like strata with sands and sandstone layers. The thickness of the Turon deposits varies from 60 to 120 m.

Five soil types dominating the Syrdarya basin are:

- well-drained alluvial soils (mainly Torrifluvents);
- moderately drained alluvial soils (mainly Fluvents and Inceptisols);
- sandy desert soils (Salorthids, Calciorthids and Psamments);
- poorly drained hydromorphic (Delta) soils (Hydraquepts);
- sandy soils of the (former) Aral Sea bottom (Psamments and Salorthids).

Alluvial soils are usually cultivated or used for pasture. Limiting factors for agriculture are insufficient rainfall and poor water-holding capacity. Hydromorphic soils and soils of the dry sea bottom are often subject to strong salinization. In the Delta, these hydromorphic soils are used for rice cultivation and grazing. Under present conditions, these soils in the Syrdarya lowlands lack natural drainage, are often waterlogged and are prone to salt accumulation and soil degradation.

Changes in soil formation processes and consequently in vegetation, such as a shift towards salt-tolerant plant species (halophytes), have negatively influenced the productivity of the soils. The annual biomass return into the soil has been reduced to a fraction of the previous quantities. Accumulation of salts into the top soils causes a widespread salinization of soils. This together with a lower rate of humus formation has caused a general physical-chemical degradation of soils, leading often to the formation of saline-alkaline soils in depressions. These soils are characterized by poor, compacted soil structure and high pH (> 8.5).

The reduction in river flow and the lowering of the river bed due to bed erosion is leading to drainage of seaside lakes, and natural wetlands. This in turn is causing an intensive drying of land and a lowering of the groundwater-tables. River water no longer reaches the seaside lakes and natural depressions, resulting in widespread desiccation and formation of saline ponds, which will eventually result in depressions covered with a salt crust. Boggy (peaty) soils have been subject to subsidence and mineralization. This process is affecting some 65% of the Delta. By 1978, there were hardly any non-saline soils left in the Delta, with the exception of some very sandy soils on higher elevated areas.

Aral Sea bottom

The development of soils on the dry Aral Sea bottom is, compared to other large dry salt lakes, a historically young process. The soil formation depends on the substrates on the sea ground, the salt content of the substrate during the drying out, the proximity of the ground water table and the time since the drying. From 1960 till 2004 more than 46,000 km² former sea surface became dry lands. The following basic substrate and soil types can be distinguished on the dry seabed (after Wucherer et al. 2004):

I) Sand desert soils – these can be plain and of different thickness or form dune areas (barkhan areas) with heights from up to 1 m or of 1-3 m height.

II) Salt desert soils – these can be distinguished in several sub-types:

- Coastal solonchaks with sand layer in the top soil
- Takyr like coastal solonchaks
- Crusty solonchaks with loamy-clayey substrates and sands only in deep horizons
    - sandy and loamy solonchaks have developed with groundwater-tables at 1-2m

- Sor soils in closed, poorly drained depressions (known as salinas) and consisting of a salt crust underlain by dark brown clay-like material with saline-alkaline characteristics.

III) Marshland solonchaks

IV) Meadow solonchaks

V) Alluvial soils

The area of sandy sediments on the dry seabed is about 20 % of the sea bottom. Sandy soils are typical for the areas at the former seashore, in particular at the eastern coast between the deltas of the Amudarya and Syrdarya Rivers, around the former islands Barsakelmes and Vozrozhdeniya and in the Saryshiganak Bay. They are developed on areas which have fallen dry first, mostly in the 1960s and 1970s, latest in the 1980s and are found at altitudes of 53 – 43 m asl (eastern coast), 53-48 m asl (northern coast) and 53 - 36 m asl (south-eastern coast). The sands have a grain size of 0.1-0.5 mm, in the delta areas larger. The sand is dominated by quartz materials; the proportion of mussel is 30-70%.

The dry seabed originating from the 1980s and later, and partly from the 1970s is characterized by salt desert soils. These soils cover about 80% of the sea bottom. The salt desert soils are diverse in terms of physical structure, mechanical content and salinity. While salt desert soils on the NAS bottom are now in a large extent covered by the water of the restored sea, the LAS is falling dry with an increasing speed. During the upcoming years the LAS area covered by salt desert will further increase and due to the growing concentration of soluble salts in the remaining water body the salinity of the soils will also increase.

Marshland solonchaks and meadow solonchaks are saline soils in areas influenced by the ground water table. They are locally found in areas close to the former deltas and along the coast line.

Project area outside the Syrdarya floodplain and Aral Sea bottom

The soil cover project area and the area of influence outside the Syrdarya delta is composed by the typical zonal desert and semi-desert soils mixed with automorphic and hydromorphic soils. The zonal soils consist of brown desert soils, characterized by the absence of a root mat and humus contents of some 1.5% and grey-brown desert soils. They occur on loamy substrates. Sand soils are typical for the Kyzylkum and Aral Karakum sand deserts and are characterized by minimum humus content and few silt and clay particles. Takyr soils are developed in depressions and are made up of the fractions clay and silt dominating. They are temporary covered by water from rainfall and after drying form a polygonally structured crust on the surface. The serozem soils are typical semi-desert soils at the foothills and plain piedmonts. Their humus content varies between 1 and 3.5% and a B-horizon with carbonate and sulfate accumulation is typical. Solonets soils have a high sodium content resulting in alkaline reaction and low physiological water availability. Solonchaks are soils with high salt content due to saline bedrock (automorphic types) or high level of saline ground water (hydromorphic types). Solonchaks have a content of 1-8 % of soluble salt in the upper horizon; on the surface salt can be even more concentrated.

In the area between Lake Tushibas and the Saryshiganak Bay, outside the former sea basin loamy and sandy substrates are found.

The area of the planned Koksaray Reservoir is foothill and piedmont area or pro-alluvial and alluvial plain. The zonal soil type is the grey serozem, developed on loess-like loam. It is mainly formed under the wormwood vegetation. In the lower part of the area grassland–serozem saline soils, solonets, solonchak and sands are developed. The meadow–serozems have low influence of ground water and the humus content varies between 1.5 and 2.5%. Solonets and solonchak are spread at small spots under halophytic vegetation. The latter are confined to the lowest and least drained sites in closed depressions. Plain fixed sands are found at small spots on the delta-alluvial plains.

Soil pollution and salinity

As a result of widespread discharge of industrial effluent in the Syrdarya River, polluted irrigation water led to soil pollution.

Table 4-9 Heavy Metal Contents in Soil Samples from the Syrdarya Delta

Element	Concentration (mg/kg)	Maximum allowable concentration (mg/kg)
Copper	12-18	36
Zinc	60-90	140
Molybdenum	0.89-2.4	10
Manganese	900-1250	
Cobalt	5-10	20
Boron	50-60	
Chromium	90-130	100
Nickel	25-35	35

Source: Institute of Pedology, Almaty (1984)

Other sources also refer to high concentrations of lead, and also of nitrates. Some seven years later, only a slight increase in some concentrations was reported (Kazgiprovodhoz Institute, 1991). Apparently, no residues of oil products were found and only low concentrations of pesticides (DDT, PCB) could be detected in some of the samples.

Information on soil salinity of agricultural lands (used for rice and alternative crops as wheat and alfalfa) in Kzylorda oblast is provided by the EDIKO report on irrigation and water management (ARCADIS EUROCONSULT/AFC/MNT, 2005, Technical Note 11). In Summary, the demonstration plots show the following picture:

- Mineralization: 0.344% minimum, 0.724% average, 1.010% maximum, after rice crop 0.522% average (i.e. below the overall average), after alternative crops 0.880% average.
- Salinity type: Na, Ca with Cl, SO_4 to equal parts. The salinity type is mainly of the chloride-sulfate type, out of 37 samples only 17 were dominated in the anionic complex by chloride. The average soils are moderately affected by salinity.

Table 4-10: Levels of salinity in relation to anion composition

Salt % in soil		Cl salt	SO4 salt
Not saline	up to	0.2	0.3
weakly saline	up to	0.3	0.6
middle saline	up to	0.5	1.0
strongly saline	up to	1.0	2.0
solonchak	greater	1.0	2.0

The salinity patterns and comparison with historical data (1985, 1988, 1994) show that rice in the crop rotation cycle supports trends to lower salinity. The analysis showed that abandoned lands develop quickly high salinity as the salt is no longer leached but remaining high ground water tables support capillary upstream of saline water. Thus, salinity is often not the cause but the effect of land abandonment. Salinization can be reversed by adequate leaching and drainage.

The soil fertility of the demonstration plots is satisfactory: nitrogen supply (total N) with an average of 0.121% is very high, phosphorus supply P_2O_5 of average 0.173% is considered low to medium and available K_2O with 0.044% is good. No restrictions of fertility due to lack of macro-elements have been found.

The South-Kazakhstan Hydrogeological-ameliorative Expedition (2005) carries out monitoring of salinity and drainage status of agricultural lands in cotton areas of South-Kazakhstan oblast, Maktaaral rayon. Figure 4-9 shows the trends in salinity over five years on lands with rehabilitated irrigation and drainage systems, but unused vertical drainage.

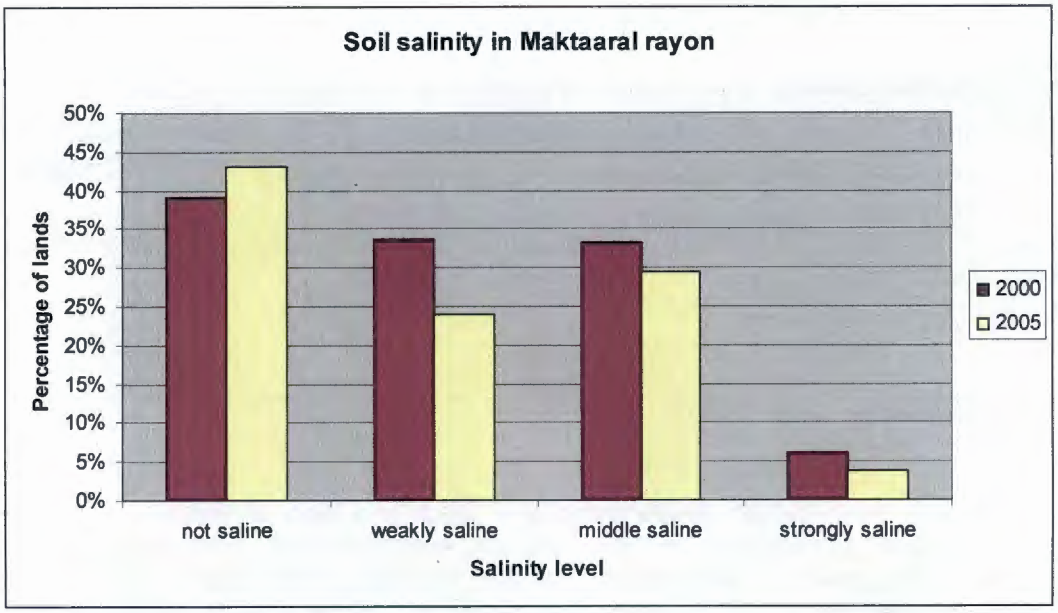


Fig. 4-10: Development of soil salinity by areas affected (Source: South-Kazakhstan Hydrogeological-ameliorative Expedition 2005)

All monitoring observations on pollutants (heavy metals, agrochemicals, herbicides, oil products) in Maktaaral rayon showed either there absence in the range of analytic sensitivity or presence in concentrations below the Maximum Allowable Concentrations. This means that the researched cotton areas at present do not show problems of soil pollution. This is likely related to the reduced application of pesticides and fertilizer during the last years plus the leaching which removes pollutants from the soils.

On the area of the planned Koksaray Reservoir the infiltration pond SHNOS is located. The pond is contaminated with various toxic hydro-carbonates. The Environmental Impact Assessment (Kazgiprovodkhoz, 1999) provides biological test of the toxicity of the sediment in the infiltration lakes. The results of the tests with biological indicators (Daphnia tests) show that in the dilution achieved in the case of flooding of the pond by the reservoir the concentration of hazardous substances would be much below toxic levels and maximum allowable concentrations.

4.3 Biological Profile

4.3.1 Vegetation

The vegetation of the project area and the areas of influence is highly diverse and relates to different but interrelated and locally overlapping vegetation zones. In its southern part (basically the South Kazakhstan oblast) the area belongs to the Mountain Middle Asia province and the sub-province of the piedmonts of West Tienshan and Pamiro-Alai. In the northern part it belongs to the North Turanian province and the sub-province West-North Turan (Rachkovskaya et al., 2003). Intrazonal vegetation includes the floodplain of the Syrdarya River and azonal vegetation of the dry seabed of the Aral Sea and of the lakes and wetlands – the main impact zones of the project.

A species list of vascular plants is provided in Annex A 2.

Vegetation of the Syrdarya floodplains

The vegetation of the Syrdarya floodplains has been studied by Dieterich et al. (2002). Figure 4-10 shows a transect through the three river terraces. As the river lost most of its dynamics, this pattern is now very stable and almost not changing over the years. The 2nd and 3rd terraces are usually carrying shrub formations. In areas where farmers keep these terraces free from woody plants, they are covered by grassland (quack grass Elytrygia repens is here dominant). On the riverbank only temporary free of water vegetation is composed of fast establishing ruderal plants, among them dominating Xanthium strumarium.

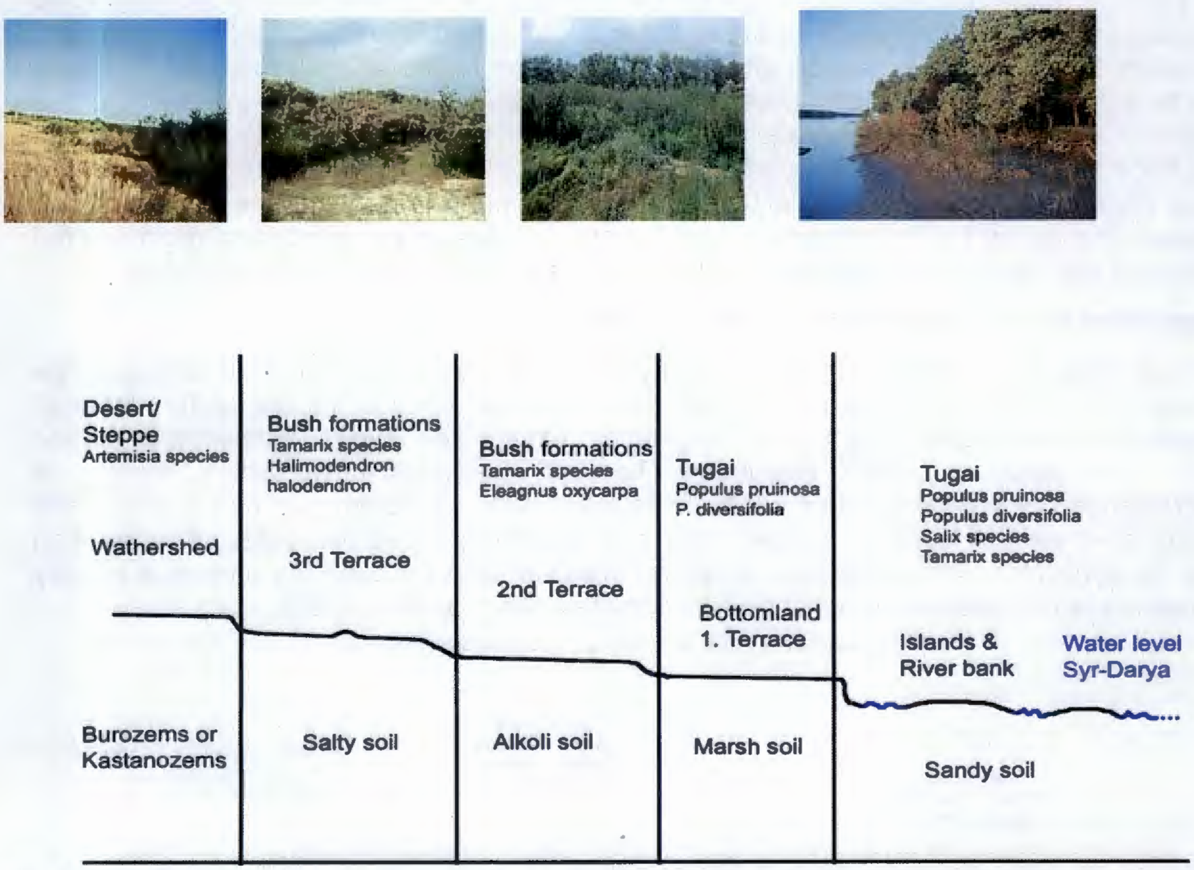


Fig. 4-11: A transect in the middle reaches shows the different terraces and typical plants growing on them. Due to the extensive water regulation by dams in the upper reaches of the river these terraces are relatively stable and not affected by the dynamic of the river any more. Dieterich et al. (2002)

Under tugai the woody vegetation on the alluvial soils of the floodplains is understood. The main species are poplars of the subgenus Turanga (Populus pruinosa and P. diversifolia), Eleagnus and Tamaricaceae species. The determining ecological factors for the tugai vegetation are regular floods during the vegetation season and high but varying groundwater tables. The soils are saline in various degrees, which allows the growth of halophytic plants, but under natural flood regime regular leaching limits the salinity level. The most turanga forests (poplars) are nowadays either clear cut or heavily degraded due to grazing and burning and replaced by Eleagnus-Tamarix shrub vegetation. Generative rejuvenation of turanga depends on flooding during the appropriate season (late spring/early summer) because the germination of the seeds requires very specific moisture conditions and the seeds are germinable only for a very short time.

The condition of floodplain vegetation is due to decreasing water availability worsens downwards the river. The most intact forest sections are found between Shardara and Kzylorda. Despite the existence of the Shardara reservoir, on the islands in the river and very low terraces still some level of riparian dynamics is effective. For instance due to the very heavy rainfalls during spring 2002, most lower parts (mainly 1st and 2nd terrace) have been under water.

In the lower reaches (northwest from Kzylorda) naturally vast reed beds have been predominant. Nowadays in many sections the river has eroded its bed very deep down and the groundwater table has dropped several meters in vast areas. Combined with the little water flow reaching this part of the river due to extensive irrigation in the upper reaches much of the reed and most tugai vegetation has vanished. Hardly one can imagine that in this region just 150 years ago numbers of tigers where roaming in the reed, hunting on wild boar and deer. Additionally to the reduced flood dynamics fire is the most important factor limiting the (re-)establishment of woody tugai vegetation. In wide areas only singular shrubs of Eleagnus and other species can be found due to regular burning of the reed areas.

The last patches of tugai forest deserve protection by the establishment of nature reserves, as planned in the national action plan for the Republic of Kazakhstan until the year 2030 (Baisakov et al., 1998). Floodplain areas still in some extent influenced by flood dynamics, including those under succession after abandonment of temporary cultivated lands should not be cut off from the river dynamics by erection of new embankments or increasing of the height of existing ones. A major requirement for any water management project impacting on the flood dynamics in the Syrdarya floodplains is the establishment and maintenance of a flood regime which by its seasonality, frequency and intensity supports the protection and natural development of the remaining tugai forests. An appropriate operational regime of the Shardara and the planned Koksaray reservoir will therefore be of outmost importance.

Vegetation of the Delta lakes and other wetland areas

Natural lakes and swamps in the Syrdarya floodplain are vegetated by typical varying series of wetland plant communities, for instance (from the water body to the dry land): submerse vegetation (Potamogeton spp.), shore vegetation (Phragmites, Typha, Schoenoplectus and other reed species), shrub vegetation (Tamarix, Eleagnus). The entire territory is characterized by a very diverse mosaic of site characteristics, determined by the micro- and meso-relief, varying levels of ground water and with them linked processes of salinization and desalinization. The vegetation characteristics are varying over the time due to very dynamic site conditions in terms of relief, substrate, salinity and hydrology.

Экологический ряд сообществ на озере Куандарьинской системы

water - reed – grass with cat-tail – karelinia (herbs) and camel thorn – shrubs and grasses on sand hills – camel thorn in depressions

Fig. 4-12: Ecological series of vegetation types of a lake in the Aksay-Kuandarya system (upper line soil surface, lower line ground water table) (Baybulov, 2005)

Under the arid conditions of the research area with about 100-150 mm average rainfall grasslands are developing under the influence of high ground water or temporary flooding combined with factors preventing the establishment of woody vegetation, such as grazing, hay cutting and fires. While in the floodplains the natural water conditions can be appropriate for the development of grasslands, in areas outside the immediate river valley those conditions are usually manmade. The so-called limans are ancient systems of irrigated meadows. They are comparable to the meadows on river floodplains created by cutting the shrub and tree vegetation but naturally flooded. Flat areas close to a river are in spring time flooded about 0.5 to 1 m, usually by damming the river or diverting water via canals. After one or two months the areas are dried up and can be used for hay making or grazing.

Swamp meadows are characterized by high wetness and the dominance of reed species. They are usually located in shallow and extended depressions. The most limans are dominated by reed Phragmites australis and Bolboschoenus maritimus and mixed with typical wetlands plants (Eleocharis argyrolepis, Eleocharis acicularis, Lythrum salicaria, Butomus umbellatus). This indicates a long time of flooding, higher ground water table (1-2 m during the dry season) and a less intensive use (rare cutting). The soils are typically humic and can be turf like.

Typical (mesophilous) meadows are developed at plain areas with ground water levels of 1.5-3 m and periodical short term flooding. The meadow soils are less humic than those of swamp meadows. The dominating plants are tall grasses as Elytrigia repens, Calamagrostis epigeios, C. pseudophragmites and Cynodon dactylon). At more saline soils associations of Puccinellia tenuissima are formed. Halophytic meadows are developed on solonchak soils with ground water close to the soil surface or by salinization of other meadow types. Usually they cover only small areas. The dominating plants are the grasses Aeluropus littoralis, Puccinellia tenuissima, P. dolicholepis, and P. diffusa. There are also found spare stands of reed (Phragmites australis var. acanthophylla) with participation of annual saltwort species (Salicornia europaea, Suaeda prostrata), Limonium otolepis, Bolboschoenus, Juncus, Xanthium and Crypsis.

Solonchaks are depressions in the desert which are under influence of at least temporary high ground water table. The soil is clayey and the capillary upstream of salty ground water due to the high evaporation leads to a high concentration of soluble salts in the upper soil. If the soil is dried up it gets a typical crusty or puffy structure. The solonchaks are covered by a spare vegetation of annual salt-tolerant herbs (Salicornia and Salsola spec.) and shrubs (Anabasis salsa, Halocnemum strobilaceum, Halostachys belangeriana). Black saxaul (Haloxylon aphyllum), tamarisk (Tamarix hispida and other spec.) and reed (Phragmites australis) can play a role in the vegetation where the salt content is moderate.

At the dry beds of former lakes stands of reed (Phragmites australis) are growing. While the areas are getting drier shrub vegetation (in particular Tamarix ramosissima Halimodendron halodendron) and different herbal species (Karelinia caspia, Limonium otolepis, Alhagi pseudoalhagi, Glycyrrhiza glabra) including annual saltworts (Atriplex tatarica, Climacoptera lanata, Petrosimonia oppositifolia, Suaeda acuminata) are spreading.

As result of the desertification in the delta and floodplain of the Syrdarya caused by the regulation of the runoff, reed swamps, small river branches, and oxbow lakes are drying out and the vegetation shifts towards a more xerophytic character. Partly reeds, swamp meadows, and woodlands are drying up. There can be observed on the one side the process of desertification of wetlands and meadows and on the other hand the formation of new meadow like vegetation at dried up lakes. At other sites new wetlands are formed by the disposal of excess water. These sites are within few seasons colonized by the typical cosmopolite wetlands plants.

Weedy herbs (Xanthium strumarium, Lepidium latifolium, Polygonum patulum) and annual saltworts (Salicornia europaea, Suaeda linifolia, S. prostrata), which were formerly found mainly on abandoned fields are now more widespread and are often replacing grass species (Calamagrostis epigeios, C.pseudophragmites, Elytrigia repens) in the meadows. Another succession process of the mesophilous vegetation in the Syrdarya valley is the progressing dispersal of shrubs (Halimodendron halodendron, Tamarix ramosissima, T. hispida).

The grazing lands in the Delta reportedly contained more than 300 fodder plants, 50 medicinal plant species, 20 species used for tannin extraction (basically zhuzgun species, Calligonum spec.), 5 etheric oil-producing plants (including Salicornia from drier lands), and 4 insecticide-producing species (including leaves of Anabasis). Bare licorice (Glycyrrhiza glabra), a valuable medicinal plant is now diminishing. In 1960-1961, some 15,000 ha of bare licorice herb could still be found on the Syrdarya and Amudarya floodplains, whereas in 1990, less than 500 ha of this herb remained.

Vegetation of the Dry Aral Seabed

The vegetation of the dry seabed reflects the mosaic of substrates and soil types as well as the time elapsed since the drying out of the respective sites.

The vegetation of the newly dried out land is still in a stage of succession towards a xerophytic (drought tolerant) and halophytic (salt tolerant) vegetation. These salt desert landscapes present a mosaic of bare saline substrates and ephemeral vegetation. Ephemerals (species, capable of completing their cycle from seed to seed in a very short period of time when conditions are favourable, e.g. after a good rain in an otherwise arid region) comprise mainly annual halophytes (Salicornia, Climacoptera, Suaeda physophora, S.microphila). At full development (40-50 cm height), these pioneering plants may cover 80-90% of the soil. This ephemeral vegetation is unstable and fluctuates in temporal and spatial patterns. A gradual replacement of annuals by perennials is noticeable, forming a low brush association. Wormwood associations (Artemisia) are developing on the slightly higher levees.

The areas earliest dried out are in large extent sand substrates with low salt content and good water holding capacity. On these sands elements of the vegetation of the Central Asian sand deserts are spreading from the adjacent deserts Kyzylkum, Priaral Karakum, Bolshie and Malye Barsuki. The vegetation succession is ongoing since 20-45 years. On the sand areas the vegetation spreads naturally well as these substrates provide comparably good conditions for plant growth. Characteristic species are shrubs as species of the genera Haloxylon, Salsola (Chenopodiaceae), Calligonum (Polygonaceae) and diverse Fabaceae species as well as some grasses (Poaceae). These species are eu- and meso-xerpophitic, psammophilous plants. The coverage can reach 20-60%.

In depressions near the seashore, extensive reed fields (Phragmitis) occur. These reed beds are usually seasonally flooded, often bordered by saline “grazing meadow” with Puccinella, Nitraria, Limonium, Aeluropus littoralis, Karelinia caspica and others and Tamarix vegetation that form the transition towards severely saline soils of takyr depressions that are barely covered with low halophytic vegetation. Tamarix shrublands are also developed along the former coast line and in dune areas which are close to the ground water table.

Annual plant species, which are typical for the areas fallen dry in recent years, include palatable ephemerals which are used for grazing where watering sites are not too far away. But yields vary greatly between dry and wet years. Woody plants as Haloxylon and Tamarix are widely used for fuel wood cutting, which locally leads to the destruction of the newly emerging woodlands.

Vegetation of the project area outside the Syrdarya floodplain, wetlands and Aral Sea bottom (Zonal vegetation)

Outside of the Syrdarya floodplain and the Aral Sea the natural vegetation is of zonal character. The dominating zonal vegetation types are composed of wormwood (Artemisia terra-albae, Artemisia diffusa), perennial saltworts (Anabasis salsa, Salsola arbusculiformis), sand-liking wormwood (Artemisia albicerata, A.songarica), sand-liking grasses (Agropyron fragile), sand-liking suffruticose plants (Krascheninnikovia ceratoides), sand-liking shrubs (Haloxylon persicum, Calligonum aphyllum, C.alatum, C.cristatum, C.leucocladum, Ammodendron conollyi), white saxaul (Haloxylon persicum), and black saxaul (Haloxylon aphyllum).

The desert-woody community is dominated by Black Saxaul (Haloxylon persicum), which occurs in lowland alluvial valleys. Saxaul is widely cut for fuelwood, and as a result this vegetation cover is mostly degraded, or, in some areas, has disappeared. The desert-bush vegetation community basically occurs in lower arid plains and is characterized by "zhuzgun" species (Calligonum spp.) and co-dominant psammophilous (sand liking)-bush. The suffruticose desert community is widespread, especially in low-lying plains with varying levels of salinity. Typical species include salt tolerant grasses and suffruticose plants characterized by wormwood (Artemisia spec.). Wormwood is widespread in sandy hills, often interspersed with quack grass (Elytrigia repens, Leymus multicaulis).

Over a large part of the project area, the vegetation has been degraded, mainly by intensive livestock grazing and human use. This has led to reduced biodiversity, invasion of noxious weeds and toxic plants, decrease of leafy perennial plants and decrease of the plant cover. Consequently, the plant biomass production and pasture quality has decreased. Further range degradation has occurred following soil salinization as a result of receding sea levels and declining river flow resulting from irrigation water diversion and water retention for hydro-power generation. But uncontrolled grazing and fuel wood cutting have also contributed to the degradation of the vegetation cover. Overgrazing near water-holes is noticeable, resulting in denudation and bush encroachment. Two plants are listed as endangered in the Red Data Book, the now rare Schrober's Nitraria (Nitraria schroberi), found on saline solonchak soils, and an aroche species (Atriplex barbarica ssp).

The pasture vegetation of the Koksaray reservoir project area, unlike the pastures in the other areas, has their own peculiarities. The natural – climatic conditions typical for this desert area allow using the pastures of this region almost the whole year.

The dominating type are wormwood (Artemisia) pastures on light loamy serozem soils (81.5% of the pasture area on the plain), which stretch as uniform massifs, sometimes – as spots among halophytic vegatation. Wormwood species (Artemisia diffusa and Artemisia santoninifolia) are dominating, a saltwort "keireuk" (Salsola orientalis) is observed as small spots among the wormwoods. On sites of high grazing pressure "ebelek" (Ceratocarpus arenarius) pastures are typical as a result of the wormwood depletion.

On the right bank of the Syrdarya River, on the alluvial plain, where the grassland–serozem saline loamy soils, desert solonets and solonchak are prevailing, saltwort (Salsola) grows: annual (88.9% of the area of all saltwort pastures) and succulent species (11.1%). Sarsazannik (Halocnemum strobilaceum) should be pointed out separately as the most typical component of the landscape formed in the solonchak depressions.

The sands occupying small areas near Syrdarya River are covered by ephemerals, camel thorn (Alhagi), and suffruticose wormwood (Artemisia diffusa) communities.

The diversity of the pastures in the floodplain part of the Koksaray project site is poor. Here the most spread are the camel thorn (Alhagi) pastures and bush – herbal pastures on the floodplain grassland soils. Camel thorn (Alhagi) is mowed off on some sites in the favourable years. There are no natural hayfields in the project area.

4.3.2 Fauna

Mammals: Aral Sea and surroundings

Drastic changes in the fauna spectrum of the Aral Sea have occurred since the 1960s. So far, very few species have permanently occupied the new, exposed lands. Some 30 mammals are recorded of which 13 species of rodents. Noteworthy mammals include:

- Hedgehog (Hemiechinus auritus): still numerous
- Saiga (Saiga tatarica tatarica): This until the 1990s numerous antelope is now close to extinction. The now almost extinct Betpakdala population formerly migrated almost to the region of Aralsk. The remnants of the Ustyurt population inhabit the western side of the Aral Sea. Formerly introduced on the island Barsakelmes, the animals originating from there are now in small groups observed on the eastern side of the Aral Sea.
- Persian or Goitered Gazelle (Gazella subgutturosa): This almost exterminated gazelle is only found on the eastern coast and dry seabed of the Aral Sea. It is included in the international and national Red books.
- Asiatic Wild Ass, Kulan (Equus hemionus kulan): Endangered species, included in the international and Kazakhstan Red books. The autochthonous wild asses of Kazakhstan are extinct since the 1930s. Specimen from Turkmenistan introduced in the 1950s on the island Barsakelmes. Now found in the areas close to the former eastern coast, about 150-200 specimen.
- Pallas cat (Felis chaus): Rare
- Wild boar (Sus scrofa): Rare species due to hunting pressure
- Wolf (Canis lupus): Status unknown
- Red fox (Vulpes vulpes): Common
- Corsac fox (Alopex corsac): Formerly common, but now diminishing, endangered
- Sand Cat (Felis margarita): Rare and on the Red List of Kazakhstan and endangered

Mammals: Delta and river floodplain

According to surveys carried out between 1977-1980 (Institute of Zoology, National Academy of Science), the fauna in this part of the project area comprises 67 mammals, including 6 species of insectivores, 10 bats, 33 rodents and hares, 13 carnivores, and 5 ungulates.

Of these, 16 species are listed in the Red Data Book (Bobrinsky Jerboa, Gray Putorak, Pale Pigmy Jerboa, Hepter's Pigmy Jerboa, Sand Cat, Pallas Cat, Marbled Polecat, Goitered Gazelle, Kyzylkum argali (extinct in Kazakhstan), and White-Bellied Long-Eared Bat, Wide-Eared Free-Tailed Bat). Besides, many animals are economically or commercially significant (muskrat, wild boar, many carnivores, Yellow Ground Squirrel). The area is at the edge of the winter home range of the Betpakdala population of the saiga antelope. This population has been numerous until the 1990s (up to 1 million specimens) and was of high economic importance. Nowadays the population is almost exterminated and few thousand animals are left.

The remaining species are in the majority those typical for desert environments, constituting a group of ecologically important species (rodents, insectivores, bats), whose collective biomass exceeds that of the other species in the arid ecosystem.

Birds

At the beginning of the 20th century, the bird fauna of the Kazakhstan part of the Aral Sea area recorded some 319 species, of which 173 breeding species. The Aral Sea's Delta lakes and shorelines provided breeding habitats for large numbers of water-fowl (ducks, geese) and other water-birds (pelicans, cormorants, herons, plovers, terns, gulls). Since the start of intensive cultivation of the region in the 1960s, and its subsequent impacts on the Delta and the Sea, the population sizes and species' variety reportedly declined (to 160 species of which 78 nesting in the area).

Some changes in the composition of bird communities of the area under consideration are already noted by observers (Gavrilov, 1999, quoted in Scott Wilson, 2005)): Thus, for example, over the last 10-20 years Squacco Heron (Ardeola ralloides) and Little Egret (Egretta garzetta), Glossy Ibis (Plegadis falcinellus), Pallas's Fish-eagle (Haliaeetus leucoryphus), Marbled Duck (Anas angustirostris), white-headed duck (Oxiura leucocephala) stopped nesting here. The population of Pygmy cormorant (Phalacrocorax pygmaeus) (it has started to restore recently), spoonbill (Platalea leucorodia), White stork (Ciconia ciconia), White-eyed Pochard (Aythya nyroca), Imperial eagle (Aquila heliaca), Spotted eagle (Aquila clanga), Saker falcon (Falco cherrug), MacQueen's (Houbara) Bustard (Chlamidotis macqueenii), Caspian plover (Charadrius asiaticus), Yellow-eyed (Eversmann's) pigeon (Columbia eversmanni), Pander's Ground Jay (Podoces panderi), Asian short-toed lark (Calandrella (cheleensis) leucophaea) has been sharply reduced.

The area is of high importance as resting site for migratory birds. Wetlands of high dynamics of water level as the delta lakes, e.g. Shmyshkol and Raim, but as well temporary sites as flooded fields are used by various limicoline birds for resting.

The Final report on ornithological monitoring (Scott Wilson, 2007) provides detailed information on a number of monitoring sites located in the project area, mainly in the lower reaches of the Syrdarya floodplain, the delta lakes and the mouth of the river in the NAS. The final report is based on the same data as the 2^{nd} Interim report (2005) used for the preparation of the pre-feasibility study.

The project area and the areas of influence include several sites which are either already identified as Important Bird Areas according to the criteria of BirdLife International or are still considered as potential sites deserving more investigation. These sites are (in upstream-downstream order):

- Shardara reservoir: The IBA includes the entire reservoir area. It is in particular of importance as a resting site for water related birds. The IBA is influenced by the operation regime of the Shardara reservoir. If SYNAS-II will lead to changes the requirements for protection of the site are to be considered.
- Aydar-Arnasay lake system: Two areas have been preliminary recognized as IBA, the Arnasay reservoir and the Tuzkan Lake. Important birds include the Dalmatian pelican, ferruginous duck. It is an important resting site for many water related birds. The entire site was heavily affected by the historic and recent spillage of water from the Shardara reservoir. Abrupt raises of the water level destroyed important nesting sites and changed the conditions for resting birds. The realization of SYNAS-II will reduce the spillage to the area. This can lead to a shrinking of the lake surface and to increasing salinity level.

Fig. 4-13: IBAs located in the Aydar-Arnasay lake system

- Arys-Karaktau zapovednaya zona: The IBA is determined by the occurrence of endangered steppe birds, notably the McQueen's bustard (Chlamydotis macqueenii) which is breeding in the area in several hundred individuals and resting their in up to 3000 specimens. There are inhabits further the typical birds of the semi-desert and desert zone. Of further importance are comparably well preserved tugai forests with its typical bird fauna. The right bank part of the site would be at about 50% flooded by the planned Koksaray reservoir. Detailed investigations however show that the majority of breeding sites of the MacQueen's bustard is located outside the proposed construction area, in particular on the left site.

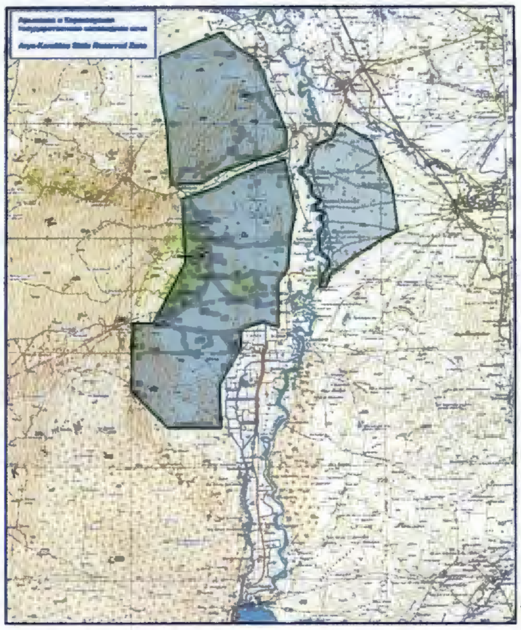


Fig. 4-14: ***IBA Arys-Karaktau***

- Shoshkakol lake system (likely not influenced by the project): The lakes are qualified as IBA due to the nesting of the endangered Dalmation pelican and ferruginous duck, the concentration of nesting and resting water related birds and the occurrence of several species restricted to the biom of the Central Asian deserts.

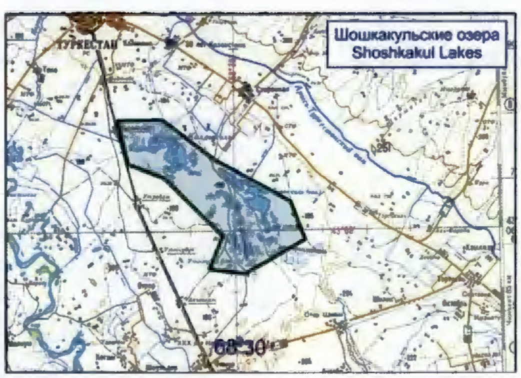


Fig. 4-15: ***IBA Shoshkakol***

- Telikol lake system: Potential IBA. Potential breeding site of Dalmatian pelican and other endangered species.

- Delta lakes: The lake system has been identified as IBA because of the occurrence of endangered Dalmatian pelican and ferruginous duck, importance of some lakes for reproduction of water birds and most important their significance as resting sites during migration. The construction of the Aklak weir was intended to improve the water supply and consequently the habitat quality of the lakes. Recent monitoring data are not yet available.

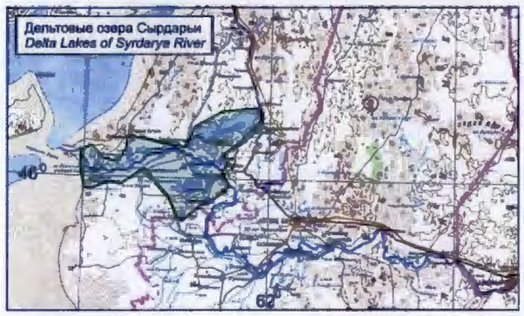


Fig. 4-16: IBA Delta Lakes of Syrdarya River

- Northern Aral Sea: Despite the environmental problems related to the shrinking of the Aral Sea the area maintained importance for the bird fauna. The globally endangered steppe pratincole (Glareola nordmanni) can be found on the dry seabed. Of most habitat value for breeding and resting water birds is the region of the mouth of the Syrdarya River. The raising of the sea level by 3 – 4 m caused by the construction of the Berg Strait dike may have affected the bird habitats. Recent monitoring data are not yet available.

Fig. 4-17: IBA Northern Aral Sea

The data sheets for the already determined IBAs are provided in Annex A 3 Ornithologist Report of this document.

Starting from the late 1990 the ornithological situation around the NAS and in the delta appears to have stabilized, as habitats have stabilized around the Aral Sea and Syrdarya delta. This has resulted in some elements of the historic bird community that were lost in the 1970s and 1980s, gradually returning to breed in this area. These include grebes, possibly pelicans, cormorants, herons, gulls, terns and some other bird species.

However, bird fauna in and around the Aral Sea and in the Delta is still spectacular. In particular, some Delta lakes still play an important role as foraging/staging areas for migratory bird species. The Aral Sea lies within one of the most important North-South flyways of Palaearctic migrants. Thirty bird species are listed to the Red Data Book of Kazakhstan, 13 species are globally endangered.

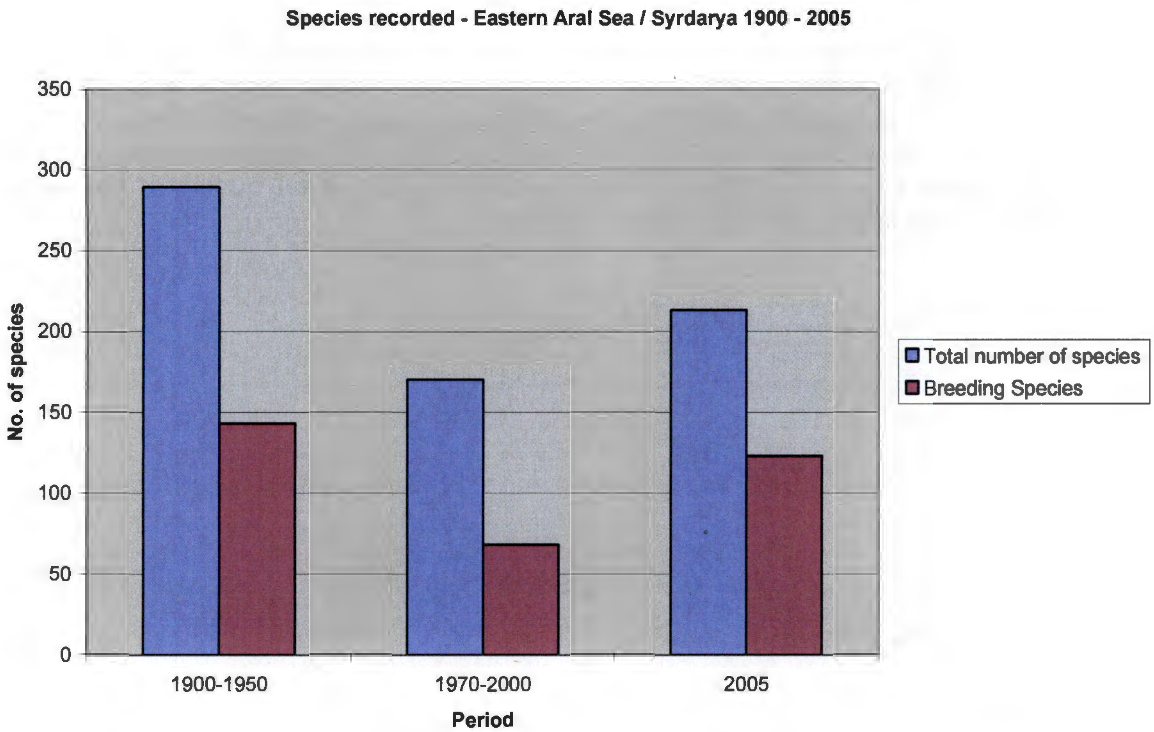


Fig. 4-18: ***Bird species recorded – Eastern Aral Sea / Syrdarya 1990 – 2005 (Scott Wilson, 2005)***

At the same time the situation south of the NAS continues deteriorating, and now that the Kokaral canal is closed by the NAS Dam, the process will accelerate. The diversion of water from the Syrdarya delta to the Saryshiganak bay will contribute to this process. Therefore with the growing unsuitability of the Southern or Large Aral Sea to support birds, the NAS and Syrdarya delta will become increasingly important in the region.

Amphibians

There are three species of amphibians, the green toad (the diploid Bufo variabilis in the north and the tetraploid Bufo pewzowi in the south, both belonging to the Bufo viridis subgroup, Stoeck et al. 2005) and the sea frog (Rana ridibunda) in the project area. Both Bufo variabilis and sea frog can still be found on the Aral Sea islands. Their present status is unknown but their tolerance to moderate salinity makes them comparably less prone to environmental degradation.

Reptiles

39 reptiles, (2 tortoise species, 23 lizards and 14 snakes) are known from the project area. Among these, two lizard species (Grey Monitor Lizard and Yellow-Bellied Lizard) and two snake species (Red Wood Snake and Black-Striped Wood Snake) are listed in the Red Data Book. Smaller reptiles (lizards, a few snake species) are still common in most of the area. Annex A4 lists the amphibians and reptiles recorded in and near the project area.

The planned construction site of the Koksaray reservoir is known for a high population density of Central Asian tortoises (Testudo horsfieldi), an endangered species, listed as vulnerable in the International Red Book ((VU A2d).

Ichthyofauna

The ichthyofauna of the project area has been severely affected by anthropogenic impacts. The key factors have been:

- Construction of barriers blocking the migration ways in the river (dams, diversion structures), leading to fragmentation of populations and for some species to the inability of reaching spawning grounds. The first fish-ladder is now installed in the new Aklak weir. Monitoring information on its functioning and impact is still awaited.
- Changes of the river runoff dynamics, especially changes of the seasonality of floods and reduction of their frequency and intensity. This affects especially the reproduction as some species use flooded areas in the floodplains for spawning.
- Reduction of water flow in the Syrdarya River and water pollution, mainly from agriculture. This is related to the reduction of fish habitat in the river itself, increased concentration of soluble salts and pollutants, changes in the water supply of the Delta Lakes and the drying out of the Aral Sea with the consequence of its almost complete loss as fish habitat.
- Introduction of allochthonous fish species. In the Syrdarya River the relation of autochthonous and allochthonous species is 33:16. The relics of the Turkestan faunistic complex have been most affected by competition and direct predation by introduced species. In the most lakes and rivers the representatives of the autochthonous ichthyofauna became very rare. As a result of different efforts at various times the following introduced species became acclimatized species in Syrdarya downstream lakes:
    - of the Cyprinidae family: grass carp (Ctenopharyngodon idella), silver carp (Hypophthalmichthys molitrix), and spotted silver carp (Aristichthys nobilis);
    - of the Channidae family: snakehead (Channa argus warpachowskii);
    - of the Atherinidae family: Caspian sand-smelt (Atherina boueri caspia);
    - of the Gobiidae family: bald goby (Pomatoschistus caucarcus Kawrajsky);
    - the bald goby and Caspian sand-smelt are unplanned settlers that accidentally got into the Aral Sea during delivery of grey mullets from the Caspian Sea.

  This had implications for the entire ecosystems and food chains. Kazakhstan ichthyologists (Mitrofanov, 2004) recommend the avoidance of the establishment and maintenance of reproductive populations of introduced species. Instead of this the protection and reconstruction of autochthonous fish populations should have priority. No new allochthonous species should be introduced. Approved economically important exotic species should be regularly released for only temporary growing, but no reproduction in natural water bodies should be supported.

The separate influence of each of these factors would result in the reduction of numbers of some species or forms of fishes, but would likely not result in the disappearance of species. However, the cumulative effect of these factors has caused the full extinction of some species in the region.

<u>Rare and endangered fish species in the project area (Under utilization of Mitrovanov, 2004 and Kovshar, 2004)</u>

The Syrdarya shovelnose (Pseudoscaphirhynchos fedtschenkoi), Red Book RK category 1, is probably already extinct. The species has not been registered in Kazakhstan since almost 30 years. If there is any chance for rehabilitation of population remnants or reintroduction needs to be evaluated. The project should avoid additional adverse impacts on this species. (Reasons for decrease, limiting factors, requirements for rehabilitation should be checked)

The Aral Sea sturgeon (Acipenser nudiventris), Red Book RK category 1, a sturgeon species, is critically endangered and in the International Red Book the autochthonous Aral Sea population is considered extinct. Acclimatized populations in other areas (e.g. Ili-Balkhash system) are in comparable less critical condition and play some commercial role. The protection and rehabilitation of the species in the Syrdarya and Aral Sea would require the establishment of a more natural hydrological regime, removal of barriers hindering migration and the improvement of the water quality. The SYNAS-II should contribute to the first two requirements. However, as the spawning of the species is bound to the upper reaches of the rivers a full rehabilitation of the natural reproduction cycle is hardly possible. Artificial reproduction would thus necessary for rehabilitation of a population in the NAS and Syrdarya River.

The Aral salmon (Salmo trutta aralensis), Red Book RK category 1, is likely already extinct. The subspecies occurred in the Aral Sea and the Amudarya and has not been found in the Syrdarya. The main limiting factors have been the reduction of waterflow in the Amudarya and the decrease of water level and increase of salinity in the Aral Sea. If the subspecies is still existent in the northern Aral Sea the SYNAS-II project should support the improvement of its habitat.

The Щуковдный жерех (лысач) (Aspiolucius esocinus), Red Book RK category 1, is possibly already extinct in Kazakhstan. The last time it was registered in 1953. The species occurred in the Syrdarya and its tributaries. The main reasons for extinction are the construction of hydro-technical structures, the withdrawal of irrigation water and water pollution. Rehabilitation or reintroduction requires fish-protecting structures at hydro-technical structures. Artificial reproduction is proposed by scientists.

The Aral barbel (Barbus brachycephalus brachycephalus), Red Book RK category 2, was considered possibly already extinct in the Syrdarya and its tributaries. It has not been met there since several years. But recently it was discovered that it comes to spawn in the Syrdarya River downstream of the Kzylorda water facilities. Research of KazNIIRH conducted in rice fields and irrigation canals of Karmakshinsky raion (Kyzylorda oblast) reported in the falls of 2002 and 2003 great numbers of Aral barbel fries. The, until recently considered, reintroduction of the species by using individuals from the other (introduced) population found in the Ili-Balkhash basin is thus not necessary. The basic requirement for the species is the existence of sufficiently long river sections without barriers preventing migration. Before the regulation of the Syrdarya the species migrated up to the lower sections of the Naryn River.

Fig. 4-19: Aral Barbel caught by fisherman in Syrdarya near river's mouth, 2005 (Source: Scott Wilson, 2007)

The Turkestan barbel (Barbus capito conocephalus), Red Book RK category 2, is a subspecies limited to the Aral Sea basin, including the Syrdarya and its tributaries, and the Chu River. During the 90s the subspecies has already not been registered. The reason is probably the changed hydrological situation (water flow dynamics, barriers to migration). The rehabilitation of the population would require the establishment of fish-protecting structures at hydro-technical structures.

Aral Sea fish (under utilization of information in Scott Wilson, 2007)

The Aral Sea was once populated by about 20 fish species, including 15 of industrial significance (bream, wild carp, Caspian roach, pike perch, barbel, pickerel zherekh, pickerel, sheatfish, sabrefish, and a few other species); these species comprised 30% of the total catch at that time. By the beginning of the 1980s, the Aral Sea had lost its fishery significance. The declining fish fauna also had a negative impact on numbers of piscivorous (fish-eating) birds.

The present ichthyofauna of the NAS is formed by two ecologically different fish groups. The first is represented by introduced flounder (Platichthys spp) that still survive as a harvestable stock in the deeper western part of NAS. A large number of species were introduced in the Aral Sea after its salinity levels started rising. Some 14 species were introduced, and except one (the flounder) none was successfully acclimatized. The second group is represented by small-sized species of salt-tolerant freshwater fish species, no longer of commercial importance because of increased salinity levels. However, following the moderate decline in salinity since 1990, in particular near the Syrdarya mouth, for the first time in many years, representatives of the indigenous ichthyofauna started to be reported: Aral roach, bream, Aral carp, pike-perch, pike-asp, etc. The previously lost food for the fish, consisting of freshwater and low-salt water organisms, started to recover. During the years 2002-2004, though there was no dam in the Berg Strait, due to relatively high inflows, the desalinated water area (1-10‰ total soluble salts) grew substantially to about 100 thousand hectares and the natural habitat of indigenous fish species expanded. After the start of operation of the new Berg Strait dam the area with low salinity level increased further. At present, indigenous fish species are feeding in the central and northeast parts of the NAS, in the regions of Ushshoky, Bessay and Tastubek that are located 60, 70 and 90 km off the Syrdarya mouth respectively. As populations of Silversides, gobies and sticklebacks recover, conditions for the potential reintroduction of Aral Sea sturgeon are favorable as those are important prey for this species.

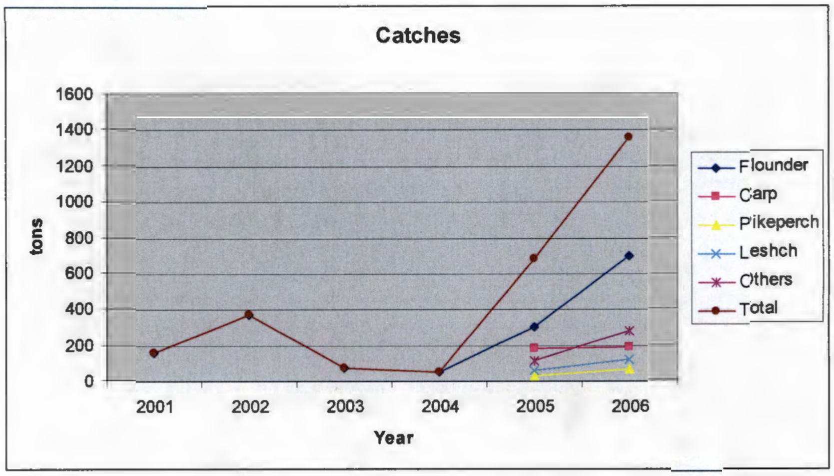


Fig. 4-20 Harvest of fish in the Northern Aral Sea 2001-2006. (Source: KazNIIRKh, 2007)

In the NAS area outside the zone of influence of the fresh water inflow from the Syrdarya, i.e. in the western bays, flounder fisheries are still thriving, mainly thanks to the Danish Society for a Living Sea, a DANIDA supported NGO providing training and marketing assistance to fishermen. Tests have shown that the quality of the NAS flounder is comparable to the best flounder from elsewhere. During the preparation of SYNAS-I, an annual sustainable harvest of over 1,000 t was estimated (Danish Society for a Living Sea and KazNIIRKh Aralsk, quoted in ARCADIS EUROCONSULT (2000)).

It is interesting to note that while official data on catches of freshwater fish in the delta lakes and river mouth indicate increasing harvests from 2002-2004 (Fig. 4-20, 4-21), official data on flounder harvest in the Sea until 2004 show a decrease. It is unclear, however, whether these official data reflected decreases in actual harvests, or rather the failure to register actual harvests. It was expected that as parts of the Sea become less saline the flounder, which prefers higher salinity than now in the river mouth, will be replaced by the fresher water and will remain in more distant areas where the water remains saline. This factor may cause the effect that flounder disappears in the main fishery areas and would lose value for commercial fishery. While such a trend was visible from 2001 till 2004, during 2005 and 2006 the flounder harvest significantly increased. It is not clear if these numbers represent a better recording of catches or a real increase. In case of real increase this may not necessarily indicate stable or growing flounder populations but may be as well a result of intensified fishery activities

<u>Delta lakes (under utilization of information in Scott Wilson, 2007)</u>

The original distribution of the second group (bream, wild carp, Caspian roach, pike perch, etc.) also included the Delta lakes. The lakes in the delta and the floodplains played an important role as spawning and nurturing sites for many original river and sea species. Some species (Aral carp, bream, and Aral roach) had two ecological forms: anadromous and local. The anadromous form fed and fattened in the sea and came to the river and the lakes to spawn. The local form spent all its life in the lakes. The now extinct Aral Sea sturgeon once migrated upstream for spawning, but its migratory route became blocked by water regulatory works in the downstream reaches of the river. Lake fisheries declined for a number of well-known reasons: increasing salinity, lack of replenishment of fresh water, blocked access to the lakes and floodplains (catfish) and drying up of lakes.

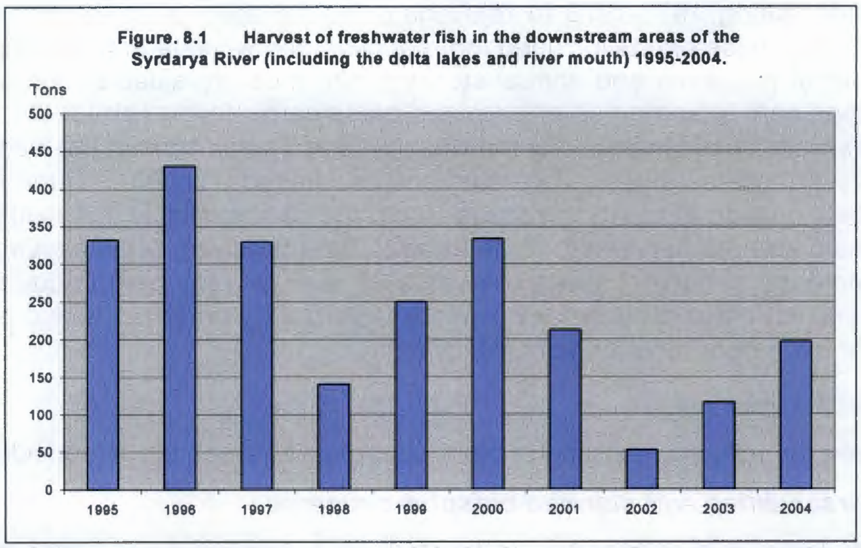


Fig. 4-21: ***Total harvests of freshwater fish in the downstream areas of the Syrdarya River (including the delta lakes and river mouth) 1995-2004. (Source: KazNIIRKh, 2005)***

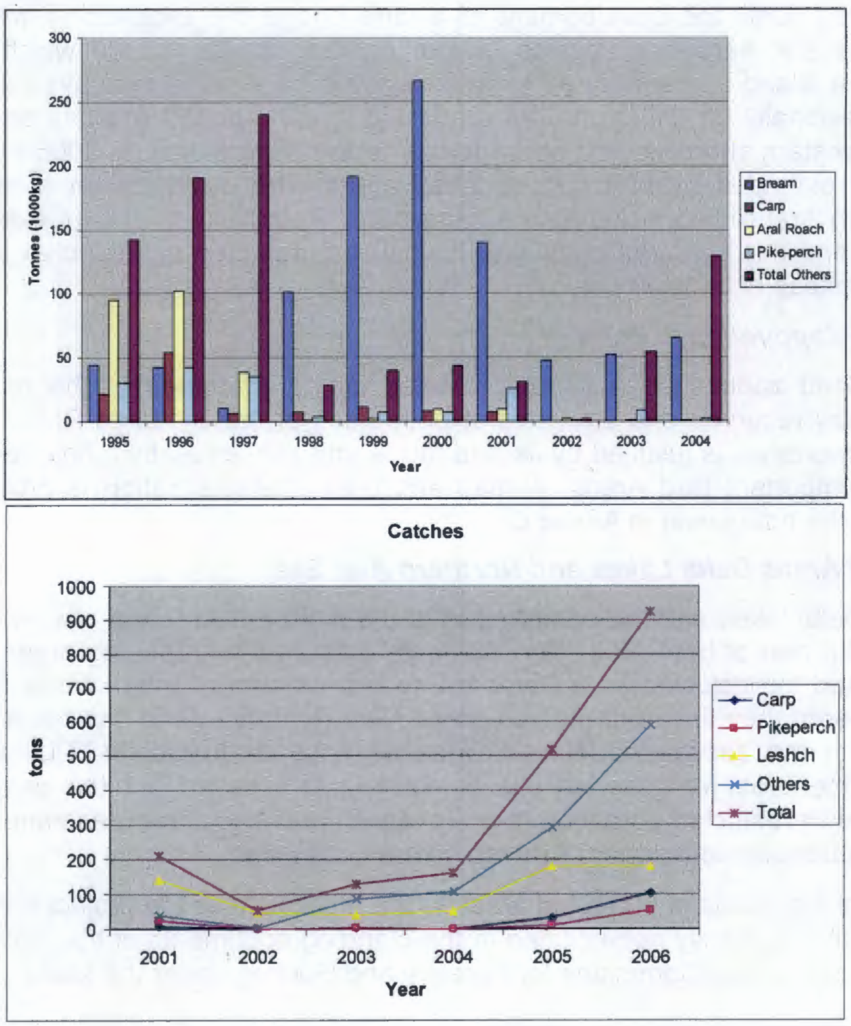


Fig. 4-22: ***Harvest of freshwater fish in the downstream Syrdarya River (including the delta lakes and river mouth) by species, 1995-2004. (Source: KazNIIRKh2005) and 2001-2006 (Source KazNIIRKh, 2007)***

Analysis of fish harvest in the Syrdarya downstream lakes since 1960 shows that before the river was dammed at Shardara total catches in lakes had been significant. Since 1975 there has been a steady decline in fish catches in almost all lakes. In order to increase fish productivity in the lakes, and taking into account the total collapse of the Aral Sea fishery, efforts were made during 1976-1978 to rejuvenate the fisheries of Lakes Kamyshlybash, Akshatau and Raim. These efforts included the reduction of low-value and non-food species, control of number of predators and annual stocking with fries of valuable food fish species Aral carp, common carp, common silver carp and grass carp. Young fish for the stocking of the lake fisheries were raised in ponds at the Koszhar and Tastak sites of the Kamyshlybash fish hatchery. Nevertheless harvests fluctuated and decreased until 2002. During the recent years fish harvests outside the NAS increased. From the data available it is neither possible to identify the main species harvested nor to analyze the underlying reasons. One thinkable cause for this increase of harvest above the years 95 till 2004 may be that during that time low harvests were not caused by lack of available fish but by other economic problems of the fishermen, or even poor recording of real harvests.

4.3.3 Protected areas

In the project area the following existing or planned protected areas are to consider:

Zapovednik Barsakelmes and planned biosphere reserve

The zapovednik (strict nature reserve) is located on a former island which since 2000 became a peninsula in the LAS. The zapovednik protects a typical section of zonal desert ecosystems and in its surroundings on the dry seabed sand desert vegetation (in particular dominated by black saxaul (Haloxylon ammodendron) and diverse zhuzgun species (Calligonum spp.). Until the development of a land bridge the zapovednik was used for protection of several herbivore species (saiga, goitred gazelle, kulan) which had been introduced to the island and supported by artificial watering sites. Nowadays these species occur only occasionally on the island but are found in sand desert habitats on the former seabed at the western shoreline and at the former island Kaskakulan. In 2006 the protected area has been extended by inclusion of these areas. The development of a biosphere reserve Northern Aral region including the zapovednik Barsakelmes and its extension area as core zones and the Syrdarya delta (see below) as protected or restricted use zone is currently in the phase of feasibility study.

Arys-Karaktau Zapovednaya Zona

The Arys-Karaktau zapovednaya zona (protected zone) is located in the region of the planned Koksaray reservoir and stretches at both sides of the Syrdarya River. The area's conservation importance is justified by its bird fauna and consequently it has been included into the list of Important Bird Areas. A map and brief characterization is provided under section 4.2 and the data sheet in Annex C.

Important Bird Areas Delta Lakes and Northern Aral Sea

The Syrdarya Delta lakes and the eastern part of the Northern Aral Sea are included in the list of IBAs and a part of both areas; the Syrdarya delta and surrounding areas of the Aral Sea are proposed for inclusion as a Ramsar Site – a wetland of International Importance. However at present they are no protected areas. The Syrdarya delta has been considered for inclusion into the zapovednik Barsakelmes as a separate cluster. Due to the high importance of the area for fisheries this is not longer followed but the designation as protected area with restricted utilization (e.g. Zakaznik) and its inclusion as zone II area in a potential biosphere reserve Northern Aral region are considered.

The assigning of the status of protected areas to the other IBAs in the project area deserves consideration but is currently not included in the planning documents of the state agency in charge of protected areas (Committee for Forestry and Hunting under the MoA).

Planned Nuratau-Kyzylkum Biosphere Reserve in Uzbekistan

A part of the planned Nuratau-Kyzylkum Biosphere Reserve in Uzbekistan is located the area of influence of the project. This concerns the Aydar-Arnasay lake system with the already existing Arnasay Ornithological Zakaznik which is supposed to form significant core and restricted use zones and the lake Aydarkul which is part of the development zone (zone III). The protection and sustainable development objectives require a stabilization of the water level in the lake system at present or slightly lower level than currently without major fluctuations. Parts of the area (Tuzkan Lake) and of the adjacent Arnasay reservoirs are recognized as IBAs.

4.4 Socio-Economic Profile

4.4.1 Ancient civilizations in the Syrdarya region

First traces of human occupancy in this region of Kazakhstan date from about 1 million years ago. This is evident from numerous archaeological findings on the slopes of the Karatau Range, which runs some distance parallel to the Syrdarya valley. The civilizations of the Bronze Age and early Iron Age living in these areas were already very advanced. Traces can be found of numerous settlements, burial grounds, mounds, mining work places and petroglyphs, dating from these periods; but many of them have as yet not been properly investigated.

During the last few thousand years, most of the population of Kazakhstan turned to a nomadic life, raising cattle and establishing tribal states. Around the Aral Sea, the Sakas or Scythians were living as in many other places of Central and East Kazakhstan. These people were warriors but developed remarkable skills in writing, “animal arts”, handicrafts and trade. Information about the Sakas can be found in Chinese, Persian and Greek sources (e.g. Herodotus).

Since the first millennium B.C., Southern Kazakhstan and the Syr Darya valley have played a dominant role as a trade route between the Far East and the countries of the Levant. The Great Silk Road is one of the most famous caravan-ways and trading routes in the history of world civilization. It connected the Mediterranean Coast, including the large empires of Egypt, Byzantium and Mesopotamia with China. The trade highway led through vast tracts of hazardous and deserted country in Central Asia. Rich caravans laden with silk from China, spices precious stones from the Indian subcontinent and Afghanistan and many other goods moved through the Karakum and Kyzylkum deserts on their way to the Middle East and Europe. They traded these for silver goods from Iran, Byzantine cloths, Turkish slaves, Afro-Arabian ceramics and more. On their way, these caravans passed rich settlements such as Bukhara, Samarkand, Turkestan, Otrar, Shymkent and other towns, following the Syrdarya River and other streams. The Silk Route in fact consisted of a number of tracks, some of them running south of the Aral Sea, others following a more northerly route through the project area and along the Syrdarya River towards Aralsk, the Caspian Sea and Samara. Not only were goods traded, but scientists, priests and craftsmen also joined the caravans. The Great Silk Road thus facilitated the exchange of ancient art, scientific and technological achievements, religious creeds and ideas.

Since the 5th century, settlements were established in the Syrdarya valley with farming communities. These people practised irrigation and used watermills and windmills for lifting water and for milling grain. Earth-fill dams were built to store water and they developed extensive systems of irrigation canals and feeders. Large tracts of the lands along the Syrdarya River, and its branches, the Inkardarya, the Zhanadarya and the Kuandarya, were irrigated. Traces of these civilizations and the irrigation schemes they build could be found in the Southern part of the project area (fig. 4-22).

Fig. 4-23: Ruins of the medieval city of Shankent on the Syrdarya right bank

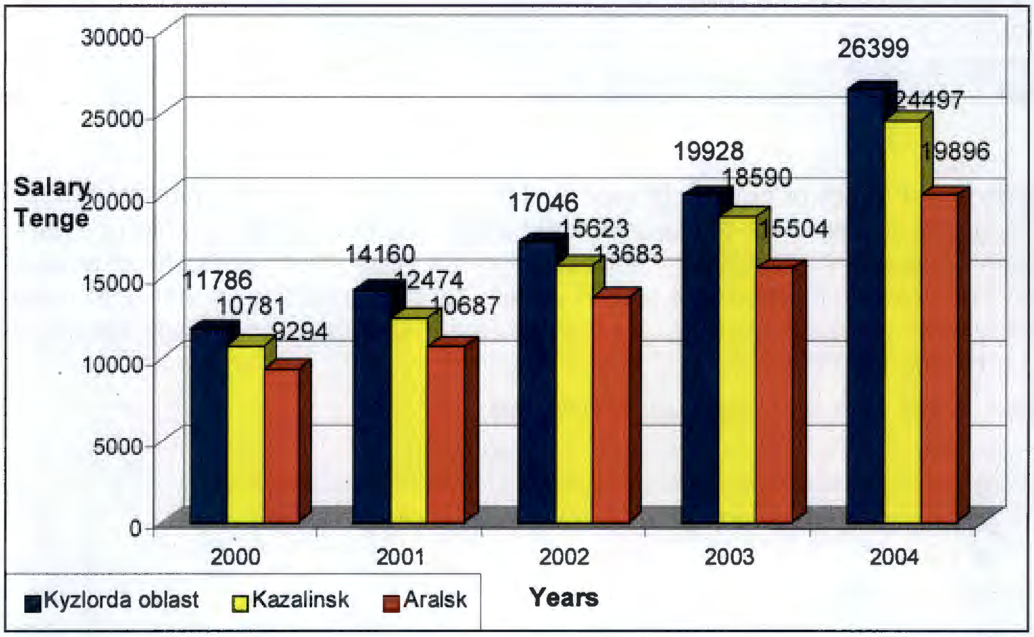
4.4.2 Demography

Introduction

Kyzylorda Oblast is one of the poorest oblasts in Kazakhstan. Characterised by a predominantly rural economy, the socio-economic situation in the project area is marked by poverty, unemployment, and outward migration. Once declared a disaster zone, the area has, however, started to recover slowly. Proximity to oil reserves and construction opportunities in the area have had some, albeit limited impact on employment patterns. Thus, the majority of the population work in subsistence farming and livestock production or are unemployed. However, as noted above the picture of Kyzylorda Oblast is beginning to transform and implementation of SYNAS is expected to help that transformation. The results of the household survey are presented in full in Appendix 9 of the Final Report)

Figure 4-24 shows average monthly incomes for the oblast as well as the rayons of Kazalinsk and Aralsk. In 2004 the average monthly income in Kazalinsk rayon was 24497 tenge and in Aralsk it was 19896 tenge - 7% and 25% lower than the oblast average of 26399 tenge per month respectively. Even though there has been an annual increase in the monthly incomes of approximately 21%, the monthly income levels are still below the oblast and national averages. The low income levels are explained by heavy reliance on agrarian economy which has only recently started to recover from crisis. The general economic situation is best described by subsistence livestock production that is acting as the major safety net for the population.

Figure 4-24: Income distribution in Kyzylorda Oblast, and Kazalinsk and Aralsk Rayons.

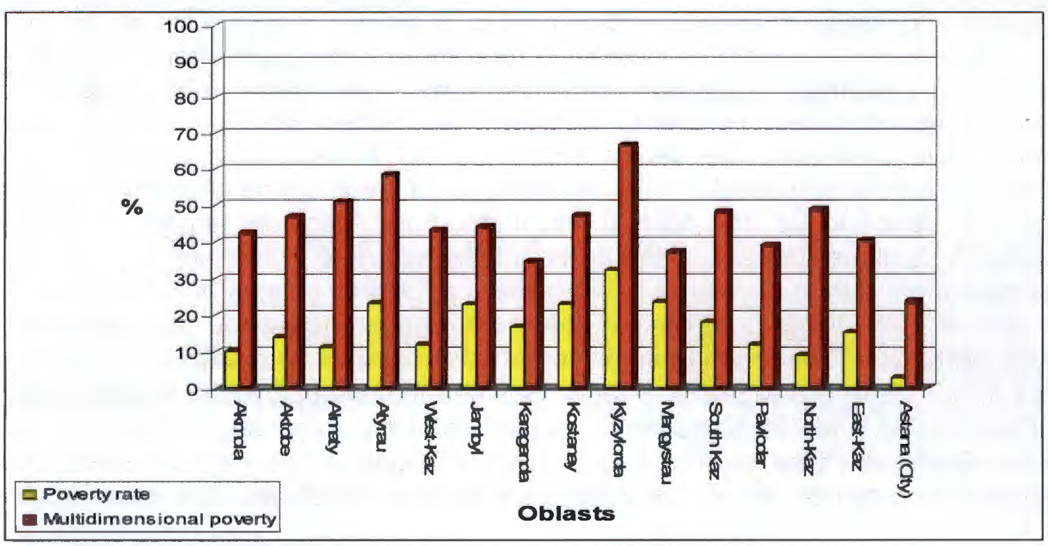


Source: State Statistics Department, income figures for 2000-2004.

Poverty

Kazakhstan is a fast growing economy with impressive annual growth of approximately 9% for the past six years. Kyzylorda Oblast has the highest poverty rate in Kazakhstan: 32.2 % (see Figure 4-25). The urban-rural distinction in poverty levels is striking throughout Kazakhstan and in Kyzylorda Oblast urban poverty is at 20.2 % whereas rural poverty is more than double at 49.2 %. Hence, in rural areas nearly half of the population is living below the poverty line. From 2001 to 2002 poverty in Kyzylorda Oblast increased from 28.1 % to 32.2 %. Multidimensional poverty is widespread in Kyzylorda Oblast, affecting 69 % of the population (see Table 4-11).

Figure 4-25: Poverty distribution in Kazakhstan by Oblasts .



Source: World Bank Poverty Report 2004.

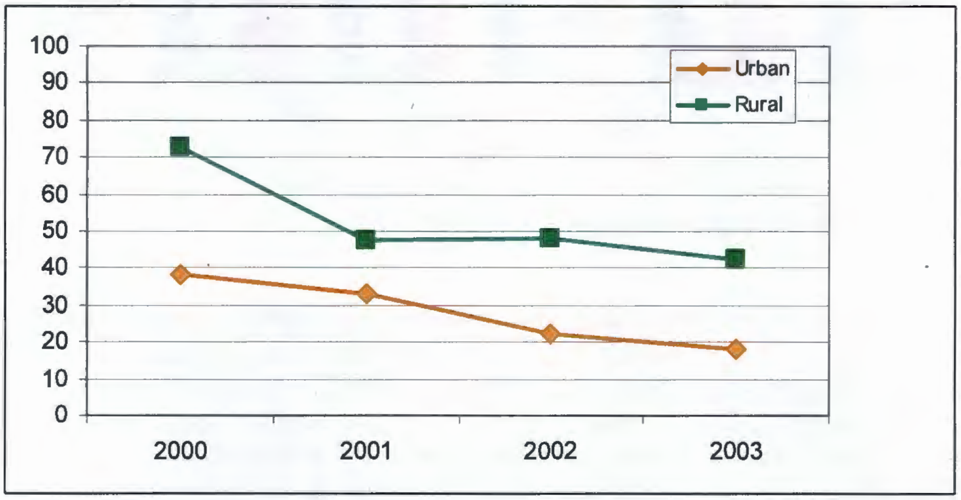
Table 4-11: Types of Poverty

Types of Poverty	2002
Consumption poverty	
Poverty rate	32.2%
Urban rate	20.2%
Rural rate	49.2%
Non-consumption Poverty	
Housing poverty	51.0%
Education poverty	7.5%

Source: World Bank Poverty Report 2004, Regional Annex

Understanding the depth of poverty is essential to portraying the whole picture in Kyzylorda Oblast. According to the UNDP data on Kazakhstan, despite the oblast's high poverty rate, food poverty is actually decreasing. Especially in the past four years, food poverty has decreased from 25.5 % in 2000 to 4.9 % in 2004. The data also shows that both urban and rural poverty levels are decreasing, yet the decrease in rural poverty lags behind that in urban poverty (see Figure 4-26).

Figure 4-26: Urban and rural poverty levels 2000-2003



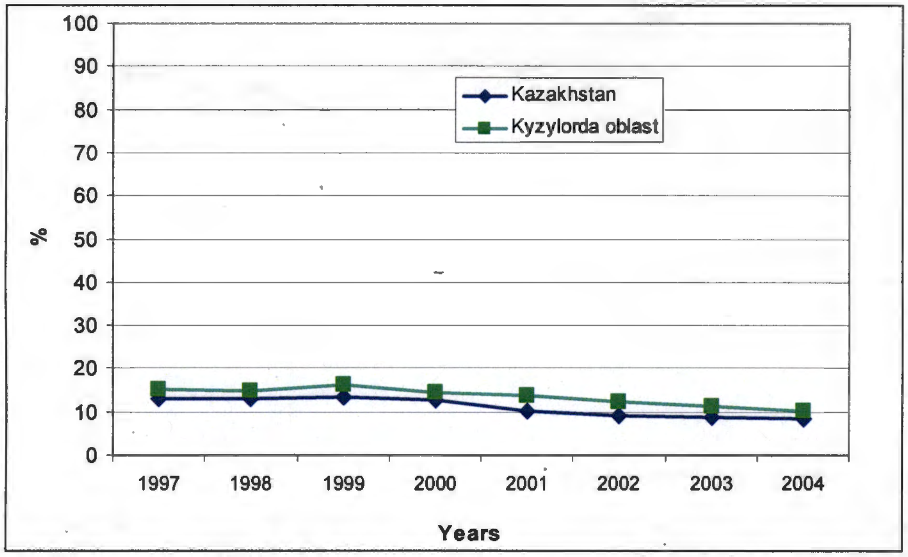
Source: UNDP Kazakhstan Infobase. Standards of Population and Poverty in Kazakhstan (Statistical Monitoring), 2004.

Unemployment

In Kazalinsk and Aralsk rayons unemployment is a grave concern. One of the emerging trends in Kazakhstan in general is increasing rural poverty and rural unemployment. As the oil and mining industries generate soaring revenues urban settlements have increasing employment opportunities. However, outdated techniques and limited investment in agriculture have prevented the sector from reaching its economic potential, adversely affecting employment prospects of rural populations. In the absence of alternative economic development opportunities the local populations have become largely dependent on subsistence agriculture and are facing an unemployment trap. According to WB indicators, the unemployment rate in Kyzylorda is the highest among all oblasts in Kazakhstan with an overall rate of 32%. What is striking is the increasing gap between the rural and urban unemployment levels. The urban unemployment rate is at 23% whereas rural unemployment rate is at 47%. There is a wide discrepancy between the unemployment figures used by the World Bank's HBS and official Kazakh Government data. According to the data obtained from State Statistics Office,which are also used by UNDP for Human Development Index, the overall unemployment level in Kyzylorda Oblast was 10.2% in 2004 (see Figure 4-27).

Over the past several years, unemployment in the oblast fell from 14.5% to 10.2%. Rural unemployment is slightly higher than urban unemployment at 11% and 9.5% respectively.

Figure 4-27: Annual unemployment rates in Kyzylorda Oblast and Kazakhstan, 1997-2004.



Source: UNDP Kazakhstan Databank 2006.

According to the UNDP Human Development Index, Kyzylorda Oblast belongs to the third group of oblasts in Kazakhstan, characterized by below average human development index. Even though the life expectancy of 67 years is slightly higher than the national average of 66.2 years, Kyzylorda's development is lagging behind, especially in education and economic development (Table E9). Economically, per capita GDP in Kyzylorda is 24% lower than the national average. Even though literacy rate is higher, enrollment rates are much lower than the national average. The infant mortality rate is the highest nationwide with 22.4 per 1000 livebirths - 43% higher than the national average. Public health is also a key determinant of development. Poor public heath is a key concern in Kyzylorda Oblast. The general incidence rate of all disease clusters for 100,000 people is 68,311, the fourth highest among all oblasts in Kazakhstan, 22% higher than the national average. Unfortunately, Kyzylorda Oblast has the highest illness rates in Kazakhstan in tuberculosis (TB), cancer of esophagus, iron deficiency and nervous system diseases. Hence, any improvement in economic wellbeing of the population is expected to have positive impact on public health since the two factors are strongly interlinked.

Table 4-12: Human Development in Kyzylorda and Kazakhstan Comparison

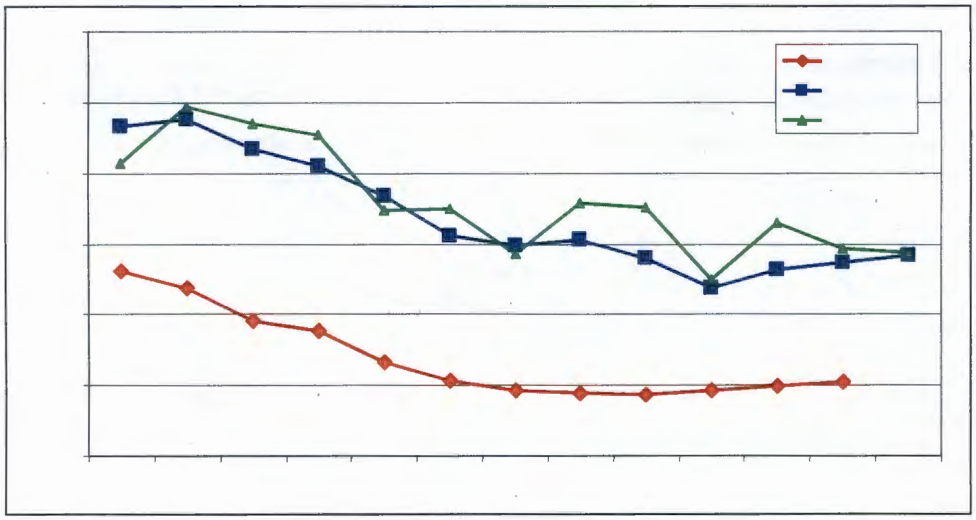
	Life expectancy	Literacy rate	Enrollment rate	Per capita GDP	Life Expectancy Index	Education Index	Income Index	HDI
Kyzylorda	67	99,6	80,4	5849	0,688	0,932	0,657	0,763
Kazakhstan	66,2	99,5	84	7260	0,681	0,943	0,715	0,782

Source: UNDP Human Development Index 2005

Health

In the rayons of Kazalinsk and Aralsk infant mortality has fallen in the past three years and in year 2004 the rates in Kazalinsk rayon were lower than the national average. However, there is a striking difference in mortality per 1000 persons. Mortality rates are a disturbingly three times higher than the national average in both Kazalinsk and Aralsk rayons (See Figure 4-28).

Figure 4-28: ***Mortality per 1000 people***



Source: Statistical Agency of the Republic of Kazakhstan

The data also reveals striking differences in terms of public health patterns between Aralsk and Kazalinsk rayons and between these areas and Kyzylorda Oblast as a whole and the country. In Kazalinsk infectious and parasitogenic disease rates are 89% higher than the national average. In Aralsk on the other hand, the rates are 9% lower than the national average.

Migration

Kyzylorda Oblast is losing inhabitants due to migration. Outward migration is a predominant factor in both cities of Kazalinsk and Aralsk. Even though both cities do have some inward migration, outward migration numbers are much higher (See Table 4-13).

Table 4-13: ***Migration in and out of Kazalinsk and Aralsk.***

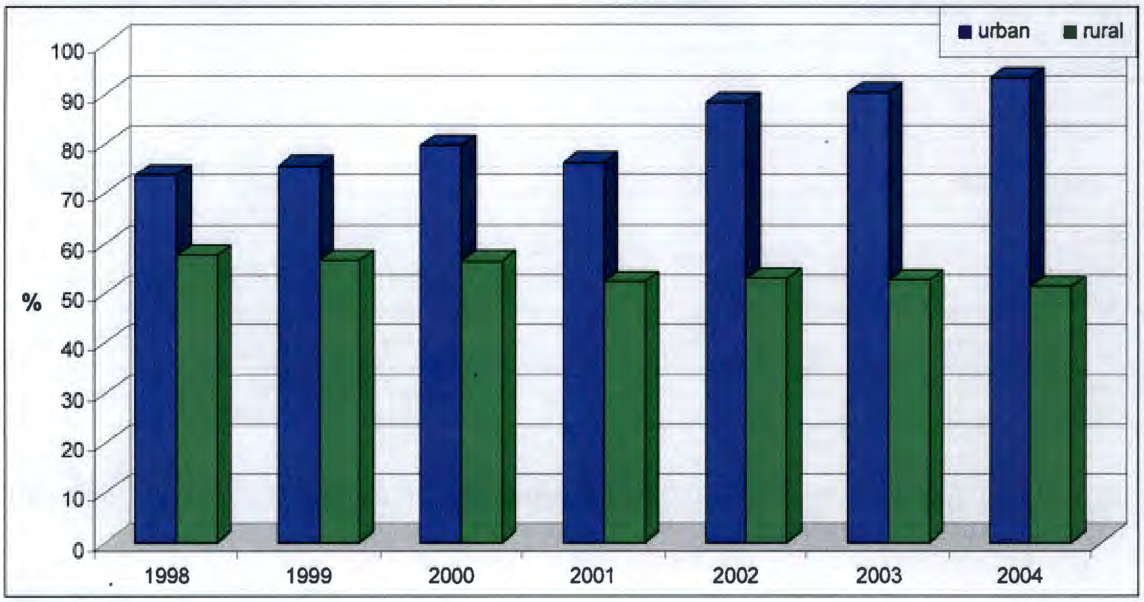
	1997	1998	1999	2000	2001	2002	2003	2004
Kazalinsk in	362	468	371	715	638	924	788	787
Aralsk in	266	403	453	326	280	588	367	522
Kazalinsk out	796	1045	824	1048	1056	1566	1124	1319
Aralsk out	934	953	713	989	1096	1178	893	1105

Source: Statistical Agency of the Republic of Kazakhstan

Education

Education is one of the pillars of development and achieving universal primary education is the second UN Millenium development goal. In 2004, the UNDP Human Development Report for Kazakhstan had a special focus on education published under the title "Education for all: The Key goal for a new millenium". According to 2004 Human Development indicators, the education index for Kyzylorda Oblast (0.932) is lower than the national average (0.943). The education enrollment rate follows a similar pattern of 80.4 at oblast level versus 84.0 at national levels. The proportion of students ages 6-24 enrolled in all levels of education reaches 75.4 % in Kyzylorda Oblast (see Figure 4-29). The urban-rural discrepancy in education is substantial in the oblast and, worryingly, grew from 1998-2004. Even though the proportion of students (aged 6-24) enrolled in all levels of education reached 93.3% in urban settlements in 2004, it reaches merely half of the population in rural settlement.

Figure 4-29: Urban-rural education rates in Kyzylorda Oblast.



Source: UNDP Living Standards and Poverty 2005

Conclusions

Kyzylorda Oblast, and its Kazalinsk and Aralsk rayons in particular, have suffered and still suffer from high poverty rates, due to various causes including ecological disaster and economic transition. The analysis illustrates that even though poverty is still widespread, it is decreasing. In addition to agriculture, thanks to the SYNAS project, fishing is expected to revive as an important economic activity in the region. Livestock rearing and agriculture production are widely practiced however, due to numerous obstacles, including lack of processing facilities and transportation barriers, they are important more for their subsistence benefits than income generating capacity. Hence, economic development in the project area is picking up, albeit at a slow pace. The standards of living on health and education are low, especially in rural areas; the social indicators show that there is a severe urban rural gap. Unless measures are taken to control the widening of the gap, outward migration, which has been a significant trend in the oblast, may continue.

4.5 Land and Resource Use

4.5.1 Agriculture and livestock

Irrigated arable lands

Arable farming in the project area and in wide parts of the Kazakhstan Syrdarya Basin is based on irrigation. Almost exclusively flood irrigation based on gravitation is applied. After the independence the area cultivated in the floodplain of the Syrdarya has strongly decreased but got stabilized during the recent years.

Irrigated agriculture currently occupies some 423,000 ha of land in the South Kazakhstan oblast (about 3.6% of the SKO area), with a decline of some 40% having been experienced since the period of maximum activity some 20-25 years ago. During the 1980s in South Kazakhstan oblast an area of 512,000 ha was reclaimed with irrigation infrastructure and at least temporary irrigated. These lands are located in the Syrdarya basin and are supplied by the Syrdarya or its tributaries. The irrigated areas in Maktaaral rayon make up 130,000 ha, on 50,000 of which irrigation and drainage systems have been rehabilitated in 2002-2006 with assistance from WB and ADB. Further rehabilitation work with WB financing is planned on another 140,000 ha of irrigated lands in the rayons Maktaaral, Shardara and Turkestan. The areas in Maktaaral rayon are supplied with irrigation water from the Syrdarya River upstream from the outlet of the Shardara reservoir. Irrigated lands in Shardara rayon are supplied by the Kyzylkum canal with water directly discharged from the Shardara reservoir.

Table 4-14: Potential and actually irrigated areas in the Syrdarya basin in Kazakhstan.

Oblast/Rayon	Potential irrigated area in the Syrdarya basin (ha)	Actual irrigated arable lands in the Syrdarya basin (ha)
South Kazakhstan oblast	512,000	250,000 (423,000 total for oblast!)
Maktaaral (upstream from Shardara)		135,680 (2004)
Shardara		48,560 (2004)
Arys		16,238 (2004)
Turkestan		40,000 (2004)
Kzylorda oblast	270,000	150,000 (158,280 in 2003)
Zhanakurgan		25,690 (2003)
Shieli		26,030 (2003)
Syrdarya		29,840 (2003)
Kzylorda		7,780 (2003)
Zhalaghash		30,320 (2003)
Karmakchi		20,000 (2003)
Kazalinks		18,060 (2003)
Aralsk		560 (2003)

In Kzylorda Oblast from the 270,000 ha areas that maximum have been irrigated; only 150,000 ha are actually used.

Table 4-15: Agricultural development, water use and yields in Kzylorda 1991 – 2004 (EDIKO, 2005)

Year	Irrigation area	Rice area		Water Use – gross		Average yields
	ha	ha	%	Million m³	m³/ha	t/ha
1990	258390	87040	33.69%	4869.0	18844	
1991	261431	82122	31.41%	4666.0	17848	
1992	271991	82705	30.41%	5070.0	18640	
1993	264252	80298	30.39%	4941.0	18698	
1994	243103	73410	30.20%	4671.0	19214	
1995	231458	68196	29.46%	3916.0	16919	4.94
1996	195430	65969	33.76%	4171.9	21347	4.90
1997	155940	64903	41.62%	9965.5	63906	4.87
1998	149830	62930	42.00%	3656.5	24405	4.28
1999	146570	58589	39.97%	3133.4	21378	3.94
2000	150060	62245	41.48%	3168.0	21112	4.00
2001	147750	58562	39.64%	2904.0	19655	4.01
2002	145940	52590	36.04%	2729.0	18699	3.75
2003	158280	69846	44.13%	3272.0	20672	4.21
2004	150390	66208	44.02%	3165.0	21045	4.17

Under the present project the water use modelling component has considered what areas in the Kazakhstan part of the Syrdarya basin are actually irrigated. Based on this the respective irrigation water needs have been estimated. No increase of the sown areas under irrigated crops is foreseen and supported in the SYNAS-II project.

The present irrigation water use efficiency is low, e.g. for rice it is application efficiency of 45 % and conveyance efficiency of 60 %, this results in this example in an overall efficiency of the system of 27 %. The new methodology of Bastiaanssen, (EDIKO, 2005, Technical Note 7) based on evapo-transpiration measurement on satellite images shows an irrigation efficiency for rice of only 17.6%. Using the calculated net potential evapo-transpiration of Bastiaanssen for all crops in Kzylorda Oblast, average system efficiency 30 % is the result against overall system efficiency of 43 % calculated by FAO Cropwat. Both methods show, that rice is the major consumer of irrigation water in Kyzylorda with very low irrigation efficiencies. At the same time both methods show, that other crops, mainly alfalfa and wheat have very high irrigation efficiencies of 50 % respectively 75%. The apparent high efficiency of these dryland crops results from rice crop residual water (EDIKO, 2005, Technical Note 11). It is assumed that the irrigation efficiency can be improved, depending on the question of how far water managers and farmers of the Syrdarya basin would be interested and able to apply water saving management and cropping systems.

Crops

In the project area different institutional types of agricultural land-users cultivate various crops in differing proportions. These types include large agricultural enterprises (corporate farms), medium sized farm enterprises and small household plots. At the household plots a significant proportion of the gross agricultural production is produced (70% in Kzylorda oblast according to Efimov, SYNAS-II) and this type of land-users dominates the production of "bakhcha", i.e. melons and gourds. They further produce vegetables, potatoes and fruit for home consumption. The large agricultural enterprises and farms in Kzylorda oblast focus on rice (about ¾ of the cultivated area) combined with alfalfa in the crop rotation. Wheat plays a minor role. In South Kazakhstan Oblast cotton is the major crop cultivated by farms and larger enterprises. Rice and grains are only cultivated by few farms and on small proportions of the irrigated lands (less than ¼).

Livestock

In Kzylorda oblast more than 90% of livestock is owned by the rural households. In these households livestock serves as a monetary equivalent to buy food, pay for services and for children's tertiary education. In the composition of livestock dominate sheep and cattle, while horses and camels have a smaller share, but are still represented in large numbers.

Table 4-16: Distribution of livestock numbers in Kzylorda oblast 2004 (after EDIKO 2005, TN 6)

Species	All categories	Large enterprises	Share of the category%	Farms	%	Individual households	%
Milking cows	78,184	405	0.5	1,553	2.0	76,226	97.5
Other cattle	120,542	969	0.8	2,837	2.4	116,736	96.8
Sheep & goats	634,852	32,658	5.1	18,580	2.9	583,614	91.9
Horses	50,772	2,997	5.9	1,966	3.9	45,809	90.2
Camels	23,154	2,326	10.0	1,333	5.8	19,495	84.2
Total animal units of above species[3]	399,622	13,228	3.3	11405	2.8	374989	93.8
Pigs	3,133	209	6.7	215	6.9	268,761	86.5
Poultry	426,656	157,324	36.9	571	0.1	2,709	92.8

3 1 AU = 1 cow, 1 horse, 1 camel or 5 sheep or goats

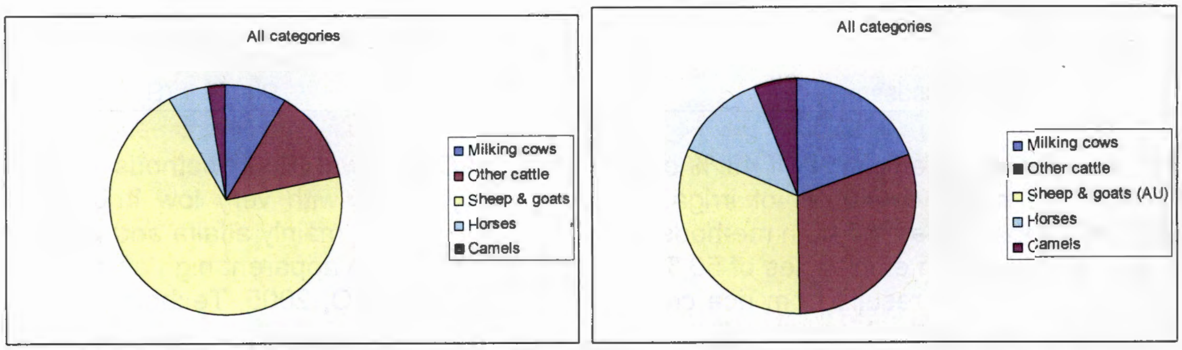


Fig 4-30: Livestock species (share by total numbers and animal units) in all categories of enterprises

During the 1990s the livestock numbers of most species, in particular small ruminants, dropped dramatically. Fig. 4-18 shows these developments for the rayons Aralsk and Kazalinsk. Since around 2001/2002 the situation stabilized and animal numbers are now growing.

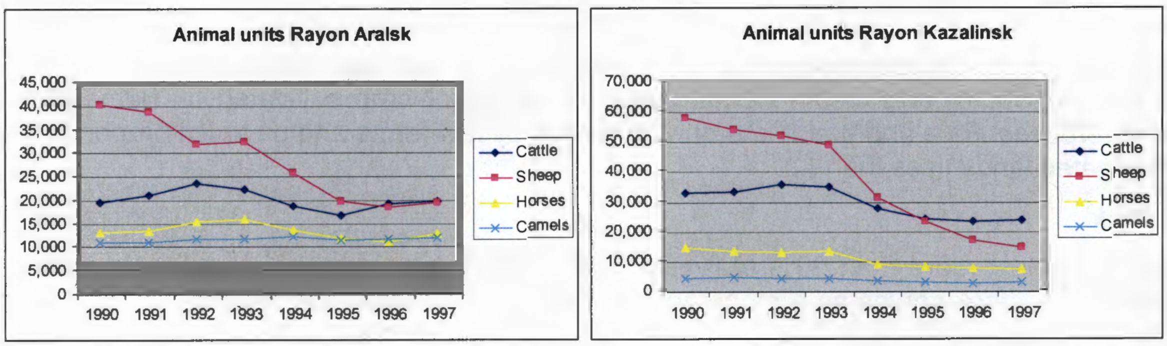


Fig. 4-31: Development of livestock numbers during the 1990s (5 sheep equivalent to one AU)

Despite vast pasture resources, seasonal migration has become either impossible or unnecessary for the large majority of livestock keepers. Large-scale owners, however, do continue to move their animals. Overall, some three quarters of farmers do not move their stock, but keep them around villages. Households that occupy the foothills of mountains are often able to move their animals to rich mountainous pastures in summer.

The small minority of farmers that moves its stock every season are among the richest owners, usually with over a thousand sheep equivalent units. To this group also belong people who manage other people's stock. Movement in every season is costly and labor-intensive (most frequent movers own a truck, well pump, barn or house at remote pastures and access to labor – usually family) and consequently, the threshold flock size for frequent movement is 350 animals. This group falls into the category of group or corporate farms.

The majority of farmers have settled in villages, grazing their animals at one day's walking distance, usually up to 5 km away. Animals may roam up 15 km, however. Management is largely passive, since the animals roam freely. In the winter season, management becomes more intensive, as fodder is commonly provided to animals. Although animals may be moved to summer mountain pastures or distant winter pastures, movement is largely impossible due to lack of financial and/or infrastructural means and incentive.

Two sources of winter fodder are used in the project area. First, in the crop rotation alfalfa is cultivated. Second, grasslands and reeds are managed as irrigated haymaking areas (limans). The reed hay is of comparable low fodder value and is preferably used in combination with more nutritious alfalfa hay and/or concentrated fodder. Livestock breeders based in winter far from irrigated arable lands (e.g. in most parts of rayon Aralsk and Karmakchi) more rely on haymaking areas than those in the proximity of irrigated fields on which alfalfa is cultivated or where livestock can graze on fields after harvest.

The relative importance of the livestock sector in Kzylorda Oblast is presently underestimated. Its combined farm gate value and market value is respectively 5.73 billion Tenge and 8.97 billion Tenge (EDIKO, 2005, TN 6). The combined value of the beef and milk sub-sector is larger than that of rice. The respective turnovers and added value of the beef, milk and mutton value chains are far larger than those of skins, wool, eggs and karakul. Sales-to-production ratios of households are low and the majority of produce bypasses formal market channels.

4.5.2 Water management in the Syrdarya basin

Water management, in particular for purposes of irrigation, power generation and flood protection, is the key factor influencing on the hydrology in the Syrdarya basin. That's why water management issues have been broadly described under section 4.2.3 Hydrology and no details are repeated here.

The Scenario 1 – "SYNAS I up-rated river channel capacities", developed for the SYNAS-II Pre-Feasibility Study represents the case with Syrdarya river channel capacities up-rated to that recommended in the SYNAS I report to allow the following discharge regime from Shardara reservoir:

- 600m³/s maximum winter release from Shardara;
- 1100m³/s nominal summer release from Shardara;
- 1800m³/s maximum summer flood release from Shardara.

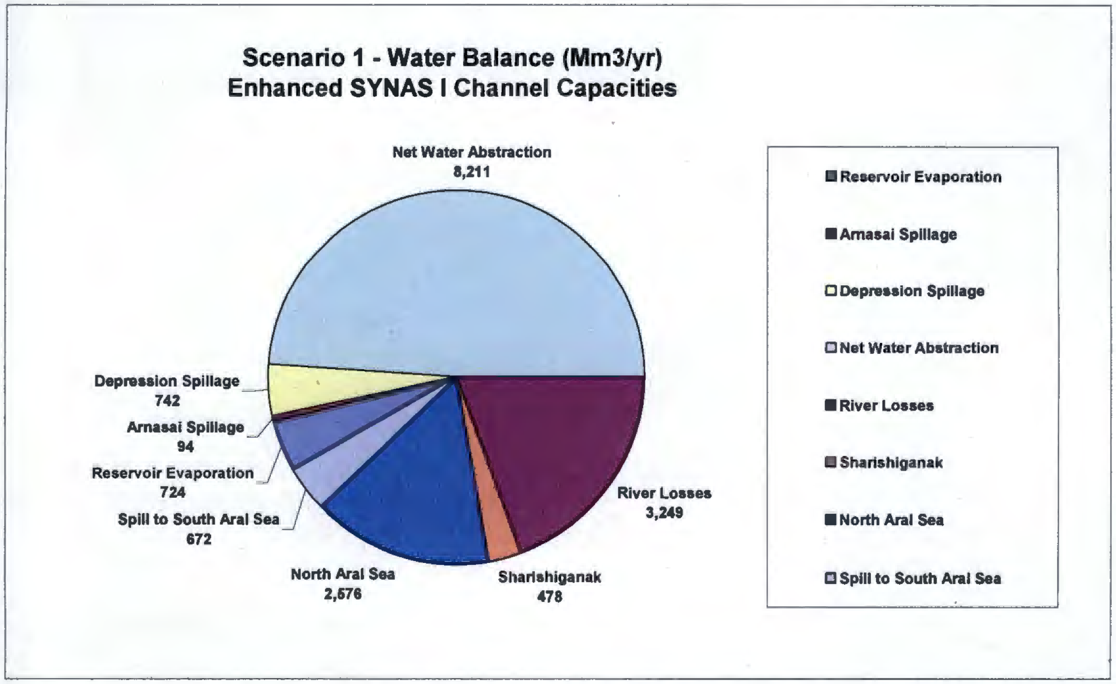


Fig. 4-32. Scenario 1 Water Balance (Source SYNAS-II, Pre-Feasibility Thematic Report on Hydrologic Modelling 2007)

As SYNAS-I in the meantime is almost completely implemented and most structures are put into operation, this scenario provides a good summary of the current water allocation.

4.5.3 Fisheries

The developments in the fisheries in the Aral Sea and in the Delta Lakes are closely related to environmental conditions for fish, in particular to water salinity and to timing and amount water supply to delta lakes. Fishery activities and achieved yields are closely related to the fish fauna and populations of economically important species. The information available on actual fish harvests is therefore provided in section 4.3.2 Fauna.

5 ENVIRONMENTAL IMPACTS OF THE SUBPROJECTS COVERED BY THE FEASIBILITY STUDY

5.1 Reconstruction of left bank offtake regulator at Kzylorda barrage

5.1.1 Brief characteristics of the Subproject Site and the Area of Influence

The subproject concerns the left-bank irrigation offtake at the Kzylorda barrage, an area heavily transformed during the construction of the barrage in 1956. The Normal Operation Level (NOL) is 129.0 m asl at design discharge of 1200 m³/s. The maximum discharge in case of flood of 1 % probability, equal to 1900 m³/s, results in an upstream water level of 129,37 m asl and a downstream water level of 128.86 m. The Leftbank Magistral Canal (LMK) has a capacity of 208 m³/s used for irrigation of some 62,400 ha of arable lands and some haymaking areas. In winter the LMK is used for flood release when ice jams limit the capacity of the Kzylorda barrage for passing the full river discharge despite of a maximum discharge capacity of 1900 m³/s. The spillage of water into the LMK for flood release purposes contradicts the objectives of SYNAS I and the particular subproject 011 "Reconstruction of Kzylorda headworks" which were justified by the improvement of water discharge to the Aral Sea and avoidance of spillages needed due to limited capacity of water diversion structures.

Fig. 5-1: Overview of the location of the subproject at Google Earth satellite image.

The hydrological situation at the Kzylorda barrage is determined by the overall hydrological characteristics described in section 4.2.3. The releases from Shardara Reservoir are the determining factor for discharges at Kzylorda barrage.

The average annual water flow during the vegetation period at the range of Kzylorda barrage varies: in dry years - 100-250 m³/s, in average wet years - 300-450 m³/s, and in high water years - 500-700 m³/s. The winter flow is less variable - 300-500 m³/s. Ice jams in the Syrdarya River cause temporary winter water levels 1 to 1.5 m higher than the summer water levels at the same discharge.

The annual average of salinity for the period of observations from 1986 to 1996 varied from 1040 to 1230 mg/l; in 2001 it amounted to 1220 mg/l. In dry years the average salinity can be significantly higher, e.g. in 1975 – dry year – it amounted to 2090 mg/l. The salinity varies considerably between the seasons. In 2001 during the flood period it amounted to 1080 mg/l, and during the autumn low-water period - 1540 mg/l. In the chemical composition the sulphate anions (SO_4) and sodium and potassium cations (Na and K) are prevailing. The salinization of the river water requires the application of sulphate-resistant cements for the repair of concrete structures.

The riverbanks of the first one hundred meters of the canal and the first 25 m of the left Syrdarya riverbank upstream from the diversion structure as well as about 80 m Syrdarya riverbank downstream are artificially formed as slopes with uniform standard inclination and are covered with concrete slabs. The ground uncovered in the vicinity of the structure is artificially transformed, i.e. the riverbank enforcement structures have been backfilled and compacted. Thus no natural soil types exist at the project site. The transformed relief and soil conditions determine the vegetation cover.

At the left Syrdarya Riverbank immediately upstream from the canal offtake in gaps between concrete slabs and in gravel below the slabs only few plants of saltworts (Atriplex tatarica, Petrosimonia squarrosa, Salsola nitraria Climacoptera aralensis) and few shrubs and trees (Elaeagnus oxycarapa, Salix songorica, Ulmus pumila) grow. At the lowest, wet parts of the slopes very few fragments of wetlands vegetation ((Eleocharis acicularis, Panicum crus-gali, Mentha aquatica, Schoenoplectus tabernaemontani) are found. On the uncovered riverbanks fragments of tugai forest vegetation (Elaeagnus oxycarapa, Salix songarica, Halimodendron halodendron, Lycium ruthenicum) with a sparse herb layer formed by weedy plants (Zygophyllum oxianum, Glycyrrhiza glabra, Setaria viridis, Pseudosophora alopecuroides, Peganum haramala, Lactuca serriola).

At the reinforced sections of the canal the slabs are partly destroyed or washed out allowing the growth of shrubs (Salix songorica, Halimodendron haolodendron, Lycium ruthenicum, Tamarix hispida) and gasses/herbs (Phragmites australis, Salsola foliosa, S.nitraria) and lianas (Clematis orientalis). Downstream of the reinforced banks bank erosion is taking place. At the not reinforced banks of the canal on both sites very narrow belts of floodplain vegetation (tugai) of shrubs (Elaeagnus oxycarapa, Tamarix ramosissima) and herbs (Alhagi pseudalhagi, Karelinia caspia, Phragmites australis, Suaeda microphylla) are developed. In these belts few turanga poplars (Populus pruinosa) with numerous offshoots from roots participate. The turanga poplars formed in the past large floodplain forests in the Syrdarya valley but are now as rare that they became included into the Red book of Kazakhstan.

During the site visits only few representatives of the typical river valley fauna were observed: swallow (Hirundo rustica) and common tern (Sterna hirundo). About the local fish fauna no information was available. According to the Kazakh Scientific Institute of Fisheries in Aralsk, Zaulkhan Ermakhanov, through the offtake significant numbers of fish are lost from the river into the canal.

The area of influence includes 62,363 ha irrigated agricultural lands and haymaking areas (several ten thousands hectares) supplied by the LMK in the rayons Syrdarya (18,638 ha), Zhalaghash (24,720 ha), Karmakchy (17,254 ha) and the city of Kzylorda (1749 ha). The main crops on these areas are rice (37.446 ha), alfalfa (18,784 ha), wheat, potatoes, vegetables and melons. Close to the canal several villages and infrastructure are located. Around 25,000 people live in the villages potentially affected by flooding caused in case of catastrophic failure of the offtake structure.

5.1.2 Brief characteristics of the Subproject Measures

The reconstruction measures at Kzylorda barrage on the Right bank main canal (RMK) and on hydro stations have been completed. The reconstruction of the left bank irrigation outlet was not included into the SYNAS-I package.

The left bank irrigation offtake at the Kzylorda barrage has been constructed about 50 years ago. During that time of operation no major repair was done and during the last 15 years even the basic maintenance was neglected due to financial constraints. Now the hydraulic structure is in deteriorating condition. This concerns all parts of the structure, i.e. basic concrete structures as are concrete chutes, guidance walls, stilling basin and bottom flushing tunnels, gates, electric and hydro-mechanical equipment as well as the gauging station located one kilometer downstream. Damages are concentrated in the area of variable water level and ice formation. All bottom gates of the flushing galleries and surface gates of the water intake are worn out and corroded. The entire hydraulic structure is in such condition that soon failure is possible. This failure can occur in the range of two thinkable extreme cases. In one scenario the opening of the gates will not be possible, disabling the structure for the diversion of irrigation water. In the other extreme the structure would fail during winter high water, leading to an unregulated spillage of water and related flooding of irrigated arable lands, irrigation infrastructure and even settlements. In the worst cases provisional measures may support irrigation with a limited amount of water in an unregulated regime or blocking of the inflow with emergency measures. However, a collapse of the structure would substantially threaten the water supply of the above mentioned irrigated arable lands and/or lead to an uncontrolled flooding of these lands, making their agricultural use at least for one season impossible.

The subproject foresees the complete rehabilitation of the irrigation outlet. Significant advances in the state of the art by using better materials and better foundations will be made while reconstructing than in the original executed work, including the provision of operation and service buildings. The work should be performed during the 7.5 months off-irrigation season from 1 September to mid April. Considering the occurrence of severe frost for at least two months in the winter two seasons will be necessary for construction. The construction costs are estimated with 367,840,000 Tenge or 3.04 million US$.

The guiding walls and covering slabs of the flushing galleries as well as the old road bridge are to be dismantled, the concrete of the galleries' bottom and walls is to be cut out to the depth of 10 cm, and corroded sections of reinforcement will be cut out and replaced by new reinforcement. The surface will be sealed with waterproofing mixture. The stilling water basin bottom and slopes will be completely rebuilt. It is foreseen to replace the operation bridge by a new one. The concrete slabs at the aprons will be replaced. Downstream of the apron it is foreseen to construct a well for an automatic regulator level sensor. At a distance of 1 km from the intake it is planned to establish the gauging station with the swing bridge, and a well for the logger. The site adjacent to the offtake regulator will be paved with asphalt. A pumping station with water intake from the river is foreseen for watering of the greenery. A shelter and a septic-tank will be built for the barrage's security service. Additionally it is planned to provide for lighting of the adjacent area and downstream part of the offtake regulator.

The bottom and surface gates and hoists will be replaced, under utilization of existing cable ducts, by new ones as well as all the electric and mechanical equipment and cable lines. According to the selected operational scheme of water level and discharge control in the left-bank main canal, it is foreseen to automatically maintain the water level. Level meters will be located in the wells along the canal: the first one – in the measuring well to be operated together with the automatic regulator, and the second – at the gauging station at a distance of 1 km.

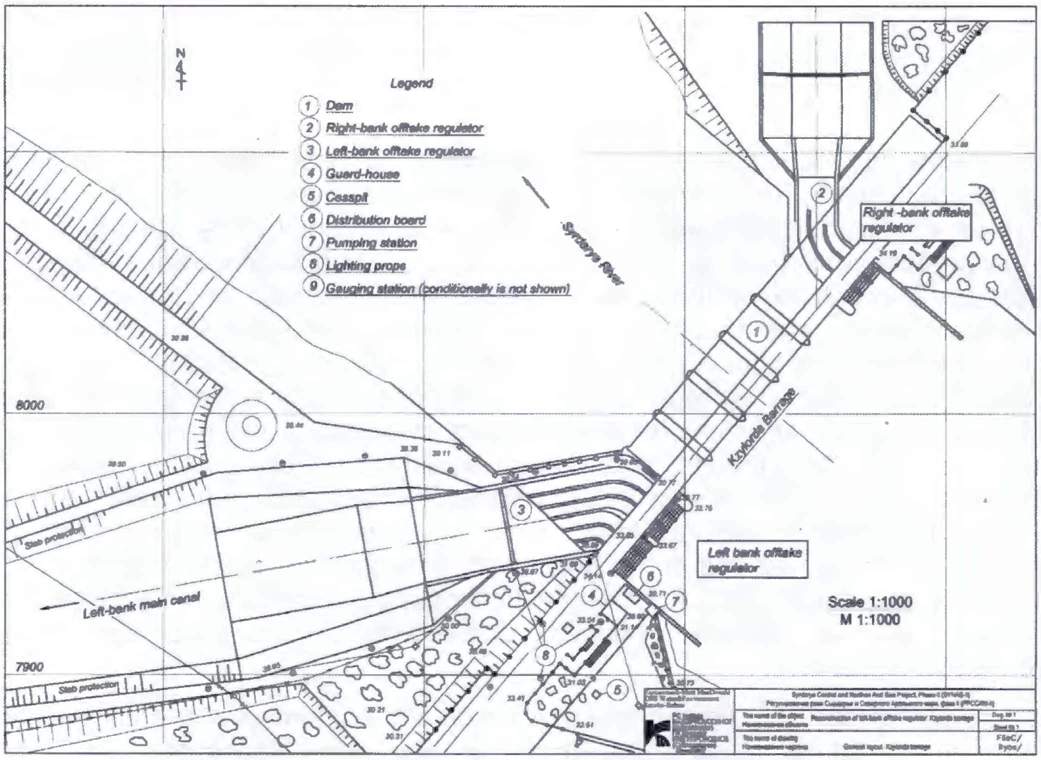


Figure 5-2: ***General layout of the Kzylorda LMC offtake structures to be reconstructed***

5.1.3 Without Project Case

(a) Impacts on the hydrology of the river system

Without the project a failure of the left bank outlet is possible. Such a failure would result in a reduced or completely lost controllability of water discharge into the LMK which would have hydrological implications. If the failure of the structure leads to the blocking of closed gates the withdrawal of water from the river would be stopped or at least reduced. Consequently a smaller amount of water would be available for irrigation. This would increase the downstream water availability, in particular in times of shortage of irrigation water. However, such a situation would cause degradation (salinization) of the majority of lands relying on water supply from the outlet. This environmental and social economic damage would largely exceed the small benefits from increased downstream water availability.

During winter the LMK offtake is used for release of excess water from the Syrdarya when ice jams reduce the discharge capacity of the Kzylorda barrage below a critical level. In this situation a failure of the offtake structure could result in an unregulated spillage into the LMK. This can lead to damages at irrigation infrastructure, irrigated lands and even settlements and to an undesired high withdrawal of river water.

Fortunately, so far the described situation is entirely hypothetical. Since winter 2006/2007 one of the six gates is out of operation and permanently blocked. The capacity of the remaining gates is still sufficient for supply of irrigation water and no shortages have been reported by local administrations and water management authorities.

(b) Impacts on water quality

Impacts on water quality by the without project case are unlikely. However, it cannot be excluded that floods caused by impossibility to regulate an emergency spillage in winter, as described above, can lead to the contamination of water with oil derivates and/or agrochemicals.

The reduction of available water for leaching and irrigation may reduce the amount of saline drainage water spilled via collectors. However, this effect would be of short term and later on the salinized soils would require intensive leaching for rehabilitation, causing respective salt loads of drainage water disposed into lakes, wetlands and potentially also into the Syrdarya River.

(c) Impacts on atmospheric air

In the case of failure of the existing offtake, irrigated lands could become abandoned in a large scale due to shortage of irrigation water or flooding. The abandonment of lands would have some local effect on air humidity and the developing salt crusts can contribute to a slight increase of salt-dust content in the air.

(d) Impact on soils

So far no soil degradation is reported to be caused under the present operational conditions of the irrigation offtake. But the unavoidable worsening of the operational conditions of the structure, impacts are likely. The abandonment of irrigated lands due to extreme floods or to lack of irrigation water would cause waterlogging and/or salinization of soils.

(e) Impacts on biodiversity

The failure of the existing irrigation outlet in the without subproject case would lead to the replacement of the existing agricultural ecosystems by secondary salt resistant (shrub-)vegetation of limited environmental value. In both cases – flooding or insufficient irrigation water supply - the situation would likely remain unstable. The rehabilitation of the former natural vegetation would only be possible over several decades with stable ecological conditions. Such a scenario of large scale renaturation of agricultural lands would contradict economic and political development concepts for the region.

(f) Impacts on human environment

More than sixty thousand hectares of irrigated land depend on the regular and safe supply of irrigation water every year. The deterioration of the irrigation outlet may at any time make the operation of the structure impossible leading to irrigation water shortage or winter floods. In the best case a gradual deterioration in the course of years may lower conveyable water quantities to a point where only a part of the irrigation area can be served. This would affect the livelihoods of tens of thousands of people employed in arable farming, including those cultivating small individual household plots. Further the LMK provides directly or indirectly via the collector and drainage system water for irrigation of hay making areas and for watering of livestock. The failure of water supply to these areas would make livestock breeding more difficult and may in some cases require relocation of herds. A failure of the irrigation system may also affect the drinking water supply of the villages in the irrigation area and thus affect human health. Further direct destruction of houses and infrastructure is thinkable in the case of a flood caused by unregulated excess water spillage. Finally the failure of the hydraulic structure can in one or another form cause conditions which would force several thousand people to relocate.

5.1.4 Environmental Impact during Construction

(a) Impacts on the hydrology of the river system

During the construction phase all works requiring a reduction of the water discharge will be timed outside the irrigation season. It is planned that reconstruction work will be phased in a way that allows full irrigation operations. However a temporary reduction of the number of operational gates cannot be excluded, reducing the canal discharge and thus the amount of irrigation water available at one time by up to 50%. In the result a higher flow would occur in the Syrdarya River. This flow increase would be in the range of the natural flow variations and not have any significant environmental implications.

The large capacity of the irrigation outlet (208 m^3/s) has been used in the past to relieve flood pressure on the barrage and on Kzylorda city immediately downstream of the barrage. This will not be possible during reconstruction, potentially engendering a slide increase of the flood risk. However, the discharge capacity of the barrage and the rehabilitation works done under SYNAS-I should allow a safe passing of high flows in the river. The planned right-side embankment strengthening in Kzylorda city (expected to be financed and implemented outside SYNAS-I) should preferably be completed before the start of the works on the left-bank offtake. Further the planned construction of the Koksaray Reservoir and an improved operation regime of Shardara Reservoir will finally remove the need for winter flood release into the LMK.

(b) Impacts on water quality

Water pollution will not be caused by the project except the possible case of accident of construction machinery during the construction phase. The observation of all applicable rules on maintenance and safety will minimize this risk.

(c) Impacts on atmospheric air

The civil works like dismantling of existing concrete structures and the exhaust fumes from machinery will cause local air pollution. This impact is limited in time and space and of low significance compared to other sources of dust and chemical pollution in the city and vicinity of Kzylorda.

(d) Impact on soils

Soil contamination by pollutants during the construction phase can be caused by leaking machinery and fuel and lubricant storage. Such contamination may not affect large areas. Any soil pollution is to avoid by observation of the applicable maintenance and safety requirements.

The subproject will not require the utilization of significant areas of land so far not used as it concerns the replacement of existing structures. The debris of the removed old concrete structures will be recycled in an appropriate way and is not to be dumped into natural habitats. After crushing it will be used for the paving of roads or fixation of dikes. The amount of needed new earth, sand and gravel is small. So far no specific sources have been identified. However, the low needed amounts can be obtained from already existing quarries and no new development will be needed.

(e) Impacts on biodiversity

The civil works at the offtake will cause the complete removal of the fragmentary vegetation at the project site. This impact is unavoidable. It concerns only plant species and vegetation types which are abundant in the project region and will easily regenerate. The turanga poplars mentioned under 6.1.1 are located outside the immediate project site and should not be removed. As the species is adapted on fluctuating water levels no indirect impact is to expect from the temporary reduction of flow in the canal.

The project site has no specific importance for the animal world as it is small by size and intensively transformed. Thus no significant impact on fauna and its habitats is expected for the construction period.

(f) Impacts on human environment

During the construction phase possible agricultural production losses during the irrigation season must be taken into account. The areas potentially affected by shortage of irrigation water and the scale of related production losses have not yet been estimated. There are basically two options in case of irrigation water shortages during the construction period. Either a part of the lands would be fully supplied while other would become temporary fallow, or all irrigated lands would receive water in insufficient quantities or timely unfavorably. These problems will be minimized by timing the construction activities in the non-irrigation season and by keeping the irrigation outlet at least partly operating during the summer between the two planned construction periods.

5.1.5 Environmental Impact during Operation

(a) Impacts on the hydrology of the river system

The impact on the hydrology under normal operation of the new offtake will be insignificant because the amount of water withdrawn from the Syrdarya will not change compared to the present situation. No increase of irrigated areas is envisaged.

The subproject will not impact on the ground water in the vicinity of the immediate project site but will influence on the ground water in the irrigated areas. The renewed outlet regulator will allow supplying water regulated and in time to the left-bank canal, to avoid excess irrigation leading to waterlogging and resulting salinization.

(b) Impacts on water quality

Water pollution will not be caused by the operation of the reconstructed offtake structure. Except of limited amounts of lubricants for mechanical equipment no dangerous substances are applied during operation. The observation of all applicable rules on maintenance and safety will minimize the risk of contamination of water. The sustaining of irrigated agriculture on large areas as intended by the project is unavoidable related to the leaching of soils and the arising of mineralized drainage water. The project will not increase the amount and salinity of drainage water above the current norms.

(c) Impacts on atmospheric air

The operation of the subproject will not have direct impacts on atmospheric air. The efficient operation of the reconstructed flushing galleries will allow flushing of sediments into the river's downstream reaches. This will replace the dumping of sediments from the main canal and avoid dust emissions from these dumped sediments.

(d) Impact on soils

The impact of the operation of the structure reconstructed by the subproject is in the area of influence where the degradation of soils as described under the without project case will be avoided. No additional or changed compared to the present situation impacts will occur at the project site.

(e) Impacts on biodiversity

The subproject will neither lead to changes of the landscape nor of natural or cultural ecosystems and no significant impact on flora and fauna is expected at this already transformed site and area of influence.

(f) Impacts on human environment

The realization of the subproject will ensure the reliable and regulated irrigation water supply needed for the maintenance and improvement of the agricultural production in particular rice cultivation and cattle breeding in the area of influence.

5.1.6 Impact in case of worst possible incident

The worst case scenario apart from the above analyzed failure of the existing outlet would be the impossibility to provide sufficiently irrigation water during the summer between the construction periods. An adequate compensation or insurance scheme should be in place for minimizing the risk for the farmers. Another risk is the above mentioned flood situation when no excess water can be spilled through the irrigation outlet. This situation is very unlikely and can be avoided by adequate operation of Shardara Reservoir and upstream located abstraction structures.

5.1.7 Synergies with other subprojects

The operation of the irrigation scheme would be positively influenced by the existence of the counter-regulating Koksaray Reservoir which would avoid the need for winter discharge of excess water via the existing or new structure. The release of retained winter flow in summer will improve the water availability during the irrigation period. The strengthening of the right embankment of Syrdarya River on the territory of Kzylorda city will reduce the probability of flood damage during the construction period and contribute to the avoidance of emergency spillage in the LMK during operation.

Conclusion about the environmental impact

The subproject has no direct or indirect negative environmental impacts. On the other hand, the project provides little benefit for the achievement of the major objectives of the SYNAS-II project. It does not contribute to the environmental revival of the NAS and the delta area and the improvement of the overall environmental conditions in the KSB nor does it contribute to improving overall water use efficiency in the basin. These limitations are caused by the purpose and character of the subproject which is oriented on the rehabilitation and sustainability of a still existing structure. The limited scope of the subproject does not provide for significant contributions to the achievement of the objectives of SYNAS-II. As the without subproject scenario imposes a considerable risk for significant environmental deterioration of more than sixty thousands of hectares irrigated land the overall environmental impact of the subproject is, nevertheless, positive.

Impact assesement and environmental protection measures in the considered sub-project are given in the annex (Annex 1.1).

Factors, sources, potential types of impact and environment components, on which the subproject exerts an influence, are given in the annex (Annex 2.1).

Residuai impact after completion of measures are given in the annex (Annex 3.1).

5.2 Syrdarya river bed straightening at Korgansha and Turumbet sites.

5.2.1 Brief characteristics of the Subproject Site and the Area of Influence

The sub-project is supposed to be implemented at two sites Korgansha and Turumber, located at Zhalagash district of Kzylorda oblast

The location of the proposed objects is given at fig. 5-3 .

Brief description of environmental conditions at sites of the proposed objects is given in table 5-1.

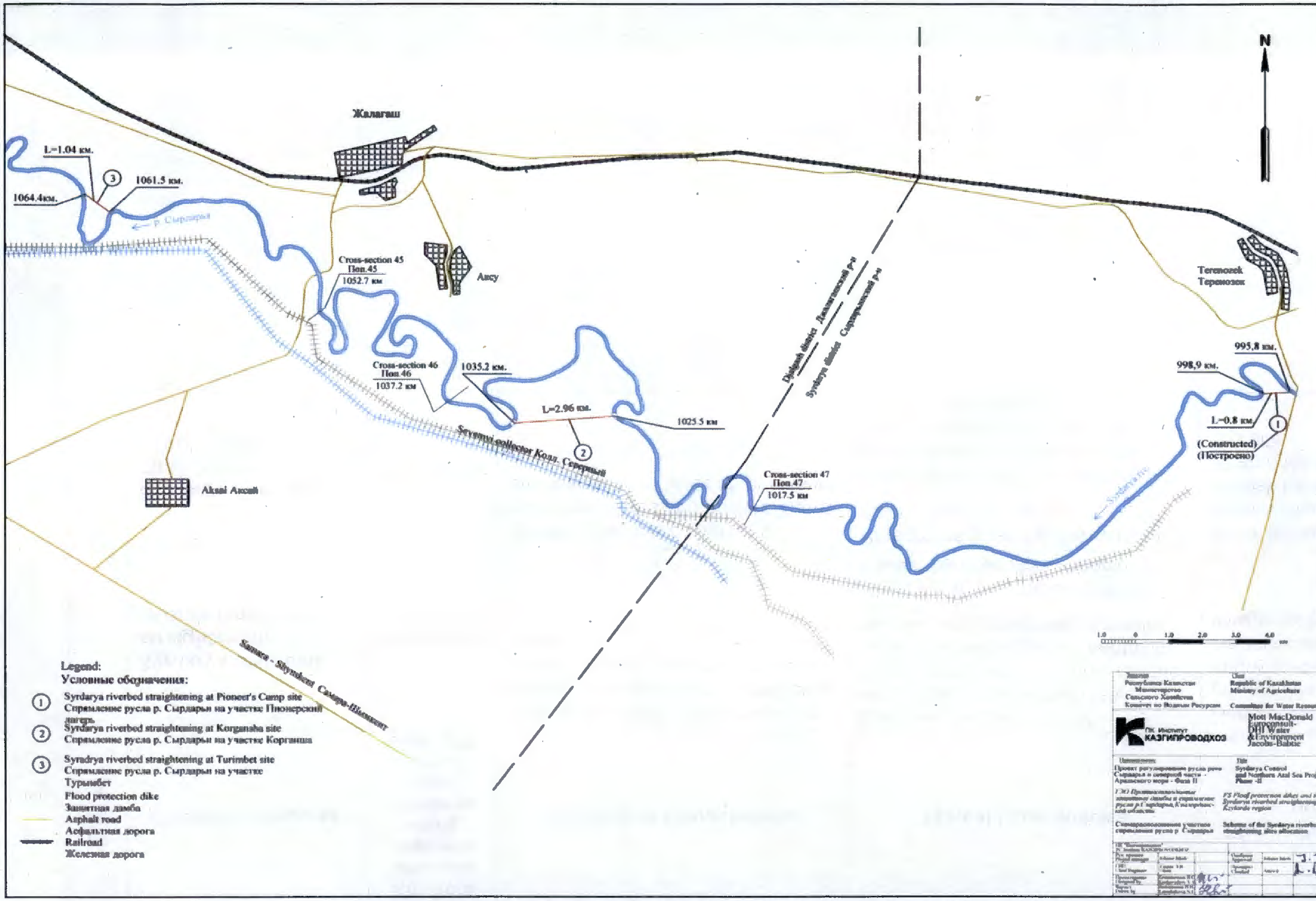


Fig 5-3:

Scheme of the Syrdarya riverbed straightening' at Korgansha and Turumbet sites

Table 5-1: Environmental conditions at sites of sub-project Syrdyarya river bed straightening .

№ site	Planned measures	Km from Shardara reservoir along Syrdarya river / Cross scetion ID	Ecosystem characteristic	Typical / rare species	Flood situation / Comments on protected objects
1	**Syrdarya river bed straightening - "Korgansha" site**	1024.9 / 46	Natural floodplain, with prevalence of reed, hay vegetation, high herns, several bushes and small groups of trees.	Eleagnus oxycarpa, Salix songorica, Populus pruinosa, Glycyrrhiza glabra, Elytrigia repens, Calamagrostis epigeios, Xanthium strumarium, Phragmites australis Great egret, grey heron, marsh harrier, barn swallow, magpie	None of the mentioned objects (village Aksu, bridge, OVL actually endangered by floods which would be addressed by the measure. Aksu village protected by local dikes.
2	**Syrdarya river bed straightening– «Turumbet» site**	1067.0 / 44	Dynamic floodplain with reed, meadows, herbs and bushes.There are abanadoned fields at peninsula	Phragmites australis, Glycyrrhiza glabra, Elytrigia repens, Common tern, grey and purple heron, pheasant, barn swallow, blue-cheeked bee-eater, marsh harrier, isabelline shrike, roller	River already since decades close to the collector. No immediate risk. No risk for Zhalagash and Shamenov village from ice jams at this site.

5.2.2 Brief characteristics of the Subproject Measures

For a thorough environmental impact assessment usually a detailed project of the planned activity is required. In the proposed form the sites for dike strengthening, construction of new dikes and straightening of river sections have been selected by the responsible engineer initially without own field visit on the basis of wishes expressed by the rayonvodkhoz organizations of the Zhalagash district.

That's why during the elaboration of the present assessment only very general and brief descriptions and drawings on 1:200,000 topographic maps were available.

The approach underlying the preliminary design of the flood protection measures seems to be based on the intention of controlling the river, keeping the river in its major course and not allowing expansion on the floodplain.

However, any flood protection measure and even the strengthening of existing dikes is unavoidably causing adverse environmental impacts. Where the need for construction measures r there suitability for fulfilling their function is clearly not given, the environmental impact assessment would need to call for refraining from the measure, just because of the need for avoiding unnecessary adverse environmental impacts.

The pre-feasibility study provides the following information on the planned measures to be assessed in the frame of the present preliminary EIA.

Syrdarya river bed straightening

At two sections of the river in Zhalagash district it is planned to divert the river by digging channels cutting of the meander and straightening the riverbed. The channels present themselves as trench, which transition smoothly to the river. The channel has the bottom width of 30 m, slope steepness 1:2 and depth of excavation to 8 m. The self-scouring of the channel will occur with time. To accelerate the self-scouring in the upstream part of the channel a cofferdam is to be constructed. It will create an additional backwater effect and increased velocity of water at the entrance into the channel. The structure of the channel for Korgansha and Turumbet sites is given in Fig. 5.4,5-5.

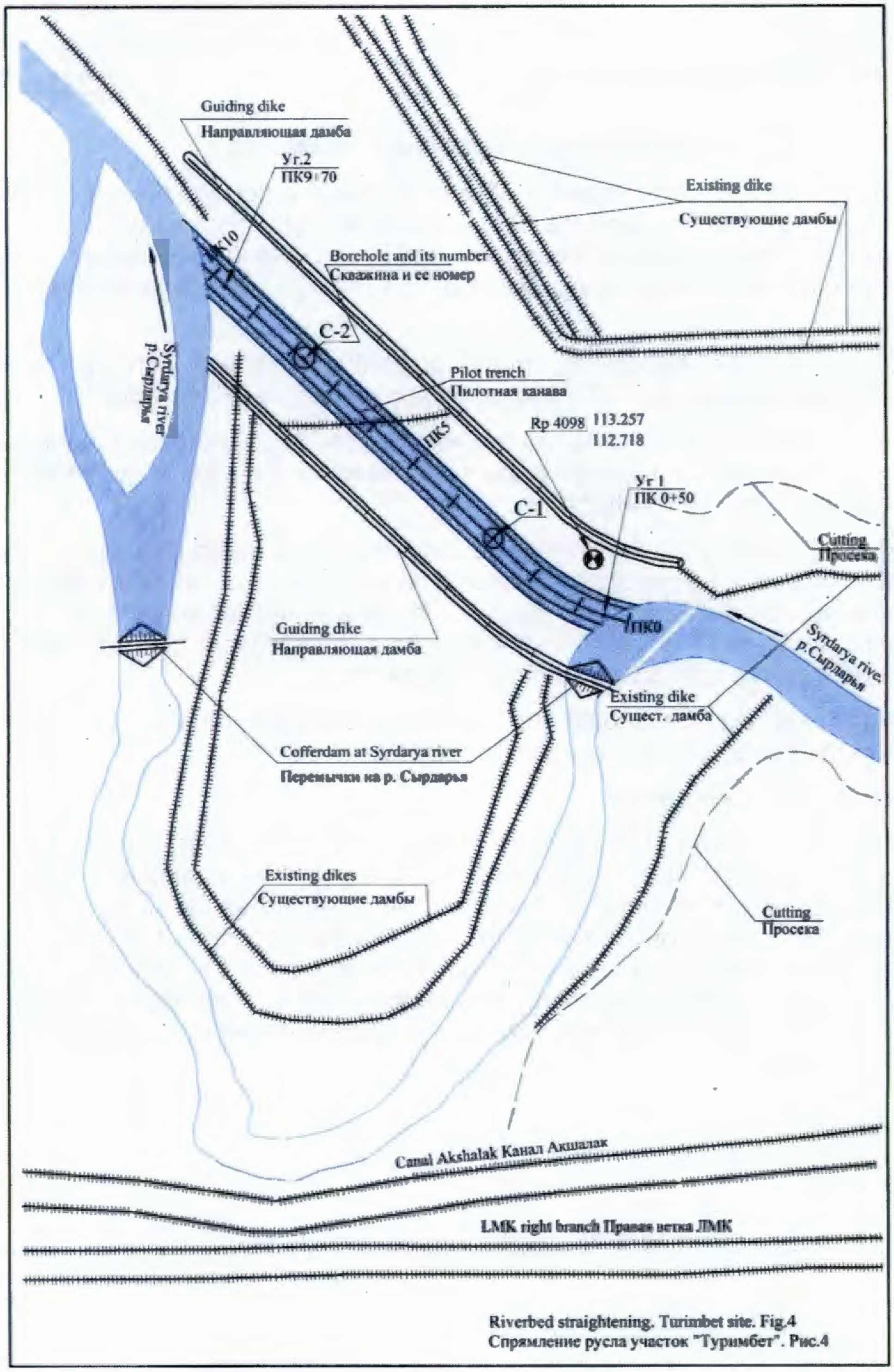


Fig 5-4: River bed straightening at Turumbet site

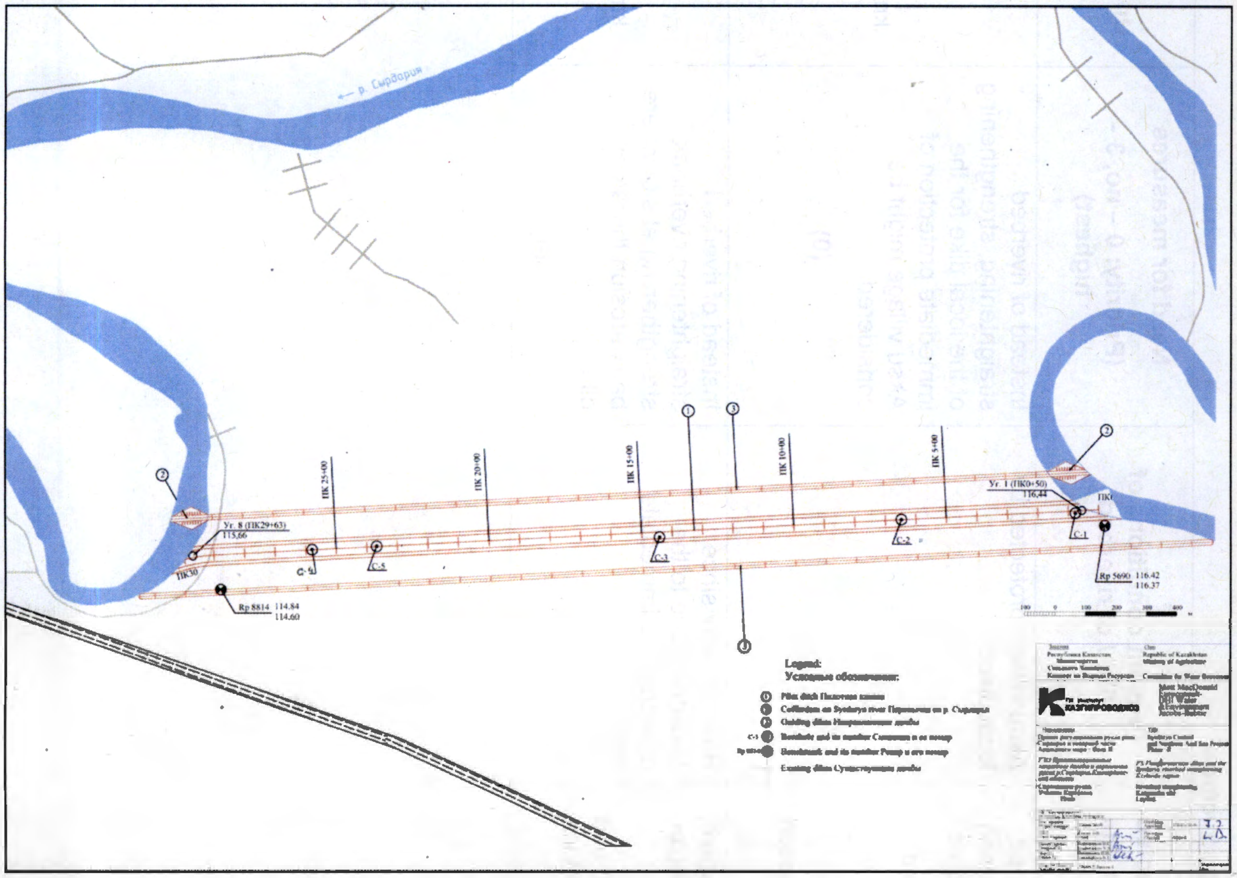


Figure 5-5: River bed straightening at Korgansha site

Table 5-2: Planned flood protection measures and conditions of existing structures

№	Name	Km from Shardara /cross section ID	Objects to be protected (Remarks based on site visit)	Present conditions of dike / of riverbed	Need for measures (Priority: 0 – no, 3 - highest)	Unit	Q-ty
1	**Syrdarya river bed straightening at «Kargansha» site**	1024.9 / 46	Aksu, bridge, motor road, OVL – from bank scouring and formation of ice jams (None of the mentioned objects (village Aksu, bridge, OVL actually endangered by floods which would be addressed by the measure.)	Aksu village protected by local dikes.	Instead of riverbed straightening, strengthening of the local dike for the immediate protection of Aksu village might be considered. **(0)**	km	2,96
2	**Syrdarya river bed straightening at "Turumbet" site**	1067.0 / 44	Shamenov aul, Zhalagash, OVL, motor road, collector «Severnyi». (No risk for Zhalagash and Shamenov village from ice jams at this site.)	River already since decades close to the collector. No immediate risk.	Instead of riverbed straightening riverbank strengthening at site where bank erosion threatens dike. **(0)**	km	1.04

5.2.3. Without Project Case

(a) Impacts on the hydrology of the river system

Since the change of operation mode of the Naryn cascade, the largest reservoir cascade, to winter power generation mode high winter discharges resulting in floods became typical for the lower reaches of the Syrdarya River.

In the currently developed SYNAS-II package the construction of the Koksaray Reservoir is included as high priority measure. The operation of this reservoir as counter-regulator will allow shifting the period of high water from winter to the vegetation period.

The Syrdarya is a typical meandering lowland river. The meanders extend the overall length of the river course and thus increase the time the water flows down to the Aral Sea. This slows down flow velocity acts as a buffer in case of high discharges and delays the occurrence of flood events in the downstream reaches. On the other hand, in narrow meanders ice jams can build up, leading to backwater and flooding of floodplain areas.

(b) Impact on water quality

The impact on water quality of the "without project case" is minor. No industrial objects are located in the potentially flooded areas and thus no risk of contamination with hazardous chemicals exists. During flood events erosion is increased leading to a higher sediment load than under average conditions. On the other hand flooding of large areas slows down low velocity and leads to a higher sedimentation rate of particles carried by the river. Thus total sediment load of the river is reduced.

(c) Impacts on atmospheric air

No impact on atmospheric air can be predicted under the without project case

(d) Impact on soils

Floods are an integral part of geo-morphological and soil formation processes in natural floodplains. Flooding allows sedimentation of loams in the floodplain. Under good drainage conditions it leaches salts while under poor drainage it can cause salinization. All these processes can take place in the areas influenced by floods under the "without project case". Further this case preserves the in some extent the natural geo-morphological dynamics, in particular riverbank erosion and accumulation. These processes are essential for the floodplain ecosystems.

(e) Impact on biodiversity

In the "without project case" remnants of natural biodiversity in floodplain areas so far not divided from the river, would remain

The existence of a naturally meandering river course is an essential element of the landscape diversity and key basis for the preservation of many elements of ecosystem diversity and species diversity depending on a living river .

A negative aspect from a biodiversity point of view is the currently not natural timing of high discharge and floods. Out of season flooding adversely affects ecosystems and species adapted to the natural flood regime. This problem concerns, for instance plants (as the turanga poplar) requiring timely flooding for generative rejuvenation, birds adapted in their breeding seasonality to the floods, as well as many invertebrates. The implementation of the project measures would even increase this environmental problem as it would further reduce flooded areas and flood frequency and cut off meanders from the river dynamics

(f) Impacts on human environment

In the context of the feasibility study human environment includes property as well as land-use and impact on health. Under the "without project case" no direct threat for human live exists.

Conclusion:

The "without project case" is from an environmental point of view always to be preferred against flood protection measures. But as human settlements and infrastructure need to be protected, the preferred solution in the frame of SYNAS-II and beyond should be a timing of high discharge and flooding in accordance to the natural flow dynamics. Flood protection of human property would be better achieved by local, specific protection of threatened objects, temporary or permanent relocation of valuable property and adaptation of land-use.

5.2.4 Environmental Impact during Construction

(a) Impacts on the hydrology of the river system

No impacts on the hydrology are expected during the construction of river straightening works and other activities planned under the sub-project.

(b) Impacts on water quality

Water contamination by pollutants during the construction phase can be caused by leaking machinery and fuel and lubricant storage. The observation of all applicable rules on maintenance and safety will minimize this risk

Other foreseeable impacts of the sub-project on water quality are insignificant

(c) Impacts on atmospheric air.

Dust emissions from earth movement and transportation and the exhaust fumes from machinery will cause local air pollution. This impact is limited in time and space.

(d) Impact on soils

Soil contamination by pollutants during the construction phase can be caused by leaking machinery and fuel and lubricant storage. Such contamination may not affect large areas. Any soil pollution is to avoid by observation of the applicable maintenance and safety requirements

The subproject will require the utilization of significant areas of land:

- Riverbed straightening at a length 4.0 km with a width of new canal and embankments of 100 m would affect 40.0 ha of soils.

The sub-project in its full extent would cause destruction of natural soils at an area of approximately 450 ha. The areas size might be considered being not very significant compared to the total area of influence of the sub-projects.

(e) Impact on biodiversity

The civil works will cause a complete destruction of vegetation and fauna at the immediate project sites. At sites of river bed straightening the regeneration of vegetation at heavily disturbed sites can be problematic.

Damage will be caused by access roads, fuel wood cutting by construction workers, disturbance of wild animals and poaching. The Syrdarya floodplain is an important habitat of the pheasant, duck and geese species as well as waders. All of them are potential subject of poaching. The presence of a larger number of people increases the risk of wildfires, one of the most significant current factors threatening biodiversity and preventing natural regeneration of tugai woodlands and forests.

(f) Impact on human environment

At construction sites temporary impacts include dust emissions, noise and impact on aesthetic value of the landscape.

The available information indicates that no physical cultural property will be affected by the project.

Conclusion

The most relevant impacts during the construction period concern soils and biodiversity. They are related to physical irreversible transformation of lands and its soils and habitats and to the disturbance of larger areas of influence. The minimizing of these impacts can be achieved by limitation of flood protection measures to those sites where they are unavoidable and by the planning of necessary measures in the vicinity of the objects to be protected.

5.2.5 Environmental Impact during Operation

The planned riverbed straightening will reduce the risk of ice jams at some sites and thus reduce winter floods by backwater. While this is an appreciated effect the total impact is negative because the straightening measures will shorten the overall length of the river and thus increase flow velocity and move flood problems to downstream areas. The old river branches cut off from the river are drying out.

Prevention of flooding can have negative effects on ground water quantity and mineralization in the floodplain areas. In the vicinity of cut off river branches likely ground water levels will drop

(a) Impacts on water quality

Foreseeble impacts of the sub-project on water quality in the river are insignificant. Ground water mineralization can increase in the vicinity of river branches cut off by river bed straightening.

(b) Impact on atmospheric air

No impacts on air are expected from the sub-project..

(c) Impact on soils

Lack of flooding and reduced ground water due riverbed straightening will change the character of hydromorphic soils.The planned riverbed straightening would completely bring to a halt the natural geo-morphological dynamics of erosion and accumulation in the meanders.

(d) Impacts on biodiversity

The river landscape of the Syrdarya is characterized by its geo-morphological dynamics, in particular the existence and dynamics of many meanders and the development of temporary islands in river sections with sediment accumulation. The planned riverbed straightening would negatively affect the characteristic river landscape. The total number of meanders was continuously reduced during the last years by step-by-step straightening of the river. The negative impact of further straightening measures on the landscape character would hence be very significant.

The flora and fauna of floodplains is adapted to regular flooding. If this is prevented the typical species diminish. The areas flooded during spring, including pieces of arable land, are during the spring migration used for resting by many waterfowl species and waders. The prevention of flooding of irrigation areas may cause the loss of these resting sites. The floodplain ecosystems are habitats for a rich diversity of nesting bird species. These species depend on the whole range of habitats, from bare sand banks, via meadows, forbs and reeds to shrub and woodlands. Particular critical are all measures which reduce the natural dynamics of flood and geo-morphological processes, i.e. the straightening of meanders

Flooded reeds and grasslands are by many fishes used for spawning. The avoidance of flooding of such areas can negatively affect the reproduction of these fish species

(e) Impacts on human environment

No physical cultural property will be affected by the operation of the project.

5.2.6 Impact in case of worst possible incident

The worst case situation would be a formation of ice jam on channel during an extreme high flood in winter, e.g.caused by upstream problems, that is the recurrence of the situation, taking place without river bed straightening.

Such a situation probably cannot be prevented by the sub-project, because an early warning and evacuation system system would be needed for saving the live of people living in the potential flood zone. The first measure for such a warning and evacuation system would be the development of a spatial dynamic flood model for potentially critical zones

5.2.7 Synergies with other subprojects

Already built Koksaray counter-regulator would allow avoiding regular floods during winter and would essentially reduce capital investments in this sub-project. Local repair and regular maintenance of existing channels of river bed straightening would be sufficient

Conclusion about environmental impact

Impacts of planned flood protection measures on hydrology, soils and biodiversity are largely negative or indifferent. Impact on land use opportunities are more positive. The sub-project only in a limited scale will contribute to the environmental revival of the NAS and the delta area, to the improvement of the overall environmental conditions in the KSB and to the improvement of overall water use efficiency in the basin. This contribution is mainly linked to the avoidance of emergency spillage into desert depressions where the water would be irreversibly lost.

Impact assesement and environmental protection measures in the considered sub-project are given in the annex (Annex 1.2).

Factors, sources, potential types of impact and environment components , on which the subproject exerts an influence , are given in the annex (Annex 2.2).

Residuai impact after completion of measures are given in the annex (Annex 3.2).

5.3 Flood Protection Dikes in Kazalinsk and Karmakchi districts of Kzylorda oblast

5.3.1 Brief characteristics of the Subproject Site and the Area of Influence

The sub-project is supposed to be implemented on two sections, located in Kazalinsk and Karmakchi districts of Kzylorda oblast.

The location of the ojects (dikes to be reconstructed) in Kazalinsk and Karmakchi districts of Kzylorda oblast is given at figures 5-6 – 5-8

The reinforcement of the existing dike for the selected objects 5,6,8 is proposed for the section in Kazalinsk district.

The reinforcement of the existing dike for the selected objects 13(18),13A is proposed for the section in Karmakchi districts.

Brief characteristic of environmental conditions at the sections on the proposed objects is given in table 5-3.

Summary Bill of Quantities Сводная таблица обьемов работ
Objects 5,6,8 . Объекты 5,6,8

	Description Виды работ	Unit of meas. Ед.изм.	Q-ty Кол-во
1	Topsoil cutting, t=0.2 m, on the dike slopes anf foot Срезка растительного слоя t=0.2 м на откосах и подошве дамб	th. m^3 тыс.$м^3$	145.9
2	Topsoil cutting, t=0.2 m, on the borrow area and reserve' surface Срезка растительного слоя t=0.2 м с поверхности карьера и резерва	th. m^3 тыс.$м^3$	139.3
3	Construction of dikes with wetting and rolling-on Устройство дамб с увлажнением и укаткой	th. m^3 тыс.$м^3$	1677.1
4	Leveling of the dike' crest and slope Планировка гребня и откоса дамб	th. m^2 тыс.$м^2$	655.0
5	Leveling of the borrow area and reserve' surface Планировка поверхности резерва и карьера	th. m^2 тыс.$м^2$	696.5
6	Construction of road crossings and extensions Устройство разъездов и переездов	th. m^3 тыс.$м^3$	87.3

Figure 5-6: ***Overview of location of protection dikes on objects 5, 6, 8.***

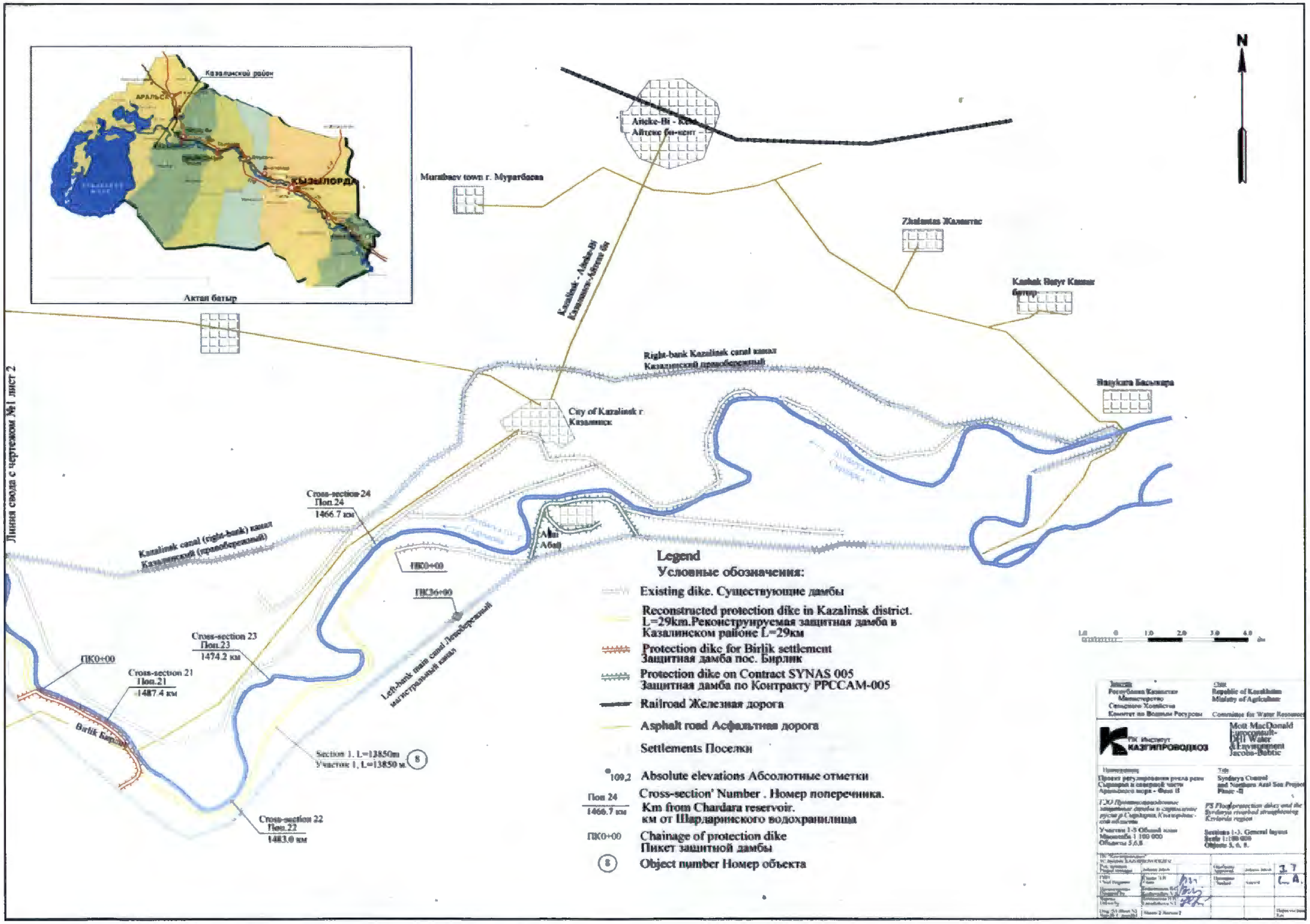
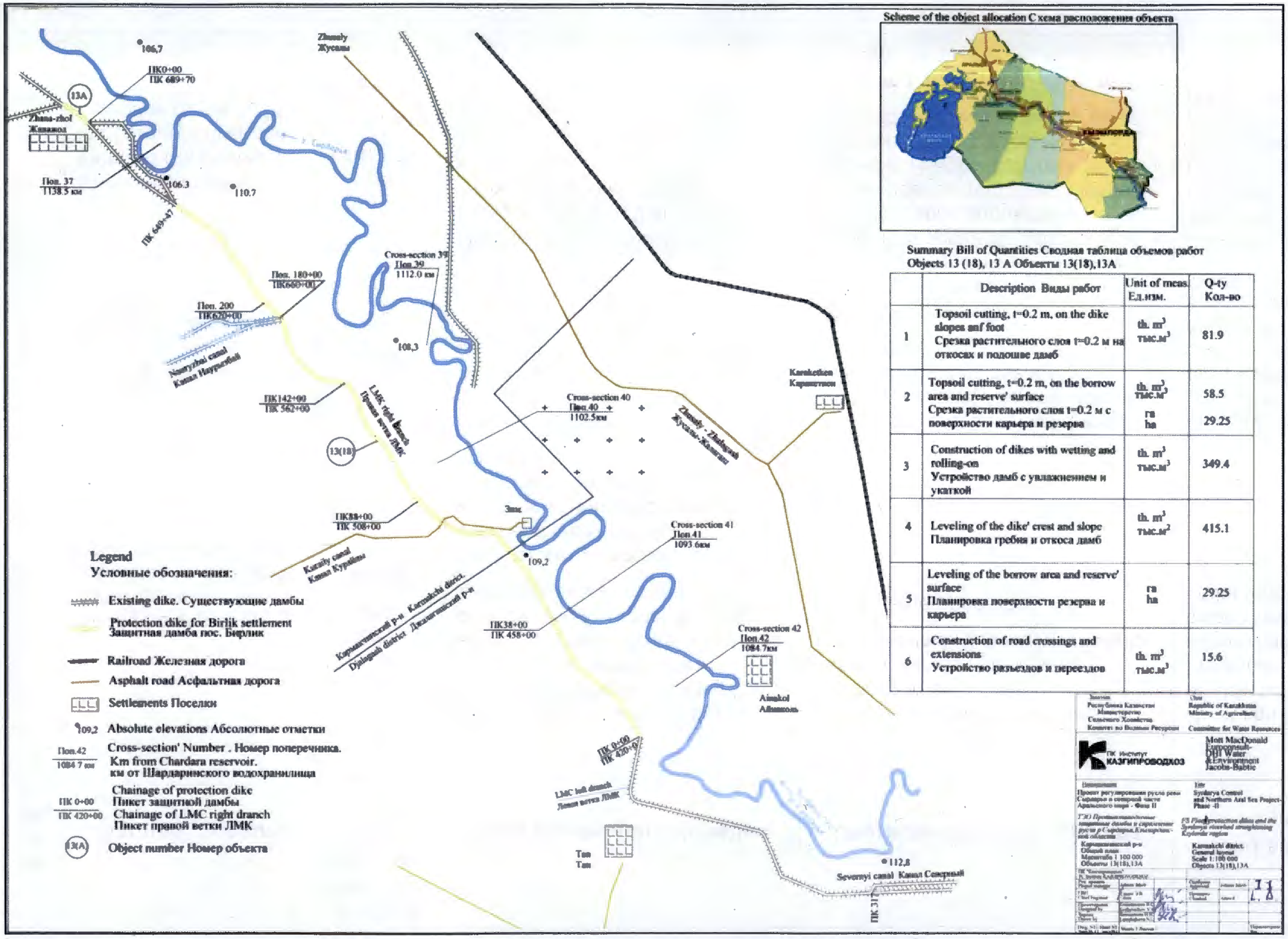


Figure 5-7: Overview of location of protection dikes on objects 5, 6, 8.



Summary Bill of Quantities Сводная таблица объемов работ
Objects 13 (18), 13 A Объекты 13(18),13A

	Description Виды работ	Unit of meas. Ед.изм.	Q-ty Кол-во
1	Topsoil cutting, t=0.2 m, on the dike slopes anf foot Срезка растительного слоя t=0.2 м на откосах и подошве дамб	th. m³ тыс.м³	81.9
2	Topsoil cutting, t=0.2 m, on the borrow area and reserve' surface Срезка растительного слоя t=0.2 м с поверхности карьера и резерва	th. m³ тыс.м³ га ha	58.5 29.25
3	Construction of dikes with wetting and rolling-on Устройство дамб с увлажнением и укаткой	th. m³ тыс.м³	349.4
4	Leveling of the dike' crest and slope Планировка гребня и откоса дамб	th. m³ тыс.м²	415.1
5	Leveling of the borrow area and reserve' surface Планировка поверхности резерва и карьера	га ha	29.25
6	Construction of road crossings and extensions Устройство разъездов и переездов	th. m³ тыс.м³	15.6

Fig 5-8: ***Overview of location of protection dikes on objects 13(18);13A.***

Table 5-2: Ecological conditions at the sub-project sites on construction of flood protection dikes

№ of object	Planned measure	km from Shardara res. along Syrdarya / cross section ID	Ecosystem characteristics	Characteristic / rare species	Flood situation / Comments on protected objects
5	Strengthening of the **existing dike** between the Syrdarya river and Left-bank Canal "LMK"	1513 - 1518 / 18 - 19	Outside the dike solonchak with typical shrub and reed vegetation. Halophytic vegetation. Few abandoned melon fields. Inside the dike, beyond the canal rice fields, large portion abandoned. South of Alseyt (pontoon bridge) outside of dike floodplain vegetation dominated by reed with few shrubs. Beyond the main canal rice fields.	Phragmites australis, Halostachys, Halimodendron halodendron, Tamarix hispida, T.elongata, T.ramosissima, Suaeda microphylla Marsh harrier, pheasant.	Need and functionality of part north of Alseyt-road to be verified! Protection of In large sections abandoned / fallow rice fields. Not clear if village Bekarystanbi is under threat from this side.
6	Strengthening of the **existing dike** between the Syrdarya river and Left-bank Canal "LMK" - (3 sites)	1487.9 - 1501.3 / 20	Between Kazalinsk LMK and river natural floodplain with wetlands (reed), locally solonchak with shrubs and halophytic vegetation.	Phragmites australis, Typha spec., Lythrum salicaria, Ailuropus littoralis, Halimodendron halodendron, Halostachys black tern	Dike indicated in Pre-FS not functional. Existing right-bank dike of Kazalinsk LMK locally overtopped, at one site between #5 and #6. Protection of LMK and irrigated lands on its left side justified.
8	Strengthening of the **existing dike** between the Syrdarya river and Left-bank Canal "LMK"	1467 - 1476.7 / 23 + 24	Outside of dike, close to the river Eleagnus trees, further extensive wetlands with reed, locally solonchak	Phragmites australis, Lythrum salicaria, Typha angustifolia, Bolboschoenus maritimus, Eleagnus oxycarpa, Pseudosophora alopecuroides, Halimodendron halodendron, Suaeda microphylla, grey heron, great egret, roller, barn swallow	Dike indicated in Pre-FS not functional. Land between river and Kazalinsk LMK probably regularly flooded. Left bank main canal and irrigated lands on its left side protected by existing dike along the canal's right bank.

13(18), 13 A	Strengthening of the **existing** right-bank dike on the right branch of LMK from Chainage 420 to Chainage 740+00	1086.1 / 37 - 42	Outside of the dike the major types of floodplain vegetation (tugai): shrubs and few trees damaged by past wildfires, grasslands, swamp meadows and halophytic meadows. Right riverbank and some areas left bank with extensive reeds. Locally ruderal vegetation. Silty loam, meadow soil, locally solonchak soil, at the riverbank fine sand, behind the natural levee clay	Aeluropus littoralis, Petrosimonia brachiata, Tamarix hispida, T. ramosissima, Elaeagnus oxycarpa, Leymus ramosus, Alhagi pseudalhagi, A.kirghizorum, Calamagrostis epigeios, Gypsophila perfoliata, Inula caspica, Clematis orientalis, Trachomitum lancifolium, Polygonum arenarium, Atriplex pedunculata, Suaeda linifolia, Argusia sibirica, Cirsium setosum, Aeluropus littoralis, Phragmites australis, Typha angustifolia, Lythrum salicaria, Inula caspica purple and grey heron, common tern, sand martin, barn swallow, salt lark, isabelline shrike, **2 spoonbills**, blue-cheeeked bee-eater, collared pratincole, magpie, **white-tailed lapwing**, black tern, kingfisher, black-winged stilt, **pigmy cormorant**,	No actual flood risk for mentioned objects visible. Dike in satisfactory condition.

5.3.2 Brief characteristic of the Sub-project measures

For a thorough environmental impact assessment usually a detailed project of the planned activity is required. In the proposed form the sites for dike strengthening, construction of new dikes and straightening of river sections have been selected by the responsible engineer initially without own field visit on the basis of wishes expressed by the rayonvodkhoz organizations of the concerned rayons (Kazalinsk, Karmakchi). No cartographic information on spatial extent and timing of floods and no elevation model for calculation of flooded areas and related damage were available.

That's why during the elaboration of the present assessment only very general and brief descriptions and drawings on 1:200,000 topographic maps were available. In few cases descriptions and drawings were significantly differing from each other. Further, the field assessment showed in some cases that proposed food protection structures already have been constructed, are not suitable for achieving the supposed flood protection of the specific mentioned objects or are not needed because the objects to be protected have never been threatened by flood.

The approach underlying the preliminary design of the flood protection measures seems to be based on the intention of controlling the river, keeping the river in its major course and not allowing expansion on the floodplain. The alternative approach of identifying really threatened objects and analyzing if and what flood protection measures would by feasible or if other adaptations to the flood threat would be more viable (e.g. temporary or permanent relocation of valuables, adaptation of land-use to flood risk) was not considered. For some of the objects, according to the Pre-feasibility study to be protected, it is not clear if they are really threatened by floods originating at the proposed construction sites or if threats have other origin and are not addressed by the proposed measures.

Of course, it cannot be the duty of environmental consultants to assess the feasibility of flood protection measures from hydrological or water management, safety and risk points of view. However, any flood protection measure and even the strengthening of existing dikes is unavoidably causing adverse environmental impacts. Where the need for construction measures or there suitability for fulfilling their function is clearly not given, the environmental impact assessment would need to call for refraining from the measure, just because of the need for avoiding unnecessary adverse environmental impacts.

The environmental consultant in this situation choose the followimg approach. At each site it was tried to identify.

- Potential flood risks and places where existing dikes have been overtopped in the near past;
- Objects potentially threatened by floods and signs of flood damages from past flooding;
- Actual condition of existing flood protection structures;
- Location of planned flood protection measures according to maps provided;
- Probable specific location of planned measures.

Based on this plausibility assessment of planned objects their environmental impact has been assessed. It is likely that many of the planned objects will be specified and modified in the feasibility and design stages of project planning. This may influence on the conclusion about environmental impacts. Of special concern are in this context borrow pits or quarries which due to the full uncertainty about locations could not be considered at all.The pre-feasibility study provides the following information on the planned measures to be assessed in the frame of the present EIA.

The data on planned measures at dikes is given in the table 5-3.

Strengthening of dikes

The height of proposed new dikes and strengthened existing dikes is designed with 1.0 m above the modeled water level corresponding to maximum winter and summer operational discharges.

The increase by 1.0 m is justified by:

- 0.50 m – correction, taking into account the ice jams and accuracy of the calculations for the free surface' curve;
- 0.50 m –standard freeboard of the dike crest above the designed water level. .

The designed dikes and dikes to be reconstructed are constructed of local soil with the compaction; the top width is 3.5 m, slope steepness: outside slope -1:3, internal slope – 1:2.50 (Fig. 5-9). Crossing points 8.0 m wide and 150 m long are foreseen at every 2 km to the pass the oncoming transport (Fig. 5-10).

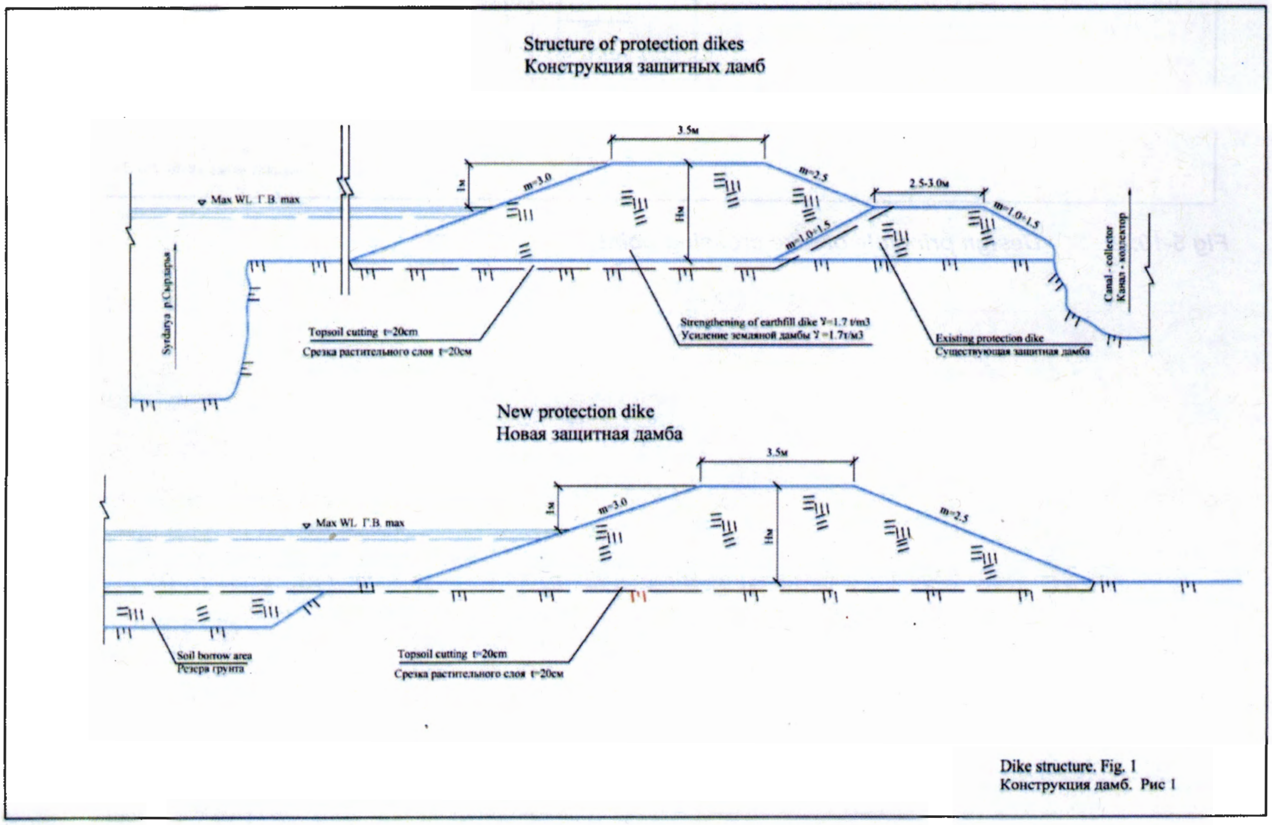


Fig 5-9: Design principle of the strengthening of the existing dikes and new dikes .

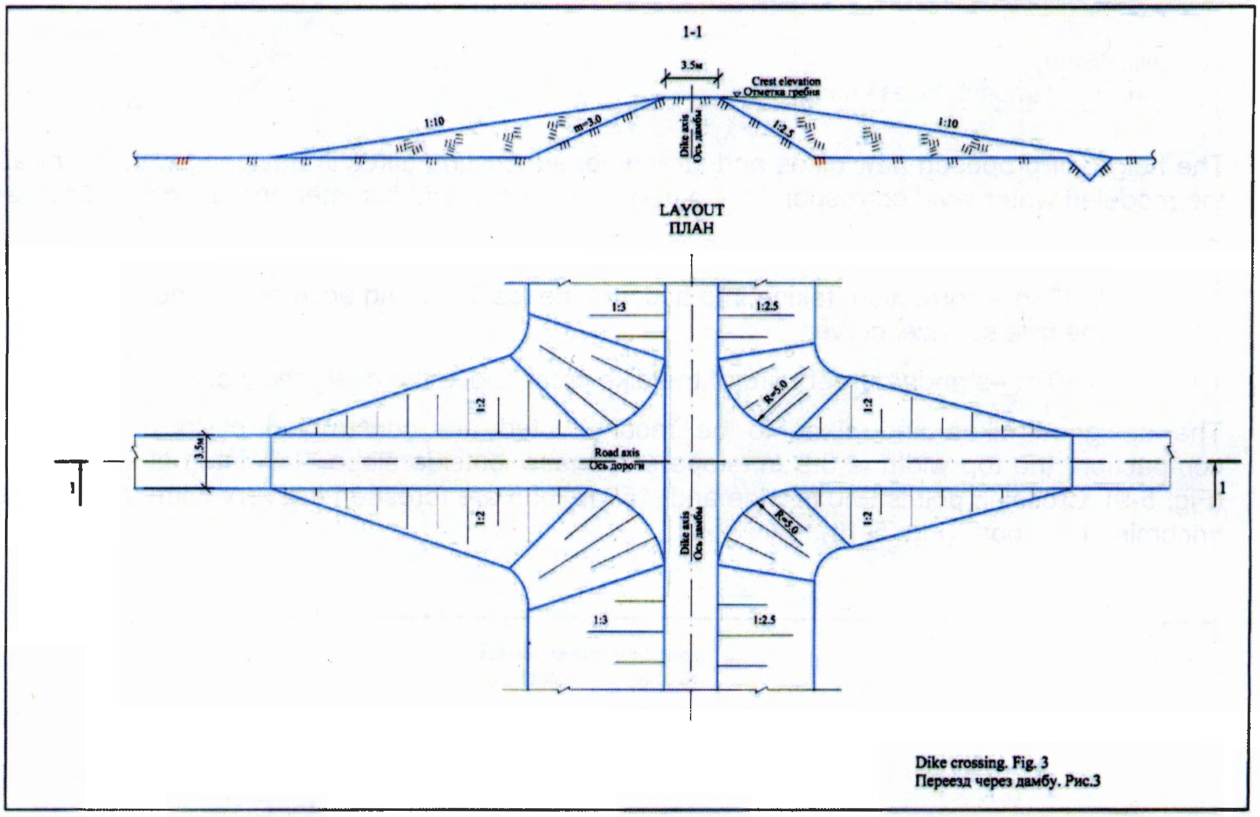


Fig 5-10: ***Design principle of dike crossing point.***

Table 5-3: Planned flood protection measures and conditions of existing structures

№ object	Name	Km from Shardara / cross section ID	Objects to be protected (Remarks based on site visit	Present conditions of dike / of riverbed	Need for measures (Priority: 0 – no, 3 - highest)	Unit	Q-ty
5,6,8	Strengthening of the **existing dike** between the Syrdarya river and Left-bank Canal "LMK" - (3 sites)	1513 - 1518 1487.9 - 1501.3 1467 - 1476.7	Aksai, Birlik, irrigation network and irrigated areas (No relevance for indicated villages)	See site specific information below!	See site specific information below!	km th. m^3	29.0 3417.9
5	Strengthening of the **existing dike** between the Syrdarya river and Left-bank Canal "LMK"	1513 - 1518 / 18 - 19	(Protection of village Bekarystan bi, protection of in large sections abandoned or fallow rice fields Need and functionality of part north of Alseyt-road to be verified!)	North of Alseyt road existing dike rather road dam, not immediately along canal, separate canal bank like dike. South of road Alseyt main dike along canal	If necessary, strengthening of dike immediately along canal, continue dike around the rice fields at their immediate boundary without inclusion of uncultivated lands. Not clear if village Bekarystanbi is under threat from this side. **(1)**		
6	Strengthening of the **existing dike** between the Syrdarya river and Left-bank Canal "LMK" - (3 sites)	1487.9 - 1501.3 / 20	(Left bank main canal and irrigated lands on its left side)	Dike indicated in Pre-FS not functional, important is right bank dike of LMK, overtopped and repaired at one site between #5 and #6	Strengthening and raising at even level recommended for right bank dike of LMK, reconstruction of dike in the immediate floodplain (as in suggested in the Pre-FS map) not acceptable **(2)**		
8	Strengthening of the **existing dike** between the Syrdarya river and Left-bank Canal "LMK"	1467 - 1476.7 / 23 + 24	Left bank main canal and irrigated lands on its left side	Dike indicated in Pre-FS not functional, important is right bank dike of LMK, overtopped and repaired	Local strengthening and raising at even level recommended for right bank dike of LMK (no large scale investment),		

					reconstruction of dike in the immediate floodplain (as in the map) not acceptable. **(2)**		
13(18); 13A	Strengthening of the **right-bank dike** on the right branch of LMK from Chainage 420 to Chainage 740+00	1086.1 / 37 - 42	Zhanazhol, International, Akzhar, motor road and irrigated areas (No actual flood risk for mentioned objects visible.)	Dike in satisfactory condition	Concentrate strengthening on sites where danger is proved. Routine maintenance and local repair probably sufficient. **(0)**	km th. m^3	21.16 1213.0

5.3.3. Without project case

The Geomorphological character of the Syrdarya floodplain is that of a depositional river characterized by meanders. The river in this kind of regime has, in the case of high water and flood, the tendency to deposit its sediment load close to the river, forming natural dikes or levees. Thus the river is continually building up its own bed. A cross-section of the floodplain would show the river is riding mostly on the most elevated part of it. In a natural state the river in case of high water would break its natural dike and inundate the adjacent floodplain and depressions. The Syrdarja floodplain shows exactly that character. In effect, in case of flood excess water would flow away from the river following a natural gradient and inundate lands beyond without coming back to the river. This is very well demonstrated by the images provided by Radarsat (fig. 5-11) on which the hypothetical flood levels are mentioned. It is clear that the further away from the river, the lower the level plain, and therefore more potential level of flooding

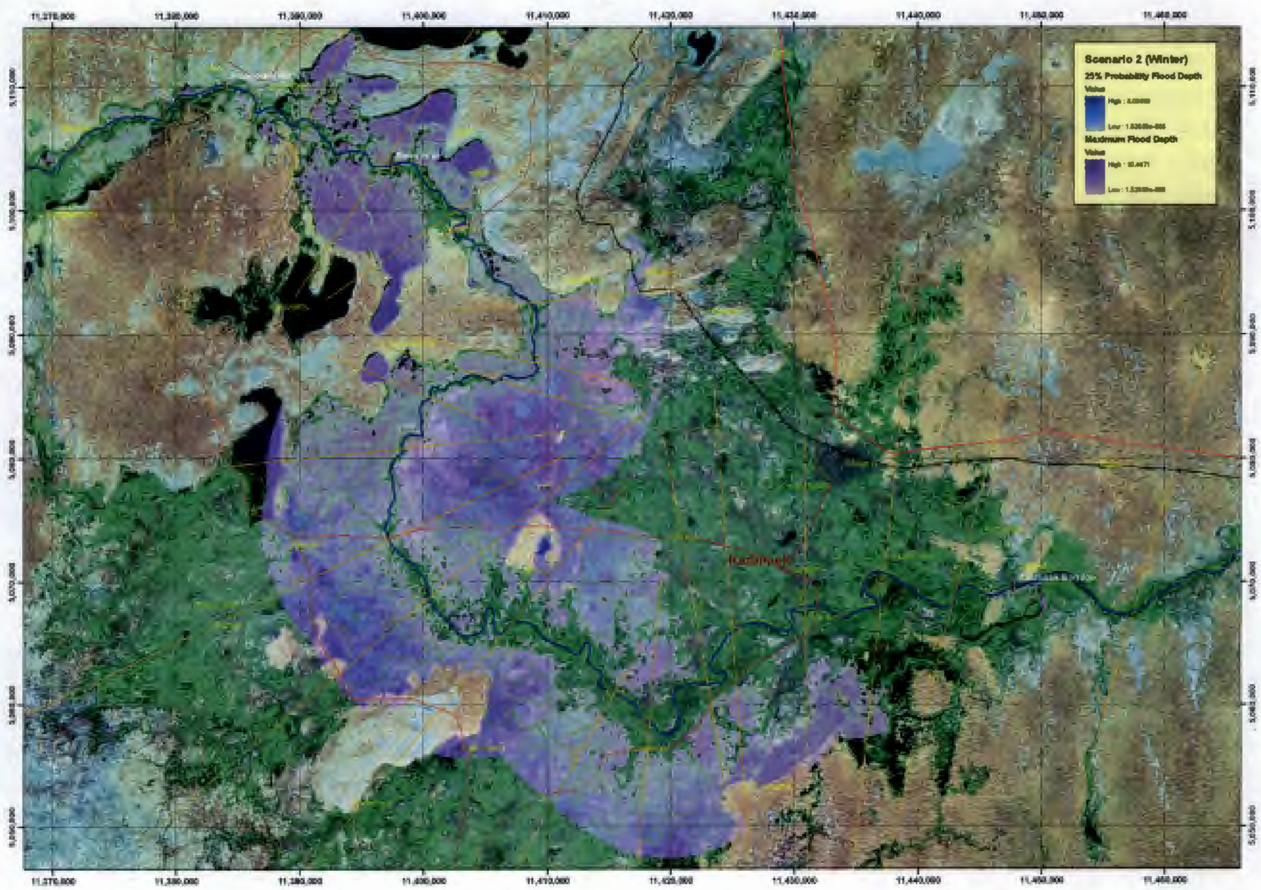


Figure *5-11:* ***Hypothetical maximum flood levels in a 50 km corridor along the Syrdarya for Scenario 2 in the Kazalinsk area. The darker the color (range from 1.5 m to 10m) the higher the flood level. It can be clearly seen, that flood levels increase with growing distance from the natural levee of the river. Based on Radarsat Topography, Synas I river crossections and Synas II WMIS modelling***

Human Landuse requires protection from this kind of event, so already early during the construction of irrigation systems and human settlements protection dikes were an indispensable part. The analysis of the 'without project case" would therefore include the effect of present dikes. In the case of a dike overtopping or failure it can be assumed that most of the land lying beyond it will be affected by flood up to a considerable distance. This fact needs to be taken into account when analysing the economic effects of flood risk.

(g) Impacts on the hydrology of the river system

The Syrdarya River and its floodplain are naturally characterized by regular high discharges, resulting in overtopping of the riverbanks and flooding of the floodplains. Before the implementation of the large scale irrigation schemes and the construction of water reservoirs on the river's upper courses floods occurred during the late spring / early summer, determined by the melting of snow in the high altitudes of the river basin. With the increasing withdrawal of water for irrigation purposes and the buffering of flow variation by reservoirs summer flooding became a rare exception. Since the change of operation mode of the Naryn cascade, the largest reservoir cascade, to winter power generation mode high winter discharges resulting in floods became typical for the lower reaches of the Syrdarya River. Until 2004 significant proportions or excess water for flood prevention purposes have been released into the Aydar-Arnasay depression in Uzbekistan. This flood release option is not longer available for various reasons (capacity of the lake system completely used, irrigation dams constructed in the Arnasay, political interest to use water for Aral Sea maintenance and other environmental and economic purposes instead of irreversible spillage.). In the result winter floods are now a common phenomenon in the Syrdarya floodplains. At present, Koksarai counter regulator will allow shifting the period of high water from winter to the vegetation period.

The impacts of high discharges for the river and the floodplains are complex and difficult to predict. Due to formation of the ice cover the carrying capacity of the river is affected due to the increased flow resistance. This results in an increased water level in order to convey what is being released. As the ice cover thickens and develops further the water level keeps increasing. The effect on the carrying capacity of the ice cover is thus highly depending on the dynamics of the ice cover development. In addition to this the discharge it self will have an effect on the formation of the ice cover: For high discharges/velocities a full ice cover can not be formed and a canal with a free water surface will be formed. When this occurs the ice will induce less friction as compared to situation with a full ice cover. Due to this phenomenon higher discharges can lead to lower water levels.

The impact of the "without project case" on the hydrology is difficult to predict and varies for different locations. Areas without flood protection dikes serve as extension space for the river and can thus reduce flood problems in downstream areas. Depending on the relief situation water flows back as the river discharge decreases or remains in the flooded areas. For the sites where dikes already exist no documentation about past and current flood situations is available. Some dikes have been locally damaged and even overtopped during the last years. All these sites have been repaired. The risk for new damages cannot be assessed by the available information. However, it can be expected that regular maintenance will minimize flooding of areas inside the dikes. Where such areas are flooded the backflow into the river is often blocked by the dikes. This leads to an extension of the flood period if no structures for release of water are built in.

(h) Impacts on water quality

The impact on water quality of the "without project case" is minor. No industrial objects are located in the potentially flooded areas and thus no risk of contamination with hazardous chemicals exists. During flood events erosion is increased leading to a higher sediment load than under average conditions. On the other hand flooding of large areas slows down low velocity and leads to a higher sedimentation rate of particles carried by the river. Thus total sediment load of the river is reduced.

(i) Impacts on atmospheric air

No impact on atmospheric air can be predicted under the without project case.

(j) Impact on soils

Floods are an integral part of geo-morphological and soil formation processes in natural floodplains. Flooding allows sedimentation of loams in the floodplain. Under good drainage conditions it leaches salts while under poor drainage it can cause salinization. All these processes can take place in the areas influenced by floods under the "without project case". Further this case preserves the in some extent the natural geo-morphological dynamics, in particular riverbank erosion and accumulation. These processes are essential for the floodplain ecosystems.

(k) Impact on biodiversity

The Syrdarya River and its floodplains have lost much of its biodiversity during the last five decades. This loss concerns at the first place the landscapes and ecosystem types. Those depending on the river dynamics were transformed in a large scale and disappeared over large areas. The entire complex of tugai ecosystems, including reeds, meadows, shrublands and forests was reduced by size and degraded in its ecosystem functions and diversity. Large areas became temporary used for agriculture and once been abandoned need long periods for fragmentary rehabilitation. The number of animal species depending on healthy river ecosystems dropped and the dominance of various plant species shifted. In particular, the characteristic tree species of Central Asian floodplain ecosystems, the turanga poplars, almost disappeared.

In the "without project case" remnants of natural biodiversity in floodplain areas so far not divided from the river, would remain. In areas where dikes no longer fulfill their functions the ongoing rehabilitation or formation of secondary ecosystems will continue. Flooded agricultural lands further present in spring time resting sites for waterfowls and waders. This compensates in some extent losses of resting sites due to the degradation of the Aral Sea and the flooding of the delta area caused by the increase of the NAS water level.

A negative aspect from a biodiversity point of view is the currently not natural timing of high discharge and floods. Out of season flooding adversely affects ecosystems and species adapted to the natural flood regime. This problem concerns, for instance plants (as the turanga poplar) requiring timely flooding for generative rejuvenation, birds adapted in their breeding seasonality to the floods, as well as many invertebrates. The implementation of the project measures would even increase this environmental problem as it would further reduce flooded areas and flood frequency.

(l) Impact on human environment

In the context of the feasibility study human environment includes property as well as land-use and impact on health. Under the "without project case" no direct threat for human live exists. Floods are in its extent, intensity and suddenness not really dangerous for human beings. The long river course provides enough time for evacuation of people as well as their mobile property even in extreme high flood situations.

Flooding and riverbank erosion can threaten infrastructure. High and very dynamic floods may even destroy regulating infrastructures and canal embankments.

At several sites without the project local overtopping of dikes, where these are too low may occur. In the result the flooding of agricultural land will occur. In the case of pasture lands and abandoned fields which make up a large proportion this flooding seems to be negatively perceived by local people and water managers, but no real economic damage is caused. Where arable lands are flooded this causes diverse problems. Fields can remain wet for extended periods, preventing cultivation and in some cases causing salinization. These problems basically occur on poorly drained lands and on areas where no structures for release of the water exist. As irrigated fields need leaching and this leaching in other areas is exactly done during the months January till March an adaptation of the agricultural technology in flood risk areas might be thinkable.

No physical cultural property will be affected by the "without project case" because, as far as visible without detailed flood modelling maps, all relevant sites (graveyards, mausoleums, ancient cities) are located at higher elevations and are not affected by floods

Conclusion:

The "without project case" is from an environmental point of view always to be preferred against flood protection measures. But as human settlements and infrastructure need to be protected, the preferred solution in the frame of SYNAS-II and beyond should be a timing of high discharge and flooding in accordance to the natural flow dynamics. Flood protection of human property would be better achieved by local, specific protection of threatened objects, temporary or permanent relocation of valuable property and adaptation of land-use.

5.3.4 Environmental Impact during Construction

(g) Impacts on the hydrology of the river system

No impacts on the hydrology are expected during the construction of flood protection dikes other activities planned under the sub-project.

(h) Impact on water quality

Water contamination by pollutants during the construction phase can be caused by leaking machinery and fuel and lubricant storage. The observation of all applicable rules on maintenance and safety will minimize this risk.

Other foreseeable impacts of the subproject on water quality are insignificant.

(i) Impacts on atmospheric air

Dust emissions from earth movement and transportation and the exhaust fumes from machinery will cause local air pollution. This impact is limited in time and space.

(j) Impacts on soils

Soil contamination by pollutants during the construction phase can be caused by leaking machinery and fuel and lubricant storage. Such contamination may not affect large areas. Any soil pollution is to avoid by observation of the applicable maintenance and safety requirements.

The sub-project will require the utilization of significant areas of land.:

- 50,16 km of dike strengthening of estimated 10 m width , i.e. 50,16 ha;
- Borrow pits for in total 2.023 million m³; the required area at depth of 2 m would be 101.3 ha, at depth 10 m - 20.23 ha;

So far no sites for borrow pits have been identified for material supply for the construction of the dikes. The principle drawing shows that borrow areas will be parallel to the newly constructed dikes, outside of the dike.

The sub-project in its full extent would cause destruction of natural soils at an area of approximately 151,5 ha. The areas size might be considered being not very significant compared to the total area of influence of the sub-projects. However the impact is relevant as it is not concentrated on one point but distributed over a large area, the entire Syrdarya Floodplain is already heavily disturbed by past earth works and the impact is in some extent avoidable as not all planned measures are actually well justified. Finally the relevance of the impact on soils during the construction phase largely depends on the specific site selection during the detailed design stage.

(k) Impacts on biodiversity

In areas where already existing dikes are to be strengthened this impact concerns mainly ecologically flexible species which have established after the construction of the respective dikes. Observations at recently finalized construction sites (riverbed straightening under SYNAS-I and older construction areas (area at Kazalinsk barrage, first kilometers between Syrdarya River and LMK) and indicate that regeneration of vegetation at heavily disturbed sites can be problematic.

Extensive construction work, spread over large areas adversely affects biodiversity in a much larger scale than just at the project sites. Damage will be caused by access roads, fuel wood cutting by construction workers, disturbance of wild animals and poaching. The Syrdarya floodplain is an important habitat of the pheasant, duck and geese species as well as waders. All of them are potential subject of poaching. The presence of a larger number of people increases the risk of wildfires, one of the most significant current factors threatening biodiversity and preventing natural regeneration of tugai woodlands and forests.

(l) Impacts on human environment

Most of the planned construction sites are located far from villages and on extensively used areas. In these cases impacts of construction work on human environment will be insignificant

At these sites temporary impacts include dust emissions, noise and impact on aesthetic value of the landscape

The available information indicates that no physical cultural property will be affected by the project.

Conclusion

The most relevant impacts during the construction period concern soils and biodiversity. They are related to physical irreversible transformation of lands and its soils and habitats and to the disturbance of larger areas of influence. The minimizing of these impacts can be achieved by limitation of flood protection measures to those sites where they are unavoidable and by the planning of necessary measures in the vicinity of the objects to be protected.

5.3.5 Environmental impact during Operation

(f) Impacts on the hydrology of the river system

River embankments cut off parts of the floodplain from the river for avoiding of flooding. By this they reduce flood relief area and narrow the available discharge cross-section. This increases the flow speed and relocates flood problems to downstream areas. On the other hand the necessary flood is withheld from the floodplain. Under the current operation mode of the upstream reservoirs most floods are occurring out of the natural flood season. The prevention of these floods is the primary purpose of the planned subproject. However, the dikes are non-selective and prevent flood at any time, also during the natural flood season

The objects # 5, 6, 8 in the form presented at the map would affect areas of about 2000 ha, where poorly functional or abandoned dikes have permitted a semi-natural hydrological regime which allowed the preservation or rehabilitation of floodplain ecosystems..

The objects # 13(18),13A would little change the present hydrological situation.

(g) Impacts on water quality

Foreseeable impacts of the subproject on water quality in the river are insignificant. Ground water mineralization can increase in the floodplain, divided from the river by dikes.

(h) Impact on atmospheric air

No impacts on air are expected from the subproject.

(i) Impact on soils

Lack of flooding and reduced ground water due to flood prevention and riverbed straightening will change the character of hydromorphic soils. The avoidance of flooding of ecosystems outside the irrigated arable lands can cause salinization due to lack of natural desalinization by flushing. Dryland soils accumulate less humus than these hydromorphic soils. Wetland soils, in particular peaty soils under reed (Phragmites australis) are important carbon sinks. Mineralization of accumulated humus occurs where peaty soils, developed under reeds, are drained and are exposed to air oxygen. This process leads to the emission of sequestrated carbon from the soil.

(j) Impact on biodiversity

Strengthening and raising of the height of existing embankments changes the landscape in a limited and acceptable scale.

Where new embankments or the strengthening and raising of the height of existing ones prevent flooding of natural and semi-natural floodplain ecosystems these are in a significant scale affected and succession towards other ecosystem types can be expected. Wetland vegetation will shift towards drier meadows or forbs, solonchak vegetation or even towards secondary semi-desert. The lack of floods at the right season is the major reason preventing the rehabilitation of floodplain forests (tugai). The most serious adverse impacts on floodplain vegetation are expected from the planned measures # 5, 6, 8.

The flora and fauna of floodplains is adapted to regular flooding. If this is prevented the typical species diminish. The areas flooded during spring, including pieces of arable land, are during the spring migration used for resting by many waterfowl species and waders. The prevention of flooding of irrigation areas may cause the loss of these resting sites. The floodplain ecosystems are habitats for a rich diversity of nesting bird species. These species depend on the whole range of habitats, from bare sand banks, via meadows, forbs and reeds to shrub and woodlands, and wetlands and other floodplain habitat.

Flooded reeds and grasslands are by many fishes used for spawning. The avoidance of flooding of such areas can negatively affect the reproduction of these fish species.

(k) Impact on human environment

The impact of improved flood protection on human health is in general considered positive because floods can cause health damage, directly and indirectly. This positive impact is only possible where actually threats to human health exist. As analysed under the "without project case" such a situation is very unlikely at the sub-project sites.

The improvement of embankments has the purpose of maintaining the existing land-use opportunities on irrigated arable lands. The prevention of damage to irrigation and drainage infrastructure, of siltation of canals and collectors, the extension of the time available for maintenance of this infrastructure out of the vegetation period and the ensuring of accessibility (sufficiently dry soils) for tillage and cultivation are positive effects of improved dikes, protecting irrigated lands. As the objective of SYNAS-II is not the extension but the maintenance of existing irrigated arable lands, dike strengthening or new dikes must not be justified by extension of irrigated arable lands or rehabilitation of long abandoned lands. In other areas (pastures, hay making areas, shrub land, woodland the embanking will have less positive impacts. Some regularly flooded are managed as liman for haymaking. Prevention of flooding would significantly reduce the productivity of these lands.

The prevention of damages from built-up areas is without doubt positive. However, during the last decades the low river discharge encouraged the development of floodplain areas for the construction of some buildings without consideration of the natural flood dynamics. Such an inappropriate land-use should further be discouraged and not be supported by construction of embankments. In cases where a limited number of objects is concerned or these have already suffered from recent floods relocation might be the better option compared to expensive and not entirely reliable protection measures. The assessment so far did not show any objects were such relocation would be required.

The expected protection of roads from flood damage for the consultant seemed to be not very obvious to be achieved by the proposed measures far away from the damaged objects. Local protection measures will more secure provide the expected protection.

No physical cultural property will be affected by the operation of the project.

5.3.6 Impact in case of worst possible incident

The worst case situation would be a local failure of the embankment during an extreme high flood, e.g. caused by upstream problems at Shardara reservoir (emergency spillage or failure). Such a situation probably cannot be entirely securely prevented by the sub-project because the embankments hardly can be dimensioned for the possible maximum flow (PMF). An early warning and evacuation system will be needed for saving the live of people living in the potential flood zone. The first measure for such a warning and evacuation system would be the development of a spatial dynamic flood model for potentially critical zones. The available hydraulic model with estimation of design water levels for different discharges still lakes a spatial component showing and considering flood relief areas under different discharges.

5.3.7 Synergies with other subprojects

The operation of Koksaray counter-regulator would allow avoiding regular floods during winter and would thus reduce the costs for sub-project execution. Local repair and regular maintenance of existing dikes at environmentally and economically useful locations protecting from extreme floods which cannot be controlled by the reservoirs would be sufficient.The realization of the alternative of spilling water into the Zhanadarya and via the Aksay canal would only mitigate the situation and winter floods may further regularly reach levels calling for higher embankments..

Conclusion

Adverse environmental impacts concern the hydrology of the river and the floodplain, the geo-morphological dynamics and soil formation processes and the ecosystems and habitat value of the project's area of influence. In areas with still comparatively natural conditions these impacts are negative. In already intensively used lands they are acceptable. The operation can have some positive impacts on human environment, but in some sites even negative impacts on present land-use (hay making areas) are conceivable. Positive impacts on human environment can be achieved by adaptation of the locations and of the design of planned measures. The most critical objects in terms of environmental impacts of operation are strengthening of dikes located far from the protected canals. No specific information is available on the structures for spillage of water from flooded lands back to the river. These structures are expected to make existing dikes permeable for water in a regulated way and will without doubt have positive impacts on the key environmental components

Conclusion about the environmental impact

The impacts of the planned flood protection measures on hydrology, soils and biodiversity are largely negative or indifferent. Critical is the uncertainty about the need for and operational effects of most of the planned measures. Impacts on land-use opportunities are more positive but can encourage the continuation of inappropriate use of the natural retention areas in the floodplains. The sub-project only in a limited scale will contribute to the environmental revival of the NAS and the delta area, to the improvement of the overall environmental conditions in the KSB and to the improvement of overall water use efficiency in the basin. This contribution is mainly linked to the avoidance of emergency spillage into desert depressions where the water would be irreversibly lost.

Impact assesement and environmental protection measures in the considered sub-project are given in the annex (Annex 1.3).

Factors, sources, potential types of impact and environment components , on which the subproject exerts an influence , are given in the annex (Annex 2.3).

Residuai impact after completion of measures are given in the annex (Annex 3.3).

5.4 Construction of bridge near Birlik settlement in Kazalinsk district.

Brief characteristic .

The bridge have been analyzed to replace pontoon between Birlik (left bank) and Kazalinsk (right bank) at the level of preparation of Feasibility Study. The existing pontoon bridge is not operational during ice periods for up to two months per year, and traffic is forced to use a detour of 40 km. Due to the limited weight capacity of the pontoon bridge and the ferry boat (3.5 – 5 t) all heavy traffic is year-round bound to the detours. This causes high costs especially for agricultural operations.

The proposed bridge will be concrete bridges of a length of 264.69 m and a width of 10 + 2 x 0.75 m, i.e. 11.5 m. The bridge is accompanied by dams at both sides of the river. The bridge will be connected by paved access roads of the category III, with a length of 3.0 km. The river canal at bridge can be widened up to 200 m and the site will not longer form barriers for the river discharge.

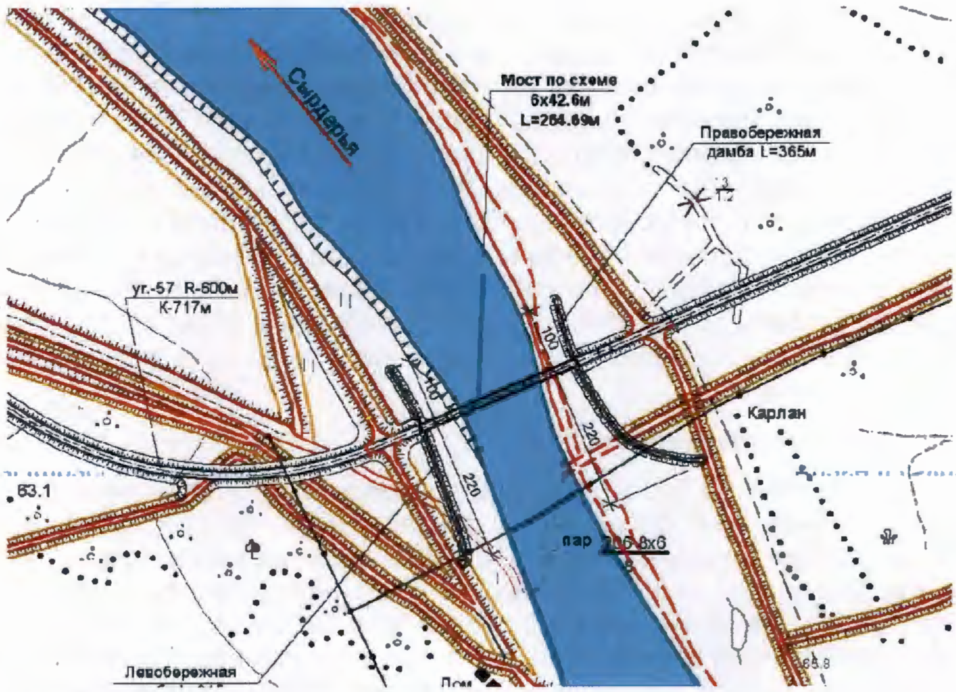


Fig 5-12: ***Location of the bridge near Birlik settlement***

The purpose of the construction of bridge is as follows and includes:

(i) removal of bottlenecks currently limiting the discharge in the Syrdarya River and causing flooding;

(ii) provision of transport connection without weight limitation;

(iii) provision of a year-round usable connection ;

(iv) reduction of the length of the motor transport traffic way;

(v) reduction of travel time;

(vi) reduction of transport expenses;

(vii) increase of traffic safety ;

(viii) possibility of two-way traffic;

(ix) absence of traffic delays

From the construction of the bridge a significant improvement of the social and economic conditions is expected.

Environmental impacts

(a) Impacts on the hydrology of the river system

The bridge will remove bottlenecks where the effective river canal width is currently limited to 70 m and allow a canal width of 200 m at both sites. These bottlenecks cause currently flood problems which will further be avoided. These floods are artificially induced and related to the changed river dynamics with winter high water. The floods in this area cause damage to agricultural and other infrastructure and settlements. The removal of the bottlenecks for river discharge reduces the need for emergency spillage of excess water into desert depressions, will have positive effects for the local land-use and allow a better water supply of downstream areas

The expected impact on ground water dynamics is limited to the effect of the changes in the flood dynamics.

(b) Impacts on water quality

The construction of the bridge reduces the risk of water pollution caused by accidents at the pontoon bridge and by the contamination of river water by pollutants from vehicles crossing the pontoon bridge. The new bridge will be safer than the existing pontoon. Measures are foreseen preventing water contamination by fluids from the bridges.

(c) Impacts on atmospheric air

. The impact on air quality is related emissions of harmful substances from motor transport. The reduction of traffic distances and improved road conditions will lead to reduced emissions of pollutants. The new bridge will reduce noise at the sites of the bridge and along the detour road

Dust emissions during construction can cause significant air pollution and need to be minimized by appropriate moistening of the substrates functioning as dust source

(d) Impacts on soils

The construction of bridge and access roads will lead to a new sealing of soil (approx. 7 km x 10 m.; 7 ha).. For the construction of the road foundations borrow pits in a limited scale will be necessary. Suitable material seems to be available close to the construction site. After finalization of the construction the re-cultivation of the borrow pits will be required in accordance to applicable legal standards

On the other hand unpaved roads and irregular tracks will be replaced and local technogenic soil erosion reduced. In the net balance the strain on soil will be not significant. Soil pollution might be caused during construction by machinery, storage and utilization of lubricants. This needs to be prevented by the observation of applicable legal standards for maintenance and handling.

Along the road soil pollution is caused by losses of fuels, lubricants and coolants from vehicles. The zone of influence can be several ten meters wide. As the access road replaces existing gravel roads and traffic distances are generally reduced the soil pollution will not exceed current levels. Measures are foreseen preventing soil contamination by fluids from the bridges and roads.

(e) Impacts on biodiversity

The bridge will be built at sites where already pontoon bridge and access roads exist.. The new access roads will be located close to the existing unpaved roads and pass intensive agricultural areas and areas with already intensively transformed vegetation. The impact on landscape will be marginal. Natural habitats will not be transformed and so far no presence of rare and endangered or economically important flora and fauna in the project area is known which could suffer from the measures. In the frame of the feasibility study a biodiversity assessment would reveal potentially critical aspects and the design planning will consider those concerns if necessary.

The reduction of traffic distances will lead to an increase of losses of animals caused by road accidents (especially reptiles and birds). The project contributes to a better water supply of downstream areas and thus improves the habitat conditions for flora and fauna

(f) Impacts on human environment

Impacts on human environment are related to the above mentioned improvement of the environmental components water, air and soil. Reduced traffic distances and year-round reliable and save connections have a positive effect for human health and improve the land-use opportunities, especially for agriculture

No physical cultural resources are known at the project sites. The design of the bridge and access roads will consider findings in the frame of the feasibility study and avoid damage of cultural heritage as archaeological sites, graveyards etc

(g) Worst case scenario

A worst case scenario would be the destruction of a bridge caused by an extreme flood incident. The design of the bridges and the foundations will have to consider this risk and take care for the avoidance of failure.

The risk of an accidental pollution by transported harmful substances will not increase but reduced due to the higher safety of the new bridge compared to the existing pontoon bridge.

(h) Synergies with other projects

The presence of the Koksaray counter-regulator would provide positive synergies as winter floods which are potentially harmful for the bridge can be avoided. The improved canal width at the sites of the new bridges will allow higher discharges in the Syrdarya River and thus positively impact on the water supply of other subproject areas (Delta Lakes)

Conclusion about the environment impact

The environmental impact of the proposed subproject is positive. No significant risks or negative impacts on environmental components are expected.

Impact assesement and environmental protection measures in the considered sub-project are given in the annex (Annex 1.4).

Factors, sources, potential types of impact and environment components , on which the subproject exerts an influence, are given in the annex (Annex 2.4).

Residuai impact after completion of measures are given in the annex (Annex 3.4).

5.5 Rehabilitation of Kamuishlibash and Akshatau lake systems in Aralsk district of Kzylorda oblast

FS «Rehabilitation of Kamuishlibash and Akshatau lake systems" is developed by PC «Institute Kazgiprovodhoz» according to the Technical Assignment , approved by the Committee for Water Resources dated September 30 2009

As a part of work on Feasibilty Study, which has passed all necessary approvals and received the positive conclusion of State expertise, the work on preliminary environment impact assesement (Pre-EIA) was perfomed. It is processed by separate book.

Contents (Pre-EIA) on this sub-project is given in the Book # 3 of this report to the full extent.

The brief characteristic of assesement of the subproject impact on the environment is given below

Brief characteristic

The object under design is located in Aralsk district of Kzylorda oblast (fig 5-13).

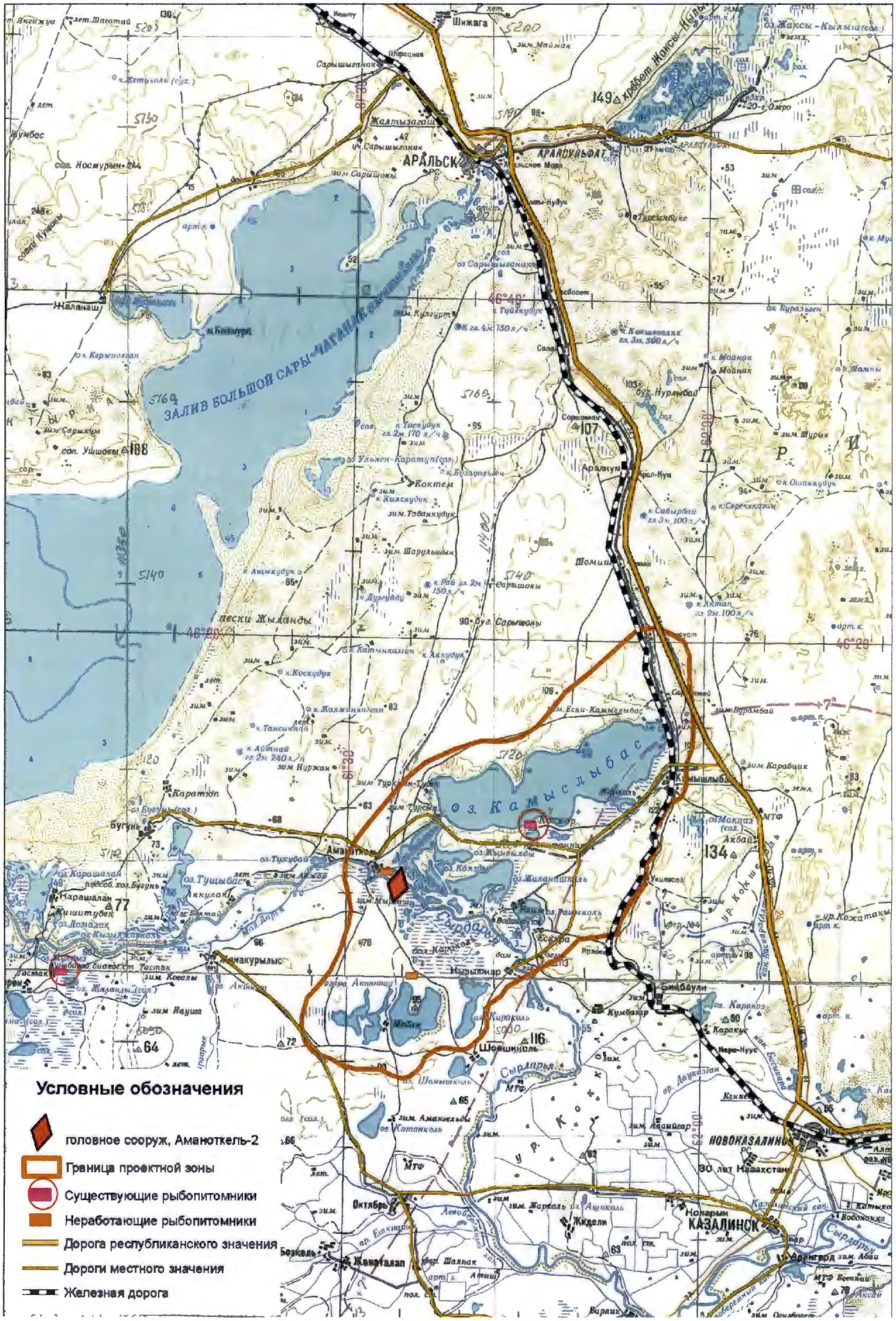


Fig 5-13: Location of Kamuishlibash and Akshatau lake system

The characteristic of the object under design

1) Amanotkel weir on Syrdarya river

• Design flow of Syrdarya river via weir (P5%)	400 m^3/s
• Verifying flow (P1%)	800 m^3/s
• Area of lake –swamp systems at normal water level (55,8)[4]	298,03 mln. m^3
• Area of lake-swamp systems at maximum water level (56,4)[5]	344,28 mln. m^3
• Volume of lake-swamp systems at normal water level (55,8)	1043,93 mln. m^3
• Volume of lake-swamp systems at maximum water level (56,4)	1227,9 mln. m^3
2) Water supply rivr beds (canals)	
Length	26,8 km
3) Operational roads	37,0 km
4) Flood protection dikes	
Length	14,9 km

Speaking about Project (FS) impact on the environment five main inter-connected tasks to be solved by it may be distinguished. They are prioritized as follows :

- General task of preservation of the unique natural complex of Kamuishlibash and Akshatau lake systems in the Syrdarya river delta, improvement of ecological and social-economic situation in the Project area;
- Task on provision of guaranteed water abstraction for the lake systems and its further release according to the required water and level regime close to natural regime. This is especially important for fishery and muskrat breeding and other components of the ecosystem;
- Task on increase of fish productivity of the lakes systems;
- Task on provision of cleaning of the Syrdarya river water incoming to the lake systems with the help of natural filters (higher water plants: reed mace, cane, reed) being one of the main components of the lakes' ecosystem;.
- Task to register abstracted and released water.

As it is seen from the list of tasks to be solved, all of them, per se, are nature protection tasks and are aimed on termination of the Syrdarya river delta' degradation

[4]Excluding the area annually flooded and during the floods of rare occurrence
[5]Excluding the areas during floods of rare occurrence

As a result of carrying out of the planned measures on the territory of Kamuishlibash and Akshatau lake systems due to sufficient water supply, hygro- and meso-phytization of vegetation will take place. Desert vegetation will be replaced by intra-zonal vegetation. Meadow and bush communities will prevail. As a result, the communities' productivity and resource status will increase as well as the species bio-diversity. In accordance with the conditions of habitats the fauna will change. Number of species of pre-water and waterfowl birds will increase significantly. .

The area of grass-reed swamps and swamping meadows will also increase significantly. Hygro- and meso-phytization of vegetation at the adjacent territories due to increase of groundwater table will be observed

Analysis of the hydro-technical measures' impact shows that increase of areas of hydromorphic habitats is anticipated, consequently, increase of flora and fauna bio-diversity, improvement of status of the forage areas, improvement of microclimate at the adjacent territories, increase of areas and improvement of status of Saxaul forests and bushes on the Project area is anticipated.

Construction of waterworks facilities will lead to changes of structure of landscape formed in last years..

The landscape with presence of antropogenic forms (weirs, water intakes, dikes, canal, roads, water sluices) is appeared. The will be increase of the areas of aquatic landscapes and reduction of ground landscapes on the territory of Kamuishlibash and Akshatau lake systems. The microclimate of the surrounded territory will improve. There will be an opportunity to organize recreation area at Kamuishlibash lake.

On thw whole the impact can characterized as positive.

Impact on social-economic situation will be positive as the construction of the object will allow:

- Increase the employment and yield of population both in the construction period of waterworks and after completion (operation of objects);
- Provide an incentive for the development of agricultural production, reprocessors, and and the social and economic infrastructure ,trade, public services, transportation, communications, etc.

Project implementation «Rehabilitation of Kamuishlibash and Akshatau lake systems », including the improvement of road network will have a positive impact on development of tourism, hunting and fishing in the project area.

Impact assesement and environmental protection measures in the considered sub-project are given in the annex (Annex 1.5).

Factors, sources, potential types of impact and environment components , on which the sub-project exerts an influence, are given in the annex (Annex 2.5.)

Residuai impact after completion of measures are given in the annex (Annex 3.5).

5.6 Reconstruction and extension of fishery ponds at "Tastak" site of Kamuishlibash fish hatchery in Aralsk district of Kzylorda oblast .

FS «Reconstruction and extension of fishery ponds at "Tastak" site of Kamuishlibash fish hatchery in Aralsk district of Kzylorda oblast" was developed PC «Institute Kazgiprovodhoz» according to the Technical Assignment, approved by the Committee for Water Resources of the Ministry of Agriculture on September 30, 2009 .

As a part of work on Feasibilty Study, which has passed all necessary approvals and received the positive conclusion of State expertise, the work on preliminary environment impact assesement (Pre-EIA) was perfomed.

Contents (Pre-EIA) on this sub-project is given to the full extent in the explanatory note of FS , which is attached to this report (Volume 5)

The assesement of the subproject impact on the environment, performed in FS, is given below .

Brief characteristic

The project under design is located in Aralsk district of Kzylorda oblast (fig 5-13, 5-14).

The characteristic of the object under design

It is foreseen under the project :

1) Reconstruction of the existing ponds on the area of 55,41ra.
2) Design of 103,29 ha of new ponds,
   Among them – on new area 93,87 ha
   – on reconstructed area 9,42 ha.
3) The scheme of water intake, water supply to ponds and discharge from the ponds
4) Completion of construction of new hatchery

Summary environment impact assesement

In the process of activity he object has a insignificant negative impact on environment. The guaranteed water abstraction to the hatchery of Tastak site and its diversion with acceptable water quality will be secured. The breeding of stocking material, two-year old of valuable fish species and artificial stocking of Kamuishlibash lake system with valuable fish species . All this will eventually lead to the improvement of environmental and socio-economic situation in the project area. The opportunity of exact recording of quantity of the abstracted water is appeared. The living conditions of population will improve, the employment of population will increase.

Impact assesement and environmental protection measures in the considered sub-project are given in the annex (Annex 1.6).

Factors, sources, potential types of impact and environment components , on which the sub-project exerts an influence, are given in the annex (Annex 2.6).

Residuai impact after completion of measures are given in the annex (Annex 3.6).

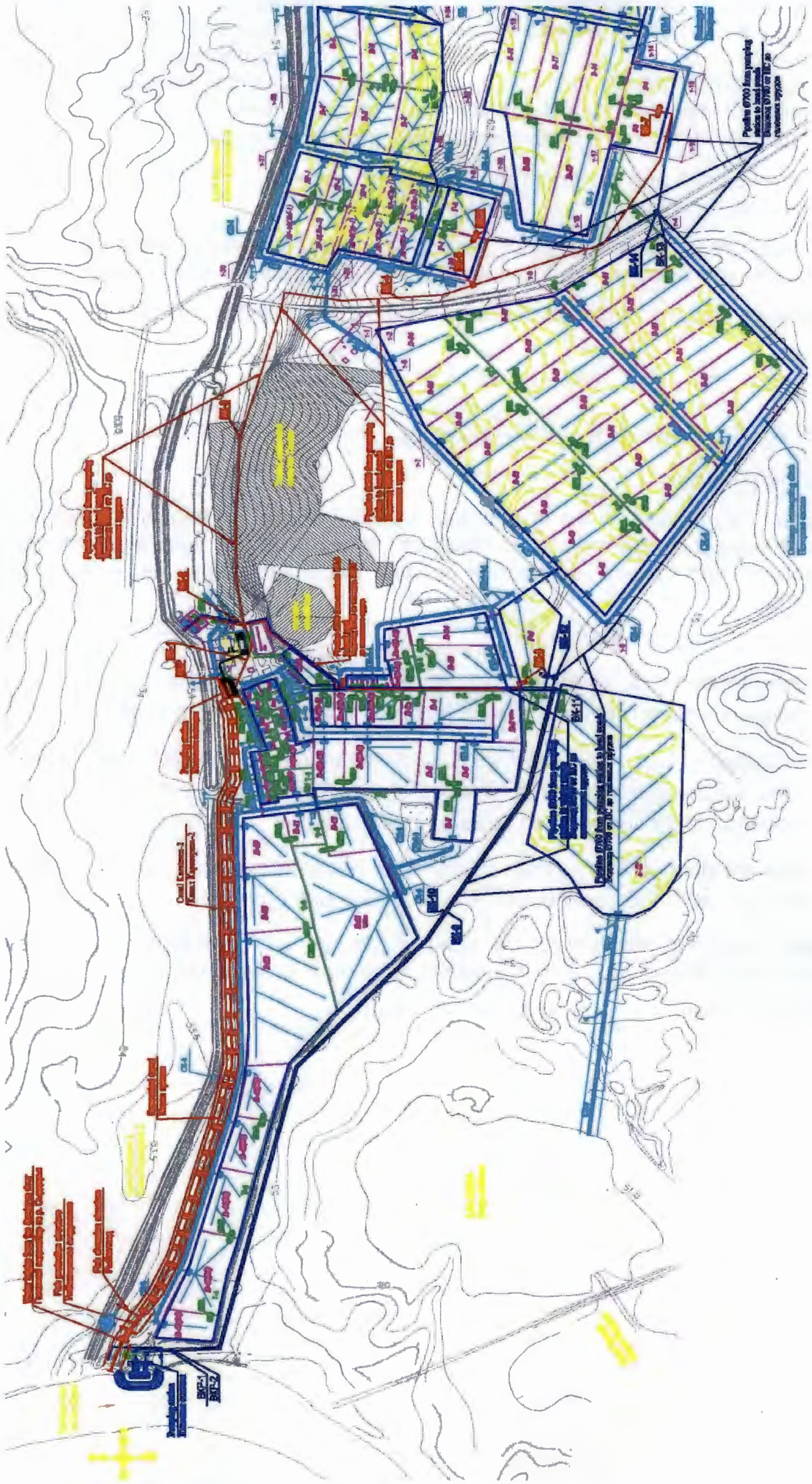


Fig 5-14: ***Plan of fishery ponds at Tastak site***

6 ENVIRONMENTAL MANAGEMENT PLAN

The EMP in accordance to World Bank requirements basically consists of two major elements. The mitigation section describes for the adverse environmental impacts identified in the frame of the assessment potential alternatives which would allow avoidance or minimizing of adverse impacts as well as measures for compensation of those impacts which cannot be avoided. The environmental monitoring section describes the measures necessary for controlling the achievement of environmental benefits from the implementation of the project as well as the proper implementation and effectiveness of the mitigation measures.

Impact assesement and environmental protection measures in the considered sub-project are given in the annex (Annex 1.1- Annex 1.6).

Factors, sources, potential types of impact and environment components , on which the sub-projects exert an influence, are given in the annex (Annex 2.1-Annex 2.6).

Residuai impact after completion of measures are given in the annex (Annex 3.1-Annex 3.6).

6.1. Environmental Impact Monitoring

Monitoring program

The monitoring program in the area of the objects' impact of Project' first stage on environment (for sub-projects to be planned for construction) is necessary for correction of technical solution on prevention, elimination and reduction of negative consequences in the period of construction and operation.

The purpose of monitoring program

- Determination of sufficiency of mitigation measures with the help of control. These measures are foreseen by the project in the period of construction and operation
- Assessement of the effectiveness of measures to mitigate the negative impacts and enhance positive influences. Change of these measures and development of new ones in response to ineffective measures or modification of conditions
- Determination and mitigation of any other negative impacts, not covered by the project but arising due to the construction and operation of the object.

Proposed monitoring program for the sub-projects corresponds to information level for FS. The amendmends of these programs is possible at the next projecting phases.

Monitoring programs are given in (table 6-1 – 6-6)

Table 6-1: Environment monitoring program for the sub-project " Reconstruction of left bank iriigation offtake at Kzylorda barrage".

egory	Subject	Period/ frequency	Plan and methodology	Organization	Performers	Accou ntabili ty
ruction period						
	Technogenic disturbances of soil covering	During the construction period	Reconstruction of left bank offtake-regulator at Kzylorda barrage.. Recultivation of disturbed lands..	CWR	Engineers inspectors, who control the construction	CWR
	Use of heavy construction equipment and machines	During the construction period	Monitoring for the use of heavy equipment in order to prevent soil compaction .	CWR	Engineers inspectors, who control the construction	CWR
	Possible soil contamination by fuel and lubricants .	During the construction period	Control over the storage and usage of fuel and lubricants in the project area	CWR	Engineers inspectors, who control the construction	CWR
ical rces	Nuisance of wild animals due to construction.	During the construction period	Field investigations	Ministry of Environmental Protection	Workers of department of wild animals protection	CWR
rces	Risk of leakage of fuel and lubricants to the soils	During the construction period	Control over the usage of fuel and lubricants in the project area	CWR	Engineers inspectors, who control the construction	CWR
onment	Collection of construction waste after completion of construction works	After completion of construction works	Control over waste collection	CWR	Engineers inspectors, who control the construction	CWR
	Dust	During the construction period	Prevention of dust generation during earthworks and during transportation	CWR	Engineers inspectors, who control the construction	CWR

Operation period						
Soils	Monitoring of water physical soil properties on irrigated lands	1 time in 5 years	1. Selection of the monitoring object and location . Lands, irrigated from LMC (selectively). 2. Soil samling from genetic horizon at the depth of 2 m. Laboratory analyses. Processing and analysis of results.	KIONPCzem	Laboratory analyses , sampling will be made by field works	C\
	Monitoring of soil salinization on irrigated lands	3 times per year	Soil samling from genetic horizon at the depth of 2 m. Laboratory analyses. Processing and analysis of results	KIONPCzem	Laboratory analyses , sampling will be made by field workers	C\
	Monitoring for the content of heavy metals , pesticides herbicides of soils on irrigated lands	1 time per year	Soil sampling from top layer for laboratory investigations.. Processing and analysis of results.	KIONPCzem	Field workers of KIONPCzem and farmers	C\
Surface waters	Volume of surface runoff	At Kzyolrda barrage–daily.	Field measurements at gauging stations along the river and Kzylorda barrage, as well as at offtake-regulators of irrigation canals.	Operational service of barrage	Department' specialists	C\
	pH, temperature, electrical conductivity, water clarity.	Each decade in flood period	Field measurements at gauging stations along the river and Kzylorda barrage, as well as at offtake-regulators of irrigation canals	Hydrogeological melorative expedition	Department' specialists of hydrogeological melorative expedition	C\
	Salinity, Na, K, Ca, Mg, Cl, HCO3, N, NH4, P, SO4, NO2, NO3, oil products.	3 times during flood period	Water sampling at gauging stations, equipped on the river. The analyses are conducted in laboratory conditions.	Hydrogeological melorative expedition	Department' specialists of hydrogeological melorative expedition	C\
	Microelements: Cu, Zn, Mn, Ni, Pb, Fe, Cr, F, Cd, Co, Hg, biotesting, bacteriological analysis	3 times during flood period	Water sampling at gauging stations, equipped on the river. The nalyses are conducted in laboratory conditions.	Hydrogeological melorative expedition	Department' specialists of hydrogeological melorative expedition	C\

ical rces	Flora	One year after the completion of construction	Determination and classification of types of vegetation. The creation of catalogue of types of vegetation with photo.	Department of vegetation protection of the Ministry of ecology and bioresources	Field workers	CWR
	Fauna	One year after the completion of construction	Determination and classification of habitant species of wild animals. Creation of catalogue of habitant species of wild animals	Department of wild animals protection of the Ministry of ecology and bioresources	Field workers	CWR
- mic rces	Monitoring of use of pesticides and heavy metals and its residual quantity in organisms and crops	One year after the completion of construction , then – milk and meat of animals , fishes is studied every 3-5 years, vegetable products are studied on annually basis	The sampling is made in the period of ageing from cash crops; analysis of pesticides, nitrates , The same applies to fish	Republican and regional veterinary laboratories, regional and district sanitary and epidemiological stations	Field workers	CWR
	Condition of Kzylorda barrage, offtake-regulator, dikes, canals and other hydraulic structures	During the operation period	Control and field observations	Operation service of the object	The workers of service	CWR

Table 6-2: Environment monitoring program for the sub-project "Syrdarya river bed straightening at Korgansha and Turumbet sections in Zhalagash district of Kzylorda oblast

Category	Subject	Period/ frequency	Plan and methodology	Organization	Performers	Ac nt
Construction period						
Soils	Technogenic disturbances of soil covering	During the construction period	Syrdarya riverbed straightening at Korgansha and Turumbet sections in Zhalagash district of Kzylorda oblast. Recultivation of disturbed lands	CWR	Engineers inspectors, who control the construction	CV
	Use of heavy construction equipment and machines	During the construction period	Monitoring for the use of heavy equipment in order to prevent soil compaction .	CWR	Engineers inspectors, who control the construction	CV
	Possible soil contamination by fuel and lubricants	During the construction period	Control over the storage and usage of fuel and lubricants in the project area	CWR	Engineers inspectors, who control the construction	CV
Biological resources	Nuisance of wild animals due to construction.	During the construction period	Field investigations	Ministry of Environmental Protection	Workers of department of wild animals protection	CV
Water resources	Risk of leakage of fuel and lubricants to the soils	During the construction period	Control over the usage of fuel and lubricants in the project area	CWR	Engineers inspectors, who control the construction	CV
Environment	Collection of construction waste after completion of construction works	After completion of construction works	Control over waste collection	CWR	Engineers inspectors, who control the construction	CV
	Dust	During the construction period	Prevention of dust generation during earthworks and during transportation	CWR	Engineers inspectors, who control the construction	CV

ation period						
	Monitoring of water-physical soil properties on lands, cut off meanders (selectively).	1 time in 5 years	1. Selection of the monitoring object and location . Lands, cut off by meanders(selectively). 2. Soil samling from genetic horizon at the depth of 2 m. Laboratory analyses. Processing and analysis of results	KIONPCzem	Laboratory analyses , sampling will be made by field workers	CWR
	Monitoring of soil salinization on lands , cut of meanders (selectively)	3 times per year раз	Soil samling from genetic horizon at the depth of 2 m. Laboratory analyses. Processing and analysis of results	KIONPCzem	Laboratory analyses , sampling will be made by field workers	CWR
ce s	Runoff and volume of surface runoff	At the existing gauging stations along the river in flood period	Field measurements of water discharge at the existing gauging stations along the river	RSE«Kazhydrom et»	Specialists of department of RSE «Kazhydromet»	CWR
	Timing and spread area of flood	Remote sensing in weekly interval in flood period	Remote sensing. Processing and analysis of results	Space Research Institute	Specialists of institute' departments	CWR
gical ırces	Flora	With interval of one year after completion of the construction	Determination and classification of types of vegetation. The creation of catalogue of types of vegetation with photo.	Department of vegetation protection of the Ministry of ecology and bioresources	Field workers	CWR
	Fauna	With interval of one year after completion of the construction	Determination and classification of habitant species of wild animals. Creation of catalogue of habitant species of wild animals	Department of wild animals protection of the Ministry of ecology and bioresources	Field workers	CWR
)- omic ırces	Prevented damage from flooding	Assessment of condition and value of infrastructure, protected by dikes	Established standard assessment methods for the respective infrastructure	Managed by the district authorities and integrated at oblast level	Specialists of department	CWR

	Condition of the canal straightening the meander and other hydraulic structures	During operation period	Control and field observations	Operation service of the object	Field workers	C\

Table 6-3: Environment monitoring program for the sub-project "Construction of flood protection dikes in Kazalinsk and Karmakchi sistricts of Kzylorda oblast

tegory	Subject	Period/ frequency	Plan and methodology	Organization	Performers	Accountability
:ruction period						
	Technogenic disturbances of soil covering	During the construction period	Construction of protection dikes in Kazalinsk and Karmakchi districts of Kzylorda oblast. Recultivation of disturbed lands.	CWR	Engineers inspectors, who control the construction	CWR
	Use of heavy construction equipment and machines	During the construction period	Monitoring for the use of heavy equipment in order to prevent soil compaction .	CWR	Engineers inspectors, who control the construction	CWR
	Possible soil contamination by fuel and lubricants	During the construction period	Control over the storage and usage of fuel and lubricants in the project area	CWR	Engineers inspectors, who control the construction	CWR
jical rces	Nuisance of wild animals due to construction.	During the construction period	Field investigations	Ministry of Environmental Protection	Workers of department of wild animals protection	CWR
rces	Risk of leakage of fuel and lubricants to the soils	During the construction period	Control over the usage of fuel and lubricants in the project area	CWR	Engineers inspectors, who control the construction	CWR
onment	Collection of construction waste after completion of construction works	After completion of construction works	Control over waste collection	CWR	Engineers inspectors, who control the construction	CWR
	Dust	During the construction period	Prevention of dust generation during earthworks and during transportation	CWR	Engineers inspectors, who control the construction	CWR

Operation period						
Soils	Monitoring of water-physical soil properties on lands, protected by dikes (selectively)	1 time in 5 years	1. Selection of the monitoring object and location . Lands, protected by dikes (selectively). 2. Soil samling from genetic horizon at the depth of 2 m. Laboratory analyses. Processing and analysis of results	KIONPCzem	Laboratory analyses , sampling will be made by field workers	C\
	Monitoring of soil salinization on lands, protected by dikes (selectively)	3 times per year	Soil samling from genetic horizon at the depth of 2 m. Laboratory analyses. Processing and analysis of results	KIONPCzem	Laboratory analyses , sampling will be made by field workers	C\
	Monitoring for the content of heavy metals , pesticides herbicides of soils on lands, protected by dikes (selectively)	1 time per year	Soil sampling from top layer for laboratory investigations.. Processing and analysis of results.	KIONPCzem	Field workers KIONPCzem and farmers	C\
Surface waters	Runoff and volume of surface runoff	At the existing gauging stations along the river, and where missing , at additional gauging staions in the flood period. Daily measurements	Field measurements of water discharges at the existing gauging stations , and where missing, at additional gauging stations	RSE«Kazhydrom et»	Specialists of departments of RSE «Kazhydromet»	C\
	Timing and spread area of flood	Remote sensing with weekly interval in the flood period	Remote sensing. Processing and analysis of results	Space Research Institute	Specialists of institute departments	C\
	Damage from floods, caused to land use, infrastructure and property	Areas of different land use types: sown arable lands, fallow land, haymaking areas, pastures	Established standard statistic methods verified by remote sensing	Managed by the district authorities and integrated at oblast level Support by KIO NPCzem or Spacr Research Institute	Specialists of departments	C\

ical rces	Flora	With interval of one year after completion of the construction	Determination and classification of types of vegetation. The creation of catalogue of types of vegetation with photo. .	Department of vegetation protection of the Ministry of ecology and bioresources	Field workers	CWR
	Fauna	With interval of one year after completion of the construction	Determination and classification of habitant species of wild animals. Creation of catalogue of habitant species of wild animals	Department of wild animals protection of the Ministry of ecology and bioresources	Field workers	CWR
- mic rces	Economic damage from flooding of arable lands and destruction of state infrastructure and property	Economic losses due to delayed or prevented cultivation of arable lands Assessment of condition and values of infrastructure under the threat of flooding	Established standard assessment methods for the respective infrastructure	Managed by the district authorities and integrated at oblast level	Specialists of departments	CWR
	Prevented damage from flooding	Assessment of conditions and value of infrastructure, protected by dikes	Established standard assessment methods for the respective infrastructure	Managed by the district authorities and integrated at oblast level	Specialists of departments	CWR
	Condition of dikes and other hydraulic structures	During operation period	Control and field observations	Operation service of the object	The workers of service	CWR

Table 6-4: Environment monitoring program for the sub-project "Construction of motor bridge near Birlik settlement in Kazalinsk district of Kzylorda oblast

Category	Subject	Period/ frequency	Plan and methodology	Organization	Performers	Ac nt
Construction period						
Soils	Technogenic disturbances of soil covering	During the construction period	Construction of motor bridge near Birlik settlement in Kazalinsk district of Kzylorda oblast. Recultivation of disturbed lands.	CWR	Engineers inspectors, who control the construction	C\
	Use of heavy construction equipment and machines	During the construction period	Monitoring for the use of heavy equipment in order to prevent soil compaction	CWR	Engineers inspectors, who control the construction	C\
	Possible soil contamination by fuel and lubricants	During the construction period	Control over the the storage andf usage of fuels and lubricants in the project area з	CWR	Engineers inspectors, who control the construction	C\
Biological resources	Nuisance of wild animals due to construction.	During the construction period	Field investigations	Ministry of Environmental Protection	Workers of department of wild animals protection	C\
Water resources	Risk of leakage of fuel and lubricants to the soils	During the construction period	Control over the usage of fuel and lubricants in the project area	CWR	Engineers inspectors, who control the construction	C\
Environment	Collection of construction waste after completion of construction works	After completion of the construction works	Control over waste collection	CWR	Engineers inspectors, who control the construction	C\
	Dust	During the construction period	Prevention of dust generation during earthworks and during transportation	CWR	Engineers inspectors, who control the construction	C\
Operation period						
Soils	Monitoring of water-physical soil properties on areas, adjacent to the bridge (selectively)	1 time in 5 years	1. Selection of the monitoring object and location . Lands, adjacent to the bridge (selectively). 2. Soil samling from genetic horizon at the depth of 2 m. Laboratory analyses. Processing and analysis of results	KIONPCzem	Laboratory analyses , sampling will be made by field workers by KIONPCzem	C\

	Monitoring for the content of heavy metals , contaminants on areas, adjacent to the bridge (selectively)	1 time in 5 years	Soil sampling from top layer for laboratory investigations.. Processing and analysis of results.	KIONPCzem	Field workers of KIONPCzem	CWR
ce s	Runoff and volume of surface runoff	At the existing gauging stations along the river in flood period	Field measurements of water discharges at the existing gauging stations	RSE «Kazhydromet »	Specialists of department of RSE «Kazhydromet »	CWR
	Timing and spread area of flood	Remote sensing with weekly interval in flood period	Remote sensing.Processing and analysis of results	Space Research Institute	Specialists of institute departments	
gical rces	Flora	1 time in 5 years	Determination and classification of types of vegetation with photo	Department of vegetation protection of the Ministry of ecology and bioresources	Field workers	CWR
	Fauna	1 time in 5 years	Determination and classification of habitant species of wild animals .	Department of wild animals protection of the Ministry of ecology and bioresources	Filed workers	CWR
- omic rces	Monitoring of intensity of road traffic via bridge .	One year after completion of the construction, then every 3-5 years	It is kept the record of vehicles passing over the bridge by periods of the year. Assessment of the effectiveness of measures	Department of passenger transport and motor roads of Kzylorda oblast	Workers of department	CWR
	Condition of the bridge and other hydraulic structures	During operation period	Control and field observations	Operation service of the object		CWR

Table 6-5: Environment monitoring program for the sub-project " Rehabilitation of Kamuishlibash and Akshatau lake systems

Category	Subject	Period/ frequency	Plan and methodology	Organization	Performers	Ac nt
Construction period						
Soils	Technogenic disturbances of soil covering	During the construction period	Construction of barrage, dikes, roads and canals. Recultivation of disturbed lands.	CWR	Engineers inspectors, who control the construction	CV
	Use of heavy construction equipment and machines	During the construction period	Monitoring for the use of heavy equipment in order to prevent soil compaction .	CWR	Engineers inspectors, who control the construction	CV
	Possible soil contamination by fuel and lubricants	During the construction period	Control over the storage and usage of fuels and lubricants in the project area	CWR	Engineers inspectors, who control the construction	CV
Biological resources	Nuisance of wild animals due to construction.	During the construction period	Field investigations	Ministry of Environmental Protection	Workers of department of wild animals protection	CV
Water resources	Risk of leakage of fuel and lubricants to the soils	During the construction period	Control over the usage of fuels and lubricants in the project area	CWR	Engineers inspectors, who control the construction	CV
Environment	Collection of construction waste after completion of construction works	After completion of construction works	Control over waste collection	CWR	Engineers inspectors, who control the construction	CV
	Dust	During the construction period	Prevention of dust generation during earthworks and during transportation	CWR	Engineers inspectors, who control the construction	CV
Operation period						
Soils	Monitoring of water-physical soil properties at stationary ecological site	1 time in 5 years	1. Selection of the monitoring object and location(stationary ecological site) . 2. Soil samling from genetic horizon at the depth of 2 m. Laboratory analyses. Processing and analysis of results	KIONPCzem	Laboratory analyses , sampling will be made by field workers	CV

	Monitoring of soil salinization at stationary ecological site	3 times per year	Soil samling from genetic horizon at the depth of 2 m. Laboratory analyses. Processing and analysis of results	KIONPCzem	Laboratory analyses , sampling will be made by field workers	CWR
	Monitoring for the content of heavy metals , pesticides herbicides of soils at stationary ecological site	1 time per year	Soil sampling from top layer for laboratory investigations.. Processing and analysis of results	KIONPCzem	Field workers of KIONPCzem and farmers	CWR
ce s	Volume of surface runoff	At barrage –every day in automatic regime	Field measurements on gauging stations along the river and Amanotkel barrage, as well as water intakes , water-supply canals	Operational service of barrage	Specialists of department	CWR
	pH, temperature , electrical conductivity, water clarity.	Each decade in flood period	Field measurements on gauging stations along the river and Amanotkel barrage, as well as water intakes , water-supply canals)	Hydrogeological melorative expedition	Specialists of departments of hydrogeological melorative expedition	CWR
	Salinity, Na, K, Ca, Mg, Cl, HCO3, N, NH4, P, SO4, NO2, NO3, oil products	3 times during flood period	Water sampling at gauging stations, equipped on the river. The analyses are conducted in laboratory conditions.	Hydrogeological melorative expedition	Specialists of departments of hydrogeological melorative expedition	CWR
	Microelements: Cu, Zn, Mn, Ni, Pb, Fe, Cr, F, Cd, Co, Hg, biotesting, bacteriological analysis	3 times during flood period	Water sampling at gauging stations, equipped on the river. The analyses are conducted in laboratory conditions.	Hydrogeological melorative expedition	Specialists of departments of hydrogeological melorative expedition	CWR
gical rces	Flora	With interval of one year after completion of the construction	Determination and classification of types of vegetation. The creation of catalogue of types of vegetation with photo.	Department of vegetation protection of the Ministry of ecology and bioresources	Field workers	CWR
	Fauna	With interval of one year after completion of the construction	Determination and classification of habitant species of wild animals Creation of catalogue of habitant species of wild animals	Department of wild animals protection of the Ministry of ecology and bioresources	Field workers	CWR

Socio-economic resources	Monitoring of use of pesticides and heavy metals and its residual quantity in organisms and crops	One year after the completion of construction , then – milk and meat of animals , fishes is studied every 3-5 years, vegetable products are studied on annually basis	The sampling is made in the period of ageing from cash crops; analysis of pesticides, nitrates , The same applies to fish	Republican and regional veterinary laboratories, regional and district sanitary and epidemiological stations	Field workers	C\
	Condition of barrage, dikes, canals and other hydraulic structures	During operation period	Control and field observations	Operation service of the object		C\

'able 6-6: Environment monitoring program for the sub-project "Reconstruction and extension of fishery ponds at Tastak site of Kamuishlibash fish hatchery in Aralsk listrict of Kzylorda oblast

:gory	**Subject**	**Period/ frequency**	**Plan and methodology**	**Organization**	**Performers**	**Accountability**
'uction period						
	Technogenic disturbances of soil covering	During the construction period	Reconstruction and extension of fishery ponds at Tastak site of Kamuishlibash fishery ponds in Aralsk district of Kzylorda oblast . Recultivation of disturbed lands..	CWR	Engineers inspectors, who control the construction	CWR
	Use of heavy construction equipment and machines	During the construction period	Monitoring for the use of heavy equipment in order to prevent soil compaction	CWR	Engineers inspectors, who control the construction	CWR
	Possible soil contamination by fuel and lubricants	During the construction period	Control over the storage and usage of fuel and lubricants in the project area	CWR	Engineers inspectors, who control the construction	CWR
ical es	Nuisance of wild animals due to construction.	During the construction period	Field investigations	Ministry of Environmental Protection	Workers of department of wild animals protection	CWR
ıe сы	Risk of leakage of fuel and lubricants to the soils	During the construction period	Control over the usage of fuel and lubricants in the project area	CWR	Engineers inspectors, who control the construction	CWR
·nment	Collection of construction waste after completion of construction works	After completion of construction works	Control over the waste collection	CWR	Engineers inspectors, who control the construction	CWR
	Dust	During the construction period	Prevention of dust generation during earthworks and during transportation	CWR	Engineers inspectors, who control the construction	CWR

Operation period						
Soils	Monitoring of water physical soil properties on the territory of fish hatchery	1 time per year	1. Selection of the monitoring object and location. Territory of fish hatchery 2. Soil samling from genetic horizon at the depth of 2 m. Laboratory analyses. Processing and analysis of results	KIONPCzem	Laboratory analyses , sampling will be made by field workers	C\
	Monitoring of soil salinization on the territory of fish hatchery	1 time per year	Soil samling from genetic horizon at the depth of 2 m. Laboratory analyses. Processing and analysis of results	KIONPCzem	Laboratory analyses , sampling will be made by field workers	C\
	Monitoring for the content of heavy metals , pesticides herbicides on the territory of fish hatchery	1 time per year	Soil sampling from top layer for laboratory investigations.. Processing and analysis of results.	KIONPCzem	Field workers KIONPCzem and farmers	C\
Surface waters	Volume of abstracted and released surface runoff	Constantly at water intake	Measurements at water intake, and outlet ditches	Operational service of fish hatchery	Specialists of departments	C\
	pH, temperature, electrical conductivity, water clarity.	Constantly	Measurements at water intake, and outlet ditches	Operational service of fish hatchery	Specialists of departments	C\
	Salinity, Na, K, Ca, Mg, Cl, HCO3, N, NH4, P, SO4, NO2, NO3, oil products.	Constantly	Water sampling in fishery ponds. Analyses are made in laboratory conditions	Operational service of fish hatchery	Specialists of departments	C\
	Microelements: Cu, Zn, Mn, Ni, Pb, Fe, Cr, F, Cd, Co, Hg, biotesting, bacteriological analysis	Constantly	Water sampling in fishery ponds.. Analyses are made in laboratory conditions.	Operational service of fish hatchery	Specialists of departments	C\
Biological resources	Flora	With interval of one year after the completion of the construction	. Determination and classification of types of vegetation. The creation of catalogue of types of vegetation with photo.	Department of vegetation protection of the Ministry of ecology and bioresources	Field workers	C\

	Fauna	With interval of one year after completion of the construction	Determination and classification of habitant species of wild animals Creation of catalogue of habitant species of wild animals	Department of wild animals protection of the Ministry of ecology and bioresources	Field workers	CWR
- omic rces	. Monitoring of use of pesticides and heavy metals and its residual quantity in fish organisms	One year after the completion of construction , then – meat of fishes is studied every 3 years,	The sampling is made in the period of ageing from cash crops; analysis of pesticides, nitrates	Republican and regional veterinary laboratories, regional and district sanitary and epidemiological stations	Field workers	CWR
	Condition of water intake, dikes, fishery ponds, canals and other hydraulic structures	During operation period	Control and field observations	Operation service of the obje		CWR

ANNEXES

Annex 1.1 – Impact assessment and environmental protection measures for the sub-project "Reconstruction of left bank offtake-regulator at Kzylorda barrage "

Object of impact	Influencing element	Affected factor	Type and character of the impact (expected)		Possible result of impact	Measures to prevent or mitigate negative impact
			Main impact	Secondary impact		
1. Atmospheric air	Reconstruction of left bank offtake-regulator, sections of access roads . Organization of temporary field camps ; movement of transport and construction machinery	Quality of atmospheric air	Dust generation , increase of salt content , Emissions of pollutants into atmosphere	Visibility worsening, especially in windy weather; Dust deposition and salt settling on vegetation and deterioration of processes of breathing and photosynthesis; Worsening of people and animal breathing .	Worsening of health status of people in the affected area , allergic reaction, impact on vision	Minimization of non-regulated field motor roads and prevention of fracturing of sor solonchaks surface; Maintenance equipment in working order .
2. Soil covering	Reconstruction of left bank offtake-regulator, sections of access roads . Organization of temporary field camps ; movement of transport and construction machinery	Structure of soil cover and soil horizon	Cutting of top fertile soil layer, mixing of soil horizons,soil compaction along the routes and motor roads and loosening on waysides	Disturbance of soils' natural structure and soil cover, development of erosion and deflation, chemical pollution (fuel and lubricants etc.)	Loss of natural conditions for vegetation growing and animal living, especially burrowing animals, formation of sections with truncated soil and deflations on sands	Cutting and stockpilling of top fertile soil layers , especially alluvial soils with the subsequent placing back at disturbed areas, regulation of transport and machinery traffic, especially on soils with light mechanical content
3.Water resources	Reconstruction of left bank offtake-regulator, sections of access roads . Organization of temporary field camps ; movement of transport and construction machinery	Quality of surface waters	Local turbidity and pollution by technical and domestic wastes, fuel and lubricants	Temporary deterioration of habitat conditions of water flora and fauna	Temporary worsening of plenty, productivity and typical diversity of water flora and fauna	Prohibition of car and other machinery washing in natural water bodies and rivers

4. Biota	Reconstruction of left bank offtake-regulator, sections of access roads . Organization of temporary field camps ; movement of transport and construction machinery .	Types of flora and fauna, natural vegetation cover, places of habitation of wild animals	Destruction of vegetation and habitats of some animal species at the construction site or transport passage , frightening of animals	Decrease of bio-diversity at construction site, loss of habitats of some species of animals	Replacement of natural vegetation communities by secondary rarefied groups of weed species , the loss of habitat of some animal species locally .	Prohibition of chaotic traffic, mimimization of section of soil cutting and excavation, restriction of light and noise impacts.
5. Atmosperi c air	Opeartion of left bank offtake-regulator	Quality of atmospheric air	Impact on atmospheric air is not expected .	Impact on atmospheric air is not expected .	Impact on atmospheric air is not expected . (positive).	Restriction of traffic near weir
6.Soil covering	Opeartion of left bank offtake-regulator	Physical-chemical soil properties and structure of soil cover	No additional impacts will arise during operation of the object in comparison with the existing situation	Impact on soil cover is not expected	Impact on soil cover is not expected (positive)	Minimazation of soil cover' disturbance and contamination

7. Water resources	Opeartion of left bank offtake-regulator	Hydrological, hydro-chemical and thermal regimes	Updated offtake-regulator allow supplying water imely and regularly to LMC in order to avoid excessive irrigation leading to swamp formation and salinization .	Impact on quality of water is not expected in the river	Impact on quality of water in the river is not expected (positive).	The measures are foreseen to prevent water contaminatiion from hydromechanical equipment of offtake-regulator .
8. Biota	Opeartion of left bank offtake-regulator	Flora, fauna, vegetation cover , areas of wild animals' habitat	Sub-project would not lead to changes in the landscape, or to changes in natural and cultural ecosystems, it is not expected any significant impact on the flora and fauna as the site and the area of influence has been already transformed	Impact on quality of water is not expected in the river	Impact on quality of water in the river is not expected (positive).	Prohibition of cutting of trees and bushes in the area of offtake-regulator .

Annex 1.2 - Impact assessment and environmental protection measures for the sub-project " Syrdarya river bed straighening at Korgansha and Turumbet sections in Zhalagash district of Kzylorda oblast

Object of impact	Influencing element	Affected factor	Type and character of the impact (expected)		Possible result of impact	Measures to prevent or mitigate negative impact
			Main impact	Secondary impact		
1. Atmospheric air	Syrdarya river bed straightening at sections, construction of sections of access roads. Organization of temporary field camps ; movement of transport and construction machinery	Quality of atmospheric air	Dust generation , increase of salt content , Emissions of pollutants into atmosphere	Visibility worsening, especially in windy weather; Dust deposition and salt settling on vegetation and deterioration of processes of breathing and photosynthesis; Worsening of people and animal breathing	Worsening of health status of people in the affected area, allergic reaction, impact on vision	Minimization of non-regulated field motor roads and prevention of fracturing of sor solonchaks surface Maintenance equipment in working order .
2. Soil covering	Syrdarya river bed straightening at sections, construction of sections of access roads. Organization of temporary field camps ; movement of transport and construction machinery	Structure of soil cover and soil horizon	Cutting of top fertile soil layer, mixing of soil horizons,soil compaction along the routes and motor roads and loosening on waysides	Failure of natural soil structure and soil cover, development of erosion and deflation, chemical pollution (fuel and lubricants etc.)	Loss of natural conditions for vegetation growing and animal living, especially burrowing animals, formation of sections with truncated soil and deflations on sands	Cutting and stockpilling of top fertile soil horizons, especially alluvial soils with their subsequent placing back at disturbed areas, regulation of transport and machinery traffic, especially on soils with light mechanical content
3.Water resources	Syrdarya river bed straightening at sections, construction of sections of access roads. Organization of temporary field camps ; movement of transport and construction machinery	Quality of surface waters	Local turbidity and pollution by technical and domestic wastes, fuel and lubricants	Temporary worsening of habitat conditions of water flora and fauna	Decrease of plenty, productivity and typical diversity of water flora and fauna	Prohibition of car and other machinery washing in natural water bodies and rivers

4. Biota	Syrdarya river bed straightening at sections, construction of sections of access roads. Organization of temporary field camps ; movement of transport and construction machinery	Types of flora and fauna, natural vegetation cover, places of habitation of wild animals	Destruction of vegetation and habitats of some animal species at the construction site or transport passage , frightening of animals	Decrease of bio-diversity at construction sites, loss of habitats of some species of animals	Replacement of natural vegetation communities by secondary rarefied groups of weed species, locally the loss of habitat, of some animal species .	Prohibition of chaotic traffic, mimimization of section of soil cutting and excavation, restriction of light and noise impacts.
5. Atmosperic air	Operation of section straightened river-bed	Quality of atmospheric air	Impact on atmospheric air is not expected .	Impact on atmospheric air is not expected	Impact on atmospheric air is not expected (positive).	Restriction of traffic along dikes
6.Soil covering	Operation of section straightened river-bed	Physical-chemical soil properties and structure of soil cover	The nature of hydromorphic soils will be changed .	Planned river bed straightening would lead to full stop of natural geomorphological dynamics of erosion and accumulation in meanders	The nature of hydromorphic soils will be changed . (neagtive)	Minimazation of soil cover' disturbance and contamination
7. Water resources	Operation of section straightened river-bed	Hydrological, hydro-chemical and thermal regimes	Reduction of inundated areas of flood plains	Straigthening of meanders, reducing natural dynamics of floods and geomorphological procceses in the floodplain would deteriorate water supply conditions	Impact on quality of water is insignificant	Minimization of disturbance and contamination of water resources

8. Biota	Operation of section straightened river-bed	Flora, fauna, vegetation cover , areas of wild animals' habitat	Planned river bed would have a negative impact on typical river landscape	Natural habitas will be transformed. There is no economically important flora and fauna in the project area .	Prevention of overflow of floodplain area can have a negative impact on reproduction of flora and fauna	Prohibition of cutting of trees and bushes in the area of meanders

Annex 1.3 - Impact assessment and environmental protection measures for the sub-project "Construction of flood protection dikes in Kazalins and Karmakchi districts of Kzylorda oblast "

Object of impact	Influencing element	Affected factor	Type and character of the impact (expected)		Possible result of impact	Measures to prevent or mitigate negative impact
			Main impact	Secondary impact		
1. Atmospheric air	Construction of protection dikes , sections of acces roads. Organization of temporary field camps ; movement of transport and construction machinery	Quality of atmospheric air	Dust generation , increase of salt content , Emissions of pollutants into atmosphere	Visibility worsening especially in windy weather; Dust deposition and salt settling on vegetation and deterioration of processes of breathing and photosynthesis; Worsening of people and animal breathing	Worsening of health status of people in the affected area, allergic reaction, impact on vision	Minimization of non-regulated field motor roads and prevention of fracturing of sor solonchaks surface Maintenance equipment in working order .
2. Soil covering	Construction of protection dikes , sections of access roads. Organization of temporary field camps ; movement of transport and construction machinery	Structure of soil cover and soil horizon	Cutting of top fertile soil layer, mixing of soil horizons,soil compaction along the routes and motor roads and loosening on waysides	Disturbance of soil s'natural structure and soil cover, development of erosion and deflation, chemical pollution (fuel and lubricants etc.)	Loss of natural conditions for vegetation growing and animal living especially burrowing animals, formation of sections with truncated soil and deflations on sands	Cutting and stockpiling of top fertile soil horizons, especially alluvial soils with their subsequent placing back at disturbed areas, regulation of transport and machinery traffic , especially on soils with light mechanical content
3. Water resources	Construction of protection dikes , sections of access roads. Organization of temporary field camps ; movement of transport and construction machinery	Quality of surface waters	Local turbidity and pollution by technical and domestic wastes, fuel and lubricants	Temporary worsening of habitat conditions of water flora and fauna	Decrease of plenty , productivity and typical diversity of water flora and fauna	Prohibition of car and other machinery washing in natural water bodies and rivers

4. Biota	Construction of protection dikes , sections of access roads. Organization of temporary field camps ; movement of transport and construction machinery	Types of flora and fauna, natural vegetation cover, places of habitation of wild animals	Destruction of vegetation and habitats of some animal species at the construction site or transport passage ,frightening of animals	Decrease of bio-diversity at construction sites, loss of habitats of some species of animals	Replacement of natural vegetation communities by secondary rarefied groups of weed species , locally the loss of habitat of some animal species.	Prohibition of chaotic traffic, mimimization of section of soil cutting and excavation, restriction of light and noise impacts.
5. Atmosperic air	Opearation of protection dikes .	Quality of atmospheric air	Impact on atmospheric air is not expected .	Impact on atmospheric air is not expected	Impact on atmospheric air is not expected (positive).	Restriction of traffic along dikes
6.Soil covering	Opearation of protection dikes .	Physical-chemical soil properties and structure of soil cover	The nature of hydromorphic soils will be changed .	Disturbance of soils' natural structure and soil cover	Soil contamination would not increase the existing levels	Minimazation of soil cover' disturbance and contamination
7. Water resorces	Opearation of protection dikes .	Hydrological, hydro-chemical and thermal regimes	Reduction of inundated areas of flood plains	Construction of dikes , reducing natural dynamics of floods and geomorphological procceses in the flood plain would deteriorate water supply conditions	Impact on quality of water in the river is insignificant	Prohibition of car and other machinery in natural water bodies and rivers
8. Biota	Opearation of protection dikes .	Flora, fauna, vegetation cover , areas of wild animals' habitat	Increase of the height of the existing embankments would change the landscape	Natural habitas will be transformed. There is no economically important flora and fauna in the project area . Prevention of overflow of floodplain area can have a negative impact on reproduction of flora and fauna	Decrease of plenty, productivity and typical diversity of water flora and fauna	Prohibition of cutting of trees and bushes in the area of meanders

Annex 1.4 - Impact assessment and environmental protection measures for the sub-project "Construction of motor bridge near Birlik settlement in Kazalinsk district of Kzylorda oblast.

Object of impact	Influencing element	Affected factor	Type and character of the impact (expected)		Possible result of impact	Measures to prevent or mitigate negative impact
			Mian impact	Secondary impact		
1. . Atmospheric air	Construction of motor bridge, sections of access roads. Organization of temporary field camps ; movement of transport and construction machinery	Quality of atmospheric air	Dust generation , increase of salt content , Emissions of pollutants into atmosphere	Visibility worsening especially in windy weather; Dust deposition and salt settling on vegetation and deterioration of processes of breathing and photosynthesis; Worsening of people and animal breathing	Worsening of health status of people in the affected area, allergic reaction, impact on vision	Minimization of non-regulated field motor roads and prevention of fracturing of sor solonchaks surface Maintenance equipment in working order .
2. Soil covering	Construction of motor bridge, sections of access roads. Organization of temporary field camps ; movement of transport and construction machinery	Structure of soil cover and soil horizon	Cutting of top fertile soil layer, mixing of soil horizons,soil compaction along the routes and motor roads and loosening on waysides	Disturbance of soils' natural structure and soil cover, development of erosion and deflation, chemical pollution (fuel and lubricants etc.)	Loss of natural conditions for vegetation growing and animal living, especially burrowing animals, formation of sections with truncated soil and deflations on sands	Cutting and stockpiling of top fertile soil horizons, especially alluvial soils with their subsequent placing back at disturbed areas, regulation of transport and machinery traffic , especially on soils with light mechanical content
3. Water resources	Construction of motor bridge, sections of access roads. Organization of temporary field camps ; movement of transport and construction machinery	Quality of surface waters	Local turbidity and pollution by technical and domestic wastes, fuel and lubricants	Temporary worsening of habitat conditions of water flora and fauna	Decrease of plenty , productivity and typical diversity of water flora and fauna	Prohibition of car and other machinery washing in natural water bodies and rivers

4. Biota	Construction of motor bridge, sections of access roads. Organization of temporary field camps ; movement of transport and construction machinery	Types of flora and fauna, natural vegetation cover, places of habitation of wild animals	Destruction of vegetation and habitats of some animal species at the construction site or transport passage, frightening of animals	Decrease of bio-diversity at construction sites, loss of habitats of some species of animals	Replacement of natural vegetation communities by secondary rarefied groups of weed species locally , the loss of habitat of some animal species.	Prohibition of chaotic traff mimimization of section of soil cutting and excavatio restriction of light and nois impacts.
5. Atmosperic air	Operation of motor bridge.	Quality of atmospheric air	Reduction of distances and improvement of road conditions will lead to decreased pollutant emissions	New bridge would reduce the noices at bridge sections and access roads.	The emissions from road transport will be reduced at the adjacent territory (positive)	Creation of conditions of free passage on the bridg
6.Soil covering	Operation of motor bridge..	Physical-chemical soil properties and structure of soil cover	Unpaved roads anf unregular route will be changed, and local и techogenoc soil erosion will be decreased	Soil contamination will not exceed the existing levels as access road substitutes the existing gravel roads and transport distance are being decrased	The load on the soil in the area of the bridge will be reduced significantly (positive).	Minimazation of soil cover disturbance and contamination
7. Water resources	Operation of motor bridge..	Hydrological, hydro-chemical and thermal regimes	Bridges will eliminate bottlenecks where effective width of river bed is limited by 70 m and allow expanding river bed up to 200 m.	The bottlenecks are reason for flooding problem. This problem will be eliminated heareinafter .	Construction of the bridge will reduce water contamination, caused by accidents on the pontoon bridge, river water contamination by the emissions from vehicles , crossing the pontoon bridge (bridge).	The measures are forese to prevent wa contamination by flui flowing from the bridge.

8. Biota	Operation of motor bridge..	Flora, fauna, vegetation cover , areas of wild animals' habitat	New access ways will be located close to the existing unpaved roads and pass over heavily used agriculutural lands and areas with already heavily transformed vegetation. Impact on landscape will be minimal..	. Natural habitas will be transformed. There is no economically important flora and fauna in the project area	The project contributes to the improvement of water inflow in the lower reaches of the river area, and thus, improves habitat for flora and fauna	Prohibition of cutting of trees and bushes in the area of meanders

Annex 1.5 - Impact assessment and environmental protection measures for the sub-project "Rehabilitation of Kamuishlibash and Akshatau lake systems".

Object of impact	Influencing element	Affected factor	Type and character of the impact (expected)		Possible result of impact	Measures to prevent or mitigate negative impact
			Main impact	Secondary impact		
1. . Atmospheric air	Construction of barrage, , water intakes, canals , dikes.Organization of temporary field camps ; movement of transport and construction machinery ..	Quality of atmospheric air	Dust generation , increase of salt content , Emissions of pollutants into atmosphere	Visibility worsening especially in windy weather; Dust deposition and salt settling on vegetation and deterioration of processes of breathing and photosynthesis; Worsening of people and animal breathing	Worsening of health status of people in the affected area, allergic reaction, impact on vision	Minimization of non-regulated field motor roads and prevention of fracturing of sor solonchaks surface; Maintenance equipment in working order .
2. Soil covering	Construction of barrage, , water intakes, canals , dikes.Organization of temporary field camps ; movement of transport and construction machinery ..	Structure of soil cover and soil horizon	Cutting of top fertile soil layer, mixing of soil horizons,soil compaction along the routes and motor roads and loosening on waysides	Disturbance of soils' natural structure and soil cover, development of erosion and deflation, chemical pollution (fuel and lubricants etc.)	Loss of natural conditions for vegetation growing and animal living , especially burrowing animals, formation of sections with truncated soil and deflations on sands	Cutting and stockpiling of top fertile soil horizons, especially alluvial soils with their subsequent placing back at disturbed areas, regulation of transport and machinery traffic , especially on soils with light mechanical content
3. Water resources	Construction of barrage, , water intakes, canals , dikes.Organization of temporary field camps ; movement of transport and construction machinery ...	Quality of surface waters	Local turbidity and pollution by technical and domestic wastes, fuel and lubricants	Temporary worsening of habitat conditions of water flora and fauna	Decrease of plenty, productivity and typical diversity of water flora and fauna	Prohibition of car and orther machinery washing in natural water bodies and rivers

4. Biota	Construction of barrage, , water intakes, canals , dikes.Organization of temporary field camps ; movement of transport and construction machinery.	Types of flora and fauna, natural vegetation cover, places of habitation of wild animals	Destruction of vegetation and habitats of some animal species at the construction site or transport passage , frightening of animals	Decrease of bio-diversity at construction sites, loss of habitats of some species of animals	Replacement of natural vegetation communities by secondary rarefied groups of weed species ,locally the loss of habitat of some animal species	Prohibition of chaotic traffic, mimimization of section of soil cuttingand excavation, restriction of light and noise impacts.
5. Atmosperic air	Filling up of lake systems according to the proposed schedule of level regime	Microclimate of the adjacent territory	Daily and annual temperature would change, the absolute and relative humidity would increase at the adjacent territory (positive)	Evaporation from the surface of the water would increase, the fogs are possible during the cold season. Fogs have a negative impact on the people	The improvement of microclimate (positive)	The creation of water protection zone not less than 100 m.
6.Soil covering	Filling up of lake systems according to the proposed schedule of level regime	Physical-chemical soil properties and structure of soil cover	The increase of hydromorphic processes in soil covering, increase of soil moisture, decrease of salinization of upper levels at the significant area	Replacement of automorphic desert crust soils by hydromorphic and semihydromorphic soils at the significant area (positive)	Change in soil cover' structure of due to the formation of more fertile soils of meadow and swamp series	Minimazation of soil cover' disturbance and contamination of
7. Water resources	Filling of lake systems according to the proposed schedule of level regime .	Hydrological, hydro-chemical and thermal regimes	Increase of surface water area . Filling of lakes in spring summer period . Raising of ground water table.	Level regime of lake systems will be maximally close to natural. .	Increase of wetlands areas (positive)	Prohibition of car and other machinery washing in natural water bodies and rivers

8. Biota	Filling up of lake systems according to the proposed schedule of level regime	Flora, fauna, vegetation cover , areas of wild animals' habitat	Replacement of desert and semi-hydromorphic habitats ofvegetations and animals by hydromorphic ones with appropriate flora and fauna.	. Increase of biodiversity of flora nad fauna, increase of area of hayfields and pastures and reedbeds	The communities of trees and bushes will be formed, the esthetic value of the landscape will improve . The number of water and semi-aquatic flora fauna, especially birds is increased.The number of species and biomass of plankton, benthos and aquatic vegetation is increased that provide forage for fishes and birds. The possibility of hunting, fishing and recreation for the population appears (positive) Significantly increase the abundance of mosquitoes and midges (negative).	Increase of fish reproduction. Stocking of lakes and creation of fish husbandry , strict control over the seasons of hunting abd fishing. Prohibition of cutting of trees and pastures. Rational use of hayfields and pastures.

Annex 1.6 - Impact assessment and environmental protection measures for the sub-project " Reconstruction and extension of fishery ponds at Tastak site of Kamuishlibash fish hatchery in Aralsk district of Kzylorda oblast".

Object of impact	Influencing element	Affected factor	Type of nature of the impact (expected)		Possible result of impact	Measures to prevent or mitigate negative impact
			Main impact	Secondary impact		
1 Atmospheric air	Construction of the object: ponds, pumping station, incubation department Organization of temporary field camps ; movement of transport and construction machinery	Quality of atmospheric air	Dust generation , increase of salt content , Emissions of pollutant into atmosphere during movement of motor transport and construction machinery	Visibility worsening, especially in windy weather; Dust deposition and salt settling on vegetation and deterioration of processes of breathing and photosynthesis; Worsening of people and animal breathing	Worsening of health status of people in the affected area, allergic reaction, impact on vision	Minimization of non-regulated field motor roads and prevention of fracturing of sor solonchaks surface; Maintenance equipment in working order . Roads' wetting during the performance of earthworks
2. 2. Soil covering	Construction of the object	Structure of soil cover and soil horizon	Cutting of top fertile soil layer, mixing of soil horizons,soil compaction along the routes and motor roads and loosening on waysides during movement of motor transport and construction machinery	Disturbance of soils' natural structure and soil cover, development of erosion and deflation, chemical pollution (fuel and lubricants etc.)	Loss of natural conditions for vegetation growing and animal living, especially burrowing animals, formation of sections with truncated soil and deflations on sands	Cutting and stockpiling of top fertile soil horizons, especially alluvial soils with their subsequent placing back at disturbed areas, regulation of transport and machinery traffic , especially on soils with light mechanical content .
3. Water resources	Construction of the object	Quality of surface waters	Local turbidity and pollution by technical and domestic wastes, fuel and lubricants	Temporary worsening of habitat conditions of water flora and fauna .	Decrease of plenty, productivity and typical diversity of water flora and fauna	Prohibition of car and other machinery washing in natural water bodies and rivers

4. Biota	Construction of the object: ponds, pumping station, incubation department Organization of temporary field camps ; movement of transport and construction machinery.	Types of flora and fauna, natural vegetation cover, places of habitation of wild animals	Destruction of vegetation and habitats of some animal species at the construction site or transport passage , frightening of animals	Decrease of bio-diversity at construction sites, loss of habitats of some species of animals	Change of natural vegetation communities by secondary rarefied groups of weed species ,locally the loss of habitat of some animal species	Prohibition of chaotic traffic, mimimization of section of soil rcutting and excavation, restriction of light and noise impacts.
5. Atmospheric air	Filling of ponds .	Microclimate of the adjacent territory	Daily and annual temperature would change, the absolute and relative humidity would increase on the adjacent territory (positive)	Evaporation from the surface of the water would increase,in cold seasons the occurrence of fogs is possible, which has negative impact on people	The improvement of microclimate (positive)	The creation of water protection zone not less than 100 m.
6.Soil covering	Filling of ponds ..	Physical-chemical soil properties and structure of soil cover	The strengthening of hydromorphic processes in soil covering, increase of soils' moisture, decrease of salinization of top levels due to filtration and flushing at the insignificant area (positive)	The replacement of automorphic desert crust soils by hydromorphic and semihydromorphic soils on the insignificant area (positive)	Change in of soil cover' structure due to the formation of more fertile soils of meadow and swamp series .	Minimazation of soil cover' disturbance contamination
7. Water resources	Filling of ponds ..	Hydrological, hydro-chemical and thermal regimes	Increase of surface water area . Raising of ground water table.	Improvement of water quality due to settling. Decrease of water quality due to nurture and fertilization .	Increase of surface of water area (positive)	Prohibition of car and other machinery washing near ponds

8. Biota	Filling of ponds .	Flora, fauna, vegetation cover , areas of wild animals' habitat	Peplacement of desert and semi-hydromorphic habitats ofvegetations and animals by hydromorphic ones with appropriate flora and fauna.	Increase of biodiversity of flora and fauna.	Esthetic value of the landscape will improve . The number of water and semi-aquatic flora fauna, especially birds, is increased.The number of species and biomass of plankton, benthos and aquatic vegetation is increased that provide forage for fishes and birds. The possibility of hunting, fishing and recreation for the population appears (positive) Significantly increase the abundance of mosquitoes and midges (negative).	Increase of fish reproduction. Stocking of lakes due to fishery farms

Annex 2.1 – Main factors of impact during reconstruction of left bank offtake-regulator at Kzylorda barrage .

Type of activity . Sources of impact	Potential types of impact	Environmental components to be impacted
Construction of left bank offtake-regulator at Kzylorda barrage .		
Temporary field camps ; Movement of transport and construction machinery; Land withdrawal and use ; Cutting of vegetation cover; Cutting of top soil layer and soil cover ; Temporary storages of materials and equipment Parking of motor transport and other machinery; Use and storage of fuel and lubricants; Technical maintenance ; Short term presence of staff, people's recreation and feeding .	Dust formation; Pollutants emissions into the atmosphere; Use of land resources; Loss of habitats of animals and plants; Compaction of soils along the motor roads routes; Disturbance of natural structure of soils and fertility at the sites of construction of offtake-regulator Increase of probability of the soils' erosion and deflation; Limitation of the animals' movement; Noise, light, frightening of animals; Small leakages of fuel and lubricants materials are possible; Formation of wastes and wastewater; Increase of traffic intensiveness; Physical presence.	Atmosperic air; Soil cover; Vegetation Landscape; Fauna.
Operation of left bank offtake-regulator at Kzylorda barrage		
Updated offtake-regulator allow making water supply to LMC timely and regularly in order to avoid excessive irrigation leading to swamp formation and salinization on the irrigated massifs	Improvement of hydro melioration condition on the irrigated massifs	Ground waters ; Socio-economic conditions .

Annex 2.2 - Main factors of impact during Syrdarya river bed straightening at Korgansha and Turumbet sections in Zhalagash district of Kzylorda oblast.

Type of activity . Sources of impact	Potential types of impact	Environmental components to be impacted
Syrdarya river-bed straightening at Korgansha and Turumbet sections		
Temporary field camps ; Movement of transport and construction machinery; Land withdrawal and use ; Cutting of vegetation cover; Cutting of top soil layer and soil cover ; Temporary storages of materials and equipment Parking of motor transport and other machinery; Use and storage of fuel and lubricants; Technical maintenance ; Short term presence of staff, people's recreation and feeding	Dust formation; Pollutants emissions into the atmosphere; Use of land resources; Loss of habitats of animals and plants; Compaction of soils along the motor roads routes; Disturbance of natural structure of soils and fertility at the sites of canals' construction; Increase of probability of the soils' erosion and deflation; Changes in landscape structure with presence of manmade forms (canal of river bed straightening); Limitation of the animals' movement; Noise, light, frightening of animals; Small leakages of fuel and lubricants materials are possible; Formation of wastes and wastewater; Increase of traffic intensiveness; Physical presence.	Atmosperic air; Soil cover; Vegetation Landscape; Fauna..
Operation of sections of river bed straightened		
Planned river-bed straightening reduce the risk of formation of ice jams and thus reduce the occurrence of winter floods due to backwater .	Elimination of bottleneck, limiting the discharges in Syrdarya river and causing flooding ;	Landscape and land ecosystems; Ground flora and fauna ; Surface and ground waters ; Socio-economic conditions

Annex 2.3 - Main factors of impact during construction of flood protection dikes in Kazalinsk and Karmakchi districts of Kzylorda oblast .

Type of activity . Sources of impact	Potential types of impact	Environmental components to be impacted
Construction of flood protection dikes		
Temporary field camps ; Movement of transport and construction machinery; Land withdrawal and use ; Cutting of vegetation cover; Cutting of top soil layer and soil cover ; Temporary storages of materials and equipment Parking of motor transport and other machinery; Use and storage of fuel and lubricants; Technical maintenance ; Short term presence of staff, people's recreation and feeding	Dust formation; Pollutants emissions into the atmosphere; Use of land resources; Loss of habitats of animals and plants; Compaction of soils along the motor roads routes; Disturbance of natural structure of soils and fertility at the sites of the dikes and canals' construction; Increase of probability of the soils' erosion and deflation; Changes in landscape structure with presence of manmade forms (bridge); Limitation of the animals' movement; Noise, light, frightening of animals; Small leakages of fuel and lubricants materials are possible; Formation of wastes and wastewater; Increase of traffic intensiveness; Physical presence.	Atmosperic air; Soil cover; Vegetation Landscape; Fauna...
Operation of flood protection dikes		
Planned construction of flood protection dikes reduce the risk of occurence of winter floods	Without any doubt the prevention of damage of built-up area is positive. No physical cultural property will be affected under the Project operation	Landscape and land ecosystems; Ground flora and fauna ; Surface and ground waters ; Socio-economic conditions

Annex 2.4 - Main factors of impact on the sub-project "construction of motor bridge near Birlik settlement in Kazalinsk district of Kzylorda oblast

Type of activity . Sources of impact	Potential types of impact	Environmental components to be impacted
Construction of motor bridge		
Temporary field camps ; Movement of transport and construction machinery; Land withdrawal and use ; Cutting of vegetation cover; Cutting of top soil layer and soil cover ; Temporary storages of materials and equipment Parking of motor transport and other machinery; Use and storage of fuel and lubricants; Technical maintenance ; Short term presence of staff, people's recreation and feeding	Dust formation; Pollutants emissions into the atmosphere; Use of land resources; Loss of habitats of animals and plants; Compaction of soils along the motor roads routes; Disturbance of natural structure of soils and fertility at the site of bridge' construction; Increase of probability of the soils' erosion and deflation; Changes in landscape structure with presence of manmade forms (bridge etc); Limitation of the animals' movement; Noise, light, frightening of animals; Small leakages of fuel and lubricants materials are possible; Formation of wastes and wastewater; Increase of traffic intensiveness; Physical presence.	Atmosperic air; Soil cover; Vegetation Landscape; Fauna...
Operation of motor bridge		
Reduction of distances and improvement of road conditions will lead to decreased emissions of pollutants . Unpaved roads and non-regulated route will be replaced and local technogenic erosion of soil will be decreased.. Provision of all-season transport communication without limitation of weight ;	Elimination of bottleneck, limiting the discharges in Syrdarya river and causing floods; Reduction of distances and improvement of road conditions will lead to decreased emissions of pollutants Reduction of transport expenses; Improvement of microclimate of the adjacent territory ;	Landscapes and land ecosystems; Ground flora and fauna ; Surface and ground waters; Socio-economic conditions.

Annex 2.5 – Main factors of impact during construction of barrage, canals and dikes on the sub-project "Rehabilitation of Kamuishlibash and Akshatau lake systems ".

Type of activity . Sources of impact	Potential types of impact	Environmental components to be impacted
Construction of barrages, canals and dikes		
Temporary field camps ; Movement of transport and construction machinery; Land withdrawal and use ; Cutting of vegetation cover; Cutting of top soil layer and soil cover Excavation of trenches for canals; Temporary storages of materials and equipment Parking of motor transport and other machinery; Use and storage of fuel and lubricants; Technical maintenance ; Short term presence of staff, people's recreation and feeding	Dust formation; Pollutants emissions into the atmosphere; Use of land resources; Loss of habitats of animals and plants; Loss of forage base Compaction of soils along the motor roads routes; Disturbance of natural structure of soils and fertility at the sites of the dikes and canals' construction; Increase of probability of the soils' erosion and deflation; Changes in landscape structure with presence of manmade forms (barrage, dikes, canals etc); Limitation of the animals' movement; Noise, light, frightening of animals; Small leakages of fuel and lubricants materials are possible; Formation of wastes and wastewater; Increase of traffic intensiveness; Physical presence.	Atmosperic air; Soil cover; Vegetation; Landscape; Fauna,especially small mammals and rodents
Filling in of lake systems according to the proposed schedule of level regime		
Increase of surface water area	Rehabilitation of hayfields. Rehabilitation of water ecosystems with respective flora and fauna; Lakes' stocking; Increase of aqua landscape area and decrease of land landscape area ; Improvement of microclimate at the adjacent territory ;	Landscapes and land ecosystems; Ground flora and fauna ; Surface and ground waters;

Annex 2.6 - Main factors of impact during construction for the sub-project "reconstruction and extension of fishery ponds at Tastak site of Kamuishlibash fish hatchery in Aralsk district of Kzylorda oblast".

Type of activity . Sources of impact	Potential types of impact	Environmental components to be impacted
Construction of fishponds, pumping station, incubation department		
Temporary field camps ; Movement of transport and construction machinery; Land withdrawal and use ; Cutting of vegetation cover; Cutting of top soil layer and soil cover Development of the ponds' bed with hillocks' cutting and backfilling of pits. Excavation of trenches for canals; Temporary storages of materials and equipment Parking of motor transport and other machinery; Use and storage of fuel and lubricants; Technical maintenance ; Short term presence of staff, people's recreation and feeding	Dust formation; Pollutants emissions into the atmosphere; Use of land resources; Loss of habitats of animals and plants; Loss of forage base Compaction of soils along the motor roads routes; Disturbance of natural structure of soils and fertility at the sites of the ponds' construction and canal laying; Increase of probability of the soils' erosion and deflation; Changes in landscape structure with presence of manmade forms (barrage, dikes o ponds , canals etc); Limitation of the animals' movement; Noise, light, frightening of animals; Small leakages of fuel and lubricants materials are possible; Formation of wastes and wastewater; Increase of traffic intensiveness; Physical presence.	Atmosperic air; Soil cover; Vegetation; Landscape; Fauna,especially small mammals and rodents ;
Filling in of fish ponds .		
Increase of water surface area	Increase of aqua landscape area and decrease of land landscape area; Improvement of microclimate at the adjacent territory	Landscapes and land ecosystems; Ground flora and fauna ; Surface and ground waters;

Annex 3.1 –Residual impact on the environment for the sub-project "reconstruction of left bank offtake-regulator at Kzylorda barrage ".

Impact	Measures on the impact' prevention and mitigation	Residual impact	
		Impact qualitative indexes	Environmental component /type of impact
Construction of left bank offtake-regulator	Limitation of motor transport traffic and minimization of earth road network Use of the most spare methods of construction for the environment Prevention of environmental pollution by fuel and lubricants, etc. Prohibition or limitation of works in especially sensitive periods for biota (April –mid-May and mid-September –end of October) Protection of dikes' slopes by vegetation in order to avoid erosion and deflation . Minimization of light and noise effects, especially during night time. Use of machinery and equipment with standard levels of noise, vibration, electromagnetic radiation.	Anticipated area of disturbance during construction works will have linear character at the construction of dikes and approximately will be 7,0 ha. Construction works at reconstruction of offtake-regulator will be performed during dry period. Equipment and structures at the construction sites and buildings provide levels of noise, vibration, lighting, electromagnetic radiation within the limits established by the respective SanPIN; Motor transport and construction machinery is the main source of noise. Established limits of noise level, foreseen in SanPIN RK №3.01.035-97 will be registered during construction works on land –at a distance of not more than 1000 m from construction site. Duration of production lighting is about 12 hours per day in amount required for safe performance of works, navigation and signal lights in accordance with the Safety Rules. Heavy machinery is the source of vibration. The design solutions foresee the use of equipment, which provides the vibration levels in accordance with the standards' requirements. Permanent communication stations will be the sources of electromagnetic radiation.	Bottom sediments and benthos /indirect (low) Relief/ direct (mean) Surface waters /indirect (low) Plankton/indirect (low) Ichthyofauna /direct (low) Birds/direct (low) Reptiles and steenbrases / direct (low) Vegetation /direct (mean)

- green: *- impact of low significance*
- yellow: *- impact of mean significance*
- red: *- impact of high significance*

Annex 3.2 - Residual impact on the environment for the sub-project "Syrdarya river bed straightening at Korgansha and Turumbet sites in Zhalagash district of Kzylorda oblast".

Impact	Measures on the impact' prevention and mitigation	Residual impact	
		Impact qualitative indexes	Environmental component /type of impact
Syrdarya river bed straigthening at sections	Limitation of motor transport traffic and minimization of earth road network Use of the most spare methods of construction for the environment Prevention of environmental pollution by fuel and lubricants, etc. Prohibition or limitation of works in especially sensitive periods for biota (April –mid-May and mid-September –end of October) Protection of dikes' slopes by vegetation in order to avoid erosion and deflation . Minimization of light and noise effects, especially during night time. Use of machinery and equipment with standard levels of noise, vibration, electromagnetic radiation.	Anticipated area of disturbance during construction works will have linear character at the construction of dikes and approximately will be 50,4 ha Construction works at construction of dikes will be performed during summer period (prohibition on works: in the area of special ecological regime from April 01 to May 15 and from September 15 up to October 30) Equipment and structures at the construction sites and buildings provide levels of noise, vibration, lighting, electromagnetic radiation within the limits established by the respective SanPIN; Motor transport and construction machinery is the main source of noise. Established limits of noise level, foreseen in SanPIN RK №3.01.035-97 will be registered during construction works on land –at a distance of not more than 1000 m from construction site. Duration of production lighting is about 12 hours per day in amount required for safe performance of works, navigation and signal lights in accordance with the Safety Rules. Heavy machinery is the source of vibration. The design solutions foresee the use of equipment, which provides the vibration levels in accordance with the standards' requirements. Permanent communication stations will be the sources of electromagnetic radiation	Bottom sediments and benthos /indirect , partially direct
			Relief/direct
			Surface waters / direct
			Plankton/indirect partially direct
			Ichthyofauna /indirect, partially direct
			Birds/direct
			Reptiles and steenbrases /direct
			Vegetation /direct

- impact of low significance
- impact of mean significance
- impact of high significance

Annex 3.3 –Residual impact on the environment for the sub-project “Construction of flood protection dikes in Kazalinsk and Karmakchi districts of Kzylorda oblast.

Impact	Measures on the impact’ prevention and mitigation	Residual impact	
		Impact qualitative indexes	Environmental component /type of impact
Construction of flood protection dikes	Limitation of motor transport traffic and minimization of earth roads network Use of the most spare methods of construction for the environment. Prevention of environmental pollution by fuel and lubricants, etc. . Prohibition or limitation of works in especially sensitive periods for biota (April –mid-May and mid-September –end of October) Protection of dikes’ slopes by vegetation in order to avoid erosion and deflation . Minimization of light and noise effects, especially during night time.. Use of machinery and equipment with standard levels of noise, vibration, electromagnetic radiation. .	Anticipated area of disturbance during construction works will have linear character at construction of dikes and will be approximately 400,0 ha. Construction works at construction of dikes will be performed during summer period (prohibition on works: in the area of special ecological regime from April 01 to May 15 and from September 15 up to October 30) Equipment and structures at the construction sites and buildings provide levels of noise, vibration, lighting, electromagnetic radiation within the limits established by the respective SanPIN;; Motor transport and construction machinery is the maun source of noise. Established limits of noise level, foreseen in SanPIN RK №3.01.035-97 will be registered during construction works on land –at a distance of not more than 1000 m from construction site. Duration of production lighting is about 12 hours per day in amount required for safe performance of works, navigation and signal lights in accordance with the Safety Rules. Heavy machinery is the source of vibration. The design solutions foresee the use of equipment, which provides the vibration levels in accordance with the standards’ requirements. Permanent communication stations will be the sources of electromagnetic radiation.	Bottom sediments and benthos /indirect, partially direct Relief/direct Surface waters /indirect, partially direct Plankton /indirect partially direct Ichthyofauna /indirect partially direct Birds /indirect Reptiles and steenbrases /direct Vegetation /direct

(green) *- impact of low significance*
(yellow) *- impact of mean significance*
(red) *- impact of high significance*

Annex 3.4 - Residual impact on the environment for the sub-project " construction of motor bridge near Birlik settlement in Kazalinsk district of Kzylorda oblast "

Impact	Measures on the impact' prevention and mitigation	Residual impact: Impact qualitative indexes	Residual impact: Environmental component /type of impact
Construction of motor bridge	Limitation of motor transport traffic and minimization of earth roads network Use of the most spare methods of construction for the environment. Prevention of environmental pollution by fuel and lubricants, etc. . Prohibition or limitation of works in especially sensitive periods for biota (April –mid-May and mid-September –end of October) Protection of dikes' slopes by vegetation in order to avoid erosion and deflation . Minimization of light and noise effects, especially during night time.. Use of machinery and equipment with standard levels of noise, vibration, electromagnetic radiation. .	Anticipated area of disturbance during construction works will have linear character at the construction of bridge and approximately will be 3,5 ha. Construction works will be performed during summer period (prohibition on works: in the area of special ecological regime from April 01 to May 15 and from September 15 up to October 30) Equipment and structures at the construction sites and buildings provide levels of noise, vibration, lighting, electromagnetic radiation within the limits established by the respective SanPIN; Motor transport and construction machinery is the maun source of noise. Established limits of noise level, foreseen in SanPIN RK №3.01.035-97 will be registered during construction works on land –at a distance of not more than 1000 m from construction site. Duration of production lighting is about 12 hours per day in amount required for safe performance of works, navigation and signal lights in accordance with the Safety Rules. Heavy machinery is the source of vibration. The design solutions foresee the use of equipment, which provides the vibration levels in accordance with the standards' requirements. Permanent communication stations will be the sources of electromagnetic radiation..	Bottom sediments and benthos /indirect, partially direct Relief/direct Surface waters /indirect, partially direct Plankton/indirect partially direct Ichthyofauna /indirect,partially direct Birds /indirect Reptiles and steenbrases /direct Vegetation /direct

- *impact of low significance*
- *impact of mean significance*
- *impact of high significance*

Annex 3.5 – Residual impact on the environment for the sub-project " Rehabilitation of Kamuishlibash and Akshatau lake systems"

Impact	Measures on the impact' prevention and mitigation	Residual impact	
		Impact qualitative indexes	Environmental component /type of impact
Construction of barrage , canals aand dikes	Limitation of motor transport traffic and minimization of earth roads network Use of the most spare methods of construction for the environment. Prevention of environmental pollution by fuel and lubricants, etc.. Prohibition or limitation of works in especially sensitive periods for biota (April –mid-May and mid-September –end of October) Protection of dikes' slopes by vegetation in order to avoid erosion and deflation . Minimization of light and noise effects, especially during night time. Use of machinery and equipment with standard levels of noise, vibration, electromagnetic radiation.	Anticipated area of disturbance during construction works will have linear character at construction of barrage , canals , dikes and approximately will be 446 ha. Construction works on canals' rehabilitation will be performed during summer period (prohibition on works: in the area of special ecological regime from April 01 to May 15 and from September 15 up to October 30) Equipment and structures at the construction sites and buildings provide levels of noise, vibration, lighting, electromagnetic radiation within the limits established by the respective SanPIN; Motor transport and construction machinery is the maun source of noise. Established limits of noise level, foreseen in SanPIN RK №3.01.035-97 will be registered during construction works on land –at a distance of not more than 1000 m from construction site. Duration of production lighting is about 12 hours per day in amount required for safe performance of works, navigation and signal lights in accordance with the Safety Rules. Heavy machinery is the source of vibration. The design solutions foresee the use of equipment, which provides the vibration levels in accordance with the standards' requirements.. Permanent communication stations will be the sources of electromagnetic radiation	Bottom sediments and benthos /indirect, partially direct Relief/direct Surface waters /indirect, partially direct Plankton /indirect partially direct Ichthyofauna /indirect, partially direct Birds /direct Reptiles and steenbrases /direct Vegetation /direct

- *impact of low significance*
- *impact of mean significance*
- *impact of high significance*

Annex 3.6 – Residual impact on the environment for the sub-project "Reconstruction and extension of fishery ponds at Tastak site of Kamuishlibash fish hatchery in Aralsk district of Kzylorda oblast".

Impact	Measures on the impact' prevention and mitigation	Residual impact	
		Impact qualitative indexes	Environmental component /type of impact
Construction of ponds , canals and dikes	Limitation of motor transport traffic and minimization of earth roads network . Use of the most spare methods of construction for the environment. Prevention of environmental pollution by fuel and lubricants, etc. Prohibition or limitation of works in especially sensitive periods for biota (April –mid-May and mid-September –end of October) Protection of dikes' slopes by vegetation in order to avoid erosion and deflation . Minimization of light and noise effects, especially during night time. Use of machinery and equipment with standard levels of noise, vibration, electromagnetic radiation.	Anticipated area of disturbance during construction works will have linear character at the construction of ponds, canals, dikes and approximately will be 249,2 ha. Construction works will be performed during summer period. Equipment and structures at the construction sites and buildings provide levels of noise, vibration, lighting, electromagnetic radiation within the limits established by the respective SanPIN; Motor transport and construction machinery is the maun source of noise. Established limits of noise level, foreseen in SanPIN RK №3.01.035-97 will be registered during construction works on land –at a distance of not more than 1000 m from construction site. Duration of production lighting is about 12 hours per day in amount required for safe performance of works, navigation and signal lights in accordance with the Safety Rules. Heavy machinery is the source of vibration. The design solutions foresee the use of equipment, which provides the vibration levels in accordance with the standards' requirements.. Permanent communication stations will be the sources of electromagnetic radiation.	Benthos /indirect,
			Relief/direct
			Surface waters /indirect
			Plankton /indirect
			Ichthyofauna /indirect,
			Birds /direct
			Reptiles and steenbrases /direct
			Vegetation /direct

(green) - *impact of low significance*
(yellow) - *impact of mean significance*
(red) - *impact of high significance*

A1 Geobotanist Report

The Geobotanist Report, May 2007

Environmental Impact Assessment for the sub-projects of Syrdarya Control and Northern Aral Project , second phase (SYNAS-II)

During the reporting period the analysis of the modern status of vegetation as well as the environmental impact assessment of sub-projects 5, 6, 9 have been performed.

5. The structures to improve water supply of the delta lakes, including Amanotkel weir

Brief description: Construction of the regulating offtakes for the delta lakes:

Key issues to be assessed:

- Botanist: Impact on the ecosystems and valuable plant species, optimum and minimum water supply, influence of the stable and variable water levels in the lakes and wetlands' ecosystems as well as on the adjacent ecosystems.

Modern status of vegetation

Lakes Akshatau and Shomishkol belong to **Akshatau lake system**.

Akshatau lake – at the shallow water areas are found the macereed (*Typha angustifolia*), reed grass (*Phragmites australis*) cenosis with bulrush (*Scirpus lacustris*) and Tuber bulrush (*Bolboschoenus planiculmis*). At the modern low lacustrine terrace the annual halophytic – aeluropus (*Aeluropus littorallis, Salsola foliosa, Suaeda acuminata*) communities are presented. Upper the grain – herb communities are spread with dominating *Lepidium obtusum, Apocynum lancifolium, Acroptilon repens, Leymus multicaulis, Puccinellia dolicholepis*. Further on the tamarisk (*Tamarix ramosissima, T.hispida*) strip with herb - aeluropus (*Aeluropus littorallis, Karelinia caspia, Limonium otolepis, Cynanchum sibiricum*) grass horizon is presented. Behind the tamarisk on the pastured sections of the lower part of low hills are found the groups of weed species consisting of peganum (*Peganum harmala*), ceratocephala (*Ceratocarpus arenarius*), camel's thorn (*Alhagi pseudalhagi*), karelinia (*Karelinia caspia*). On the flat plumes of low hills the zonal ephemer-white-ground-wormwood (*Artemisia terrae-albae, Poa bulbosa, Carex physodes*) with anabasis (*Anabasis aphyllum*) communities are spread disturbed by the over-grazing. The micro-phytocenosis of peganum (*Peganum harmala*), camel's thorn (*Alhagi pseudalhagi*) and ceratocephala (*Ceratocarpus arenarius*) are found.

Shomishkol lake has the significant inclination of lacustrine terraces. The climax vegetation is presented by the complexes of anabasis and white-ground-wormwood communities with ephemers and burrowing mayflies (*Anabasis salsa, Artemisia terrae-albae, Poa bulbosa, Eremopyrum orientale, Carex physodes, Ferlua caspica*). Everywhere the specie – an indicator of man-made disturbance – anabasis (*Anabasis aphylla*) is found. At the shallow water sections and along the bank the reed grass (*Phragmites australis*) is growing, also at some places the communities of annual saltworts (*Salicornia europaea, Suaeda prostrata*), aeluropus (*Aeluropus littoralis*) with rare tamarisk (*Tamarix laxa*) are found. On the slopes of the lacustrine terraces the camel's thorn (*Alhagi pseudalhagi*) and climacoptera (*Climacoptera brachiata*). The man-made disturbance is medium and strong, main factor – grazing.

Kamyshlybash lake system includes 9 lakes. Raimkol and Zhalanashkol lakes have been investigated.

Raimkol lake

At the Syrdarya riverbed shelf cocklebur groups (*Xanthium strumarium*) were found. At the higher elevation of the riverbed shelf in the cocklebur groups crypsis (*Crypsis aculeata*) and coming-up of oleaster (*Elaeagnus oxycarpa*), willow (*Salix songorica*), reed grass (*Phragmites australis*) are found. At the riverbed embankment the dense shrubby bushes were formed – lycium tamarisk - silvery salt tree (*Halimodendron halodendron, Tamarix ramosissima, T.hispida, T.laxa, Lycium ruthenicum*). At the slopes of the riverbed embankment the tamarisk cenosis (*Tamarix hispida, T.ramosissima*) with halostachys (*Halostachys belangeriana*) and annual halophytic (*Suaeda acuminata, Climacoptera brachiata, Petrosimonia triandra*) grass horizon are presented. The annual halophytic cenosis (*Suaeda prostrata, Salsola foliosa*) with halophytic bushes (*Halostachys belangeriana, Tamarix hispida, Lycium ruthenicum*) interchanges with solonchak sites with hyper-halophytic bushes (*Suaeda physophora, S.microphila, Kalidium capsicum, K.foliatum, Halocnemum strobilaceum*).

At the strongly wetted and shallow water sections of Raimkol lake the reed mace (*Typha angustifolia, T.minima*), juncaceous (*Scirpus lacustris, S.littoralis, S.kazachstanicus*), reedy (*Phragmites australis*) and tuber bulrush (*Bolboschoenus planiculmis*) communities are spread. Around the lake close to the shore line the tamarisk communities are found (ephemer, aeluropus, annual halophytic).

The strong man-made disturbance is typical. It is determined by grazing, numerous canals and fires. Around Raim settlement the annual halophytic vegetation with anabasis (*Climacoptera lanata, C.aralensis, Petrosimonia triandra, Ceratoracpus utriculosus, Anabasis aphylla*) is widely spread.

Raimkol lake is divided from ***Zhalanashkol*** lake depression by a dike. The water and coastal-water communities of tuber bulrush (*Bolboschoenus planiculmis*), bulrush (*Scirpus lacustris, S.kasachstanicus*), reed mace (*Typha angustifolia, T.minima*), reed grass (*Phragmites australis)* occupy the shallow water and strongly wetted areas of the lower lacustrine terrace. Further on the annual halophytic cenosis (*Salicornia europaea, Suaeda prostrata*) are found, which are replaced by aeluropus (*Aeluropus littoralis*) followed by tamarisk strip (*Tamarix hispida, T.elongata*). Higher, at the flat slopes of the lacustrine terrace the halophytic – bush cenosis of *Suaeda physophora, S.microphila, Halostachys belangeriana, Lycium ruthenicum* is presented. At the hills' slopes the ephemer – anabasis vegetation (*Anabasis salsa, Eremopyrum orientale, Anisantha tectorum, Alyssum desertorum*) is spread on the zonal brown soils. The strong man-made disturbance is due to grazing.

Impact on the ecosystems

The lake systems in the Syrdarya Delta are maintained by the hydraulic structures and depend on the water supply from Syrdarya. The variations of water level are typical for them. Water supply and increase of water level in Raim lake in 2007 are observed starting from March. During the investigations of the lake shore one of the overhead transmission lines was found in the shallow water area. It is not the task of a geobotanist to study how the increase of water levels influences the stability of concrete posts. But, in any case the increase of water levels above the elevation reached at the middle of May 2007 is not recommended, because the dwelling houses and the cemetery in Raim settlement are located in close vicinity to the lake. May be, these figures are available in Kazgiprovodkhoz Institute. The significant variations of the water levels in the lakes are not desirable for preservation of the water-swamping areas, valuable for migrating bird species (in 2007 Kazakhstan signed and ratified the Ramsar Convention). The water-swamping ecosystems are formed by the hydrophytic and hygrophytic plants – reed, bulrush, rush, reed mace, etc. The shallowing of the lakes and then the abrupt increase of water level results in disturbance of the plants' revegetation, loss of biodiversity, reduction of the phytomass and seeds' effectiveness, disturbance of the mechanism of the water bodies' self-purification. All these will scale down water quality and forage resources for the fish and birds. During the shallowing the salinization of the coastal biotopes and increase of water temperature occur. The increase of water temperature may result in water «bloom». If water level increases abruptly, the terrestrial biotopes, which turned out to be under water, may perish. In the middle of May at Zhalanashkol lake the tamarisk bushes were under water. Tamarisk can withstand flooding not more than 60 days (Nikitin, 1966). At the shallow areas of Raim and Zhalanashkol lakes the bushes of Kazakhstan endemic were found – Kazakhstan bulrush (*Scirpus kasakhstanicus*). This species periodically appears and disappears at Raim lake. For example, it was not found during the investigation of the lake in August 2001. Obviously, Kazakhstan bulrush is fastidious to water quality and habitats.

Construction of Amanotkel weir should stabilize water levels in the delta lakes and should not allow water levels' abrupt variations. This will have beneficial influence on the biota.

Conclusion: Construction of Amanotkel weir is necessary to maintain the lakes' ecosystems and preserve water-swamping sites.

A 2 List of Vascular Plants

List of the species of vascular plants in the Project area, Syrdarya Control and the Northern Aral Sea Project (SYNAS-II)

Name of the plant species			The species status	Location		
Latin	English	Russian		1	2	3
Trees and bushes, semi-shrubs, dwarf semi-shrubs						
Ammodendron bifolium	Sand acacia	Песчаная акация двулистая				1
Anabasis aphylla	Anabasis	Анабазис безлистный (итсигек)		1	1	1
Artemisia terrae-albae	Sagebrush	Полынь белоземельная		1		
Atraphaxis spinosa	Atraphaxis	Курчавка колючая				1
Elaeagnus oxycarpa	Oleaster	Лох остролистный		1	1	1
Ephedra distachya	Ephedra	Эфедра двухколосковая				
Halimodendron halodendron	Silvery salt tree	Чингил серебристый		1	1	1
Halocnemum strobilaceum	Halocnemum	Сарсазан шишковатый			1	1
Halostachys belangeriana	Halostachys	Солянoколосник Беланжеровский		1	1	1
Haloxylon aphyllum	Black saxaul	Саксаул черный	protected			1
Kalidium caspicum	Kalidium	Поташник каспийский		1		
Kalidium foliatum	Kalidium	Поташник олиственный		1		1
Kalidium schrenkianum	Kalidium	Поташник Шренковский		1		
Krascheninnikovia ceratoides	Eurotia	Терескен роговидный		1	1	1
Limonium suffruticosum	Sea lavender					1
Lycium dasystemum	Licyum	Дареза волосистотычинковая			1	1
Lycium ruthenicum	Licyum	Дереза русская		1	1	1
Nitraria schoberi	Nitrebush	Селитрянка Шобера				1
Populus pruinosa	Turanga	Тополь сизолистный (туранга)	Red book		1	1
Salix songarica	Willow	Ива джунгарская			1	1

Salix wilhelmsiana	Willow	Ива Вильгельмса			1	1
Suaeda microphilla	Suaeda	Сведа мелколистная		1	1	1
Suaeda physophora	Suaeda	Сведа вздутоплодная		1		
Tamarix elongata	Tamarisk	Тамарикс удлиненный		1	1	1
Tamarix gracilis	Tamarisk	Тамарикс изящный		1		
Tamarix hispida	Tamarisk	Тамарикс щетинистый		1	1	1
Tamarix laxa	Tamarisk	Тамарикс рыхлый			1	1
Tamarix ramosissima	Tamarisk	Тамарикс многоветвистый		1	1	1
Ulmus pumila					1	1
Травянистые одно- и многолетники						
Achnatherum splendens	Acnatherum	Чий блестящий				1
Acroptilon repens	Smartweed	Горчак ползучий			1	1
Aeluropus littoralis	Aeluropus	Прибрежница солончаковая (ажрек)		1	1	1
Agropyron fragile	Wheat grass	Пырей ломкий (еркек)		1		
Alhagi kirghisorum	Camel's thorn	Верблюжья колючка киргизская		1	1	1
Alhagi pseudalhagi	Camel's thorn	Верблюжья колючка ложная (жантак)		1	1	1
Althaea officinalis	Althaea	Алтей лекарственный		1	1	1
Alisma plantago aquatica	Water platain	Частуха подорожниковая		1		
Alyssum turkestanicum	Alyssum	Бурачок туркестанский		1		
Argusia sibirica	Argusia	Аргузия сибирская			1	1
Artemisia schrenkiana	Sagebrush	Полынь Шренковская		1	1	1
Asparagus brachyphyllus	Asparagus	Спаржа коротколистая	Red book			1
Asparagus breslerianus	Asparagus	Спаржа Бреслера		1		
Astragalus sesamoides	Astragalus	Астрагал кунжутный		1		
Atriplex laevis	Orach	Лебеда гладкая		1		
Atriplex littoralis	Orach	Лебеда прибрежная			1	1
Atriplex micrantha	Orach	Лебеда мелкоцветковая		1		
Atriplex pedunculata	Orach	Лебеда плодоножковая			1	

Atriplex saggitata	Orach	Лебеда блестящая		1	1	1
Atriplex tatarica	Orach	Лебеда татарская		1	1	1
Bassia hyssopiofolia	Bassia	Бассия иссополистая		1		1
Bassia sedoides	Bassia	Бассия очитковидная		1		
Bolboschoenus maritimus	Tuber bulrush	Клубнекамыш морской		1	1	1
Bolboschoenus planiculmis	Tuber bulrush	Клубнекамыш равноверхушечный		1	1	1
Butomus umbellatus	Flowering rush	Сусак зонтичный		1		1
Calamagrostis epigeios	Woodreed	Вейник наземный		1	1	1
Calamagrostis pseudophragmites	Woodreed	Вейник ложнотростниковый			1	1
Calystegia sepium	Calystegia	Повой заборный		1		
Centaurea squarrosa	Centaury	Василек растопыренный		1		
Ceratocephala falcata	Ceratocephala	Рогоглавник прямрогий		1		
Chenopodium acuminatum	Goosefoot	Марь заостренная		1		
Chenopodium album	Goosefoot	Марь белая		1		
Chenopodium rubrum	Goosefoot	Марь красная		1		
Cirsium setosum	Cirsium	Бодяк щетинистый			1	
Clematis orientalis	Clematis	Клематис восточный		1	1	1
Climacoptera aralensis	Climacoptera	Климакоптера аральская		1	1	1
Climacoptera brachiata	Climacoptera	Климакоптера супротивнолистная		1	1	1
Climacoptera lanata	Climacoptera	Климакоптера шерстистая		1		
Climacoptera obtusifoila	Climacoptera	Климакоптера туполистная			1	1
Convolvulus arvensis	Bindweed	Вьюнок полевой		1	1	1
Cousinia affinis	Cousinia	Кузиния родственная		1		1
Crypsis aculeata	Crypsis	Скрытница колючая		1		
Crypsis schoenoides	Crypsis	Скрытница камышевидная			1	1
Cuscuta momogyna	Dodder	Повилика однотычинковая			1	

Cynanchum sibiricum	Cynanchum	Цинанхум сибирский		1	1	1
Dodartia orientalis	Dodartia	Додарция восточная				1
Echinops ritro	Globe-thistle	Мордовник обыкновенный		1		
Eleocharis acicularis		Болотница игольчатая			1	
Elytrigia repens	Couch grass	Пырей ползучий		1	1	1
Eremopyrum buonapartis	Eremopyrum	Мортук Бонапарта		1		
Eremopyrum triticeum	Eremopyrum	Мортук пшеничный		1		
Euphorbia seguieriana	Euphorbia	Молочай Сегиеровский		1		1
Frankenia hirsuta	Frankenia	Франкения жестковолосистая		1	1	1
Frankenia pulvirulenta	Frankenia	Франкения мучнистая		1	1	1
Galatella fastigiformis	Galatella	Солонечник щитковидный				1
Glycyrrhiza glabra	Licorice	Солодка голая		1	1	1
Gypsophila perfoliata	Gypsophila	Качим пронзеннолистый		1	1	
Hordeum bogdanovii	Barley	Ячмень Богданова			1	
Inula britannica	Elecampane	Девясил британский		1		
Inula caspica	Elecampane	Девясил каспийский			1	1
Iris sogdiana	Iris	Ирис согдийский				1
Iris tenuifolia	Iris	Ирис тонколистный		1		
Juncus gerardii	Rush	Ситник Жерара		1		
Karelinia caspia	Karelinia	Карелиния каспийская		1	1	1
Kirilowia eriantha	Kirilowia	Кириловия пушистоцветковая				1
Lactuca serriola	Latice	Латук дикий		1		1
Lactuca tatarica	Latice	Латук каспийский		1	1	1
Lappula spinocarpos	Lappula	Липучка колючеплодная		1		
Lepidium latifolium	Peper grass	Клоповник широколистный		1	1	1
Lepidium perfoliatum	Peper grass	Клоповник пронзеннолистный		1		
Leptorhabdos parviflora	Leptorhabdos	Лепторабдос мелкоцветковый		1		

Leymus multicaulis		Волоснец многостебельный		1	1	1
Leymus racemosus	Lyme grass	Волоснец кистевидный (кияк)			1	1
Limonium otolepis	Sea lavender	Кермек ушковатый		1	1	1
Litwinowia tenuissima	Litwinowia	Литвиновия тончайшая		1		
Lotus frondosus	Lotus	Ледвянец густолиственный		1		
Londesia eriantha	Londesia	Лондезия пушистоцветковая			1	
Lythrum salicaria	Loosestrife	Дербенник иволистный			1	1
Melilotus albus	Melilot	Донник белый			1	1
Mentha aquatica	Mint	Мята водяная			1	
Ofaiston monandrum	Ofaiston	Офайстон однотычинковый			1	1
Panicum crus-gali	Millet	Просо гусиное		1	1	1
Peganum harmala	Peganum	Гармала обыкновенная (адраспан)		1	1	1
Petrosimonia brachiata	Petrosimonia	Петросимония супротивоветочная		1	1	
Petrosimonia squarrosa	Petrosimonia	Петросимония оттопыренная			1	1
Petrosimonia triandra	Petrosimonia	Петросимония трехтычинковая		1		
Phragmites australis	Reed grass	Тростник южный		1	1	1
Poligonum arenarium	Knotweed	Горец песчаный			1	1
Poligonum aviculare	Knotweed	Горец птичий		1		
Potamogeton pectinatum	Pondweed	Рдест гребенчатый		1		
Psathyrostachys juncea	Psathyrostachys	Ломкоколосник ситниковый				1
Pseudosophora alopecuroides	Pseudosophora	Софора лисохвостная (брунец)		1	1	1
Puccinellia distans	Sea spear grass	Бескильница расставленная				1
Puccinellia dolicholepis	Sea spear grass	Бескильница		1		

		длинночешуйная				
Rochelia retorta	Rochelia	Рохелия согнутая		1		
Salicornia europaea	Glasswort	Солерос европейский		1	1	1
Salsola australis	Saltwort	Солянка южная				1
Salsola foliosa	Saltwort	Солянка олиственная		1	1	1
Salsola nitraria	Saltwort	Солянка натронная		1	1	1
Salsola paulsenii	Saltwort	Солянка Паульсена				
Saussurea amara	Saussurea	Горькуша горькая		1	1	1
Scirpus kasahstanicus	Bulrush	Камыш казахстанский	Endemic, Red book	1		
Scirpus lacustris	Bulrush	Камыш озерный		1		1
Scirpus tabernaemontani	Bulrush	Камыш Табернемонтана			1	
Scirpus littoralis	Bulrush	Камыш прибрежный		1	1	1
Senecio noeanus	Groundsel	Крестовник Ноевский		1		
Setaria viridis	Setaria	Щетинник зеленый			1	
Solanum nigrum	Nightshade	Паслен черный			1	
Sonchus arvensis	Sowthistle	Осот полевой		1		
Sonchus palustris	Sowthistle	Осот болотный				1
Sparganium stoloniferum	Sparganium	Ежеголовка побегоносная		1		
Sphaerophysa salsula	Sphaerophysa	Сферофиза солончаковая		1	1	1
Strigosella africana	Strigosella	Стригозелла африканская		1		
Srtigosella circinata	Strigosella	Стригозелла завитая		1		
Suaeda acuminata	Sea blite	Сведа заостренная		1		
Suaeda altissima	Sea blite	Сведа высокая			1	1
Suaeda linifolia	Sea blite	Сведа льнолистая		1		
Suaeda paradoxa	Sea blite	Сведа запутанная			1	
Suaeda prostrata	Sea blite	Сведа простертая		1	1	
Taraxacum officinale	Dandelion	Одуванчик лекарственный		1		
Trachomitum lancifolium	Dog-bane	Кендырь ланцетолистный		1	1	1

Tripolium vulgare	Sea aster	Астра приморская		1		
Thymelaea passerina	Thymelaea	Тимелея воробьиная		1	1	
Typha angustifolia	Reed mace	Рогоз длиннолистный		1	1	1
Thypha laxmannii	Reed mace	Рогоз Лаксмана			1	
Typha minima	Reed mace	Рогоз малый		1		
Xanthium strumarium	Cocklebur	Дурнишник обыкновенный		1	1	1
Zygophyllum fabago	Bean-caper	Парнолистник обыкновенный		1		
Zygophyllum oxianum	Bean-caper	Парнолистник амударьинский		1	1	1
Всего видов: 163				108	85	91

Location: 1 – Raimkol and Zhalanashkol lakes; 5 – Kzylorda irrigation massif; 6 – Kazalinsk irrigation massif.

Floristic content is established based on determination of herbarium collected during the field trip (May, August 2007) (Illustrated identifier ...1969; 1972), literature and archive materials (Baibulov, 2006a, 2006b).

In total 163 plant species were registered. The species diversity of the Project area is as follows: Raimkol and Zhalanashkol lakes - 108; Kzylorda irrigation massif – 85; Kazalinsk irrigation massif – 91 species.

The flora content contains:

1 endemic of Kazakhstan: Scirpus kasahstanicus.

3 species from the Red Book:

Species in the Red Book of Kazakhstan (2007): Populus pruinosa, Scirpus kasahstanicus

Species in the Red Book of the USSR(1985): Asparagus brachyphyllus

1 protected species: Haloxylon aphyllum (the saxaul cutting is prohibited in accordance with the Regulation of the Government of the Republic of Kazakhstan dated 2002).

List of Literature:

1. A. Baibulov. Modern status of tugai vegetation in the Syrdarya river valley. // Publications of the III International Conference devoted to the memory of withstanding botanists of Kazakhstan (April 13-15, 2006). Almaty. 2006a. Pages 93-97.
2. A. Baibulov. Evaluation of the spatial distribution of vegetation of the water-swamp areas in Kzylorda region using the methods of the distance penetration // Terra. 2006b. № 1. Pages 52-61.
3. Illustrated identifier of the Kazakhstan plants. Alma-Ata, 1969-1972. T.1-2.
4. The Red Book of the Kazakhstan plants. 2 issue (under publication).
5. The Red Book of the USSR. 1985.

A 3 Ornitologist report (Annex to report)

Table 1.

List of bird species found during the period of investigations

№	Russian name	English name	Scientific (Latin) name	Place and character of stay	
				Syrdarya river valley	Delta lakes
1	Большая поганка	Great Crested Grebe	Podiceps cristatus	nesting	nesting
2	Серощекая поганка	red-necked Grebe	Podiceps griseigena	-	nesting
3	Кудрявый пеликан	Dalmatian Pelican	Pelecanus crispus	nesting	-
4	Большой баклан	Great Cormorant	Phalacrocorax carbo	nesting	nesting
5	Малый баклан	Pygmy cormorant	Phalacrocorax pygmeus	nesting	nesting
6	Кваква	Black-crowned Night-Heron	Nycticorax nycticorax	nesting	nesting
7	Большая белая цапля	Great White Egret	Egretta Alba	nesting	nesting
8	Серая цапля	Grey Heron	Ardea cinerea	nesting	nesting
9	Рыжая цапля	Purple Heron	Ardea purpurea	nesting	nesting
10	Колпица	Eurasian Spoonbill	Platalea leucorodia	-	nesting
11	Серый гусь	Greylag Goose	Anser anser	-	nesting
12	Лебедь шипун	Mute Swan	Cygnus olor	-	nesting
13	Огарь	Ruddy Shelduck	Tadorna ferruginea	nesting	nesting
14	Пеганка	Common Shelduck	Tadorna tadorna	-	nesting
15	Кряква	Mallard	Anas platyrhynchos	nesting	nesting
16	Чирок-свистунок	Green-winged Teal	Anas crecca	migrating	-
17	Серая утка	Gadwall	Anas strepera	nesting	nesting
18	Чирок-трескунок	Common Teal	Anas querquedula	nesting	nesting
19	Широконоска	Northern Shoveler	Anas clypeata	nesting	nesting
20	Красноносый нырок	red-crested Pochard	Netta rufina	nesting	nesting
21	Голубая чернеть	Common Pochard	Aythya ferina	migrating	migrating
22	Белоглазая чернеть	Ferruginous Duck	Aythya nyroca	nesting	nesting
23	Болотный лунь	Marsh Harrier	Circus aeruginosus	nesting	nesting

24	Степной лунь	Pallid Harrier	Circus macrourus	migrating	-
25	Тювик	Shikra	Accipiter badius	nesting	nesting
26	Курганник	Long-legged Buzzard	Buteo rufinus	nesting	nesting
27	Змееяд	Short-toed Eagle	Circaetus gallicus	nesting	-
28	Степной орел	Steppe Eagle	Aquila nipalensis	-	nesting
29	Могильник	Imperial Eagle	Aquila heliaca	nesting	nesting
30	Большой подорлик	Spotted Eagle	Aquila clanga	migrating	-
31	Чеглок	Eurasian Hobby	Falco subbuteo	nesting	nesting
32	Обыкновенная пустельга	Eurasian Kestrel	Falco tinnunculus	nesting	nesting
33	Обыкновенный фазан	Ring-necked Pheasant	Phasianus colchicus	nesting	-
34	Лысуха	Eurasian Coot	Fulica atra	nesting	nesting
35	Галстучник	Ringed Plover	Charadrius hiaticula	-	migrating
36	Малый зуек	Little Ringed Plover	Charadrius dubius	nesting	nesting
37	Морской зуек	Kentish Plover	Charadrius alexandrinus	-	nesting
38	Чибис	Northern Lapwing	Vanellus vanellus	nesting	nesting
39	Белохвостая пигалица	White-tailed Lapwing	Vanellus leucurus	nesting	nesting
40	Камнешарка	Ruddy Turnstone	Arenaria interpres	-	migrating
41	Ходулочник	Black-winged Stilt	Himantopus himantopus	nesting	nesting
42	Шилоклювка	Pied Avocet	Recurvirostra avosetta	-	nesting
43	Кулик-сорока	Eurasian Oystercatcher	Haematopus ostralegus	-	nesting
44	Черныш	Green Sandpiper	Tringa ochropus	migrating	migrating
45	Травник	Common Redshank	Tringa totanus	-	nesting
46	Поручейник	Marsh Sandpiper	Tringa stagnatilis	-	migrating
47	Перевозчик	Common Sandpiper	Tringa hypoleucos	nesting	nesting
48	Мородунка	Terek Sandpiper	Xenus cinereus	migrating	migrating
49	Круглоносый плавунчик	Red-necked Phalarope	Phalaropus lobatus	-	migrating
50	Турухтан	Ruff	Philomchus pugnax	migrating	migrating
51	Кулик-воробей	Little Stint	Chalidris minuta	migrating	migrating
52	Белохвостый песочник	Temminck's Stint	Calidris temminckii	migrating	migrating
53	Краснозобик	Curlew Sandpiper	Calidris ferruginea	migrating	migrating

54	Чернозобик	Dunlin	Calidris alpina	migrating	migrating
55	Гаршнеп	Jack Snipe	Lymnocryptes minimus	-	migrating
56	Бекас	Common Snipe	Gallinago gallinago	-	migrating
57	Большой кроншнеп	Eurasian Curlew	Numenius arquata	-	nesting?
58	Средний кроншнеп	Whimbrel	Numenius phaeopus	-	migrating
59	Большой веретенник	Black-tailed Godwit	Limosa limosa	-	migrating
60	Луговая тиркушка	Collared Pratincole	Glareola pratincola	-	nesting
61	Степная тиркушка	Black-winged Pratincole	Glareola nordmanni	-	nesting
62	Черноголовый хохотун	Great Black-headed Gull	Larus ichthyaetus	-	feeding
63	Озерная чайка	Black-headed Gull	Larus ridibundus	nesting	nesting
64	Хохотунья	Caspian Gull	Larus cachinnans	nesting	nesting
65	Черная крачка	Black Tern	Chidonias niger	nesting	nesting
66	Чайконосая крачка	Gull-billed Tern	Sterna nilotica	nesting	nesting
67	Чеграва	Caspian Tern	Sterna caspia	-	feeding
68	Речная крачка	Common Tern	Sterna hirundo	nesting	nesting
69	Малая крачка	Little Tern	Sterna albifrons	-	nesting
70	Чернобрюхий рябок	Black-bellied Sandgrouse	Pterocles orientalis	feeding	feeding
71	Белобрюхий рябок	Pin-tailed Sandgrouse	Pterocles alchata	-	feeding
72	Сизый голубь	Feral Rock Dove	Columba livia	nesting	nesting
73	Кольчатая горлица	Collared Dove	Streptopelia decaocto	nesting	nesting
74	Малая горлица	Laughing Dove	Streptopelia senegalensis	nesting	-
75	Обыкновенная кукушка	Common Cuckoo	Cuculus canorus	nesting	nesting
76	Домовый сыч	Little Owl	Athene noctua	nesting	-
77	Обыкновенный козодой	European Nightjar	Caprimulgus europaeus	nesting	nesting
78	Черный стриж	Common Swift	Apus apus	nesting	-
79	Сизоворонка	European Roller	Coracias garrulus	nesting	nesting
80	Золотистая щурка	European Bee-eater	Merops apiaster	nesting	nesting
81	Зеленая щурка	Blue-cheeked Bee-eater	Merops superciliosus	nesting	nesting
82	Удод	Hoopoe	Upupa epops	nesting	nesting
83	Деревенская ласточка	Barn Swallow	Hirundo rustica	nesting	nesting

84	Береговая ласточка	Sand Martin	Riparia riparia	nesting	nesting
85	Хохлатый жаворонок	Crested Lark	Galerida criststa	nesting	nesting
86	Малый жаворонок	Greater Short-toed Lark	Calandrella cinerea	nesting	nesting
87	Серый жаворонок	Lesser Short-toed Lark	Calandrella rufescens	nesting	nesting
88	Солончаковый жаворонок	Asian Short-toed Lark	Calandrella leucophaea	-	nesting
89	Степной жаворонок	Calandra Lark	Melanocorypha calandra	nesting	nesting
90	Двупятнистый жаворонок	Bimaculated Lark	Melanocorypha bimaculata	nesting	nesting
91	Полевой жаворонок	Skylark	Alauda arvensis	-	nesting
92	Индийский жаворонок	Oriental Skylark	Alauda gulgula	-	nesting
93	Желтая трясогузка	Blue-headed Wagtail	Motacilla flava	migrating	-
94	Черноголовая трясогузка	Black-headed Wagtail	Motacilla feldegg	nesting	nesting
95	Желтолобая трясогузка	Yellow Wagtail	Motacilla lutea	-	migrating
96	Желтоголовая трясогузка	Citrine Wagtail	Motacilla citreola	-	migrating
97	Белая трясогузка	White Wagtail	Motacilla alba	migrating	-
98	Маскированная трясогузка	Masked Wagtail	Motacilla personata	nesting	nesting
99	Туркестанский жулан	Turkestan Shrike	Lanius phoenicurjides	nesting	nesting
100	Обыкновенный жулан	Red-backed Shrike	Lanius collurio	migrating	migrating
101	Длиннохвостый сорокопут	Long-tailed Shrike	Lanius schach	nesting	nesting
102	Чернолобый сорокопут	Lesser Grey Shrike	Lanius minor	nesting	nesting
103	Пустынный сорокопут	Southern Grey Shrike	Lanius meridionalis	nesting	nesting
104	Обыкновенная иволга	Eurasian Golden Oriole	Oriolus oriolus	nesting	-
105	Обыкновенный скворец	Eurasian Starling	Sturnus vulgaris	nesting	nesting
106	Обыкновенная майна	Common Myna	Acridotheres tristis	nesting	nesting
107	Сорока	Black-bellied Magpie	Pica pica	nesting	nesting
108	Обыкновенная галка	Eurasian Jackdaw	Corvus monedula	nesting	nesting
109	Грач	Rook	Corvus frugilegus	nesting	nesting
110	Восточная ворона	Eastern Carrion Crow	Corvus orientalis	nesting	nesting
111	Широкохвостка	Cettis's Warbler	Cettia cetti	-	nesting
112	Индийская камышевка	Paddyfield Warbler	Acrocephalus agricola	nesting	nesting
113	Садовая камышевка	Blyth's Reed Warbler	Acrocephalus dumetorum	-	migrating

114	Дроздовидная камышевка	Great Reed Warbler	Acrocephalus arundinaceus	-	nesting
115	Южная бормотушка	Syke's Warbler	Hippilais rama	nesting	nesting
116	Бледная бормотушка	Eastern Olivaceous Warbler	Hippolais pallida	nesting	nesting
117	Славка-завирушка	Lesser Whitethroat	Sylvia curruca	nesting	nesting
118	Белоусая славка	Menetries's Warbler	Sylvia mystacea	nesting	nesting
119	Пустынная славка	Desert Warbler	Sylvia nana	-	nesting
120	Пеночка-теньковка	Chiffchaff	Phylloscopus collybita	migrating	-
121	Серая мухоловка	Spotted Flycatcher	Muscicapa striata	migrating	migrating
122	Обыкновенная каменка	Northern Wheatear	Oenanthe oenanthe	-	nesting
123	Каменка-плешанка	Pied Wheatear	Oenanthe pleschanka	-	nesting
124	Пустынная каменка	Desert Wheatear	Oenanthe deserti	nesting	nesting
125	Каменка-плясунья	Isabelline Wheatear	Oenanthe isabellina	nesting	nesting
126	Черноголовый чекан	Siberian Stonechat	Saxicola torquata	migrating	-
127	Тугайный соловей	Rufous Bushchat	Cercotrichas galactotes	-	nesting
128	Южный соловей	Nightingale	Luscinia megarhynchos	nesting	nesting
129	Варакушка	Bluethroat	Luscinia svecica	-	nesting
130	Усатая синица	Bearded Tit	Panurus biarmicus	-	nesting
131	Черноголовый ремез	White-crowned Penduline Tit	Remiz coronatus	nesting	nesting
132	Бухарская синица	Turkestan Tit	Parus bokharensis	nesting	-
133	Домовый воробей	House Sparrow	Passer domesticus	nesting	nesting
134	Индийский воробей	Indian Sparrow	Passer indicus	nesting	-
135	Испанский воробей	Spanish Sparrow	Passer hispaniolensis	nesting	-
136	Полевой воробей	Eurasian Tree Sparrow	Passere montanus	nesting	nesting
137	Буланый вьюрок	Desert Finch	Rhodospiza obsoleta	nesting	nesting
138	Желчная овсянка	Red-headed Bunting	Emberiza bruniceps	nesting	nesting

Note: n - nesting, m – migrating, f – relocation for feeding. By **Bold** are marked the rare and endangered bird species included into the Red Book of the Republic of Kazakhstan.

Table 2

Species content and number of birds at the monitoring stations according to the data of visual investigations in July 2007

№	Species	Scientific (Latin) name	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18
			2.07	4.07	5.07	6.07	8.07	10.07	12.07	12.07	13.07	13.07	13.07	14.07	16.07	16.07	17.07	18.07	19.07	19.0
1	Great crested grebe	Podiceps cristatus		2		1	6	16	3	4	20	5	4	9		2	30	20		8
2	Red-necked grebe	Podiceps griseigena														10				
3	Great cormorant	Phalacrocorax carbo		6	10	1		3		2	10		4	2		20	40		5	
4	Pygmy cormorant	Phalacrocorax	2	12	16	4		6		6	4	2	3	16		9	17	2	10	2
5	Black-crowned night	Nycticorax nycticorax		3	36													40		
6	Great white egret	Egretta Alba	3	12	18	25	3	9	2	4	9	7	4	24		30	15	15	4	5
7	Grey heron	Ardea cinerea	2	8	15	10	4	7	3	7	6	4	2	30		10	20	12	2	5
8	Purple heron	Ardea purpurea	1	3	13	15	1	4	1	4	8	2		12		6	10	8	1	3
9	Eurasian spoonbill	Platalea leucorodia								3		1				1				
10	Greylag goose	Anser anser		4				6	2	12	30	5	6	20		50	60	20	6	20
11	Mute swan	Cygnus olor						2		4	16					2	12		2	1
12	Ruddy shelduck	Tadorna ferruginea			2		2	8	4	2	12			25			4			
13	Common shelduck	Tadorna tadorna						4	4	6	7	2		12		4	7			2
14	Mallard	Anas platyrhynchos		2		3	1	12	3	8	25	4		40		7	9	8	3	
15	Gadwall	Anas strepera		1	2	8		4	1	5	3	4		5		2	16	2	2	1
16	Common teal	Anas querquedula			3	12	1	30	1	14	2	6	1	30	2	30	40	2	2	4
17	Red-crested pochard	Netta rufina		6	26	13		50	2	25	60	18	7	150		20	100	20	5	[illegible]
18	Ferrugineous duck	Aythya nyroca		2		6	3	13		7	14	9	4	11		4	7	6	12	4
19	Marsh harrier	Circus aeruginosus	2	7	4	12		10	2	10	17	6	3	7		9	12	8	5	4
20	Shikra	Accipiter badius	2		2	1					1							1		
21	Long-legged buzzard	Buteo rufinus							1			1	1				1			
22	Short-toed eagle	Circaetus gallicus					1													
23	Steppe eagle	Aquila nipalensis							1					1						
24	Imperial eagle	Aquila heliaca						1									1			
25	Eurasian hobby	Falco subbuteo	1		2						1							1		
26	Eurasian kestrel	Falco tinnunculus	2	1	1		1	2	1		2	1								

Ring-necked pheasant	Phasianus colchicus	2	2	6															
Eurasian coot	Fulica atra	3	24		3				4	48	19	2	16		2	100	40	6	20
Little ringed plover	Charadrius dubius	2				2	2	4		6		2	4	12	6		2		3
Kentish plover	Charadrius						4	6	2	12			16	40	12				1
Northern lapwing	Vanellus vanellus	4	2		1		6	5		26		2	25		2	3	4	2	6
White-tailed lapwing	Vanellus leucurus	2			2	4	1			2					4				
Ruddy turnstone	Arenaria interpres												1	2	6				
Black-winged stilt	Himantopus	15	4		15	3	20	8		7		2	40	4	4	15	3	2	9
Pied avocet	Recurvirostra avosetta						2	6					4	8					
Eurasian oystercatcher	Haematopus						1								2				
Green sandpiper	Tringa ochropus	1	2		4	1	6	2		5	1	3	6	2	3	4	2	1	3
Common redshank	Tringa totanus		1		3	1	7			8	1		3		1	3			1
Marsh sandpiper	Tringa stagnatilis				1		2			2			1		1				
Common sandpiper	Tringa hypoleucos	1			3	4	6	3		5		1	4		6				
Red-necked phalarope	Phalaropus lobatus						3						12	15					
Ruff	Philomchus pugnax	3			15	10	45	2	3	50		1	80	10	35	9			30
Little stint	Chalidris minuta				2	1	5			3			12	4	10	5			
Common snipe	Gallinago gallinago				1		4			3			1	4		2			
Eurasian curlew	Numenius arquata							1		1			4	1	30	3			
Whimbrel	Numenius phaeopus						2			3			1		3	5			
Black-tailed Godwit	Limosa limosa				3		8			4			5		4	8			
Collared Pratincole	Glareola pratincola				4		5			7			25		2				
Black-winged Pratincole	Glareola nordmanni						1				2		6		6		2		
Great Black-headed Gull	Larus ichthyaetus				1		2		2	1					6	1			
Black-headed Gull	Larus ridibundus		10	3	5		30	1	12	25	9	3	20		50	40	9	3	6
Caspian Gull	Larus cachinnans	2	2	8	20	5	20	3	20	30	13	2	9		40	60	2	4	10
Black Tern	Chidonias niger		20	2	3		25		2	30	4	1				5	16	1	
Gull-billed Tern	Sterna nilotica	1	3	1	10	5	7		15	6	8	2	9		30	3	1	2	
Caspian Tern	Sterna caspia				1				2		1				3	1			
Common Tern	Sterna hirundo	4	15	6	2	10	20		30	8	4	2	20		20	13	3	6	3
Little Tern	Sterna albifrons					2		3	8		2				25				
Black-bellied Sandgrouse	Pterocles orientalis						3	1		6			24						
Feral Rock Dove	Columba livia	3	10		6	3				10									

60	Collared Dove	Streptopelia decaocto		2	4															
61	Common Cuckoo	Cuculus canorus	1	2	8	1						1		3			1	2		
62	Common Swift	Apus apus				4				2										2
63	European Roller	Coracias garrulus		6	1		2		2		1		1							
64	European Bee-eater	Merops apiaster	6	50	23	5						3	8							
65	Blue-cheeked Bee-eater	Merops superciliosus			6		3	2	3	6	25		4	5			9			
66	Hoopoe	Upupa epops	1	3	2	4		1		1	2	3	2	2				1		1
67	Barn Swallow	Hirundo rustica	26	100	50	6		15		2	40	6		6		4	25		4	15
68	Sand Martin	Riparia riparia	30	50	100	12	4		20	3	150		3	20		10	10		8	
69	Crested Lark	Galerida criststa		3						3										2
70	Greater Short-toed Lark	Calandrella cinerea						25	30	20	12	10	4	100	40		10	7	6	4
71	Lesser Short-toed Lark	Calandrella rufescens				2	1	2	5	8				10	50	40	25		2	2
72	Asian Short-toed Lark	Calandrella							2					3	6	3	2			
73	Calandra Lark	Melanocorypha															18			
74	Bimaculated Lark	Melanocorypha						10	4		3	1					4		3	
75	Skylark	Alauda arvensis							2								1			
76	Oriental Skylark	Alauda gulgula						1		2				2			1			
77	Black-headed Wagtail	Motacilla feldegg		2	6			4	2	6	2	3		30	5		20	10		
78	Citrine Wagtail	Motacilla citreola						1		2		2		1						
79	Masked Wagtail	Motacilla personata	1	5	2		2	2		1	10	1		2		3		4		2
80	Turkestan Shrike	Lanius phoenicurjides		1	4							1		3	1		2			
81	Long-tailed Shrike	Lanius schach			1													2		
82	Lesser Grey Shrike	Lanius minor	2	2	1													1		
83	Southern Grey Shrike	Lanius meridionalis						1												
84	Eurasian Golden Oriole	Oriolus oriolus			1													1		
85	Eurasian Starling	Sturnus vulgaris		25	2						2						6			20
86	Common Myna	Acridotheres tristis	2		2	4														
87	Black-bellied Magpie	Pica pica	1	3	5		1										2	3		
88	Eurasian Jackdaw	Corvus monedula			3															
89	Rook	Corvus frugilegus	25	56	25	100	1	20					2	5				40		4
90	Eastern Carrion Crow	Corvus corone	4	4	10	3	2	6		3	1	3	1	6		1	1	3		
91	Cettis's Warbler	Cettia cetti			1									1				2		
92	Paddyfield Warbler	Acrocephalus agricola		3		4	1	2		3	6	4	2	4			20	2	4	

Great Reed Warbler	Acrocephalus								2		3	2	2			30			
Syke's Warbler	Hippilais rama	2	20	100	3					1	1		30	2		20	1		
Eastern Olivaceous	Hippolais pallida		3	6									3						
Lesser Whitethroat	Sylvia curruca		50	20						3	2		20	1					
Menetries's Warbler	Sylvia mystacea	1	4	2						1			2						
Desert Warbler	Sylvia nana															1			
Northern Wheatear	Oenanthe oenanthe						1	2		1									
Pied Wheatear	Oenanthe pleschanka									1									
Isabelline Wheatear	Oenanthe isabellina				2	1	3	4	1	4	2	3	2	3		2		3	1
Rufous Bushchat	Cercotrichas galactotes			2									4			2			
Nightingale	Luscinia		3	10													1		
Bluethroat	Luscinia svecica		2	6						2			1			2	3		
Bearded Tit	Panurus biarmicus								8		10								
White-crowned Penduline	Remiz coronatus	6	6	8	1					2							3		
Turkestan Tit	Parus bokharensis	2	2	4													1		
House Sparrow	Passer domesticus	10	28	3		3				15	2								10
Indian Sparrow	Passer indicus			45	20														
Spanish Sparrow	Passer hispaniolensis			30	10														
Eurasian Tree Sparrow	Passere montanus	20	10	15		2	4										20		
Desert Finch	Rhodospiza obsoleta			2					6							2			
Red-headed Bunting	Emberiza bruniceps	1	2	3		1	2		3		1		3			3			

Table 3 Species content and number of birds at the monitoring stations according to the data of visual investigations in August 2007

№	Species	Scientific (Latin) name	Site 1	Site 7	Site 8	Site 10	Site 11	Site 13	Site 14	Site 17	Site 18
			15.08	16.08	16.08	16.08	16.08	16.08	17.08	17.08	17.08
1	Great Crested Grebe	Podiceps cristatus		3	4	6	3		12	2	20
2	Red-necked Grebe	Podiceps griseigena			2				23		2
3	Great Cormorant	Phalacrocorax carbo			6	4			31		3
4	Pygmy cormorant	Phalacrocorax	1		5	12	2		16	3	2
5	Great White Egret	Egretta Alba	3	1	8	4	2		150	2	23
6	Grey Heron	Ardea cinerea	1	2	10	2	2		26	4	15
7	Purple Heron	Ardea purpurea	1		4	1				2	6
8	Greylag Goose	Anser anser			30	40	6		200	4	38
9	Mute Swan	Cygnus olor							2		6
10	Ruddy Shelduck	Tadorna ferruginea				2			2		1
11	Common Shelduck	Tadorna tadorna						4			
12	Mallard	Anas platyrhynchos		2	4	7	2		20	3	19
13	Gadwall	Anas strepera			2	1			5	2	3
14	Common Teal	Anas querquedula			8	4	3		30		13
15	Northern Shoveler	Anas clypeata			1				3		
16	Red-crested Pochard	Netta rufina			7	9	10		45	9	24
17	Common Pochard	Aythya ferina				2			18		
18	Ferruginous Duck	Aythya nyroca			6	5	2		4	7	1
19	Marsh Harrier	Circus aeruginosus	2	2	7	8	3		6	4	8
20	Shikra	Accipiter badius	2								
21	Long-legged Buzzard	Buteo rufinus		1		1					
22	Steppe Eagle	Aquila nipalensis				1					
23	Eurasian Hobby	Falco subbuteo	1								
24	Eurasian Kestrel	Falco tinnunculus	1	1							
25	Eurasian Coot	Fulica atra		3		25	9		8	30	23
26	Ringed Plover	Charadrius hiaticula						1	6		
27	Little Ringed Plover	Charadrius dubius		6				5	3		4
28	Kentish Plover	Charadrius		4				3	7		1
29	Northern Lapwing	Vanellus vanellus		3	2		4		9	1	16
30	Ruddy Turnstone	Arenaria interpres					1		16		
31	Black-winged Stilt	Himantopus		5	4		2	4			6
32	Pied Avocet	Recurvirostra avosetta						12			
33	Green Sandpiper	Tringa ochropus		3	2	4	2	3	9	2	3
34	Common Redshank	Tringa totanus			1		3		4		1
35	Marsh Sandpiper	Tringa stagnatilis					1	2	8		5
36	Common Sandpiper	Tringa hypoleucos	3	2			3		16		1
37	Terek Sandpiper	Xenus cinereus					1	2	7		3
38	Red-necked Phalarope	Phalaropus lobatus						30			3
39	Ruff	Philomchus pugnax			15	6	4	10	60	5	23
40	Little Stint	Chalidris minuta					2	8	20		5
41	Temminck's Stint	Calidris temminckii					1	4	3		2
42	Curlew Sandpiper	Calidris ferruginea						8	9		3
43	Dunlin	Calidris alpina				3		20	50		4

44	Jack Snipe	Lymnocryptes minimus						1			
45	Common Snipe	Gallinago gallinago						3	2		1
46	Eurasian Curlew	Numenius arquata							41		2
47	Whimbrel	Numenius phaeopus							2		
48	Black-tailed Godwit	Limosa limosa				2	1		3		4
49	Collared Pratincole	Glareola pratincola			3						7
50	Black-winged Pratincole	Glareola nordmanni				2					
51	Great Black-headed Gull	Larus ichthyaetus			2				4		
52	Black-headed Gull	Larus ridibundus	4	3	25	5	2		40		28
53	Caspian Gull	Larus cachinnans	2	6	40	8	7	1	36	2	47
54	Black Tern	Chidonias niger			2	4				3	
55	Gull-billed Tern	Sterna nilotica	1		3				4		6
56	Caspian Tern	Sterna caspia							3		2
57	Common Tern	Sterna hirundo	8		10	12			29	1	17
58	Little Tern	Sterna albifrons			15				27		
59	Feral Rock Dove	Columba livia	4								3
60	Common Cuckoo	Cuculus canorus			1						
61	European Roller	Coracias garrulus	2							1	
62	European Bee-eater	Merops apiaster	36						4		
63	Blue-cheeked Bee-eater	Merops superciliosus		6	30	6	3				15
64	Hoopoe	Upupa epops	3								1
65	Barn Swallow	Hirundo rustica	50		6	10		2	6		36
66	Sand Martin	Riparia riparia	200		20	8		20	12		20
67	Crested Lark	Galerida criststa	2								1
68	Greater Short-toed Lark	Calandrella cinerea		3	10	14	10	8			5
69	Lesser Short-toed Lark	Calandrella rufescens							30		1
70	Asian Short-toed Lark	Calandrella							2		
71	Bimaculated Lark	Melanocorypha					2				1
72	Skylark	Alauda arvensis		1							
73	Black-headed Wagtail	Motacilla feldegg			2	4		1			2
74	Yellow Wagtail	Motacilla lutea				1					
75	Citrine Wagtail	Motacilla citreola				2			1		
76	Masked Wagtail	Motacilla personata			1	3			4		3
77	Turkestan Shrike	Lanius phoenicurjides	1								
78	Red-backed Shrike	Lanius collurio			1						
79	Long-tailed Shrike	Lanius schach	1								
80	Southern Grey Shrike	Lanius meridionalis				1					
81	Eurasian Starling	Sturnus vulgaris			3						4
82	Common Myna	Acridotheres tristis	3								7
83	Black-bellied Magpie	Pica pica	1			1			1		2
84	Eurasian Jackdaw	Corvus monedula	6			3					
85	Rook	Corvus frugilegus	150	8	2	12					4
86	Eastern Carrion Crow	Corvus orientalis	8		6	4	2		3		2
87	Paddyfield Warbler	Acrocephalus agricola			4	10	2			1	3
88	Blyth's Reed Warbler	Acrocephalus				4	1				
89	Great Reed Warbler	Acrocephalus			3	3					
90	Syke's Warbler	Hippilais rama	2								
91	Lesser Whitethroat	Sylvia curruca	4		6	2					

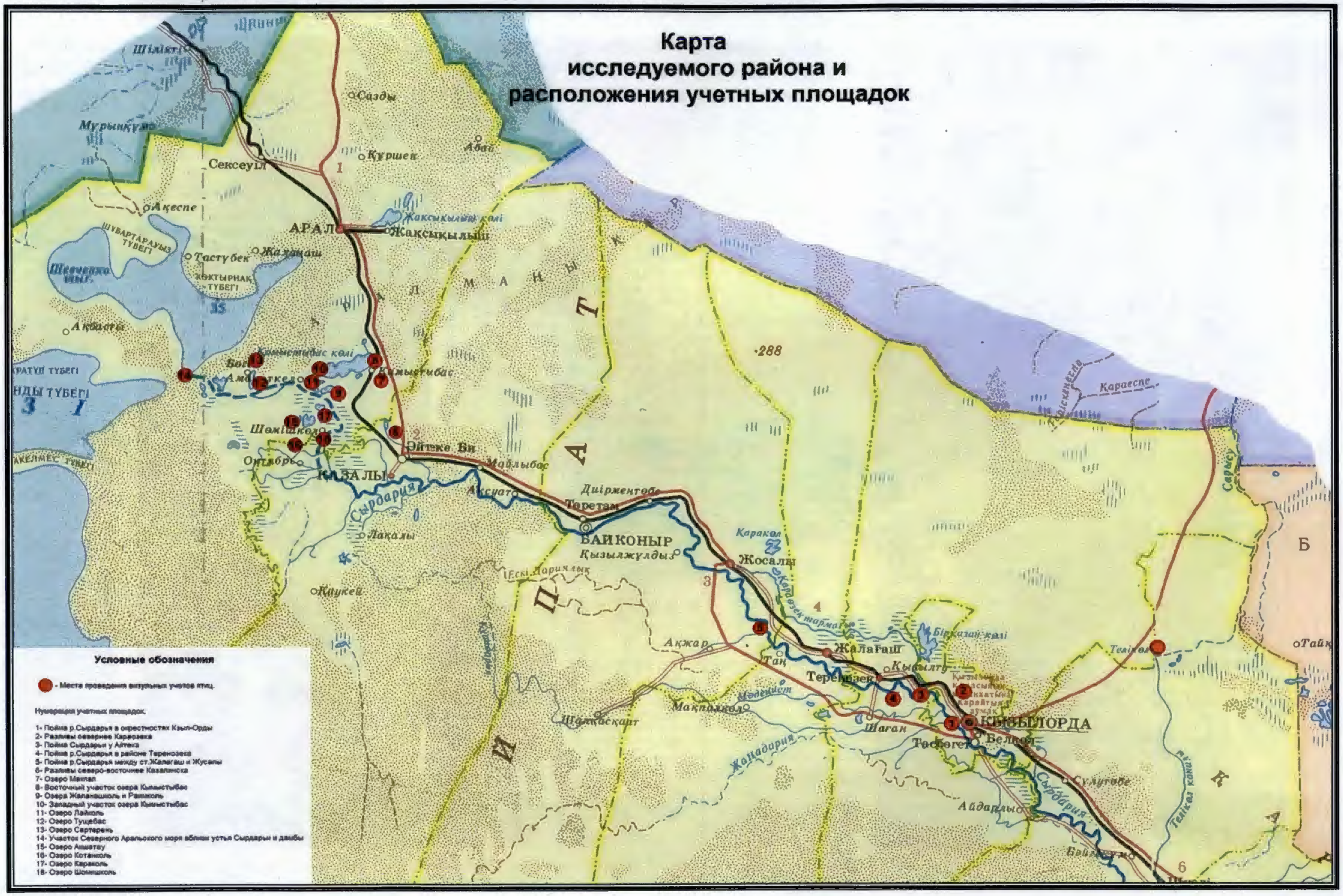
92	Spotted Flycatcher	Muscicapa striata				1					
93	Isabelline Wheatear	Oenanthe isabellina	2	3	3	4	1		1	1	2
94	Bearded Tit	Panurus biarmicus				5					
95	White-crowned Penduline	Remiz coronatus	4								
96	House Sparrow	Passer domesticus	40								20
97	Eurasian Tree Sparrow	Passere montanus	3								2
98	Red-headed Bunting	Emberiza bruniceps	3								1

Table 4

Species content and number of birds at Telikol lake, April 19th, 2007

№	Species	Scientific (Latin) name	**Registered (bird units)**
1	Dalmatian Pelican	Pelecanus crispus	21
2	Pygmy cormorant	Phalacrocorax pygmeus	20
3	Grey Heron	Ardea cinerea	20
4	Greylag Goose	Anser anser	90
5	Ruddy Shelduck	Tadorna ferruginea	6
6	Mallard	Anas platyrhynchos	2
7	Green-winged Teal	Anas crecca	15
8	Gadwall	Anas strepera	70
9	Common Teal	Anas querquedula	30
10	Northern Shoveler	Anas clypeata	500
11	Red-crested Pochard	Netta rufina	170
12	Common Pochard	Aythya ferina	10
13	Ferruginous Duck	Aythya nyroca	50
14	Marsh Harrier	Circus aeruginosus	30
15	Pallid Harrier	Circus macrourus	1
16	Spotted Eagle	Aquila clanga	2
17	Ring-necked Pheasant	Phasianus colchicus	3
18	Eurasian Coot	Fulica atra	15
19	Northern Lapwing	Vanellus vanellus	2
20	Eurasian Curlew	Numenius arquata	2
21	Collared Pratincole	Glareola pratincola	20
22	Black-headed Gull	Larus ridibundus	6
23	Gull-billed Tern	Sterna nilotica	2
24	Blue-headed Wagtail	Motacilla flava	30
25	Black-headed Wagtail	Motacilla feldegg	50
26	White Wagtail	Motacilla alba	1
27	Eastern Carrion Crow	Corvus orientalis	20
28	Chiffchaff	Phylloscopus collybitus	1
29	Bluethroat	Luscinia svecica	1
30	Siberian Stonechat	Saxicola torquata	1

Figure 1. Map of the investigated area and allocation of the monitoring sites



Picture 1. Flooded area near Karaozek

Picture 2. Flooded areas near Kazalinsk

Picture 3. The Syrdarya bush floodplain near Aitek

Picture 4. Karakol lake

Pictureo 5. Tushibas lake

Picture 6. Black-crowned night herons above turanga forest at Katankol lake

Picture 7. Makpal lake

Picture 8. The eastern part of Kamyshlybash lake

Picture 9. **The western part of Kamyshlybash lake**

Picture 10. **Shallow areas of the Aral sea near the Syrdarya mouth**

Picture 11. Kokaral channel

Picture 12. The Northern Aral sea near the NAS dike

Picture 13. Akshatau lake

Picture 14. Karakol lake

Picture 15. Shomishkol lake

Picture 16. The Syrdarya river near Kyzylzhar settlement

Picture 17. Colony of sand martins at the Syrdarya river near Kyzylzhar settlement

Picture 18. Masked wagtail – a common nesting species in the Syrdarya valley

Picture 19. Mute swans at Shomishkol lake

Picture 20. Swarm of great white egrets at the shallow sites of the NAS near the Syrdarya mouth

Picture 21. Pied avocet at Sarteren lake

Picture 21. Curlew sandpipers and dunlins at artesian water near Sarteren lake

Picture 22. Gleylag geese above Kamyshlybash lake

Picture 23. Pied avocets at Sarteren lake

Picture 24. Black tern above Raimkol lake

Picture 25. Caspian tern above Kokaral channel

Picture 26. Young Imperial eagle near Akshatau lake

Picture 27. Black-crowned night heron near the colony at Kotankol lake

Picture 28. Pygmy cormorant at Kotankol lake

Picture 29. Caspian gull – one of the most numerous gulls in the Syrdarya river valley and at the Aral sea

Picture 30. Great white egret near Kotankol lake

Picture 31. Purple heron above Zhalanashkol lake

Picture 32. White-tailed lapwing on the earth road near Kokaral channel

Picture 33. Marsh harrier – one of the most numerous predators of the water-swamping areas

Picture 34. Common snipe at the shallow areas of the Northern Aral sea near the Syrdarya mouth

Picture 35. Red-necked phalaropes at the artesian water near Bugun settlement

Picture 36. Marsh sandpiper at the artesian water near Bugun settlement

Picture 37. Red-necked grebe at the Northern Aral sea near the NAS dike

Picture 38. Great cormorants at Kokaral channel

Picture 39. Telikol lake

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A 4 List of Amphibians and Reptiles

Scientific name	English name	Russian name	Status	Syrdarya floodplain	Delta lakes	NAS	Other wetlands (incl. Aydar-Arnasay)	Koksaray area
Rana ridibunda	Sea frog	Озерная лягушка	Common	+	+	+	+	?
Bufo pewzowi (B. viridis subgroup)	Green toad	Зеленная жаба	Unknown, likely in the south of the project area	Likely common in the downstream part	-	-	Common in the south	? Green taods of the area not determined
Bufo variabilis (B. viridis subgroup)	Green toad	Зеленная жаба	Unknown, likely widely distributed	Likely in the downstream part	Likely	Likely widely distributed, found NW coast Shevchenko gulf	-	?

No data on reptiles available.

A5 Fish species found in the Aral Sea in 2004 (Scott Wilson 2006)

1. Aral roach – Rutilus rutilus aralensis
2. Grass carp – Ctenopheryngodon idelle
3. Aral pike-asp– Aspius aspius iblioides
4. Rudd - Scerdinus erychicefalus
5. Aral barbel – Barbus brahiocephalus brahiocephalus
6. Eastern bream – Abramis brama orientalis
7. Aral white-eyed bream – Abramis sapa aralensis
8. Aral shemaya - Chalcalbunus ohalcoides aralensis
9. Sabrefish – Pelecus cultratus
10. Silver crucian – Carasius carasius gibelio
11. Aral carp– Cyprinus carpio aralensis
12. Common silver carp – Hypophthalmichthys molitrix
13. Common catfish – Silurus glanis
14. Common pike-perch – Stizostedion lucioperca
15. Common perch – Perca fluviatilis
16. Snakehead– Channa argas werpochowswii

A6 Fish species found in the Syrdarya Delta Lakes, 1934-2004 (Scott Wilson 2005, Source: KazNIIRH, 2005.

Names of Species		Years of observation			
		1934	1964	1973-76	2001-04
Indigenous Species					
Acipensiredae Family – sturgeons					
Acipensir nudiventris– bastard sturgeon		+	+	-	-
Salmonidae Family – salmons					
Salmo trutta aralensis – Aral salmon		+	-	-	-
Cyprinidae Family – carps					
Rutilus rutilus aralensis– Aral roach		+	+	+	+
Leuciscus idus oxianus – Turkestan ide		+	+	+	+
Aspius aspius iblioides – Aral pike-asp		+	+	+	+
Scardinius erythropthalmus – rudd		+	+	+	+
Barbus capito conocephalus– Turkestan barbell		+	+	-	-
Barbus brachiocephalus brachiocephalus– Aral barbell		+	+	-	-
Abramis brama orientalis– eastern bream		+	+	+	+
Abramis sapa aralensis – Aral white-eyed bream		+	+	-	-
Chalcalburnus chaloides aralensis – Aral schemaya		+	+	-	-
Pelecus cultratus – sabrefish		+	+	+	+
Carasius carasius gibelio – silver crucian		+	-	+	+
Cyprinus carpio aralensis – Aral carp		+	+	+	+
Gobio gobio lepidolaemus – Turkestan gudgeon		+	-	-	-
Capeotobrama kuschakewtschi – ostroluchka		+	-	-	-
Cobitidae Family – loaches					
Cobitis aurata aralensis – Aral spiny loach		-	+	-	-
Siluridae Family – silurus					
Silurus glanis – Wels catfish		+	+	+	+
Esocidae Family – pikes					
Esox lucius – pike		+	+	+	+
Percidae Family – perches					
Stizostedion lucioperca – common pike-perch		+	+	+	+
Perca fluviatilis – common perch		+	+	+	+
Gymnocephalus cernuus – ruff		-	+	-	-
Gasterostiidae Family – sticklebacks					
Pungitius platygaster aralensis – Aral stickleback		+	+	+	+
Introduced Species					
Cyprinidae Family – carps					
Ctenopharingodon idella – grass carp		-	-	+	+
Hypophtalmichthys molitrix – white silver carp		-	-	+	+
Aristichthys nobilis – spotted silver carp		-	-	+	+
Channidae Family – snakeheads					
Channa argus warpachowskii– snakehead		-	-	+	+
Atherinidae Family – Atherinas					
Atherina boeri caspia – Caspian sand-smelt		-	-	+	+
Gobiidae Family – gobies					
Pomatoschistus caucarcus – bald goby		-	-	+	+
Total number of species		**21**	**19**	**20**	**20**
Including	Indigenous	21	19	14	14
	Introduced	-	-	6	6