ENVIRONMENTAL IMPACT ASSESSMENT

Project Number: 41121
February 2010

Kazakhstan: Multitranche Financing Facility for the CAREC Transport Corridor 1 (Zhambyl Oblast Section) Investment Program—Tranche 3

Road section approaching Kyrgyzstan border

Prepared by the Ministry of Transport and Communications for the Asian Development Bank

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CURRENCY EQUIVALENTS
(as of February 2010)

Currency Unit	–	tenge (T)
T1.00	=	$0.006650
$1.00	=	T150.365005

ABBREVIATIONS

ADB	–	Asian Development Bank
CAREC	–	Central Asia Regional Economic Cooperation
EA	–	executing agency
EIA	–	environmental impact assessment
EMP	–	environmental management plan
IA	–	implementing agency
MOTC	–	Ministry of Transport and Communications
PRC	–	People's Republic of China
ROW	–	right-of-way

NOTE

In this report, "$" refers to US dollars.

Contents

INTRODUCTION

The Assessment of impact on the environment (AIE) of the solutions of the road reconstruction work project at "Almaty-Kordai – Blagoveschenka – Merke – Tashkent – Termez" section of the approach of the border with the Republic of Kyrgyzstan (Karasu), length 17,7 km, was worked out based on the assignment to develop AIE.

LLP "GeoData Plus" is executing the assessment of impacts on the environment at the stage of "AIE" section of the work design "Road construction Korday-the border of the Republic of Kyrgyzstan". This company is entitled to carry out AIE for all types of planning, reconstruction projects and new construction projects – license № 00039P of the Ministry of the Environment Protection dated April 29, 2004, re-registered with № 01193P (0042262) dated January 30, 2008.

All the previous materials were thoroughly analyzed and summarized during the project development, which allowed to significantly complimenting to the field studies and measurements. The following sources were used during the work on the project:

1. Materials of field surveys, studies and measurements done by LLP Astana Dor Project
2. Feasibility study and WP for road reconstruction "Almaty-Kordai – Blagoveschenka – Merke – Tashkent – Termez" at the section of approach of the border of the Republic of Kyrgyzstan (Karasu)
3. Study materials and scientific and technical reports of different road organizations of Kazakhstan
4. Governmental National Program "Transport and Communication development", Section 5, "General scheme of network development of roads for general use for the period till 2010". The Program was developed in accordance with order N 82-p of the Prime-Minister of the Republic of Kazakhstan dated March 17, 1993, and was approved by the Ministry of Economy of the Republic of Kazakhstan, Decree N 20/2, dated June 25, 1993.
5. Governmental program of road network improvement of roads for general use "Roads of Kazakhstan" for the period till 2010, 1995.
6. Decree №1018 of the Government of the Republic of Kazakhstan dated 11.10.2005.

The structure, composition and contents of AIE documents were adopted in accordance with the assignment and "Instructions on assessment of supposed impact of economic or other activity on the environment during development of pre-planned, pre-project and project documents" (Astana, 2007), approved by order № 204-п of MEP dated June 28, 2007.

The road under construction is located in the land of Zhambyl oblast. The beginning of the section under the project is km 202 (Almaty-Bishkek road), the end is km 14 (Korday-Karasu) road), length 17,7 km.

The existing road belongs to the 3rd category with two lanes. Today, in accordance with the future traffic intensity and the fact that the road reaches the border of the Republic of Kyrgyzstan the transfer of the road to the 2nd category is needed.

Two-lane traffic is adopted in the project in accordance with future intensity. The transfer of the existing sections of the road from the 3rd to the 2nd category will solve the problem of traffic safety, the capacity of this section, will influence the decrease of commercial risks during goods delivery, will decrease transport costs, passengers' travel time, will have positive influence on social sphere of main regions of Kazakhstan, will decrease road impact on the environment. All these issues are highlighted in the respective sections of the project.

Implementation of this road construction will allow gaining stable transport communication of Central Asia and Middle East countries with Russian Federation, Ukraine, European countries and Transcaucusus countries, China, South Korea and will be of great significance.

The section includes determination of the character and the level of ecological danger during the construction of the above-mentioned road section.

The main goal of AIE is prevention of the environment degradation, development of measures decreasing the level of ecological danger of planned economical activity.

The solutions on the road development are evaluated according their impact on the air, water and land resources, flora and fauna and other factors of the environment.

Total length of the road is 17,7 km.

The approximate construction period at the road section of the approach of the Republic of Kazakhstan is 18 months.

1. General part

The main terms, definitions, laws, methods, standards of environmental quality assessment used during elaboration of this section are presented in this subsection. The list of organizations, the activity of which is connected with environment protection is also given here.

MAIN TERMS AND DEFINITIONS

environment – a complex of natural objects, including atmospheric air, the Earth's ozone layer, water, soil, mineral resources, vegetation and animal kingdom and climate in their interaction;

impact – any consequence of the planned economical or other activity for the environment, including the health and security of people and animals, as well as vegetation, soil, mineral resources air, climate, landscape, historical monuments and other material objects, the interaction between these factors; it also comprises consequences of cultural heritage and social and economic conditions, it is the result of the change of these factors

change – reversible and (or) irreversible change in the environmental components

and (or) their combinations;
consequence – the result of the impact of economical or any other activity and the resulting changes, reflected in the surrounding natural and (or) social and economic environment;
ecological risk – the probability of unfavorable consequences for the environment and people's health of any (deliberate or random, gradual or catastrophic) anthropogenic changes of natural objects and factors;
ecological hazard – the state, characterized by the presence or possibility of destruction, environmental change, under the influence of anthropogenic and natural changes, among other things caused by disasters and catastrophes, including natural disasters, and as a result threatening the vital needs of people, it may cause or causes a negative impact on the people's health and the environment.
ecological monitoring – the procedure, providing the sequence of organizational and technical and logically connected actions on environmental feasibility study of the planned activity at all stages of its implementation;
public consultations - a generalized name of an indispensable component of environment protection, providing direct information communication and feedback, ensuring the population's participation (community) in making decisions on implementation of the planned activity, concerning their interests;
environmental impact assessment – the determination of the conformity of economical and other activity to the environmental quality standards and ecological requirements, permissibility of execution of the subject of review in order to prevent a possible negative impact of this activity on environment and the resulting consequences.

2. Characteristics of the region of the area of road location.

The road "Almaty-Korday-Blagoveschenka- Merke – Tashkent – Termez" at the section of the approach of the border of the Republic of Kyrgyzstan (Karasu) is located within the territory of the Republic of Kazakhstan and crosses the territory of Zhambyl oblast.

2.1.Territory, population

Zhambyl oblast located in the south of the Republic of Kazakhstan was founded in 1939.in terms of geography its territory is mainly plain. The area of the oblast occupies the territory of 144.2 square km. There are 10 regions in the oblast, the city of oblast subordination is Taraz and three towns under regional jurisdiction – karatau, Zhanatas, Shu.

The permanent population of the oblast is 1 million and 17 thousand people. The population is represented by more than 100 ethnicities and nations. Kazakhs comprise 68,3 % of the permanent population.

The average density of population in the oblast (per 1 square km) is 7,1 person.

2.2.Topography, climate

The climatic characteristics of the surveyed area is given according to the data of meteorological stations “Burno-Oktyabrskoye”, “Maimak”, “Lugovaya”, “Merke”, “Dzhambul”, “Stepnoye”, and “Kurday”. The average annual amount of precipitations ranges from 355 mm to 465 mm.The highest ten-day snow cover of 5% of reliability is within 50 cm (Kurday), 38 cm -”Dzhambyl”, and is not revealed in other areas under study.

The climate of the region is sharply continental, the summer is hot, and the winter is moderately cold with grate daily and annual ranges of temperature.

In terms of geomorphology the surveyed road area is predominantly plain. The waste sloping plains and cross blankets are formed by merged alluvial cones of numerous small mountain rivers flowing down the slopes of Kara-Tau Mountains, the Kyrgyz Ridge and Kendyk-Tas Mountain.

2.3.Characteristics of the area in terms of geology and hydrology

Near the mountains the plain surface is complicated with numerous dry narrows. On the section where the rivers Assy, Talas, Aspora, Karabolta, Aksu, Shorgo, Shu cross with each other the valleys have formed ranging approximately from 150 m to 2,0 km (the Shu River).

The surveyed road area is located near the cavity and recent quaternary deposits are mostly wide-spread. Proluvial and alluvial quaternary deposits form alluvial cones in the submountain region and are represented by gravel soils with the content of boulders up to 10%.

As a whole the section of proluvial-alluvial deposits is characterized by great heterogeneity along strike and depth and poor assortment of material. Sands are mainly represented by silt and fine fractions, loams and fine sandy loams are predominant in the near-surface section, they are light and heavy, silt with gravel content.

According to the road and climatic zoning the surveyed road section is referred to the 4^{th} and 5^{th} road climatic zone.

Almost all mountain part of the stream outlet formation of this region is located within the territory of Kyrgyzstan, except small tributaries of the Chu river, formed on the slopes of the Zhetyzhol and Kendyktas Ridges and the Chu-Ili Mountains. Low reaches of the Chu and Talas Rivers located in the areas of flow balance and diffusion make up the main part of the territory of Kazakhstan.

Hydrometeorological study of the area is conducted by hydrometeorological agencies of Kazakhstan and Kyrgyzstan.

The Kyrgyz Ridge and a sandy hilly Moiynkum Plain degrading from 660 to 200 m westward serves as a morphological boundary of the Chu cavity in the south. There are a number of echelon ridges changing each other and degrading in the north-western direction and base-levelled mountains (Eastern End of Trans-Ili Alatau, Zhetyzhol, Kendyktas, the Chu-Ili Mountains, Maizharylgan) and a high plain Betpak-Dala.

The change from plain relief of the Chu Cavity to the Kyrgyz Ridge is expressed in the relief of a number of piedmont and low-mountain uplands with ridges of hard-rock or covered by loess loams and intermountain cavities of the

east-west strike, filled be rudaceous deposits. Gorges, sinks and holes are developed on loess. Such irregularity is of great importance in the formation of surface discharge.

Terrain elevation has a decisive impact on climate formation of the region. As a rule, the temperature and evaporation reduce with height, while the amount of precipitations, the period when snow is lying, the wind speed increase with height. The mentioned relation is often violated under the influence of orographical peculiarities and local atmospheric circulation.

The amounts of precipitations are very unequally distributed across the territory. Their amount is first of all determined by the terrain elevation, ridge orientation in relation to moisture-carrying air masses and their accessibility for these masses. The high land zone of the northern slope of the Kyrgyz Ridge is the wettest zone.

Two types of river valleys where precipitation distribution with height has its peculiarities are distinguished according to relief conditions and geographical location inside separate small and average river valleys:

a) longitudinal widely-stretched valleys with the area of more than 1000 square km., with their spreaders facing the moisture-carrying air flows and a relatively equal increase of precipitation is noticed with the height;

b) transverse valleys of marginal ridges and small river basins of the northern slope of the Kyrgyz Ridge, the depth of erosional trench reaches 1,5-2,5 km, due to it the middle part of these valleys becomes mostly shadowed precipitations in comparison with the piedmont and high-mountain zone. On open slopes, especially windward ones the amount of precipitation generally increases with height. In most cases the amount of precipitations increases at the river sources. This law should be taken onto account during calculation of precipitations in drainages of the 2nd type. The total precipitation here turns out to be 10% underestimated because the graphic charts EX=f(н) were carried out based on the data of the points located at the valley bottom.

2.4. Soils and soil-forming materials.

Dark- chestnut soils are found at the Talass foothills and the most elevated parts of the Taratau ridge. Basic elements of the relief - slopes of different exposure, inclined foothill plains, and wavy plateaus.

Soil-forming materials - weak poorly sorted eluvial and diluvial and proluvial loess loams at the depth of 1-2.5m mixed with compact rocks and sandy and pebble deposits.

The thickness of the fertile layer of soils composes 30cm. These soils are used in the agriculture.

Light-chestnut soils are located at the foothills of the Kyrgyz and Talass Alatau, Karatau ridge and Shu- Ili Mountains. The relief is represented by inclined plains of different exposure and intermountain valleys.

Significantly thick loess deposits and loess loams with underlying gravel and pebble formations serve as the soil-forming materials. The thickness of the fertile

layer of soils composes 20-25cm.

Serozem soils - in the region of the road route dark serozem soils and regular serozem soils of different mechanical composition (light-, middle, and heavily clayish) soils are popular, as well as meadow and serozem soils. These extensively sloping sub-mountainous plains along the Chu-Ili Mountains and the Kyrgyz Alatau present desert and steppe sub-mountain zone.

Loess deposits and loess loams, frequently rubble and gravelly, shallow sandy and pebble layers form local soil-forming materials. These soils are carbonate. Serozem soils usually differ from dark serozem soils in terms of humus thickness. The thickness of the fertile layer of soils is 20-25cm.

Meadow serozem soils are solis of the saz band of a semi-hydromorphic soil types are wide-spread in foothill plains and terraces of rivers. These soils are mostly solonized by easiily soluble salts. Among them one can meet both alkali soils and solonized soils. The salting of soils is sulfate. This salting is not dangerous but strongly salty sulfate alkali soils need to be washed.

Meadow serozem soils are good plough lands. The thickness of the fertile layer of soils is 25-30cm.

2.5. Fauna and flora.

The following types of vegetation can be distinguished: desert vegetation – xerophytic, suffrutesces and semifrutexes) - silky wormwood, Turanian wormwood, and ebelek.

Steppe type vegetation is insignificantly spread, represented by erkek and tyrsik.

Meadow type of vegetation is met in river valleys, ravines, around springs and lakes. Most frequently met is reed, rush, reedgrass, woodreed and wheatgrass associations, azhrek, kiyak and vostrets.

Bushy type of vegetation is sufficiently widespread and represented by meadow-sweet, pea shrub, salt tree, tamarisk, zhuzgun brushwood.

Wood type vegetation is mostly represented by black saxsaul, euphrates poplars, and elaeagnus.

The total area of hunting lands is 13,9 thousand hectares, more than 40 species of animals live there. Fishery fund, occupying the territory of 27,8 thousand hectares, consists of 81 ponds, of which 59 reservoirs are suitable for fishing activities. Among large reservoirs Tasotkel and Ters-Ashibulak reservoirs are distinguished. The prevailing target species are silver carp, grass common carp, carp, pike perch, bream, kral, Caspian roach.

2.6. Transport and roads

The total local road network is 3928,7 km. The oblast's road network is 2098,5 km, 1 category – 9 km, 2 category- 339 km, 3 category -1031,3 km, 4 category – 719,2 km., including roads with asphalt road surface – 140,7 km, with black gravel surface – 1828,8 km, with gravel macadam surface -129 km.

The total region's road network is 1830,2 km, including 3 category -51,8 km, 4 category – 1588,3 km, 5 category -190,1 km, including roads with asphalt surface– 23,8 km, with black gravel surface – 1000,5 km, with gravel macadam

surface -760,2 km, with soil surface -45,7 km.

27 transportation companies offer passenger traffic services for the oblast's population. These transportation organizations offer their services on 223 routes. 1781 buses of different makes, with one-time seating capacity of 38292 seats are involved on the routes.

The total length of all routes is 16564 km. The distribution of the routes is the following:

- Intra city routes – 64, where 1093 units of passenger transport are involved.
- Village route – 13, where 73 units of passenger transport are involved.
- Suburban routes -89, where 326 units of passenger transport are involved.
- Intercity routes -57, where 289 units of passenger transport are involved.

For the year of 2004 5382 thousand ton of cargo and 175,18 million passengers were transported by all means of transport of the Atyrau oblast.

3. Characteristics of the designed object.

3.1. Road description

"Almaty-Korday-Blagoveschenka – Merke- Tashkent –Termez" road at the section of the approach of the border of the Republic of Kyrgyzstan (Karasu), length – 17,7 km crosses the territory of Korday region Zhambyl oblast. The category of the existing road is 3rd. The surface is macadam. There are some longitudinal and cross cracks, sagging. There are places where the pavement lies in separate spots. (islands).

3.2. Artificial structures

Artificial structures on the road are presented by the bridges and culverts. All the structures are made of moonlit reinforced concrete, the construction was carried out during 1966-1989 under the load of H-18, RK-80 and H-30, NK-80 to satisfy III technical category of the roads.

Total amounts of pipes on the road at the section of the approach to Kyrgyzstan border (Karasu) is 12.

The main design solutions regarding existing culverts are:

- Reconstruction with extension up to Lave = 5 m of all round pipes with diameter of 1,0 m – 4 pieces, 1,5 m – 2 pieces, 2x1,2 m – 2 pieces.

In detailed design based on thorough survey of each pipe it is possible to use part of old pipe elements.

As the experience of pipes survey shows, the possibility of pipe deformation is very big due to non-fulfilling of several requirements of the regulations during the pipe construction, due to the low quality of concrete and due to high salinity of the sectors where the pipeline goes.

3.3. Crossings and junctions

Crossings and junctions of the roads must provide maximum safety and comfort of car driving within the interchange.

The planning of the crossing must point out the advantages of driving along the main road.

Crossings and junctions are planned taking into consideration the recommendations of the standard project 503-0-51.89 “Crossings and junctions of roads on one level” by Souzdorproject, 1989.

Independently of the crossing layout, it is recommended to construct the interchange under right angle or close to it. The smallest radius of the curves in the road intersections is 5 meters.

On the secondary roads the road pavement should be constructed with the same material as the main one within the bends of the road , the rest length pavement may be done of gravel and sand mix, 20 cm thick.

Due to the ground conditions the length of exit roads is adopted as 200 m (CNR RK 3.03-09 – 2003, 6.2.4).

3.4. Road furniture

According to CNR RK 3.03-09 – 2003, section 10, safety traffic and traffic management measures are provided for.

Installation of road signs in accordance with CR RK 1125-2002 “Road signs. General technical conditions” is stipulated for in order to manage the traffic, to provide safety, to inform the drivers during the trip.

The structure of the signs should be of metal stands on metal poles according to the standard project 3.503.9-80 “Bases of road signs on the roads”. The base of SKM type should be on the basement F1 and F2 with moonlit pole.

The allocation of the signs is done based on the condition that the signs must be visible, that the possibility to damage them with vehicles must be excluded, in accordance with GOST 23457-86 “Technical means of traffic management”.

The drivers are informed about the presence of dangerous sections of road direction changing with reinforced concrete warning poles CC-1 installed on the roadside at the distance of 0,35 m from the edge of the roadbed (standard project 3.503.1 – 89 “Barriers at the roads”:

- At the straight road sectors with the embankment height at least 2 m, without road carriageway barriers , every 50 m;
- Within the curve at the junctions and crossings at the distance indicated in CNR 3.03.09 – 2003, table 10.4, for external curve line (every 3 m);
- At the culverts with diameter of 1,5 m – three poles at the distance of 10 m from the pipe main line (on each side of the road).

According to the existing rules and requirements if the embankment height is more than 3 m and the slope ramp is 1:3 as well as at the approaches to the bridges it is planned to install barrier railings of 11DO.MM type according to the standard project 3.503.1 – 89 “Barriers at the roads”.

It is planned to paint markings to improve the traffic and pedestrians movement on the carriageway according to CR RK 1124-2003.

The bus stops are planned to construct with landing fields, enclosed bus stops type АП-6 toilets (on one side) for two units, repair works on redevelopment of rest and short-term parking areas. The pavement of rest and short-term parking areas are according to the type of major road. The construction of 5 rest and short-term parking areas is planned. The rest areas are equipped with service docks, shades and toilets for two units.

3.5. Road pavement

Design of the road pavement should be done in accordance with local standards taking into account 20-years traffic maintenance of solid structures life time (life time between rehabilitations).

Name of interval	Length, km	Category	Type of pavement	Road condition			Future traffic intensity for 2030	Required parameters	
				pavement		roadbed		category	Type pf pavement
				evenness	strength				
Approach to Kyrgyzstan border	17.7	III	Earth-gravel, cold asphalt concrete	Unsat.	Kact = 0.74 K req. = 1.0 Unsat.	Sat.	5500	II	solid

Conclusions:

1. It is necessary to improve the roadbed up to the parameters of II technical category at the whole section.

2. The existing road pavement should be ripped to the depth of 0,3 m, crushed and lay for the whole width of the roadbed (to use as the working layer of the roadbed).

3. To construct the roadbed according to the CN RK 3.03-19-2003 “Instructions on calculation of non-rigid road pavements”.

3.6. Potential sources of building materials and structures

Potential sources of building materials and structures for construction and rehabilitation works are recommended based on the bills of sources and methods of transportation of main building materials, products and semi-finished products.

Taking into consideration simple relief and landscape conditions of the region it is not difficult to determine the locations of soils, pits and reserves during designing. Under the terms of the tender procedures the contractors are entitled to take over the supply sources of materials and instructions upon coordinating with the Employer.

It is proposed to use bitumen and organic binding materials of Orsk oil refinery (Russian Federation).

It is proposed to provide the construction with reinforced concrete products and

structures as well as with materials and products for the road furniture from the specialized enterprises of Almaty (JSC “AZMK” and JSC “Almaty factory of road signs”).

3.7.Technical risks and evaluation of the equipment selection

Technical and production risks are the risks related to the operation capacities. The source of technical and production risks are economical problems which are caused by poor supply of the enterprise as well as by the growth of production costs due to non-qualified engineering, lack of personnel qualification and also by noncompliance of the implemented project to the requirements for the object. The risk is considerably decreased by means of hiring qualified personnel or by means of additional training of the existing personnel. Regarding possible noncompliance between the requirements and the implemented project it may be avoided by means of equipping with up-to-date and even revolutionary technologies as well as by means of managing the project by a highly qualified team of managers who are able to use the existing capacities for 100%.

At present the capacity of some road complex enterprises are out-of-date. Asphalt and concrete plants which were constructed several decades ago have not been reconstructed and modernized. Amortization of road construction machinery and equipment has reached its critical level.

Amortization of main assets does not allow reproducing of capital assets in the road companies. In these conditions it is especially crucial for the road constructors to have an investment program aimed at concentration of all sources of investment resources to ensure up-to-date requirements in the road sector.

To increase reliability, solidity and technical conditions of the road network it is necessary to introduce modern technologies during road works execution:

- increase of quality and operating life of the roads and structures including by means of permanent supervision and maintenance of the road elements and structures, by means of up-to-date rehabilitation works taking into consideration traffic intensity growth, by means of introduction of weight control, metrological provision of the road maintenance services;
- development and implementation of new technologies and equipment for recycled use of old asphalt concrete, production wastes, and local building materials with the use of national know-how;
- improvement of road engineering furniture, increase of road safety (use of acetate chemical agents to fight with winter slippery road pavements), ecological safety, esthetic requirements;
- Creation of completely new materials and structures;
- Implementation of technical reequipment of the road.

		Required by regulatory documents	Required by regulatory documents	Accepted	Founded
1	**2**	**3**	**4**	**5**	**6**
	Design rules	CNR RK 3.03-09.2003			
1	Road category	-	II	II	items 4.1.2 Table 4.1.1
2	Design speed	km/hour	120	120	items 4.2.2 table 4.2.1
3	Number of lanes	lane	0	2	items 5.1.1 table 5.1.1
4	Lane width	m	3,75	3,75	-
5	Minimal width of hard roadside (according to the main carriageway type)	m	0,75	0,75	
6	Roadside width	m	3,75		-
7	Curb width	m	-	-	-
8	Earth roadbed width	m	15	15	-
9	Radius of curve	m	600	600	items 5.2.2 table 5.2.1
10	Radius of curve convex concave	thousand m thousand m	15 5	15 5	items 5.2.2 table 5.2.1
11	Minimal visibility ranges: -oncoming vehicle - for stoppage	m m	450 250	450 250	items 5.2.2 table 5.2.1
12	Road pavement type	-		Heavy-duty	Items 8.3 Table 8.1
13	Surface type	-		Hot asphalt concrete	Items 8.4.2. Table 8.4.2

3.8. Traffic intensity determination and forecasting

The data about the traffic intensity were received from the materials of field surveys and investigations.

Based on the data about the traffic intensity of the previous years on the designed road it may be stated that for the past years traffic intensity tends to change considerably.

There is a considerable instability in the traffic intensity amounts within the road section due to their length. Intensity values change depending on the location within the site. As a rule, intensity increases at the approaches to the settlements due to local traffic.

Considerable changes of traffic intensity occur also during the year.

The most intense traffic flow is observed in the third quarter which is connected with seasonal transportation of agricultural products within this region as well as outside the region.

The study of the traffic intensity is carried out in order to determine the composition of the traffic flow, directions of cargo and passenger flows, points of origin and destination of the transported cargo, types and character of cargo, periodicity of its transportation, purposes and periodicity of passenger transportation, presence of transit cargo and its nature, country and owner of vehicles, traffic speed of vehicles and measures on reduction of travel time of cargo and passengers, etc. The analysis of the data received based on the study of the economical situation of Kazakhstan and neighbouring countries will allow forecasting traffic intensity growth rates for the future and as a result will allow finally determining the road category, structure of road clothing and other parameters, estimating economical efficiency of the project.

The record of the road traffic was carried out in order to get and gather the information on the amount of the vehicles and separate groups of rolling stocks in the general traffic flow and the operating condition of traffic. The camera processing was carried out according to “Instructions on road traffic record PR RK 218-04-97”.

The points of traffic intensity record and the length of space intervals where the intensity was taken as constant one were determined due to the following conditions:

- Homogeneity of transport flow at the space interval,
- Presence of settlements,
- Location of crossing with the roads with the same economical meaning,
- Influence of local traffic approaching the settlements,
- Location of traffic record points in the past.

All vehicles were recorded subdividing them into the following categories:

- Cars;
- Pick-ups;
- Minivans;
- Buses;
- 2-axle trucks;
- 3-axle trucks;
- 4-axle trucks;
- 5-axle trucks and more including ling haul trucks;
- Tractors and special transport;
- Motorbikes.

3.9. Determination of estimated traffic intensity.

Average annual average daily traffic intensity for the required year is accepted as estimated traffic intensity.

Average annual average daily traffic intensity was corrected taken into consideration seasonal coefficient of oscillation according to the instruction.

Based on leasing introduction, centralising of machines and equipment purchase, increase of efficiency of the use of advanced equipment and process management of the use of machines and equipment:

- Introduction of up-to-date methods of diagnostics equipment and laboratory control of road works quality (means of non-destructing control of the road clothing condition), devices to diagnose transport and operation condition of the road, devices for express-control of the production quality;
- Introduction of up-to-date methods of engineering surveys and automatic road design based on up-to-date software and technologies (optimization and speeding-up of design works);
- Introduction of up-to-date systems (equipment) of geodesic provision of road field.

Development of road construction industry in the following direction: creation of enterprises for production of inert materials (crushed stone, sand, gravel, mineral powder, bitumen emulsion) and their appropriate location taken into consideration the distance of transportation of the said materials;

Recently, certain work on introduction of new equipment and new technologies is being carried out in the road field of the republic.

A great choice of road construction machinery is offered for construction and maintenance of roads. Except bulldozers and excavators the following machinery

can be included in this list:

- Road angle cutters
- Auto bitumen spraying machine and bitumen trucks using MAZ and KAMAZ with heating of the material in the tank;
- Asphalt pavers with the capacity of 210-500 t per hour with the width of the strip paved up to 7,5 m.
- Auto graders light, medium and heavy from 6 up to 19,5 ton.
- Rollers self-propelled static and vibration ones, with the weight of 1000 up to 20 000 kg.
- Marking vehicles for road marking with painting (thermal plastic).
- Compressor stations (stationary, movable, diesel, electrical) to produce compressed air used for pneumatic instruments and mechanisms as well as for industrial needs during construction and road works, with the capacity of 3.5 up to 12 m3\min, with operational pressure up to 8 Atm.
- Diesel (stationary and movable) welding devices for 450A
- Welding transformers, rectifying equipment
- Air sand blowers to clean surfaces.
- Painting devices.
- Plastering machines and devices for accepting, preparation and laying wet plaster mixes.

Technical parameters

No	Name of indicators	Unit	For roads outside settlements

According to local and resources cost estimates of the working project 14 types of construction equipment and vehicles using diesel and gasoline will be involved during construction and installation works.

Fuel consumption for the road construction period (road construction

machinery and transport)

№	**Sources of pollution emissions**	**Fuel type**	**Fuel consumption, Kg/hour**	**Machinery operating time, m/hour**	**Fuel consumption, ton**
1	Sprinkler tank, ЗИЛ-130, 6000 l	Petrol	22	43607,88	959,36
2	Road grader 99 kVt, 79 kVt	Diesel	4,5	75043,56	337,69
3	Bitumen spraying machine 7000 l	Diesel	20	1080,12	21,60
4	Asphalt paver	Diesel	14	30325,32	424,55
5	Bulldozers 108 l.s., 165 l.s.	Diesel	8	421645,8	3373,17
6	Bulldozers, 80 l.s.	Diesel	64	584,94	3,74
7	Rollers, self-propelled, 5t, 8t, 10t, 13t, 16t	Diesel	13	140307,09	1823,99
8	Truck cranes, 6,3 t	Diesel	14	1060,08	14,84
9	Crawler crane, 25 t	Diesel	14	12461,68	181,46
10	Pneumatic wheel-mounted cranes, 25 t	Diesel	10	2599,08	25,99
11	Marking machine, T-40	Diesel	11	839,82	9,24
12	Tractor, 108 l.s.	Diesel		107478	859,83
13	Tractor, 80 l.s.	Diesel	3,7	73,57	0,27
14	Excavator, E-652B, o,65 m3	Diesel	7,4	50571,9	374,23
15	Excavator, E-10011, 1,0 m3	Diesel	8,2	98921,64	118,15
16	Hole digger	Diesel	6,4	617,82	3,95
17	Drilling machines with drilling depth of 3,5 m on truck 85 kVt, 115 l.s.	Diesel	8,4	338,7	2,84

Calculation of exhaust emissions during car and machinery operation for the road construction period

#	Sources of pollution emissions	Fuel type	Fuel consumption, ton	Emissions for construction period, ton				
				CO2	CH	NO2	C	SO
	Specific emissions, ton/fuel ton	**Diesel** **petrol**		**0,01** **0,07**	**0,03** **0,10**	**0,04** **0,04**	**0,05** **0,005**	**0,02** **0,002**
1	Sprinkler tank, ЗИЛ-130, 6000 l	**petrol**	**959,36**	**67,15**	**95,93**	**38,37**	**4,80**	**1,92**
2	Road grader 99 kVt, 79 kVt	Diesel	**337,69**	**3,38**	**10,13**	**13,51**	**16,88**	**6,75**
3	Bitumen spraying machine	Diesel	**21,60**	**0,21**	**0,65**	**0,86**	**1,08**	**6,75**
4	Asphalt paver	Diesel	**424,55**	**4,24**	**12,74**	**16,98**	**21,23**	**8,49**
5	Bulldozers	Diesel	**3376,91**	**33,77**	**101,31**	**135,07**	**168,84**	**67,54**
6	Rollers, self-propelled, 5t, 8t, 10t, 13t, 16t	Diesel	**1823,99**	**18,24**	**54,72**	**72,96**	**91,20**	**36,48**
7	Truck cranes, 6,3 t	Diesel	**14,84**	**0,15**	**0,44**	**0,59**	**0,74**	**0,23**
8	Crawler crane, 25 t	Diesel	**181,46**	**1,81**	**5,44**	**7,26**	**9,07**	**3,63**
9	Pneumatic wheel-mounted	Diesel	**25,99**	**0,26**	**0,78**	**1,04**	**1,30**	**0,52**

	cranes, 25 t							
10	Marking machine	Diesel	**9,24**	**0,09**	**0,28**	**0,37**	**0,46**	**0,18**
11	Tractor, 108 l.s.	Diesel	**859,83**	**8,6**	**25,79**	**34,39**	**42,99**	**17,20**
12	Tractor, 80 l.s.	Diesel	**0,27**	**0,003**	**0,008**	**0,011**	**0,013**	**0,005**
13	Excavator, E-652B, o,65 m3	Diesel	**374,23**	**3,74**	**11,23**	**14,97**	**18,713**	**7,48**
14	Excavator, E-10011, 1,0 m3	Diesel	**811,15**	**8,11**	**24,33**	**32,45**	**40,56**	**16,23**
15	Drilling machines on truck 85 kVt, 115 l.s.	Diesel	**2,84**	**0,03**	**0,08**	**0,11**	**0,40**	**0,06**
16	Hole digger	Diesel	**3,95**	**0,04**	**0,12**	**0,16**	**0,20**	**0,08**
	Total: for construction period	Diesel	**17862,1**	**82,67**	**248,05**	**330,46**	**413,67**	**165,31**
		Petrol	**959,36**	**67,15**	**95,93**	**38,37**	**4,80**	**1,92**
	Total:		**18821,46**	**149,82**	**343,98**	**368,83**	**418,47**	**167,23**

Calculation of dust exhaust during transportation of building materials

Dust exhaust is determined by transport traffic during road construction. . The dust is exhausted as a result of wheels interaction with the road surface and when it is winded off the surface of material in the cargo body.

The total amount of dust exhausted by cars within the start-up complex is calculated using the formula:

$$Q = \frac{C1 \times C2 \times C3 \times C6 \times N \times L \times g1 \times C6 \times C7 \times q1}{3\,600} + C4 \times C5 \times C6 \times g2 \times Fo \times n, \text{ g/sec}$$

where:

C1 – coefficient of average load capability of one vehicle (for 10 ton vehicles C1=1,0)

C2 – coefficient of average speed of a vehicle at 30 km – 3,5

C3 – coefficient of road condition

C4 – coefficient of material surface profile in the cargo body

C5 – coefficient of airflow velocity of material in the cargo body

C6 – coefficient of wetness of material surface layer

C7 – coefficient of dust share blown off into the atmosphere - 0,01

N – number of routes per hour

G1 – dust emission into the atmosphere per 1 driven kilometre – 1450 g

G2 - dust emission into the atmosphere per one unit of actual surface of material

n – number of cars

Results of calculations

Table 1

Name of works	Coefficients							Dust emission per 1 km G1	Dust emission per surface unit G2	Area of truck body F0
	C1	C2	C3	C4	C5	C6	C7			
Soil transportation	1	3.5	1	1,3	1,2	0,3	0,01	1450	0,005	12
Transportation of GPS and crushed stone	1	3.5	1	1,3	1,2	0,7	0,01	1450	0,005	12

C4 – is determined by correlation F_{actual} / F_o, where

F_{actual} – actual surface of material in the cargo body

F_o – average area of the cargo body

Dust exhaust during soil transportation will be 0,72312 ton/year

Dust exhaust during transportation of PGS and crushed stone will be 3,2538 ton/year

Calculation of non-organic dust exhausts during earthworks and construction of road pavement

The amount of non-organic dust exhausted into the atmosphere during construction of road bed as well as road pavement construction is composed of the exhaust amounts during:

- construction of road bed;
- loading and unloading works.

Dust exhaust amount during roadbed construction and during loading and unloading works is calculated using the formulae:

$$П = K_0 \times K_1 \times K_4 \times K^{□}_{в} \times q_{уд^{ст}} \times M_г \times 10^{-6}, \frac{ton}{year}$$

$$П = K_0 \times K_1 \times K_4 \times K^{□}_{в} \times q_{уд^{ст}} \times M_ч \frac{□}{3600}, \frac{g}{s}$$

Where:

Ko – coefficient of wetness

K 1 - coefficient of local conditions, degree of unit protection from surrounding impacts

K 4 - coefficient of wind velocity

K 5– coefficient of piling height

q sp - specific emission of hard particles from 1 ton of material coming to the road (accepted equal 3 g\t)

M g– amount of the material coming to the road, t\year

M h– maximum amount of the material coming to the road, t\hour

Calculation of dust exhausted during earthworks during road pavement construction

Name of works	Coefficients				$q_{уд^{ст}}$ g\t	Amount of material		Amount of exhaust	
	Ko	K1	K4	K5		Mh t\hour	My t\year	g\s	t\year
Unloading of crushed stone and GPS	0,7	1,0	1,20	0,3	3	93,12	595000	0,019	0,045
Unloading of soil	0,3	1,0	1,20	0,5	3	111,83	3030000	0,0168	1,6362

Formation of s\p	0,3	1,0	1,20	0,5	3	111,83	3030000	0,0168	1,6362
Distribution of crushed stone and GPS	0,7	1,0	1,20	0,3	3	93,12	595000	0,019	0,045
TOTAL								0,0716	3,3624

Taking into account the aforesaid the project recommends to use preventive and protection measures to reduce dusting during works execution, in particular:

- watering;
- paving of diversions, construction sites;
- using of personal protective equipment.

Reduction of dust formation during roadbed construction and embankments construction is achieved by means of soil dampening.

When the work is organized properly, the soil wetness should be close to optimal one which provides good compaction and erosion resistance. The soil with density close to optimal almost does not form dust because of wind.

Together with air pollution, noise has become a wide-spread pollutant, the result of technical progress and transport development.

The calculations done in the road reconstruction project allow making conclusions that level of noise impact on the settlement situated far from the designed road section does not influence on it and does not exceed the established standards (CNR II-12-77).

Despite the aforesaid the project recommends the following measures to reduce noise impact level:

- most appropriate traffic management through the means of traffic management (the section devoted to traffic management has been developed in the project);
- traffic management through the increase of road operational functions;
- the use of road pavement from fine-grain asphalt concrete mix which causes less noise formation;
- execution of main works during day time;
- provision of sanitary zones around permanent site during road reconstruction;
- possible allocation of non- mobile units (e.g. compressors) in special sound absorbing tents or soundproof cabins which reduce noise level by

70%;

- traffic management through the means of traffic management (the section devoted to traffic management has been developed in the project).

The use of traffic management means in the project, in particular, installation of 60 km\hour speed limit road signs at the sections of the road going through the settlements, will decrease of noise by 7 dB.

- During road reconstruction it is recommended to locate a man camp at the outskirts of the settlement with obligatory sanitary zones around the sites.

The calculations done let us to determine that noise level at the distance of 50 m from the nearest lane does not exceed the established sanitary norms.

3.10. Pavement works

During road reconstruction the impact on air is inevitable during the use of oil road bitumen. Mainly this impact will occur during pavement works.

Calculations of harmful substances exhausts during the use of oil road bitumen BND -60\90.

Bitumen consumption for the construction period will be 1500 t.

Gross kerosene steam exhausts during this type of works is calculated using the formula:

$$G = \frac{0.160 \times (Pt\ max \times K\ b + Pt\ min) \times m \times Kp,ave \times K\ t \times B}{104 \times p\ b \times (546 + t\ max + t\ min)}$$

Where:

Pt min, Pt max – pressure of saturated bitumen steams in minimum and maximum bitumen temperature (t min = 100 C, T max = 140 C) and, respectively, in mm

P t min = 4,26, P t max = 19,91;

Kp ave, Kp max – test coefficients, equal 0,58 and 0,83;

Vh max – maximum volume of steam and water mix pressured out of the

reservoirs during its pouring = 12 m3\hour;

m – molecular weight of bitumen steams = 187;

Kb – test coefficient, equal 1;

P b – bitumen density = 0,95 t\m3;

Kt – turning round coefficient = 2,5;

B – amount of liquid poured into the reservoir during the construction period, 1500 t.

$$G_{kerosene} = \frac{0{,}160 \times (19{,}91 \times 1 + 4{,}26) \times 187 \times 0{,}58 \times 2{,}5 \times 1500}{104 \times 0{,}95 \times (546 + 140 + 100)} = 0,\ 210\ 645\ t$$

Maximum one-time exhaust is calculated using the formula:

$$M_{kerosene} = \frac{0{,}445 \times Pt \times m \times K\,p\,max \times k\,b \times V\,h\,max}{102 \times (273 + t\,max)}$$

$$M_{kerosene} = \frac{0{,}445 \times 9{,}57 \times 187 \times 0{,}83 \times 1 \times 12}{102 \times (273 + 140)} = 0.192\ g\backslash s$$

Established standard of harmful exhausts into the atmosphere during the construction period

The calculations above are the basis for establishing norms of pollutants exhausts during construction works. The permission for the environment protection during construction works is processed by the company awarded the construction tender.

Exhausts from building machinery and vehicles are not standardized . The payment for these exhausts is taken due to actual exhausts (due to fuel consumption).

Table. Norms of maximum permissible exhausts for the construction period.

No	**Exhaust component**	**PDK, m\r**	**Hazardous class of substance**	**____ exhausts of harmful substances into the atmosphere**

				t\year	g\s
1	Kerosene	1,2 OBUV	-	0.210645	0.192
2	Non-organic dust, containing SiO2 (20-70%)	0,3	3	7, 33932	1,75564
Total:				**7,54965**	**1,94764**
Incl.: hard				**7,33932**	**1,76564**
gaseous				**0,210645**	**0,192**

4. Atmosphere pollution during operation period.

4.1. Sources of atmosphere pollution and characteristics of exhausts.

Car and road complex damages the environment most of all out of all means of transport – about 80%. At the same time we must take into account that the intensity of the environment pollution from motor vehicles directly depends on the road conditions for the vehicles operations as well as on the technical level of transport and operation condition of the roads.

The most unfavourable indicator for vehicles is specific exhausts of harmful substances (carbon oxide, nitrogen oxide, carbon hydride). They are higher with motor vehicles than with railway or water transport.

Carbon dioxide CO2 is mass "greenhouse" gas influencing the change of climate. Mass exhaust of this gas is in proportion to the amount of the fuel used and the fuel consumption considerably depends on the road conditions. More than 60% of CO2 in the road-transport sector is due vehicles.

Vehicles are the main reason of mass exhaust of other pollutants – carbon C, sulphur dioxide SO2, lead Pb.

Impact of roads and road facilities on the environment shows itself in the pollution of air, acoustic, vibration and electrical magnetic pollution, in the pollution of surface and subsoil waters, topsoil and soils, in the violation of life conditions of vegetation and animal kingdoms, in negative social consequences.

The pollution of soil, air and water starts on the road carriageway and then spreads far beyond its limits for the roadside territories. The environment is damaged within 10 meters along both sides of the road carriageway.

Corrosion impact of vehicles exhausts on building materials and structures cannot be but taken into consideration. Hazard of concrete and metal elements corrosion of the road complex increases with the growth of traffic intensity. Though the amount of components in burnt gases which destruct building materials is not so big, the cases of quick ageing of bridge and barrier structures elements have been noted in the road practice. The reason is in complex physical and chemical impact of nitrogen compounds and other substances which are corrosive even in small quantities.

The most hazardous type of transport pollution is considered to be exhausts of

burnt gases into the atmosphere. Gases hitting the atmosphere are transported with air flows at the distance of tens and hundreds kilometres, they are combined with energy and industry exhausts. However they are concentrated most of all near the road.

The objects of vehicles impact are almost all components of the environment, but the main hazardous criterion is the damage caused to people's health.

Cars pollute the air with exhausts which are emitted with burnt gases coming into the atmosphere as a result of fuel evaporation. Burnt gases make up the main amount of harmful car exhausts. Car burnt gases are the mix of approximately 250 chemical elements and compounds. Main components of burnt gases are carbon oxide CO, carbon hydroxides, nitrogen oxides NOx, smut coal, aldehydes, benzapyrene, lead tetraethyl, sulphur dioxide.

At present car exhausts of CO2, carbon dioxide, are not standardized and not controlled in the world practice, as it is not toxic. Also exhausts of sulphur dioxide SiO2 are not standardized and controlled due to its inconsiderable amount in transport exhausts in comparison with the exhausts of heating energy units, metallurgic and chemical enterprises. The amount of sulphur dioxide is controlled only in the exhausts of diesel engines so far. Sulphur dioxide is colourless, and has sharp irritating smell. It is well dissolved in the water forming sulphurous acid. "Acid rains" – is the solution of sulphuric and sulphurous acids and they are characteristic for many industrial regions. They damage the vegetation far beyond the borders of the exhaust sources. Wheat plants, feed lucerne, are sensible for acid rains most of all. Pain green or yellow dead parts appear on leaf plants.

The increase of acidity decrease the ability of the soil to adsorb pollutants, to combine heavy metals. The more acid rains fall the more heavy metals become free as a result of desalination and come into subsoil waters and are absorbed by the plants.

The most numerous subgroup of toxic substances consists of carbon hydroxides, they are mainly formed in the lack of oxygen conditions – methane CH4, propane C3H8, hexane C6H14. Some of their types, aldehides are referred to as cancer-causing substances which cause cancer. 3.4 benzapyrene C14H12 is the most well-known of them. Coming into the organism through the respiratory organs it stimulates the origin and development of malignant swellings.

Carbon oxide (CO) disturbs oxidation processes in a person's organism, it comes into reaction with the blood pigment with the speed which is 200 times higher than the oxygen does. When it is inhaled with the hypoxia occurs. Sometimes the poisoning can happen even with small quantities of CO.

Nitrogen oxides NOx – are oxides formed during high oxidation temperature of the air nitrogen and low oxidation temperature of nitrogen compounds of the engine fuel. When they get into the atmosphere they are transformed into more stable nitrogen dioxides NO2. Interacting with water nitrogen oxides form nitric and nitrous acids which destroy person's lungs, damage the mucous membranes of the

eyes and cardiovascular system of a person. In case of high content nitrogen oxides affect the nervous system of a person causing inadequate behaviour.

Car exhausts as a rule create a multiple increase of NO2 concentration. The presence of nitrogen oxides in the atmosphere is one of the main reasons of hazardous phenomenon -a phytochemical smog.

Depending on the conditions smog can have different reasons of creation, but car exhausts take part in all the cases. Phytochemical smog is one of the most spread one when there is a chain of complex reactions in the atmosphere under the influence of ultraviolet rays of the sun. As a result of this a peculiar fog is created consisting of nitric acid compositions, nitrogen dioxide, carbon hydrates irritating respiratory system.

Besides well-spread types of burnt gases the so-called “hard particles” are included into the exhausts. Their main component is smut coal. Sulphur and lead compounds are contained in “hard particles”. Smut coal itself is not a hazardous toxic substance, but different carbon hydrates are adsorbed on its surface. Some of them have cancer-causing properties. Fine particles of the size of several microns form aerosols and are spread with gases on big distances.

Pollution of the environment with heavy metal exhausts requires special consideration. The first place from these metals is occupied by lead. Lead exhausts refer to the first hazardous class. About 70% of lead added to gasoline with ethyl liquid comes into the atmosphere together with burnt gases. Lead compounds accumulating in the organism cause changes and damages to the metabolic process in the organism.

Dust from tyres wear and tear, brake shoes, and clutch disks as well as evaporation of oil products from the road is one more source of the air pollution with “hard particles”. Dust pollution of air is formed during works on reconstruction of roadbeds, slopes, during transportation of building materials.

Dust particles have the ability to accumulate microorganisms and that may result in development of lung and infectious diseases.

Road pavement works may be a considerable source of air pollution though it may be more specific than the pollution from earthworks. The main hazard here concerns the use of organic binding substances.

All non-oxidised carbon hydrates mixtures contain cancer causing high molecular carbon hydrates in more or less amount. Benzapyrene is the most active from them.

Based on special medical studies maximum permissible concentrations (MPC) of air pollutants are determined for the dwelling areas.

The following MPC, mg\m3, are adopted for substances contained in burnt gases of car engines.

Table №1

Name of substances	Average daily MPC mg/ m^3	
	For human	For tree species
Carbon monoxide, CO	3.0	1.0
Hydrocarbons, Cm Hn	1,5	
Nitrogendioxide, NO_2	0,04	0.02
Smut coal	0,05	0.05
Air lead	0,0003	in soil 32 mg/kg
Dust-like matter	0,15	0.05
Sulfur dioxide, SO_2	0,05	0.015

From the table it is seen that the sensibility for air pollution is higher in plants than in animals and a person.

The calculation of harmful substances concentrations is done in the project taking into account the growth of traffic intensity.

The calculation of harmful substances emissions is done in accordance with " Methods for motor vehicles exhausts determination to make total calculations of city atmosphere pollution" (3), developed by the research institute for atmosphere (1999). The concentrations of the following pollutants are determined according to the Methods: nitrogen dioxide, carbon oxide, smut coal, hydrocarbons (gasoline, kerosene), sulphur dioxide, formaldehyde, benzapyrene as well as aerosols of lead compounds.

Estimated traffic intensity

Type of vehicle	Intensity per year		
	2007	2015	2030

Cars, pick-ups, motorbikes	3414	5043	10147
Minivans	351	515	1036
Heavy buses	282	415	834
Trucks up to 2 tons	124	187	376
Trucks from 2 to 5 tons	141	212	427
Single trucks from 5 to 10 tons	1	1	3
3-axle trucks more 10 tons	124	187	376
2-axle trucks up to 20 tons	4	6	12
3-axle trucks up to 20 tons (with trailer)	5	7	15
5-axle trucks more 20 tons (with trailer)	14	20	41
2-axle tow-trucks up to 20 tons	19	27	55
2-axle tow-trucks more 20 tons	104	151	303
2-axle trucks with trailer (11-11)	103	149	300
Light tractors	62	89	180
Heavy tractors	6	8	18

4.2. Noise impact and vibration.

Air vibration - noise impact occurs due to passing of motor vehicles along the road. Transport noise is one of the most hazardous pollutions. Main factors influencing noise level are traffic intensity, stock of vehicles, pavement condition, longitude inclination, availability of greenery and noise barriers and protective zone within the settlements. Depending on the type of a vehicle noise level changes considerably. Trucks (especially with diesel engines) cause the noise level at all the operation modes 15 dB higher than any motor vehicle. The specific problems are

the noise of large dump trucks working in quarries when their speed possibilities are restricted, and their working specific time in the regime of light run is great.

The design sound level determination (L_p):

$L_p = L_{trs} + \Delta L_{max} + \Delta L_{de} + \Delta L_{sp} + \Delta L_{grad} + \Delta L_{nsq} + \Delta L_{sc} + \Delta L_{sd}$

Where: L_{trs} - a design equivalent sound level from transport stream dB at the distance of 7,5 m from axis of the nearest movement traffic lane of road straights with asphalt concrete pavement at spreading under soil (in the composition of transport stream there are 40% of auto trucks, including 5% with diesel engine);

ΔL_{max} - a correction considering quantity change of auto trucks with the carburetor engine, dB;

Δl_{de} - a correction considering quantity change of auto trucks with the carburetor engine, dB;

ΔL_{grad} - a correction considering of length way gradient, dB;

ΔL_{sp} - a correction considering of medium speed movement change in comparison with design one, dB;

ΔL_{nsq} - a correction considering of nonskid quality, dB;

ΔL_{sc} - a correction considering of design sound level reduction by surface cover, dB;

ΔL_{sd} - a correction considering the influence of site development adjacent to the road, dB;

$L_{trs} = 50+8,81g\ n$

where: n – design movement intensity, vehicles per hour.

$n = 0.076N$

where: N – design movement intensity, vehicles per day.

Take Δl_{max}, ΔL_{de}, ΔL_{sp}, ΔL_{grad} from below given table.

The systematical effect of noise on a man causes a state of irritation, fatigue, the probability of stress and sleep disturbance increases. Acoustic disturbance is also probable because of constant noise effect.

The calculations showed that transport noise rate reaches 68,2 – 70,5 dB on road reconstruction of local sections.

According to Construction Rules and Regulations 11-12-77 “Noise protection” and in accordance with the order of Acting Health Minister of the Republic of Kazakhstan from 24th March, 2005 No 136 the extreme admissible noise level is 70 dB.

The extreme admissible noise level is accepted for territories that directly adjacent to dwelling houses, rest areas of micro districts and dwelling houses groups , playgrounds of preschool establishments, school sections, taking into account corrections as follows:

- The noise created via transport – 10dB
- Existing dwelling site development – 5dB
- The daytime from 7 till 23 o'clock – 10dB

On the basis of calculations represented in the appendix it is possible to determine that noise effect is in norm along the road.

Vibrations arising in road pavement are caused by its temporary compression at vehicles passage and the following quick unloading. Such oscillations of road pavement are transferred to soil and further to buildings and constructions situated at road side. Vibration transfer depends on soil, its density, wetness, homogeneity and granulometric composition.

Vibration reduction depends on technical state of the vehicle. In the work process it is necessary to keep work regime with vibrating vehicles , the vibration of which corresponds the sanitary standard. It is recommended using two regulated breaks.

The admissible levels of transport-technological and technological vibrations of work places have to correspond the requirements of the Health Minister's order of the Republic of Kazakhstan from 29th June, 2005 No 310 "About sanitation and epidemiological regulations and norms" recorded in the Register of state regulatory legal acts of RK for No 3781.

To increase the protection qualities of the organism, working capacity and working activity it i9s necessary to use special complexes of production gymnastics and vitamin therapy.

4.3. Surface and soil water

On the projected road section there are no surface sources.

Water object pollution happens in the result of chemical and mechanical pollutants in water. The most wide spread pollutant of water is the oil products. The main pollutions of road water flow have a state of suspension and emulsion. At their presence in water, they accumulate in the bottom in seaweeds, and transfer in the composition of silt, and then they form a membrane on the surface which make difficult oxygen entry from air that is harmful for living organisms.

The salts are non organic pollution materials using for deicing, cause a meaningful effect on environment. In spring while melting the salts deposit at right-of-way side, leaks into soil or flows out into reservoirs and water passages and in the result it pollutes them.

Bad strengthened back slopes of road pavement may serve as pollutants of water passages. The soil is washed away from the embankment to low places of relief, and the part of it is gone to reservoirs and water passages.

The soil water is also can be polluted by various mixtures of harmful things during road-building material development in quarries with high level of soil water and at withdrawal of soil water.

Soil water in the region of road alignment are on a deep level, that is why there is no effect on it. The development of flooded road-building materials and soil water withdrawal are not provided in the project. According to above-mentioned, the effect on surface and soil water will not happen during project realization and the following road exploitation.

Taking into account that in the region of road reconstruction there are no surface water sources and soil water, they are deposited deep and negative influence is not effected on it. According to it the measures on negative consequences reduction are not provided. The water flow is implemented through

heavy rainfalls. The rainfalls distribution is unsteady, evaporation is great, it is 10 time as more rainfalls.

The water disposal from traffic way is implemented with the help of transverse and longitudinal gradients.

Taking into account relief peculiarities of road location, water release is done adjoining to the road ditches serving evaporating basins . Thus the pollutants settles down in reserve-technological stripe of road zone.

4.3.1. Water supply and sewage during construction and operation period of the road

The state of culverts on the separate road sections require their repair and installation of new ones.

To remove stated drawbacks and bringing parametres of existing road to the requirements accepted to roads of II technical category., during reconstruction there is no need to of extra constant withdrawal , since the earlier done withdrawal is enough for road reconstruction of II technical category.

Temporary withdrawal is provided for lateral road, construction site and mobile asphalt concrete plant, pre line lay reserves. In the project of road reconstruction were used typical cross profile of road bed for road of II technical category with keeping of existing back slope gradiants.

On the period of work production under road reconstruction, the project is provided the lateral road arrangement with the length 80,0 km.

For road reconstruction it recommended using of soil from pre line lay reserves, situated on the areas adjoining to line lay road and soil from digging.

To prepare asphalt concrete mixtures using in road reconstruction is recommended installation of asphalt concrete plant. Taking into account the specifics of these enterprises , asphalt concrete plant installation is recommended doing on the territories removed from inhabited locality.

The water sources fixing to the road have to be done by the Contractor on the basis of contract concluding with water economy enterprises.

All land parcels requested for temporary use for road reconstruction have to be recultivated and returned in the state of further use in agriculture at the end of construction works.

According to Land Code of the Republic of Kazakhstan at land occupation for temporary and permanent use, the agricultural production losses are compensated to retain the agricultural production level by area rehabilitation of agricultural holdings and their qualities.

4.3.2. Disturbed land recultivation

Usually there are two kinds of new construction object effect on earth resources: land withdrawal from agricultural use and change of physical properties of upper layer of soil in the result of earthworks implementation during

construction.

The disturbed lands in the implementation of working project solution of road construction on road reconstruction, will be lands temporary withdrawn for needs of construction and also lands temporary withdrawn for lateral road laying. Also the disturbed lands in the implementation of working project solution will be lands withdrawn for road construction on II category.

The project provides recultivation of abandoned land parcels, temporary building technological passages and territories occupating for the period of construction.

It is provided to take away the vegetation layer , its storage, keeping and the following use for recultivation and back slopes strengthening.

To provide erosion preventive steadiness of line lays it is presupposed the herbs planting on the basis of 20 kg per hectare. To strengthen the steep slopes it is presupposed the use of geosynthetical materials.

Recultivation of land parcels, occupied by agricultural holdings represented for construction and reconstruction is included in general complex of building-erection works and provides rehabilitation of soil fertility.

Before work commencement the fertile soil layer is taken away and stored in temporary barrows located along the construction stripe according to regulations on withdrawal, and is used for recultivation or earthing after construction and project work completion.

At the technical stage of land recultivation it is presupposed the execution of the following works:

- construction garbage disposition, all temporary construction remove out of the construction area;
– distribution of the left soil on recultivated area with uniform layer or its transporting in special places stated in the project.
– Preparation of side-piling of back slopes, embankments, diggings or flattening of potholes and pots;
– measures on erosion process prevention;

At biological stage of recultivation the requirements to land recultivation have to be followed on the directions of their use.

The biological stage has to be implement after complete ending of technical stage.

Land parcels in the period of biological recultivation in agricultural purposes have to pass the stage of meliorative preparation.

4.3.3. Soil pollution by hazardous substances discharge

Earth surface pollution by transport and road discharge accumulates gradually depending on the number of transport vehicles passages and retains a very long time.

Accumulating chemical elements in soil are acquired by plants and through

them on foodchain and then they pass to the organism of the animal and man.

The most wide spread and toxic pollutant is lead. The calculation of concentration in soil of pre road space the lead compounds was done depending on the movement intensity and exploitation year (20 years) to the left and right from traffic way edge.

The power of lead emission at the present medium day vehicle movement intensity is determined by the formula {1}:

$$P_{mgm} = K_{rec} \cdot K_{wo} \cdot m_r \cdot K_{sp} \cdot \sum(G_1 \cdot P_1 \cdot N_1) \quad (1)$$

Where: P_{mgm} – is measured in milligram per metre per day;

$K_{rec} = 0.74$ – coefficient of measurement unit translation;

m_r - coefficient considering the road and auto transport conditions, is accepted according to schedule on picture 4.2.1. "Recommendations ..." {1} depending on the movement speed, in our case for computed speed 60 km/h $m_r = 1.27$, for 120 km/h (on this road section) - $m_r = 1.4$.

$K_{wo} = 0.8$ – coefficient accounting the lead landing in the system of waste gases issue.

$K_{sp} = 0.8$ – coefficient considering the part of lead in the view of solid particles in general volume discharge.

G_1 - medium exploitation of fuel consumption for appropriate vehicle brand.

N_1 - medium day intensity of appropriate brand vehicle.

P_1 - lead admixture content in fuel used on the vehicle of this type.

In ethylated petrol of A-76 brand the calculation lead content is taken in amount of 0.17 g per kg of fuel and for A-93 in amount of 0.37 u per kg of fuel in accordance with "Recommendations …." {1}.

The level of soil surface layer lead pollution on various distances from the traffic part is determined by the formula:

$$P_l = P_s /(h \cdot p) \quad (2)$$

Where: P_l - is a level of lead pollution of soil, mg/kg.

H – thickness of soil layer (in metres) with lead discharge, for croplands is taken in 0.2 m.

p – soil density.

P_s - lead deposition on land surface (mg/m^3) which is determined on the formula:

$$P_s = 0.4 K_1 U_v T_r P_e \quad (3)$$

Where K_1 - coefficient considering the distance from traffic part and admitted on table 4.2.1. "Recommendations … " {1}

U_v - coefficient depending on strength and direction of the wind, oppositionally considering zone to general area.

T_r - calculation period of road exploitation per days, is equal to 7300 days, that corresponds a 20-year forecast period.

P_e - power of lead emission

The calculation of soil pollution with lead on the considered algorithm is realized with MS Excel taking into account transport stream composition, the growth of its intensity on forecasting 20-year period and preferential wind direction , by the way the density of soil cover is equal 1.6 t/m^3 , and its thickness – 0.1 m.

The calculation of soil pollution with lead on the perspective of 2030

Movement intensity for 2007 is 4754 veh/day. The road category – II. The pavement is black crushed stone. The movement speed is 120 km/h. 0.5 – coefficient depending on strength and direction of wind is equal to relation of world part location from road side, oppositional considered zone to its general square. Soil density is 1600 kg/m^3 . The depth of plowing – 0.2 m. the computed period of road exploitation is the period before 2030. The distance from traffic part edge is 10 m.

For the calculation were taken the following initial data:

Vehicle type	**Content in the stream,%**	**Intensity, veh/day (Annual growth 7%)**	**Fuel type**	**Medium exploitation of fuel consumption, l/km**
Light vehicle	40	963	A-93	0.11
Small auto truck (with carburetor engine)	5	135	A-76	0.16
Auto truck (with carburetor engine)	30	179	A-76	0.33
Auto truck (with diesel)	20	357	Diesel fuel	0,34

Calculation results

Calculated indicator	Measure unit	Quantity on sides of road	
10 m. from the edge of driveway			
Power of lead emission	mg/m* day	335,96	335,96
Lead deposition quantity	mg/sq.m	276397,4	287678,9
Pollution level of surface cover of soil	mg/kg	863,7419	899
20 m. from the edge of driveway			
Power of lead emission	mg/m* day	335, 9597	335, 9597
Lead deposition	mg/sq.m	55279,48	57535,79

quantity			
Pollution level of surface cover of soil	mg/kg	172, 7484	179,8
40 m. from the edge of driveway			
Power of lead emission	mg/m* day	335, 9597	335, 9597
Lead deposition quantity	mg/sq.m	22111,79	23014,31
Pollution level of surface cover of soil	mg/kg	69, 09935	71, 91973
60 m. from the edge of driveway			
Power of lead emission	mg/m* day	335, 9597	335, 9597
Lead deposition quantity	mg/sq.m	11055,9	11507,16
Pollution level of surface cover of soil	mg/kg	34, 54968	35, 95987

According to calculation data at averaged calculation movement intensity in road reconstruction the lead content in soil exceeds MPC in 27 time (MPC – 32 mg/kg)at the distance of 10 m. from the edge of driveway, it exceeds MPC in 5,4 time at the distance of 20 m. from the edge of driveway, it exceeds MPC in 2,2 time at the distance of 40 m. from the edge of driveway, it is in norm at the distance above than 60 m. from the edge of driveway.

4.3.4. Soil erosion

Soil erosion is of two types: water and wind. Water erosion is called the process of soil remove by running off water. The water erosion is the most dangerous of road bed at engineering structures and on near-by territories which is noted on separate road sections. The washway may result the deep rain channels, deans formation which disjoin the surface on separate sections.

Washed away soil from rain channels is like a cone at embankment toe and on other places.

When there is water in embankment body may happen the subgrade embankment as the soil properties of steady begin to decrease.

Wind erosion or deflation – is pit-run fines remove by wind. The upper layer of soil is scalped. In the result of wind erosion the road sections are “blown up” or “blown off”. In this and that cases it is a harmful phenomenon which deteriorate the soil fertility. The light-textured soil is exposed to wind erosion more often., especially sandy loam soil which begin to erode at the wind speed 4 m/sec.

Erosion development in great degree results grass sods destruction, cultivable and pasture areas destruction.

4.3.5. Subsurface resources

To provide the needs in road building materials in "Almaty – Korday – Blagoveshenka – Merke – Tashkent – Termez" road reconstruction project on the road section entry point to the border of the Republic of Kyrgyzstan (Karasu) it is recommended using the deposits of sand gravel mixes and sand located on the area of the road.

All stated in record sources of building materials receipt are acting, that is why during road reconstruction there will be no direct effect on these subsurface resources from the side of road services.

The location of pre line lays reserves for road reconstruction is attached in the record of temporary withdrawal.

The measures to reduce the effect on the environment during reserves development and their following recultivation is rested on the Contractor.

4.4. Production wastes

Production works technology on road reconstruction and the following road exploitation do not provide wastes production requiring the locating and burial.

All building materials (sand gravel mixes, sand, crushed aggregates, soil etc.) have 100% of use. The object construction technology of temporary withdrawal with the use of crushed rock road and its use at building of added road border. The project provides the return of replaced links of pipe culverts, concrete warning pillars, barrier railings and other types of road furniture, the base of the Employer for the following use during repair works.

In accordance with Construction Rules and Regulations 3.01-01-2002 the accumulation of solid human wastes is for one person 347 kg per year, that is 31,25 kg per month.

For the period of construction:

Solid – 90 persons x (36 x 31,25)kg = 101250 kg.

Solid human wastes are stored in containers and driven away on the places of SHW location (agreed by the Contractor with local authorities).

The material debris may result during work production which must be taken to the waste dump of the nearest village.

The contractor has to pay compensation to conservation organizations for the recycling of material debris.

4.5. Impact on flora and fauna

The objects of environmental conservation are the natural components of ecological system, they are vegetable and animal worlds, natural landscapes and others.

The harmful consequences for vegetation arise from the effect of vehicle blowouts. The specialists determined the the influence of various pollutants causing pigmentolysis, abiotic polymerization suppression and other functions of

plants. All above-mentioned cause growth and development disorder, aging process quickening, especially in plurannuals. Broad-leaved plants better adapt to air pollution, transpiration processes are active in them than in coniferous plants.

Moreover, most of plants have an ability to accumulate heavy metals polluting the soil. Some plants are more sensitive to the atmosphere pollution than animals and men. So sulfur dioxide in safe concentration for men 0.05 mg/m^3 begins to suppress photo synthesis in 20-30 min. of action.

Pollution of the surface of the earth and vegetation by car exhausts directly depends on the distance from the carriageway.

That is why the impact that the exhaust gases,dusty emissions, especially containing heavy metals and acid rains will have on vegetation and forests may cause different consequences.

It is worth noting different deicing chemical substances, first of all salts among non-organic polluting materials able to cause a significant impact on the environment during road operation. They have an impact on the territories, soils, vegetation, animals adjacent to the road. These substances are washed away by rain and settle along the road. Under the influence of deicing salts the structure physico-chemical properties of soils get worse. The negative impact of chemical deicing materials on green plantating occurs both during the immediate contact with the top of plants and through the root system. Immediate contact with salts result in the destruction of plant tissue, especially bark. Sodions concentrating in soil prevent nutritive absorption.

During protection of the environmental pollution using chlorides, the best way is to refuse from using them by using other deicing materials, such as fractional ones.

Clashes between driving transport and wild animals occur during road operation which cause accidents. At the same time the possibility of dying of not only an animal but also human may arise.

Taking into consideration the existing situation and the road location, only insignificant impact of the road and driving vehicles on animal kingdom may be perceived.

The fact of the road's existence before the planned measures proves a developed lifestyle of the animals and the road and impossibility of introducing significant changes into the animal world.

According to the data of the investigations conducted by zoologists, the road does not cross the migration routes of wild animals and birds. Thus it may be stated that the possibility of clashes of wild animals with the driving transport will be minimal.

4.6. Social environment

The existing road is a part of the roads of Southern Kazakhstan with the approach of the Republic of Kyrgyzstan

The road “Almaty -Korday-Blagoveschenka- Merke-Tashkent-Termez” at the section of the approach of the border of the Republic of Kyrgyzstan (Karasu) influences the social environment both positively and negatively.

Among the negative factors the following should be noted:

- The possibility of accidents due to a poor road condition and a negative attitude to road use efficiently.

Among the positive factors the reconstructed road will cause the following influence on environment:

- Create the financing influx in the region's economy;
- Reduce the number of unemployed people in the region by means of creating work places both during the reconstruction road and operation;
- increase the rate of traffic;

improve passenger service;

- lead to further development of international communication;
- allow driving along the road with a higher speed and with more comfort.

5. Mitigation measures against impact on the environment.

5.1. Mitigation measures against impact on air.

Taking into consideration impact on air during construction and reconstruction it is recommended to use preventive and protection measures to reduce dusting during works, in particular:

- Watering;
- Paving of diversions, sites;
- Using personal protective equipment.

Reduction of dust formation during construction of roadbed and roadsides can be reached by means of soil wetness.

In correct work organization soil wetness should be close to appropriate one, it will provide good compaction and erosion resistance. Soil with wetness close to appropriate almost does not form dust from wind.

Traffic management by excluding frequent braking and speeding-up, which most of all contribute to harmful substances exhaust, and efficient distribution of traffic flows are organizational measures of air protection from pollution during road operation.

Organization of road traffic with installation of signs and marking of the carriageway.

Installation of road signs plays an important role in traffic management. Signs are supposed to inform the road users on the conditions and operation mode on

the roads. The project provides for installation of the following types of signs:

- warning;
- traffic priority;
- forbidding;
- mandatory;
- information and indicating
- service.

Joint work of transport enterprises and medical services and road police regarding control of air pollution by vehicles must take an important place in the system of organizational measures. Protective measures are based on the fact that some regularity of exhaust gases is close to the sound spreading. That is why it is necessary to stipulate for the relative measures to protect dwelling block in the roadside.

5.2. Mitigation measures against impact of noise.

The following measures are recommended to reduce noise level:

- most efficient traffic management through the means of traffic organization (traffic management section was developed in the project);
- traffic management through the increase of operational functions of the road;
- use of the road pavement from fine grain asphalt concrete mixture which causes least noise formation;
- works execution during day time;
- provide for protective zones around road reconstruction sites;
- non-mobile units (for example compressors) can be located in special soundproof tents and sound-insulating cabins which reduce noise level to 70%.
- traffic management by means of traffic management. Application of traffic means, namely installation of 60 km speed-reducing signs on the road sections near settlements, will result in decrease of noise up to 7 dBa.

5.3. Mitigation measures against impact on soil.

To prevent erosion the project stipulates for drainage system from the carriageway and for fixing slopes and roadsides. Artificial structures provide for fixing inlet and outlet flows.

Parking lots for excavating and road-building machines must be piled with soil to prevent damage and to prevent leakage of lubricants at the adjacent territory.

Issues of littering of the roadside with tires, household and construction rubbish must be solved during road reconstruction and operation. Construction rubbish must be taken away to solid wastes landfill. The contractor must conclude an agreement with the management of the landfill for removal of construction and household wastes and allocation of production wastes.

5.4. Mitigation measures against impact on flora and fauna.

As a result of the project implementation there will be no significant impact on the landscape as possible changes of the landscape have already happened during the construction and further road operation before the reconstruction works.

All the aforesaid mitigation measures against transport exhausts and noise impact are directly related to flora and fauna of the territories adjacent to the road.

Under the influence of de-icing salts the soil structure and properties change, plants tissues are destroyed. As a result of salts poisoning mammals and birds (hares, foxes, quails, pigeons, etc.) are dying.

The best measure is to refuse from the use of salts during the road operation and to replace them with the use of sand, slag, stone chippings, etc., which do not contain clay and ash admixtures.

It is necessary to install warning road signs at the sections where one can observe the appearance of the animals on the carriageway.

Due to the fact that permanent birds' nesting and animals' habitats have not been revealed at the area of the road routing, the road reconstruction will not have a significant impact on fauna.