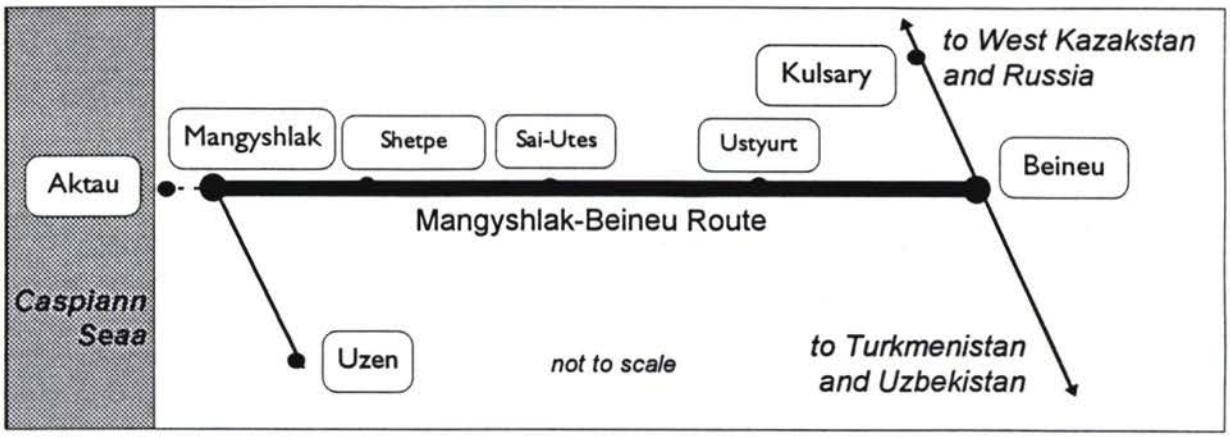
1. Introduction



2. Traffic Forecast

2.1 Traffic Flows

2.1.1 Short Description of the Catchment Area of the Route

The route (Aktau-) Mangyshlak-Beineu is situated in the administrative District of Mangistau (Mangistau Oblast) in south-west Kazakstan. This Oblast covers the peninsula of Mangistau, with a total area of 166,000 km². Approximately 335,200 inhabitants lived in the Mangistau Oblast in 1996 (324,400 in 1995). The population density is very low at 2.0 per square km. The share of the urban population amounts to approximately 80%[1].

The administrative centre of the Mangistau Oblast is Aktau, which was founded in 1963 and has 157,600 inhabitants (46.8% of the total population). The distance between Aktau and the capital Almaty is 3267 km.

Further important communities (over 10,000 inhabitants) in the Mangistau Oblast are Shanaosen (pop. 46,800), Mangyshlak (pop. 14,800), Beineu (pop. 12,800) and Shetpe (pop. 10,800).

---

[1] Sources:

Regional Statistics of Kazakstan 1991 - 1994, Goskomstat Almaty 1996
Kazakstan Economic Trends
The Government of the Republic of Kasakstan, Centre for Economic Reforms, Issue of Second Quarter 1996
Population Statistics of the Republik of Kasakstan on the 1th of January 1996, Goskomstat Almaty 1996
Short Statistical Yearbook of Kazakstan 1995, Goskomstat Almaty 1996
Statistical Bulletin , Goskomstat Almaty 1996

The Mangistau Oblast is an important industrial centre in Kazakstan. The industrial structure in the catchment area of the Aktau-Beineu line is characterised by extensive extractive and chemical industries.

In the Mangistau Oblast there is a network of public rail routes totalling 776 km, among which is the subject of the present Study, the 403 km. route from Mangyshlak to Beineu. This route connects the Mangistau Oblast and the industrial area of Aktau/Mangyshlak (including the Caspian Sea port) with other regions within Kazakstan and neighbouring countries.

The route is also important for the connection of the West Kazakstan region to the port of Aktau. Following the independance of Kazakstan, the importance of this Caspian Sea port has declined.

The port of Aktau is one of two Kazak ports on the Caspian Sea and is important for Kazakstan's external trade, via the Caspian Sea ports in Azerbaijan and Iran, with other countries such as the Transcaucasian states, Turkey, Europe, United Arab Emirates, South and South East Asian countries. The second port at Atyrau (former Guryev) is situated in the north east part of the Caspian Sea in Atyrau Oblast, but its capacity and freight turnover is very low.

The road network in the Mangistau Oblast totals 2,600 km, of which 2,300 km are roads with a firm (metalled) surface. The density of these roads is very low at 13.9 km/1000 km².

A road runs parallel to the route. Between Shetpe and Beineu the road is classified as a 'republic road', and between Mangyshlak and Shetpe the classification of the road is lower.

2.1.2 Current Economic Situation in the Mangistau Oblast with Reference to the Mangyshlak-Beineu Route

Industrial production in 1994 in the Mangistau Oblast amounted to 5.7% of the Kazakstan total and 2.0% of the GDP in 1993. The level of industrial production per inhabitant was higher than the average in Kazakstan in 1994 (KZT 57,000 in Mangistau, KZT 20,700 in Kazakstan as a whole).

About half of the semi-finished products for the Kazak chemical industry, crude oil, natural gas and fertilisers are either extracted or produced in Mangistau Oblast (see Table 2-1).

Table 2-1: Production Volumes of the Major Commodities in the Mangistau Oblast in 1994*

Commodity	Volume of production in Mangistau Oblast	Share of Mangistau Oblast (%)
Semi-finished products for the chemical industry (styrol, polystyrene)	31,175 tonnes	58.1
Crude oil and gas condensate	9.5 million tonnes	46.9

Natural gas	2,050 million m3	45.7
Mineral fertiliser	57,600 tonnes	45.5
Sulphuric acid and caustic soda	60,500 tonnes	8.8
Construction materials (concrete building components)	91,300 tonnes	8.4
Electro energy	3.5 billion kWh	5.2

* Data on economic output for 1995 was not available.

Source: Regional Statistical Yearbook of Kazakstan 1991 - 1994, Goskomstat Almaty 1996

Industry in the Mangistau Oblast suffers from the same problems as the economy of Kazakstan in general. The industrial output of most factories has declined in the last few years. This decline has been accompanied by a corresponding decrease in demand for transport.

The current development of the economy in the Mangistau Oblast shows a different picture. Table 2-2 shows the economic situation comparing two periods in 1996 and 1995.

Table 2-2: Development of major product output from January to March 1995 in Mangistau Oblast

Commodity	Level in 1996 compared to 1995 (in %)
Semi-finished products for the chemical industry (styrol, polystyrene)	40.9
Crude oil and gas condensate	104.9
Natural gas	102.3

Source: Statistical press-bulletin No. 2
Goskomstat Almaty 1996

The economic situation is characterised by a continuing decline in the chemical industry affecting the production of semi-finished products. In comparison, the production of crude oil and gas is growing, albeit slowly.

The oil and chemical industry, which accounts for the greater part of the industrial activity, is concentrated in the area of Mangyshlak-Aktau-Uzen.

Table 2-3 gives an overview of the most important factories in the catchment area of the railway route from (Aktau-) Mangyshlak to Beineu. It should be noted that the section fo route between the port of Aktau and the inland town of Mangyshlak (c. 18 km) does not form part of the 'public' West Kazakstan Railway, but is effectively an industrial line owned and operated jointly by the factories along its route using the operating company KASKOR.

Table 2-3: Characteristics of the Major Companies in the Catchment Area of the Route (Aktau-) Mangyshlak-Beineu

Railway station	Company	Characteristics of production	Volume of production in 1995
Section	***Mangyshlak-Beineu***		
Mangyshlak	PO Mangistaumunaigas	Extraction of crude oil and gas, production of oil products and gas condensate	4.6 million tonnes
	AO Karashanbasmunai	Extraction of crude oil and gas, production of oil products and gas condensate	0.7 million tonnes
	MAEK Energy company of Mangistau	Production of electro energy	3146 million kWh
	(Mangistauskiy energitsheskiy kombinat)	Production of mineral fertilisers	77,900 tonnes
	AK KASKOR	Production of technologic equipment's and replacement parts	KZT 271.5 mill
		Exploitation of an unpublic railway network between Aktau and Mangyshlak railway station, transport services for other companies	
	AK AKPO	Production of semi-finished products for the chemical industry (polystyrol and styrol)	45,200 tonnes
	Seaport of Aktau	Freight turnover Land-Sea (incl. crude oil)	0.4 million tonnes
Shetpe	Quarry of Ksyl-Turan (Ksyl-Turanskiy Karer)	Production of construction materials (bricks)	4,300 tonnes
Section	***Mangyshlak-Uzen***		
Uzen	PO Uzenmunaigas	Extraction of crude oil and gas	3.0 mill tonnes
		Production of liquid gas	42,300 tonnes
Yeralivo	TOO Ultas	Production of prefabricated construction materials	15.5 million units

Sources: *- Interviews with various companies*
- Seaport of Aktau: Transport Statistics of Kazakstan, Goskomstat Almaty 1996

The agricultural production in the Mangistau Oblast is not important, the natural conditions are not suitable for extensive agriculture. The share of Mangistau Oblast in the total Kazak agricultural production amounted to only 0.4% in 1994.

The share of Mangistau Oblast in the Kazak external trade is very low at present:

Exports 0.4% in 1993 and 0.04% in 1994
Imports 0.7% in 1993 and 1.8% in 1994

2.1.3 Freight Traffic on the Mangyshlak-Beineu Line

2.1.3.1 Railway Stations Forwarding and Receiving Freight Traffic

The following five railway stations forward and receive traffic:

- Mangyschlak
- Shetpe
- Say-Utes
- Ustyurt
- Beineu.

In addition to the above, there are three further stations on the southern section between Mangyshlak and Uzen (Yeralivo, Shetibay and Uzen).

The port of Aktau is not directly connected with the public railway network of the West Kazakstan Railway: forwarding and receiving takes place via the railway station of Mangyshlak. Between Aktau Port and Mangyshlak the 18 km railway connection is run by a private company named KASKOR[2].

Traffic arising at Beineu is of no direct importance for the freight traffic on the route being studied. The next marshalling yards are situated in Makat and Kungrad.

The stations have tracks giving an average length of approximately 850 m. This capacity is suitable for freight trains with an average 57 wagons.

2.1.3.2 Volume and Structure of Freight Traffic in 1995

Volume

The national and international importance of the route is in fact very low. Of the total freight traffic in Kazakstan, the line accounted for only 1.3% in 1995.

The freight traffic volume using the route in 1995 amounted 2.0 million tonnes in 1995, of which

---

[2] The whole railway network between Aktau and Magyshlak, run by the KASKOR company, amounts to 287 km. Of this length 18 km is the trunk route between Magyshlak and Aktau. The other lines are feeder lines from/to factories and distribution companies in the industrial complex between Magyshlak and Aktau as well as within Aktau port itself.

- 0.6 million tonnes forwarded
- 1.4 million tonnes received (see table 2-4).

This volume additionally includes freight forwarded and received on the Mangyshlak-Uzen section, which must also be considered when evaluating the main Mangyshlak-Beineu route.

The volume of freight traffic has been decreasing since 1990. The volume amounted to 10 million tonnes in 1990, with current levels at approximately 20% of that amount (see Annex 2-1). The reasons for this decline can be linked directly with the economic changes in Kazakstan overall and the current economic situation of most factories along the route and in the Mangistau Oblast, resulting from the changes following the breakup of the USSR and movement towards a market economy.

Table 2-4: Freight Traffic Volume by Station in 1995

Railway Station/ Section	Freight traffic volume in 1995 ('000 tonnes)			Share (%)
	Forwarded	Received	Total	
Mangyshlak (incl. Port of Aktau)	466.8	1133.4	1600.2	80.4
Shetpe	38.0	25.1	63.1	3.2
Say-Utes	0.6	26.5	27.1	1.4
Ustyurt	1.5	0.3	1.8	0
Section Mangyshlak-Beineu total	**506.9**	**1185.3**	**1692.2**	**85.0**
*Section Mangyshlak-Uzen **	*121.0*	*176.5*	*297.5*	*15.0*
total	***627.9***	***1361.8***	***1989.7***	***100.0***

* This volume does not include local traffic within the Mangyshlak-Uzen section.

Source: West Kazakstan Railway

Mangyshlak has the biggest share of the freight traffic, corresponding to the concentration of industry in the Mangyshlak-Aktau region. Its share amounted to 80% in 1995, 74% of forwarded tonnage and 82% of received. Mangyshlak station (including Aktau traffic) is thus the main origin and destination point for freight traffic on the route.

Of the freight traffic using the route, 85% originates or terminates on the Mangyshlak-Beineu section and the remaining 15% originates or terminates on the Uzen branch.

It should also be noted that, of the total traffic on the route, approximately two-thirds is 'received' and one-third 'forwarded'. There is no transit traffic since the line terminates at Uzen, some 150 km *[to be checked]* beyond Mangyshlak.

Breakdown by Commodity

The industrial structure of the Mangistau Oblast is reflected in the main composition of the freight traffic by commodity.

Over 80% of the loaded freight volume is oil products, construction materials and fertilisers. These main commodities have a share of about 70% of the total received freight on the route.

The transport of consumer goods by rail is very low.

The total freight volume of 2.0 million tonnes in 1995 consisted of:

- 0.36 million tonnes (18.2%) oil products
- 0.44 million tonnes (21.9%) fertilisers
- 0.41 million tonnes (20.4%) construction materials
- 0.26 million tonnes (13.3%) metals
- 0.43 million tonnes (21.6%) other commodities (general cargo, chemicals, grain, timber, coal etc.)

Table 2-5 and Annex 2-2 show the detailed breakdown for 1995.

Table 2-5: Main Structure of the Freight Traffic Volume by Commodity in 1995

Section	Forwarded/Received	Total ('000 tonnes)	Major Commodities:			
			Oil products	Fertiliser	Construction materials	Metals
Mangyshlak-Beineu	Total	1692.2	215.9	435.3	354.5	237.4
	Forwarded	*506.9*	*62.2*	*144.5*	*195.0*	*9.2*
	Received	*1185.3*	*153.7*	*290.8*	*159.5*	*228.2*
of which Mangyshlak and Aktau	Total	1600.2	210.7	435.2	286.1	234.0
	Forwarded	*466.8*	*62.2*	*144.5*	*157.5*	*8.5*
	Received	*1133.4*	*148.5*	*290.7*	*128.6*	*225.5*
Mangyshlak-Uzen (excluding local traffic within the section)	Forwarded and received	297.5	146.2	0	52.1	25.9
Total	**Total**	**1989.7**	**362.1**	**435.1**	**406.6**	**263.3**
	Forwarded	***627.9***	***159.9***	***144.5***	***206.3***	***10.5***
	Received	***1361.8***	***202.2***	***290.9***	***200.3***	***252.8***

Sources:West Kazakstan Railway.

Regional Structure

Freight traffic flows on a regional basis in 1995 can be sub-divided as follows (see also table 2-6):

- Local traffic within the Mangistau Oblast (construction materials, gravel):
  about 17% of forwarded and 8% of received freight

- Forwarded to other regions:
  - to the neighbouring oblasts Atyrau (oil products from Tengiz) and Aktyubinsk (several commodities): 33%
  - to the Southern region of Kazakstan (oil products):17%
  - to other countries: 33% (Russia: construction materials; China: fertilisers)

- Received from other regions:
  - from Atyrau Oblast (oil products from Tengiz):15%
  - from other Kazak Districts (raw material of fertilisers): 46%
  - from other countries: 31% (Russia. Ukraine)

50% of the forwarded and 77% of the received traffic volume is carried over long distances (more than 2000 km).

Table 2-6: Main Freight Traffic Flows on the Mangyshlak-Beineu Route

Destination Area	Distance (km)	Freight volume (million tonnes)	*Area of origin*	*Distance (km)*	*Freight volume (million tonnes)*
Atyrau Oblast	800	0.1	*Atyrau Oblast*	*800*	*0.2*
Aktyubinsk Oblast		0.1	*Mangistau Oblast*	*200*	*0.1*
Mangistau Oblast	200	0.1	*Karaganda Oblast*	*> 3000*	*0.1*
South Kazakstan	> 2000	0.1	*Dzhambyl Oblast*	*>2000*	*0.2*
South Kazakstan	> 2000	0.1	*Shezkazgan Oblast as well as East and South Kazakstan*	*>2000*	*0.2*
China /via Drushba	> 2000	0.1	*North and East Kazakstan*	*> 2000*	*0.1*
Russia/via Aksaraiskaya	> 2000	0.1	*Russia (Eastern part), Ukraine*	*> 2000*	*0.4*

Source: West Kazakstan Railway

Annex 2-3 gives a detailed overview of the main traffic flows by regions and commodities.

Number of Freight Trains

The above volume was transported by an average of two freight train pairs per day during 1995, with a peak requirement of 2.6 pairs to cope with seasonal variations. Table 2-7 shows the detail in 1995.

The maximum capacity of the route itself is between 16 and 18 train pairs per day, including passenger trains, and therefore the 1995 average equates to about 15% capacity utilisation. The service in 1990 — the last year before the breakup of the USSR — amounted to an average of eight train pairs per day.

Table 2-7: Number and Tonnage of Freight Trains in 1995

	Section			
	Mangyshlak-Shetpe *	Shetpe-Say Utes *	Say Utes -Beineu *	Mangyshlak-Uzen §
Number of trains daily on average	2.0 / 2.2	2.0 / 2.1	1.8 / 2.0	1.1/ 1.0
of which:				
Wagonload trains	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0	1.1/ 1.0
Block trains	1.0 / 1.2	1.0 / 1.2	0.8 / 1.0	
Number of trains per month:				
on average	60.8 / 66.9	60.8 / 63.9	54.8 / 60.8	
maximum	74.4 / 77.5	74.4 / 74.4	69.0 / 74.4	
Fluctuation between maximum and average (%)	+22.3/ +15.8	+22.3/ +16.4	+25.9/ +22.3	
Tonnage of trains ('000 tonnes):				
gross tonnes	2228/ 2696	2241/ 2582	2163/ 2771	1226/ 856
net tonnes	891/ 1685	862/ 1614	832/ 1630	613/ 276

* first figure: direction Mangyshlak-Beineu; second figure: direction Beineu-Mangyshlak
§ first figure: direction Mangyshlak-Uzen; second figure: direction Uzen-Mangyshlak
Source: West Kazakstan Railway

One freight train per day operates between Mangyshlak and Uzen on average.

The average tonnage of freight trains along the Mangyshlak-Beineu line is differs according to section and direction.

Because Mangyshlak receives more loaded traffic than it forwards, there is an imbalance in the movement of both loaded and empty wagons.

Because of the physical configuration of the line[3], the permitted maximum gross trailing tonnage in each direction for freight trains is 3200 tonnes from Mangyshlak to Beineu and 2200 tonnes in the other direction.

2.1.4 Freight Traffic Volumes by Other Transport Systems and Competitive Situation in the Mangistau Oblast

The predominant means of freight transport within the Mangistau Oblast is the conveyance of extracted crude oil and gas using the pipeline from Atyrau to Kalamgaz via Kulsary, Beineu, Sai Utes and Aktau. The system consists of two parallel pipes, of which one is currently out of use.

3 See Chapter 3 of this Report.

Road freight traffic is mainly engaged in local and regional distribution (see Table 2-8). The available fleet of road freight vehicles is very low and totalled only 900 vehicles in 1994. The average distance travelled is generally less than 50km. Because of the inadequate road network, road traffic to and from the neighbouring oblasts (Atyrau. Aktyubinsk etc.) is at present unimportant.

The freight volume through the port of Aktau is also very low. Transport to and from the port is carried out exclusively by rail or pipeline.

Table 2-8: Freight Traffic Volume in the Mangistau Oblast in 1995

Type of transport	Transport volume in 1995 (million tonnes)
Pipeline (crude oil)	13.2
Pipeline (gas) *million m³*	20.8
Road freight traffic	1.1
Sea transport (turnover at Aktau port)	0.4
of which: dry cargo (by rail)	0.258
oil (by pipeline)	0.142
Rail	2.0

Sources: *-Projection of Indicators of the Socio-Economic Development in the Mangistau Oblast in 1997. Administration of Mangistau Oblast in 1996*
-West Kazakstan Railway

There is no direct competition between railway and road traffic. Rail concentrates on long distance traffic, whereas road traffic carries out mainly local and regional distribution. This situation is demonstrated by the sample of transport prices in the Mangistau region (see Table 2-9). Transport over longer distances by rail is cheaper than by road.

Table 2-9: Prices of freight traffic by rail and road

Mode	Distance	Commodity	Price in USD per 10 tkm
Rail	200-400 km	Oil products	0.10—0.08
		Construction materials	0.07—0.05
	1000-3000 km (domestic transport)	Oil products	0.06—0.05
		Construction materials	0.04—0.03
Road	Regional traffic 25 km	Average prices (general cargo)	0.66
		oil products in tanks	2.74

Sources: *Railway* *Tariff No. 10-01 (1989). issued of the Goskomitet of the Republic of prices and tariff policy*

Road *Survey of the five largest road transport companies in the Mangistau Oblast*

2.1.5 Rail Passenger Traffic

Ticket Sales

The number of tickets sold (which equates to the number of passengers joining trains along the route)[4] totalled 400,000 between Mangyshlak and Beineu in 1995 (see Table 2-10) as well as 71,000 between Mangyshlak and Uzen.

The volume of tickets sold in the whole of Kazakstan was 37.4 million in 1995 and therefore the proportion in Mangistau Oblast was 1.24%.[5]

Table 2-10: Tickets sold by Stations between Mangyshlak and Beineu in 1992 and 1995 ('000 tickets/year)

	Mangyshlak-Beineu total	Mangyshlak	Shetpe	Say-Utes	Ustyurt	Beineu	*Passing points 6-15*
Sold tickets 1992	614.2	324.2	47.7	92.3	40.0	91.9	3.7
Sold tickets 1995	399.7	201.4	32.2	4.7	2.3	156.7	2.4

Source: West Kazakstan Railways (statistics of sold tickets)

The volume of tickets sold and thus the number of rail travellers has decreased by one third since 1992 and was influenced by the following:

- Decline of population in Mangistau Oblast due to the emigration of ethnic Russians to Russia (between 1992 and 1995 by approximately 20,000)
- Decline of the standard of living, particularly of salaries and household income since 1992
- Increase of railway passenger tariffs in the same period in real terms
- Basic changes in the structure of travel purpose and destination due to the independence of Kazakstan from the USSR

---

4 The Kazakstan Railway publishes statistics of the number of sold tickets only. Statistics concerning the number of passengers and their individual destinations are not kept. Therefore these figures had to be estimated on the basis of the distance structure inherent in the fares calculation, which is entirely distance-based.

5 Source: Statistical Yearbook of Transport of Republic of Kazakstan, Goskomstat Almaty 1996

Seasonal Variations of Passenger Rail Traffic

There is a strong seasonal fluctuation of passenger flows over the course of a year. Compared with the average monthly passenger traffic (100%) the fluctuation rates by station in 1995 were:

Mangyshlak	minimum	61%	maximum	142%
Shetpe	minimum	30%	maximum	251%
Say Utes	minimum	38%	maximum	210%
Ustyurt	minimum	0%	maximum	368%
Beineu	minimum	57%	maximum	162%

Average monthly traffic = 100%

Journey Characteristics

The analysis of ticket sales[6] reveals the following general journey characteristics:

- around 25% of passengers joining trains between Mangyshlak and Beineu, and between Mangyshlak and Uzen, are passengers whose journey both starts and finishes along the route Uzen-Mangyshlak-Beineu (so-called "local traffic").

  These passengers purchase their tickets for their journey from origin to destination and return at the railway stations between Uzen, Mangyshlak and Beineu.

- the majority of passengers travel to or from areas outside the route being evaluated:

  65% of passengers joining the trains are travelling to destinations between 800 and 2,000 km away. Thus the destinations are situated in general in the area of the West Kazakstan Railway, particularly Aktyubinsk. Atyrau. Uralsk. Pavlodar etc.

  10% of the travellers travel to destinations beyond West Kazakstan, in other regions of Kazakstan and abroad (Russia, other CIS countries, China etc.).

Based on the structure of distance and the number of tickets sold along the route, the number of passengers (one return journey = two passengers) was calculated and totalled 810,600 passengers in 1995.

Table 2-11: Number of Passengers in 1995

Section	Number of Passengers in 1995 *			
	Local traffic	*Traffic to and from West Kazakstan*	*Traffic to and from other Kazak regions and abroad*	Total
Mangyshlak-Beineu	100,000	520,000	80,000	

6 It should be noted that tickets are sold for a specific distance (in kilometres) rather than to a specific destination, hence the need to 'estimate' the precise destination station.

Mangyshlak-Uzen	4,500[7]	92,000	14,100	
Total	**104,500**	**612,000**	**94,100**	**810,600**
Average passengers per day	286	1,677	258	2,221

* One trip is a journey from origin A to destination B (one way). The return trip is a second journey in these statistics. One journey from A to B and return is therefore two trips.

Source: Calculation based on tickets sold in 1995

In the opinion of local authorities and railway administration there are also some passengers travelling without purchasing tickets. The extent is unknown but is not thought to be significant.

The main traffic objectives for passengers are Mangyshlak (for Aktau) and Beineu. In 1995 approximately 90% of all passengers joined trains at these stations, 50% in Mangyshlak and 40% in Beineu.

Rail passenger traffic is undertaken mainly by residents of Mangistau Oblast. In contrast, very few passengers from outside the Oblast choose to travel into it.

Mobility by Rail

The average number of journeys made by residents of Mangistau Oblast along the Mangyshlak-Beineu route can be summarised as:

2.50 trips per inhabitant and year (in 1995) of which

0.39 trips in local traffic (along the route, between 100 and 400 km per trip)
1.89 trips to/from West Kazakstan (800 to 2000 km per trip)
0.29 trips to/from other Kazak regions and abroad (over 2000 km per trip)

The use of rail transport along the route is higher than the average rail mobility in Kazakstan as a whole.

One reason for this situation is the location of the Mangistau Oblast in the fringe of Kazakstan and the low road density, and thus lack of competition, in the Mangistau peninsula. A further reason is the above-average relationship of the Mangistau residents to other regions in Kazakstan and other CIS countries (particularly Russia and Ukraine); the industrialisation of the Mangistau peninsula began in the 1960s and the capital of Mangistau Oblast (Aktau) was founded only in 1963, hence the majority of residents are not local to the region.

Another factor is that the average wage in the Mangistau Oblast is about twice as high as the average wage in other parts of Kazakstan.

---

7 It is estimated that about 75% of all local passengers in this section travel to stations between Uzen and Mangyshlak, particularly Mangyshlak itself, the railhead for Aktau, the Oblast centre. This local traffic is not significant for the Mangyshlak-Beineu route.

Table 2-12: Mobility by Rail of the Population in the Mangistau Oblast and in Kazakstan

Year	Trips per inhabitant and year	
	Mangistau Oblast (Mangyshlak-Beineu route)	**Whole Kazakstan**
1992	3.5	2.5
1995	2.5	2.2

Sources: *Transport Statistics of Republic Kazakstan, Goskomstat Almaty 1996. page 24*

Number and Routing of Passenger Trains

The full passenger service is as follows (see also Table 2-13):

- two daily train pairs from Mangyshlak to Beineu and West Kazakstan (one each to Atyrau and Aktyubinsk)
- the Aktyubinsk trains convey through coaches for Moscow and Almaty
- the trains consist of passenger coaches with seating and sleeping accommodation (compartments with two and four berths), plus one or two luggage vans. This luggage service is very important for passengers in view of the high volume of 'private trading' carried out in distant markets particularly in Russia. The possibility of transporting large quantities of 'luggage' gives the railway a significant advantage compared with road and air travel
- the travel time between Mangyshlak and Beineu varies from 10.3 to 11.8 hours
- the average travel speed between Mangyshlak and Beineu is between 34 and 39 km/h
- the train capacity offers 1,133 places daily and 847,530 places annually in all categories; this is sufficient to satisfy the average demand (810,600), though inadequate to meet peak demand
- Beineu offers the facility to change trains: there are two departures weekly to Volgograd in Russia, and one weekly train each to Nukus and Urgench in Uzbekistan

Table 2-13: Passenger Trains between Mangyshlak and Beineu

Train No.	Route	Number of coaches* and places** per train	Travel time (hours)	Average speed (km/h)
201/	Mangyshlak-Atyrau and	11 coaches	11.3 - 11.8	35.7 - 34.2

202	return	568 places		
203/ 204	Mangyshlak-Aktyubinsk and return incl. through coaches to/from Moscow and to/from Almaty	12 coaches 585 places including -54 places to/from Moscow -90 places to/from Almaty	10.3 - 11.4	39.1 - 35.3

* excluding mail and luggage vehicles

** these figures include seats in various classes and sleeping places in compartments.

Source: Timetable of West Kazakstan Railways 1996

2.1.6 Other Passenger Transport Services in the Mangistau Oblast

The remaining passenger transport facilities in the Oblast can be summarised as follows[8]:

Air Traffic

There are nine flights per week (average 1.3 per day) from Aktau to Almaty and return, including two connections via Dzhambyl to Almaty. but no connection to other airports in Kazakstan or abroad. There are small private air companies which fly if required from/to other destinations.

Air traffic from Aktau to all destinations conveyed 130,000 passengers in 1995. This volume has been declining since 1991, a peak of 488,000 passengers being achieved in 1990.

The air company Kazakstan Airlines still uses aircraft of the Soviet types ЯК-42 and ТУ-134/154 between Aktau and Almaty.

The possibilities for transportation of quantities of luggage are very limited.

Bus Traffic

The bus service in the region is in two categories:

- Local traffic between Mangyshlak and Aktau and within the city of Aktau generally operates on a 15-minute service interval
- Connection of the communities in the Mangistau Oblast with Aktau, the centre of population, administration, trade and services

These bus services are characterised by the following facts:

---

8 Source: Statistical Yearbook of Transport of Republic of Kazakstan, Goskomstat Almaty 1996

- Four routes run parallel to the existing rail line from Aktau to Uzen, Kuryk and Shetibay (parallel to the Mangyshlak-Uzen section) and to Shetpe (parallel to the Mangyshlak-Beineu section).

- The other bus routes run outside the rail route, i.e. from Aktau to Fort Shevchenko, Tuchekudyk and Turkmenbashi (Krasnovodsk) in Turkmenistan.

The stock of buses in the Mangistau Oblast was about 608 vehicles in 1995, of which 323 were in private ownership.

The quality of services and the comfort of the buses used is low; most buses are Hungarian-built Ikarus vehicles, though there is also a limited number of imported second-hand buses from western Europe which offer more comfort.

The number of bus passenger journeys (local and regional) amounted to 108.8 million in 1995, an average of 335 trips per person per annum, or almost one every day.

The number of passengers using buses declined between 1992 and 1994 but has picked up somewhat in 1995.

Traffic by Private Cars

Private cars are used in local and regional traffic over short and medium distances but generally not for long-distance traffic. Between Aktau and Beineu and beyond to West Kazakstan, private cars usage is very low because the road between Ustyurt and Beineu is not tarred.

The stock of private cars is very small in the Mangistau Oblast in comparison with other Kazak regions (see Table 2-14).

Table 2-14: Motorisation Rate

	Motorisation rate (cars per 1000 inhabitants)			
	1990	1993	1994	1995
Republic of Kazakstan (average)	47	54	58	61
Mangistau Oblast	44	39	37	40

Source: *Statistical Yearbook of Transport of Republic of Kazakstan Goskomstat Almaty 1996*

Whereas the motorisation rate grew by 30% in the whole of Kazakstan between 1990 and 1995, the rate in the Mangistau Oblast remained more or less constant.

Assessment of the Present Competitive Situation Between the Different Regional Transport Systems

There is still a clear breakdown of function between the various modes of transport in the Mangistau Oblast which is characterised by the following:

- The railway meets the passenger demand in the medium- and long-distance areas (mainly to West Kazakstan).

- Bus services are used in local traffic within Aktau, between Mangyshlak and Aktau, as well as connecting smaller non rail-connected communities in the Mangistau region to Aktau, the centre of the Oblast.

  A developing competitive situation between rail and bus can be observed where four bus routes run parallel to a section of the rail route. The competitive situation is not yet important, but it exists.

Table 2-15: Comparison of Travel Times and Prices on Competitive Routes Rail/Bus

Route	Travel time (hours per journey)		Price (USD per journey)	
	By rail *	By bus direct	By rail *	By bus direct
Aktau-Uzen	4.8	3.3	1.923	2.601
Aktau-Kuryk	3.0	1.8	1.506	1.300
Aktau-Shetibay (Munayshi)	3.4	2.3	1.581	1.760
Aktau-Shetpe	3.3	4.0	1.142	2.310

* including by bus to the railway station

Source: Calculation by Kazgiprozheldortrans

- A journey by bus is more expensive than a railway journey in general (except Aktau-Kuryk). The important advantages by bus are the generally shorter travel time, the higher frequency (departures by bus 4-6 times per day, by rail twice per day) and direct connection without change of transport means.

- Air traffic meets the demand for longer distance services to and from Almaty and Dzhamboul with the shortest travel times. In this respect there is clearly no alternative.

  The price of a journey by air is about four times higher than for an equivalent rail journey, as the next table shows. Therefore, many passengers travel by rail because of their economic situation.

Table 2-16: Comparison of Travel Times and Prices Between Long-Distance Carriers

Route	By air		By rail*	
	Travel time (hours)	Price (USD)	Travel time (hours)	Price (USD)
Aktau-Almaty	3.0	122.0	> 24	29.4

* Sleeping car

- Traffic by private cars has not developed so far as a threat to other modes, since car ownership is relatively low and the road network is unsatisfactory.

2.2 Development of Relevant Factors Influencing Future Traffic Flows

The existing economic conditions form a poor basis for an assessment of future economic activity in the area and thus for the projection of future traffic volumes along the Mangyshlak-Beineu route.

Therefore, in order to make an assessment of the potential economic and socio-economic development along the route's catchment area, it was necessary to consult the following organisations:

- the Kazakstan Ministries of Economy and Transport and Communication
- the Regional Administration of Mangistau Oblast

Additionally, empirical research was undertaken with important companies in the region (e.g. AKPO; KASKOR; MAEK). and in the Commercial Port of Aktau. Discussions were also held with the West Kazakstan and Turkmenistan Railway administrations regarding the potential influence of a future North-South railway corridor

The validation of potential developments has been concentrated on the years up to 2005, projecting beyond that date wherever relevant. Since most of the projected development in the area is a function of Government rather than private industry (and thus the market), such development depends to a large extent on foreign financing, often by bi- and multilateral aid. Any delay in the provision of such foreign support will naturally have a marked effect on the timing of any industrial development and thus ultimately on the future level of demand for transport, making precise projections for such demand hazardous.

2.2.1 Relevant Economic Prospects

General Development Trends

As a result of the political and economic changes in the countries of the former USSR the Kazakstan economy is undergoing considerable change.

Industrial production is declining in most sectors and additionally the regional structure of the market has changed. The process of privatisation of the companies in the region has begun but is not yet finished. In the Mangistau Oblast the proportion of companies in state ownership was 85.6% in 1994. This share is decreasing and amounted to only 23.0% in 1996. The proportion of companies in foreign ownership is very low at present.

The Kazak Government has forecast a growth of GDP by 10-12% by 2000. In general, this figure is also considered valid for the Mangistau Oblast.

This estimate is confirmed by a short-term forecast of the World Bank and the real development in the first half-year in 1996 (see table 2-17).

Table 2-17: Projected Development of GDP

			1994	1995	1996	1997
World Bank Scenario (1)	GDP total	Percentage change on previous year	-7.5	-2.2	+0.3	+3.9
	of which industry		-12.0	-6.0	-1.0	+5.0
Actual development (2)	GDP total	in million Tenge	449.917	409.777	1st and 2nd quarter: 169.077	
		Percentage change on previous year	-25.0	-8.9	1st quarter: +1.0 2nd quarter: -0.8	

is this adjusted for inflation???

Sources: *(1) Kazakstan Economic Report . World Bank Report No. 12856-KZ. July 1994*
(2) Kazakstan Economic Trends Second Quarter 1996. Government of the Republic of Kazakstan. Centre for Economic Reforms

Although the trends and projections provide little basis for concrete prognosis, a moderate acceleration of the economic growth and especially of industrial growth in the next few years would appear to be realistic in the absence of any alternative indicators.

The projections indicate a clear increase of the industrial production in the catchment area of the route. This will also mean a growth of transport demand due to increasing input of raw materials and output of final products.

The basis of this assessment is a Medium-Term Programme of the Government of Kazakstan, which projects continuing economic reforms and investment in the most important industrial sectors[9]. The growth of industrial production requires comprehensive investment. This programme includes numerous projects for industrial development throughout the country as well as in the catchment area of the route being analysed.

However, it will clearly be necessary to obtain extensive financing in order to implement this major programme of investments. In the Consultant's opinion, there is a considerable risk factor implicit in the projections for future investment, industrial production and therefore potential transport volumes. The risks can be anticipated as applying to both the extent and timescale of any investment projected. It is therefore very difficult to define precisely the probability of implementation and the time horizon for the completion of the planned projects, or indeed whether they will be implemented at all.

[9] Source: *Kasachstan beschließt Investitionsprogramm in: Nachrichten für Außenhandel* No. 196 /1996

A key factor in the future industrial development within the Mangistau Oblast is the privatisation of the existing enterprises. This process is already very advanced, and indeed the share of privatised enterprises currently amounts to 76.5%. These enterprises depend very strongly on the participation of foreign capital and investment for their future industrial development, but there must also be a serious doubt — in some cases — about the long-term future of some of these enterprises.

The sources for the future traffic demand for freight transport using the route are particularly:

- Growth of production volume (input and output) of existing factories in the catchment area
- Implementation of planned investment projects in the oil industry and in the chemical industry
- Development of domestic and external trade
- Implementation of planned infrastructure projects

Projects potentially impacting on Future Freight Traffic Flows

There are at present a number of investment projects in planning for the region around Aktau which, if implemented, will have a significant impact on the freight traffic carryings of the Mangyshlak-Beineu rail line.

However, it should be clearly understood that the context of many of these plans relates to the time of the USSR and thus before the implementation of a market economy. It must be considered, in some cases, extremely doubtful whether the proposed planned investment will actually go ahead, for the following reasons:

Plans no longer relevant: the dictates of the markets have not necessarily been taken into account in the plans, particularly where these are merely relics of the USSR period. What may have made perfect sense in a planned economy, where industrial production was often remote from both the sources of raw materials and the ultimate consumer, may simply be unrealistic in a competitive environment.

Lack of investment funds: notwithstanding the high proportion of industries which have been privatised in the last few years (see above), there remains a serious shortage of venture risk capital in Kazakstan. Given the current economic climate, it is at present unclear where the funds for investment will arise, whether it be from central Government, private industry or foreign aid. There is clearly some risk that such investments will not take place, or may be scaled down, in such circumstances.

Industrial instability: the future of those industries which have been privatised relies entirely on their ability to market their products and to sell them in sufficient quantities and at such prices that survival is ensured and that funds are generated for

renewal and investment. It is the Consultant's experience that not all of these companies will indeed survive in this environment.

Remoteness from markets: the physical location of the industrial area surrounding Aktau is remote from areas of high population and concentrated industrial production, the nearest of which is probably the southern Ural area of Russia, some 1,500 km distant. Aktau is also remote from many of the sources of raw materials for the chemical industry located there. The primary potential export market through the port of Aktau is Iran, plus other CIS countries such as Turkmenistan, Azerbaijan, etc. who not only have their own problems, but also have their own indigenous production facilities.

Known projects in the industrial zone of Mangyshlak/Aktau/Uzen and in the Atyrau Oblast which potentially have an impact on future freight traffic volume for the route Aktau-Beineu are described below.

It should be noted that a detailed consideration of the traffic forecast, with the various scenarios described, follows in Chapter 2.3.1. At this stage, the alternative scenarios **pessimistic** and **optimistic** have been used as broad indicators of potential future traffic levels.

- *Growth of polystyrene production and other oil-based products*

The **pessimistic** forecast includes a growth from 40,000 tonnes in 1995 to 70,000 tonnes production output and transport volume per year by 2005. The **optimistic** variant forecasts an increase of output to 300,000 tonnes per year.

In order to achieve the **optimistic** tonnage output, it will be necessary to modernise the existing factory and to extend its production capacity. This project is part of the government investment programme.

It is estimated that about 70% of output of the **optimistic** variant would be exported via the Aktau Seaport. The rest of this volume would be transported to other areas of Kazakstan and to other countries by rail.

- *Growth of production of phosphate fertilisers*

An increase of output of fertilisers to 200,000-300,000 tonnes per annum is expected in the future.

The raw material will be transported from Dzhamboul District to Mangyshlak by rail. The volume of raw materials is expected to be between 450,000 and 700,000 tonnes per year. It is planned to export the biggest share of the production output overland by rail to Russia and China.

The Consultant considers that this proposal has a low probability, in view of the very long distances which both the raw materials and finished products will require to be transported. Dzhamboul lies in the south of Kazakstan, on the Kirgizstan border, some 2,000 km east of Aktau in a direct line. The Chinese border is a further 1,000 km beyond. It can hardly make

economic sense for raw materials and products to be conveyed over such distances, when there are surely more local sources of supplies.

✹ *Construction of a new factory for production of nitrate fertilisers*

It is planned to build a new factory for production of nitrate fertilisers by Japanese financing on the basis of using local raw materials transported by road. The planned annual output capacity of this factory will be 250,000-300,000 tonnes. It is planned to transport the finished product by rail. According to the Ministry of Economy, the factory will be completed by 2002.

✹ *Construction of a new oil refinery in Mangyshlak*

There are plans to construct a new refinery in the Mangistau Oblast 40km to the north of Aktau/Mangyshlak.

It is planned to construct this refinery in three stages:

Stage 1: a processing capacity of 1.5 million tonnes.
Stage 2: 3 million tonnes
Stage 3: 6 million tonnes per year.

Since there are no investment funds available for this project at present, projected start and completion dates cannot be given.

The Ministry of Economy estimates that approximately 5-6 years will be required for the completion of the first stage.

The implementation of this investment includes a very high degree of uncertainty; opinions within Kazakstan concerning the real need for the refinery vary considerably[10]

- The Ministry of Economy is considering this project in the context of the planning of industrial development in Kazakstan.
- The Ministry of Oil and Gas Industry is of the opinion that the existing processing capacity of crude oil is sufficient in Kazakstan and it is not necessary to construct a new refinery in the Mangistau Oblast.
- The company of Munaigas has a similar opinion.
- The administration of the Mangistau Oblast would prefer the refinery for the industrial stabilisation of the region, but financing of this project is not available at present.

As determined during discussions held in October/November 1996 in Kazakstan.

The output of the refinery is likely to be 90% of the processing capacity. Transport of raw materials between oilfield and refinery will be by pipeline.

The above mentioned organisations also have different views and opinions on the potential and regional structure of distribution and consumption of the oil products.

Therefore the **traffic forecast** for the rail route takes into consideration a low and a high variant on the basis of the second stage (output 2.7 million tonnes per year) for dispatching of different oil products by rail, which should, however, be regarded as "possible" rather than "probable":

low variant	1.35 million tonnes per year
high variant	1.5 million tonnes per year

Both variants include regional consumption of oil production of about 0.4-0.5 million tonnes, which would be transported by road.

The **low variant** takes into consideration the following estimate of future rail transport volume:

0.25 million tonnes export to Russia by rail

1.1 million tonnes consumption by other regions in Kazakstan and transport by rail

The rest will be carried by road or pipeline.

The **high variant** assumes the following structure of distribution:

0.4 million tonnes regional consumption and transport by road

1.6 million tonnes transport to a storage point in Uzen (transport by branch line from the refinery to Mangyshlak and then via the Mangyshlak-Uzen route); this transport to the storage point is not important for the route under consideration).

The distribution from the storage will be expected to 50% by rail using the route being analysed and 50% by road (each 0.8 million tonnes).

The remainder of 0.7 million tonnes could be forwarded to other regions in Kazakstan directly by rail.

N. B. should the new refinery be constructed, it will clearly be necessary to construct a new connecting line for the 40 km distance from Aktau/Mangyshlak to the refinery itself.

- *Growth in demand for production and consumption in other factories in the industrial zone of Mangyshlak-Aktau-Uzen*

Different surveys show an expected growth of the future freight traffic demand of 1.2-1.5 million tonnes per year, shared equally between forwarded and recievd traffic.

- *Increase of crude oil extraction in the Tengiz Oilfield, situated in the District of Atyrau near the railway station of Kulsary*

Kazakstan has an agreement with Iran to export between 1.5 and 3.0 million tonnes of crude oil from the Tengiz Oilfield via Aktau Seaport to north Iran by ship. The export should begin in 1997 with a volume of 1.5 million tonnes. In the next few years it is expected that there will be a further agreement to export up to 3 million tonnes.

This volume will be transported by rail from Tengiz Oilfield to Aktau Seaport.

2.2.2 Projected Socio-Economic Development in the Mangistau Oblast

Population

The number of inhabitants in the Mangistau Oblast has been decreasing since 1993 and stood at 324,400 in 1995. This situation was caused largely by the migration of ethnic Russians (18,000 in 1994).

In 1996 the population increased over the previous year (335,200). following the return of around 10,000 Russians.

The birth rate is decreasing and the mortality rate is growing in the Mangistau Oblast, largely because the migration involved mainly younger Russians. The birth rate is higher than the mortality rate (births: 21 per 1000 inhabitants, deaths 7 per 1000 inhabitants in 1996).

The Administration of the Mangistau Oblast and the Ministry of Economy estimate a population of about 340,000 in 2000[11]. This means that the decrease of birth rate will continue and the rates of migration and mortality will increase up to 2000.

An official population forecast beyond the year 2000 does not exist at present. Therefore it is estimated that, assuming the level will stabilise after 2000 and the decline in population can be stopped in the Mangistau Oblast, the population will be around 352,000-355,000 inhabitants after 2000[12].

Wages and Incomes

The monthly wage of an employee shows the following development:

Period	Monthly wages in Tenge (in USD *)	
	Mangistau Oblast	Kazakstan average

[11] Sources: Consultant's own survey
Economic Strategy of Republic of Kazakstan in 1996-2000, Ministry of Economy 1995 (unpublished)

[12] Source: Consultant's own estimates

January - June 1996	13826 (215)	6298 (97)
July 1996	18500 (285)	7083 (110)

* 1 USD = 65 Tenge (Summer 1996)

Source: Socio-economic analysis of Republic of Kazakstan in the period January - August 1996. page 119. Goskomstat Almaty 1996

The average wage in the Mangistau Oblast is twice as high as the Kazakstan average, due to the difficult working and living conditions at the coast of the Caspian Sea.

The yearly income of an employee amounted to approximately US$3000 in the Mangistau Oblast in 1996.

The proportion of the wages in the GDP amounted to 30-36% in 1996. This proportion is projected to increase to 40-44% in 2000.

The growth of GDP in Kazakstan is forecast to increase by 10-12% from 1996 to 2000. For the period after 2000 there are no existing forecasts.

In consideration of these economic basic figures a real growth of wages by 30-50% per employee is expected in the Mangistau Oblast from 1996 to 2005.

Household income will also rise, but more quickly, because the employment rate is expected to increase again.

Vehicle Ownership

Vehicle ownership is very low in the Mangistau Oblast at present and amounts to 43 cars per 1000 inhabitants. There is a stock of about 14,400 private cars.

New passenger cars are expensive, and therefore many buy second-hand cars. Although the prices for foreign types are similar to those in Western Europe, Russian products are significantly cheaper.

On the base of the expected growth of wages an increase of the number of private cars in the Mangistau Oblast is expected.

Because of the low incomes and the high prices for passenger cars it is expected that the number of private passenger cars will only increase at a slow rate.

The Consultant considers therefore that the existing passenger car stock in the Mangistau Oblast will almost double by 2005.

2.2.3 Infrastructure Projects and Development of Regional Transport Systems

2.2.3.1 Infrastructure Projects

There are two important infrastructure improvement projects which may influence the future of the route.

The first project is the ***reconstruction and modernisation of Aktau Seaport***.

This project with a total cost of US$74 million was started in October 1996 and is financed by EBRD and the Kazak Government. The reconstruction works concentrate on the part of the port handling of bulk and general cargo. The reconstruction will be finished within three or four years.

There are different forecasts concerning the expected freight handling volume in the port.

A 1994 prognosis[13] forecast handling of 7.9 million tonnes in 2005, of which 4.5 million tonnes would be crude oil and 2.7 million tonnes other cargo (general cargo, bulk goods).

On the basis of current data from the Ministry of Transport and Communications, a volume 2.7-3.2 million tonnes (without crude oil)[14] is forecast. The planned volume of export of crude oil via the Aktau Seaport from Tengiz amounts to 1.5-3 million tonnes per year beginning within the next few years.

The second project involves the construction of a *railway corridor between Russia and Turkmenistan/Iran via Kazakstan* known as the ***North-South corridor***[15].

The planned corridor will run via the following routes:

This new route would be important for future traffic, mainly between European Russia, Kazakstan and Iran via Turkmenistan. Its further importance for other European countries will depend on the future development of external trade between these countries and Iran, India and Pakistan and the ability of the route to compete with established shipping connections.

---

[13] Source: Business plan of Aktau Seaport 1994

[14] Source: Official data for the future capacity of Aktau Seaport after the reconstruction, given by Ministry of Transport and Communication of Republic of Kazakstan in November 1996

[15] Sources: -Kolyshkina/ Artamkina: *Neue Wege in den Iran*, in: Rail international No. 8-9/1996
-Feasibility Study about the railway connection Astrakhan-Bekdash-Turkmenbashi-Gazandshik-Kysyl Etrek-Tedshen-Serakhs, Report to part II Traffic Volume
GIPROTRANSTEI Moskva 1995 (russ.)

It is assumed that this new link could replace the existing, currently interrupted, connections via the Transcaucasian region.

The new corridor would shorten the rail distance between Kazakstan and Turkmenistan by 1085 km.

There is an agreement between the Russian and the Turkmenistan Governments concerning this new railway corridor. The Beineu-Mangyshlak section would then form an integral part of the corridor.

The development of this corridor requires the construction of new railway connections between Yeralievo and Turkmenbashy and between Gazandshyk and Gorgan/ Bandar Torkaman.

The GIPROTRANSTEI Study estimates a traffic volume of 2.1 million tonnes via this North-South corridor, including 1.5 million tonnes transit in the direction from Beineu to Mangyshlak and 0.6 million tonnes transit in the other direction.

The traffic volume takes into account transit traffic between Russia/other countries and Iran, and ports on the Persian Gulf, and does not include domestic traffic originating and arriving along the Mangyshlak-Beineu route or export/import movements via Aktau Seaport.

A high variant of the traffic forecast for the North-South corridor includes a volume of 2.4 million tonnes crude oil which could be exported from Mangyshlak Oilfield via Mangyshlak station to North Iran. This volume is not important for the route between Mangyshlak and Beineu, because this crude oil will be forwarded from Mangyshlak station and transported southwards and not towards Beineu.

According to Kazakstan Government authorities, **the financing of this infrastructure project has not been secured** and therefore there is no precise information about the expected construction period.

Another problem facing this project are the competitive routes from Russia and China via Kazakstan, Uzbekistan, Turkmenistan to Iran and the plans for their upgrading (the so-called "New Silk Road"). This line already exists and a strong growth of freight traffic via this route is expected. It is therefore very difficult to judged whether the planned North-South corridor project wil ever become reality.

This project will be considered as a **high level scenario** for the traffic forecast as far as the Mangyshlak-Beineu route is concerned.

2.2.3.2 Development of Regional Transport Systems

The development of regional transport systems requires investment. It is very difficult to estimate their potential scale of development because the economic situation of the regional transport companies, the development of road infrastructure and the construction of new pipelines is uncertain because of a lack of financial support.

Freight traffic

In general, road freight traffic is expected to increase its market share at the expense of railway transport. However, because of the poor condition of the existing trunk road infrastructure it is estimated that road haulage will only be important for local distribution traffic. Growing competition between rail and road freight traffic is not expected.

The construction of new pipelines may cause strong competition between rail and pipeline. There are some plans to built new pipelines, but the implementation of these plans will depend mainly on procurement of adequate funds.

According to the Kazakstan Ministry of Economy, the following plans exist:

- Construction of a pipeline for transportation of crude oil from West Kazakstan (Beineu or Tengiz) to the central regions of Kazakstan (Kumkol)

  This pipeline might connect the West Kazakstan region with the existing system of pipelines in Central Kazakstan. especially to the existing refinery in Pavlodar (North Kazakstan).

- Construction of a pipeline for transportation of oil products from Aktau to Beineu (3 million tonnes per year)

- Construction of pipelines for transportation of ethane (0.2 million tonnes) and oil products (0.5 million tonnes) between Tengiz and Aktau

The Munaigas Company has suggested that the Chevron Oil Company may plan a pipeline from Tengiz to the Aktau Seaport if the volume of crude oil export to Iran were to grow to more than 3 million tonnes per year. Such construction would not take place until after 2005.

Passenger Traffic

It can be expected that:

- the regional bus companies will extend their working area in future. This particularly means the development of medium-distance routes for buses to West Kazakstan and to Turkmenistan

- the network of air routes between Aktau Airport and other regions in Kazakstan and abroad will extend in the next few years

This indicates that part of the expected growth in passenger demand will not be met by rail, but by aircraft and by bus. Due to the higher fare scales, air traffic will not be a real alternative to long-distance travel by rail.

However, this will give the rail operator two alternatives:

- to continue to offer the same type of service as at present, at approximately the same fares, and see market share (though not absolute passenger journeys) reduce as passengers become more affluent

  or

- to react aggressively to the expected changes in the market by offering:
  - a premium service at a higher price
  - more attractive transit times
  - improved accommodation
  - a through service from Beineu to Aktau

2.3 Future Traffic Flows

2.3.1 Freight Traffic

2.3.1.1 Scenarios

The potential development of the economy and infrastructure in the Mangistau Oblast is very difficult to forecast, since there are many different influences and dependencies.

The speed of development has a strong influence on the financing of the planned investments, especially those involving foreign capital.
The future rail freight traffic demand is therefore a function of:

- the future production output of industry
- the development of domestic and external trade
- the implementation of the planned infrastructure measures in the region
- the ability of the railway to compete in the market place against pipeline, road transport and alternative industrial locations

In order consider these different development possibilities it is useful to describe several **scenarios** for the future freight demand along the route being surveyed.

These scenarios take into account the probability of the implementation of planned investment and have the following contents and key points:

Scenario A

- Growth of industrial production in existing enterprises in the Mangistau Oblast on the basis of the results of the Consultant's survey of the regional enterprises
- Increased capacity of Aktau Seaport after the reconstruction
- Export of crude oil from Tengiz Oilfield to north Iran via Aktau Seaport

Scenario B

Scenario A and in addition the expected traffic volume of the planned investment in industry in Mangistau Oblast, specifically:

- the new refinery in Mangyshlak
- construction of a new factory for nitrate fertilisers
- optimistic variant for growth of polystyrene production

Scenario C

Scenario C includes Scenario B as well as the potential traffic volume of the future North-South corridor.

As far as possible, a low and high level will be considered within the scenarios.

2.3.1.2 Future Freight Traffic Flows

Traffic Volume

The projected future freight traffic will have the following volumes, considering the expected economic development of the existing companies in the Mangistau Oblast, the implementation of planned industrial investment of the infrastructure projects already described.

The traffic forecast is based on the expected economic development in the Mangistau Oblast (see 2.2.1 above) and takes into account the results of the Consultant's surveys of the relevant companies, administrations and authorities.

As Table 2-18 shows, freight traffic demand by rail can be expected to grow significantly in comparison with the present situation.

Even in the most pessimistic growth variant (Scenario A_{LOW}), traffic will increase, from 2 million tonnes in 1995 to 8.1 million tonnes in 2005. In the optimistic variant, Scenario

A_{HIGH}, a growth to 9.7 million tonnes in 2005 can be expected. This volume is almost at the level of freight traffic in 1990 (10.3 million tonnes). The other scenarios include higher freight volumes reflecting increases in the estimated production output and industrial consumption as well as the building-up of the North-South corridor.

The expected volumes of Scenario B_{LOW} (26.4%) and B_{HIGH} (25.2%) are higher than the comparable cases in Scenario A.

Table 2-18: Expected Freight Traffic Volume Mangyshlak-Beineu in 2005

Sources of rail freight traffic	Freight traffic volume ('000 tonnes)						
	1995	*2005*					
	Base	**Scenario A**		**Scenario B**		**Scenario C**	
		low	high	low	high	low	high
Production input and output of existing companies in the catchment area received/forwarded*	1990 630/1360	2420 1070/1350	3480 1470/2010	2610 1160/1450	3720 1560/2160	2610 1160/1450	3720 1560/2160
Export of Tengiz Oil (transport by rail) received/forwarded		3000 3000/0	3000 3000/0	3000 3000/0	3000 3000/0	3000 3000/0	300 0 3000/0
Growth of turnover in Aktau Seaport received/forwarded	200	2680 770/1910	3190 860/2330	2680 770/1910	3190 860/2330	2680 770/1910	3190 860/2330
New industrial investment received/forwarded	-	-	-	1950 1650/300	2200 1900/300	1950 1650/300	2200 1900/300
North-South railway corridor received/forwarded	-	-	-	-	-	2100 1500/600	2100 1500/600
Total received/forwarded	**1990** 630/1360	**8100** 1840/6260	**9670** 2330/7340	**10240** 3580/6660	**12110** 4320/7790	**12340** 4180/8160	**14210** 4920/9290

* received = direction from Beineu to Mangyshlak; forwarded = direction from Mangyshlak to Beineu

Sources: *Research with companies concerned*
Information provided by Ministry of Economy. Ministry of Transport and Communication. Ministry of Oil and Gas Industry as well as Munaigas Company and Administration of Mangistau Oblast
Feasibility Study North-South corridor. part II. GIPROTRANSTEI

As previously stated, it is very difficult to realistically validate any of the above forecasts. In particular, the projected developments which underlie the growth in production for Scenarios B and C depend on investment from Government agencies and/or foreign sources. It is noteworthy that none of the projected investment schemes are related to *private* investment by Kazak companies, which would obviously need to be based on market conditions.

The Consultant is particularly concerned that some of the projected developments continue to reflect the philosophy of a planned rather than a market economy, particularly where this concerns locating industry in areas physically remote from markets and/or raw material

sources. In normal circumstances, the only way in which such investments can be made viable is by artificially depressing freight haulage prices so that they do not unduly affect the final cost of the product in the market. The Consultant is not totally convinced that this fact is appreciated fully in Kazakstan.

Breakdown of Freight Traffic by Commodity

The breakdown of projected rail traffic by commodity in Scenarios A and B will clearly be determined by the industrial structure in the catchment area of the route (see Table 2-19).

In Scenario A it is expected that the share of crude oil and oil products will amount to approximately 43-37%, and in Scenario B to about 47-42%.

These commodities will have a considerable effect on the freight traffic structure in the future. Further important commodities will be chemicals and fertilisers, whose share is expected to be approximately 13-15% in both scenarios. This means that about the half of the future freight traffic by rail will comprise crude oil/oil products and chemicals/fertilisers.

Table 2-19: Projected Freight Traffic Volume Mangyshlak-Beineu by Commodity in 2005

Commodity	Freight volume ('000 tonnes)						
	1995	2005					
		Scenario A		Scenario B		Scenario C	
		low	*high*	*low*	*high*	*low*	*high*
Chemicals/Fertilisers	440	1010	1260	1300	1650	1300	1750
Crude oil	-	3000	3000	3000	3000	3000	3000
Oil products	360	500	550	1850	2050	1850	2050
Construction materials	410	490	800	690	1000	690	1000
Metals, ores	260	460	620	460	620	660	820
Timber	20	120	150	120	150	120	150
Grain	50	1120	1500	1120	1500	1320	1700
Other	450	1400	1790	1700	2140	3300	3740
Total	**1990**	**8100**	**9670**	**10240**	**12110**	**12240**	**14210**

Sources: *Discussion with major customers*
Ministry of Economy and Ministry of Transport and Communication

Annex 2-4 shows the structure of freight volume by commodity as well as forwarded and received.

The additional expected transport demand on the route being surveyed arising as a result of the construction of the North-South corridor will include a high proportion of "other goods", which in this context includes manufactured industrial products such as machinery,

industrial equipment, vehicles, paper products etc. This proportion is estimated to be approximately 70%.

Number of Wagons

On the basis of the projected future freight traffic volume, its breakdown by commodity and the average tonnage by wagon and commodity[16], the projected number of loaded wagons between Beineu and Mangyshlak (including from/to Aktau Seaport) has been broadly calculated.

Table 2-20: Number of Loaded Wagons

	Number of loaded wagons					
	Scenario A		Scenario B		Scenario C	
	low	high	low	high	low	high
Forwarded	38918	48322	67481	80818	82866	96202
Received	106651	127019	115354	137000	149140	170786
of which transport of Tengiz oil	*46875*	*46875*	*46875*	*46875*	*46875*	*46875*

The breakdown of loaded wagons by type for Scenarios A and B is described in Annex 2-5.

The calculation was carried out on the basis of suitable types of wagons for each of the commodities.

Number of Freight Trains

The number of freight trains has been calculated by considering the followings facts:

1. Gross tonnage for each type of commodity group

The calculation was carried out on the basis of:

Commodity	*Factor* *Gross tonnage : net tonnage*
Chemicals	1.64
Fertiliser	1.42
Crude oil/ Oil products	1.36
Ores	1.32
Construction materials	1.38
Metals	1.36
Timber	1.49

16 According to the West Kazakstan Railway, the average load by commodity and average type of wagon (in tonnes/wagon) is:
chemicals 52, ores 68, fertilisers 63, crude oil/oil products 64, metals 61, timber 44 ,construction materials 56, grain 61, other goods 39

Grain	1.41
Other	1.64

Source: West Kazakstan Railway

2. Maximum value of fluctuation

A value for the fluctuation of number of trains in a defined time unit between the average and maximum needs to be calculated.

For the calculation of the maximum number of trains per day via the route Mangyshlak-Beineu, the fluctuation value ψ is used.

The maximum value of ψ *(peak)* amounted to 1.16 and 1.26 (average value = 1) in an average month in 1995. The general trend for development of this value is that the maximum value decreases, if the number of trains increases.

Therefore a maximum value $\psi = 1.2$ for the fluctuation of number of trains per day has been estimated.

3. Maximum train length

The existing size of passing loops on the line effectively restricts train length to 850 metres, or 57 normal wagons plus locomotive. However, it is to be expected that loops these would be capable of extension should longer trains be required.

4. Maximum gross tonnage per freight train

In order to forecast the number of trains, the existing maximum gross tonnage between Mangyshlak and Beineu was used:

direction Mangyshlak-Beineu	2200 tonnes per train
direction Beineu-Mangyshlak	3200 tonnes per train

These tonnages are governed by the permitted trailing load for one locomotive unit (two single locomotives coupled back-to-back) of class 2ТЭ10Л.

It should be noted that the maximum gross weight of a normal four-axle wagon is 90 tonnes (22.5 tonne axleweight); the line has a permitted maximum axleweight of 23 tonnes (see also Chapter 3.1.1).

The Feasibility Study for construction of the North-South corridor includes a higher gross tonnage for the section Mangyshlak-Beineu of 3600 tonnes per train in both directions, presumably using a more modern and thus more powerful locomotive type.

Therefore the calculation of the number of trains was made on the basis of both values.

5. Categories of freight trains

Block trains:

It is expected that the rail transport of crude oil from the Tengiz Oilfield (Kulsary station, about 200 km north of Beineu on the main line to the north) to Aktau Seaport will be in block trains:

> from Kulsary to Aktau with loaded wagons and return from Aktau to Kulsary with empty wagons

Wagonload trains:

It is assumed that the transport of all other commodities will be carried out in wagonload (mixed freight) trains.

6. Re-loading of freight wagons

The projected freight volume developed for the scenarios shows that the received freight volume is higher than the forwarded volume. Therefore a check was made to determine whether the received wagons by number and type are suitable for re-loading or not.

It was also considered that the freight volume for dispatching of oil products in Scenario B requires a higher number of empty wagons.

Taking into account all facts, the future number of freight trains implied in the different scenarios will be as follows:

Table 2-21 Number of freight trains between Mangyshlak and Beineu in 2005

Type of train and **direction**		**Number of freight trains per day in 2005**					
		Scenario A		**Scenario B**		**Scenario C**	
		low	**high**	**low**	**high**	**low**	**high**
	Variant 1: Current gross train tonnage: Beineu-Mangyshlak 2200 tonnes. Mangyshlak-Beineu 3200 tonnes						
Wagonload trains:	trains/						
Direction Beineu-Mangyshlak	day	5	7	6	8	10	11
Direction Mangyshlak-Beineu		5	7	9	11	11	12
Block trains:	trains/						
Direction Beineu-Mangyshlak	day	4	4	4	4	4	4
Direction Mangyshlak-Beineu		4	4	4	4	4	4
Number of freight trains in total:	trains/						
Direction Beineu-Mangyshlak	day	9	11	10	12	14	15
Direction Mangyshlak-Beineu		9	11	13	15	15	16
	Variant 2: Gross train tonnage: both directions 3600 tonnes (option with North-South Corridor)						
Pick-up trains:	trains/						

Direction Beineu-Mangyshlak Direction Mangyshlak-Beineu	day	5 3	6 4	6 6	7 7	8 7	9 8
Block trains: Direction Beineu-Mangyshlak Direction Mangyshlak-Beineu	trains/ day	 4 4	 4 4	 4 4	 4 4	 4 4	 4 4
Number of freight trains in total: Direction Beineu-Mangyshlak Direction Mangyshlak-Beineu	trains/ day	 9 7	 10 8	 10 10	 11 11	 12 11	 13 12

2.3.2 Passenger Traffic

The future demand for passenger rail traffic is governed by the following projections (see Chapter 2.2.2):

- The population in the Mangistau Oblast will increase to 352,000-355,000 inhabitants.
- The disposable income of the population will increase.
- The number of cars will increase by 100% approximately.
- The local bus companies in the Mangistau Oblast will extend their services into regional and medium-distance traffic.

It is very difficult to estimate future passenger traffic demand by rail given the potentially wide variations in socio-economic development. It is therefore necessary to consider the future demand for rail passenger transport in the context of mobility in the Mangistau Oblast as a whole.

For regional and medium-distance traffic, mobility of inhabitants can be expected to increase significantly, but this growth will be primarily met by new services of the bus companies and by an increase in private car ownership. It is estimated that the growth of mobility by rail will be lower than the overall growth in mobility in medium-distance traffic. Therefore, an increase of rail passenger traffic of no more than 10% is projected.

Long-distance traffic will experience a higher growth of mobility. It is estimated that long-distance rail traffic will grow by between 10 and 20% by 2005. There will be further growth in air traffic.

Table 2-22: Estimated Development of Mobility and Number of Trips by Rail in Mangistau Oblast in 2005

	Mobility by rail (trips/inhabitant/year)		Trips of all inhabitants in 2005* ('000)	
	1995	2005	per year	per day

		Expected growth (%)	trips per inhabitant per year		
Local and regional traffic	0.39	+/- 0	0.39		
Medium-distance traffic	1.89	+10%	2.08		
Long-distance traffic	0.29	+10 → 20%	0.32-0.35		
Total	2.50	+11.5 → 12.7%	2.79-2.82	981.4-1.000.0	2700

check against earlier table/data

* Forecast of population in 2005: 352-355,000 inhabitants in the Mangistau Oblast

The future passenger traffic demand by rail will amount to 2,700 passengers per day on average, equating to **3 train pairs** per day.

This assumes that

- the accommodation in each passenger train will be about 550-600 seats and sleeping berths of different classes and
- the offer of daily departures should be improved by 2005

meaning???

2.3.3 Number of Freight and Passenger Trains in total in 2005 between Mangyshlak and Beineu

Using the forecasts for traffic levels developed in the preceding chapters, the projected number of freight and passenger trains between Mangyshlak and Beineu is shown in Table 2-23:

Table 2-23: Number of Trains on the route Mangyshlak-Beineu in 2005

Type of train and direction		**Number of trains per day in 2005**					
		Scenario A		**Scenario B**		**Scenario C**	
		low	**high**	**low**	**high**	**low**	**high**
	Variant 1: Current gross train tonnage: Beineu-Mangyshlak 2200 tonnes. Mangyshlak-Beineu 3200 tonnes						
Number of freight trains in total:	trains/						
Direction Beineu-Mangyshlak	day	9	11	10	12	14	15
Direction Mangyshlak-Beineu		9	11	13	15	15	16
Passenger trains:	trains/						
Direction Beineu-Mangyshlak	day	3	3	3	3	3	3
Direction Mangyshlak-Beineu		3	3	3	3	3	3
Number of trains in total:	trains/						
Direction Beineu-Mangyshlak	day	12	14	13	15	17	18

Direction Mangyshlak-Beineu		12	14	16	18	18	19
	Variant 2:Gross train tonnage : both directions 3600 tonnes (option with North-South Corridor)						
Number of freight trains in total:	trains/						
Direction Beineu-Mangyshlak	day	9	10	10	11	12	13
Direction Mangyshlak-Beineu		7	8	10	11	11	12
Passenger trains:	trains/						
Direction Beineu-Mangyshlak	day	3	3	3	3	3	3
Direction Mangyshlak-Beineu		3	3	3	3	3	3
Number of trains in total:	trains/						
Direction Beineu-Mangyshlak	day	12	13	13	14	15	16
Direction Mangyshlak-Beineu		10	11	13	14	14	15

PROJECT TITLE	TRACECA Rail Maintenance Central Asia: Infrastructure 2
PROJECT NUMBER	TNREG 9310
MODULE	A Feasibility study for upgrading of the Aktau - Bejneu line in Kazakhstan.

WP 1210	Survey of Existing Situation
3.1.	Survey of Existing Line Condition
3.1.1.	Permanent Way
3.1.2.	Telecommunications
3.1.3.	Signalling
3.1.4.	Operations

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

3.1. Survey of Existing Line Condition

3.1.1. Permanent Way

3.1.1.1. The Methodology of the Study, Visits and Discussions

First Visit from 3rd September to 4th October, 1996

At first (4th to 8th September), we had a discussion with the local partner - the KAZGIPROZHELDORTRANS Institute of Almaty - including the following experts:

Mr. Kasianov	Vice Director of the Institute
Mr. Novitskiy	Track Expert
Mr. Jagmurov	Signalling Expert
Mrs. Izvejova	Telecom Expert
Mr. Aldobaev	Head of Bridge Department
Mr. Kuibeda	Bridge Expert
Mrs. Smirnova	Economist and Marketing Expert

The experts of the Kazgiprozeldortrans Institute provided several maps of and information about the Aktau - Bejneu line and presented the missing records. They informed us that a visit to the Railway Organisation or the branch of the Kazgiprozeldortrans Institute in Aktyubinsk will not be necessary.

The next meeting took place in the Ministry of Transport and Telecommunication on the 5th September with

Mr. Panov	Vice Minister

Together we organised the field expedition to the Aktau - Bejneu line, and were told about the major problems regarding the infrastructure of the line.
At the field mission we met:

Mr. Tabyldy Amirov	Chief of the railway line Bejneu - Mangyshlak
Mr. Chalbek	Chief of permanent way district between Bejneu (km 0) and km 203
Mr. Kozhachmet	Chief of permanent way district between km 203 and Mangyshlak
Mrs. Sayrangul	Engineer of permanent way district between km 203 and Mangyshlak
several gang foremen	

The first day of the field mission was a day trip by train from Mangyshlak to Bejneu on 9th September. The journey took 10 hours. On the 10th September, we went back in an inspection coach with a separate locomotive, so we were able to stop the train at interesting locations as e.g. bridges, level crossings, passing loops and so on. From 11th to 17th September, there were discussions with the staff in the Mangyshlak station.

Between 18th and 26th September, discussions were held and preparatory work was done with the staff of the local partner, the Kazghiprozheldtortrans Institute.

Tacis This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

At the same time, we had a meeting with Mrs Shivareva from the Kazakh Scientific-Research Institute of Environmental Monitoring and Climate (KazNIIMOSK) regarding the Caspian Sea level.
An excursion to a concrete sleeper factory near Almaty followed.
Mr. Serbayev, Track Department Chief of the Almatynska Railway Organisation, informed us about the local costs of track machines.

Second Visit from 12th to 22nd November, 1996

During the second visit meetings were held with the local partner discussing former development plans.
From 14th to 19th November, a second field mission took place, including visits to bridges near Mangyshlak as well as a presentation of new track-fastenings and discussions about long-welded track.

As regards our discussion partners, they all proved to have much experience. This holds also true for the partners of the Institute as well as the Railway Organisation's staff. The only problem was that it took some time to get accurate records.

3.1.1.2. Technical Characteristics of the Line

The line is situated in the Kazakhstan desert district Mangyshlak.
The line belongs to the third category (this is one of the lowest categories of the FSU railway line classification).
The line was opened in 1966, the construction of the line being according to:
SN 129-60 (Standards and technical conditions of projecting of railway lines with a gauge of 1520 mm on the entire network of the USSR)
BSN 56-61 (Technical indications for projecting stations and junctions on railway lines on the entire network of the USSR)
SN 41-58 (Rules and standards of planning and construction for buildings, cities and villages), and
other technical standards used at the end of the 1950s. Today, these standards are no longer used.

The Aktau -Bejneu line is a single-track line with diesel traction.

The length of the line from Bejneu to the Mangyshlak station is 403.07 km
(the private line between Mangyshlak and Aktau Port is 16 km, Aktau Town 18 km)
The kilometrage begins in Bejneu at km 0 and ends in Mangyshlak at km 403.07.

There are three intermediate stations between Bejneu and Mangyshlak.
(Ustyurt, Say-Utes and Shetpe)
There are 15 passing loops on a maximum distance of about 29 km.
The only town near the line is Aktau having 165.000 inhabitants. It did not exist before 1963.
People travelling by train have to take a bus from Aktau to the Mangyshlak station.
Several hundred people are living in Ustyurt, Say-Utes and Shepte.
There are big factories between Aktau and Mangyshlak, also a small factory in Shepte.
Houses for rail workers have been built in the vicinity of the passing loops.

Tacis This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

The subgrade has a width of 5.8 m.
The track length on embankments is 368 km.
The track length in cuttings is 34 km.

The line has 61 bridges with a maximum length of 100 m.
There are 206 pipe culverts through the embankment, 23 level crossings, but no tunnels and retaining walls.

3.1.1.3. The Topography of the Line

The line passes through two geologic zones of West Kazakhstan. Also the boundary between these two zones is of interest.

Between the Bejneu station and the Say-Utes station, the line passes through the Ustyurt plateau, which is a stony desert with hardly any elevations.

After the Say-Utes station (km 180), the Ustyurt plateau ends with a steep slope. Between km 180 and km 199, the level of the track changes from 220 m to 0 m. This zone is cut by ravines. At the border line between the two geologic zones - between km 199 and km 226 - lies the edge of the marshland Kaidak, which became in the last years a gulf of the Caspian Sea.
The Caspian Sea lies in a depression area which is 26.5 m below sea level.

The second geologic zone is the peninsula Mangyshlak having mountains of up to 556 m. The railway line goes up only to 230 m. The mountains are fractured by several canyons. The line runs always in the valley bottom of the canyons, between a couple of metres and several hundred metres apart from the slope of the valley.

		air	rail
Climate:	Maximum temperature	- 25 °C	- 25 °C
	Minimum temperature	45 °C	70 °C
	Frost line	1.4 m	
	Rainfall:	less than 100 mm per year, sometimes there is no rain at all if it is raining, it is raining very heavily	
	Wind:	When there is bad weather, this means it is cloudy and windy.	

3.1.1.4. Maximum Speed and Speed Restrictions

Every year speed restrictions on a long-term basis are issued and handed over to the locomotive drivers. It was not possible to get information about the former maximum admissible speed. These long-term speed restrictions form the basis for the calculation of the travel time of trains, which presently amounts to 10 hours between Bejneu and Mangyshlak.

There are three categories of trains with speed restrictions:

passenger trains
freight trains
empty freight trains

Tacis This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Speed restrictions for passenger trains:	199.6 km with 60 km/h (50 % of the line) 148.1 km with 50 km/h (37 % of the line) 51.3 km with 40 km/h (13 % of the line)
Speed restrictions for freight trains:	188.1 km with 60 km/h (47 % of the line) 11.5 km with 50 km/h (3 % of the line) 199.4 km with 40 km/h (50 % of the line)

Speed restrictions for empty freight trains are the same as that for freight trains.

The secondary tracks in the stations and the passing loops are mostly restricted to 25 km/h.

A list of the exact speed restrictions is attached.

3.1.1.5. Axle Load and Length of Trains

The axle load between Aktau and Bejneu is 23 tons.
The admissible load is 14 t/m.

The maximum train weight is 3200 tons between Bejneu and Aktau (so-called even direction)
In the direction Aktau to Bejneu (so-called odd direction):
2200 tons between Mangyshlak and Say-Utes
3000 tons between Say-Utes and Bejneu

The usable length of passing tracks is 850 m.

3.1.1.6. The Organisational Structure of the Line Staff

On the railway line Bejneu - Mangyshlak there are two permanent way districts.
One is situated in Bejneu, the second in Mangyshlak.

The permanent way district Bejneu has a staff of 250, controlling about 281 km of the line. They are responsible from Bejneu (km 0) to km 203, which is 72 % of the whole permanent way district area.
The organisation of the staff in the permanent way district consists of:

Total staff	Staff responsible from km 0 to km 203
central staff (district inspector, assistants, secretariat etc.): 15 employees	10
mechanical workers and drivers: 35	25
workers for bridges: 5	4
9 sections with 9 section foremen incl. Bejneu Station	9
18 gang foreman districts with 18 gang foremen	18
122 rail workers	122
Total staff for the area Bejneu to km 203	188

Tacis This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

The permanent way district Mangyshlak has a staff of 330, controlling about 370 km of the line. They are responsible from km 203 to Mangyshlak, which is 54 % of the whole permanent way district area.
The organisation of the staff in the permanent way district consists of:

Total staff	Staff responsible from km 203 to Mangyshlak
central staff (district inspector, assistants, secretariat, etc.): 18	10
mechanical workers and drivers: 20	11
workers for bridges: 6	3
8 sections with 7 section foremen incl. Mangyshlak Station	7
19 gang foreman districts with 13 gang foremen	13
170 rail workers	170
Total staff for the area km 203 - Mangyshlak	214

Thus, on the line Bejneu - Mangyshlak, 402 people are permanently working in the field of permanent way maintenance.

The district office controlling this line is situated in Atyrao (this is one of the three district offices of the West Kazakh Railway Organisation).

The general directorate is in Aktyubinsk (it is one of three in Kazakhstan). In Aktyubinsk, there are 5 service trains (mobile permanent way gang), each having a staff about 130 people. These gangs are available for major repair works.

The responsible ministry is the Ministry of Transport and Telecommunications in Almaty.

3.1.1.7. Geometry - Curves and Superelevation

In the following, the geometry of the track between the main sections on the line is listed in 5 categories:

straight
R>= 1000 m
R< 1000 m to R>= 800 m
R< 800 m to R>= 500 m
R< 500 m

Tacis This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

In the following, the numbers of the curves per section and category are summarised.

section of the line	(km)	straight	R>1000	1000-800	800-500	R<500
Bejneu (km 0) to Say Utes (km 178)	178 km	173.4 km	4.6 km 9 curves			
Say Utes (km 178) to passing N° 8 (197)	19 km	5.0 km	4.6 km 7 curves	1.0 km 4 curves	2.5 km 7 curves	5.9 km 12 curves
passing N° 8 (km 197) to Shepte (km 312)	115 km	76.8 km	11.9 km 25 curves	10.2 km 20 curves	14.5 km 27 curves	1.6 km 3 curves
Shepte (km 312) to Mangyshlak (403,07)	91.07 km	75.0 km	10.37 km 22 curves	3.3 km 6 curves	2.4 km 3 curves	
total	403.07 km	330.2 km	31.47 km 63 curves	14.5 km 30 curves	19.4 km 37 curves	7.5 km 15 curves

The minimum radius on the line is 398 m.

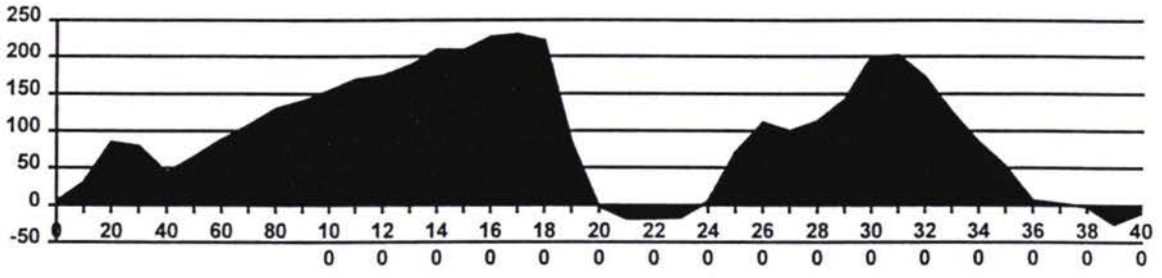
The superelevation is calculated in such a way that there is nearly no cant deficiency.

3.1.1.8. Geometry - Gradient

Over long distances, the gradient is adapting to the surface of the country-side.
Thus, there are long distances with rising and falling gradients of up to 8 %o.

Between the end of the Ustyurt plateau and the Caspian Sea, the line shows a steep falling gradient in the direction to Mangyshlak. In this section, the gradient amounts to 15.6 %o.

longitudinal map length 1 : 2.500.000
level 1 : 10.000



3.1.1.9. Level of the Track - Sea Level

The track runs between 28 m below sea level and 232 m above sea level.
The Caspian Sea is 26.5 m below sea level.

Tacis This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

In the following, the track lengths are listed in categories of sea level.

lower than -27 m	1.7 km
-27 m to -26 m	0.5 km
-26 m to -25 m	0.3 km
-25 m to -24 m	0.7 km
-24 m to -23 m	0.4 km
-23 m to -22 m	0.7 km
-22 m to -21 m	0.7 km
-21 m to -20 m	1.6 km
-20 m to -15 m	32.4 km
-15 m to -10 m	10.6 km
-10 m to 0 m	24.4 km
0 m to 50 m	57 km
50 m to 100 m	72 km
100 m to 150 m	81 km
150 m to 200 m	64 km
above 200 m	56 km

The lowest areas of the line are in the following mileage points:

lower than -27 m	388.0 - 389,8=	1.8 km	
lower than -25 m	387.6 - 390.1=	2.5 km	
lower than -23 m	386.8 - 390.4=	3.6 km	
lower than -20 m	204.9 - 205.9=	1.0 km	and
	385.3 - 390.9=	5.6 km	
lower than -15 m	203.7 - 231.4=	27.7 km	and
	383.4 - 391.6=	8.2 km	and
	396.5 - 399.6=	3.1 km	

3.1.1.10. Standard and Condition of Civil Engineering Structures

Standard and Condition of Bridges and Pipe Culverts

There are 206 pipe culverts on the line.
181 of them are round concrete pipes with a diameter between 1 and 2 m. 30 of them have more than one tube beside them (up to 9 tubes).
25 pipe culverts are rectangular concrete pipes with a width between 2 and 3 m.

There are also 61 bridges. 60 bridges are made of concrete and have a maximum length of 56.1 m. 1 bridge is made of steel (in km 339.4) with a length of 100 m. This bridge was built in 1993, after the old one was destroyed by heavy rainfall.

km	length	parts	material
39.9	90 m	5x18	concrete
53.2	9 m	2x4.5	concrete
81.3	10 m	2x5	concrete
88.3	15 m	3x5	concrete
119.4	15 m	3x5	concrete
179.4	42 m	7x6	concrete
194.4	32 m	4x6	concrete
195.2	19 m		concrete

Tacis This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

196.7	38 m	2x19	concrete
198.9	18 m	3x6	concrete
205.0	10 m	2x5	concrete
209.7	18 m	3x6	concrete
213.2	10 m	2x5	concrete
213.8	25 m	5x5	concrete
220.6	10 m	2x5	concrete
221.0	15 m	3x5	concrete
222.6	15 m	3x5	concrete
223.2	10 m	2x5	concrete
229.4	17 m	5+2x6	concrete
231.8	15 m	3x5	concrete
236.8	15 m	3x5	concrete
238.6	20 m	4x5	concrete
247.3	25 m	5x5	concrete
263.6	18 m	3x6	concrete
263.8	15 m	3x5	concrete
270.0	54 m	3x18	concrete
272.3	27 m	3x5+3x4	concrete
277.5	18 m	3x6	concrete
278.2	18 m	3x6	concrete
279.4	30 m	5x6	concrete
283.4	12 m	2x6	concrete
286.9	18 m	3x6	concrete
290.0	24 m	4x6	concrete
290.6	18 m	3x6	concrete
291.1	40 m		concrete
298.4	33 m	3x5+3x6	concrete
300.4	15 m	3x5	concrete
306.4	10 m	2x5	concrete
307.2	15 m	3x5	concrete
307.9	22 m	2x5+2x6	concrete
317.3	14 m		concrete
319.8	14 m		concrete
324.3	25 m	5x5	concrete
325.8	5 m		concrete
328.2	10 m	2x5	concrete
331.6	15 m	3x5	concrete
337.5	24 m	4x6	concrete
338.9	36 m	6x6	concrete
339.5	100 m	88+2x6	steel
343.4	61 m		concrete
347.6	14 m		concrete
350.6	18 m	3x6	concrete
350.7	12 m	2x6	concrete
352.8	18 m	3x6	concrete
354.4	15 m		concrete
359.7	66 m		concrete
366.4	10 m	2x5	concrete
370.9	36 m	2x18	concrete
375.9	10 m		concrete
377.5	10 m	2x5	concrete
379.2	10 m	2x5	concrete

Tacis This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Standard and Condition of Embankments and Cuttings

The width of the subgrade is 5.8 m.

The highest embankments and cuttings are between Say-Utes and km 199, where the railway line runs in an area cut by ravines.

The track length on embankments is 368 km.
The maximal height of embankment is 20m.
The embankments are made up of different kinds of sand, clay and marls.

The track length in cuttings is 34 km.
The maximal depth of cuttings is 14 m.
Cuttings are constructed in areas of marls, limestone and clay.

Standard and Condition of Drains

Mostly the drains are open catch water drains with natural soil.
In some parts, where the falling gradient is too steep, the soil is supported by means of concrete plates.

Standard and Condition of Level Crossings

There are 23 level crossings on the line.
Only at four of them more than 50 cars per day are crossing the line.
The maximum crossing of the line is near the Mangyshlak station (1800 cars per day).
The level crossings mainly consist of concrete plates, some are asphalted.

3.1.1.11. Standard and Condition of the Track

Standard and Condition of Rails with Joints and Welding

The line was constructed with rails of 43 kg/m.
During the past years, some rails were replaced by rails weighing 50 kg/m or 65 kg/m.
Presently, there are the following rails:

from km	to km	weight of rail	year
0	34	65 kg/m	1990s
34	179	43 kg/m	1966
179	180	50 kg/m	1966
180	187	65 kg/m	1990s
187	197	50 kg/m	1966
197	208	65 kg/m	1987
208	278	43 kg/m	1966
278	279	50 kg/m	1966
279	297	65 kg/m	1989-91
297	298	50 kg/m	1966
298	312	65 kg/m	1988-90
312	313	43 kg/m	1966
313	342	65 kg/m	1991-96
342	403	43 kg/m	1962

Tacis This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

There are rails weighing	43 kg /m	277 km	69 %
	50 kg/m	13 km	3 %
	65 kg/m	113 km	28 %

Each rail has a length of 25 m and fish-plated joints.
On the whole line, the joints are suspended rail joints. There are six bolts at each joint.
On the whole line, there is no welded track.

Standard and Condition of Sleepers

Only from km 17 to km 34, there are concrete sleepers which were inserted during the last year. These concrete sleepers were bought in Russia and laid for about 20 years in a Russian railway line.
Nearly the whole line is equipped with wooden sleepers, all having been inserted in 1966, the year in which the line was opened. Only very few sleepers have been replaced by new wooden sleepers. This means, 386 km of the line are equipped with such wooden sleepers.
The new wooden sleepers are impregnated.

Size of the new wooden sleepers:	length	2.70	m
	width	23	cm
	height	16	cm

Standard and Condition of Fastenings

There are ribbed base plates on the 17 km with old Russian concrete sleepers,. Every ribbed base plate is fixed to the sleeper by two sleeper bolts. The rail is fixed by T-bolts and rail clips.
At the 386 km with wooden sleepers, there are base plates. Every base plate is fixed by 4 spikes (two inside the rail, two outside). The two spikes at the inside of the rail also fasten the rail. Of the two spikes outside of the rail, only one is fixing rail and plate, the other fixes only the plate.
The sleepers are equipped with rail anchor devices.

Size of new bottom plates	for 65 kg/m rails:	36/17 cm
	for 43 kg/m rails:	28/16 cm

There is no elastic material between rail and bottom plate. At the new wooden sleepers, there is elastic material inserted between sleeper and bottom plate having about 8 mm.

Standard and Condition of Ballast

For the construction of the line in 1966, ballast from a quarry near Bejneu was used, which was mainly sandy ballast. In the past years, stone ballast was ordered from Aktyubinsk.

Stone ballast is only used in the following sections:

from	to	length
2	7	5 km
17	34	17 km
198	202	4 km

So there are only 26 km with stone ballast bed.

The rest of the line (377 km) has a sand ballast bed.

For about 10 km of the line, an asbestos ballast bed is used.

Tacis This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

3.1.1.12. Stations and Loading Points

All stations are equipped for freight and passenger traffic.

In the Bejneu station (km 0), the line parts from the main line (Makat - Uzbekistan). The station has 12 tracks and several dead-end tracks as well as about 60 turnouts. In this area lies a little town.

Near passing loop N° 4 (km 80), there is a little village named Ustyurt. The passing loop has 3 tracks and 8 turnouts.

Say-Utes (km 178) is a village. In this station the locomotives of freight trains are changed. This station has 4 tracks and some dead-end tracks as well as 19 turnouts.

Shetpe (km 312) is a village with small factories. The station has 8 tracks and several dead-end tracks as well as 33 turnouts.

Mangyshlak (km 403) is also a village with factories and repair shops, the station is the nearest to the town Aktau. The station has 18 tracks and several dead-end tracks as well as about 80 turnouts.

All passing loops have between 2 and 4 tracks, most of them have one dead-end track and between 3 and 9 turnouts. The maximum distance between the passing loops amounts to 29 km.

Usable Length of the Station Tracks

The two main tracks of the passing loops and stations mostly have a usable track length of about 850 m and 1100 m.
Only the two passing loops N° 5 and N° 11 have a usable length of 824 m and 840 m respectively.

Standard and Condition of Turnouts

Most of the turnouts consist of rails with 50 kg/m.
There are only single turnouts used.
The arch of the turnouts is 300 m.
The crossing angle of the turnouts is 1:9 or 1:11.
The construction of the tongues is a rigid point.
The construction of the switch diamond is monoblock.
The sleepers are always wooden sleepers. The slide chairs and the switch diamond are fixed to the sleepers with sleeper screws. The other parts of the rails are fixed by means of spikes to the sleepers.

Standard and Condition of Platforms

Each station where passenger trains do stop has platforms about 15 cm above the top of the rail.

Tacis This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Standard and Condition of Buildings

Most of the buildings in the station are about 100 m2.
Most of the buildings at the passing loops are about 50 m2.
These buildings house the operator, the signal box and sometimes telecommunications equipment.

3.1.1.13. Inspection of the Line

Once a month a track inspection coach is used.
The gang foreman has to make an inspection round twice a month.
The chief permanent way engineer has to make an inspection round twice a year.

3.1.1.14. Maintenance Works

Floating Repair Works or day-to-day Repair Works

The works include above all:

repair of defects in the track
repair of defects in turnouts
repair of defects in track geometry
repair of defects in turnout geometry
repair of loose fastenings (spikes)
maintenance of joints
maintenance of isolation joints
repair of broken sleepers
renewal of broken bottom plates
renewal of cracked rails
ballasting of missing ballast
grinding of small parts of the rail
sometimes weed killing
maintenance of level crossings
maintenance of buildings
maintenance of catch water drains
and so on

These works have to be done by the local staff without any track maintenance machines.

Mediate Repair Works or Scheduled Track Maintenance

These works are done annually on a defined part of the line. It is planned to work between 30 and 80 km per year. The distance is determined by the money being available for buying of track material.

These works include above all:

renewal of bad rails (about 3x25 m per km)
renewal of bad sleepers (about 300 sleepers per km)
renewal of broken bottom plates (about 500 plates per km)
ballasting of missing ballast (about 300 m3 per km)
straightening and tamping of the track
renewal of broken equipment in turnouts

Tacis This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Sometimes, these works are done by two gangs together. In general, the works have to be done without any track maintenance machines.

3.1.1.15. Major Repair Works or Renewal Works

Rail Renewal

In the past 10 years, 113 km (track) were renewed manually, mostly by local staff. Only in some sections they were supported by the staff of the service trains from Aktyubinsk.
Most of the work is done during a 4-hour closure of the line. During this period 1000 m are worked by 50 - 60 workers. We were informed that per metre 0.3 man/hours have to be calculated, however, the number evidently is higher.

Track Renewal

There were nearly no track renewal works at this line. Only from km 17 to km 34, the track was renewed during the last year. The equipment used was a Platov crane to replace 25 m long track panels, and an excavator for taking out the old ballast bed. Ballasting was done by means of a ballast wagon, other machines used were a track lining machine and a tamping machine. These machines can be ordered for such a kind of work. The main work was done every Thursday during a closure of the line lasting for 5-6 hours. During such a closure, about 1200 m were completed. We were informed that per meter 0.5 man/hours are to be calculated, however the number evidently is higher.

3.1.1.16. Mechanised Track Maintenance

There are no heavy track maintenance machines for maintenance work. Only small machines are available at the permanent way district

Existing Machinery and Equipment

The following heavy machines are available at Aktyubinsk and can be ordered to this line only for large maintenance works:

Platov crane
SHOM ballast cleaning machine
Rail grinding machine
VPO-3000 lifting, levelling and lining machine
Tamping machine

Equipment available at the permanent way departments:

3 big track cars (for about 30 workers)
10 small track cars (for about 15 workers)
3 track cars with crane (max. lifting weight about 1 to)
6 ultrasonic testing equipment
rail drilling machines with motor
hand-tamping machines with electric-motor
hand rail grinding machine
hand rail lifting cranes

3.1.1.17. Annexes

Photo documentation
Map of the line 1: 1 000 000
List with speed restrictions

Tacis This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

3.1.2. Telecommunications

3.1.2.1. Existing types of communication on this line

The existing communication equipment has been planned and constructed according to the telecommunications demand on the line (railway stations and crossings) and between this line and the superior offices (central dispatcher in Atyrau, operating control in Aktjubinsk and the Ministry in Almaty). Before describing the existing telecommunications equipment in detail, an explanation regarding the existing communication types between the mentioned offices and the Kazakh Railway is given.

Communication within the Operating Department

Due to the existing type of operation, today the central dispatching and control of the running of trains on the line Beijney - Mangyshlak is done by the central dispatcher in Atyrau. This is done by remotely controlling the whole line Bejneu - Mangyshlak, with the exception of the two terminal stations, where the preparation of the route is done by the local station inspectors. Along the whole line, shunting operations and the operation of connecting railways are done by local personnel. In case the remote control fails, the central dispatcher submits his commands by phone which then are executed by the local personnel.

There are the following types of communication for operation:

- central dispatcher to local station inspectors (dispatcher line)
- station inspectors along the railway line with one another (dispatcher line)
- selected staff members along the line without central dispatcher (additional dispatcher line), however with communication possibilities to superior offices (up to Almaty)
- central dispatcher to locomotive drivers (radio communication with trains)
- station inspectors to locomotive drivers (radio communication with trains)
- locomotive drivers to one another (radio communication with trains)
- shunting personnel to locomotive drivers and station inspectors (radio used for directing shunting operations)
- maintenance staff for signalling and telecommunications installations along the line with one another (own farmer line)
- maintenance staff for permanent way with one another (own farmer line)

Communication regarding administrational procedures

The railway line Bejneu - Mangyshlak also has a commercial function. For this function, there are connections between the railway stations along the line and Mangyshlak as well as from Mangyshlak directly to Atyrau, Aktjubinsk and Almaty. For this purpose, the general telephone channels of the existing carrier systems are used.

3.1.2.2. Overhead line and cable

As basis for all communication along the railway line as well as to the superior offices in Atyrau and Aktjubinsk serves an overhead line along the railway line. Every 50 meters, there is a pole of the overhead line equipped with three cross arms. In general, these poles are concrete poles. Only at the transition from the overhead line to the earthing cable, there is a wooden scaffolding, at which the overhead line is braced (anchor pole).

Tacis This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Conducting of the overhead lines into the technical rooms of telecommunications is done via earthing cables of the type T3B or TZB with 7 * 4 * 1.2.

The number of telecommunication circuits is adapted to the demand. Starting with km 126, in addition to the telecommunication circuits being necessary for the railway, there are also the circuits for the public telephone network as well as the Ministry of the Interior, which means that the number of connections along the line changes. The railway's equipment consists of eight lines having the following parameters:

- 5 lines (10 wires) made of steel having a diameter of 5 mm: serve for the connections between the railway stations.
- 3 lines (6 wires) made of bimetal (inside steel and outside copper) having a diameter of 4 mm: are used for the carrier systems.

The wiring of these eight lines existing on the whole line is as follows:

- dispatcher line from Bejneu to Mangyshlak including all local station inspectors as well as the central dispatcher in Atyrau,
- special dispatcher line for station inspectors along the line without inclusion of the central dispatcher in Atyrau, but having access to superior offices,
- farmer lines for the permanent way maintenance staff,
- farmer lines for maintenance staff for communication facilities and signalling installations,
- communication between the signal boxes regarding remote control,
- local lines between two railway stations: these include also the telephone sets of the telephone boxes at the signals and turnouts in the entry and exit area. There are no telephone boxes between the railway stations. In case of works on the line, communication with the neighbouring railway stations is done via these lines, by connecting a telephone set to these telephone boxes by means of a connection device. Yet, this line exists only from km 124.
- carrier links (2 for the railway, further for the public network and the Ministry of the Interior)

The following lines exist along the whole railway line:

- 8 lines (16 wires) from km 1 up to km 124
- 9 lines (18 wires) from km 124 up to km 313
- 19 lines (19 wires) from km 313 up to km 372
- 11 lines (22 wires) from km 372 up to Mangyshlak

These indications were taken from the written answer to the submitted questionnaire regarding telecommunications.

The plans indicate the connections according to type. The carrier links are marked by a unique 4-digit numerical code which is also listed in the communication chart of carrier links of the Westkazakh Railway. The code corresponding to the systems being directly used by the railway always starts with 16, e.g. 1635 or 1617. The communication chart of carrier links only shows the carrier systems belonging to the railway, not the described additional ones for the public network and the Ministry of the Interior, which however are included in the communication chart of the communication systems. The code for the additional systems always starts with 13, e.g. 1307 or 1313. Yet, the communication chart does not show where the individual terminal stations of these additional carrier systems are located.

Tacis This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

3.1.2.3. Transmission technology

For long-range communications, two different carrier systems are used:

- two-wire/twelve-channel system within a frequency range of 36 - 143 kHz, designated B-12-3
- two-wire/three-channel system within a frequency range of 4 - 31 kHz, designated B-3-3

The first figure always states the number of channels, the second the generation of the respective device, with 3 meaning the third generation. This generation already is equipped with transistors. As may be seen in the communication chart for carrier-frequency equipment, also devices of the second generation - conduit devices (e.g. all amplifiers on the line Bejneu - Mangyshlak and also of some terminal stations) are still used.

In case of both systems, direction separation is done by means of grouped-frequency operation. Since both systems function in different frequency ranges, both can be switched by means of a corresponding frequency separating filter to a common two-wire circuit. In addition, a low-frequency link (LF-link) is switched to this two-wire circuit. The transmission capacity for the railway (only 16xx systems, not the 13yy for the public network) on this line is:

- 3 channels Mangyshlak - Shetpe
- 3 channels Mangyshlak - Say-Utes
- 3 channels Shetpe - Say-Utes
- 2*3 channels Say-Utes - Bejneu
- 1 LF communication Mangyshlak - Shetpe
- 1 LF communication Shetpe - Say-Utes
- 1 LF communication Mangyshlak - Say-Utes
- 2 LF communications Say-Utes - Bejneu
- 2*12 channels Mangyshlak - Bejneu

Moreover, Mangyshlak and Bejneu dispose of the following systems for the connection of the lines beginning or ending in these railway stations:

- Mangyshlak: 3 channels towards Uzen having terminal stations in the two intermediate stations
- Bejneu: 2 * 3 and 2 * 12 channels towards Makat and 1 * 3 and 1 * 12 channels towards Uzbekistan
- it is possible at any time to add to the three-channel systems an LF channel

As the wiring scheme for these channels shows, nearly all of the existing channels are used. Thus, there are only few free capacities available.

As an example for wiring a large terminal station, in the following the outgoing and incoming connections of Mangyshlak are listed:

- first 12-channel system:
  - channel 1: central dispatcher line
  - channel 2: operator-switched telephone connection to Aktjubinsk
  - channel 3: operator-switched telephone connection to Atyrau (old name Gureuv)
  - channel 4: operator-switched telephone connection to Kasalinsk
  - channel 5: dedicated line for conference circuit
  - channel 6: operator-switched telephone connection to Atyrau

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

  - channel 7: dedicated line Atyrau - Mangyshlak as voice-frequency bearer circuit
  - channel 8: operator-switched telephone connection to Bejneu
  - channel 9: dedicated line for the farmer line to Shetpe for permanent way maintenance staff
  - channel 10: operator-switched telephone connection to Shetpe
  - channel 11: operator-switched telephone connection to Shetpe
  - channel 12: dedicated line for conference circuit
- first 3-channel system including respective LF channel:
  - channel 1: dedicated line for data transmission to Say-Utes
  - channel 2: special dispatcher line
  - channel 3: dedicated line for farmer line to Shetpe for maintenance staff for communication facilities and signalling installations
  - LF communication: no indications
- second 12-channel system:
  - channel 1: dedicated line for conference circuit (district level)
  - channel 2: dedicated line for operating department
  - channel 3: automatic telephone connection to Atyrau
  - channel 4: reserve
  - channel 5: reserve
  - channel 6: automatic telephone connection to Atyrau
  - channel 7: operator-switched telephone connection to Aktjubinsk
  - channel 8: operator-switched telephone connection to Makat
  - channel 9: dedicated line of the data pack-unpack device in Mangyshlak to Aktjubinsk
  - channel 10: operator-switched telephone connection to Bejneu
  - channel 11: reserve
  - channel 12: reserve
- second 3-channel system including respective LF channel:
  - channel 1: automatic telephone connection to Atyrau
  - channel 2: indications could not be read
  - channel 3: indications could not be read
  - LF communication: no indications

3.1.2.4. Telephone connections along the line

As was already described in the section overhead line and cable, the following telecommunication circuits exist along the entire railway line, which are also accessible in every railway station or passing point.

- dispatcher line from the central dispatcher in Atyrau to all local station inspectors
- farmer lines for local station inspectors without inclusion of the central dispatcher in Atyrau, but having access to important offices in the whole Kazakh railway network (Aktjubinsk, Almaty)
- farmer lines for the permanent way maintenance staff
- farmer lines for maintenance staff for communication facilities and signalling installations
- local line

The first four connections have central battery working and voice-frequency signalling. In case of long distances, the lines are conducted via carrier frequency systems. Only the local connection of extensions is done by means of metallic wires of the overhead line. Because of the voice-frequency signalling, individual calls as well as multi-party calls are possible.

The last line (local line) functions with local battery and hand generator for signalling (ringing current generation).

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Central dispatcher line

The central dispatcher for the line Bejneu -- Mangyshlak is situated in Atyrau. The central dispatcher line is routed from Atyrau via a voice-frequency channel as dedicated line without inclusion of any subscriber up to Bejneu, and from there it is again routed via a voice-frequency channel up to Mangyshlak, including the railway stations Say-Utes and Shetpe. The railway station Ustyurt, being situated between Bejneu and Say-Utes, is only included in the form of a passing point (N° 4) and does not dispose of a terminal station of the 3-channel system as do all other railway stations.

In the railway stations Bejneu, Say-Utes, Shetpe and Mangyshlak, the connection of the end-to-end voce-frequency line is executed by means of the local terminal stations as well as by means of the two-wire connection, which is necessary for the supply of the neighbouring passing places. The following passing places are connected to the individual railway stations:

- Bejneu towards Say-Utes: passing places 1 - 4 (4 corresponds to Ustyurt Station)
- Say-Utes towards Bejneu: passing places 5 - 7
- Say-Utes towards Shetpe: passing places 8 - 10
- Shetpe towards Say-Utes: passing points 11 -13
- Shetpe towards Mangyshlak: passing points 14 -15
- Mangyshlak towards Shetpe: passing point 16
- Mangyshlak towards Uzen: Uzen Station and three intermediate stations

Farmer line for maintenance staff for communication facilities and signalling installations

This connection is constructed similar to the central dispatcher line. Yet, its reach is restricted to the area from Bejneu via Mangyshlak to Uzen and there is no central office. The allocation of the individual passing points to the railway stations is nearly identical to that of the central dispatcher line, only the passing points 14 and 15 being connected to Mangyshlak instead of Shetpe. The technology is identical to that of the central dispatcher line.

Farmer line for permanent way maintenance staff

This connection only starts in Say-Utes, and from there up to Uzen it is analogue to that of telecommunication service and signalling.

3.1.2.5. Operational telephone systems

In all passing places and railway stations, attendant consoles of the type DSP have been installed for telecommunications along the railway line. These are used in three different sizes (number of lines that can be connected: 6, 8 or 19), in general at least two links being not connected. The following lines are always connected:

- dispatcher line from the central dispatcher in Atyrau to all local station inspectors,
- farmer lines for the local station inspectors without inclusion of the central dispatcher in Atyrau, but having access to all important offices in the entire Kazakh railway network,
- farmer lines for the permanent way maintenance staff, and
- farmer lines for the maintenance staff for communication facilities and signalling installations.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Since these connections are farmer lines, it makes four connections. Starting with km 124, there is the local line being a point-to-point connection to the left and the right neighbouring railway station. This means that starting from the passing point, in each railway station at least 2 connections are added. In some railway stations also determined local telephone stations are included in the operational telephone system

3.1.2.6. Radio installations

Radio communication with trains

The railway line is equipped with the radio communication with trains which was standard in the former Soviet Union and still is standard in today's CIS. It works with a frequency of 2.1 MHz. Because of the large range, the advantage of using this frequency is that only few fixed radio stations are required. The aerials of the fixed installations are stretched between the anchor poles of the overhead line (at the transition to an earthing cable for conducting the telecommunication circuit into the building housing the technical equipment) and this building; they are about 20 to 30 m long.

There is no own modulation line for the feeding of the fixed radio installations. These installations are connected to the central dispatcher line. The central dispatcher can see in the center where the individual trains are and sends a call via the central dispatcher line to the corresponding track section. Also the local station inspector can intrude into the radio communication via his own telephone set.

The technical equipment for the fixed radio installation is in a locked wall-mounting cabinet, to which only determined staff members of the telecommunication service have access. All other telecommunications equipment is in unlocked wall-mounting cabinets to which all railway staff members have access.

Each passing point and each railway station disposes of a fixed radio station. There are no further fixed radio stations in-between. In total, on the line Bejneu - Mangyshlak 34 locomotives are equipped with mobile radio sets.

Radio used for directing shunting operations and radio installations for other services.

The railway stations Mangyshlak, Shetpe and Bejneu and the passing point N° 1 are equipped with radio installations used for shunting operations. These work in the frequency range 152 - 154 kHz.

Similar radio sets are installed in snow-plough, breakdown trains and fire- extinguishing trains. The technical department in Mangyshlak is also equipped with such devices.

Also the staff members being responsible for recording the classification of wagons in Bejneu are equipped with portable radio sets.

All in all, there are 7 fixed, 8 mobile and 106 portable radio sets.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

3.1.2.7. Telephone network

The large railway stations dispose of automatic switching centres having the following access capabilities:

- Bejneu: 400
- Usturt: 100 (10 wired)
- Say-Utes: 100 (68 wired, plus 2 parallel sets makes 70 extensions)
- Shetpe: 100 (80 wired)
- Mangyshlak: 800

With the exception of the telephone centre in Mangyshlak which is state of the art, all other centres do not have automatic trunk connection, but a manual exchange. Only Mangyshlak disposes of automatic long-distance services towards the following railway stations:

- Eralievo
- Zhetybal
- Uzen
- Usturt
- Bejneu
- Atyrau
- Say-Utes

Moreover, there exists an automatic service between Usturt and Say-Utes.

As regards the communication with the public telephone network, an own switching equipment of the type M-60 is used. Such an equipment is installed in the following railway stations:

- Bejneu: 18 lines, 14 seized
- Usturt: 6 lines, 2 seized
- Say-Utes: 6 lines, 5 seized
- Shetpe: 6 lines, 6 seized
- Mangyshlak: 30 lines, 22 seized

Similar to other railway organisations, also the flats of some railway staff are equipped with a telephone connection to the railway telephone system. This applies to all railway stations and the passing points N° 10, 13 and 15.

3.1.2.8. Telegraph and data transmission network

As regards telex and data transmission, the railway stations are equipped as follows:

- Bejneu: 8 terminals
- Say-Utes: 2 terminals
- Shetpe: 2 terminals
- Mangyshlak: 4 terminals

The terminals in Say-Utes and Shetpe are connected to Mangyshlak the via voice-frequency telegraph equipment. Two types of terminals are used: old mechanical terminals and modern ones based on PC and having storage medium for telegrams. As regards the intermediate stations, there is always one terminal in the telegraph office and one in the data processing office.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

In Mangyshlak, there is a telegraph switching centre with 20 lines, 16 of which are seized. This centre has 6 outlets which are connected to the voice-frequency telegraph system having in total 48 channels (2 * 24). In addition to the 6 outlets of the telegraph switching centre, two dedicated lines to Bejneu are seized.

As regards data transmission, there is a data pack-unpack device to which five terminals (four in Mangyshlak and one in Say-Utes) are connected. This device is directly connected to Aktjubinsk via a voice-frequency telegraph system channel.

An application of this data transmission constitutes the on-line ticket sale using PC and ticket printing machine.

3.1.2.9. Other technical telecommunication installations

Loud-speaker equipment

The railway stations Bejneu, Say-Utes, Shetpe and Mangyshlak dispose of loud-speaker equipment. In general, each railway stations has only one amplifier (Mangyshlak: 3), one microphone (Mangyshlak 4 and Bejneu 2) and 8 to 12 loud-speakers (Mangyshlak and Bejneu 36 each). The indoor loud-speakers have a power of 2 W and the outdoor loud-speakers of 5 to 10 W.

Clock installations

The railway stations Say-Utes, Shetpe and Mangyshlak are equipped with clock installations, the large station of Bejneu, however, does have none. These installations consist of one master clock (Mangyshlak 2 master clocks) and 3 - 4 secondary clocks (Mangyshlak 31). The clocks are used indoor as well as outdoor.

Fire-alarm systems

The technical rooms in the Bejneu station, in the buildings of the passing points (starting from N° 7) as well as in the railway stations up to Mangyshlak are equipped with fire-alarm system.

Hot-box detectors

In the railway stations Usturt and Shetpe and in the passing points N° 6, 12 and 15, hot-box detectors are installed.

Ticket issuing machines

The railway stations Bejneu, Say-Utes, Shetpe and Mangyshlak dispose of ticket issuing machines of the type "Express-2". These are based on a PC with on-line connection and a ticket printing machine producing tickets having a form of European standard.

Power supply

The technical installations within the telecommunications area are supplied with 24 or 60 V DC. In the individual places, the necessary rectifiers and batteries are available being operated by means of a buffer-battery system.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

The railway stations Say-Utes, Shetpe and Mangyshlak as well as the passing places N° 1, 3, 5, 7, 9, 11, 14 and 16, dispose of an emergency power supply system in the form of a diesel motor with connected generator.

3.1.2.10. Measuring devices

The following measuring devices are available in the telecommunications workshop in Mangyshlak (without indication of number):

- cable test set
- cable measuring bridge
- cable fault locator
- cable insulation testing instrument
- level-measuring set
- frequency counter
- attenuation-measuring set
- universal measuring instrument (Volt, Ampere, resistance)
- generator for transistor testing and
- diode testing device

3.1.3. Signalling

At present, the railway line Bejneu - Mangyshlak is equipped with high-quality signalling installations with relay technology.

The two railheads Bejneu and Mangyshlak dispose of electric signal boxes. The 18 passing loops or intermediate stations dispose of electric signal boxes that are remotely controlled from Atyrau. A total of 100 automatic block posts divide the line into block sections between 0.9 km and 9.2 km. 21 of the 22 level crossings are equipped with train-operated automatic light signals and one with a manually switched barrier.

The entire railway line has a track-release installation with track circuits. The information of the automatic train-running control is sent to the locomotives via these track circuits.

Voltage supply and transmission of signalling information is done via a separate overhead line at the right side of the railway line (starting from 362.3/4 at the left side of the line) with 2 systems 3x10kV three-phase current and a number of weak-current lines according to demand.

A relay technology with gravity relay is used.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

3.1.4. Operation

Co-ordination and admission of journeys

In principle, all journeys on the line, at the stations and passing loops are co-ordinated and admitted by the central dispatcher office in Atyrau.
The train and shunting routes (turnouts and signals) are controlled by the local dispatcher (operator) of the station.
The stations Bejneu, Say-Utes, Shetpe and Mangyshlak are exempted from this rule. In these railway stations, the shunting movements are co-ordinated and controlled by the dispatcher (operator) of the station who also admits the journeys.

Passenger trains

At present, 2 pairs of passenger trains circulate on this line. The passenger trains need about 8 hours and 20 minutes from Bejneu to Mangyshlak, stopping in Ustjut, Say-Utes and Shetpe (see Annex 6.4.4.5).

Freight trains

At present, 5 pairs of freight trains circulate between Bejneu - Say-Utes and 7 pairs of freight trains between Say-Utes - Mangyshlak. Block trains need about 12 hours from Bejneu to Mangyshlak (see Annex: 6.4.4.5).

Signalling, automatic train running control, radio communication with trains

All railway stations are equipped with locally operated signal boxes with push button geographical circuitry. There is a continuous track-release installation.
The automatic train running control transmits the positions of the fixed signals to the drivers' cabins.
On the whole line radio communication with trains is possible. All tractive units and trolleys can be reached by the central dispatcher and the dispatchers (operators) of the railway stations via radio communication. Also the tractive units do have radio communication with one another.

Running speeds, load hauled, capacity

Annex 3.1.4.1 lists the existing admissible running speeds according to type of train and state of conservation of the track layout, the maximum load hauled per tractive unit, the possible number of trains based on the existing sequence of trains and the existing passing loops (capacities).

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Inspection of running qualities of wagons

The inspection of running qualities of goods wagons is done in the originating station. For the inspection of one wagon axle, 2 minutes are planned. It is common that the inspection of a train having 50 wagons needs 200 to 400 minutes.
After a journey of 200 to 300 km, another inspection of running qualities of the wagons is done (e.g.: between Bejneu - Mangyshlak, an inspection is done in Say-Utes).

Number of tractive units

In principle, the trains have two tractive units (tandem). Block trains are also driven by 3 tractive units.
In Say-Utes, a change of locomotives is planned.

Hot box detector

There are hot box detectors in the railway stations Ustjurt and Shetpe as well as in the passing loops XP 6, XP 12, XP 15.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Annex 3.1.4.1.

Existing Condition								
station	distance		speed		load hauled		possible number of trains (capacity)	
	km	km	P	F	B / M	M / B	B/M	M/B
Bejneu		11.2	60	60	3200	3500	18.9	20.8
XP 1		11.5		50				
XP 2 G		17.1	40	40				
Ustjurt		44.9	50					
Say-Utes	178.0	93.3			3200	3500	13.1	20.8
XP 9		41.1	60	60				
Km 214			50	40				
Km 223			40					
XP 10 G		16.8	60	60				
Km 258			50	40				
Km 279			40					
XP 12		39.5	60	60				
Km 288								
Km 299		1.5	50	40				
XP 13		13.5	60	60				
Km 310		5.0	50	40				
Shetpe	134.4	17.0	60	60			15.6	12.5
Km 335		24.1	40	40				
XP 15		35.2	60	60				
Mangyshlak	90.8	31.5			3200	2200	15.6	14.8
	403.2	403.2						
(Mangyshlak-Aktau)	19.0							
Section: Mangyshlak-Uzen								
Mangyshlak								
Zhetybay		114.0			3200	3000	7.4	7.0
Uzen		65.0			3200	3000	7.4	7.0
		179.0						

Legend:

P = passenger trains, F = freight trains
B = Bejneu, M = Mangyshlak,

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

PROJECT TITLE	TRACECA Rail Maintenance Central Asia: Infrastructure 2
PROJECT NUMBER	TNREG 9310
MODULE	A Feasibility study for upgrading of the Aktau - Bejneu line in Kazakhstan.

WP 1220	Analysis of former development plans
3.2.	Analysis of previous development plans
3.2.1.	Permanent Way
3.2.2.	Telecommunications
3.2.3.	Signalling

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

3.2. Analysis of previous development plans

3.2.1. Permanent Way

Reconstruction Plans for the Line

The reconstruction of the line was planned in the years 1979 and 1991. It was planned for separate sections as well as for the whole line.

In 1979, a reconstruction project for the section Say-Utes to Mangyshlak was started by the Novosibirsk Giprotransputj. Today, there is no information about this project.

In 1991, the Kazpromtransproject Institute elaborated a project regarding the increase of the capacity of the railway line between Bejneu and Mangyshlak. The reason for this project was the plan of a Dutch oil company to construct a factory with a capacity of 6 million tons per year. Yet this plan of the Dutch company was stopped, and we were informed that the company now plans to build a factory with a capacity between 1.5 and 3 million tons per year. Thus, the planned works to increase the capacity of the line were not completed. Obviously, the other reason for not executing the project is lack of money. As result of this project, we have very good longitudinal maps, maps of the stations and cost estimates at hand.

Works	Costs in Kzt (1991)	Costs in Kzt (1996)	Costs in US $ (1996)
1) embankments and cuttings	59 million	5.310 million	77 million
2) bridges and pipe culverts	41 million	3.690 million	54 million
3) track	108 million	9.720 million	142 million
4) signal and communication	10 million	900 million	13 million
5) rolling stock	15 million	1.350 million	20 million
6) equipment and maintenance	7 million	630 million	9 million
total	240 million	21.600 million	315 million

Project to Protect the Line from the Rising Caspian Sea

Because the level of the Caspian Sea was steadily rising, a project to protect the line from spring tide was prepared. The project was started some years ago, and a dam was build between km 216 and km 221. Then forecasts predicted that the sea level of the Caspian Sea will stop rising in future, and thus the project was stopped. If the sea level should rise again, the project to lengthen and heighten the dam will be continued.

Passenger Line between Aktau and Mangyshlak

The head of the railway line in Mangyshlak told us that he proposed to the ministry to buy the industrial railway line between Mangyshlak and Aktau. We were shown a map of this line including all tracks and asked for it. Unfortunately, this was not possible, because this map (1: 50.000) is said to be secret. Furthermore, it was not possible to obtain cost calculations regarding the project.
We were also told that the industrial railway organisation of Aktau would like to buy the railway line between Bejneu and Mangyshlak.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Mechanised Maintenance Gang

Because the staff was reduced by about 25 % during the past years, the chief of the permanent way district plans to create a mechanised maintenance gang. This gang would be responsible for the whole permanent way district. The main parts of the equipment should be a track car with crane, a ural-car (domestic transport truck) for the workers, an excavator, a tamping machine and modern mobile machines.

3.2.2. Telecommunications

As regards the railway line Bejneu - Mangyshlak, the Planning Institute of the Kazakh Railways disposes of a study on the reconstruction of this line. However, the measures proposed in this study have not been realised. The text below is the English translation of the Russian original text.

Remark: the following text is available at ARE and DE-Consult as copy of the Russian original!

The track section Bejneu - Mangyshlak is equipped with telephone systems for the telephone long distance traffic of the railway, the district telephone traffic of the railway, the local telephone traffic as well as the radio traffic.

This track section has a main overhead line with multiplexing using the systems V-12-3 and V-3-3.

During the planned reconstruction of the railway stations Bejneu, Say-Utes and Shetpe it is planned to maintain during the first construction phase the existing types of telephone traffic and to equip the stations additionally with telephone connections, two-way intercom systems between sets of tracks, radio communication with trains as well as with fire-alarm systems and security installations.

In the planned signal box buildings in the railway stations Say-Utes and Shetpe, the following installations will be installed:

- switchboards for the operational telephone system "KTS"
- railway station radio installations for radio communication with trains, of the type "Transport RS-2"
- sets for two-way intercom systems between sets of tracks, type "SDPS-M"
- panel for the fire-alarm systems and security installation, type "PPS-3"
- power supply source

It is planned to equip the planned buildings in the railway stations Bejneu and Mangyshlak with a telephone system, clocks as well as fire-alarm systems being based on the existing installations.

Second construction phase

As regards upgrading of the railway station Mangyshlak, it is planned to switch the existing telecommunications systems to the new signal-box and to equip the stations additionally with telephone connections, two-way intercom systems between sets of tracks, radio communication with trains, fire-alarm systems and security installations as well as clocks.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

In the planned signal-box, the following telecommunications installations are planned: switchboards for the operational telephone system "KTS", fixed radio installation for radio communication with trains and radio used for directing shunting operations, of the type "Transport RS-2", installation for two-way intercom systems between sets of tracks, type "SDPS-M", panels for the fire-alarm system and security installation, type "PPS-3" and electrical primary clock and power supply sources.

The project includes also the replacement of the existing automatic PABX UATS-49 having 700 call units by the automatic exchange "ATS KE Quant" having 2048 call units. The reason for the replacement of the existing exchange by the new one is that the capacity of the existing exchange makes it impossible to connect additional extensions, and it is technically obsolete and physically worn out, and there are no spare parts available.

Moreover, it is planned to install in the railway station Mangyshlak a professional television set of the type "PTU-75-I". This will support the following technological tasks: control of the work in the sets of tracks of the railway station, check of the rear of the train at incoming trains, track release supervision for incoming trains, checking the setting up of routes, observation of the railway station area, checking if the employment protection regulations are observed regarding staff members working in danger zones.

For all passing points where track reconstruction is planned, it is planned to keep the existing communication devices and add new telephone networks.

3.2.3. Signalling

It was planned to construct at about halfway between XP 16 and Mangyshlak another railway station with a branch line for the direct connection towards Bejneu and Mangyshlak. It was further planned to construct, starting from this station, a new line with a length of about 50 km and 2 intermediate stations towards a petrochemical plant. Construction works were started at the factory, yet they were stopped many years ago.

PROJECT TITLE	TRACECA Rail Maintenance Central Asia: Infrastructure 2
PROJECT NUMBER	TNREG 9310
MODULE	A Feasibility study for upgrading of the Aktau - Bejneu line in Kazakhstan.

WP 1230	Identification of bottlenecks, definition of upgrading strategies
3.3.	Identification of bottlenecks, definition of upgrading strategies
3.3.1.	Permanent Way
3.3.2.	Telecommunications
3.3.3.	Signalling

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

3.3. Identification of Bottlenecks and Definition of Upgrading Strategies

3.3.1. Permanent Way

3.3.1.1. Assessment of the Existing Situation

Assessment of the Technical Characteristics of the Line

For the existing traffic volume, the standard of the line (single-track line with diesel traction and passing loops with a maximum distance of 29 km) is sufficient.
Also for the maximum traffic forecast, the standard of the line is sufficient.

Assessment of Maximum Speed

Because of the speed restrictions to 40 km/h to 60 km/h on the whole line, the travel time for passenger trains between Bejneu and Mangyshlak is 10 hours. The good profile of the line would allow much higher maximum speeds, the only reason for the speed restrictions being the condition of the track.

Assessment of Axle Load and Length of Trains

The maximum axle load on the line is 23 tons, which is also the normal axle load in Kazakhstan.
The line is adequate for the maximum train length (850 m) and weight (3000-3300 t).

Assessment of the Organisational Structure

Several years ago, the permanent way district in Mangyshlak was responsible for the whole line between Bejneu and Mangyshlak. Then a new permanent way district was opened in Bejneu, so each of them is responsible for nearly 200 km of the line. This is a good solution, since today the travel time is about 5 hours for one direction in every district.
On the line, the personnel was reduced by about 25 % during the past 3 years.
In total, there are 0.99 people per one kilometre for permanent way maintenance. 0.83 of them are workers, 0.16 administrative staff (gang foremen, section foremen, central staff in the permanent way district office). Because nearly all works have to be done by hand, this number can be accepted.

Assessment of the Line Geometry

Between Bejneu (km 0) and Say Utes (km 178), the layout of the line is very good. There are nearly no curves and the few existing curves have a minimum radius of more than 1000m. The maximum rising gradient is 8 ‰.
Between Say Utes (km 178) and passing loop N° 8 (km 197), there is a falling gradient of up to 15.6 ‰, and many curves down to a minimum radius of 398 m. It is not necessary to upgrade the geometry, because the distance is only 19 km with a complicate topography.
Between passing loop N° 8 (km 197) and Mangyshlak (km 403), the line has a good profile. The maximum rising gradient is about 8‰, and there are only 3 curves with a radius of less than 500 m.

Tacis
This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Assessment of the Caspian Sea Level

We were told that in the past the sea level of the Caspian Sea rose.
So we searched information about the forecast regarding the Caspian Sea level and found some in the Kazakh Scientific-Research Institute of Environmental Monitoring and Climate (KazNIIMOSK).

Since there exist exact data regarding the Caspian Sea level in 1900, it can be seen that the sea level fell from about -25 m in 1900 to -29 m in 1977. The reason for this proved to be the construction of hydrological power stations at the Volga river having large artificial lakes. During this period, less water came from the Volga river into the Caspian Sea. In 1977, the lakes and the ground around the lakes were saturated, but the Volga brought as much water as before 1900. Since the surface of the Caspian Sea was smaller, the water could not evaporate. This was the reason that since 1977 the sea level of the Caspian Sea steadily has been rising. Today, the sea level of the Caspian Sea is -26.6 m.
In 1993, the Institute predicted that the sea level will not rise in future, because, the surface of the Caspian Sea being large enough, all the water brought by the rivers will evaporate. Last year's values, however, show that this is not quite true, since the Caspian Sea is still slowly rising. We think that it will rise a little bit during the next years.

Unfortunately, it was not possible to get copies of the development of the Caspian Sea level. We paid 30 $ for this information, yet copies would cost 300 $.

There are two depression areas on the line where the level of the track is near the Caspian Sea level. The first is between km 203 and km 230, where the Caspian Sea is nearest to the line (about 200 m). A new dam was constructed to protect the existing embankment between km 216 and km 221. The project to enlarge the dam, in case the Caspian Sea will rise further, still exists.
The second depression area is between km 384 and km 399. This section is protected by a natural dam between the Caspian Sea and the railway line.

Assessment of Bridges and Pipe Culverts

Sometimes there are heavy rainfalls in this area. Because the natural ground is very dry, the water cannot trickle away, but all the water is flowing on the surface. This water develops much power. Thus, sometimes the water causes erosions in the river-bed. Where the bridges or pipe culverts are too small, the water filtrates through the embankment or destroys entering or outlet of the pipe culverts. In 1993, a heavy rainfall destroyed the bridge at km 339.5 and several hundred metres of the embankment in this section, mainly because the old bridge was too small.
The Kazgiprozheldortrans Institute showed us a study of 1991 listing the bridges and pipe culverts showing such problems. During the field mission, we visited some of the listed bridges near Mangyshlak, but the technical solutions proposed by the study seem to be overdimensioned. Therefore, a separate study should be elaborated.
The structure of the existing bridges are in an acceptable condition.

Assessment of Embankments and Cuttings

According to the rules in force, the 5.8 m width of the subgrade is too small. However, there are no problems as regards the ballast bed, only the track bench being too small.
The cuttings are in good condition, also the embankments are in good condition, except for the sections where pipe culverts or bridges are too small.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Assessment of Drains

The existing catch water drains are in good condition, however in some sections new ones will have to be built.

Assessment of Level Crossings

The level crossings are often in poor condition. But since there is hardly car traffic, this is not a major problem.

Assessment of Rails and Joints

The 65 kg/m rails are in good condition; the 50 kg/m rails are in normal condition.
Since the total load of the 43 kg/m rails during their life cycle is too high, today they are no longer permitted. The admissible load is 350 million tons, but in this case the actual load amounts to about 370 million tons.
The joints are in normal condition, only where different rail profiles come together, the joints are in very bad condition.

The track layout is in surprisingly good condition taken the fact that there is a sandy ballast bed.

Assessment of Sleepers

The main problem is that nearly all sleepers (about 90%) are 30-years old wooden sleepers. They are nearing the end of their life. The statistics of permanent way district inspectors show that about 30 % of them are in bad condition (bad condition means that the sleepers are absolutely rotten), and also most of the other sleepers are in bad condition). The rules of the railway organisation hold that, if 50 % of the sleepers are in bad condition, the line has to be closed.
The concrete sleepers between km 17 and km 34 (nearly 4 %) are in normal condition taking into account their age of about 20 years.
The rest of the sleepers (about 6 %) was replaced by wooden sleepers during the past years, however never in closed parts, but one by one. The new sleepers are in good condition.

Assessment of Fastenings

The wooden sleepers have only spikes. At the 30-year old wooden sleepers, the bottom plates are broken. So the spikes cannot fasten the rail tightly. Today, spikes are absolutely not a good fastening. Fastening should be by bolts and screws. Thus, it would not be necessary to use rail anchors at every sleeper. The existing rail anchors are often situated between two sleepers, and thus they are non-effective.

The fastenings at the concrete sleepers are in normal condition.

Assessment of Ballast

94 % of the line are filled with used sand ballast. This sand ballast makes impossible to apply a modern maintenance method (cleaning and tamping). Therefore, if the track will be renewed, the sand ballast should be completely exchanged. Also the 10 km asbestos ballast will have to be replaced.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Assessment of Stations and Passing Loops

The number of stations, the passing loops and their number of tracks as well as the track lengths are sufficient.

Assessment of Turnouts

The rails, tongues and diamonds of most of the turnouts are in good condition and well maintained. The staff of the permanent way district knows that turnouts constitute the center part of a line, and so they permanently changed defective turnouts or parts of them. But there is the same problem as on the track: the sleepers were never replaced, and screws and bolts are used only at tongues and diamonds, in the other parts of the turnouts the rail is fixed to the sleeper by means of spikes.

Assessment of Platforms and Buildings

The existing buildings and platforms may not be of European standard, but they are in acceptable condition.

Assessment of Working Methods

Nearly all works have to be done by hand. For the most time, only parts of the track or turnouts were replaced, not the whole track or turnout. So it was impossible to use track renewal machines. Because there is sand ballast on the greatest part of the line, it was impossible to use ballast cleaning machines and it was not customary to use tamping machines. Since there is not enough money for replacing whole parts of the track, the usual working method is to change only a couple of bad sleepers. But with this working method, it will never be possible to raise the maximum speed.

3.3.1.2. Availability of track material

It is possible to get every track material needed, if there is enough money to buy it.
The wooden sleepers are bought in Russia, because Kazakhstan is not well-wooded. Mostly, used larch wooden sleepers have been inserted.
There are 3 concrete sleeper factories in Kazakhstan, each of them having a relatively small output of about 50,000 sleepers per year. One factory is situated near Aktyubinsk. The concrete sleepers do not have the same high quality as European prestressed concrete sleepers. For this project, it is proposed to increase the output of the concrete sleeper factory near Aktyubinsk.
The rails, turnouts and other steel material are bought in Russia.
Today, stone ballast from Aktyubinsk is used.

3.3.1.3. Identification of Bottlenecks

Connection to Aktau

There is only one city near the line - Aktau - having about 165,000 inhabitants. The passenger trains stop in Mangyshlak, which is about 18 km outside of Aktau. Thus, all passengers have to travel by bus from Aktau to Mangyshlak.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Maximum Speed (Condition of the Track)

Today, the maximum speed is 60 km/h, the reason being the condition of the track. Because the geometry of the line has a good profile, there will be no problems when increasing the speed after the track will have been renewed.

Working Methods

The usual method is to change only one or the other bad sleeper. Therefore, the condition of the track will never be good, and it will not be possible to raise the speed. For a modern track maintenance, a stone ballast bed has to be used.

Fastening of the Track

The spikes used might be cheap, but it is not economic to use them as fastening. Every type with screws and bolts would be better and more economical, because the service life of the sleepers would be longer.

Dimension of Bridges and Pipe Culverts

Some pipe culverts and bridges are too small, so the water can destroy pipe culverts, bridges and the embankment in case of heavy rainfalls. Also sometimes there are erosions in the river-bed near the line, which could be dangerous for bridges and pipe culverts.

The Caspian Sea Level

In case the Caspian Sea level should continue to rise, it would be necessary to enlarge the existing dam on the section km 215 and km 225. If the Caspian Sea will not rise to more than -26 m, as was predicted by the observatory, it would not be necessary to do anything at the dam.

3.3.1.4. Definition of Upgrading Strategies

Aktau to Mangyshlak

For passenger trains, the existing line between Aktau and Mangyshlak should be extended. There is the same track condition as on the line Bejneu - Mangyshlak. We think that it is not important who owns the line, because it must also be possible to circulate passenger trains on a private line and pay for the usage. At the existing station in Aktau, a new station building should be constructed.

Renewal of Track and Turnouts

Because most of the rails and sleepers are in bad condition, whole track sections should be renewed by means of a platov crane. Also the existing sand ballast must be replaced. Existing 65 kg/m rails being in good condition could be re-used in the same track on other track sections. The same applies to new wooden sleepers which could be re-used in secondary tracks in stations. All new sleepers, either wooden or concrete sleepers, must have bolts to fix the bottom plate to the sleeper and the rail to the bottom plate. Also the pandrol fastening system would be a good solution for this line.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

When rehabilitating the track, a long welded track without joints should be constructed up to a minimum radius of 700 m in case of wooden sleepers and up to 300 m in case of concrete sleepers. If, in some sections, it is not possible to lay long-welded tracks, the joints have to be on twin sleepers.
The quality of the rails and sleepers with the fastenings should be checked, since the price is nearly the same as in Europe.
In general, concrete sleepers should be used. In sections where there are often sand-storms, wooden sleepers (about 20 %) should be used.
In all existing turnouts, the sleepers have to be replaced. In the parts of the turnout with spikes, screws and bolts should be used to fasten the rail to the sleepers. The steel parts of the turnouts should be replaced to the same amount as during the past 10 years.
After track renewal and renewal of the sleepers in turnouts, the maintenance works could be reduced and done by means of maintenance machines.

The speeds being possible after having renewed the track are listed in Annex 6.1.3.

The resulting travel time for passenger trains between Bejneu and Mangyshlak would be nearly half of that of today, namely about 5 hours.

Maintenance and Renewal of Bridges and Pipe Culverts

Where the existing pipe culverts or bridges are too small, new or additional larger ones have to be constructed.
If entering or outlet of pipe culverts are destroyed, the pipe culvert has to be rehabilitated.
Where there are erosions in the river-bed, a protection has to be constructed, so that the erosion cannot destroy the bridge or pipe culvert.

Protection Dam for the Caspian Sea

There was a second project of building a larger dam than the existing one to protect the line from the Caspian Sea. This project was stopped, as the forecast regarding the Caspian Sea level predicted that the sea level would stop rising. This decision seems to be right, however, if the Caspian Sea level will rise again, a new project will has to be worked out.

3.3.1.5. Time Estimates

Aktau - Mangyshlak

The opening of the line between Aktau and Mangyshlak to passenger traffic does not constitute a technical problem, but rather an economic decision. The works of track renewal and construction of a station building in Aktau will last for several months.

Renewal of Track and Turnouts

Because there are about 90 % wooden sleepers having an age of more than 30 years and being in bad condition, the track is nearing the end of its life. The existing working method has to be changed as soon as possible. The large number of wooden sleepers being replaced individually is not economical over a longer period. Therefore, every year about 60 km will have to be replaced, which will take 6 years. This renewal must start as soon as possible. The best sections of the track have a maximum life of about 7 years. So the works have to be done between 1998 and 2003.
The same schedule is valid regarding the replacing of the sleepers in turnouts.

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Bridges and Pipe Culverts

Certainly, nobody knows when there will be again heavy rainfalls. So the bridges and pipe culverts have to be constructed as soon as possible. The best would be to do this at the same time as track renewal.

3.3.2. Telecommunications

The existing communication systems and installations were dimensioned for the demand that could be foreseen at the time of the construction of the railway line. They still are sufficient and in good condition. Nevertheless, there are the following problems:

- largely name and address of the producers are not known,
- procurement of spare parts not possible,
- obsolete technology which needs a high level of maintenance
- no possibility to enlarge the system, not even by system components of Western companies, since the systems do not correspond to international standards.

In order to maintain the operability of the installations, according to the method "make one out of two", components (transistors, diodes, condensators, etc.) are unsoldered out of less important installations and are inserted in systems being urgently necessary. Therefore, it is foreseeable that at a determined point in time the system will no longer be operable.

Thus, the only solution that can be offered is to completely renew nearly all communication systems, which is urgently recommended. The concrete measures are described in detail in the section 3.4.2.

3.3.3. Signalling

All signalling installations are properly maintained and thus in good condition and fit for operation. With the exception of the 8 passing loops which were built 14 years ago, the installations stem from the time of the construction of the railway line, which means today they are 30 years old. Also the overhead line is in good condition, except for the area near the Caspian Sea, which is endangered by floods.

Apart from the rehabilitation of the 30-year-old installations, no direct improvement measures are necessary.

As regards maintenance of the signalling installations along this line as well as the continuing line up to Tehte, there is an office including a workshop in Mangyshlak. Here, maintenance work and working up of the relays are done. 76 workers are planned for these works.

At present, there are no suppliers of signalling equipment. All spare parts have to be purchased in Russia (abroad).

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

PROJECT TITLE	TRACECA Rail Maintenance Central Asia: Infrastructure 2
PROJECT NUMBER	TNREG 9310
MODULE	A Feasibility study for upgrading of the Aktau - Bejneu line in Kazakhstan.

WP 1240	Definition of volume of repair and reconstruction works
WP 1250	Description of proposed programme of works
3.4.	Definition of volume of repair and reconstruction works and description of proposed programme of works
3.4.1.	Permanent Way
3.4.2.	Telecommunications
3.4.3.	Signalling

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

3.4. Definition of Volume of Repair and Reconstruction Works and Description of Proposed Programme of Works

3.4.1. Permanent Way

3.4.1.1. Description and Volume of Renewal Works

Track and Turnouts

Except for the part from km 17 to km 34, the sleepers have to be replaced, which means they have to be replaced on a length of 386 km.
All rails weighing 43kg/m or 50 kg/m have to be changed. These are 290 km.
So it is necessary to renew:

96 km sleepers
290 km track including sleepers

In general, 65 kg/m rails and concrete sleepers are to be used. Only in sections with sandstorms and sand in the ballast bed, wooden sleepers should be used, thus there is no danger of breaking of sleepers. These areas constitute about 20% of the line. Also the ballast bed has to be replaced in all sections. These works have to be done by means of a Platov crane.

During the past years, at 15 turnouts per year all parts of the turnouts except for the sleepers have been replaced. Thus, these parts of the turnouts are in normal condition. It is recommended to continue to replace 15 turnouts on a yearly basis, but together with the sleepers, and to insert new fastenings by bolts instead of spikes.

Therefore, it is necessary to renew during the next 6 years:

100 complete turnouts
100 sleepers of turnouts with new fastening

The 100 new turnouts should be used only in the main track. The old turnouts of the main track could be used with new sleepers for secondary tracks in stations.

Pipe Culverts and Bridges

The study of 1991 which we received from the Kazgiprozheldortrans Institute showed a number of problems at bridges and pipe culverts. Sometimes the solutions presented in the study seem to be overdimensioned. This situation requires an exact study to calculate the length of new bridges.

There is erosion in the river bed at 37 bridges or pipe culverts. These bridges and pipe culverts are in good condition, but, if the erosion cannot be stopped, the bridges will have been destroyed in several years, in case there should be heavy rainfall. So the river bed has to be protected from erosion with stones or partly by a retention installation in the river bed.
These works have to be done at the following mileage points: 13.3, 17.4, 39.9, 182.2, 194.4, 198.9, 207.8, 213.8, 221.0, 222.6, 223.2, 236.8, 238.5, 246.7, 263.8, 270.0, 272.3, 277.5, 278.2, 279.4, 286.9, 290.0, 290.6, 291.1, 298.4, 300.4, 307.2, 307.9, 324.3, 334.5, 337.5, 338.9, 350.6, 366.4, 370.9, 377.5, 379.2

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

At 52 pipe culverts, inlets and outlets are destroyed, which means they have to be rehabilitated.
These works have to be done at the following mileage points: 128.6, 181.4, 182.8, 183.0, 183.2, 183.4, 183.8, 184.3, 184.8, 185.0, 185.8, 187.0, 187.2, 187.5, 187.8, 189.7, 190.4, 192.0, 192.2, 210.3, 212.2, 215.7, 219.8, 257.2, 262.6, 270.9, 272.8, 279.6, 288.7, 289.0, 289.1, 289.4, 291.5, 292.2, 292.8, 293.3, 293.6, 293.7, 303.2, 304.2, 308.4, 308.8, 326.4, 350.9, 352.1, 368.6, 369.4, 376.6, 390.7, 391.3, 391.5, 395.4,

85 pipe culverts have too small a diameter, therefore new and larger pipe culverts have to be constructed.
These works have to be done at the following mileage points: 180.6, 182.5, 183.4, 184.0, 185.3, 185.9, 186.0, 186.3, 186.7, 188.0, 188.2, 188.4, 189.1, 189.4, 189.9, 190.1, 190.8, 191.0, 191.3, 191.8, 192.7, 193.3, 193.7, 203.8, 205.9, 206.4, 208.7, 209.1, 210.9, 211.1, 214.4, 215.0, 215.4, 219.1, 221.5, 222.0, 222.7, 251.5, 252.9, 256.8, 257.0, 257.8, 261.5, 267.8, 268.7, 269.0, 273.5, 274.3, 275.7, 277.5, 280.7, 282.0, 283.7, 285.0, 285.8, 288.8, 289.6, 289.7, 292.0, 292.4, 294.4, 295.7, 301.5, 302.2, 302.9, 303.5, 309.2, 318.9, 321.9, 325.1, 325.6, 326.2, 329.5, 330.6, 332.7, 333.0, 341.5, 355.8, 372.7, 374.6, 391.8, 393.2, 397.7, 398.5, 399.6,

19 bridges are too short, thus they have to be enlarged. The existing bridges will form a part of the longer bridges:

km	old length	new length	height of embankment
195.183	25.6 m	71 m	6.0 m
196.722	44.4 m	89 m	4.0 m
209.730	22.1 m	98 m	2.6 m
213.250	14.1 m	20 m	3.0 m
220.685	14.1 m	20 m	2.6 m
229.486	41.3 m	72 m	3.8 m
231.872	19.2 m	38 m	1.5 m
247.332	29.3 m	38 m	4.6 m
266.338	22.2 m	35 m	2.5 m
283.490	16.0 m	28 m	2.0 m
306.415	14.1 m	26 m	2.0 m
319.867	14.1 m	26 m	2.8 m
328.200	14.1 m	20 m	1.1 m
331.676	19.2 m	31 m	1.2 m
343.430	65.9 m	95 m	4.0 m
347.697	14.1 m	32 m	3.2 m
350.658	22.4 m	41 m	2.5 m
352.852	19.2 m	31 m	2.8 m
359.710	65.9 m	96 m	3.5 m

30 pipe culverts or bridges have too small a diameter, so it is necessary to build a larger bridge instead of the existing one:

km	old diameter	new length	height of embankment
179.462	4.0 m	45 m	
188.921	2x2.0m	101 m	16.3 m
201.329	2.0 m	22 m	2.7 m
202.827	1.5 m	22 m	2.5 m
205.027	5.0 m	46 m	2.1 m

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

217.526	2x1.5 m	41 m	3.9 m
223.950	1.5 m	41 m	3.6 m
224.927	1.5 m	22 m	3.0 m
234.487	5.0 m	34 m	2.5 m
238.560	6.0 m	47 m	1.8 m
244.492	2x2.0 m	56 m	7.9 m
254.386	2x2.0 m	41 m	3.3 m
258.090	3x2.0 m	41 m	4.7 m
259.574	1.0 m	22 m	1.8 m
265.742	1.0 m	22 m	2.0 m
276.297	1.5 m	22 m	2.3 m
284.788	1.5 m	22 m	2.8 m
286.324	1.5 m	22 m	2.3 m
287.677	1.5 m	22 m	2.4 m
297.477	2.0 m	22 m	3.0 m
311.435	2.0 m	28 m	2.4 m
322.899	2x1.5 m	22 m	2.2 m
325.896	5.0 m	22 m	2.7 m
335.414	1.5 m	28 m	2.4 m
341.024	1.5 m	22 m	2.8 m
344.592	1.5 m	22 m	2.7 m
346.159	2x1.5 m	28 m	2.7 m
354.446	8.7 m	28 m	2.8 m
375.959	5.0 m	22 m	1.9 m
389.548	2.0 m	46 m	4.0 m

3.4.1.3. Necessary Equipment

The machines required for renewal of track and turnouts (platov crane and excavator) are available. But there are no modern tamping and re-ballasting machines, which will be necessary for the rehabilitation works, and later on for maintenance work. Since the capacity of the machine will be higher than needed, it can also be used on other lines (about 50% capacity).

For the track renewal machine (platov crane), it is necessary to construct two assembly sites for the production of track panels, having a roof, a crane, containers for the workers etc.

Based on the proposal made by the chief of the permanent way district to create a mobile mechanised gang, this gang should have the following equipment: a track car with crane, an ural car for the workers, an excavator and several mobile track machines such as mobile motor screw drivers, mobile motor drilling machines, generatic sets, rail drilling machines, etc.

3.4.1.3. Options for Upgrading Standards

All prices regarding the work are calculated on the basis that only the existing track will be renewed, which means that all works have to be done during a closure of only about six hours per day.

The alternative would be to make a wider subgrade of about 4 metres and to construct a new line along the existing one. Thus, the works could be done in less than half the time. The local price for the construction of a new dam or cutting amounts to about US $ 3.6 per m3. Per metre of railway line, about 10 m3 of civil works have to be calculated, which makes US $ 36 per metre. The local manpower costs regarding the renewal of 1 metre of track amount to about US $ 3.

In the study of 1991, a cost calculation was made to enlarge the subgrade. During the track renewal, the old ballast bed (sand) will have to be taken out of the track and put alongside the existing embankment, which will enlarge the subgrade by about half a metre. This should be sufficient as regards the future traffic volume and maximum speed.

Another option would be to use old track material. This would be cheaper, however not more economical, because the service life would be reduced.

3.4.1.4. Volume of Present Maintenance Works

The strategy of today's maintenance works shall ensure that it is possible to use the line also in future, when there will be no investments in track renewal. Based on the present maintenance procedures, annually about 20,000 wooden sleepers, rails of about 6,500 m track, broken base plates, joints and the rails of about 15 turnouts will be replaced. The costs of track material make up about 80 % of the maintenance costs, that of workers about 20 % of the maintenance costs.

3.4.1.5. Schedules of Maintenance and Repair during the next 20 Years

In future, maintenance works will depend very much on the volume of track renewal during the next couple of years. If bad sleepers and rails will be replaced during the next years, it will not be necessary to replace them for the next 20 years. So the standard of the line would be better (speed), and at the same time the costs for maintenance would be less than today.
On the other hand, if there is no track renewal, the costs of track maintenance will be higher than today, because it will be necessary to replace more sleepers and rails per year than today.

3.4.1.6. Priorities of the Different Components

Based on the analysis of the present situation and the definition of the volume of repair and reconstruction work, we recommend the following activities without order of priority.

The programme of track renewal is the only technical solution to improve the standard of the railway line.

The programme of pipe culvert repair and construction of longer bridges is important for protecting the line from breakdowns in case of heavy rainfalls.

The opening of the line between Aktau and Mangyshlak to passenger traffic, however, rather is a political and economic question, from the technical point of view there are no problems.

3.4.2. Telecommunications

3.4.2.1. General

As has already been mentioned in chapter 3.3.2., nearly all telecommunications systems of the line Bejneu - Mangyshlak will have to be renewed. The fact that this line constitutes only part of the West Kazakh railway network is important for the planning of new systems and their integration into the existing network. This integration not only is necessary at the two railheads of this line, but also at other places in Kazakhstan, since there is also a direct communication between the line's railway stations and Atyrau, Aktjubinsk and Almaty. Thus, it will also be necessary to invest in telecommunication in locations of the Kazakh Railway that are not situated along the line.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

The following list (according to chapter 3.1.2) comprises a summary of the proposed measures, which are then described in detail:

- Overhead line and cable: replacement of the existing systems by optical cables
- Transmission technology: replacement of the analogue carrier-frequency systems by digital PDH and SDH systems,
- Telephone connections along the line: replacement of the existing terminal equipment for farmer lines by terminals for a party line with digital signalling
- Operational telephone systems: replacement of the existing installations by modern, digital systems
- Radio installations:
  - ⇒ Radio communication with trains: retaining the present system
  - ⇒ Radio communication in stations: replacement of the existing installations
- Telephone network: replacement of the existing analogue switching centres by digital telephone exchanges. The Mangyshlak Station is excepted, since it already disposes of a digital system
- Telegraph and data transmission network:
  - ⇒ replacement of the existing telegraph switching centre in Mangyshlak by a computer-controlled system
  - ⇒ replacement of the existing analogue voice-frequency telegraph systems by digital transmission systems
  - ⇒ replacement of the old mechanic teleprinters by systems based on PCs
  - ⇒ retaining the existing PC-based teleprinter terminals and
  - ⇒ retaining the pack-unpack device in Mangyshlak
- Other technical telecommunications installations:
  - ⇒ loud-speaker equipment: renewal
  - ⇒ clock installations: renewal
  - ⇒ fire-alarm systems: renewal
  - ⇒ hot-box detectors: renewal
  - ⇒ ticket issuing machines: retaining
  - ⇒ power supply installations: renewal
- Measuring devices: the existing measuring devices partly have to be renewed and completed by those being necessary for the maintenance of digital systems

3.4.2.2. Overhead line and cable

There is an overhead line on each side of the railway line - one for telecommunications and one for signalling and power supply department. Along the Caspian Sea, the overhead line route for signalling and power supply department is scoured on a section of 40 km, and thus its static is endangered. In order to solve this problem and at the same time reduce the maintenance effort for two overhead lines, in future there shall only be one overhead line. For this, two variants exist. The third variant would be to construct a grounding conductor for all three applications. The variants one and two (one overhead line for all three services) would be to shift, in the endangered section along the Caspian Sea, the overhead line for the power supply department to the other side of the railway line.

The suspension of the aerial cables in case of the variants 1 and 2 is always done in the same manner. The factory length of the cables is 2 km. Rolls are mounted to the poles by means of straps, and over these, the cable is stretched. Every two kilometres, the cable is anchored over anchor spirals (in the following, these poles are called anchor poles). The sag in the sections between the poles is regulated automatically.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

This method of mounting has the advantage that trees falling onto the cable route, will not damage the cable, since the latter gets the corresponding length reserves from the neighbouring sections and, after removal of the obstacle, will get back into the initial position undamaged. Also in case of accidents, in which a pole is knocked over, the cable will remain intact, as could be seen in case of an accident at the Hungarian Railways (MAV).

The static of the existing overhead line poles is sufficient. Only the anchoring poles would need an additional protection through anchoring the pole on both sides in the direction to the overhead line route.

Variant 1: Optical aerial cable

To the standard poles of the power supply department, an optical self-supporting 12-fibre aerial cable is mounted. The fibres are allocated as follows:

- 2 fibres for the local communication from station to station (telecommunication service),
- 2 fibres for the telecommunication Bejneu - Mangyshlak (telecommunication service),
- 2 fibres for the remote control of the signal boxes and block posts (signalling),
- 2 fibres for the public network,
- 2 fibres for the Ministry of the Interior, and
- 2 fibres as reserve.

The signalling pilot wires existing on these poles can be removed, since the corresponding signals will be transmitted via the optical cable.

This variant does not include a telephone link along the line as exists today from km 124 up to Mangyshlak. Today, it is possible to enter this telephone link at any place of the line via a connecting device. Since the whole line is equipped with radio communication with trains, and also the breakdown train disposes of a corresponding device, it seems to be justifiable to do without this line telephone link, all the more because even today there is none in the section Bejneu up to km 124.

Similar to variant 2, local telephone links (for example from a signal box to the pointsmen) could be realised along the line via local copper aerial cables or by placing buried cables in the conduit of signalling being necessary for the supply of light signals at the ends of the railway stations. Since the distances are very short, and thus also the investment costs are not very high, these costs are included in the statement of costs per railway station in the form of a lump sum. The necessary excavation work is included in the schedule of costs of signalling.

In each railway station and passing loop, the 12 fibres are fully connected, and thus are accessible for measuring and inspection. Fibres to which no system is connected (e.g. telecommunication Bejneu - Mangyshlak) are patched through by means of plug connections. However, at the block posts only the two fibres planned for signalling are entered.

Variant 2: Optical aerial cable supplemented by a copper aerial cable

If a line telephone link should be necessary, an own copper connection will be required. Two wires of an overhead line cannot be used for this, if these should be mounted to the only remaining overhead line pole for the power supply department, since in this case the influence would be far too high. Thus, for such a communication link only a self-supporting copper aerial cable disposing of 10 pairs is possible.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

To be able to also enter the line telephone link in-between of the stations, at adequate distances (e.g. every 2 kilometres) telephone sets have to be mounted either in a cabinet being fixed to the pole or in a tin box and to be connected to the corresponding copper wires. Unlike the optical cable, the distance between the anchor poles for the copper cable amounts to 1 km.

Variant 3: Replacement of both overhead lines by a common buried cable system for all three applications

Obviously, this variant is the most expensive one as regards investment. Yet, the maintenance effort will be less and it bears the advantage that the installation will be protected against damage by weather, accidents or vandalism. In a conduit having a width of 60 cm, the three following cables will be posed:

- optical buried cable with 12 fibres,
- telecommunication copper cable with 10 pairs, and
- power cable with 3 x 10 kV.

The width of the conduit results from the necessity to observe a corresponding distance between telecommunications and power cable.

As regards the entering of the optical fibres for signalling into the block posts as well as putting telephone sets into cabinets or boxes along the line, the same applies as for the variants 1 or 2.

3.4.2.3. Transmission technology

For transmission technology, only digital systems are possible. According to the demand of communication along the line, three levels of hierarchy are necessary:

- long-range communication system (Bejneu - Mangyshlak without field equipment) being composed of one SDH node at each of the two railheads and a digital connection with 155 Mbit/s,
- local system between the railway stations by means of PDH nodes and a transmission speed of 8 Mbit/s, and
- system for low-speed data transmission with 50 baud up to 9.6 kb/s.

Long-range communication system

In both railway stations - Bejneu and Mangyshlak - one SDH node will be installed. The two nodes are directly connected - without field equipment - via two optical fibres having a transmission speed of 155 Mbit/s. At the tributary station, it is possible to connect 63 2 Mbit or four 34 Mbit links or a corresponding mix thereof.

Local system

As regards the connection between the railway stations and passing loops, a system with 8 Mbit/s is planned. In each railway station or passing loop one node will be necessary. In the sense of branch and re-seizure technology, these nodes make possible any access to max. 4 x 2 Mbit or to one or more of the 64 kb-channels existing per 2 Mbit system.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Each node is a flexible multiplexer which can collect 64 kb-channels to one 2Mbit signal and also 4 x 2 Mbit to one 8 Mbit signal in a very flexible way.

The 2 Mbit channels are used for the connection of the telephone exchanges, while the 64 kb-channels serve for the other telephone connections between the individual places (e.g. party lines, data circuits or hot standby for voice-frequency telegraph systems, etc.).

System for low-speed data transmission

Along railway lines, a multitude of communications links operating with a speed lower than 64 kb/s is necessary. These include low-speed data connections, telegraph connections and connections for remote control systems, etc.

For these connections, a 64 kb sub-multiplexer is used. This sub-multiplexer summarises asynchronous and synchronous connections with a transmission speed of 50 baud up to 9.6 kb/s in one 64 kb signal, which is transmitted via the local system to the next node. Within the 64 kb bandwidth, the low-speed data transmissions can be combined and summarised in any form. Special compressing procedures enable also voice transmission including signalling in one channel of 9.6 kb.

Also on this sub-multiplexer level, the individual connection can be branched and re-seized in the nodes in any form. These sub-multiplexers can also be directly connected to optical fibres by means of adequate converters.

Such a sub-multiplexer is planned for each railway station and each passing loop, which, because of its capability regarding branching and re-seizure, can work in both directions (incoming and outgoing).

3.4.2.4. Telephone links along the line

The following telephone connections exist along the whole line:

- dispatcher lines from the local dispatcher in Atyrau to all local station inspectors,
- farmer lines for local station inspectors without inclusion of the central dispatcher in Atyrau, but having access to important offices in the whole Kazakh railway network / Aktjubinsk, Almaty),
- farmer lines for the permanent way maintenance staff, and
- farmer lines for the maintenance staff for communication facilities and signalling installations.

Not every railway station or passing loop disposes of telephone stations for all farmer lines. We propose a uniform equipment for the new system.

A modern party line system shall be used, for which 2-wire or 4-wire connections are enough along the line, whereby all stations are interconnected in a farmer line. Multi-address calls and group calls as well as intrusion to a busy line in case of an accident are possible. Signalling is done in the voice band by seizing a 150 Hz frequency band in which signalling is done via FSK modulation. As transmission paths between the railway stations and/or passing loops, 64 kb-channels of the 8 Mbit system are used. Since this is a four-wire circuit, the individual railway stations need an own installation for the branch line to local installations. In the following, this is called branch device. Moreover, for the conversion of signalling on the line to a common telephone set, another device - local device - is needed.

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Each railway station and each passing loop needs one branch device per farmer line and one local device per station. Any common telephone with dial or push-button dialling telephone can be used as telephone set.

Since not only positions on the line Bejneu - Mangyshlak are connected to the mentioned farmer lines, investments are also necessary at locations that can be reached via these links. Via carrier-frequency systems, the party line can also be prolonged to remote locations, and there it can be connected to a telephone station. For this, per location and farmer line a branch device and per station a local device with standard telephone set are necessary.

According to the present project, the following locations are affected

- Atyrau,
- Aktjubinsk,
- Almaty, and
- the railway stations of the line Mangyshlak - Uzen:
  - ⇒ Eralievo and
  - ⇒ Zhetybai.

It seems to be adequate and necessary to equip these two railway stations with installations of the new party line, since otherwise the new party lines and the old farmer lines would have to be interconnected in Mangyshlak. This would necessitate the development of additional interfaces, which will result in high costs and a low operational reliability. The prolongation of the party lines to the locations being outside of the railway line Bejneu - Mangyshlak can be executed via existing analogue TF-channels.

3.4.2.5. Operational telephone systems

An operational telephone system serves as central communication equipment in each railway station and each passing loop. All have to be renewed, however, using only digital systems. It has to be possible to connect to these systems:

- farmer lines,
- local telephone links with local battery working,
- public network extensions,
- radio communication with trains,
- radio communication in railway stations,
- two-way intercom systems,
- loud-speaker installations and
- clocks needed for synchronisation.

A modular expansion of the system has to be possible, in order to be able to connect the number of lines being necessary according to the size of the railway station. Thus, the statement of costs lists installations of different sizes for the individual railway stations and passing loops (differing number of lines that can be connected planned).

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

3.4.2.6. Radio installations

Radio communication with trains

In the former Soviet Union, a uniform radio communication with trains has been developed and constructed in the 2 MHz range, being a uniform standard within the whole CIS. Thus, it makes no sense to renew it on the section, which - compared to the whole network of the Kazakh Railways - is relatively short. Moreover in case of a new system, the tractive units would have to be equipped with a second radio equipment along this line. As soon as these locomotives would be assigned to other lines or other locomotives would come out of the workshops, it might be that locomotives circulate on the line which do not have the corresponding radio equipment. This problem can only be solved by means of an overall plan being applied in the whole country.

Today, the fixed stations for radio communication with trains in the railway stations and passing loops are connected to the dispatcher line. Since these installations have to be renewed in any case, at each fixed station for radio communication with trains - which means in each railway station and passing loop - an interface between the new dispatcher line and the old radio communication with trains will be necessary.

Radio communication in railway stations

The radio equipment for shunting operation and technical services must be renewed. A 20 % increase in equipment is supposed. If, however, the number of locomotives used should increase, additional mobile radio equipment would be necessary.

The renewal could be done in the same frequency range (2 meter band). Due to a better transmission quality, a shift to the 70 cm band should be considered. This, however, requires a new frequency assignment by the authority.

3.4.2.7. Telephone network

The existing telephone exchanges in the railway stations

- Bejneu (400 subscribers),
- Usturt (10 subscribers),
- Say-Utes (70 subscribers) and
- Shetpe (80 subscribers)

have to be renewed. Only the installation in Mangyshlak corresponds to the state of the art. We propose digital ISDN PABXs. A 20% increase in subscribers has to be expected. Since today only 10 subscribers are connected in Usturt, for this railway station no system is planned. The subscribers will be connected to the next installation in Say-Utes via the existing 8 Mbit system, which also disposes of user-network interfaces.

Individual neighbouring installations will be interconnected by means of a 2 Mbit-connection of the 8 Mbit system. Bejneu disposes of several direct 2 Mbit connections of the 155 Mbit system to Mangyshlak.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

3.4.2.8. Telegraph and data transmission network

The teleprinter exchange in Mangyshlak (20 extensions) has to be replaced by a computer-aided system. A slight increase in the number of subscribers has to be considered.

The existing voice-frequency telegraph connections will be replaced by digital connections of the sub-multiplexer network (see chapter 3.4.2.3). As regards the number, this can be done one-to-one. Because of the modular design of the sub-multiplexer and the fact that there is sufficient transmission capacity, it will any time be possible to increase the number at low costs.

The old mechanic teleprinters (at present 6) have to be replaced by devices being equipped with PC.

The PC-based systems that exist already today as well as the pack-unpack device installed in Mangyshlak can be further used.

In this context, the question arises if one should really renew teleprinter installations or rather install an X 400 system. The same applies to the data network. Why keep this network? Wouldn't it be better to plan a modern X 25 network or Frame Relay System?

As regards these questions, the same holds true as for radio communication with trains. Teletype and data transmission networks can only be considered for the whole country. It is only useful to introduce new technologies in an overall plan for the Kazakh Railways.

3.4.2.9. Other technical telecommunication installations

Loud-speaker equipment

At present, the following systems exist:

railway station	amplifier	loud-speaker	stations
Bejneu	1	36	2
Say-Utes	1	10	1
Shetpe	1	10	1
Mangyshlak	3	36	4

The systems have to be renewed according to modern technology. Systems should be planned which not only fulfil the functions of a loud-speaker installation, but also that of a two-way intercom system. Thus, the number of stations will increase. Also the number of loud-speakers will have to be increased.

Clock installations

At present, the following systems exist:

railway station	master clocks	secondary clocks
Say-Utes	1	4
Shetpe	1	4
Mangyshlak	2	26

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

The systems have to be renewed, planning electronic quartz clocks as master clocks. The number of secondary clocks may slightly increase. Moreover, in Bejneu a clock installation of the same size of that in Mangyshlak is to be constructed.

Fire-alarm systems

At present, there are 21 systems with 3 detectors each. The installations have to be renewed.

Hot-box detectors

The five existing detectors have to be renewed according to modern technology. Moreover, it should be considered to supplement these installations by detectors locating blocking brakes.

Ticket issuing machines

The existing ticket issuing machines correspond to the state of the art. Thus, at present no renewal is necessary. A renewal would only be useful in a country-wide project, similar to radio communication with trains and telegraph and data transmission networks.

Power supply

Because of their age, the existing 21 power supply installations (rectifiers and batteries) for 24 V have to be renewed. The existing 60 V installations are no longer needed, since modern communication systems use 48 V. Thus, for all locations where modern systems shall be installed, a 48 V installation has to be planned.

3.4.2.10. Measuring devices

The number of existing measuring devices is sufficient for the technology used. However, the measuring devices to be generally used, as e.g. universal measuring device, do not correspond to the state of the art. Thus we propose to acquire a number of measuring devices that corresponds to the number of personnel.

It is rather difficult to elaborate a concrete proposal for the individual systems, since many communication systems dispose of special test and measuring devices. Thus, the statement of costs includes only a lump sum.

Tools and measuring devices for optical cable and transmission equipment are excepted from this procedure, since there are international standards for measuring systems.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

3.4.3. Signalling

The present signalling system on the line Bejneu - Mangyshlak corresponds to today's train circulation. Because of the high standard of the equipment, it would be possible to handle much more traffic than is presently planned with the present installations.

The disadvantage of this high-grade equipment being overdimensioned as regards the present traffic lies in the high maintenance effort. In general, no construction measures are necessary as regards the planned increase in the number of trains. The old age of part of the installations, however, necessitates the renewal of the signalling installations.

When renewing the signalling technique, the national signalling system has to be taken into consideration. Nevertheless, for all new signalling installations, the interface signalling installation / track-release installation and signalling installation / train-running control system has to be made in such a way that it will be possible to later shift to other systems being easier maintained.

When renewing the automatic block posts, longer block sections and thus a lower number of block posts are to be executed. Despite the planned increase of the running speed, this will not lead to a reduction of the line capacity, it will, however, enormously reduce the number of installations to be newly constructed.

At the renewal of the installations it has to be considered that there are 2 parallel overhead lines. By digitisation and employing fibre cables, a common transmission and communication line shall be created. Thereby, the present transmission line can be adapted accordingly. However, in the Caspian Sea area, this common line has to be positioned at the side of the railway line that is at the remote side of the sea.

The following installations should be rehabilitated:

(installations marked by *, are only 14 years old)

Atyrau:	remote control part Bejneu - Mangyshlak
Bejneu - XP 1:	5 automatic block posts, to be reduced to 2
XP 1:	* signal box (4 tracks, 9 turnouts)
XP 1 - XP 2:	5 automatic block posts, to be reduced to 2
XP 2:	signal box (2 tracks, 3 turnouts)
XP 2 - XP 3:	5 automatic block posts, to be reduced to 3
XP 3:	* signal box (3 tracks, 5 turnouts)
XP 3 - Usturt:	6 automatic block posts, to be reduced to 3
Usturt:	signal box (3 tracks, 8 turnouts)
Usturt - XP 5:	5 automatic block posts, to be reduced to 3
XP 5:	* signal box (3 tracks, 5 turnouts)
XP 5 - XP 6:	5 automatic block posts, to be reduced to 3
XP 6:	signal box (2 tracks, 3 turnouts)
XP 6 - XP 7:	5 automatic block posts, to be reduced to 3
XP 7:	* signal box (3 tracks, 5 turnouts)
CP 7: - Say-U:	6 automatic block posts, to be reduced to 4
Say-Utes:	signal box (4/6 tracks, 18 turnouts)
Say-U - XP 8:	5 automatic block posts, to be reduced to 3
XP 8:	signal box (2 tracks, 4 turnouts)
XP 8: - XP 9:	3 automatic block posts, to be reduced to 1

XP 9:	* signal box (3 tracks, 5 turnouts)
XP 9 - XP 10:	7 automatic block posts, to be reduced to 5
XP 10:	signal box (2 tracks, 6 turnouts)
XP 10: - XP 11:	4 automatic block posts, to be reduced to 2
XP 11:	* signal box (3 tracks, 5 turnouts)
XP 11 - XP 12:	5 automatic block posts, to be reduced to 3
XP 12:	signal box (2 tracks, 3 turnouts)
XP 12 - XP 13:	5 automatic block posts, to be reduced to 3
XP 13:	* signal box (3 tracks, 5 turnouts)
XP 13 - Shetpe:	4 automatic block posts, to be reduced to 3
Shetpe:	signal box (8/10 tracks, 34 turnouts)
Shetpe - XP 14:	4 automatic block posts, to be reduced to 2
XP 14:	* signal box (3 tracks, 5 turnouts)
XP 14 - XP 15:	5 automatic block posts, to be reduced to 3
XP 15:	signal box (2 tracks, 3 turnouts)
XP 15 - XP 16:	6 automatic block posts, to be reduced to 4
XP 16:	* signal box (3 tracks, 7 turnouts)
XP 16 - Mang.:	10 automatic block posts, to be reduced to 4

The new signalling installations should be constructed in such a way that the maintenance efforts will be relatively low. For this, a computer technology has to be used. The connection of the installations with one another as well as with the central train control system is done via digital transmission channels. Thus, two optical fibres for signalling are planned in the telecommunications cable to be newly placed. The required terminals are seen as part of the signalling installation. Moreover, it is important that the digital connection between Bejneu and Atyrau is realised via copper links of the telecommunications installations existing in this section.

From the technical point of view it would be appropriate to execute the rehabilitation of the entire signalling system during one construction phase (no adaptation of existing installations necessary, common design of all installations). From the economic point of view, an extension in 2 stages of construction seems to be suitable. During the first, the installations dating from the time of the construction of the railway should be renewed. Only after the completion of this stage, the remaining installations should be renewed in a second stage. The renewal of the block installations can be done by sections between the two large stages of construction.

It is not necessary to renew the signalling installations on whole sections. This should be done station by station over a longer period. The following procedure should be observed:

The first step will be to create a remote-control system in the central train control system in Atyrau for the whole railway line as well as digital transmission paths from Atyrau up to XP 3. Then, the remote-control system of XP 1 and XP 3 as well as the intermediate signal box including remote control part of XP 2 will have to be completed. As regards these installations, a longer dummy run for the training of the operational and maintenance staff has to be planned, with the light signals being covered. The automatic block posts should remain the same for the time being.

During the next step, the digital transmission path up to XP 5 has to be enlarged. In Usturt, the intermediate signal box including the remote control part and the remote-control system of XP 5 have to be completed and put into operation including the corresponding part in the central train control system in Atyrau.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

These steps have to be repeated until the last installation in XP 15 including the remote-control system in XP 16 will have been renewed.

The renewal of the level-crossing remote control is done at the same time as the corresponding railway stations and automatic block posts, respectively.

This procedure has the benefit that the oldest installations are renewed first, there will, however, be some provisionals during the construction and transition time (adaptation of the computer-technology remote control to the existing, 14-year-old installations). It allows the remote control of all signalling installations from the central train control system in Atyrau during the entire transition time.

The renewal of the block installations that are only supervised in the central train control system is done independently of the other renewal works.

For the new signalling installations, a computer technology has to be used, and there has to be a digital connection to the central train control system disposing also of computer technology. Because of the high-quality training level of the maintenance staff being presently employed, also when using the most modern computer technology, there should be no problems after having trained the staff accordingly.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Module A

**Feasibility Study for Upgrading of
Aktau - Beineu Line**

4 Economic and Financial Viability

Annexes

4 Economic and Financial Viability

Introduction

This section of the report concerns the economic and financial aspects of the measures recommended in other sections. It concerns the costs for new construction work to be undertaken as well as the necessary equipment.

The forecasted costs consist of an estimation of the capital outlays which will be necessary to bring the line up to the required standard as detailed in the relevant technical sections of this study. Based on these capital requirements a further estimate has been made of the annual costs involved in maintaining the line at the level to be attained. A further calculation has then been made of the annual depreciation charges against revenues in line with generally used rates and in accordance with directives in place within the Railway. The latest instructions being Directive No. 1072 of 22nd October 1990, published in Moscow.

The calculations and observations below are made by the Consulting experts and based on information acquired in Almaty and on visits to the area by the technical experts involved and the staff of the local consultant. The actual figures used for 1995 and the first half of 1996 are as obtained from the Railway by the local partner.

For information purposes Table 4.1- 1 reproduces the figures for the Atyrau District as obtained. A calculation was made to annualise the figures based on an average of the results of the last seven quarters. Table 4.1- 2 is an estimation of the average annual results on the line based on the figures obtained. No figures were available for infrastructure costs for 1995. Therefore the total costs as obtained were allocated to the infrastructure and operations based on the results for 1996.

In considering the figures available it should be taken into consideration that the current financial situation of the Railways in Kazakstan has caused essential repairs and maintenance, which would normally be undertaken as routine measures, to be neglected. As a result the historically reported amounts for repairs and maintenance do not represent the charges necessary in a normal functioning operation. Therefore, any estimates for maintenance must take into account the normal costs involved and cannot be based on the historical figures available.

4.1 Evaluation of Construction and Equipment Costs

The outlays for the recommended measures to be taken are shown in Table 4.1- 3. These figures are as calculated by the experts involved in accordance with the explanations contained in other sections of this report.

4.2 Evaluation of Maintenance Costs

The experts for Permanent Way, Telecommunications and Signalling made calculations of the annual maintenance requirements when estimating the construction costs. These are shown in Table 4.1- 3.

These costs represent the necessary annual outlays to maintain the line at the performance level reached, once the required investments have been made.

4.3 Future Revenue

A calculation of the impact on revenues according to the scenarios outlined in another section of this report are shown in Table 4.1- ?. The current revenues have been extrapolated according to their expected percentage increase over the current level, in line with the forecast increase in traffic over the present volumes.

4.4 Economic and Financial Profitability

Tables 4.1- ? to 4.1- ? show the effect of the recommended investments on the forecast results up to 2005 for the various scenarios. Included in this exercise is the effect of undertaking the investments even though there is no improvement in the revenue figures.

The calculations have been made in the first instance without taking loan repayments and interest payments into account, then subsequently assuming the total investments are to be fully financed over 40 years at varying rates of interest. The rates of interest assumed are 5%, 7% and 9%.

The calculations show that the Railway will not be in a position to fund the investments unless there is a substantial increase in revenues.

Without taking loan and interest factors into account the Railway will in the best case only be in a profit position in the year 2000, assuming that construction begins in 1998. In the worst case this stage will only be reached in 2002.

When taking the repayment of loans and interest into consideration the best case scenario indicates a break-even point in the year 2002, assuming 5% interest, whereas the worst case indicates a break-even point beyond the year 2005.

Annexes

4.1-1

TRACECA - Central Asia: Module A

Atyrau District

Assessment of Revenues and Expenses: (In millions)

	Total 1995		1st Half Yr. 1996		3rd Qtr Plan 1996		Total		Annualised	
Transport Volumes:				2,323.70		1,350.00		3,673.70		4,898.27
Freight; Tkm nett				2,070.70		1,200.00		3,270.70		4,360.93
Passengers; Pass-km				253.00		150.00		403.00		537.33
	Tenge	$US	Tenge	$US	Tenge	$US	Tenge	$US	Tenge	$US
Revenues:	3,056.00	48.51	1,764.00	26.93	1,072.00	15.87	5,892.00	91.31	3,366.86	52.18
Freight	2,383.68	37.84	1,375.92	21.00	836.16	12.38	4,595.76	71.22	2,626.15	40.70
Passenger	672.32	10.67	388.08	5.92	235.84	3.49	1,296.24	20.09	740.71	11.48
Revenue/km.(T/$ per km.)										
Freight (Tkm)			0.664	0.010	0.697	0.010	0.676	0.010	0.676	0.010
Passenger (Pass.km.)			1.534	0.023	1.572	0.023	1.548	0.023	1.548	0.023
Operating Costs:	2,669.00	42.37	1,928.00	29.43	888.00	13.15	5,485.00	84.95	3,134.29	48.54
Payroll	896.00	14.22	632.00	9.65	287.00	4.25	1,815.00	28.12	1,037.14	16.07
Social Benefits	283.00	4.49	225.00	3.43	86.00	1.27	594.00	9.20	339.43	5.26
Materials & Spares	384.00	6.10	489.00	7.46	154.00	2.28	1,027.00	15.84	586.86	9.05
Fuel	293.00	4.65	187.00	2.85	94.00	1.39	574.00	8.90	328.00	5.08
Energy	90.00	1.43	48.00	0.73	28.00	0.41	166.00	2.58	94.86	1.47
Depreciation	162.00	2.57	101.00	1.54	38.00	0.56	301.00	4.68	172.00	2.67
Administration & Other	561.00	8.90	246.00	3.76	201.00	2.98	1,008.00	15.64	576.00	8.94
Profit/Loss	387.00	6.14	-164.00	-2.50	184.00	2.72	407.00	6.36	232.57	3.64

Table 4.1.2

TRACECA - Central Asia: Module A

Aktau - Beineu Line

Assessment of Revenues and Expenses: (In millions)

	Total 1995		1st Half Yr. 1996		Total		Annualised	
	Tenge	$US	Tenge	$US	Tenge	$US	Tenge	$US
Revenues:	642.00	10.19	293.00	4.47	935.00	14.66	623.33	9.78
Freight	500.76	7.95	228.54	3.49	729.30	11.44	486.20	7.62
Passenger	141.24	2.24	64.46	0.98	205.70	3.23	137.13	2.15
Infrastructure:	637.28	10.12	342.41	5.23	979.69	15.34	653.13	10.23
Track Maintenance	215.41	3.42	115.74	1.77	331.15	5.19	220.77	3.46
Signalling Equipt. Maint.	122.84	1.95	66.00	1.01	188.84	2.96	125.89	1.97
Stations & Other Maint.	87.16	1.38	46.83	0.71	133.99	2.10	89.33	1.40
Locomotive Maint.	91.49	1.45	49.16	0.75	140.65	2.20	93.77	1.47
Carriage Maint.	120.38	1.91	64.68	0.99	185.06	2.90	123.37	1.93
Operating Costs:	110.04	1.75	197.43	3.01	307.47	4.76	204.98	3.17
Payroll	36.94	0.59	17.60	0.27	54.54	0.86	36.36	0.57
Social Benefits	11.67	0.19	13.92	0.21	25.59	0.40	17.06	0.27
Materials & Spares	15.83	0.25	109.26	1.67	125.09	1.92	83.39	1.28
Fuel	12.08	0.19	41.85	0.64	53.93	0.83	35.95	0.55
Energy	3.71	0.06	0.15	0.00	3.86	0.06	2.57	0.04
Depreciation	6.68	0.11	-4.68	-0.07	2.00	0.03	1.33	0.02
Administration & Other	23.13	0.37	19.33	0.30	42.46	0.66	28.31	0.44
Total Costs:	747.32	11.86	539.84	8.24	1,287.16	20.10	858.11	13.40
Profit/Loss	-105.32	-1.67	-246.84	-3.77	-352.16	-5.44	-234.77	-3.63

Table 4.7-3

TRACECA Central Asia: Module A

Construction Costs ($US'000)

	1998	1999	2000	2001	2002	2003	2004	2005	Total
Permanent Way	16,000.0	32,000.0	32,000.0	32,000.0	32,000.0	11,546.0			155,546.0
Telecommunications	999.7	999.7	999.7	999.7	999.7	999.7	999.7	999.7	7,997.3
Signalling	4,100.0	4,100.0	4,100.0	4,100.0	4,100.0	4,100.0	4,100.0	4,100.0	32,800.0
Total	21,099.7	37,099.7	37,099.7	37,099.7	37,099.7	16,645.7	5,099.7	5,099.7	196,343.3

The telecommunications costs have been allocated over eight years. This may be subsequently revised.

Maintenance Costs

Permanent Way	3,629.0	3,333.0	3,037.0	2,741.0	2,445.0	2,149.0	2,149.0	2,149.0	21,632.0
Telecommunications									
Signalling									
Total	3,629.0	3,333.0	3,037.0	2,741.0	2,445.0	2,149.0	2,149.0	2,149.0	21,632.0

These costs have not yet been established

Depreciation

Permanent Way	640.0	1,920.0	3,200.0	4,480.0	5,760.0	6,221.8	6,221.8	6,221.8	34,665.5
Telecommunications	50.0	100.0	149.9	199.9	249.9	299.9	349.9	399.9	1,799.4
Signalling	273.3	546.7	820.0	1,093.3	1,366.7	1,640.0	1,913.3	2,186.7	9,840.0
Total	963.3	2,566.6	4,169.9	5,773.3	7,376.6	8,161.7	8,485.1	8,808.4	46,304.9

TRACECA Central Asia: Module A

Forecast Evolution of Traffic:

1995				
Freight		**Tenge**	**$US**	
Tonnage ('000)	1990			
Revenue (in millions)		500.76	7.95	
Passenger				
Revenue 1995		141.24	2.24	

2005							
	Low				**High**		
		Tenge	**$US**			**Tenge**	**$US**
Scenario A							
Tonnage	8,100				9,670		
% Increase	407.04			% Increase	485.93		
Revenue		2,038.27	32.36			2,433.34	38.63
Scenario B							
Tonnage	10,240				12,110		
% Increase	514.57			% Increase	608.54		
Revenue		2,576.78	40.91			3,047.34	48.38
Scenario C							
Tonnage	12,340				14,210		
% Increase	620.10			% Increase	714.07		
Revenue		3,105.22	49.30			3,575.78	56.77
Passenger							
% Increase	11.50				12.70		
Revenue		157.48	2.50			159.18	2.52

TRACECA Central Asia: Module A									
Aktau - Beineu Line									
Forecast Revenues and Expenses (in $USmill.)									
Without Increase in Revenues									
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**Total**
Current Revenues	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	78.24
Current Costs	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	107.20
Additional Costs	4.59	5.90	7.21	8.51	9.82	10.31	10.60	10.96	67.91
Maintenance	3.63	3.33	3.04	2.74	2.45	2.15	2.15	2.15	21.63
Depreciation	0.96	2.57	4.17	5.77	7.38	8.16	8.46	8.81	46.27
Net Result	-8.21	-9.52	-10.83	-12.13	-13.44	-13.93	-14.22	-14.58	-96.87
Scenario A Low									
Revenues	9.78	13.36	16.95	20.53	24.11	27.69	31.28	34.86	178.56
Annual Costs	17.99	19.30	20.61	21.91	23.22	23.71	24.00	24.36	175.11
Net Result	-8.21	-5.94	-3.66	-1.39	0.89	3.98	7.27	10.50	3.45
Scenario A High									
Revenues	9.78	14.26	18.74	23.22	27.71	32.19	36.67	41.15	203.72
Annual Costs	17.99	19.30	20.61	21.91	23.22	23.71	24.00	24.36	175.11
Net Result	-8.21	-5.04	-1.86	1.31	4.48	8.48	12.66	16.79	28.61

N.B. Requires addition of operating costs!
for Scenarios A-C

Scenario B Low	1998	1999	2000	2001	2002	2003	2004	2005	Total
Revenues	9.78	14.58	19.39	24.19	29.00	33.80	38.61	43.41	212.76
Annual Costs	17.99	19.30	20.61	21.91	23.22	23.71	24.00	24.36	175.11
Net Result	-8.21	-4.72	-1.22	2.28	5.78	10.09	14.60	19.05	37.65
Scenario B High									
Revenues	9.78	15.65	21.53	27.40	33.28	39.15	45.03	50.90	242.72
Annual Costs	17.99	19.30	20.61	21.91	23.22	23.71	24.00	24.36	175.11
Net Result	-8.21	-3.65	0.92	5.49	10.06	15.44	21.02	26.54	67.61
Scenario C Low									
Revenues	9.78	15.78	21.79	27.79	33.79	39.79	45.80	51.80	246.32
Annual Costs	17.99	19.30	20.61	21.91	23.22	23.71	24.00	24.36	175.11
Net Result	-8.21	-3.52	1.18	5.87	10.57	16.08	21.79	27.44	71.21
Scenario C High									
Revenues	9.78	16.85	23.93	31.00	38.07	45.14	52.22	59.29	276.28
Annual Costs	17.99	19.30	20.61	21.91	23.22	23.71	24.00	24.36	175.11
Net Result	-8.21	-2.45	3.32	9.08	14.85	21.43	28.21	34.93	101.17

The above calculations do not take into account loan repayments or interest costs.

Effect of Loan Repayments								
	1998	1999	2000	2001	2002	2003	2004	2005	Total
Without Increase in Revenues									
Net Results as Calculated	-8.21	-9.52	-10.83	-12.13	-13.44	-13.93	-14.22	-14.58	-96.87
Repayment & Interest - 5%	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-104.36
Revised Net Results	-21.26	-22.56	-23.87	-25.18	-26.49	-26.98	-27.27	-27.62	-201.23
Net Results as Calculated	-8.21	-9.52	-10.83	-12.13	-13.44	-13.93	-14.22	-14.58	-96.87
Repayment & Interest - 7%	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-125.47
Revised Net Results	-23.90	-25.20	-26.51	-27.82	-29.13	-29.61	-29.91	-30.26	-222.34
Net Results as Calculated	-8.21	-9.52	-10.83	-12.13	-13.44	-13.93	-14.22	-14.58	-96.87
Repayment & Interest - 9%	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-150.40
Revised Net Results	-27.01	-28.32	-29.63	-30.93	-32.24	-32.73	-33.02	-33.38	-247.27

	1998	1999	2000	2001	2002	2003	2004	2005	Total
Scenario A Low									
Net Results as Calculated	-8.21	-5.94	-3.66	-1.39	0.89	3.98	7.27	10.50	3.45
Repayment & Interest - 5%	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-104.36
Revised Net Results	-21.26	-18.98	-16.71	-14.43	-12.16	-9.06	-5.77	-2.54	-100.91
Net Results as Calculated	-8.21	-5.94	-3.66	-1.39	0.89	3.98	7.27	10.50	3.45
Repayment & Interest - 7%	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-125.47
Revised Net Results	-23.90	-21.62	-19.34	-17.07	-14.79	-11.70	-8.41	-5.18	-122.02
Net Results as Calculated	-8.21	-5.94	-3.66	-1.39	0.89	3.98	7.27	10.50	3.45
Repayment & Interest - 9%	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-150.40
Revised Net Results	-27.01	-24.74	-22.46	-20.19	-17.91	-14.82	-11.53	-8.30	-146.95
Scenario A High									
Net Results as Calculated	-8.21	-5.04	-1.86	1.31	4.48	8.48	12.66	16.79	28.61
Repayment & Interest - 5%	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-104.36
Revised Net Results	-21.26	-18.08	-14.91	-11.73	-8.56	-4.57	-0.38	3.75	-75.75
Net Results as Calculated	-8.21	-5.04	-1.86	1.31	4.48	8.48	12.66	16.79	28.61
Repayment & Interest - 7%	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-125.47
Revised Net Results	-23.90	-20.72	-17.55	-14.37	-11.20	-7.21	-3.02	1.11	-96.86
Net Results as Calculated	-8.21								
Repayment & Interest - 9%	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-150.40
Revised Net Results									

	1998	1999	2000	2001	2002	2003	2004	2005	Total
Scenario B Low									
Net Results as Calculated	-8.21	-4.72	-1.22	2.28	5.78	10.09	14.60	19.05	37.65
Repayment & Interest - 5%	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-104.36
Revised Net Results	-21.26	-17.76	-14.26	-10.77	-7.27	-2.95	1.56	6.01	-66.71
Net Results as Calculated	-8.21	-4.72	-1.22	2.28	5.78	10.09	14.60	19.05	37.65
Repayment & Interest - 7%	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-125.47
Revised Net Results	-23.90	-20.40	-16.90	-13.40	-9.91	-5.59	-1.08	3.37	-87.82
Net Results as Calculated	-8.21	-4.72	-1.22	2.28	5.78	10.09	14.60	19.05	37.65
Repayment & Interest - 9%	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-150.40
Revised Net Results	-27.01	-23.52	-20.02	-16.52	-13.02	-8.71	-4.20	0.25	-112.75
Scenario B High									
Net Results as Calculated	-8.21	-3.65	0.92	5.49	10.06	15.44	21.02	26.54	67.61
Repayment & Interest - 5%	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-104.36
Revised Net Results	-21.26	-16.69	-12.12	-7.56	-2.99	2.40	7.98	13.50	-36.75
Net Results as Calculated	-8.21	-3.65	0.92	5.49	10.06	15.44	21.02	26.54	67.61
Repayment & Interest - 7%	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-125.47
Revised Net Results	-23.90	-19.33	-14.76	-10.19	-5.63	-0.24	5.34	10.86	-57.86
Net Results as Calculated	-8.21	-3.65	0.92	5.49	10.06	15.44	21.02	26.54	67.61
Repayment & Interest - 9%	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-150.40
Revised Net Results	-27.01	-22.45	-17.88	-13.31	-8.74	-3.36	2.22	7.74	-82.79

	1998	1999	2000	2001	2002	2003	2004	2005	Total
Scenario C Low									
Net Results as Calculated	-8.21	-3.52	1.18	5.87	10.57	16.08	21.79	27.44	71.21
Repayment & Interest - 5%	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-104.36
Revised Net Results	-21.26	-16.56	-11.87	-7.17	-2.48	3.04	8.75	14.40	-33.15
Net Results as Calculated	-8.21	-3.52	1.18	5.87	10.57	16.08	21.79	27.44	71.21
Repayment & Interest - 7%	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-125.47
Revised Net Results	-23.90	-19.20	-14.50	-9.81	-5.11	0.40	6.11	11.76	-54.26
Net Results as Calculated	-8.21	-3.52	1.18	5.87	10.57	16.08	21.79	27.44	71.21
Repayment & Interest - 9%	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-150.40
Revised Net Results	-27.01	-22.32	-17.62	-12.93	-8.23	-2.72	2.99	8.64	-79.19
Scenario C High									
Net Results as Calculated	-8.21	-2.45	3.32	9.08	14.85	21.43	28.21	34.93	101.17
Repayment & Interest - 5%	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-13.05	-104.36
Revised Net Results	-21.26	-15.49	-9.73	-3.96	1.80	8.39	15.17	21.89	-3.19
Net Results as Calculated	-8.21	-2.45	3.32	9.08	14.85	21.43	28.21	34.93	101.17
Repayment & Interest - 7%	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-15.68	-125.47
Revised Net Results	-23.90	-18.13	-12.36	-6.60	-0.83	5.75	12.53	19.25	-24.30
Net Results as Calculated	-8.21	-2.45	3.32	9.08	14.85	21.43	28.21	34.93	101.17
Repayment & Interest - 9%	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-18.80	-150.40
Revised Net Results	-27.01	-21.25	-15.48	-9.72	-3.95	2.63	9.41	16.13	-49.23

Depreciation Rates: Former Soviet Railways

Based on Directive No. 1072 of 22 October 1990, Published in Moscow		
Type of Asset	**Expected Life**	**Depreciation (%)**
Cranes	13 yrs	7,7
Portable Cranes	8 yrs	12,5
Machinery for Wagons	12 yrs	8,3
Signalling Equipt.	15 yrs	6,7
Telephone Systems	20 yrs	5,0
Locomotives Electric	33 yrs	3,3
Locomotives Diesel	25 yrs	4,0
Wagons Hopper	25 yrs	4,0
Wagons: Covered and Flat	33 yrs	3,3
Wagons Tank	33 yrs	3,3
Special Wagons	20 yrs	5,0
Buildings	50 yrs	2,0
Permanent Way	25 yrs	4,0
Sleepers; Concrete	20 yrs*	5,0
Sleepers; Wood	15 yrs*	6,7
Tools	4 yrs	25,0
Other Production and Commercial Equipt	10 yrs	10,0

*From actual experience.

PROJECT TITLE	TRACECA Rail Maintenance Central Asia: Infrastructure 2
PROJECT NUMBER	TNREG 9310
MODULE	A Feasibility study for upgrading of the Aktau - Bejneu line in Kazakhstan.

WP 1310	Construction and equipment costs
4.1.	Evaluation of Construction and Equipment costs (input)
4.1.1.	Permanent Way
4.1.2.	Telecommunications
4.1.3.	Signalling

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Currencies:
1 ECU = 13.23 ATS as of 29.8.96
1 US $ = 10.396 ATS as of 29.8.96
1 US $ = 68.5 KZT in September 96

All costs in US $

4.1. Evaluation of Construction and Equipment costs

4.1.1. Permanent Way

4.1.1.1. Detailed Direct Costs for Track (Material, Workers, Machines, Wagons)

Remark:

We received cost estimates from different sources in Kazakhstan. Due to the fact that the figures varied considerably, a thorough plausibility check has to be made.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Track Material	unit	$/unit	local costs	foreign costs	origin
rail 65 kg/m	to	850.00		850.00	Russia
rail 65 kg/m (64.72 kg/m)	**m**	**55.00**		55.00	
fishplates	to	850.00		850.00	Russia
fishplate (29.5 kg)	each	25.00		25.00	
fishplate bolts	to	1,500.00		1,500.00	Russia
fishplate bolt (1 kg)	each	1.50		1.50	
2 coil spring washer	to	1,400.00		1,400.00	Russia
2 coil spring w. (0.09 kg)	each	0.13		0.13	
per track joint (twin sl.)	**compl.**	**172.26**		172.26	Russia
concrete sleeper	each	28.00	28.00		Kazakhstan
pad under bottom plate	each	1.40	1.40		Kazakhstan
ribbed bottom plate	to	880.00		880.00	Russia
ribbed bottom plate (7 kg)	each	6.15		6.15	
sleeper bolts	to	1,500.00		1,500.00	Russia
sleeper bolt (0.7 kg)	each	1.05		1.05	
2 coil spring w. (0.09 kg)	each	0.13		0.13	Russia
T-head bolts	to	1,500.00		1,500.00	Russia
T-head bolt (0.46 kg)	each	0.69		0.69	
clip	to	1,300.00		1,300.00	Russia
clip (0.66 kg)	each	0.86		0.86	
pad under rail	each	0.79	0.79		Kazakhstan
flat washer (flat plates)	each	0.22		0.22	Russia
insulated bushes	each	0.27	0.27		Kazakhstan
concrete sleeper + fasten.	**compl.**	**57.56**	33.46	24.10	Rus+Kaz
wooden sleeper impregnated	each	22.70		22.70	Russia
new screwed fastening	each	30.00		30.00	Russia
wooden sleeper + bolts	**compl.**	**52.70**		52.70	Russia
wooden sleeper impregnated	each	22.70		22.70	Russia
base plate + spikes	compl.	17.00		17.00	Russia
rail anchors	compl.	5.00		5.00	Russia
wooden sleeper + spikes	**compl.**	**44.70**		44.70	Russia
insulated joints	**compl.**	**15.00**		15.00	Russia
ballast(stone) incl. transp.	**m3**	**8.50**	8.50		Aktjubinsk
1km track (concrete sl.)	**compl.**	**239,800.00**	78,566.00	161,234.00	
1km track (wooden +bolts)	**compl.**	**230,858.00**	17,000.00	213,858.00	
1km track (wooden + spike)	**compl.**	**216,138.00**	17,000.00	199,138.00	
turnout incl. sleeper	**compl.**	**25,400.00**		25,400.00	Russia
turnout sleeper + fasten.	**compl.**	**6,000.00**		6,000.00	Russia

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

direct costs for worker	unit	$/unit
in desert area		only local costs
worker	1 hour	0.82
worker	1 month	140.00
worker	1 year	1,680.00
1 km track renewal	3800 h	3,116.00
renewal of 1 turnout	800 h	656.00

machines,	total direct costs in $
locomotives, wagons	only local
per 1 km track renewal	10,000.00

4.1.1.2. Indirect Costs of Track Renewal

All indirect costs are local costs

Manpower

Costs of workers
+ 30 % Social Benefits
+ 2 % Danger Money
+ 00 % Regional Bonus (incl. in costs of workers 60 %)
+ 25 % Workers Bonus
+ 23.5 % Overhead
+ 0.5 % Contingencies
= 81 % Indirect Manpower Costs

Material

Costs of Material
+23.5 % Overhead
+ 0.5 % Contingencies
= 24 % Indirect Material Costs

Machines, other costs

Costs of Machines, Locomotives
+ 0.5 % Contingencies
+ 0.5 % Indirect Costs of Machines, Locomotives

4.1.1.3. Total Costs of Track Renewal

1 km Track Renewal with Concrete Sleepers

description	total direct	Direct local	% indirect	**foreign costs**	**local costs**	**total costs**
material	239,800	78,566	24%	161,234	136,118	297,352
manpower	3,116	3,116	81%		5,640	5,640
mach., loc.	10,000	10,000	0.5%		10,050	992
total	252,916	91,682		**161,234**	**151,808**	**313,042**

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

1 km Track Renewal with Wooden Sleepers with Bolts

description	direct total	direct local	% indirect	**foreign costs**	**local costs**	**total costs**
material	230,858	17,000	24%	213,858	72,406	286,264
manpower	3,116	3,116	81%		5,640	5,640
mach., loc.	10,000	10,000	0.5%		10,050	10,050
total	243,974	30,116		**213,858**	**88,096**	**301,954**

1 km Track Renewal with Wooden Sleepers with Spikes

description	direct total	direct local	% indirect	**foreign costs**	**local costs**	**total costs**
material	216,138	17,000	24%	199,138	68,873	268,011
manpower	3,116	3,116	81%		5,640	5,640
mach., loc.	10,000	10,000	0.5%		10,050	10,050
total	229,254	30,116		**199,138**	**84,563**	**283,701**

1 km Sleeper Renewal with Concrete Sleepers

description	direct total	direct local	%indirect	**foreign costs**	**local costs**	**total costs**
material	129,800	78,566	24%	51,234	109,718	160,952
manpower	3,116	3,116	81%		5,640	5,640
mach., loc.	9,000	9,000	0.5%		9,045	9,045
total	141,916	90,682		**51,234**	**124,403**	**175,637**

1 km Sleeper Renewal with Wooden Sleepers with Bolts

description	direct total	direct local	%indirect	**foreign costs**	**local costs**	**total costs**
material	120,858	17,000	24%	103,858	46,006	149,864
manpower	3,116	3,116	81%		5,640	5,640
mach., loc.	9,000	9,000	0.5%		9,045	9,045
total	132,974	29,116		**103,858**	**60,691**	**164,549**

Each Renewal of Turnouts with Sleepers

description	direct total	direct local	%indirect	**foreign costs**	**local costs**	**total costs**
material	26,400	1,000	24%	25,400	7,336	32,736
manpower	656	656	81%		1,187	1,187
loc + wagon	100	100	0.5%		100	100
total	27,156	1,756		**25,400**	**8,623**	**34,023**

Each Renewal of Sleepers and Fastening of Turnouts

description	direct total	direct local	%indirect	**foreign costs**	**local costs**	**total costs**
material	7,000	1,000	24%	6,000	2,680	8,680
manpower	656	656	81%		1,187	1,187
loc + wagon	100	100	0.5%		100	100
total	7,756	1,756		**6,000**	**3,967**	**9,967**

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

4.1.1.4. Equipment costs

All equipment costs are foreign costs.

Modern Track Tamping and Levelling Machines in total			**2,300,000 $**
1	Unimat Compact 08-16-3s-split	1,600,000 $	
1	re-ballasting machine SSP 203	700,000 $	
Equipment for 2 mechanised mobile gangs in total			**2,450,000 $**
2	Track cars with OBW 10 crane	1,600,000 $	
2	Ural-cars for 20 workers	100,000 $	
2	Generatic sets	10,000 $	
2	Excavators	400,000 $	
30	Sleeper screw drivers	150,000 $	
6	Sleeper drilling machines	40,000 $	
6	Rail drilling machines	40,000 $	
2	Rail bending device machines	10,000 $	
	Hand equipment	100,000 $	
Equipment for 2 assembly sites for track panels			**500,000 $**

4.1.1.5. Total Investment Costs

The costs of bridges and pipe culverts were stated by the Kazgiprozheldortrans Institute. The costs of the equipment were estimated according to West European standard, except for the Ural Car.

In general, it has to be said that local material for track and bridges is only somewhat cheaper than in Europe, but does not have the same quality.

So there are two possibilities either to reduce the costs or to improve the quality:

1. Engage a general contractor to execute the whole rehabilitation project

2. High-quality material is available in Western Europe at slightly higher prices. The following calculation summarises the total investment costs in US$.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

description	unit costs in US $			number	total amount in US $ 1,000		
	local	foreign	total		local	foreign	total
track							
track renewal with concrete sleepers	151,808	161,234	313,042	230 km	34,916	37,084	72,000
track renewal with wooden sleepers + bolts	88,096	213,858	301,954	60 km	5,286	12,831	18,117
sleeper renewal with concrete sleepers	124,403	51,234	175,637	76 km	9,455	3,894	13,349
sleeper renewal with wooden sleepers + bolts	60,691	103,858	164,549	20 km	1,214	2,077	3,291
complete turnouts	8,623	25,400	34,023	100 pc.	862	2,540	3,402
sleepers of turnouts	3,967	6,000	9,967	100 pc.	397	600	997
pipes and river-bed							
fastening of the river-bed near pipes + bridges	66,500		66,500	37 br.	2,460		2,460
reconstruction of inlet and outlet of pipes	78,500		78,500	52pipes	4,080		4,080
build new pipes	86,600		86,600	85pipes	7,360		7,360
enlarging bridges							
length 20-30 m	170,000		170,000	6bridge	1,020		1,020
length 30-40 m	240,000		240,000	5bridge	1,200		1,200
length 40-60 m	340,000		340,000	2bridge	680		680
length 71m	510,000		510,000	2bridge	1,020		1,020
length 90-95 m	670,000		670,000	4bridge	2,680		2,680
constructing new bridges							
length 20-30 m	290,000		290,000	19bridge	5,510		5,510
length 30-40 m	430,000		430,000	1bridge	430		430
length 40-60 m	560,000		560,000	9bridge	5,040		5,040
length 101 m				1bridge	1,250		1,250
Aktau-Mangyshlak							
track renewal with concrete sleepers	151,808	161,234	313,042	18 km	2,733	2,902	5,635
complete turnouts	8,623	25,400	34,023	15 pc.	129	381	510
station building	530		530	500 m2	265		265
Equipment							
modern tamping machine						2,300	2,300
mechanised mobile gang						2,450	2,450
assembly places						500	500
total					87,987	67,559	155,546

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

4.1.1.6. Schedules of Investment Costs (in 1.000 S $)

(in US $ 1,000)	1998	1999	2000	2001	2002	2003	total
local amount	9,000	18,000	18,000	18,000	18,000	6,987	87,987
foreign amount	7,000	14,000	14,000	14,000	14,000	4,559	67,559
total amount	**16,000**	**32,000**	**32,000**	**32,000**	**32,000**	**11,546**	**155,546**

4.1.3. Signalling

4.1.3.1. Equipment costs

The gradual renewal of the installations bears the disadvantage that during the transition period - which could last for 10 years of more - spare parts for the old system as well as spare parts for the new system will have to be available. By dismantling old installations, however, the number of old material that still can be used will be adequate to have sufficient spare material for the stated transition period.

The following costs for the individual stages of construction have to be calculated (average estimated costs in million US $):

1st stage:	41.00
2nd stage:	27.00
intermediate stage	26.00
Total project	94.00

1st stage of construction:

Replacement of the oldest installations:

Type of costs		Units	Unit costs	Costs
Central train control system Atyrau:				
basic equipment, basic costs:				0.40
work place, technical equipment:				0.10
additional costs per	double-track station	6	0.15	0.90
	three-track station	9	0.20	1.80
	four-track station	2	0.25	0.50
	eight-track station	1	0.40	0.40
Total				4.10

Installations on the line:

	Station	with N° of tracks	Modernisation	Costs
XP 1		4 tracks	remote control	0.5
level crossing	31.0			0.3
XP 2:		2 tracks	*)	3.0
XP 3:		3 tracks	remote control	0.5
Usturt:		3 tracks	*)	3.3
level crossing	80.7			0.3
XP 5:		3 tracks	remote control	0.5
XP 6:		2 tracks	*)	3.0
level crossing	128.5			0.3
XP 7:		3 tracks	remote control	0.5
level crossing	176.9			0.3
Say-Utes:		4 tracks	*)	3.5
XP 8:		2 tracks	*)	3.0
XP 9:		3 tracks	remote control	0.5
XP 10:		2 tracks	*)	3.0
level crossing	251.7			0.3
XP 11:		3 tracks	remote control	0.5
XP 12		2 tracks	*)	3.0
level crossing	279.1			0.3
XP 13:		3 tracks	remote control	0.5
Shetpe:		8 tracks	*)	4.5
level crossing	313.6			0.7
XP 14:		3 tracks	remote control	0.5
XP 15		2 tracks	*)	3.0
level crossing	362.4			0.3
XP 16:		3 tracks	remote control	0.5
level crossing	387.8			0.3
				36.6
Central train control system				4.1
Contingency				0.3
1st stage of construction				41.0

*) ... intermediate signal box including remote control

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

2nd stage of construction:

Replacement of the remaining intermediate signal boxes

Central train control system: no works (some adaptations being necessary are included in the costs of railway stations).

Installations of the line:

	Station	with N° of tracks	Modernisation	Costs
XP 1:		4 tracks	only intermediate signal box	3.1
level crossing	16.0			0.3
XP 3:		3 tracks	only signal box	2.9
XP 5:		3 tracks	only signal box	2.9
XP 7:		3 tracks	only signal box	2.9
XP 9:		3 tracks	only signal box	2.9
XP 11:		3 tracks	only signal box	2.9
XP 13:		3 tracks	only signal box	2.9
XP 14:		3 tracks	only signal box	2.9
level crossing	376.1			0.3
XP 16:		3 tracks	only signal box	2.9
				26.9
Contingency				0.1
2nd stage of construct.				27.0

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Intermediate stage:

Renewal of block installations.

Central train control system: no works (some adaptations being necessary are included in the costs of block installations).

Installations of the line:

Track section		Number of automatic block posts to be modernised	Unit costs	Costs
level crossing	8.4			0.3
Bejneu - XP 1:		2	0.4	0.8
level crossing	16.0			0.3
XP 1 - XP 2:		2	0.4	0.8
level crossing	40.8			0.3
XP 2 - XP 3:		3	0.4	0.8
level crossing	66.0			0.3
XP 3 - Usturt:		3	0.4	1.2
Usturt - XP 5:		3	0.4	1.2
XP 5 - XP 6:		3	0.4	1.2
XP 6 - XP 7:		3	0.4	1.2
level crossing	163.5			0.3
XP 7 - Say-U:		4	0.4	1.6
Say-U - XP 8:		3	0.4	1.2
XP 8 - XP 9:		1	0.4	0.4
XP 9 - XP 10:		5	0.4	2.0
level crossing	230.3			0.3
XP 10 - XP 11:		2	0.4	0.8
XP 11 - XP 12:		3	0.4	1.2
XP 12 - XP 13:		3	0.4	1.2
level crossing	304.2			0.3
XP 13 - Shetpe:		3	0.4	1.2
Shetpe - XP 14:		2	0.4	0.8
level crossing	323.8			0.3
level crossing	336.2			0.3
XP 14 - XP 15:		3	0.4	1.2
level crossing	362.4			0.3
level crossing	367.2			0.3
XP 15 - XP 16:		4	0.4	1.6
level crossing	387.8			0.3
XP 16 - Mang.:		4	0.4	1.6
level crossing	398.4			0.3
				25.9
Contingency				0.1
intermediate stage				26.0

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

PROJECT TITLE	TRACECA Rail Maintenance Central Asia: Infrastructure 2
PROJECT NUMBER	TNREG 9310
MODULE	A Feasibility study for upgrading of the Aktau - Bejneu line in Kazakhstan.

WP 1320	Definition of maintenance costs (only input)
4.2.	Evaluation of maintenance costs (only input)
4.2.1.	Permanent Way
4.2.2.	Telecommunication
4.2.3.	Signalling

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

4.2. Evaluation of Maintenance Costs

4.2.1. Permanent Way (per Year)

4.2.1.1. Current Maintenance Costs Permanent Way

description	unit costs			numb	ind.c.	total amount in US $ 1,000		
	local $	foreign $	total $	x	+%	local	foreign	total
workers	1680		1680	325	81%	988		988
wooden sleeper		44.7	44.7	20000	24%	215	894	1109
rails (km track)		110000	110000	6.5	24%	172	715	887
ballast	70000		70000	1	24%	87		87
turnout rails		20000		15	24%	72	300	372
plates + joints		150000		1	24%	36	150	186
total						1570	2059	3629

4.2.1.2. Maintenance Costs Permanent Way if there is no Track Renewal

description	unit costs			numb	ind.c.	total amount in US $ 1,000		
	local $	foreign $	total $	x	+%	local	foreign	total
workers	1680		1680	325	81%	988		988
wooden sleeper		44.7	44.7	30000	24%	322	1341	1663
rails (km track)		110000	110000	14	24%	370	1540	1910
ballast	70000		70000	1	24%	87		87
turnout compl.	8019	25400	33419	15	24%	212	381	593
plates + joints		200000	200000	1	24%	48	200	248
total						2027	3462	5489

4.2.1.3. Maintenance Costs Permanent Way after Track Renewal

description	unit costs			numb	ind.c.	total amount in US $ 1,000		
	local $	foreign $	total $	x	+%	local	foreign	total
workers	1680		1680	243	81%	739		739
sleepers	33.46	24.1	57.56	500	24%	20	12	32
rails (km track)		110000	110000	0.5	24%	13	55	68
ballast	70000		70000	1	24%	87		87
turnout compl.	8019	25400	33419	2	24%	28	51	79
plates + joints		15000		1	24%	4	15	19
equipment				1		125	1000	1125
total						1016	1133	2149

? 4.2.2. [illegible] Telecommunications

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

4.2.3. Signalling

The signalling system already used today, makes possible an operation with a minimum number of operational staff. Thus, with a new signalling system, there will be no more savings in this regard.

Since the signalling system which is presently applied by far allows the planned number of trains, no investments are necessary in this regard.

The partly very old age of the existing signalling installations makes necessary to gradually renew the existing installations, in order to be able to operate the line in today's form in the long run.

Savings as regards the replacement of existing signalling installations are only possible in two ways:

Reduction in the number of installations

The reduction in the number of passing loops does not make sense, since then the line's capacity would be much reduced, and therefore operation would become inflexible.

The reduction of the number of level crossing protection equipment is not possible, since the investment costs for construction of subways or overpasses (bridges) are far higher than that of the installation of technical protection equipment. Due to the large distance of the roads to one another, it is not expected that level crossings will be closed.

Thus, only the reduction of the number of block installations remains. The doubling of the lengths of block sections can be striven for without major reduction of track capacity. This will lead to a division in half of the number of block installations.

Saving of staff

Because of the high technical level of the signalling system, further savings of operational staff cannot be expected. Thus, only in the maintenance sector savings are possible. Also in this sector, the potential for savings is rather low, since only those staff members could be saved who work in the repair of gravity relays. The disadvantage would be that, because of the large track sections, long distances have to be overcome by the maintenance staff, which also is very time consuming.

From today's point of view, after the completion of all new installations, a saving of about 10 maintenance staff members can be calculated.

?? Cost of signalling maintenance?

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Depreciation Rates: Former Soviet Railways

Based on Directive No. 1072 of 22 October 1990, Published in Moscow		
Type of Asset	**Expected Life**	**Depreciation (%)**
Cranes	13 yrs	7,7
Portable Cranes	8 yrs	12,5
Machinery for Wagons	12 yrs	8,3
Signalling Equipt.	15 yrs	6,7
Telephone Systems	20 yrs	5,0
Locomotives Electric	33 yrs	3,3
Locomotives Diesel	25 yrs	4,0
Wagons Hopper	25 yrs	4,0
Wagons: Covered and Flat	33 yrs	3,3
Wagons Tank	33 yrs	3,3
Special Wagons	20 yrs	5,0
Buildings	50 yrs	2,0
Permanent Way	25 yrs	4,0
Sleepers; Concrete	20 yrs*	5,0
Sleepers; Wood	15 yrs*	6,7
Tools	4 yrs	25,0
Other Production and Commercial Equipt	10 yrs	10,0

*From actual experience.

PROJECT TITLE	TRACECA Rail Maintenance Central Asia: Infrastructure 2
PROJECT NUMBER	TNREG 9310
MODULE	A Feasibility study for upgrading of the Aktau - Bejneu line in Kazakhstan.

WP 1510	Initial design and project plan
6.1.	Initial design and project plan
6.4.	Proposals and Recommendation for the Upgrading Programme

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

6.1. Initial Design and Project Plan

6.1.1. Line Bejneu - Mangyshlak

Introduction

The project was to examine the existing Railway Line of the Western Kazakhstan Railways between Bejneu, km 0+0 and Mangyshlak km 404+3 with the view to suggesting improvements for this about 400 km track.
Additionally it was a part in the project, according to the terms of references to examine the private line, owned by KACKOP from Mangyshlak to Aktau port and Aktau Center.

The existing line

The aim was to see whether it is possible to increase the average speed for the different trains from about 40 km/h (passenger train) to 80 km/h for freight trains and 100 km/h for passenger trains.
As a result of the examination of the route it can be concluded that app.80 % of the existing line, after reconstruction, would enable rail traffic to proceed at the required speeds.
Considering the problems raised by remaining 20 % of the route which runs through a rather mountainous area it is not recommended and it would be too expensive to construct a totally new line along a different route (see length profile with curves R min. = 400 m).
It is recommended a partly replacement of the existing superstructure, some short sections have to be repaired, over the whole route because even over the above mentioned 20 % of the line the average speed would be increased to 80 km/h.

A further recommendation is:

For app.30 km the line runs along the Caspian Sea, indicated in the length profile at km 203 to 232, which is expected to rise by app. 2,0 m over the next ten years. July 1996 the Caspian Sea level was counted with -26,6 m.
The existing sea level of the Caspian Sea is about -27 m and will be about -25 m in the nearer future. The existing level of the tracks is between -19.0 to -20.1 m. When this has taken place the present line will be in danger of destruction at times of flooding. It is therefore suggested that the construction of the „sea wall" should be continued along the whole length of the Caspian Sea route.
Additionally it is recommended a new drainage system to be designed and constructed on the „inland side" of the Caspian Sea section of the route, so as to retain the water from the hills at these times of flooding. A hydrological study is also required for the basic information.
The present drainage system operates at almost the same level as the Caspian Sea will reach today. Consequently as such time of flood the water will flow back from the Sea into the drainage system and will destroy the track unless a new drainage system is designed which prevents the water flowing back from the sea.

The level of the new drainage system needs to be constructed several meters higher than the existing one. The existing track level will be kept.
Thirdly it is recommended that the existing Railway Stations should be retained as they are adequate for the future traffic, but reconstruction is needed.

Tacis
This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Conclusions:

1. Renovation of the existing track and superstructure, except for a few sections which are in better conditions.
2. Renovation of the existing drainage system over the whole line.
3. The designing and construction of a new drainage system several meters higher from km 203 to 232 on the hill side of the railway line.
4. Continuation of construction of the „sea Wall" along the Caspian Sea side section from km 203 to 232.
5. Keeping the existing Railway Stations and crossing Stations but renovation is required.

Results:

1. Increase of the average speed for freight trains to 80 km/h over the whole line of these 400 km.
2. Increase of the speed for passenger trains to an average speed of 100 km/h and partly more, for about 80 % of the total length of the line and up to 85 km/h for the remaining sections.

Enclosures as annexes:

Annex 6.1.1.1.:	Length profile Scale 1:200.000/2.000 from km 0+0 to 403+3
Annex 6.1.1.2.:	Technical description of the Alignment Bejneu - Mangyshlak
Annex 6.1.1.3.:	Calculation of speed limits

6.1.2. Line Mangyshlak - Aktau

Introduction:

There is a single track line starting in Mangyshlak and arriving at the Port of Aktau. From km 12.0 a branch line into the center of Aktau is existing but not in use. These two lines are owned by a private company KACKOP. That means, that public transport for passengers only can start in Mangyshlak.
A bus service and taxis are providing the connection from Aktau to Mangyshlak.
(see Annex 4)

The existing line:

As mentioned above, there is no regular traffic from Aktau to Mangyshlak. In Aktau Centre a more or less complete passenger station is existing. It would be worth to built a Station Building and parking facilities. Between the nearest track and the existing road network is space enough (app. 40m) to built the station and the parking for taxis and buses. The three existing platforms will be provided for the local passenger traffic.

Conclusions:

1. A contract between Western Kazakhstan Railways and KACKOP for a passenger train service from Aktau via Mangyshlak to Bejneu.
2. Renovation of the existing line Aktau - Mangyshlak
3. Construction of a station building and the other necessary facilities like parking etc.
4. Renovation of the line to the Port of Aktau according to the Port Project, which will be executed within a few months.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Results:

1. A Railway connection from Aktau Centre to Bejneu for passenger trains
2. A Railway connection from the „NEW AKTAU PORT" to Bejneu for freight trains.

Enclosures as annexes:

Annex 6.1.2.1.:	A map enlarged from a scale at 1:200.000 to 1:50.000
Annex 6.1.2.2.:	A more detailed at a scale app.1:50.000 of the centre of Aktau indicating the existing railway station.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Annex 6.1.1.1.: Length profile Scale 1:200.000/2.000 from km 0+0 to 403+3

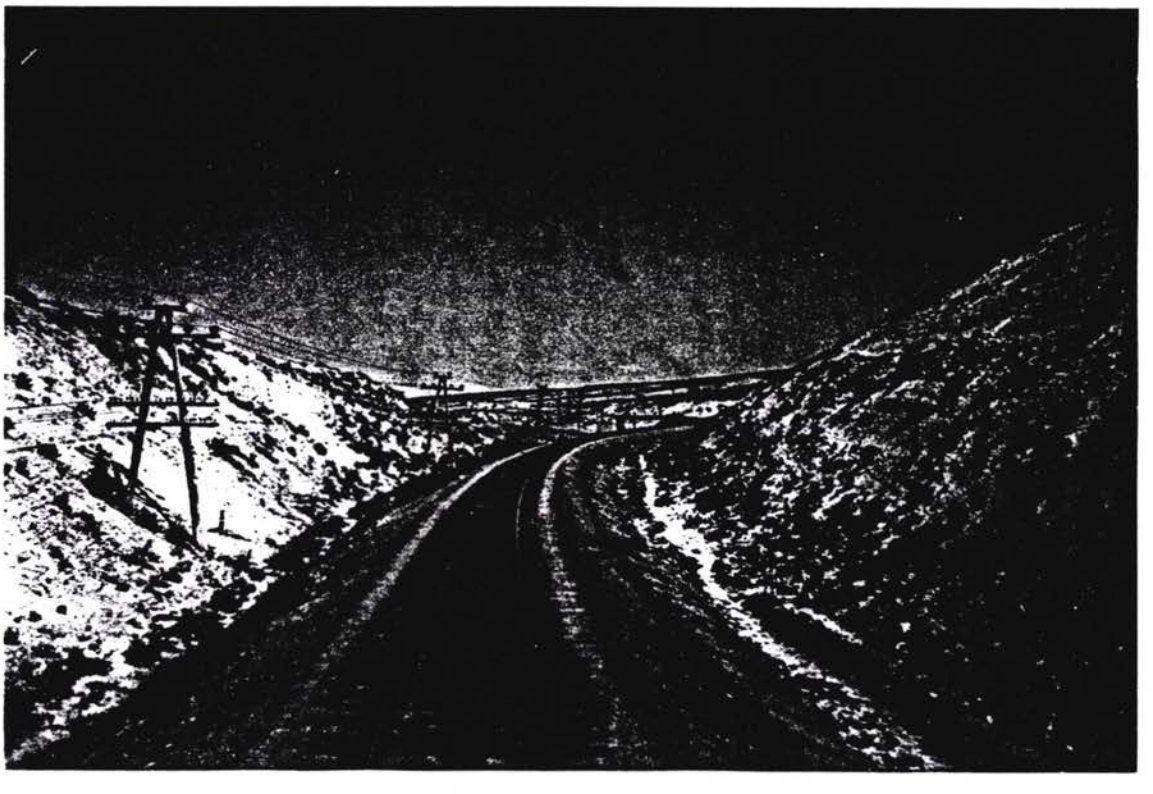
Tacis

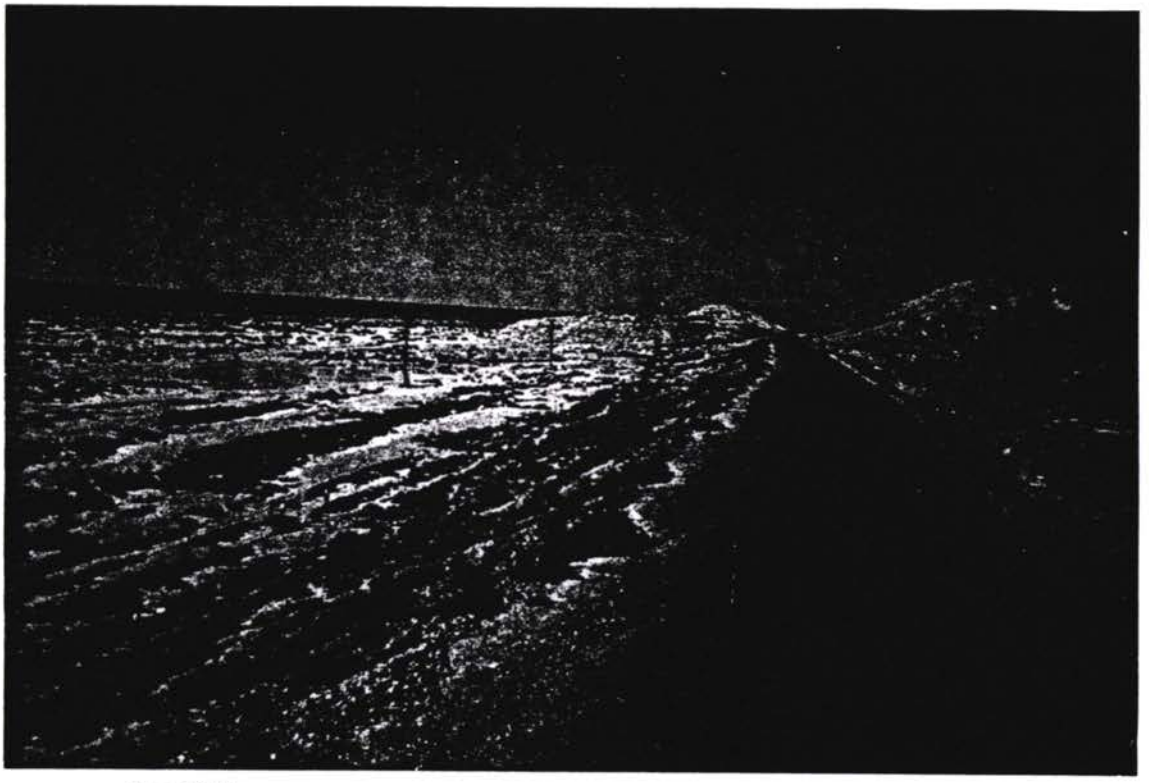
This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Photo dokumentation
The Topography of the line

km 128
Passing Loop Nr.: 6
typical linepart between Bejneu and Say Utes (km 178) on the Ustyurt Plateau

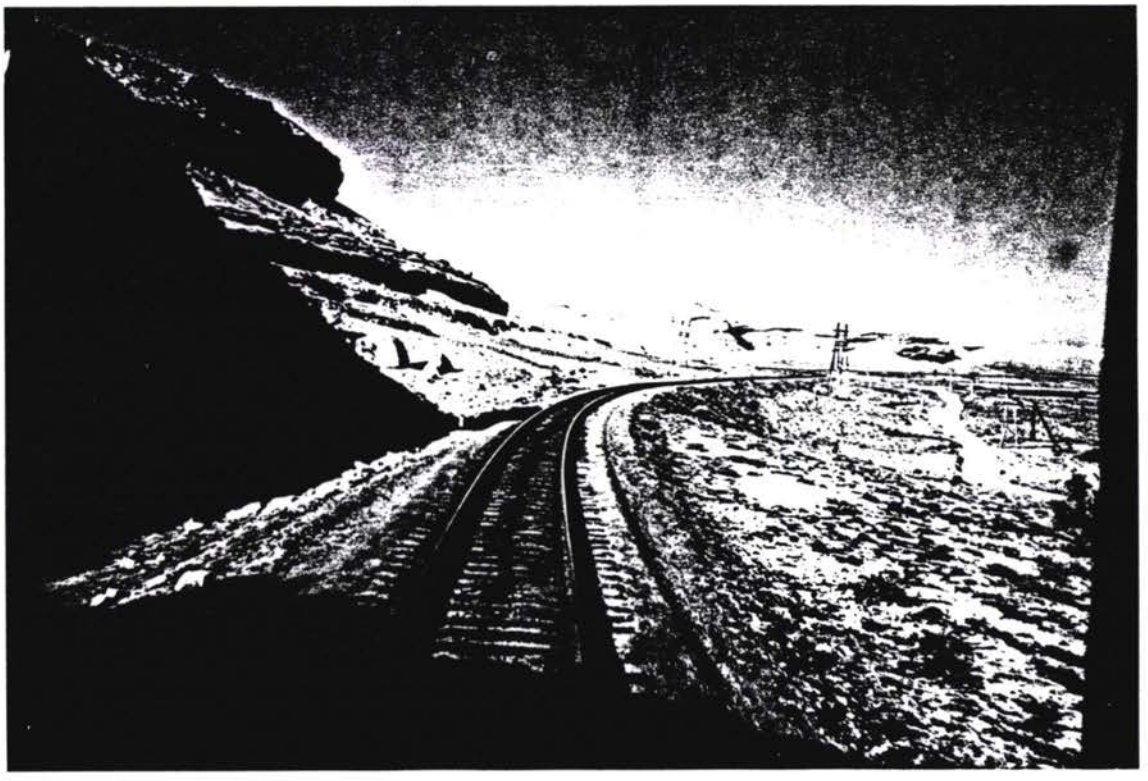
km 185
typical line profile between Say Utes and km 199 at the steep slope

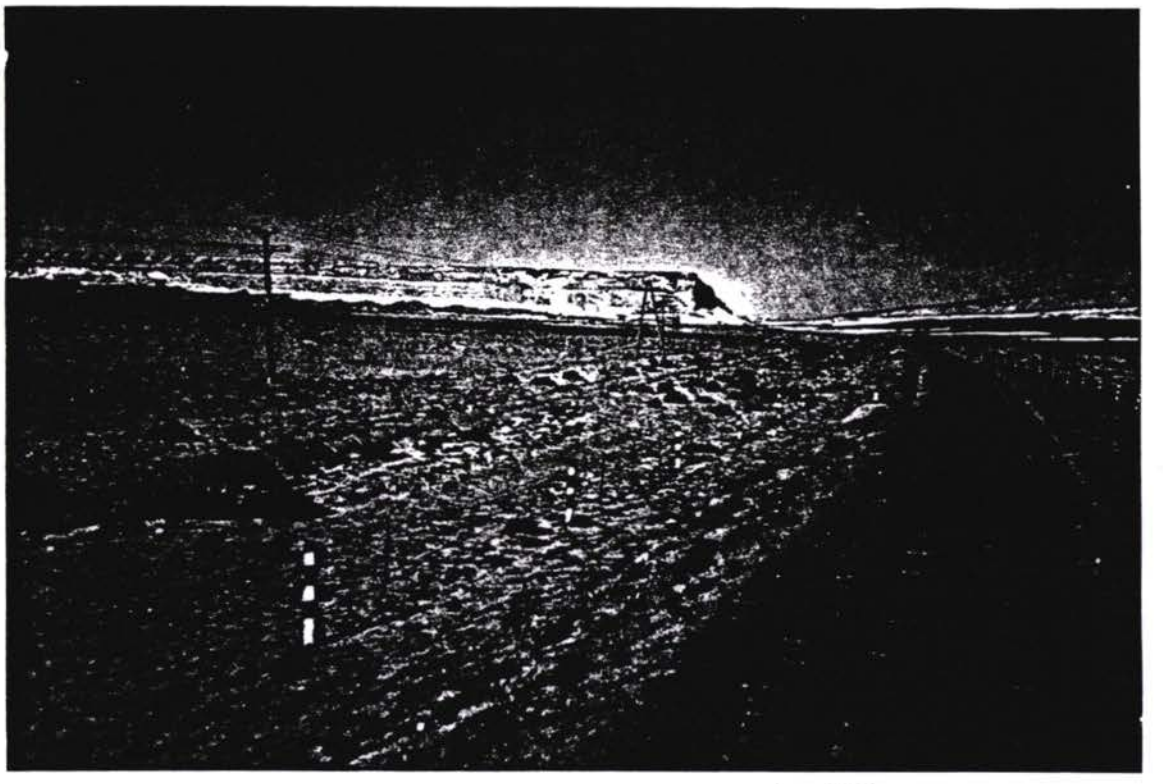




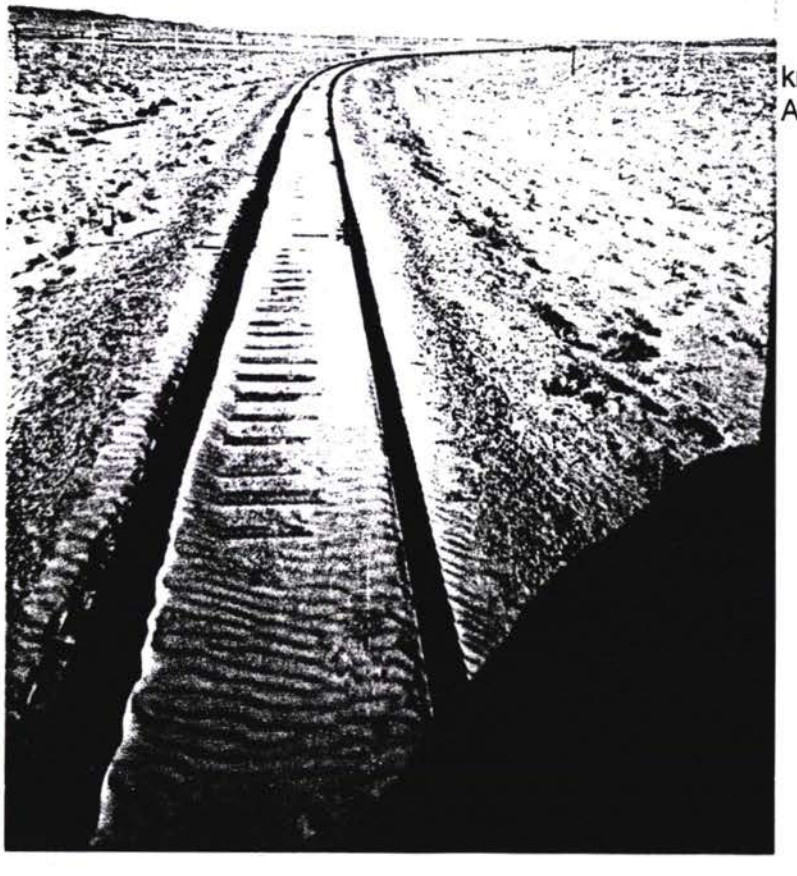
km 215
Linepart near the Kadijak Bay (Part of the Caspian Sea)

km 294
Linepart a the ground of a canyon
The slope of the canyon is some meters beside the line



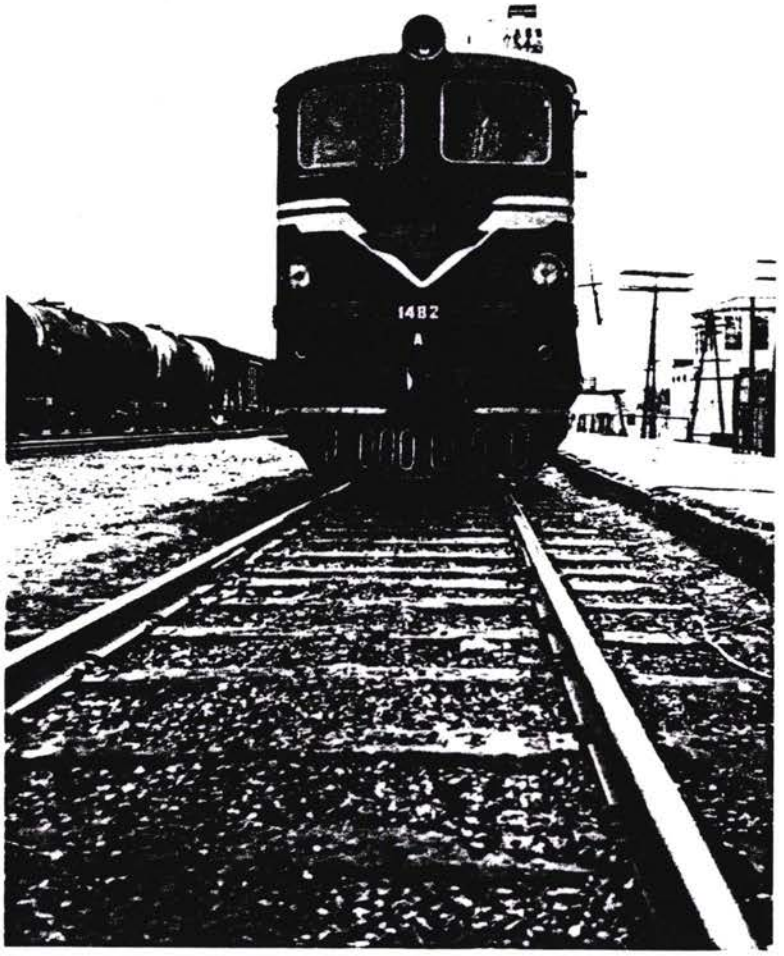


km 298
The end of the canyon and the beginning of a broad valley



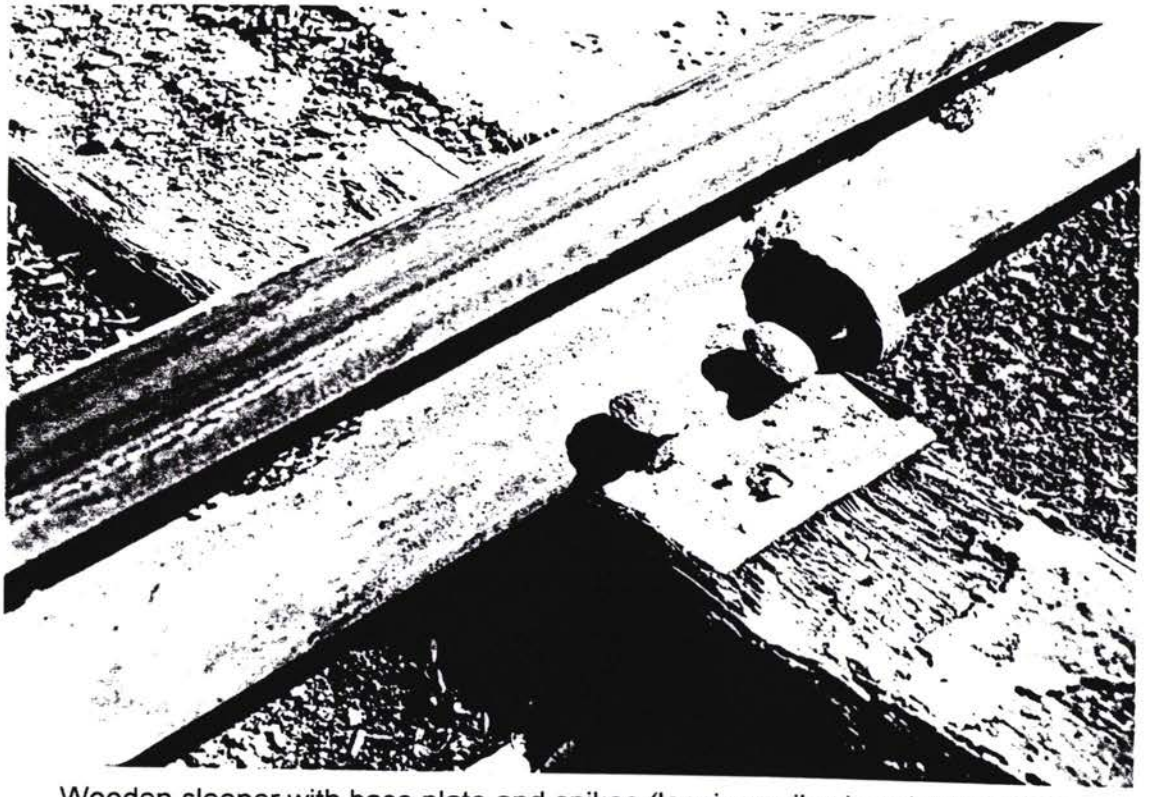
km 328
A linepart with sand in the track

km 377
The landscape near passing loop Nr.: 16
the deepest part of the line



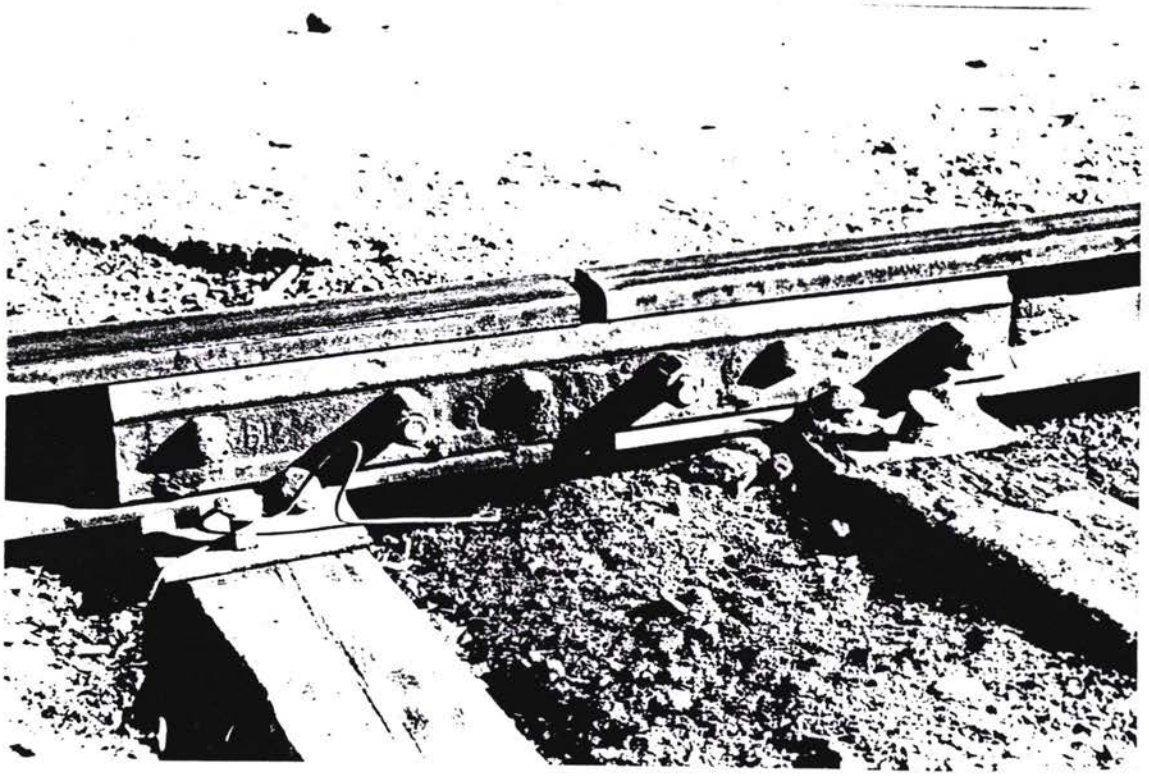
km 403
Manghishlak Station
with the platform

Detail of the track

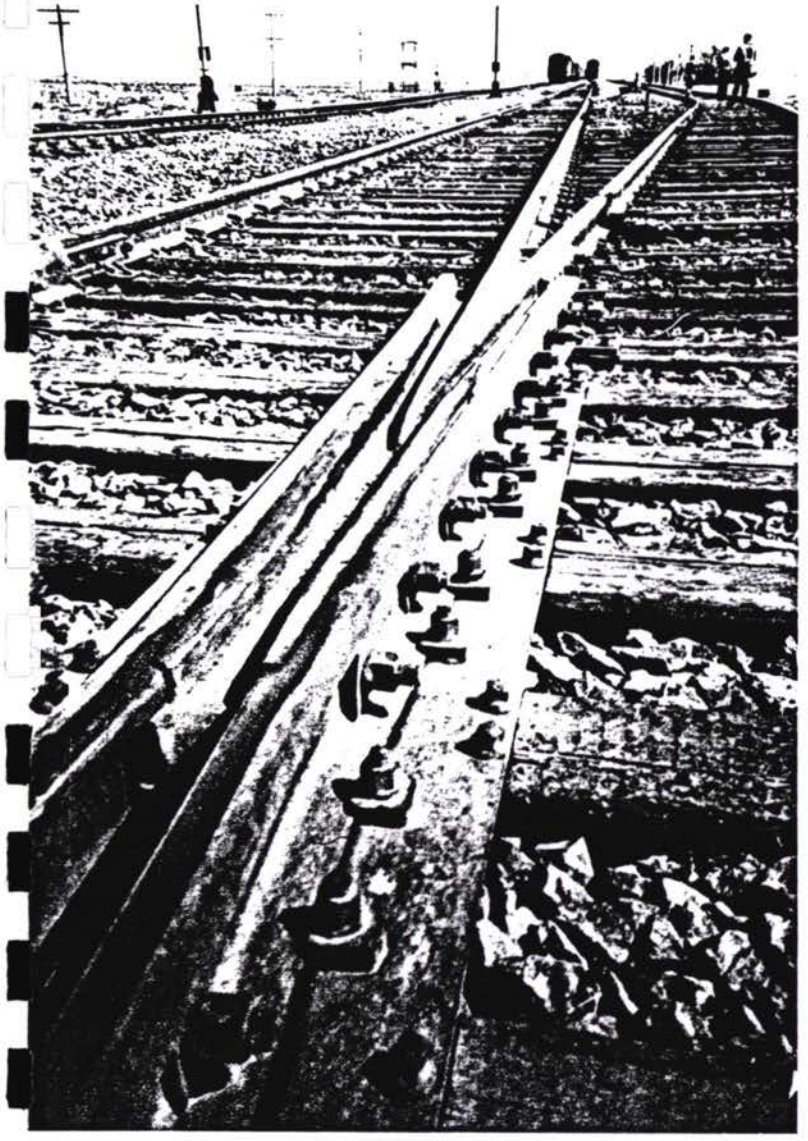


Wooden sleeper with base plate and spikes (loosing spikes) and rail anchor and typical sand ballast

Fish plate joint

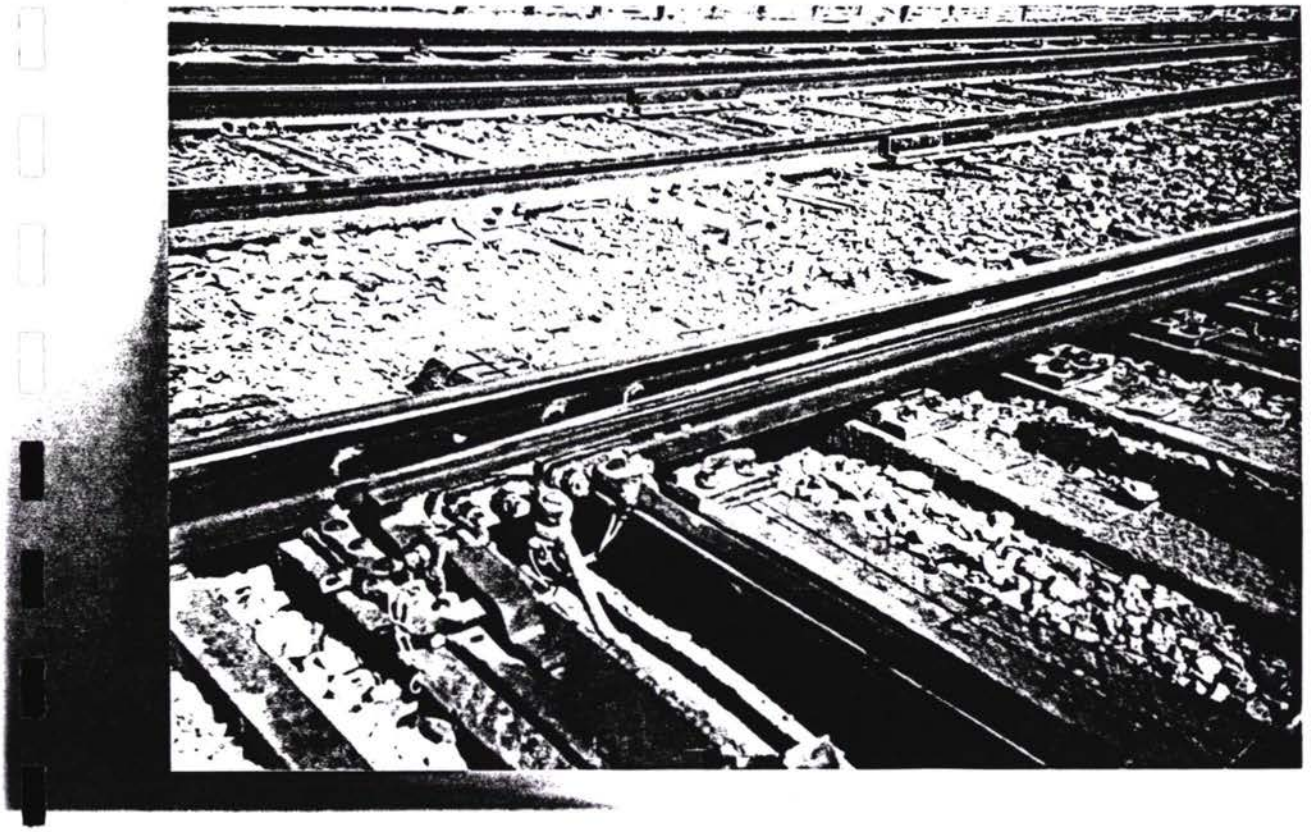


Turnouts

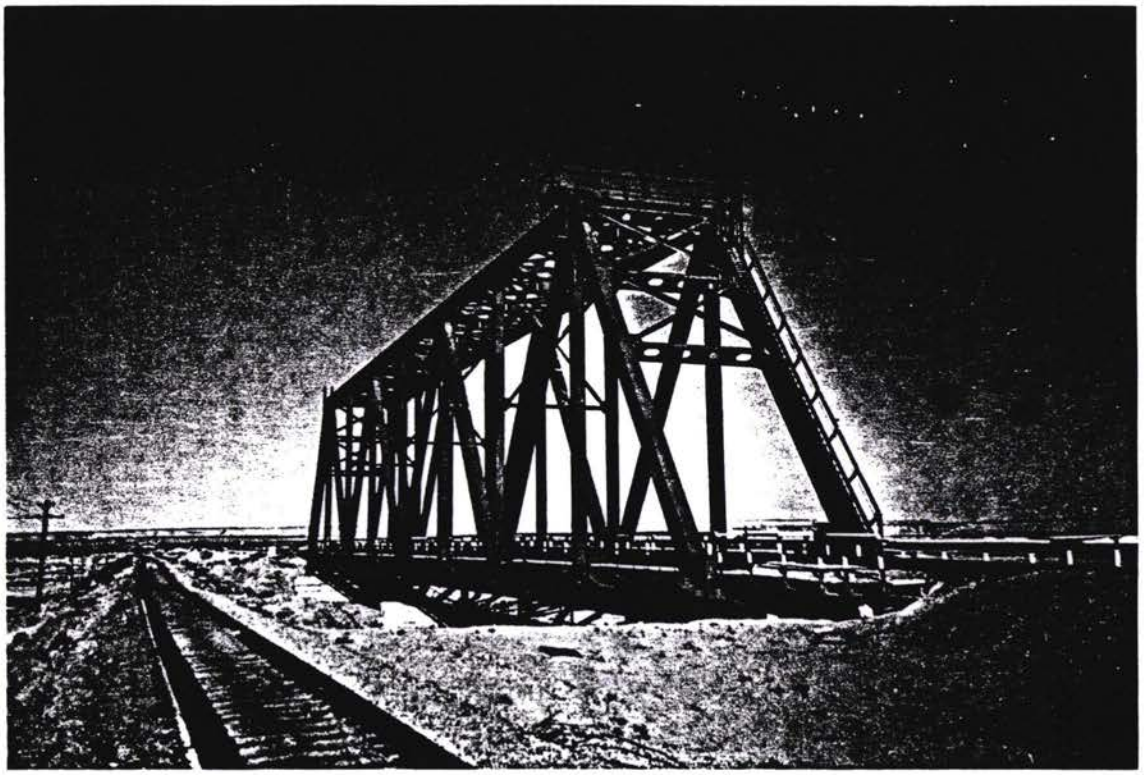


Turnout in passing loop Nr.: 7
monoblock switch diamond

A tongue of a turnout

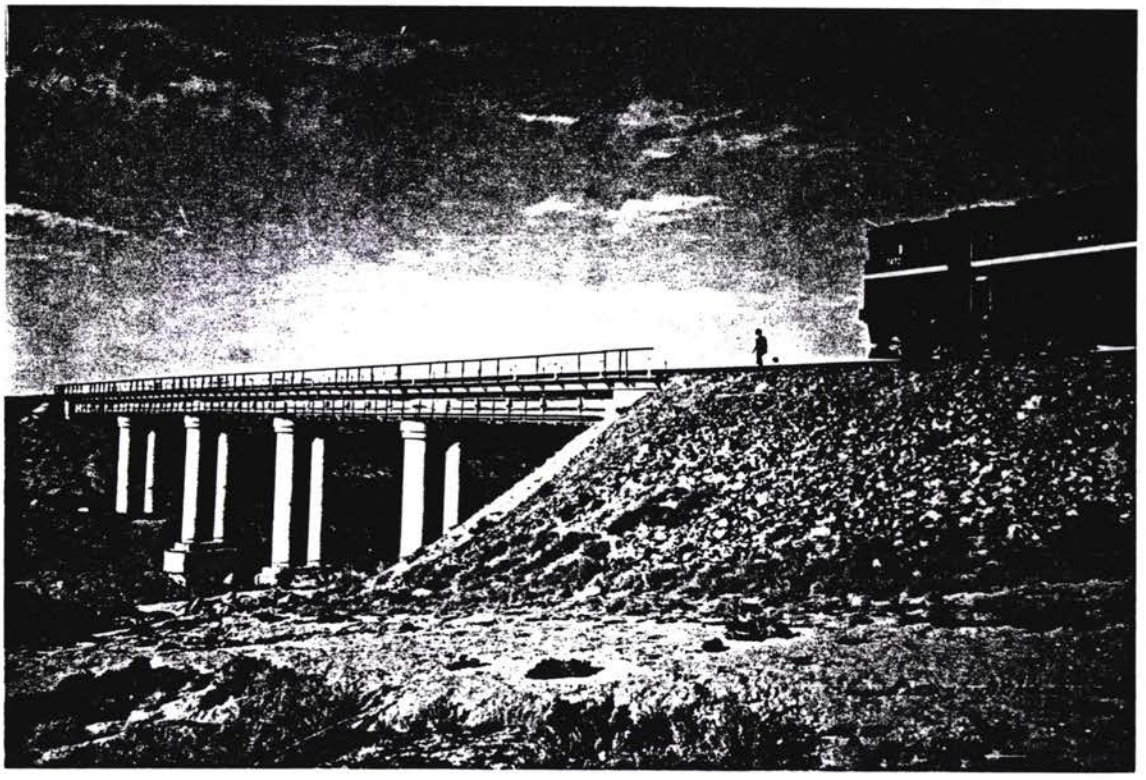


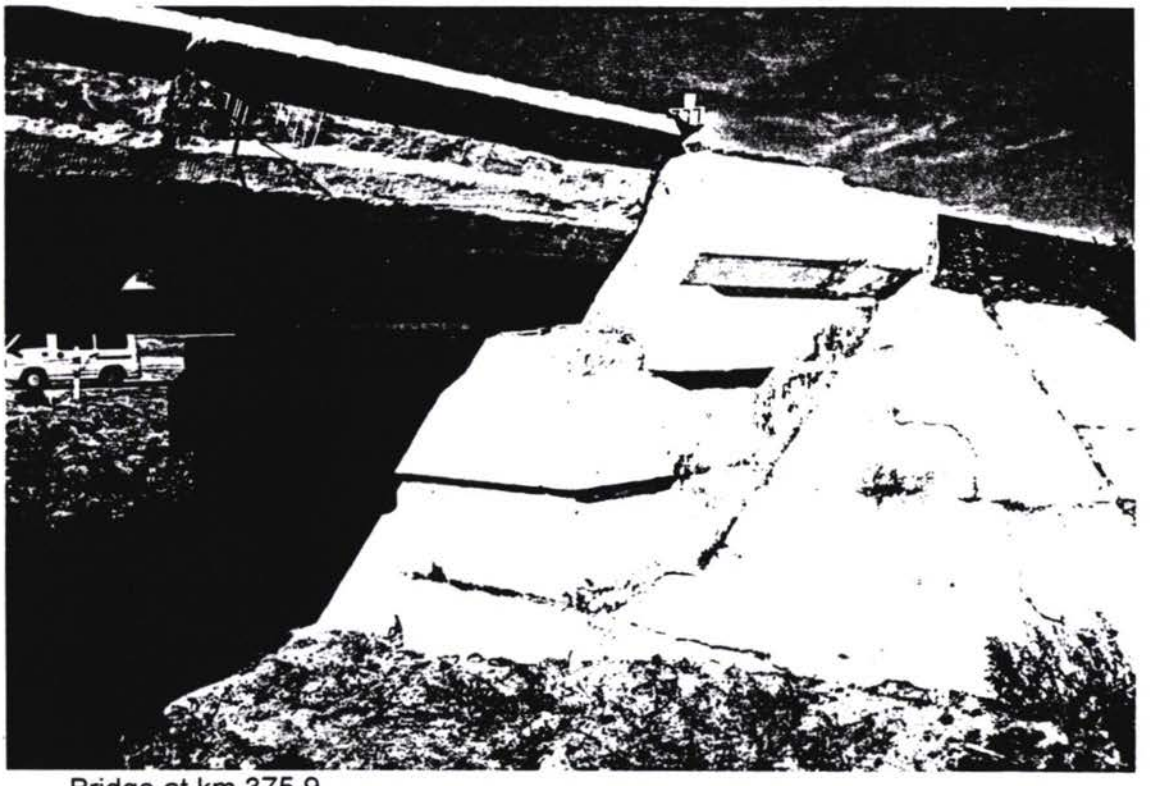
Bridges



Bridge at km 39,9
Eosion at the river bed

Bridge at km 339,5
This bridge was build up 1993 after the old one was distructed during a rainfall



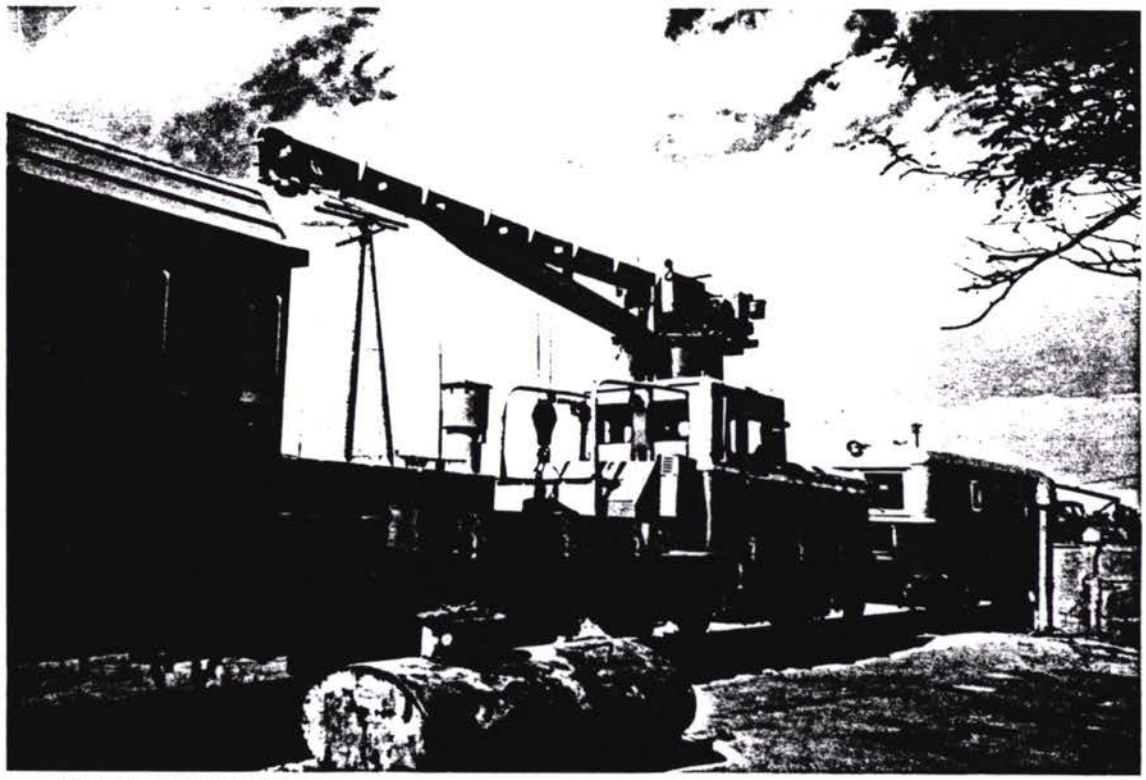


Bridge at km 375,9
This bridge is today 10 m long, it is planed to build up a new one with 22 m.

Working methods

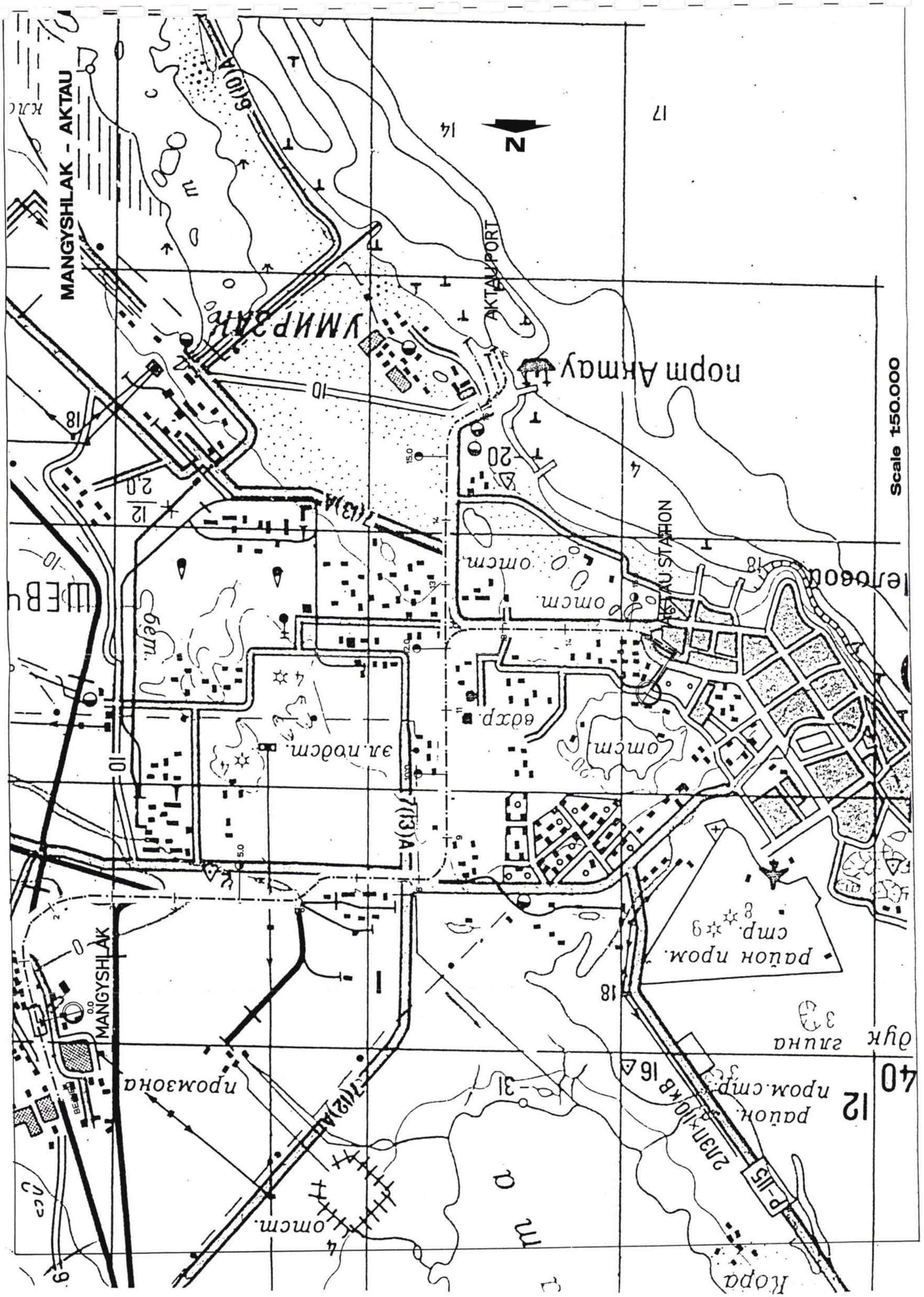
A maintenance gang in Manghishlak Station
They are leveling a track by hand

Equipment



Existing Track Cars

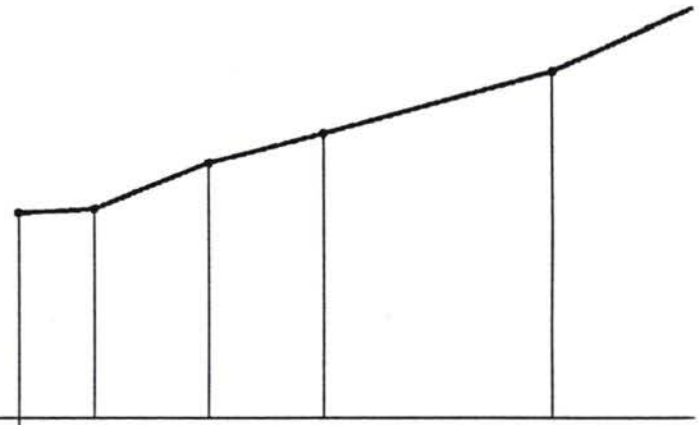
Existing tamping machine and rail lifter


MANGYSHLAK - AKTAU
N
AKTAU PORT
AKTAU STATION
MANGYSHLAK
Scale 1:50.000

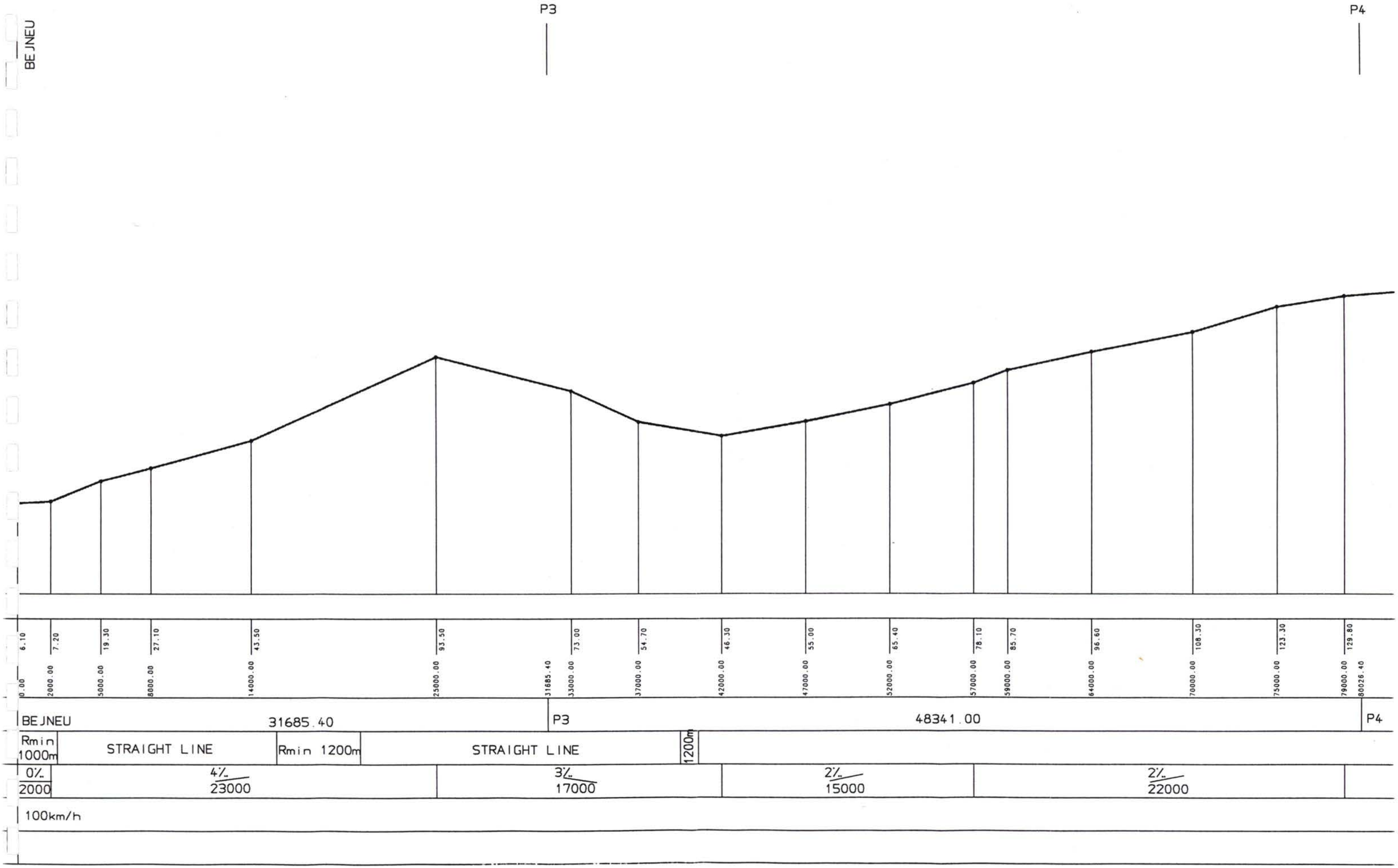
BEJNEU

STATION 00+000.00
M 1 : 200000/2000

ABOVE SEA
LEVEL -48.00m



BEJNEU-MANGYSHLAK	
GROUND LEVEL	6.10 · 7.20 · 19.30 · 27.10 · 43.50
KILOMETER	0.00 · 2000.00 · 5000.00 · 8000.00 · 14000.00
STATIONS	BEJNEU 31685
CURVES	Rmin 1000m · STRAIGHT LINE · Rmin
SCALE OF SLOPES	0% / 2000 · 4% / 23000
DESIGNED SPEED	100km/h
REMARKS	


BEJNEU
P3
P4
6.10
7.20
19.30
27.10
43.50
93.50
73.00
54.70
46.30
55.00
65.40
78.10
85.70
96.60
108.30
123.30
129.80
0.00
2000.00
5000.00
8000.00
14000.00
25000.00
31685.40
33000.00
37000.00
42000.00
47000.00
52000.00
57000.00
59000.00
64000.00
70000.00
75000.00
79000.00
80026.40
BEJNEU
31685.40
P3
48341.00
P4
Rmin 1000m
STRAIGHT LINE
Rmin 1200m
STRAIGHT LINE
1200m
0% 2000
4% 23000
3% 17000
2% 15000
2% 22000
100km/h

P4 P5 P6 P7

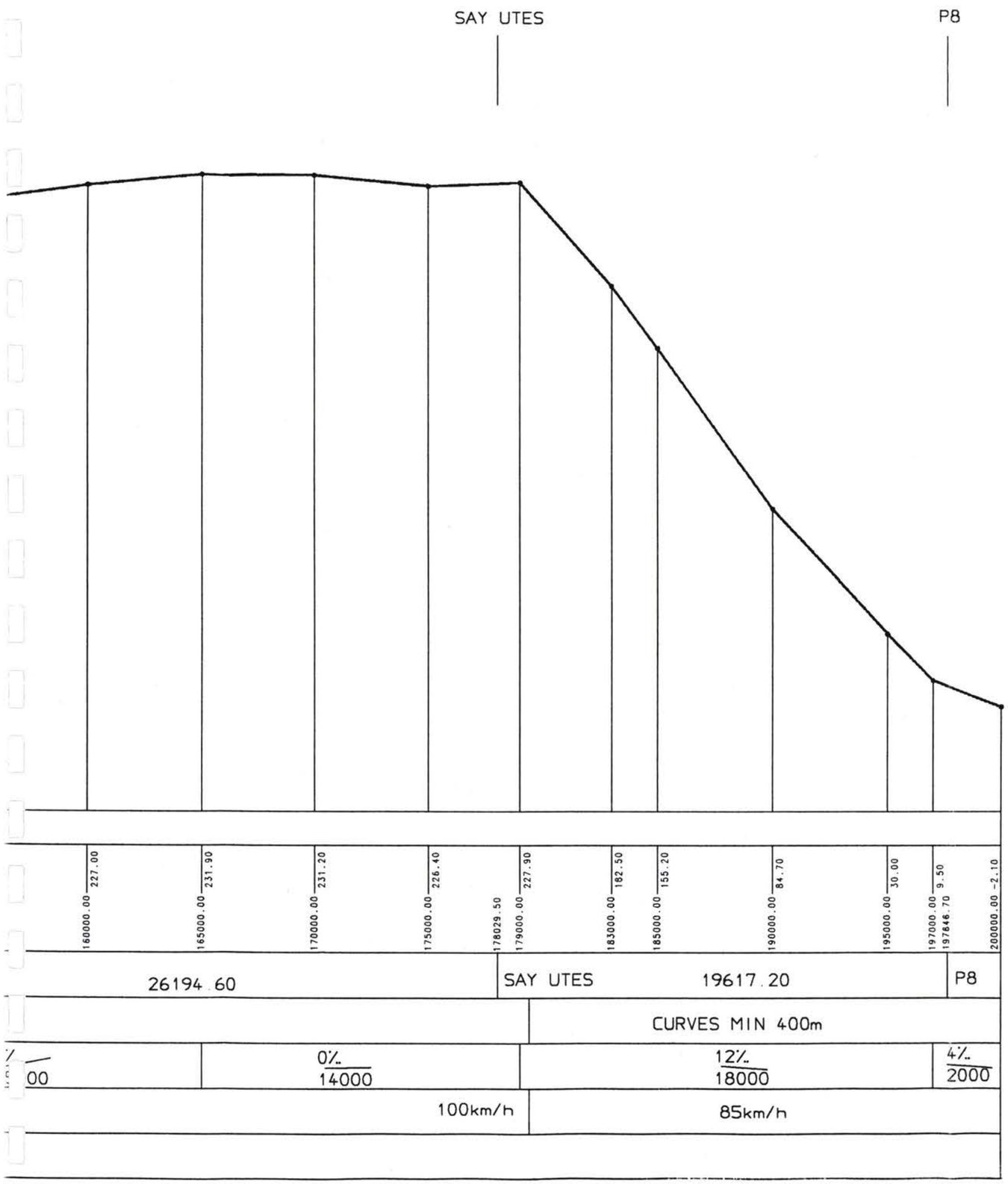
79000.00 129.80
80026.40
83000.00 133.00
85000.00 137.80
90000.00 140.70
95000.00 147.40
100000.00 153.90
103648.50
105000.00 165.10
110000.00 169.10
115000.00 176.50
119000.00 177.20
125000.00 178.00
127912.00
130000.00 187.80
135000.00 200.40
140000.00 209.80
145000.00 214.50
150000.00 208.20
151834.90
155000.00 220.50

P4 23622.90 P5 24263.50 P6 23922.90 P7

STRAIGHT LINE and Rmin 2500m

1% / 26000 | 1% / 10000 | 0% / 10000 | 2% / 15000 | 1% / 5000 | 1% / 5000 | 2% / 15000

100km/h



TRACECA PROJECT MODUL A

BEJNEU – MANGYSHLAK

LENGTH PROFILE

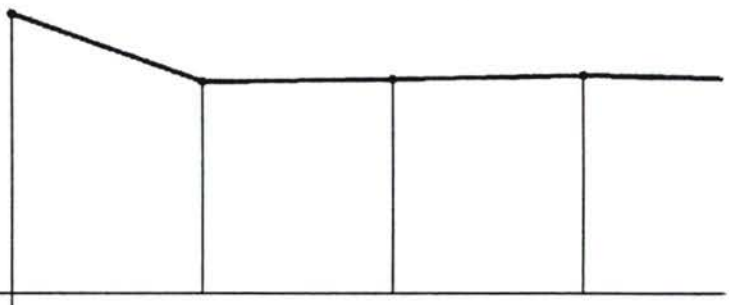
SCALE 1 : 200000/2000

KM 0+0 – 200+0

P9

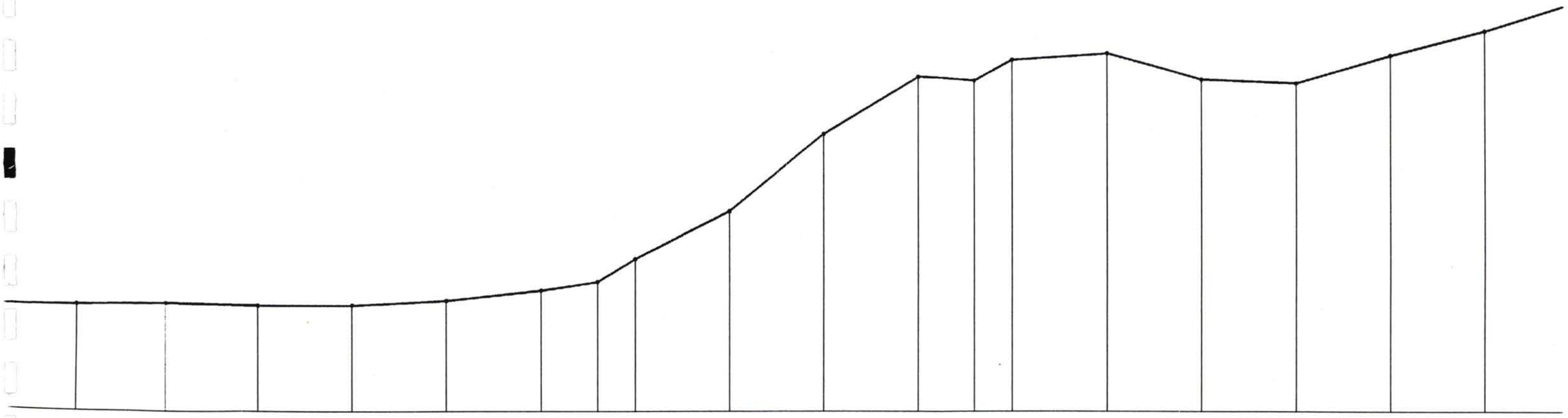
STATION 200000+000.00
M 1 : 200000/2000

ABOVE SEA
LEVEL -76.00m



BEJNEU-MANGYSHLAK						
GROUND LEVEL	200000.00 -2.10		205000.00 -20.10	208487.00	210000.00 -19.40	215000.00 -18.40
KILOMETER						
STATIONS	10840.30		P9			
CURVES	CURVES MIN 400m					
SCALE OF SLOPES	4‰ / 5000					
DESIGNED SPEED	85km/h					
REMARKS		FLOOD PLAIN RELATED TO THE WATE ADDITIONAL DRAINAGE				

P9 P10 P11 P12

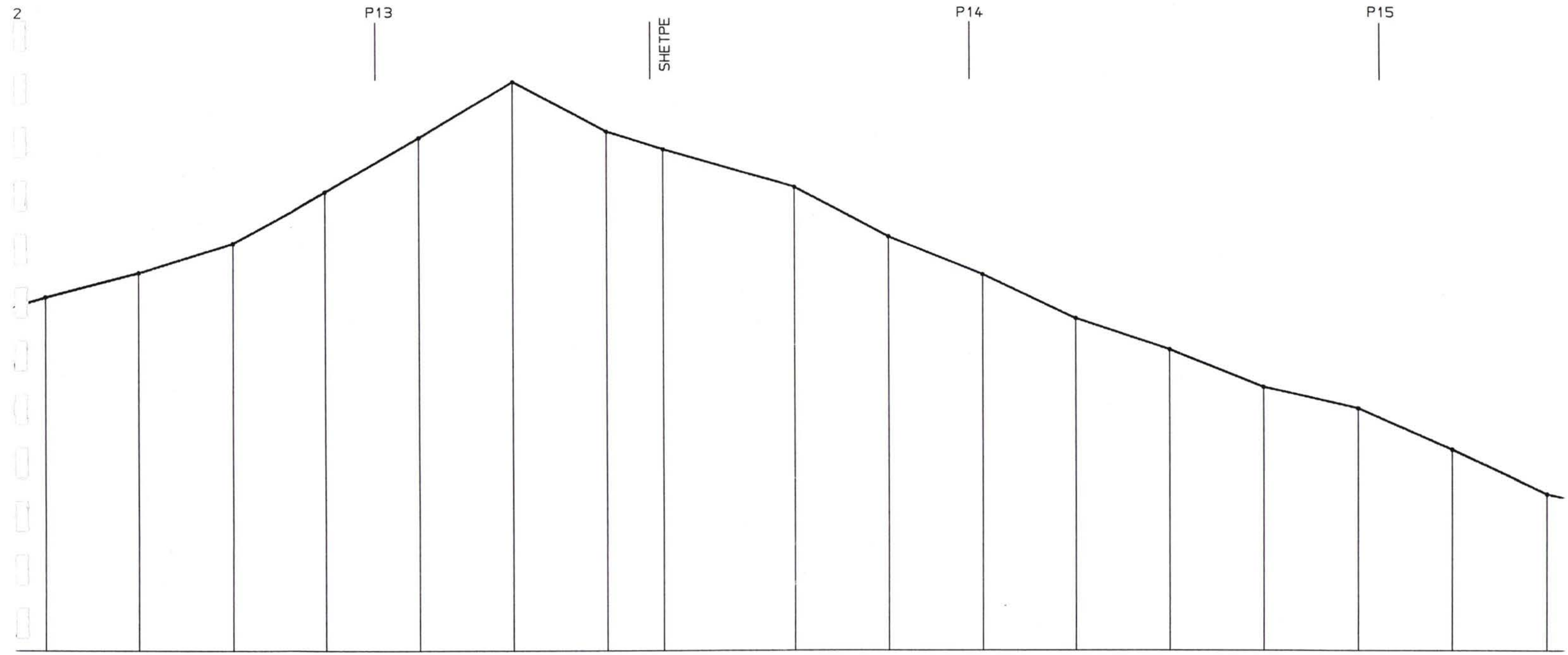


208487.00 | 210000.00 -19.40 | 215000.00 -18.40 | 220000.00 -19.80 | 225000.00 -19.50 | 230000.00 -17.00 | 235000.00 -11.50 | 237742.00 238000.00 -7.00 | 240000.00 5.10 | 245000.00 30.60 | 250000.00 71.60 | 255000.00 255799.80 102.00 | 258000.00 100.20 | 260000.00 111.30 | 265000.00 114.60 | 270000.00 100.50 | 275000.00 98.60 | 277811.00 | 280000.00 113.30 | 285000.00 126.30

P9	29255.00	P10	18057.80	P11	22011.20	P12	19889

CURVES MIN 400m	CURVES MIN 1500m	C=800m	CURVES MIN 600m	CURVES MIN 960m	C=600m	CURVES MIN 800m
	0‰ 33000	6‰ 17000	1‰ 10000	2‰ 10000		3‰ 15000
85km/h	100km/h					

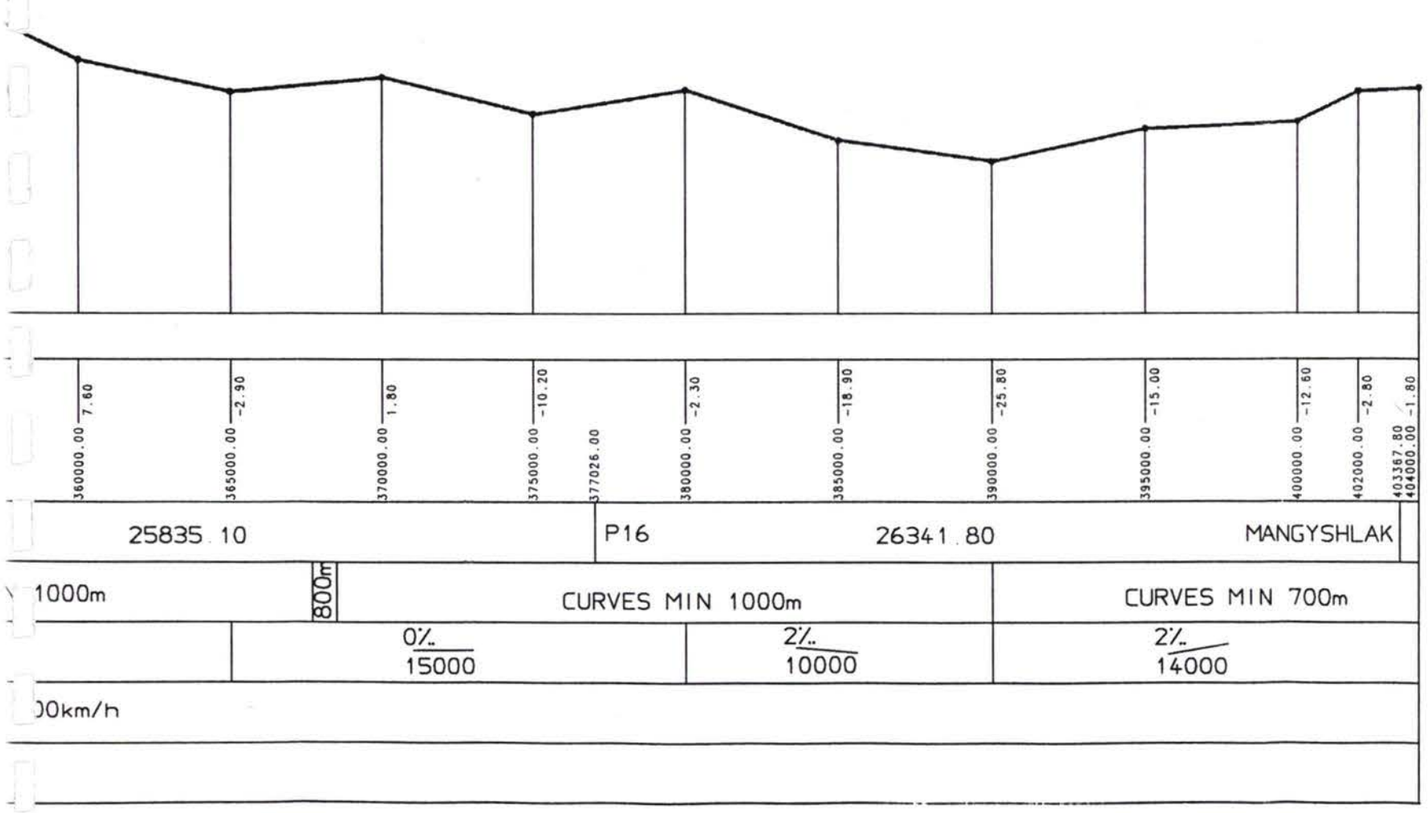
LAIN RELATED TO THE WATER LEVEL OF THE CASPIAN SEA
ADDITIONAL DRAINAGE STRUCTURE PROJEKT



280000.00	113.30	285000.00	126.30	290000.00	142.10	295000.00	169.90	297700.00	300000.00	198.70	305000.00	228.80	310000.00	201.90	312338.50	313000.00	192.30	320000.00	172.00	325000.00	145.30	329323.50	330000.00	125.20	335000.00	101.60	340000.00	84.80	345000.00	64.80	350000.00	53.40	351190.90	355000.00	31.40	360000.00	7.60
2		19889.00						P13		14638.50				SHETPE			16985.00					P14			21867.40						P15				
CURVES MIN 800m				CURVES MIN 500m					CURVES MIN 800m					CURVES MIN 1000m								800m	CURVES MIN 1000m											
3% / 15000				6% / 15000																		4% / 60000														
				90km/h																					100km/h										

P16

MANGYSHLAK



TRACECA PROJECT MODUL A

BEJNEU – MANGYSHLAK

LENGTH PROFILE

SCALE 1 : 200000/2000

KM 200+0 – 404+0

Annex 6.1.1.2.: Technical description of the Alignment Bejneu - Mangyshlak

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Annex 6.1.1.2.

WESTERN KAZAKHSTAN RAILWAYS

The Aktau - Bejneu Line

TECHNICAL DESCRIPTION OF THE ALIGNMENT
Section Bejneu-Mangyshlak
km 0.0 - 404.4

km	station	distance	radius	left curve	right curve
0+0	Bejneu				
1+469,53		1469,53			
2+404,27		934,74	1000		48 °24'
15+565,75		13161,48			
15+995,18		429,43	2000	10 °35'	
17+150,50		1155,32			
17+432,34		381,84	1200	15 °22'	
19+294,44		1862,10			
20+547,07		1252,63	1200		56 °28'
31+685,40	P3gn2	31685,40			
39+465,11		18918,04			
39+855,57		390,46	1200	16 °44'	
40+007,84		152,27			
40+661,83		653,99	1200		27 °53'
50+461,04		9799,21			
50+676,16		215,12	3500	2 °52'	
64+209,79		13533,63			
64+334,65		124,86	3500		1° 38'
80+026,40	P4	48341,00			
103+648,50	P5	23622,40			
119+445,42		55110,77			
119+692,31		246,89	2500	4° 17'	
127+912,00	P6	24263,50			
151+834,90	P7	23922,90			
178+029,50	Say Utes	26194,60			
179+374,36		59682,05			
180+052,05		627,39	495		66 °52'
180+071,88		19,83			
181+151,36		1079,48	498	112° 07'	
181+164,14		12,78			
181+595,58		451,44	405		51° 08'
181+630,80		35,22			
182+086,05		455,25	402	53°29'	
182+093,01		6,96			

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Bejneu

km	station	distance	radius	left curve	right curve
182+427,22		334,21	400		35°42'
182+490,22		63,00			
182+735,25		245,03	920	10°54'	
182+899,21		163,96			
183+552,48		653,27	1500		21°08'
183+602,00		49,82			
183+920,16		318,16	770	16°14'	
184+167,72		247,56			
184+493,21		325,49	500		29°51'
184+533,26		40,05			
184+805,96		272,70	478	21°54'	
184+825,97		20,01			
185+025,14		199,17	800		10°41'
185+248,60		223,46			
185+637,74		389,14	398		35°53'
186+002,84		365,10			
186+366,76		363,92	800		21°03'
186+578,58		211,82			
186+772,52		193,94	1960	4°30'	
187+123,71		351,19			
188+156,19		1032,48	1000	54°00'	
188+240,03		83,84			
188+530,30		290,27	600	22°28'	
188+561,24		30,94			
188+890,36		329,12	400		37°07'
188+973,06		82,70			
189+304,78		331,72	400		44°39'
189+481,23		176,45			
189+843,99		362,76	400	44°48'	
189+887,59		43,60			
190+453,38		565,79	400		71°01'
190+866,87		413,49			
191+430,91		564,04	600	45°16'	
191+753,41		322,50			
192+190,36		434,95	485		36°37'
192+192,72		2,36			
192+709,41		516,69	497	49°46'	
192+741,57		32,16			
192+950,05		208,48	800		12°04'
193+491,50		541,50			
193+849,56		358,06	1960	8°34'	
194+043,65		194,09			
194+357,48		313,83	1870		8°05'

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Bejneu

km	station	distance	radius	left curve	right curve
194+833,44		475,96			
195+136,99		303,55	1000		15°06'
195+550,29		413,30			
196+070,70		520,41	1000		25°14'
196+102,54		31,84			
196+575,07		472,53	600	37°29'	
196+794,10		219,03			
197+094,38		300,28	600		23°54'
197+646,70	P8	19617,20			
198+661,71		1567,33			
198+801,77		140,06	800		5°44'
198+819,43		17,66			
199+052,81		233,38	580	14°10'	
199+080,98		28,17			
199+336,91		255,93	980	9°07'	
201+178,56		1841,65			
201+817,85		639,29	1500	20°36'	
205+352,70		3534,85			
205+865,11		512,41	800	33°50'	
208+487,00	P9	10840,30			
208+702,15		2837,04			
208+958,44		256,29	2300	7°01'	
209+736,56		778,12			
210+240,87		504,31	1510		16°06'
210+376,26		135,39			
210+670,81		294,55	600	19°32'	
210+796,16		125,35			
211+138,76		342,60	600	23°10'	
211+260,19		121,43			
211+665,05		404,86	1000		17°28'
212+092,62		427,57			
212+592,80		500,18	2000		13°11'
212+730,68		137,88			
213+179,66		448,98	2000		11°43'
214+917,93		1738,27			
215+450,47		532,54	1380		15°28'
215+499,80		49,33			
216+857,51		1357,71	598	120°28'	
216+899,73		45,22			
217+577,68		677,95	455		75°18'
219+061,95		1484,27			
219+300,29		248,34	815	15°21'	
219+593,69		293,40	795	13°59'	
220+361,61		767,92			

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Bejneu

km	station	distance	radius	left curve	right curve
221+292,29		930,68	800		60°34'
221+741,26		448,97			
222+092,62		351,36	800	20°52'	
222+236,27		143,65			
222+679,60		443,33	455	46°23'	
222+752,43		72,83			
223+256,96		504,53	498		48°16'
223+789,25		532,29			
224+317,92		528,67	1510		17°41'
225+126,53		808,61			
225+670,34		543,81	1510		19°07'
226+477,74		807,40			
226+949,86		472,12	2000		11°14'
232+017,83		5067,97			
232+545,37		527,54	1950		13°09'
237+742,00	P10	29255,00			
237+950,81		5405,44			
238+236,22		285,41	3000	3°21'	
243+265,47		5029,25			
243+838,54		573,01	800		33°10'
247+382,03		3543,49			
247+923,97		541,94	800	35°14'	
250+916,66		2992,69			
251+632,66		716,00	995		38°21'
251+851,05		218,39			
252+646,52		795,47	1000	41°34'	
253+123,14		476,62			
254+134,66		1011,52	995		51°03'
255+799,80	P11	18057,80			
256+586,96		2452,30			
257+465,16		878,20	596	76°44'	
257+532,73		67,57			
258+173,51		640,78	600		49°44'
258+946,02		772,51			
260+176,90		1230,88	1200		56°23'
260+801,87		624,97			
261+469,21		667,34	600	55°08'	
261+786,03		316,82			
262+385,05		599,02	990	26°34'	
265+328,61		2943,56			
266+011,98		683,37	2000		16°17'
268+263,08		2251,10			
268+633,83		370,75	1000		14°22'
269+252,17		618,34			

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Bejneu

km	station	distance	radius	left curve	right curve
269+647,11		394,94	960	18°12'	
272+448,14		2801,03			
272+776,31		328,17	1200	11°51'	
273+006,29		229,98			
273+420,01		413,72	608	31°27'	
273+535,76		115,75			
274+141,16		605,40	600		49°13'
275+403,73		1262,57			
275+795,67		391,94	790		23°21'
275+894,26		98,59			
276+353,46		459,20	600	37°10'	
277+811,00	P12	22011,20			
280+139,79		3786,33			
280+595,01		455,22	1500		14°20'
282+662,54		2067,53			
282+976,14		313,60	1000	13°23'	
285+386,18		2410,04			
285+750,31		364,13	1000		15°08'
286+089,62		339,31			
286+530,68		441,06	1000	17°15'	
286+578,60		47,92			
286+856,84		278,24	850		16°15'
286+878,83		21,99			
287+206,89		328,06	800		16°20'
288+211,05		1004,16			
288+668,70		457,65	600	33°12'	
289+067,48		398,78			
289+473,75		406,27	584	31°02'	
290+715,01		1241,26			
291+094,06		379,05	645		26°34'
291+741,67		647,61			
292+399,43		657,76	502	69°22'	
292+416,28		16,85			
292+679,41		263,13	520		23°29'
292+706,93		27,52			
293+061,91		354,98	500	32°05'	
293+144,72		82,81			
293+415,77		271,05	500		19°02'
293+536,32		120,55			
294+068,57		532,25	500		52°24'
294+311,15		242,58			
295+252,19		941,04	800	63°06'	
295+711,59		459,40			

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Bejneu

km	station	distance	radius	left curve	right curve
296+916,06		1204,47	1200		54°53'
297+586,84		670,78			
297+700,00	P13	19889,00			
298+095,79		508,95	1000	25°09'	
299+811,42		1715,63			
300+147,90		336,48	1200	13°12'	
300+776,41		628,51			
301+735,54		959,13	500	101°19'	
301+742,89		7,35			
302+588,94		846,05	501		92°11'
302+624,46		35,52			
303+110,08		485,62	500	51°04'	
303+134,04		23,96			
304+089,96		955,92	500		99°48'
304+375,29		285,33			
304+858,39		483,10	500		48°29'
305+034,13		175,74			
305+658,20		624,07	500	65°47'	
306+236,62		578,42			
306+565,86		329,24	1200		11°54'
307+373,97		808,11			
307+869,53		495,56	600	41°07'	
308+415,82		546,29			
309+314,08		898,26	500		94°55'
309+333,03		18,95			
309+729,34		396,31	500	36°15'	
309+907,42		178,08			
310+392,99		485,57	950		18°44'
310+834,69		441,70			
311+360,74		526,05	800	29°05'	
312+338,50	Shetpe	14638,50			
314+333,10		2972,36			
314+815,45		482,35	1200		18°44'
315+373,45		558,00			
316+019,86		646,41	800	39°51'	
316+644,53		624,67			
317+066,84		422,31	1000	18°28'	
317+384,15		317,31			
317+952,05		567,90	1500		19°24'
320+755,00		2802,95			
321+504,56		749,56	1000		37°13'
321+691,52		186,96			
322+362,84		671,32	1500	23°21'	
324+557,25		2194,41			

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Bejneu

km	station	distance	radius	left curve	right curve
324+889,25		332,00	800	17°20'	
325+655,29		766,04			
325+962,57		307,28	2000		7°05'
328+437,32		2474,75			
328+723,07		285,75	800		16°10'
329+323,50	P14	16985,00			
330+024,82		1301,75			
330+331,22		306,40	1000		14°07'
330+895,31		564,09			
331+322,53		427,22	1000	20°28'	
331+707,05		384,52			
331+959,61		252,56	1200		10°09'
334+902,58		2942,97			
335+518,87		616,29	1500	20°52'	
337+951,58		2432,71			
338+089,19		137,61	2000	3°05'	
338+106,81		17,62			
338+196,97		90,16	1100		3°08'
339+050,53		853,56			
339+246,43		195,90	4000		2°14'
339+263,45		17,02			
339+396,53		133,08	2500	2°08'	
341+793,31		2396,78			
342+217,62		424,31	2000		10°09'
342+759,17		541,55			
343+386,05		626,88	800	39°53'	
343+472,11		86,06			
344+290,23		818,12	815		54°00'
351+190,90	P15	21867,40			
355+475,14		11184,91			
356+473,51		998,37	1195	44°02'	
356+721,43		247,92			
357+498,26		776,83	1200		31°36'
367+001,02		9502,76			
367+582,78		581,76	1000		28°45'
367+737,57		154,79			
368+352,36		614,79	800	39°01'	
371+256,34		2903,98			
371+831,42		575,08	1000	28°22'	
377+026,00	P16	25835,10			
377+637,69		5806,27			
377+977,73		340,04	3000		4°58'
380+216,33		2238,60			

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Bejneu

km	station	distance	radius	left curve	right curve
380+991,23		774,90	2000		20°46'
385+529,71		4538,48			
386+105,78		576,07	1980		14°56'
389+659,98		3554,20			
390+263,72		603,74	700		42°03'
391+101,75		838,03			
392+039,94		938,19	798	62°20'	
398+955,73		6915,79			
399+798,07		842,34	700	62°24'	
403+367,80	Mangyshlak	26341,80			
404+400,00		4601,93			

0+0		Mangyshlak	
18+0	app	Aktau Center	no maps available
0+0		Mangyshlak	
16+0	app	Aktau Port	no maps available

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Annex 6.1.1.3.: Calculation of speed limits

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Annex 6.1.1.3.

WESTERN KAZAKHSTAN RAILWAYS

The Aktau - Bejneu Line

Calculation of speed limits
Section Bejneu-Mangyshlak
km 0.0 - 404.4

Calculation of the superelevation:

H = 11,8 x V x V : R - 70mm
H max = 130mm

Radius	V max. Hmax.=130mm
400m	80 km/h
500m	90 km/h
600m	100 km/h
700m	110 km/h
800m	115 km/h
900m	125 km/h
1000m	130 km/h

Analysis of the existing line Bejneu to Mangyshlak
Designed speed for passenger trains 100 km/h and for freight trains 80 km/h

km	radius min.	v max.	designed v =100km/h	distance full speed and more then 100km/h	reduced speed
0+0					
179+4	800		100 km/h	179,4 km	
192+7	400	80 km/h			13,3 km
196+1	800		100 km/h	3,4 km	
199+0	600	100 km/h			2,9 km
210+4	800		100 km/h	11,4 km	
211+2	600	100 km/h			0,8 km
215+5	800		100 km/h	4,3 km	
217+6	450	85 km/h			2,1 km
222+2	800		100 km/h	4,6 km	
223+3	450	85 km/h			1,1 km
256+6	800		100 km/h	33,3 km	
261+5	600	100 km/h			4,9 km
273+0	800		100 km/h	11,5 km	
276+3	600	100 km/h			3,3 km
286+6	1000		100 km/h	9,3 km	
288+2	800		100 km/h	2,6 km	

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Calculation speed limits page 2

km	radius min.	v max. designed v = 100km/h	distance full speed and more then 100km/h	reduced speed
294+1	500	90 km/h		5,9 km
300+7	800	100 km/h	6,6 km	
309+7	500	90 km/h		9,0 km
328+7	800	100 km/h	19,0 km	
342+7	1000	100 km/h	14,0 km	
343+5	800	100 km/h	0,8 km	
367+7	1000	100 km/h	24,2 km	
368+4	800	100 km/h	0,7 km	
389+7	1000	100 km/h	21,3 km	
404+4	700	100 km/h	14,7 km	
404+4 km total length Bejneu-Mangyshlak			361,1 km	43,3 km
		Total 404,4 km		

After finishing the reconstruction works on the total length of the line, including rehabilitation of the existing stations the following speed limits could be reached:

Bejneu	km	0+0	to	179+4	100 km/h	179,4 km
		179+4		223+3	85 km/h	43,9 km
		223+3		288+2	100 km/h	64,9 km
		288+2		309+7	90 km/h	21,5 km
		309+7		404+4	100 km/h	94,7 km

Total length with full speed 100km/h	339,0km	=	83,9%
Total length with reduced speed	65,4km	=	16,1%

The theoretical travelling time without stops is calculated with 4,15 hours.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Annex 6.1.2.1.: A map enlarged from a scale at 1:200.000 to 1:50.000

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Annex 6.1.2.2.: **A more detailed at a scale app.1:50.000 of the centre of Aktau indicating the existing railway station.**

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

6.4. Proposals and Recommendation for the Upgrading Programme

Operational evaluation of the renewed line and the signalling system based on the prognosis regarding traffic demand and the resulting passenger and freight traffic volumes in 2005

6.4.4. Operations

Co-ordination and admission of journeys

The fact that route control in the railway stations and passing loops between Bejneu, excluded, and Mangyshlak, included, is remotely done by the central dispatcher office in Atyrau, results in a reduction of time expenditure for the set-up and cancellation of the routes. Moreover, the time needed for the handling of crossings and rights of way are reduced.
Therefore, an important increase in node capacity and thus also in the capacity of the whole line will be achieved.
A local operation of the signalling installation is available for shunting operations in the stations and passing loops and as reserve in case of a failure of the remote control or parts thereof.

Automatic train running control

According to the rules being applied by West European railway organisations, a transmission of the positions of the fixed signals to the drivers' cabins is only necessary in case of a speed of more than 160 km/h. However, the existing installation should be further used. With this, the subjective feeling of a reduction in operational safety is countered, and the valid rules are observed.
Thus, information required for the functioning of the existing automatic train running control system has to be made available and transmitted to the necessary places by the new signalling system to the extent needed and at the same time in sufficient quality.

Running speeds, load hauled, comparison of capacity

Annexes 6.4.4.1 and 6.4.4.2 list the admissible running speeds depending on the curves and gradient ratios that will be possible after the renewal of the track, the maximum load hauled of a tractive unit, the number of trains, separated according to direction of traffic, as well as a variant and a scenario resulting from the calculation of passenger and freight traffic volumes in 2005 (traffic demand prognosis and number of trains see Annex 4.1.x.x). Also the comparison with the existing capacities based on the existing train sequences and the existing passing loops is included.

Annexes 6.4.4.3 and 6.4.4.4 take the common tandem operation of goods trains as basis for the comparison of capacities. With this premise, all variants of prognoses and scenarios are possible without enlarging the existing passing loops.

Annex 6.4.4.7 shows a comparison between existing and future capacities of the line. It can be seen that the expected future traffic volume can be handled without tandem operation.

Tacis
This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

Timetable

Travel times

The increase of the speed of trains results in a further increase in line capacity.
The increase of the running speeds of passenger trains reduces the travel times by 3 hours and 10 minutes to 5 hours, in case of freight trains, the travel time is reduced by 3 hours to 9 hours (see Annexes 6.4.4.5 and 6.4.4.6).

In case of a concentration of train journeys, a further increase in line and node capacity is possible.

The shorter travel times in passenger traffic make possible that the trains depart at a later time in Mangyshlak in the direction to Bejneu and at the same time the arrival times in Bejneu and other railway stations further away remain the same. As regards the direction Bejneu to Mangyshlak, the trains will arrive earlier.
Thus, the customer has more time at the place of destination. However, only an increase the speed in the remaining network guarantees a further improvement of traffic relations in passenger traffic.

Freight traffic benefits from the increase in the capacity of the line.

Efficiency

There are not much savings of tractive fuel consumption and no important increase in efficiency of the engines used, which result from the reduction of travel times on this line. Only a further increase of speeds on longer distances will bring about a distinct increase in the efficiency of engines.

Reduction of automatic block installations

The proposed reduction in automatic block installations from presently 100 to 56 in the future, only slightly reduces the line capacity. The passenger and freight traffic volumes prognosticated for the year 2005, in all variants (1 and 2) and scenarios A - C can be handled despite the loss of capacity (see Annexes 6.4.4.1 to 6.4.4.7)

For a further reduction of the time needed for the handling of passing, an optimum block division (shorter block sections) before railway stations and passing loops has to be observed.

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

ANNEX 6.4.4.1.

Comparison between the capacity of the line (existing and new) **and the number of trains stated in the traffic demand prognosis for 2005**

Line: Bejneu - Mangyshlak																	
existing situation		after modernisation		prognosis 2005													
				variant 1							variant 2						
stations	capa-city	capa-city	speed	tons	number of passenger and freight trains scenario						tons	number of passenger and freight trains scenario					
					A		B		C			A		B		C	
			km/h		L	H	L	H	L	H		L	H	L	H	L	H
Bejneu	18.9	28.6	100	3200	12	14	13	15	17	18	3600	12	13	13	14	15	16
XP 1																	
XP 2																	
Ustjurt																	
Say - Utes	13.1	19.6	85	3200	12	14	13	15	17	18	3600	12	13	13	14	15	16
XP 9																	
Km 214																	
Km 223			100														
XP 10																	
Km 258																	
Km 179																	
XP 12																	
Km 288			90														
Km 299																	
XP 13																	
Km 310			100														
Shetpe	15.6	23.9			12	14	13	15	17	18		12	13	13	14	15	16
Km 335																	
XP 15																	
Mangyshlak	15.6	23.9			12	14	13	15	17	18	3600	12	13	13	14	15	16

Legend:

L = low, H = high,

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

ANNEX 6.4.4.1.

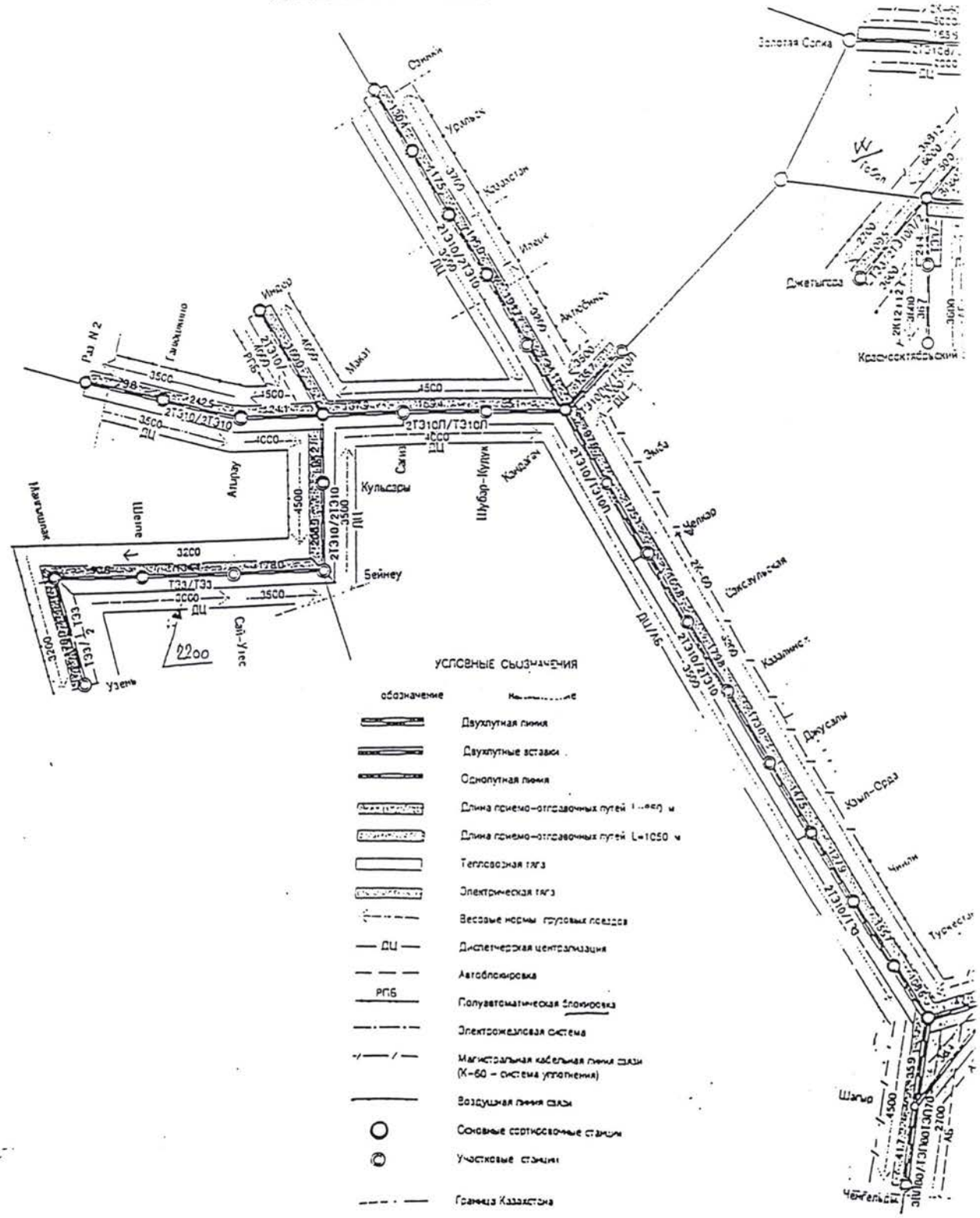
Enclosed

Loads hauled for the tractive units employed on the line Bejneu - Mangyshlak

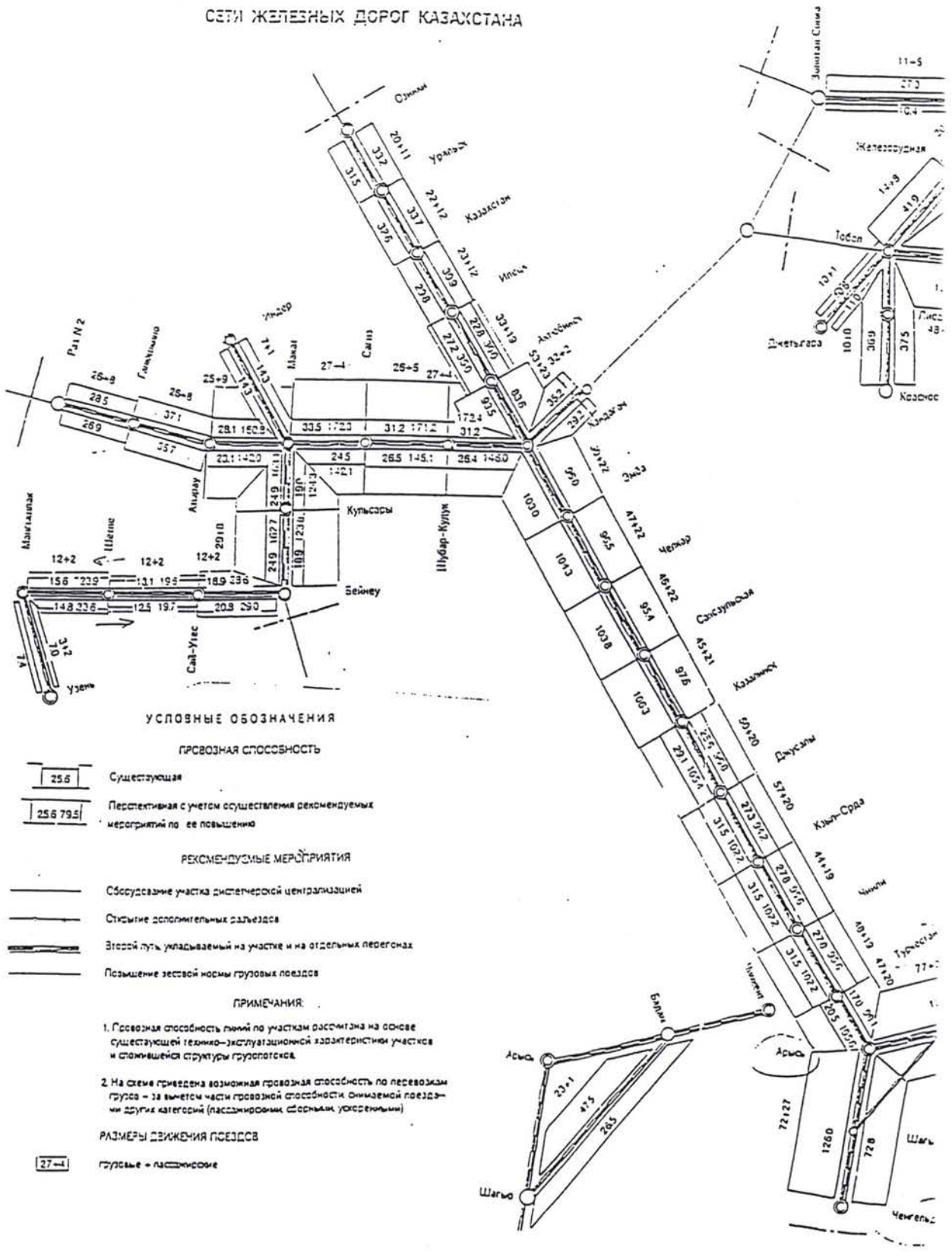
Highest possible numbers of trains with present state of the line and after modernisation

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

ТЕХНИКО-ЭКСПУАТАЦИОННАЯ ХАРАКТЕРИСТИКА СУЩЕСТВУЮЩЕЙ СЕТИ ЖЕЛЕЗНЫХ ДОРОГ РЕСПУБЛИКИ КАЗАХСТАН



ПРОВОЗНАЯ СПОСОБНОСТЬ
СЕТИ ЖЕЛЕЗНЫХ ДОРОГ КАЗАХСТАНА



УСЛОВНЫЕ ОБОЗНАЧЕНИЯ

ПРОВОЗНАЯ СПОСОБНОСТЬ

25.6 — Существующая

25.6 79.5 — Перспективная с учетом осуществления рекомендуемых мероприятий по ее повышению

РЕКОМЕНДУЕМЫЕ МЕРОПРИЯТИЯ

Оборудование участка диспетчерской централизацией

Открытие дополнительных разъездов

Второй путь укладываемый на участке и на отдельных перегонах

Повышение весовой нормы грузовых поездов

ПРИМЕЧАНИЯ:

1. Провозная способность линий по участкам рассчитана на основе существующей технико-эксплуатационной характеристики участков и сложившейся структуры грузопотоков.

2. На схеме приведена возможная провозная способность по перевозкам грузов – за вычетом части провозной способности, занимаемой поездами других категорий (пассажирскими, сборными, ускоренными)

РАЗМЕРЫ ДВИЖЕНИЯ ПОЕЗДОВ

27–4 — грузовые + пассажирские

ANNEX 6.4.4.2.

Comparison between the capacity of the line (existing and new) and the number of trains stated in the traffic demand prognosis for 2005

Line: Mangyshlak - Bejneu																	
existing situation		after modernisation		prognosis 2005 variant 1							prognosis 2005 variant 2						
					number of passenger and freight trains scenario							number of passenger and freight trains scenario						
					A		B		C			A		B		C	
stations	capa-city	capa-city	speed km/h	tons	L	H	L	H	L	H	tons	L	H	L	H	L	H
Mangyshlak	14.8	23.6	100	2200	12	14	16	18	18	19	3600	10	11	13	14	14	15
XP 15																	
Km 335																	
Shetpe	12.5	19.7			12	14	16	18	18	19	3600	10	11	13	14	14	15
Km 310			90														
XP 13																	
Km 299																	
Km 288			100														
XP 12																	
Km 226																	
Km 258																	
XP 10																	
Km 223			85														
Km 214																	
Km 299																	
XP 9																	
Say - Utes	20.8	29.0	100	3500	12	14	16	18	18	19		10	11	13	14	14	15
Ustjurt																	
XP 2																	
XP 1																	
Bejneu	20.8	29.0	100	3500	12	14	16	18	18	19	3600	11	11	13	14	14	15

Legend:

L = low, H = high,

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

ANNEX 6.4.4.2.

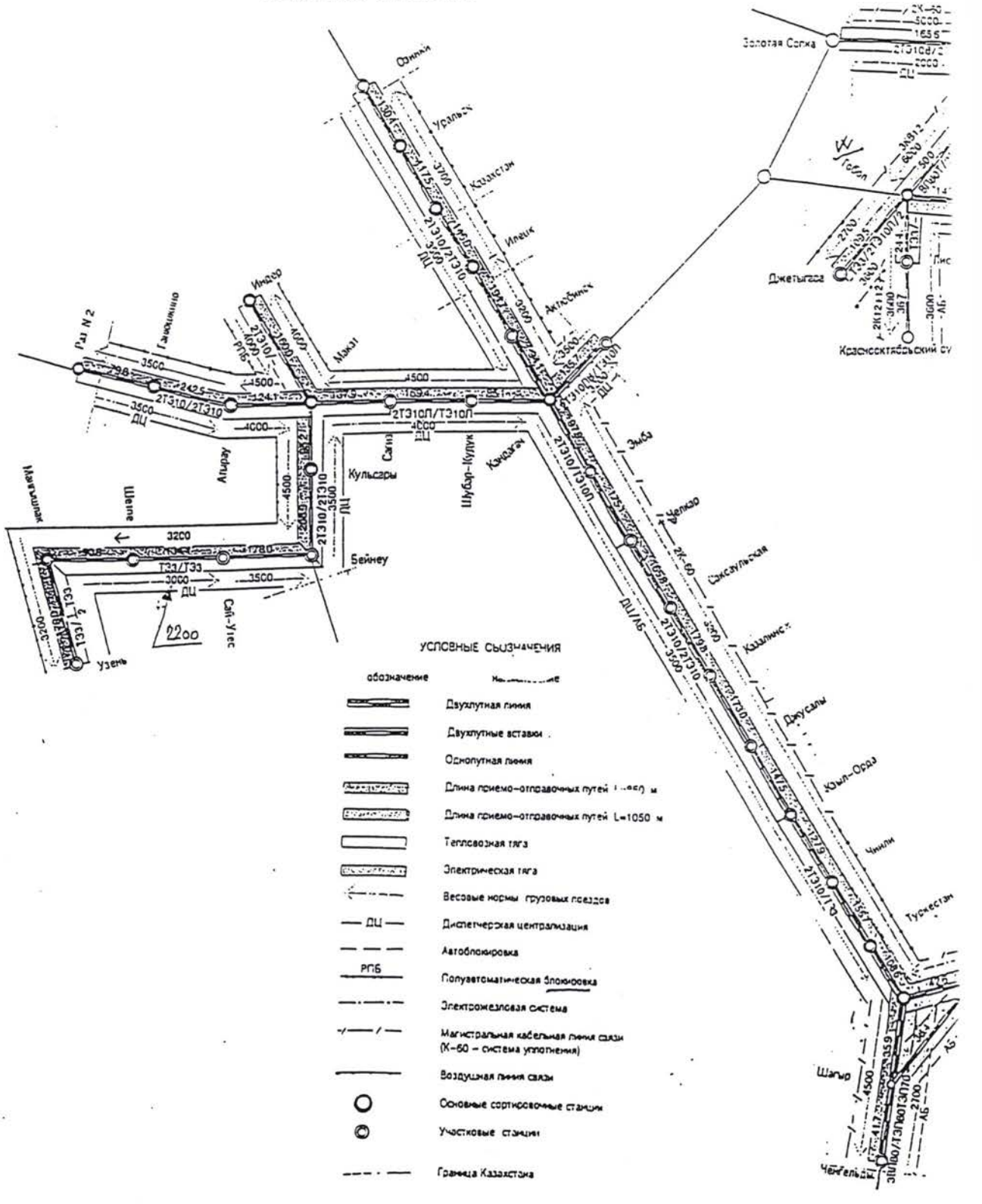
Enclosed

Loads hauled for the tractive units employed on the line Bejneu - Mangyshlak

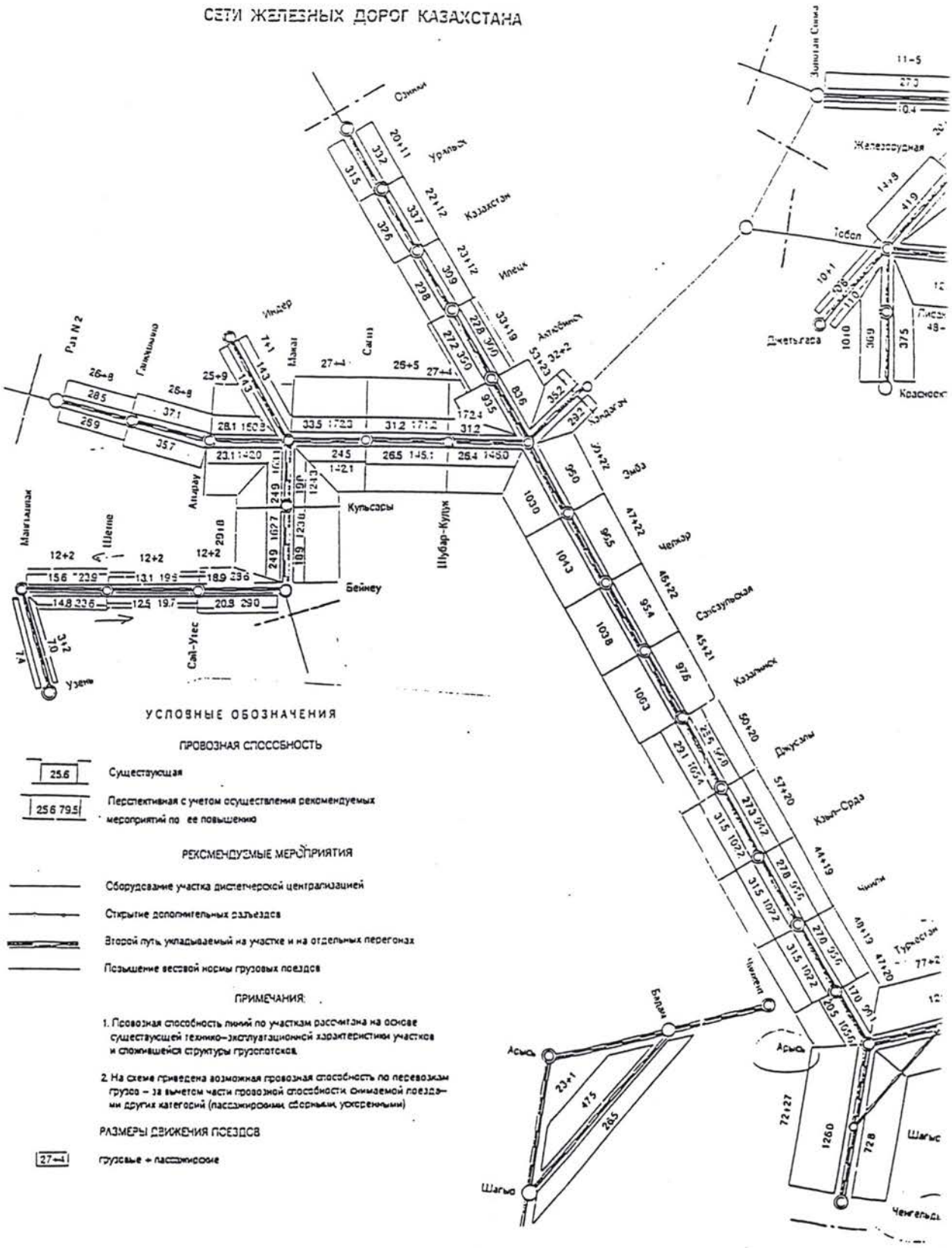
Highest possible numbers of trains with present state of the line and after modernisation

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

ТЕХНИКО-ЭКСПУАТАЦИОННАЯ ХАРАКТЕРИСТИКА СУЩЕСТВУЮЩЕЙ СЕТИ ЖЕЛЕЗНЫХ ДОРОГ РЕСПУБЛИКИ КАЗАХСТАН



ПРОВОЗНАЯ СПОСОБНОСТЬ
СЕТИ ЖЕЛЕЗНЫХ ДОРОГ КАЗАХСТАНА



УСЛОВНЫЕ ОБОЗНАЧЕНИЯ

ПРОВОЗНАЯ СПОСОБНОСТЬ

25.6 — Существующая

25.6 79.5 — Перспективная с учетом осуществления рекомендуемых мероприятий по ее повышению

РЕКОМЕНДУЕМЫЕ МЕРОПРИЯТИЯ

- Оборудование участка диспетчерской централизацией
- Открытие дополнительных разъездов
- Второй путь укладываемый на участке и на отдельных перегонах
- Повышение весовой нормы грузовых поездов

ПРИМЕЧАНИЯ:

1. Провозная способность линий по участкам рассчитана на основе существующей технико-эксплуатационной характеристики участков и сложившейся структуры грузопотоков.
2. На схеме приведена возможная провозная способность по перевозкам грузов – за вычетом части провозной способности, занимаемой поездами других категорий (пассажирскими, сборными, ускоренными).

РАЗМЕРЫ ДВИЖЕНИЯ ПОЕЗДОВ

27+4 — грузовые + пассажирские

ANNEX 6.4.4.3.

Comparison between the capacity of the line (existing and new) **and the number of trains stated in the traffic demand prognosis for 2005**

in case of tandem operation of freight trains

Line: Mangyshlak - Bejneu																	
existing situation		after modernisation		prognosis 2005													
				variant 1							variant 2						
stations	capa-city	capa-city	speed	tons	number of passenger and freight trains scenario						tons	number of passenger and freight trains scenario					
					A		B		C			A		B		C	
			km/h		L	H	L	H	L	H		L	H	L	H	L	H
Mangyshlak	14.8	23.6	100	2200	6	7	8	9	9	10	3600	5	6	7	7	7	8
XP 15																	
Km 335																	
Shetpe	12.5	19.7			6	7	8	9	9	10	3600	5	6	7	7	7	8
Km 310			90														
XP 13																	
Km 299																	
Km 288			100														
XP 12																	
Km 226																	
XP 10																	
Km 223			85														
Km 214																	
XP 9																	
Say - Utes	20.8	29.0	100	3500	6	7	8	9	9	10	3600	5	6	7	7	7	8
Ustjurt																	
XP 2																	
XP 1																	
Bejneu	20.8	29.0	100	3500	6	7	8	9	9	10	3600	5	6	7	7	7	8

Legend:
L = low, H = high,

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

ANNEX 6.4.4.4.

Comparison between the capacity of the line (existing and new) **and the number of trains stated in the traffic demand prognosis for 2005**

in case of tandem operation of freight trains

Line: Bejneu - Mangyshlak

existing situation		after modernisation		prognosis 2005													
				variant 1							variant 2						
stations	capa-city	capa-city	speed	tons	number of passenger and freight trains scenario						tons	number of passenger and freight trains scenario					
					A		B		C			A		B		C	
			km/h		L	H	L	H	L	H		L	H	L	H	L	H
Bejneu	18.9	28.6	100	3200	6	7	7	8	9	9	3600	6	7	7	7	8	8
XP 1																	
XP 2																	
Ustjurt																	
Say - Utes	13.1	19.6	85	3200	6	7	7	8	9	9	3600	6	7	7	7	8	8
XP 9																	
Km 214																	
Km 223			100														
XP 10																	
Km 258																	
Km 179																	
XP 12																	
Km 288			90														
Km 299																	
XP 13																	
Km 310			100														
Shetpe	15.6	23.9			6	7	7	8	9	9		6	7	7	7	8	8
Km 335																	
XP 15																	
Mangyshlak	15.6	23.9	100	3200	6	7	7	8	9	9	3600	6	7	7	7	8	8

Legend:

L = low, H = high,

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

ANNEX 6.4.4.5.

Estimated travelling times for passenger and freight trains on the section Bejneu - Mangyslak

Passenger trains:
The average travelling time is determined with 55 kilometers per hour (for the basic values for calculation see Annex: 3.1.4.1)

station	dis-tance	km point	passenger trains					
			speed	travel-ling time	add. start-ing/ stop time	time of arrival	length of stop	time of depart ure
	Km	Km	km/h					
Bejneu	0.0		55.0		00:03			**00:00**
Ustjut	84.7	84.7		01:32	00:06	01:38	00:10	01:48
Say-Utes	93.3	178.0		01:42	00:06	03:36	00:10	03:46
Shetpe	134.4	312.4		02:26	00:06	06:18	00:10	06:28
Mangyshlak	90.8	403.2	55.0	01:39	00:03	**08:13**		

Legend:
- Travelling times, additional starting/ stop times, length of stops, times of arrival and departure are stated in hours and minutes.
- Travelling times were calculated without starting and braking curve. The additional starting/ stop times roughly balance the travelling time loss during acceleration and braking phase.

Freight trains:
The average travelling time of a block train is determined with 50 kilometres per hour (for the basic values for calculation see Annex: 3.1.4.1). The cause for the stop in Say-Utes is an inspection of running qualities of 50 coaches.

station	dis-tance	km point	freight trains (block trains)					
			speed	travel-ling time	add. start-ing/ stop time	time of arrival	length of stop	time of depart ure
	Km	Km	km/h					
Bejneu	0.0		50.0		00:05			**00:00**
Ustjut	84.7							
Say-Utes	93.3	178.0		03:33	00:10	03:43	03:30	07:13
Shetpe	134.4	312.4						
Mangyshlak	90.8	403.2	50.0	04:30	00:05	**11:53**		

Tacis
This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

ANNEX 6.4.4.6.

Table of possible travelling times

station	dis-tance	km point	passenger trains						freight trains (block trains)					
			speed	travel-ling time	add. start-ing / stop time	time of arrival	length of stop	time of depart ure	speed	travel-ling time	add. start-ing / stop time	time of arrival	length of stop	time of depart ure
	Km	Km	km/h						km/h					
Bejneu	0.0		100.0		00:03			**00:00**	80.0		00:05			**00:00**
Ustjut	84.7	84.7		00:51	00:06	00:57	00:10	01:07						
Say-Utes	93.3	178.0	85.0	00:56	00:06	02:09	00:10	02:19		02:14	00:10	02:24	03:30	05:54
	45.0	223.0	100.0	00:32										
	65.0	288.0	90.0	00:39										
	22.0	310.0	100.0	00:15										
Shetpe	2.4	312.4		00:01	00:06	03:52	00:10	04:02						
Mangyshlak	90.8	403.2	100.0	00:55	00:03	**05:03**			80.0	02:49	00:05	**08:53**		

Legend:

- Travelling times, additional starting / stop times, length of stops, times of arrival and departure are stated in hours and minutes.
- Travelling times were calculated without starting and braking curve. The additional starting / stop times roughly balance the travelling time loss during acceleration and braking phase.

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

ANNEX 6.4.4.7.

Comparison of the capacity of the line
after modernisation of the signalling system and increase in speed

station	distance		existing				future			
			speeds		capacity		speeds		capacity	
	Km	Km	P	F	B/M	M/B	P	F	B/M	M/B
Bejneu		11.2	60	60	18.9	20.8	100	80	28.6	29.0
XP 1		11.5		50						
XP 2 G		17.1	40	40						
Ustjurt		44.9	50							
Say-Utes	178.0	93.3			13.1	20.8	85	80	19.6	29.0
XP 9		41.1	60	60						
Km 214			50	40						
Km 223			40				100	80		
XP 10 G		16.8	60	60						
Km 258			50	40						
Km 279			40							
XP 12		39.5	60	60						
Km 288							90			
Km 299		1.5	50	40						
XP 13		1.5	60	60						
Km 310		5.0	50	40			100	80		
Shetpe	134.4	17.0	60	60	15.6	12.5			23.9	19.7
Km 335		24.1	40	40						
XP 15		35.2	60	60						
Mangyshlak	90.8	31.5			15.6	14.8	100	80	23.9	23.6
	403.2	403.2								
(Mangyshlak-Aktau)										

Legend:

P = passenger trains, F = freight trains
B = Bejneu, M = Mangyshlak,

Tacis

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia